THE SUPPRESSOR-MUTATOR SYSTEM OF CONTROL OF GENE ACTION IN MAIZE

Part I

1. Introduction
2. General Review of Mode of Operation of the Spm System
   a). Basic Elements of System
   b). Mode of Operation and Behavior of Spm
   c). States of a_1^{m-1} and a_2^{m-1}
   d). Types of change in action of Spm other than that associated with change in its cycle of action
   e). Transposition of Spm
   f). Modifiers of the Spm System
   g). Resume of Mode of Operation of the Spm System

Part II

The Origin and Behavior of a_1^{m-1}

1. Origin of a_1^{m-1} and of its States
2. Discovery of an Independently Located Controlling Element Associated with a_1^{m-1} Expression
3. Initital Evidende of the Primary Mode of Operation of the Independently Located Controlling Element, Suppressor-Mutator (Spm)
4. Additional Evidence Supporting the Interpretation of the Primary Mode of Action of Spm
5. Individuality of Expression of Each State of a_1^{m-1} when Two States are Present in a Plant or Kernel
6. Establishment of the Validity of the Interpretation of the Mode of Operation of the Spm - a_1^{m-1} System

Part III

Transposition of the Spm Element in the a_1^{m-1} Cultures

Part ~~IV~~ VI

Altered States of Spm

Part IV

The Modifier in the Spm System

Part V

The Origin and Behavior of a_2^{m-1}

Part VII

Proof of the Identity of the System Controlling both a_1^{m-1} and a_2^{m-1}

Part VIII

Types of Mutants Produced by a_1^{m-1} and a_2^{m-1} and their stability

Part IX

Alternating Cycles of Activity of Spm

Part X

Conclusions

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Part I

The manner by which controlling elements in maize affect the action of genes and induce specific changes in this, has been examined by a number of investigators in recent years. Several independent systems, each composed of one or more controlling elements, have been identified. It is ~~recognized~~ considered that controlling elements are chromosomal unit ~~components~~ apart from the genes even though they are carried by the chromosomes and reside at specific sites in them. It was possible to ~~determine~~ this when it was learned that these elements may undergo transposition from one site to another in the chromosome complement. It was further learned that the mode of control of gene action was a reflection of the specificity of operation of the individual components of a system and the interactions that occur between them. Furthermore, it was learned that one such system would control the action of different genes in like manner.

For induction of operation of a particular system at a known gene locus, it is only necessary that one of its elements be inserted at a site within or close to the locus of the gene. This is shown in the two known cases of control of gene action by the element Ac (Activator) at the P locus in chromosome 1 and the Bz_1 locus in chromosome 9 (Brink et al, McClintock, 1956 a, b, c).*

*Footnote:

Brink and his associates have used the term Modulator (Mp) instead of Activator (Ac). This term was given to the controlling element at the P locus before it was recognized to be the same Ac element that operates in the Ds-Ac system, first reported in 1947.)

A system composed of the above mentioned Ac element and a second element, designated Dissoaiation (Ds), also has shown that the mode of control of gene action resides in the ~~the~~ controlling elements. In this system, it is the Ds element that becomes inserted at or close to the locus of the gene whose action is being controlled. The operation of this system at a number of different gene loci ~~has been extensively~~ was examined by the author (McClintock, 1947 to 1956) and ~~an independently arising~~ a case of its ~~action~~ operation at the Bz_2 locus in chromosome 1 ~~has been~~ was investigated by Nuffer (195). This system also has been used for specific purposes by a number of other persons (Brink et al., Fabagé, Schwartz, Oliver, Notani, Peterson, Dollinger, Sprague).

The Suppressor-mutator (Spm) system is another ~~one~~ in which the mode of control of gene action by its componenet elements could be examined at more than one gene locus. ~~In this report, a detailed account of this~~

Its ~~mode of~~ operation in effecting control of gene expression at ~~the~~ two ~~gene~~ loci of A_1 in chromosome 3 and at that of A_2 in chromosome 5, have been compared. Both A_1 and A_2 are associated with the production of anthocyanin pigmentation in plant and kernel. When a plant or a kernel is homozygous for the standard recessive allele, either a_1 or a_2, no anthocyanin pigment appears in either plant or kernel. When both ~~A_1 and A_2~~ are present, ~~both~~ the plant and the kernel are deeply pigment. ~~Of the two cases~~ In this study, the Spm system of control of gene action appeared ~~arose~~ first at the locus of A_2 and in the course of ~~a study~~ examination of instability of expression of a gene associated with chlorophyll development. In this ~~study~~ examination, a number of plants of a culture were self-pollinated and on the ear produced by one plant, kernels appeared that exhibited variegation for anthocyanin pigmentation. Each showed some areas of deep pigmentation, and in some kernels other areas of pale pigmentation in a background that was ~~and still other areas that were~~ totally colorless.

~~Examination~~ The attempt to learn of the system responsible for the newly appearing anthocyanin variegation commenced with plants grown from kernels on the above mentioned ear. It was soon realized that the instability of gene expression, responsible for the variegation, was initiated by some modification that had occurred to ~~of~~ the standard A_2 locus in chromosome 5, ~~and that this was associated with the instability of its expression~~. ~~This~~ Variation of gene express in different parts of ~~instability~~ could be exhibited ~~in~~ plant or kernel when the modified locus

was either homozygous or was heterozygous with the standard recessive, a_2. The modified A_2 locus was then given the designation a_2^{m-1} and study of it was continued.

~~No~~ but clear impression of the mode of operation of the system responsible for ~~variegation was gained from the~~ them, early study of a_2^{m-1}. ~~In the course of this, however,~~ During this period, numerous types of different patterns of variegation were noted in the silks of an ear of a plant carrying the system responsible for control of gene action at a_2^{m-1} received pollen from a plant that was homozygous for the standard recessive, a_1, carried in chromosome 3, and for the standard A_2, carried in chromosome 5. In this cross, all of thekernels on the ear were expected to be fully pigmented. This was found for all kernels except one. The exceptional kernel exhibited variegation for anthocyanin pigmentation. It had spots of deep pigmentation in a colorless background. The plant grown from it also exhibited variegation for anthocyanin pigmentation and tests conducted with it indicated that the variegation was associated with some modification of the standard A_1 locus that had occurred in a cell whose descendents produced the female gametophyte in the ovule that gave rise to the original variggated kernel. The ~~new~~ modified ~~modification~~ locus was than given the designation a_1^{m-1} and study of it was continued.

Early examination of a_1^{m-1} behavior suggested that a relatively simple system was associated with control of gene action but as the study progressed, it became evident that the system was far from being a simple one. Nevertheless, some appreciation of its mode of operation was gained during this period. At the time, study of a_2^{m-1} ~~was~~ had been discontinued as no clues had been grasped of the mode of operation of the system associated with it. After the basic mechanism responsible for control of gene expression at a_1^{m-1} was recognized, study of a_2^{m-1} was recommenced, with the expectation that some similarities might be found in the control systems associated with each. It was ~~soon~~ unsuspectedly realized that the mode of control of gene expression was essentially ~~the same~~ similar for both a_1^{m-1} and a_2^{m-1}. With this in mind, further tests were conducted and these, in turn, proved that gene action at both of these loci was controlled by the very same system of elements. By means of these concurrent studies of a_1^{m-1} and a_2^{m-1}, confounding aspects of behavior given by each, when examined alone, were resolved. It then became apparent that lack of recognition of the cyclically occurring changes in action undergone by the dominant element of the system, Suppressor-mutator (Spm), was one of the main ~~reason for~~ causes of confusion in attempts to find an interpretation of ~~confussed impressions of the~~ mode of operation of the system associated with control of gene action at a_2^{m-1} ~~involved gained in the early part of this study~~. These cycles of

of change in phase of activity of Spm are responsible for many different types of phenotypic expression that appear within individual plants or kernels and also for highly discrepant ratios of particular phenotypes that appear in progeny derived from either self-pollination or from test crosses of some plants.

2. Mode of Operation of the Spm System

An outline of the mode of operation of the Spm system will be given here in order that the following sections, each dealing with some particular aspect of this, may be read with an appreciation of the operation of the system as a whole. The Spm system is considered to be composed, basically ~~primarily~~, of two ~~basic~~ controlling elements. One of these is assumed to be located at or close to the gene whose action is being controlled, and in the cases under discussion, at the locus of A_1 in chromosome 3 and of A_2 in chromosome 5. The other controlling element, Spm, is known to be located elsewhere in the chromosome complement, and it may ~~This latter element~~ undergo~~s~~ transposition from one location to another, ~~in the complement~~. On different occasions, ~~its~~ transposition has resulted in insertion of it at a site sufficiently close to a known gene marker to allow ready detection of the new location by means of linkage studies with the marker; and its insertion at and transposition from ~~specific~~ sites in chromosomes 3, 5, 6, and 9 have been examined.

It has not yet been proved that a transposible element resides at the locus of the gene whose action is being controlled by the Spm system. That this is to be expected is indicated by evidence of the ~~presen~~ presence of such an element at ~~the~~ a gene locus exhibiting instability of expression obtained from study of another two element control system, Ds- Ac. It could be shown that the Ds element of this system is inserted at or near the locus of the gene whose action is being controlled by the system, and that Ac resides elsewhere in the complement. Both Ac and Ds ~~is~~ are ~~known to be a~~ transposible elements. Again, the fact that a_1^{m-1} arose in a plant in which the a_2^{m-1}-Spm system was operating, and that the behavior of both a_1^{m-1} and a_2^{m-1} are impressively alike, strongly supports the assumption that ~~the same~~ a transposible element resides at each of these two loci, and that it is the same element in both cases ~~and that each~~ it may be considered, then, that each arose from insertion of this element, first from an unknown location in the chromosome complement to the locus of A_2 and subsequently to the locus of A_1.

b) Mode of action and the behavior of the Spm element.

In each of the two cases under discussion, modification of gene action probably occurred as an immediate consequence of insertion of the above mentioned ~~this~~ controlling element at the locus. In both cases, ~~this~~ it appears to have effected a reduction in capacity of the gene to contribute to

anthocyanin pigment formation. This reduced capacity is exhibited when the Spm element is absent or inactive either in a plant or kernel ~~or when it is inactive in some part of a plant or kernel~~.

In plants and kernels that have A_1 and A_2, anthocyanin pigment intensity is deep either when Spm is present or when it is absent.

In contrast to this, pigment intensity is reudced in those kernels and plants that are homozygous for the original state of either a_1^{m-1} or a_2^{m-1} or are heterozygous with the corresponding recessive allele* whenever Spm is absent or inactive. When, however, Spm is present

* The constitutions of these plants would be:

for a_1^{m-1}: A_2A_2 or A_2/a_2; a_1^{m-1}/a_1^{m-1} or a_1^{m-1}/a_1 and

for a_2^{m-1}: A_1A_1 or A_1/a_1; a_2^{m-1}/a_2^{m-1} or a_2^{m-1}/a

and active in both plants and kernels having one of these constitutions, anthocyanin pigment formation appears but only in well defined areas, ~~of either plant or kernel~~. ~~Within these areas, pigment appe~~ras. Three distinctiy different types of events are responsible for the appearance of these pigmented areas. The first of them is associated with some ~~mutation-type~~ event occurring at the locus of the gene concerned, i.e., either a_1^{m-1} or a_2^{m-1} as the case may be. Such an event can ~~This~~ results in reestablishment of

the full or near full capacity of the locus to contribute to anthocyanin production ~~formation~~. These mutation-type events occur~~s~~ in individual cells whose progeny cells may then exhibit intense pigmentation. When ~~this~~ one such occurs in a cell of the germ line of a plant, gametes may be formed that carry the locus with restored gene activity, and ~~its presence~~ cases of this may be detected ~~on~~ across individuals of the progeny. Tests of such ~~progeny~~ individuals indicate that ~~this~~ mutation-type event also restores ~~modification results in~~ stability of gene expression for no further changes in its action occur ~~both~~ in the presence and the absence of Spm.

Although the second and third ~~types of~~ event may result in the appearance of ~~give rise to quite similar~~ pigmented areas of similar phenotype, the nature of the responsible event is not the same ~~appearing~~ areas ~~but, the event responsible for each is different and the~~ and the consequences of each ~~the event~~ are ~~also~~ distinctly different. The first of these is associated with a ~~somatically occurring~~ transposition of Spm from one location to another in the chromosome complement in a somatic nucleus. ~~which, through~~ Subsequent segregation of chromatids at the following mitotic anaphase, may result in its absence ~~removal it~~ from one of the two sister nuclei. The progeny cells arising from one in which Spm has been so removed then exhibit the same reduced grade of pigment intensity that ~~characterizes the~~ appears in ~~appearance of~~ whole plants or kernels in which Spm is totally absent, and the area is uniformly pigmented; no variation appears within it. ~~The phenotypic expression within the area or in progeny kernels and plants~~ Likewise, in progeny derived from ears or from pollen produced within such an area, ~~is quite stable~~. ~~Since Spm is absent,~~ no further change in gene action occurs ~~at the locus of the gene involved~~, unless Spm is again introduced in some subsequent cross.

The third type of event gives rise to pigmented areas exhibiting the very same phenotype as that just described. However, the cause ~~for~~ of

this is not removal of Spm from the nucleus but rather its complete inactivation without change in to location. The phenotypic expression resulting from this inactivation ~~produces~~ is stable as long as Spm remains in ~~its~~ the inactive phase. Return to the active phase in some subsequent cell again will initiate not only suppression of gene action in the immediate progeny cells, but also it will initiate ~~again~~ once more the same round of events just described. Consequently, within some of the large lightly pigmented areas of a plant or kernel, smaller, non-pigmented areas may be formed and within them, in turn, both deeply pigmented and lightly pigmented areas may appear. Whether or not a variegated pattern of the type just described will appear following a particular inactivation of Spm, and ~~and~~ if should it appear, just what type of pattern of variegation will be exhibited, depends upon the duration of the inactive phase of Spm. Following some inactivations, the inactive phase may persist through many cell or even plant generations. Following others, the duration of the inactive phase may be short, with frequently occurring returns to the active phase in some cells that ~~are~~ may be only a few cell generations removed from that in which inactivation occurred. And, a large range of difference in duration of either ~~the~~ an inactive or the active phase of Spm has been noted.

On the basis of the above description of events occurring at the locus of either a_1^{m-1} or a_2^{m-1} and also to the Spm element itself, it is evident that the variegated pattern~~s~~ in a plant~~s~~ may be simple and readily interpreted if the Spm element is one with ~~with a long duration of its~~ an active phase of long duration, ~~is present~~ and if transposition of it is infrequent or does not occur during ~~during~~ developmental stages of the plant.

In contrast, the pattern may be very complex if the active phase of Spm is of short duration and is followed by inactive phases of various durations, or if transpositions of it occur in a number of cells rather early in development.

When two or more active Spm elements are present in a plant, the frequency of occurrence of the mutation-inducing events at either a_1^{m-1} or a_2^{m-1} remains the same. In other words, the pattern of variegation ~~produced~~ associated with the mutation-producing events ~~by such events~~ is ~~unaltered~~ unaffected by increased dose of the Spm element. In contrast, the pattern of variegation induced by transposition or by change in phase of Spm is much altered by increased dose of Spm. The number of pigmented areas attributable to these events is decreased as the Spm number increases. For this reason, the number of Spm elements in a plant or kernel ~~is able to~~ affects in a marked way the over-all pattern of variegation. ~~xxxxxxxx~~ However, in any one plant or kernel ~~that~~ exhibiting only that pattern of variegation attributable to mutation at the gene locus, it is not possible to know without test whether this pattern is

produced because of the presence of two or more active Spm elements ~~are present~~ or whether it is produced because of the presence of only one Spm element which has a very long duration of its active phase, and also undergoes few or no transpositions during early + mid-developmental stages.

The time of change in phase of activity of Spm during development of plant or kernel also ~~contributes to modification of~~ affects the patterns of variegation. With the original state of both a_1^{m-1} and a_2^{m-1}, mutations to a full or near full expression of gene action ~~may~~ occur in some cells early in plant or kernel development if a fully active Spm element ~~was~~ is present in at the beginning of development. Such mutations give rise to large, deeply-pigmented areas in ~~both~~ either plant ~~and~~ or kernel. However, if an inactive Spm is present mutually that returns to the active phase in some cells ~~but~~ only late in development, then only small areas ~~are produced~~ may be present in which it is active. These areas are characterized by the ~~presence~~ appearance of small spots of deep pigmentation ~~appearing~~ in a non-pigmented background. Since mutation to full capacity of gene action ~~can~~ occurs only in some cells of those tissues in which ~~when~~ Spm is active, delayed in change from the inactive to active phase ~~in phase of activity~~ of Spm would give rise ~~under these conditions~~ and within them only to small spots of deep pigmentation would appear within the restricted small areas in which it is active. ¶ It is evident from the above discussion, ~~then~~, that the type of variegation exhibited by a plant or kernel may be very complex ~~complicated~~ if the Spm element in it is undergoing change in phase of activity at

at different times during development. It is largly because of this that the early study of a_2^{m-1} lead to no clear understanding of the system involved in its control, although other conditions, which will be mentioned ~~shortly~~ later, likewise contributed to this. In contrast, appreciation of the system controlling a_1^{m-1} behavior was more readily attained. The reason for this is now ~~evident~~ clear. In the early studies of it, the Spm element present in the plants investigated had a very long duration of its active phase. So few changes to the inactive phase occurred during development that these did not obscure the generally consistent pattern of ~~behavior~~ variegation and inheritance behavior that was observed. And, it was this consistent ~~pattern of~~ behavior that allowed interpretations to be drawn of the basic mode of operation & the spm-spm ear. ~~and tests of them to be made~~.

c) ~~The~~ States of a_1^{m-1} and a_2^{m-1}

One of the most ~~consistent~~ striking ~~aspects~~ manifestations of the ~~behavior~~ presence of a controlling element at a gene locus is the modification ~~of it or~~ induced by it that ~~will give rise~~ results ~~in~~ in subsequent~~ly to~~ change in expression of mutation, either in the frequency of this, ~~of visible mutation at the locus of the gene,~~ or in type of mutation, or both. In the pattern of variegation resulting from this, be in marked contrast ~~type and frequency of mutation~~, in ~~comparison~~ to that which was ~~appearing~~ expressed before this modification occurred. ~~Since~~ Each such modification is heritable in that with other conditions being equal, each will ~~it~~ continue~~s~~ to produce its own particular type and pattern ~~and type~~ of mutation in subsequent generations. Therefore, each such modification must arise from some particular type of change at the locus. ~~it is called a change in~~

and with respect to a_1^{m-1} and a_2^{m-1}, these are termed changes in state of a_1^{m-1} or a_2^{m-1}.

Study of several different control systems indicates that all manifestations of change in action of the gene that are ~~of a~~ heritable ~~type~~, whether it be a stable mutation or an altered state, are expressions of modification induced by the controlling element of the system associated ~~resides at the locus of~~ with the gene. In a two element system such as Ac-Ds, Dt-a_1, En-palegreen, etc., ~~the~~ each modification represents ~~arises as a consequence of the~~ a response of the element ~~at the gene locus~~ to the presence of the independently located element of the system, which is Spm in the cases under consideration. Therefore, a change in state of a_1^{m-1} or a_2^{m-1} will occur only when this element is present and active and only at those times during development when mutation may also occur. A change in state is, then, only one of several possible consequences of a single response of the element associated with the gene to the presence of the complementary element of the system.

From the above stated ~~consideration of~~ model origins of new states, ~~given above~~, it is evident ~~clear~~ that isolation of a newly altered state for subsequent examination requires that it arise in some cell of the germ line and be present in a gamete. Therefore, the chance of isolation of a new state depends

largly upon the time during development of aplant when the controlling element associated with the gene locus is responsive to the independently located element of the system and, indeed, the time of this is one of the distinctive expressions of state. If, in a plant, the state is such that it responds relatively early in development, and if such responses occur in sporogenous cells, a number of gametes may be produced each of which carries either a mutation or an altered state. Both types of change may be detected in the progeny of this plant, and each may thereby be isolated for subsequent study. If, on the other hand, the state is one in which the element associated with the gene locus responds to the independently located element only very late in development of the plant, few or no gametes may be produced that carry either a mutation or an altered state. With the former state, other states would arise with appreciable frequencies, whereas with the later state they would arise either very rarely or not at all. Considering the factors associated with their origin and isolation, it is evident that no conclusions are regarding relative stabilities of the two states are justified from comparisons of this type. With the latter state, as many changes of state may occur as with the former but there is no way of detecting and isolating those produced by the latter. Therefore, in this study, mix each new

state was derived from one in which response of the gene-associated element ~~associated with the gene locus~~ to an active Spm occurred relatively early in plant development.

As stated above, mutation to a stable expression of gene action ~~and~~ or to change in state ~~are~~ is the consequence of a response of the gene-associated element to Spm. Methods are available for determining the relative frequency of occurrence of different types of mutation to a stable gene expression but it is difficult, if not impossible, to estimate accurately the relative frequency of occurrence of modifications effecting change in state. This is because ~~some of them give an type of~~ the expression ~~that~~ of some of them differs only slightly from that from which it originated, and it is often difficult to detected such cases ~~of this~~. Those that effect a marked change are, in experience, on the other hand, readily recognized, ~~and~~ It is ~~evident~~ obvious with both a_1^{m-1} and a_2^{m-1} that the ~~appearance~~ appearance of such ~~changed~~ markedly altered states is considerably less frequent than ~~the frequency~~ ~~appearance of modifications effecting a~~ appearance of mutants with stable gene expression.

From the original state of a_1^{m-1}, whose gene-associated controlling element may respond to an active Spm very early in development, 18 independently arising changes of state were selected. Each was recognized in an individual kernel appearing on those ~~an~~ ears that developed when pollen of the original plant carrying a_1^{m-1} was placed on silks ~~of~~ ~~ears~~ of plants that were homozygous for the standard recessive, a_1 which is quite stable in the presence of Spm. Observations were made of the variegated pattern in the plant derived from each, and each, in turn, was crossed to plants homozygous for a_1 in order to examine the expression of the modified a_1^{m-1} locus in ~~its~~ the progeny. ~~Subsequent~~ Tests were then conducted with the plants derived from selected kernels in the progeny in order to establish the mode of expression of the altered state in subsequent generations, both in the presence and absence of Spm.

~~With~~ With regard ~~to expression~~ patterns of variegation, the 18 selected cases of change in state of a_1^{m-1} ~~, the 18 selected cases~~ could be ~~placed within~~ sorted into five main groups. The ~~2~~ in the first group ~~were~~ are characterized by some early occurring mutations to full or near full A_1 expression and very many late occurring mutations of this type and an active Spm is required for this. In contrast, the original state gives rise to many early occurring mutations and to various different levels of A_1 expression, but these are ~~and to~~ fewer later occurring ones. ~~In the absence~~

In the absence of Spm, the expression of the two ~~altered~~ states in the first group differ~~ed~~. With each, pigment developed slowly in the plant until it is quite intense but in the kernels, one of the ~~se~~ two is characterized by the appearance only of faint pigmentation whereas the kernels having the other are much more intensely pigmented ~~other gives rise to deeply pigmented kernels~~. In this regard, the original state expresses a medium grade of pigment intensity in the kernels in the absence of Spm.

~~There were~~ Five ~~5~~ altered states could be placed in a ~~in the~~ second group. These ~~were~~ are characterized by production, in the presence of Spm, of late and very frequently occurring mutations in both plant and kernel, which usually gave the full or near full expression of pigment intensity. Again, subdivisions of them could be made because of differences in degree of pigment intensity that were expressed in kernels in the absence of Spm.

¶ Four of the 18 selected altered states fall within a third group. These ~~were~~ are characterized by the appearance, when Spm was present, of mutant areas that are small because the mutation-inducing events ~~mutations that~~ occurr~~ed~~ late in development of both plant and kernel, ~~but~~ However, the frequency of such events ~~this~~ ~~was~~ is very much less than that exhibited ~~given~~ by members of the group just described. Here, also, they differ~~ed~~ among themselves with regard to intensity of pigment appearing in ~~the~~ kernels when Spm ~~was~~ is absent.

There ~~were~~ are two altered states in the fourth group. Very few mutations to give an A_1 ~~type expression~~ phenotype ~~occurred~~ are expressed in either plant or kernels and all of them arose late in development for the areas with such a phenotype are always small. The remaining 5 ~~selected~~ cases fall within a fifth group. In the presence of Spm, nearly all of the mutations ~~xxxxxxx~~ express~~ed~~ only low levels of pigment intensity and the type of pigment appears to differ from that produced by A_1. With two of these states, ~~In some of them,~~ an occasionally mutant area appears ~~appeared~~ that exhibits ~~exhibited~~ the full A_1 type pigmentation, but the frequency of appearance of such areas is low and the areas always is small. ~~Thexxxdiffxxxxxxxxxxxxxxx~~ The states within this group differ from one another not only ~~both~~ in the time of occurrence of mutation, in the presence of Spm, ~~and~~ but also in the degree of pigment production in ~~the~~ its absence, ~~of Spm.~~ With one, no anthocyanin pigment is produced in either plant or kernel in the absence of Spm. In this respect, the phenotype is quite similar to that appearing in plants and kernels that are homozygous for the standard a_1 recessive.

From the total of 18 examined ~~cases of~~ altered state, 6 have been widely used over a period of years in study of the Spm system. Photographs of kernels, figures , illustrate the the phenotype each produced in both the presence and the absence of Spm.

Detection and analysis of altered states of a_1^{m-1} was uncomplicated because, as mentioned earlier, the Spm element in the original plant, and in the progeny derived from it, had an active phase of long duration. Had it undergone frequent change in phase of activity, variegation patterns and inheritance behavior would have been so complex that no certain conclusions would have been drawn from them of the precise nature of the state of a_1^{m-1} that might be present in a particular plant or kernel. Such, indeed, were the conditions encountered in early study of a_2^{m-1}. Variegation patterns and inheritance behavior were so complex that even though different states were recognized, a precise characterization of each could not then be formulated because the relation of cyclical change in activity phase of Spm to altered expression of variegation and irregular ratios of phenotypes in progeny tests had not yet been recognized. It was not until these states were examined in the presence of an Spm element with an active phase of long duration that it was possible to characterize them precisely. It was then found that their types were similiar to those that had appeared in the a_1^{m-1} cultures. There was one, however, that was quite unlike any of the selected states of a_1^{m-1}. Initially, its behavior was an additional cause of confused impressions of the mode of

operation of the system responsible for control of gene action at a_2^{m-1} that were generated early in the study. Subsequently, it proved an invaluable tool in analysis of this system. In the absence of Spm, or when it is inactive, plants and kernels having this state are intensely pigmented and the degree of this is nearly equivalent to that produced ~~when~~ by the standard A_2, ~~is present~~. When an Active Spm is present, all pigment formation is suppressed in the kernels, except in those cells in which Spm has become inactive or has been removed by transposition. No mutations to give a stable A_1 expression have yet been identified. Thus, the variegation patterns appearing when this state is present are reflections solely of modifications occurring to the Spm element itself, either transposition of it or change in phase of its activity, and the ~~use~~ usefulness of this state ~~in analysis of~~ for investigating cycles of activity of Spm will be described in one of the sections of this report.

Some definite conclusions may be drawn regarding the significance of state in control of variegation expression. For this purpose, all examined states of either a_1^{m-1} or a_2^{m-1} that give rise to stable mutations, ~~which are~~ expressed ~~by~~ in both type and intensity of anthocyanin pigment after ~~formation and by intensity of this~~, may be grouped together, and this includes all of them except the one just mentioned above. It ~~is~~ may be concluded that in the

presence of an active Spm element, both the time of occurrence of mutation during development of plant or kernel and the type and intensity of any one type ~~of this that may occur~~, are expressions of the state of the a_1^{m-1} or the a_2^{m-1} that may be present in a particular plant or kernel, this expression will be constant regardless of ~~for increased~~ doses of Spm, ~~do not alter this expression~~. Again, the type and intensity of anthocyanin pigment formation in kernel and plant in the absence of Spm or when it is present but inactive, is also an expression of state.

¶ ~~The~~ Different states of a_1^{m-1} + a_2^{m-1} ~~have been~~ proved to be most useful in this study. ~~It has been~~ at times it was necessary to select a particular state~~s~~ for ~~xxxxxxxxxx~~ a specific ~~purposes~~ type of analysis, and the reasons for this will be made apparent in later sections when the requirements for solution of a particular problem ~~purposes~~ are discussed.

¶ In the absence of Spm, all states are quite stable and ~~xxxx~~ some of them have been carried through many plant generations without giving any indication of change. Those states that give rise to early occurring mutation in the presence of an active Spm also give rise in its presence to some ~~nearly~~ newly altered states and ~~that~~ may be recognized in individual progeny ~~derived~~ of such ~~from~~ plants, ~~having one such state~~. In contrast, those states that are characterized by very late occurring mutations do not give rise to or must do so very rarely altered states in the presence of Spm. In the extreme studies ~~of~~ conducted with two of them, and carried through 9 generations of plants, not one case of altered state has been encountered.

d). Types of change in action of Spm other than those related to its cycles of activity.

In addition to the activity cycles undergone by Spm, mentioned earlier, another type of modification occurs to it that effects a marked alteration in pattern of mutation produced by different states of a_1^{m-1} or a_2^{m-1}. These modification appear to arise in individual cells in which a fully active Spm element had been present. The descendent cells then express the presence of the modified Spm element in them by exhibiting markedly altered patterns of mutation. Evidence now available does not suggest that the responsible event is associated with change in location of Spm in the chromosome complement, for it has been determined in several cases that an Spm element whose location is known may undergo such a modification without conincident detectable transposition.

The type of modifications of Spm underconsideration, effects its capacity to suppress gene action at either a_1^{m-1} or a_2^{m-1} and to induce mutation of either type to stable alleles. When one such Spm element is present, anthocyanin pigment, resembling that appearing in the absence of an Spm element, is produced in plants but it develops at a very slow rate. No pigment may appear in young plants but it develops gradually as the plant progresses towards ~~reaches~~ maturity. In kernels, the capacity of such an Spm element to suppres gene action likewise is

reduced but the degree of this is less marked than in the plant. The difference may be related to the more limited time that is available for accumulation of pigment in the kernel. Its rapid maturity stops the process. Whatever may be the cause, very little or sometimes no pigment of the type produced in the absence of Spm appears in kernels having one such modified Spm element. However, spots of pigment derived from mutation at either a_1^{m-1} or a_2^{m-1}, as the case may be, do appear but the number of them is much lower than that produced with a fully active Spm element. For each state, the reduction is expressed as a proportion of that given when a fully active Spm is present. Both the suppressive and mutative capacity of Spm appears to be weakened, and for this reason, such modified Spm elelents are designated Spm-w in contrast to the so-called standard Spm element that gives full suppression of gene action of a_1^{m-1} or a_2^{m-1} and a constant and predictable pattern of mutation with any one state of a_1^{m-1} and with all but one exceptional state of a_2^{m-1}. In subsequent discussions that deal with Spm-w, it will be necessary to distinguish it from the standard Spm element. Therefore, in these discussions, the standard Spm element will be ~~designated~~ symbolized as Spm-s.

When Spm-s and Spm-w are present in the same plant or kernel, the Spm-s element is dominant. In a plant having one ~~of~~ each of these two types of Spm element, expected patterns of segregation of the two occur at meiosis and each is recovered in the progeny. When the locations ~~of each~~ in the chromosome complement is known, ~~the two appear in the progeny in expected proportions an~~d each in its respective location in the complement, barring a few cases of transposition of one or the other that may have occurred. ~~However,~~ In an extensive study in which comparisons were made of the effect of one xxxxxxxxxxxxxxxxxxxxxxxxxxxx isolate of Spm-w on mode of expression of four of the described states of a_1^{m-1} and of one state of a_2^{m-1}, no evidence of transposition of the Spm-w element was obtained in tests conducted through five plant generations and in different genetic backgrounds.

Spm-w may express the same cycle of change in phase of activity as does Spm-s. It may also undergo subsequent modification that effects a return to higher levels of capacity to suppress gene action and induce mutation at a_1^{m-1} and a_2^{m-1}. Again, the event responsible for this occurs in an individual cell whose progeny exhibit the effect of its increased expressivity. The rate of return to or towards Spm-s has not been the same with all Spm-w isolates. With the one mentioned above that

was extensively investigation, no gametes carrying a new modification of it that alters its capacity of action have yet been identified. However, in a few plants and kernels having it, sectors showing the Spm-s capacity have appeared but their frequency is low. In contrast, another Spm-w isolate exhibits relatively frequent returns to or twoard the Spm-s type capacity of action.

e). Transposition of Spm

Initially, the most complelling evidence of unit elements, independent of the gene but capable of controlling its action, came from discovery of their transposition from one location to another in the chromosome complement without lose ~~ing~~ of specificity of action in the process. Transposition is a behavioral mechanism that all of them may share in common. However, in studies of this, it was learned that an element known to be transposible, may not undergo transposition within a given set of conditions. When these conditions apply, it could be difficult to determine whether or not the observed altered phenotypes were the result of action of a controlling element, ~~or~~ of gene mutation, ~~or~~ of the presence of a modifier or because of a "mutator-gene". In the cases we have examined, this could be distinguished on the basis of known histories of origin and of of comparitive behaviors under given conditions. In other words,

transposition makes possible ready identification of a controlling element but lack of evidence of this does not exclude, necessarily, the possibility that a controlling element is responsible for observed types of mutation or of instability of gene ~~action~~ expression. There is evidence to suggest that controlling elements in maize may play a larger part in the origin of mutants than has previously been suspected, and this will be considered in the concluding section of this report.

Evidence of transposition of Spm is extensive. It has been observed in various types of experiment conducted for purposes other than that of examining the phenomenon of transposition itself. Tests conducted for the latter purpose reveal more about it than evidence, however, extensive, obtained from other types of tests. Therefore, in this report, only those tests will be reported in detail that are centered on an examination of transposition of Spm.

There is no doubt that the time during development when it occurs, and also ~~and~~ the frequency ~~of occurrence of~~ of this transposition of Spm are under some form of control, ~~such~~ just as the time and frequency of occurrence of mutation at a_1^{m-1} and a_2^{m-1} are controlled by the state of one's genes that is present in any one plant or kernel. Up to now, the conditions responsible for ~~such~~ controls have not been ~~identified~~ defined and no

tests have been conducted that might serve to reveal them, although such are possible. Nevertheless, it is suspected that ~~the~~ such control may reside in the Spm element itself, and that changes in this may reflect some alteration that occurred to this element. Even though an examination of factors associated with control of transposition of Spm were not investigated ~~neglected~~, the following types of control are known. With some isolates of Spm, transposition of it occurs in some cells early in plant development. With others, this occurs only late in development and with still others, transpositions may occur both early and late in development. With ~~still~~ other isolates, transposition of Spm, either early or late, may occur only very rarely, and with one isolate, no evidence of transposition has yet been obtained although it has received extensive study.

~~The~~ Spm ~~system~~ is not ~~ideal~~ well suited for study of ~~examining~~ the mechanism associated with transposition. This is more readily accomplished with other systems, and that of Ds, or of Ac at the P or Bz_1 loci, serve this purpose better. No additional evidence of the mechanism of transposition ~~involved~~ has come from this study of Spm.

f). Modifier element in the Spm system

In the course of study of a_1^{m-1}, a series of tests were being conducted to determine Spm number and location in nearly a thousand (995) plants, all of which were derived from the second generation backcross to plants that were homozygous for the standard a_1 locus and in which no Spm was present. The state of a_1^{m-1} was the same in all plants that carried it. The behavior of this state with a fully active Spm is shown in photograph With ~~this state~~ it, mutations occur late in development of both plant and kernel, ~~with~~ there being only a few exceptions to this. ~~For this reason~~ Consequently, it would be expected to ~~be~~ remain stable in expression ~~in~~ through successive plant generations, and this was found to be true. In fact, although it has been used very extensively in these studies, no ~~gamete~~ kernel or plant carrying a newly altered state of it has ~~appeared~~ been recognized in any test. However, ~~a~~ one of the plants in the test series mentioned above that was a_1^{m-1}/a_1 and carried one Spm element in chromosome 5, was crossed by one that was homozygous for a_1 and had no Spm. On the resulting ear, ~~xxxxxx~~ all a_1^{m-1} carrying kernels that also had Spm exhibited the expected pattern of mutation to A_1 ~~with~~ that this state produces with the exception of one kernel. This exceptional kernel exhibited a marke~~dly~~ increased number of A_1 mutant spots in comparison with that shown by the other variegated kernels on the same ear, (~~and this is~~ see illustrated ~~in~~ photographs +-). Its phenotype

suggested that an alteration of state of a_1^{m-1} had occurred in an ancestor cell ~~that produced~~ of this kernel. The plant derived from this kernel likewise exhibited the same marked increase in frequency of mutation. Tests were conducted with this plant in order to examine the nature of the altered phenotype, and these indicated that the increased mutation rate was not the consequence of an altered state of a_1^{m-1} but rather of the presence of an independently located heritable unit. The effect on a_1^{m-1} mutation rates produced by this heritable unit could be seen only when an active Spm element was also present in the chromosome complement. In the absence of Spm, or when it is inactive, no evidence of the present of this Modifier is noted. Tests of it conducted in subsequent plant generations indicated that it underwent frequent transposition and thus, could be considered as an independent controlling element within the Spm system. Its presence in any one kernel or plant could be detected readily by the increase in rate of mutation to A_1 it effects with those states of a_1^{m-1} that are characterized by the production of relatively few such mutations in its absence. This rate of increase of mutation is proportional ~~with each~~ to that normally given by the state in that the number of mutant spots is increased over this by a factor somwhere between 2 and 3. The time when mutations occur, however, is not altered by this element. Also, on

states of a_1^{m-1} that give very many mutations to A_1 in the presence of active Spm, this element appears to exert little or no effect. ~~Also,~~ There is no evidence to indicate that increased doses of it will effect a proportional increase in rate of mutation.

Tests of the action of the Modifier on four states of a_1^{m-1} were conducted. In addition, tests of its transposition were made. Likewise, its behavior was examined with a fully active Spm-s element, an Spm-w element and also ones that are undergoing frequent change in phase of activity. It is of interest to note that it produces the same phenotype with either Spm-s or Spm-w.

No more is known of the origin of the Modifier other than that stated above, nor has another instance of origin of it been noted. It could be related both to the Spm element, since it enhances Spm-w activity, and to the element at a_1^{m-1}, since it exhibits one of the properties of this element, that is, control of rateof mutation to A_1.

g). Resume of mode of operation of the Spm system

From the descroptions given in the preceeding parts of this section, the reader may have gained the impression that the Spm system of control of gene action is inordinatly complex. There is no doubt that the analysis of a system of this type may be inordinately frustrating because of the many ~~xxxxxxx~~ diverse phenotypes that may appear, even in different parts of an individual plant or in different areas of ~~one~~ a kernel, and also because of the irregular and ~~superficially~~ presumably irreconcilable ratios of phenotypes that may appear in progeny of sister plants or even in progeny derived from different parts of the same plant. It was because of this that study of a_2^{m-1} had to be discontinued for a period of time, as no ~~effective~~ adequate interpretations ~~was drawn~~ came from observations and tests of it. Study of a_1^{m-1} progressed more rapidly and successfully; and relatively early in its study, interpretations could be drawn of the basic mode of operation of the elements involved in ~~this~~ the system, and these have remained essentially valid for all observations and tests that have subsequently been conducted.

For a ready appreciation of the mode of ~~action~~ operation of this system, an understanding only of the two primary aspects are essential. The first is ~~Thxxxxxxx~~ concerned with ~~an understanding of the~~ expression given by each of the different states of a_1^{m-1} and a_2^{m-1}, and the second is concerned with the basic mode

of ~~control of the by~~ action of the independently located Spm element. All other aspects are secondary in that they are concerned almost exclusively with the degree of effective~~ness of~~ action of the Spm element at any one time, and the consequences of this with any one state. These secondary aspects, nevetheless, are responsible for much of the apparent ~~inordinate~~ complexity of this system, and for ~~many~~ of the difficulties and frustrations experienced in the causes of its analysis.

As mentioned earlier, the states of a_1^{m-1} and a_2^{m-1} control the types of mutation, the time of their occurrence, and the frequency of this at any one stage in development when Spm is present and active. They also control the type of gene expression that appears in the absence of Spm. The states vary greatly with regard to these expressions. Thus, within the system, diverse ~~phe~~notypes are produced that are attributible solely to state differences. ~~The primary action of~~ The Suppressor-mutator element, Spm, ~~is a~~ acts to suppress~~ion of~~ anthocyanin pigment formation in plant and kernel tissue that appears with all but ~~expression of gene action, given by any~~ one state in its absence, and ~~to~~ also induc~~tion of~~ changes at ~~the~~ a_1^{m-1} or a_2^{m-1} ~~locus~~, that ~~lead to~~ result in altered ~~phenotypic~~ expressions of ~~gene~~ gene action. Included among them are mutations to stable alleles, either to a totally recessive, a_1 or a_2, or to higher alleles, ~~each~~ associated with the production of a particular type and with the degree of ~~production~~ this of anthocyanin pigment. ~~Another consequence of the change that~~ Spm ~~may~~ also induces a modification ~~of the~~ a_1^{m-1} or a_2^{m-1} that does ~~results~~ not give ~~in mutation to a~~

a stable mutant allele, but rather ~~to~~ an altered type of behavior of the locus in subsequent cell and plant generations both in the presence and absence of Spm, that is, to a change in its state.

Part II. Origin and Behavior of a_1^{m-1}

1. Origin of a_1^{m-1} and of its different states.

The origin of a_1^{m-1} was outlined in the previous section. It first appeared in a single kernel on an ear produced by the cross of a plant homozygous for a_1 and for A_2 to one which was A_1/a_1 and A_2/a_2. The a_2 in this latter plant had been derived from mutation of a_2^{m-1} to the stable recessive, a_2. All of the kernels on the ear, except one, were either uniformly dark pigmented (A_1 and A_2) or totally colorless (A_2, a_1). The exceptional kernel had spots of deep pigmentation in a colorless background. The plant derived from it (culture number 5371) likewise exhibited variegation for anthocyanin pigmentation. It had a number of distinct areas of deep pigmentation in a non-pigmented background. From the known constitutions of the parents, it was suspected that the instability of genic expression was associated with an alteration that had occurred at the A_1 locus in the heterozygous parent and in a single cell, late in development of the plant. Therefore the variegated plant was crossed with a number of plants that were homozygous for the standard recessive, a_1. It was also crossed with plants homozygous for the standard recessive, a_2, and to other homozygous for other recessive alleles of other genes known to be involved in development of anthocyanin pigment formation.

From these crosses it was readily determined that the variegated plant carried the standard recessive, a_1, in one chromosome 3, and a recently modified A_1 locus in the homologue, and that the modified locus was responsible for the expression of variegation. This locus was given the designation $\underline{a}_1^{\underline{m}-1}$. The original variegated plant, 5371, carried the standard A_2 in one chromosome 5 and a stable recessive, a_2, derived from mutation of a_2^{m-1}, in the homologue.

On the ears produced by the cross of the original a_1^{m-1} plant to plants homozygous for a_1 and A_2, kernels exhibiting several different phenotypes appeared: those that were uniformly and deeply pigmented, those that were uniformly but lightly pigmented, those that had areas of deep and light pigmentation in a colorless background, and those that were totally colorless. ~~kernels~~. The types of pigmented areas and the patterns of these were much alike among nearly all of the variegated kernels. There were some large areas that were either deeply pigmented or more lightly pigmented and also many small areas with these pigment types, as illustrated in photo. . However, on a few ears, there were one or several kernels that exhibited a pattern of variegation that differed markedly from this. Some had only small spots of deep pigmentation in a colorless background, and the number of these ranged from only a few in some kernels to very many in others. Other exceptional

kernels exhibited pigmented areas of various sizes in which the intensity was always low.

Kernels exhibiting different phenotypes were selected from some ears and planted in the greenhouse the following winter, 1950-51. The phenotypes of the selected kernels are entered in column 1 of table 1. The phenotype exhibited by each plant was similar to that expressed in the kernel from which each was derived. For example, if the kernel had shown only a few small spots of deep pigmentation in a colorless background, the plant likewise showed only a relatively few small streaks in which the deep anthocyanin pigmentation appeared. Or, a plant derived from a variegated kernel having pigmented areas whose intensity was low, likewise exhibited pigmented areas in which the grade of intensity of this was low. It was evident that the altered patterns of variegation in the selected kernels and in the plants derived from them arose as a consequence of some genetic modification controlling the times during development at which change in gene action occurs, the ~~in~~ numbers of cells in which such changes occurs at any one time, and ~~in~~ types of pigmentation that would result from this. Confirmation of this precise type of control of gene action came from tests conducted with these plants, through self-pollination of them and through crosses of them to plants that were homozygous for the standard recessive, a_1. The phenotypes of the variegated kernels on the ears

these crosses produced resembled that which had been expressed in the kernel from which each plant had arisen.

The kernels selected for greenhouse planting belonged to several different categories, enumerated in table 1. All four plants derived from kernls in row 1 carried a stable A_1 mutant of a_1^{m-1}. Those derived from the uniformly pale colored kernels in row 2 appeared to carry a stable intermediate allele of A_1 from tests conducted with them in the greenhouse. Subsequent tests conducted with their progeny indicated that the a_1^{m-1} locus in them was unmodified and that it would express the original type of variegation pattern in the presence of S_{pm}. Tests of one of them, plant 5700A, and of its progeny will be considered in detail later. The two kernels in row 3 had been selected because each exhibited a few small colorless areas in what appeared to be a fully pigmented background. Tests conducted with them indicated~~, however~~, that this phenotype was not produced by somatically occurring change in gene action from A_1 to a_1 but rather it was produced by a very large number of late occurring mutations ~~from~~ to A_1.

of kernels that appeared on ears derived from self-pollination of these plants, and from crosses of them to plants that were homozygous for the standard recessive, a_1. The phenotypes of the variegated kernels in the progeny of ~~each of~~ any one of these plants resembled that which had been expressed in the kernel from which each had arisen.

For the greenhouse planting, ~~a few~~ 2 kernels ~~were~~ had been selected ~~that~~ because each ~~appeared~~ ~~to~~ exhibit ed a few small colorless areas in what appeared to be a fully pigmented background (Rows 3, total). Tests of the plants derived from them indicated, however, that this phenotype was not produced by somatically occurring change in gene expression from the A_1-type to a_1, but rather it ~~was~~ due to a very large number of late occurring mutations ~~from the a_1~~ to A_1. ~~When this occurs, large areas that appear to be uniformly pigmented may be present. However, these do not arise from early occurring~~ This may result in what appears to be a large, fully pigmented area, but it arises from confluence of many small, closely placed areas each of which represents a mutation to A_1, ~~but rather from confluence of pigmented areas~~. This confluence ~~does~~ is not ~~arise from~~ the consequence of direct contact of one mutant area with another, but rather ~~from~~ of spread of some substance, produced in the cells of the A_1 mutant areas, ~~into~~ to the surrounding genetically a_1 ~~areas~~ cells that allows pigment to be formed in ~~them~~ the latter. This substance may spread through a number of cells, and it gives rise to a halo about each ~~genetically~~ A_1 mutant ~~area~~ spot, the intensity of pigment decreasing as the distance from the ~~mutant area~~ spot in which mutant cells are present increases. Thus, whenever a large number of closely placed mutant

A_1 areas are formed, confluence of their halos may occurs. When this ~~occurs~~ happens within a large area of a plant or kernel, the area may appear to be uniformly pigmented and to have arisen from an early occurring mutation to A_1. However, microscopic examination of such an area~~s~~ usually reveales some irregularities within it in grades of intensity of pigmentation. ~~Such is~~ This would be expected ~~to appear from~~ if confluence of some halos occurs only at their border regions where pigment intensity is low. ~~of halos of mutant areas~~.

Halos of the type described above ~~are not produced by mutant~~ do not surround areas exhibiting ~~the lower intensities~~ pigment intensities of lower grade. The borders of such mutant areas are sharply defined. Thus, a change in gene action at a_1^{m-1} to full A_1-type expression may be distinguished from those that give the lesser intensities of pigmentation not only on the basis of the intensity of the pigment itself but also on the basis of presence or absence of halos. ~~formation~~. It is suspected that the pigment produced in ~~the so-called~~ some pale areas is not the same as that produced by the standard A_1 and some evidence of this will be given later.] ~~This is shown more clearly in the plant than in the kernel~~. However, indirect evidence of it appears in plants. In them, the pale-~~producing~~ phenotype is expressed only in some tissues, and it is conspicuously absent from the leaf-blade with the exception of the mid-rib. In contrast, the full A_1 phenotype is ~~readily~~ expressed in the leaf-blade, intense pigment being expressed within it. Also, in the plant, some of the pale-producing mutants give rise to anthocyanin pigments with pastel shades that obviously

would not appear merely from reduction in amount of the same pigment that is produced ~~by~~ with the standard A_1. It is likely that the action of the pale mutants ~~produces~~ result in pigments that differ from that ~~appearing when~~ produced with standard A_1, ~~is present~~ or ~~by~~ when a mutant~~s~~ ~~derived from~~ of a_1^{m-1} ~~that resembles A_1 in their action.~~ arises whose action resembles that of A_1.

In addition to the 2 cases of modified a_1^{m-1} ~~action~~ behavior, ~~that result in the appearance of phenotypes~~ described above, tests were conducted with ~~30~~ 28 other plants grown in the greenhouse during the winter of 1950-51. Four of them (Row 1, table 1) were derived from kernels that appeared to be uniformly pigmented and the type ~~bein~~ was similar to that produced ~~by~~ when standard A_1 is present. In the progeny derived by test crosses of of three of them, the ~~stabel~~ A_1 phenotype appeared in expected proportions and there was no evidence of instability in expression. The fourth ~~proved to have~~ progeny of the plant indicated the presence in it of a modified a_1^{m-1}. Kernels carrying it exhibited ~~behavior in that it produced~~ very many ~~mutations~~ mutant areas ~~that occurred~~ that arose from mutations that had occurred late in development. It is probable, therefore, that the phenotype of the kernel that gave rise to this plant was produced ~~by~~ because of confluence of haloes about mutant areas in the manner ~~as~~ described above. Five other plants (Row 2, table 1), each derived from a kernel exhibiting only pale pigmentation, uniformly distributed over the aleuron layer, were also examined. The pale phenotype ~~appeared to be quite stable in expression and it~~ was recovered in expected proportion in ~~the~~ progeny derived from tests crosses made with each of these plants. No navigated kernels appeared.

In addition, tests were conducted with 19 other plants, each of which were ~~derived~~ from a variegated kernel. (Row 4, Table 1) Five came from kernels that had exhibited the pattern of this that was common to the majority of variegated kernels on ears produced by test crosses conducted with the original a_1^{m-1} carrying plant. Each of the remaining 14 plants came from a kernel that had exhibited some marked deviation from this pattern, and the types of this are described in rows 5 to 10 of column 1 of table 1. In this table, the culture number of each plant is given, and that of four of them are underlined. From them ~~these four plants~~ originated ~~are the source of~~ four of the six modified states of a_1^{m-1} that were used extensively throughout the study of a_1^{m-1}. In subsequent references to a particular state, it will be designated by the culture number of the plant that ~~which~~ originally carried it. It may be mentioned ~~stated~~ at this time that although the original state of a_1^{m-1} has given rise to many altered ~~different~~ states, only a 16 ~~small representative sample of types~~ of them has been ~~received full~~ examined ~~examination~~.

No clear indication ~~evidence~~ of a two-element system, responsible for control of gene expression at a_1^{m-1}, was obtained from ratios of kernel types on ears produced by self-pollination or by test cross of the plants grown in the greenhouse during the winter of 1950-51. Several examples will be given which will illustrate this. Plant 5715A, row 4, table 1, arose from a kernel that had very many small deeply pigmented spots ~~[illegible]~~ in a colorless background.

Examples illustrating this are given in table 2. In this table, the phenotypes of kernels produced by tests crosses conducted with the six plants entered in line 7 of table 1 are given. All six variegated plants were a_1^{m-1}/a_1, A_2/A_2 in constitution. In table 2, the progeny kernels derived from any one test are divided into three classes; uniformly pigmented, variegated, and colorless. The intensity of pigment exhibited by kernels entered in the uniformly pigmented class differed according to the plant that was tested. Those derived from tests of plant 5715A were intensely pigmented. The pigment in those derived from plants 5717A, 5719A-1, and 5719A-2 was deep but it was slightly less intense. In contrast, the kernels in this class in the progeny of plants 5714E and 5718 expressed a very low level of intensity pigment. All were very pale.

Similarly, differences were expressed in the pattern of variegation exhibited by kernels in the variegated class in the progeny of plants entered in row 7 of table 1. In the progeny of plant 5715A, the variegated kernels were characterized by the presence of very many, small, deeply-pigmented spots. A few of these kernels also had a large deeply-pigmented area. The pattern given by the variegated class of kernels in the progeny of plants 5719A-1 and 5719A-2 was alike, and it resembled that given by plant 5715A except that there were far fewer deeply pigmented spots. Plants 5717A and 5718 produced

variegated kernels in their progeny that had small, deeply pigmented spots but the numbers of them were ever fewer than those in the variegated class of kernels in the progeny of ~~produced by~~ plants 5719A-1 and 5719A-2. ~~and~~ Also no large pigmented areas appeared in any of them. The pattern exhibited by the variegated kernels in the progeny of plant 5714E was likewise distinctive. ~~Only small~~ The spots of deep pigmentation were very small ~~appeared in them~~ and these were widely dispersed ~~distributed lightly~~ over the aleurone layer.

Tests subsequently conduced with the progeny of the plants entered in table 2,-- and that of plant 5718 and 5719A-1 ~~some of them~~ through many plant generations-- indicated that the pattern of variegation given by each was a reflection of some modification that had occurred to a_1^{m-1} in a cell of the original a_1^{m-1} carrying plant. This modification was responsible for the altered pattern of expression of a_1^{m-1} given by each of the plants entered in table 2. It is known that this expression will persist through ~~cell and~~ plant generations until another event occurs in some cell of a plant that again ~~to~~ modifies the behavior of a_1^{m-1} and this modified behavior will be expressed in ~~subsequent~~ descendant cells ~~and plant generations~~. That the degree of stability of any one state of a_1^{m-1} through plant generations depends, in part, on the ~~is related to~~ time of occurrence of mutation-inducing events, -- those events that produced the deeply pigmented spots in the progeny tests just described,--will be pointed out later ~~shortly~~. It need only be stated here that the later the time during

development that such mutations occur, the less the change of appearance in a gamete of a newly altered state, and a newly altered state must be present in a gamete if it is to be isolated for further examination.

Plant 5720, row 9, table 1, arose from a kernel that exhibited both large and small pigmented areas in a colorless background but the intensity of pigment in nearly all of them was much lower than that produced by A_1. The different areas exhibited pigment of quite different intensities, ranging from very pale in some to quite dark in others. The plant also exhibited pigmented areas in which different grades of intensity were expressed. Progeny of this plant, derived from self-pollination and from reciprocal crosses with plants homozygous for a_1, produced variegated kernels of the same type as that which gave rise to this plant. In a few of them, however, one or several very small spots of the full A_1-type pigment appeared. In addition, there were many kernels exhibiting pigment of one grade of intensity uniformly distributed over all of the aleurone layer, the intensity of pigment ranged from very light in some kernels to quite dark in others. Among them the same grades of pigment intensities were expressed as that exhibited among the different pigmented areas in a variegated kernel. There were also a number of colorless kernels. Subsequent study of the progeny of plant 5720 made it evident that a modification of a_1^{m-1} had occurred in a

sporogenous or spore cell of the original a_1^{m-1} carrying parent plant that had effected a marked shift in the proportions of different mutant phenotypes it would produce in comparison with those given by the original state of a_1^{m-1}. However, this alteration did not ~~alter~~ modify the time during development at which a mutation-inducing event would occur, as it had done ~~xxxxxx xxxxx xxxxxxxxxxxxxxx~~ with respect to ~~the~~ a_1^{m-1} carried in the plants entered in ~~line~~ row 7, table 1, described above.

As mentioned earlier, none of the tests conducted with plants grown in the greenhouse during the winter of 1950-51 ~~indicated~~ gave evidence suggesting the presence of an independently located element that was associated with control expression of gene ~~instability~~ of a_1^{m-1}. Only ~~when~~ after progeny of some of the greenhouse plants were ~~grown~~ examined and and test-crossed during the summer of 1951 was ~~it realized~~ evidence ~~that an independently located element was associated with this~~ of this obtained, and the type ~~of evidence of this~~ will be considered below.

2. Discovery of an independently located controlling element in the a_1^{m-1} system. ~~Tests of the constancy of behavior of different states of a_1^{m-1}~~

During the summer of 1951, ~~plants were grown from~~ selected kernels in the progeny ~~derived~~ ears produced by crosses conducted with ~~from~~ five of the plants entered in table 1, 5700A, 5718, 5719A-1, 5719A-2, and 5720 were grown. In addition, plants were grown from kernels with special phenotypes that were selected from ears produced by cross of the original a_1^{m-1} carrying plant (5371) to plants that were homozygous for a_1. ~~Among the latter, there were 48 plants derived from~~

kernels exhibiting the pattern of variegation appearing in most of the kernels receiving a_1^{m-1} from the parent plant, 4 plants derived from kernels whose variegated patterns deviated markedly from this, 7 plants derived from kernels that appeared to be fully A_1 in phenotype, and 7 other plants derived from kernels that were uniformly but less intensely pigmented.

A record was made of the phenotype exhibited by each plant and test crosses were conducted with each. ~~An effort was made to cross each plant~~ many of these plants were crossed with ones that were homozygous for the standard recessive, a_1, and for the recessive, sh_2 (shrunken endosperm) which is very closely linked to a_1, giving only 0.4 percent recombination with it. This stock had been obtained from Dr. M.M.Rhoades for the purpose of making more accurate examinations of ~~the~~ different independently arising modifications of gene action ~~types of behavior of instability~~ of A_1. ~~Independently~~ ~~arising~~ Cases of this had been accumulating in my cultures. Close linkage of a well expressed gene~~tic~~ marker with ~~the~~ an ~~unstable~~ locus would allow accurate ~~detection~~ determinations ~~identification~~ of some types of ~~genetic~~ change in ~~gene~~ its action ~~of the unstable locus~~ that otherwise might not be detected readily. Since all a_1^{m-1} plants grown in the summer of 1951 were homozygous for Sh_2, crosses of them with plants homozygous for a_1 and sh_2, prepared the way for more precise investigations of ~~it~~ a_1^{m-1} in the future. ~~Other tests of these plants~~

In addition, ~~also were made.~~ Some ~~plants~~ were self-pollinated, ~~and~~ Also crossed were made between ~~to~~ plants carrying unlike ~~other~~ states of a_1^{m-1}, ~~or to those derived from the pale class of kernels.~~ ~~However,~~ At this time, other projects were in progress that took precidence over ~~the immediate continued~~ study of a_1^{m-1} and therefore, the ears obtained from the various types of cross made in the summer of 1951 were not carefully examined until more than a year had elapsed. Included in these other projects was examination of the behavior of a_1^{m-2}, a_1^{m-3}, and a_1^{m-4}, three independent inceptions of instability ~~expression~~ of gene expression at the locus of A_1. It was soon realized that ~~instability~~ ~~control of~~ gene expression at a_1^{m-3} and a_1^{m-4} was controlled by ~~resided in~~ the Ds-Ac system. ~~of control of gene action.~~ The system controlling a_1^{m-2} was not Ds-Ac, nor that in which Dt is involved. A system having ~~with~~ a quite different mode of operation ~~action~~ was responsible for its ~~types of~~ expression. An interpretation of the mode of operation of this system was formulated from tests conducted with it during the ~~over a period of~~ three preceding years. Evidence obtained from ~~From results of~~ tests crosses conducted ~~obtained during the summer of 1952~~ with them with ~~the~~ few A - plants carrying were grown in the summer of 1952. a_1^{m-1} ~~plants that were grown and also from examination of kernel types of ears produced during the previous summer,~~ suggested ~~it was suspected~~ that the system operating to control gene action at ~~both~~ a_1^{m-1} ~~and a_1^{m-2}~~ might be ~~the same~~ (similar to that effecting control of gene action at a_1^{m-2}). Subsequent study of a_1^{m-1} ~~tests~~ indicated, however, that this assumption was incorrect. The two systems do not have elements in common

nor is their mode of operation comparable.

Even though a decision had been made to postpone study of a_1^{m-1} until more time would be available for its examination, it was desired to learn if the change at A_1, responsible for the origin of a_1^{m-1}, would effect an alteration in crossing-over between this modified locus and sh_2. To determine this, only a few plants would be required and only a small amount of time would need to be given to ~~accomplish~~ this test. Therefore, 10 variegated kernels were removed from an ear produced by each of two variegated plants that were a_1^{m-1} Sh_2/a_1 Sh_2 in constitution when pollen from a plant homozygous for a_1 and sh_2 had been ~~was~~ used on the silks of each ear. Each of the two ~~Both~~ variegated plants had been derived from a variegated kernel on the ear produced by the cross conducted with plant 5719A-1, entered in C of table 2. Therefore both of them had the 5719A-1 state of a_1^{m-1}. Nineteen mature plants were obtained from the 20 selected kernels. All exhibited variegation for anthocyanin pigment, and all were a_1^{m-1} Sh_2/a_1 sh_2 in constitution. The silks of all fertile ears produced by 17 of these plants received pollen from plants that were homozygous for a_1 and for sh_2. The reciprocal cross was conducted with 8 of these variegated plants. The kernel types appearing on the ears these crosses produced are entered in table 3.

In table 3, very close linkage ~~is expressed~~ between Sh2 and the ~~classes of kernels that show pigment in them~~. Within the 7490 kernels that exhibited pigment, there were three distinct classes. In two of them, pigment was uniformly distributed over the aleurone layer. Of the 3617 kernels with uniform distribution ~~of~~ pigment, only 4 ~~xxxx~~ had the type of pigment produced when A_1 is present. The pigment in the other ~~xxxxx~~ 3613 kernels was ~~distinctly different~~, and this was well expressed by the ~~distinctions xxxxxxxxxxxxxxxxx xxxxxx(Pr)xxxxxPrxxxxxprxxxxxxxxxx~~ in pigment intensity ~~between~~ ~~in~~ those that had Pr ~~and~~ those that were homozygous for pr. With the standard A_1, the presence of Pr results in the production of intensely purple pigment. When pr is homozygous, the kernels exhibit, with A_1, an intense red color. Some of the a_1^{m-1} plants had Pr in one chromosome 5 and pr in the homologue. The a_1, sh_2 tester plants were homozygous for pr. Therefore, on some of the ears, half of the kernels carried Pr and the other half was homozygous for pr. On these ears, it was very evident that the intensity of pigment appearing the uniformly ~~pale~~ class ~~of kernels~~ depended upon ~~their~~ constitution with respect to the alleles of Pr. The color in those kernels having Pr was a deep purple, almost as intense as that produced when the standard A_1 is present. ~~On the other hand, these kernels that were homozygous for pr were only~~

In contrast, those homozygous for pr were a very light shade of pink. It was apparent from this that the pigment present in the pale class of kernels did not ~~represent~~ suggest dilution of that produced by A_1, but rather the presence of a different ~~a distinctive~~ type of pigment. ~~All of the pale kernels that were Pr~~ The Pr kernels entered in the pale class were alike among themselves in phenotypic expression and, ~~xxxx~~ all those that were pr were ~~xxxxxxxx~~ likewise alike. The pale class represents, then, one particular genotype. Among the variegated class of kernels, the pigment type in the ~~xxxxxxxx~~ deeply pigmented spots resembled that produced by A_1, either a very deep purple or a very deep red depending on the presence or absence of Pr in them. (Pr, purple aleurone, pr recessive allele, red aleurone, located in chromosome 5.) The pattern of such spots was quite similar in all but a very few kernels. [See page 00 for a description of the pattern of variegation exhibited by these few exceptional kernels]. Illustrations of this pattern are given in photo .

In examining the data of table 3, attention should be given to the ratio of the pale class to the variegated class appearing on different ears ~~produced by each~~ of a single plant, and on these ears derived from use of its pollen in the test cross to plants homozygous for a_1 and sh_2. It may be seen that an approximate ratio of 1 pale to 1 variegated kernel appeared on ears produced by tests crosses conducted with plants 1,2,4, 5, 6, 7, and 8 in culture 6452 and by plants 1, 2, 4, 5, 6, 7, and 8 in culture 6453, although there are some marked deviations from this expressed by tests of the pollen of plants 6452-5 and 6453-4. The ratio of pale to variegated kernels derived from

test crosses of plants 6452-3, 6453-3, and 6453-9 deviated very much from 1 : 1 and with plant 6453-9, marked differences in ratio of these two phenotypes were expressed on ears produced ~~from~~ on different parts of this plant. Nevertheless, it was clear that some chromosomal component, present in the a_1^{m-1} carrying plants, and not linked to this locus, was ~~being~~ segregated at meiosis and that the expression of ~~a~~ the uniformly pale class of kernels and ~~a~~ the class showing deeply pigmented spots in a colorless background was related to the presence or the absence of this component. Since in the grandparent (5719A-1), in the two a_1^{m-1} carrying parent plants, and also in all plants of cultures 6452 and 6453, variegation was ~~expressed~~ exhibited, it seemed evident that the presence of this component in the chromosome complement was related to the expression of variegation -- mutant spots in a colorless background --, and that its absence resulted in ~~to~~ the appearance of the pale phenotype.

As stated earlier, none of the kernels on the ~~xxxxxxxxx~~ ears derived from test crosses with the a_1^{m-1} - carrying plants grown in the summer of 1951 had been examined carefully up to this time. When it was realized that the ratio of kernel types appearing on the ears of plants entered in table 3 ~~indicated~~ was related to ~~xxxxxxxxxx~~ segregation of an independently located controlling element ~~in the chromosome complement associated with control of a_1^{m-1} behavior~~, the kernels on ears produced by test crosses of plants in the parent culture, 6046 and

6047, were then examined. More direct evidence of the presence of ~~this~~ such an element was then obtained, ~~for~~ and it was found to be linked in some plants with the ~~to the genetic~~ Y or its allele, marker, y, in chromosome 6 (Y, yellow starch in endosperm; y, recessive allele, white starch in endosperm). The plants in ~~this~~ culture 6047, were derived from kernels on ~~an~~ the ear produced by the cross of ~~a plant~~ to homozygous for a_1, Sh_2 and y, ~~by~~ plant 5719A-1, which was a_1^{m-1} Sh_2/a_1 sh_2, Y/y, ~~entered in~~ (C of table 2). Some kernels ~~in the~~ variegated with yellow (Y) starch ~~Y class~~ on this ear ~~were~~ sown in the summer of 1951 under A of culture 6047. Others that were variegated but had white starch (y) ~~were~~ sown under B and C of culture 6047. ~~In addition~~, Variegated kernels that were Y also ~~were~~ selected from the ear produced by self-pollination of plant 5719A-1 (A, table 2) and shown under B and C of culture 6046. All plants in cultures 6046 and 6047 received some type of test by means of crosses to plants of known constitution, ~~or~~ by self-pollination, or ~~both~~ by means of both types of test. The kernel ~~types~~ phenotypes on ears obtained by crosses of these plants to plants that were homozygous for a_1, sh_2 and y are given in table 4. All plants entered in column 1 in this table were a_1^{m-1} Sh_2/a_1 Sh_2. Those in Part I were Y/y whereas those in Part II were y/y.

In Part I of table 4, a ratio of 1 pale to 1 variegated kernel among those showing pigment ~~was exhibited~~ appeared ~~among the kernels~~ on ears produced from crosses conducted with plants 6046B-1 and 6047A-3.

Linkage of the pale phenotype with Y and the variegated phenotype with y is clearly expressed by the test with plant 6046B-1. In plant 6047A-3, these linkage relations were reversed; the pale phenotype was linked with y and the variegated phenotype with Y. The ratio of kernel types obtained from tests of the other plants in Part I of table 4 indicated that each carried more than one ~~of this independent~~ controlling element, ~~in the a~~ ~~m-1~~ ~~system~~. In plants 6046B-3 and 6046C-2, ~~linkage of~~ one of the ~~m~~ ~~elements~~ was linked with Y, ~~is evident~~ but in plant 6047A-1, no evidence of such linkage was given ~~is shown~~.

The a plants in Part II of table 4 were all y/y in constitution and thus no linkage relationships with this marker in chromosome could be shown by them. Nevertheless, the evidence suggested the presence of more than one independently located controlling element in all plants except 6047C-3. The plants in culture 6452 (table 3) originated from the y class of variegated kernels on the ear produced by the cross of plant 6047A-3 entered in table 4. According to the ratio of kernel types on this ear, ~~data contained in of table 4~~, this plant had only one independent controlling element and it was located in the Y carrying chromosome. The plants in culture 6453 originated from the variegated class of kernels on the ear produced from the test cross of plant 6047C-4, table 4. The ratio of kernel types ~~on its test cross~~ this ear suggested the presence in this plant of two ~~of the independent~~ controlling elements, each ~~at~~ occupying a different location in

the chromosome complement. Selection ~~of the y class of~~ variegated kernels was made in order that the color of the anthocyanin pigment in the aleurone layer in kernels on ears of that were plants derived from them would be expressed on a white rather than a deep-yellow background. As stated earlier, the only purpose of the test had been to determine crossing over between a_1^{m-1} and Sh_2.

From the ratio of kernel types given in table 4, and from those obtained from self-pollination and from the test cross of plant 5719A-1 (A and C of table 2), it would appear that plant 5719A-1 had more than one ~~independently located~~ controlling element, ~~and that~~ However, one of them occuppied a position in its y bearing chromosome 6.

The plants in cluture 6452 (as mentioned above, table 3) arose from variegated kernels on the ear of plant 6047A-3, which had one controlling element. ~~whose kernel types are entered in table 4.~~ Thus, ~~These~~ plants in culture 6452 would be expected to have only one ~~independently located~~ such controlling element. This appeared to be true for all plants except plant number 3. The plants in culture 6453, table 3, arose from variegated kernels on the ear produced by plant 6047C-3, which had two controlling elements, ~~whose kernel types are entered in table 4.~~ independently located in the chromosome complement. The plants in culture 6453 would therefore be expected to have either one or two ~~of the independently located~~ such controlling element. As the data in table 3 ~~indicates~~ suggest, ~~xxxxxxxx~~ seven of the nine plants in this culture had one such element

~~but~~ and the remaining two plants, plant number 3 and plant number 9, had more than one. ~~such element~~ ~~and~~ The ratio of kernel types on ears produced by different parts of plant 9 suggested that the number of this element was not the same in all of its part. ~~of this plant~~. It was suspected from this that the controlling ~~independently located~~ element could undergo transposition in somatic cells and that this mechanism was responsible for the observed aberrancies ~~deviations from expected ratios~~.

3. Initial evidence ~~suggesting~~ of the primary mode of operation of the independently located controlling element in the a_1^{m-1} system, the Suppressor-Mutator.

The mode of control of a_1^{m-1} action induced by the independently located element of the system, whose discovery was outlined above, was not appreciated until the results of tests made in the summer of 1953 were analysed. From them, a reasonable interpretation could be drawn, ~~of its mode of operation~~. With this interpretation in mind, all test cross ears that had been produced in the summer of 1951 were then carefully examined for the first time. The evidence obtained from them conformed ~~fitted nicely~~ with this interpretation. It was possible, then, to devise ~~This suggested the types of~~ precise test of the validity of this interpretation ~~of this that should be made~~ and these were conducted in the summer of 1954. Before these tests are considered, the evidence suggesting ~~leading to an appreciation of~~ the mode of operation of the independently located contolling element derived from examinations of kernel types on test crosses will be outlined, ~~briefly~~.

Due to unforseen conditions, the total planting during the summer of 1953 had to be restricted. Space was available for only a fraction of the number of plants usually grown in the summer season. For this reason, study of a_1^{m-1} was very much limited, preverence being given to other projects then under investigation. ~~The reason that~~ The decision ~~was made~~ to limit study of a_1^{m-1} was dictated by the fact that up to this time, many of the test cross ears ~~obtained~~ produced ~~from tests conducted in~~ the summer of 1951 had not yet been examined and little was ~~really~~ known of the behavior of a_1^{m-1}. It was decided, then, to confine ~~limit~~ its study to an examination of the number and position~~s~~ of the independently located element in the system in the progeny obtained from plant 6047C-2 ~~or~~ (table 4), and to the plants derived from the pale class of kernels in the progeny of plant 6046C-4. This latter plant had been derived from a variegated kernel on the self-pollinated ear of plant 5719A-1 (A1 table 2). The constitution of plant 6046C-4 was a_1^{m-1} $Sh_2/a_1^{m-1}Sh_2$, Y/y, pr/pr/. The ear from which the pale kernels were selected had been produced by self-pollination of this plant. On this ear there were ~~It gave rise to~~ 406 kernels. Among them there were ~~with the following phenotypes:~~ 35 uniformly pale colored kernels of which 33 were Y and 2 were y and to 371 kernels that had deeply-pigmented spots in a colorless background and 267 of these were Y and 104 were y. Twenty pale kernels that were 4 were selected from this ear and plants grown from them during the summer of 1953 under

culture number 6628. ~~The decision to select~~ pale kernels were selected ~~from this ear~~ ~~was~~ which bore this ear because the plant was homozygous for a_1^{m-1}, and thus ~~each~~ both chromosomes 3 should carry a derivitave of a_1^{m-1} in a plant derived from a pale kernel. It was desired to examine the ~~behavior~~ ~~of each of~~ phenotypic products of these derivatives in each chromosome 3. ~~in the progeny derived from the test cross of~~

Therefore the plants derived from the pale kernels were tested for this by crosses with plants homozygous for a_1, sh_2 and y, and, as will be pointed out, plants all of the kernels on the resulting ears had the pale phenotype.

Plant 6047C-2, table 4, had the constitution A_1^{m-1} Sh_2/a_1 Sh_2, pr/pr, and Y/y. An ear of this plant had been crossed by a plant that was homozygous for a_1, sh_2, y and Pr in one chromosome 5 and pr in its homologue. The types of kernels appearing on the resulting ear, given in table 4, suggested that plant 6047C-2 had one ~~of the~~ independently located controlling element ~~of the a_1^{m-1} system~~ in the Y bearing chromosome 6 and, in addition, two others located elesewhere in the chromosome complement. Ten kernels in the variegated, Y, Pr class and ten other in the variegated, y, Pr class were selected and sown in the summer of 1953 under culture number s 6629A and B. Nearly all the ears produced by the plants derived from these kernels were used in crosses with plants that were homozygous for a_1, sh_2 and y. Two stocks were ~~used~~ employed for this, but their constitution with respect to the Pr alleles was not then known. Tests conducted with them indicated that one stock was Pr/Pr and the other pr/pr. The need for knowning the constitution of the tester stocks with respect to the Pr alleles

will be evident shortly. In addition, a few ears of plants in culture 6629 were either self-pollinated or sib crossed.

The phenotypes of kernels on the ears of plants in culture 6629A, produced by the test cross, are entered in table 5. Again, it will be noted that there is very close linkage between the kernels carrying the Sh_2 marker and those exhibiting pigment. The position of the tested ear on each plant is also indicated in this table. It will be noted that on all tested ears of plants A-2, A-5, and A-8, and on the first ear of the main stalk of plant A-7, a ratio of one pale kernel to one variegated kernel among the anthocyanin pigment bearing classes, and that the pale phenotype was linked with Y whereas the variegated phenotype was linked with y. To facilitate ready appreciation of this, the phenotypes of the pigment bearing classes of kernels on these ears are entered in table 6. The ratio of these kernel types entered in table 5, exhibited other ratios, and for a more ready appreciation of this, the numbers of kernels pale and variegated in the Y and y classes are entered in table 7. It would appear from these ratios that more than one independently located controlling element was present in tested parts of plants A-2, A-5 and A-8. Linkage of pale with Y was evident on the ear obtained from plant A-8 but on none of the other ears was there good evidence of this. The ratio of kernel types on the ear produced by the tiller of plant A-7 was very aberrant, Only 4

variegated kernels appeared among the total of 112 that had anthocyanin in them. From the ratios of Sh_2 to sh_2 on this ear, it was clear that there was no deficiency in transmission of the a_1^{m-1} bearing chromosome.

The types of kernels appearing on the ears ~~produced by~~ of plants in B of culture 6629, ~~following~~ produced by the test cross with plants that were homozygous for a_1, sh_2 and y, are entered in table 8. An approximate 1 : 1 ratio of pale to variegated kernels was expressed on the ears ~~produced by~~ of plants B-1, B-3, B-4, B-7, and B-10 and on the first ear of the main stalk of B-5. On the remaining 10 ears, whose kernel types are entered in this table, other ratios of these two classes of kernels were ~~expressed~~ given. On several other ears, a class of kernels appeared that exhibited a marked alteration in pattern of variegation. The number of such kernels is indicated by an asterik. These kernels were colorless except for 1, 2, or several very small dots that exhibited the A_1 phenotype. It will be noted, also, that on those ears in which they ~~number of them~~ appeared in appreciable numbers, likewise exhibited a marked increase in the proportion of the colorless Sh_2 class of kernels. As will be shown later, these totally colorless, Sh_2 kernels, with rare exceptions, belong with the variegated class of kernels. On a few of the ears whose kernel types are entered in table 5, one or several kernels exhibiting only one or a very few small dots of the A_1-type pigment likewise

were present but because the table already had many entries, ~~already is complicated~~, they were not indicated in it, and mention ~~a description~~ of them was deferred until this time. (It may ~~will~~ be stated ~~mentioned~~ now, however, that study of the progeny derived from ~~those~~ kernels showing ~~with~~ these very decided modification of variegation expression revealed the Spm-w state of the Spm element and this will be considered in detail in section 00.) It should be mentioned also ~~here~~ that the Sh2 kernels exhibiting either a very reduced number of pigmented spots or showing no pigment at all ~~the modified variegation pattern~~ were not always randomly distributed over the ear. In some ears, they were adjacently aligned, forming a cluster on the ear.

In addition to the test crosses conducted with plants in culture 6629, already described, an ear of a tiller of plant 6629A-2 and 6629A-4 was ~~had been~~ self-pollinated and pollen collected from the tiller of plant 6629A-4 was ~~had been~~ placed on the silks of a tiller ear of plant 6629B-2 and 6629B-6. The ratio of kernel types on the resulting ears need not be given here as they add little to the information already given ~~gained~~. However, the phenotypes of some kernels among them served to illucidate the mode of operation of the independently located element and this will be discussed shortly after the test crosses with plants in culture 6628 are considered.

As mentioned earlier, page 00, the plants in culture 6628 were derived from the pale, Y, pr class of kernels on the self-pollinated ear of plant

6626C-4, which was homozygous for a_1^{m-1}, Sh_2 and pr but heterozygous for the alleles of Y (Y/y). In order to learn whether or not the derivatives of a_1^{m-1} in each chromosome 3 would express the pale phenotype and if so, in the samme manner by each, these plants were crossed by plants homozygous for a_1, sh_2 and y. All kernels on the resulting ears were uniformly pigmented and the grade of intensity of this was the same in all of them. Some of the a_1, sh_2, y ~~tester~~ plants used in the test cross to plants of culture 6628 were ~~also~~ homozygous for Pr whereas other were homozygous for pr. From comparisons of pigment type and intensity in kernels on ears produced by use of ~~the~~ these two ~~types~~ classes of tester plant, it was ~~clearly~~ apparent that with Pr present, ~~the~~ an intense anthocyanin pigmentation appeared in the aleurone layer of the kernel, ~~approaching close to~~ approaching that ~~appearing~~ produced when A_1 is present. In contrast, the intensity of anthocyanin pigment in those that were homozygous for pr was much ~~less than that~~ very reduced in comparison with that which appears ~~which is produced~~ with A_1. There ~~c~~could be no ~~confusion~~ difficulty in ~~identifying~~ distinguishing ~~the~~ a pale, pr, ~~class~~ kernel from ~~the~~ an A_1, pr ~~class~~ kernel. With this in mind, attention ~~will be given~~ is drawn to the note entered at the base of ~~both~~ table 5 and table 8. Here is given the number of kernels that expressed ~~the~~ a full A_1 phenotype ~~xxxxxxxxxxx~~ but only in the pr class. Those of this type in the Pr class could not always be distinguished ~~readily~~ with absolute certainty and therefore they are included in the pale classes in these tables. The frequency of appearance of kernels with an A_1 phenotype is so low that inclusions of a few of them in the pale

classes does not invalidate the deductions drawn from the distribution of kernel types ~~significance of the given ratios~~ in ~~these tables~~. (In this regard, it may be mentioned here that in subsequent study of a_1^{m-1} it was often necessary to use another state of a_1^{m-1} that gives rise to kernels exhibiting a very pale phenotype in both the purple (Pr) and red (pr) classes.) ~~that is readily distinguished from the purple and red classes produced by A_1.)~~

In examining the kernels on the ears derived from cross of plants 6629B-2 and 6629B-6, which were y/y, by plant 6629A-4, which was Y/y, some variegated kernels ~~appeared~~ were found that had ~~several~~ areas exhibiting the pale phenotype in addition to the deeply-pigmented spots. In the Pr class, the pigment in these areas was quite intense. In the pr class, in contrast, the pigment intensity in the ~~areas~~ was low. In fact, with respect to this pigment, the pale areas exhibited similar intensities ~~of pigment~~ as those expressed by the pale kernels in the Pr and pr classes ~~of kernels~~ on ears entered in tables 5 and 8. In plant 6629A-4, one independently located controlling element was present and it was carried in its y-bearing chromosome. ~~By means~~ As a consequence of crossing over, some of the Y carrying gametes produced by this plant should have this element, and from the crosses with plants in 6629B, some kernels on the resulting ear should ~~have only one of this element and~~ should be present that carried this element in the Y bearing chromosome.

Among the Y class of variegated kernels on this ear, several ~~kernels~~ were found that exhibited white starch instead of yellow starch immediately benigh a pale area, and the correspondence in their borders was exact. In these cases There seemed little doubt that the coincident expression of pale anthogram and white starch ~~the appearacne of the pale area~~ was associated with a somatically-occurring loss of the segment of the X-bearing chromosome 6 that removed both Y and the independently located controlling element. In other words, it could be concluded that the pale areas appearing in the variegated kernels ~~did not~~ arose ~~as the consequence of~~ from removal (or inactivation in some somatic mitosis. Absence of this element resulted in expression of the pale phenotype) and this ~~see later~~ as discovered) of the independently located controlling element, confirmed with conclusions drawn from ratios of kernel types on test cross ears.

No attempt was made to cross plants of culture 6629 to those of culture 6628, which were homozygous for a derivative of a_1^{m-1} and for pr, and y. Similar types of cross had been made in the summer of 1951 even though the ears derived from them had not been examined. However, on one ear of a plant of culture 6628, which had been used in a cross with a plant homozygous for a_1, sh_2, y, and pr, a single variegated kernel was present. It was a contaminant in that ~~it had~~ the phenotypes was expressed Pr and Y instead of pr and y. ~~It~~ Obviously it arose ~~was derived~~ from functioning of a stray pollen grain produced by a plant in culture 6629A. The~~se~~ plants of culture 6629A were growing in the next row and were immediately adjacent to those in culture 6628. Since this kernel showed spots of deep A-1 type pigment in a colorless instead of in a dark-pale background ~~as well as~~ a ~~few dark pale areas~~, it seemed evident that the independently located element

in the a_1^{m-1} system had a duel function. In its absence, a_1^{m-1} functioned in the production of anthocyanin pigment, although in a manner not ~~totally~~ comparable to A_1. In the presence of this element, on the other hand all evidence of this ~~function~~ was suppressed. In its absence, ~~the mode of functioning of~~ a_1^{m-1} ~~was constant, no change in this occurred~~ behaved as a stable allele of A_1. In its presence, on the other hand, return to ~~the~~ an A_1-type ~~of functional~~ capacity of action was initiated and A_1-type pigment was expressed in its presence; ~~expression arose~~ in some cells, ~~and~~ the time during development when this change in mode of action occurred ~~in a cell~~, and the number of cells in which this took place, was genetically controlled. With the newly gained insight into the system controlling gene action at a_1^{m-1} careful examination of ears produced during the summer of 1951 was then immediately undertaken. ~~Enough insight into~~ Sufficient appreciation of the mechanism associated with control of gene action at a_1^{m-1} had been gained to allow meaningful interpretations to be drawn from ~~them~~ these examinations, ~~which had not been true up to this time~~. These examinations substantiated the interpretation of the mode of operation of the independently located element and therefore this element was given the designation Suppressor-mutator and symbolized as Spm. Before considering the evidence obtained from these examinations, a resume will be given of the results so far obtained, the interpretations drawn from them, and the problems they posed.

Studies outlined in this and the previous section were conducted with the progeny of oneplant, that of plant 5719A-1. In this plant, the expression of ~~the~~ a_1^{m-1} l~~ocus~~, carried in one of its chromosomes 3, was very different from that given by the parent plant having a_1^{m-1}. As stated in ~~xxxx~~ section 3 of this report, ~~it~~ was considered ~~to have~~ to be present in plant 5719A-1 an altered state of a_1^{m-1}. In plants having this state and also Spm, small streaks ~~of~~ with deep-anthocyanin pigmentation appear in a non-pigmented background although occasionally, a large area exhibiting this phenotype may appear. In the kernel, small ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ deeply pigmented spots appear in a non-pigmented background (photo.) although, here also, ~~an~~casionally, a large area of this type appears. The ~~described~~ same phenotypes ~~were~~ exhibited by the kernel that gave rise to plant 5719A-1, by ~~the~~ plant itself ~~and it also~~ appeared in the majority of variegated plants ~~and~~ kernels in the progeny of ~~it~~ plant 5719A-1 that ~~were~~ had been carried through three generations. However, on some test cross ears produced by some of the progeny plants, a few kernels appeared that exhibited a marked deviation from this pattern. In them, the number of deeply-pigmented spots was very much reduced or none appeared. No explanation for this had yet been found. Also, on a few ears produced by the test cross, a kernel exhibiting the full A_1-type pigmentation appeared. The nature of the

change at a_1^{m-1} responsible for their appearance had not yet been determined, although it was suspected to have arisen from mutation at a, that gives the A_1 type of gene action and also stability in this expression.

In the absence of Spm, the 5719A-1 state of a_1^{m-1} gave rise to plants that were uniformly pigmented but the intensity of this, and its distribution within the plant was not the same as that given by A_1. ~~differed from that expressed when A_1 is present~~. The kernels were likewise pigmented in the absence of Spm and this pigment was uniformly distributed over the aleurone layer of the kernel. It was intense with ~~when~~ Pr ~~was present~~ but ~~was~~ light when the kernel~~s~~ was ~~were~~ homozygous for pr. The phenotype produced in the absence of Spm appeared to be quite stable, its expression was constant in successive generation ~~and reappeared unaltered in progeny of plants exhibiting it~~, if Spm was absent. ~~these plants were either self-pollinated or crossed by plants in the tester stocks that were homozygous for a_1~~.

From the ratio of pale to variegated kernels on the ears produced by the test cross of plant 5719A-1 (C, table 2), and from the ratio of these kernel types on ears produced by test crosses of its progeny (tables 3 to 8), it was concluded that plant 5719A-1 had at least three Spm elements in it and that one of them was located in its y bearing chromosome. However, the number of this element in the progeny derived from a test cross did not always conform with that expected, and the test of plant 6452-3, table 3, illustrates this. It was expected to have one Spm element but the ratio of

pale to variegated kernels deviated markedly from the expected one to one.

Also, ~~similar~~ the same types of test conducted with different parts of a single plant, -- ~~with ears on different parts of the same~~ plant or with pollen ~~from a plant,~~ sometimes resulted in ears on which ~~xxxxxxxxxxxx produced~~ the ratio of these two classes of kernels ~~on the resulting ears~~ that did not agree with the one another.

This suggested that the Spm constitution in different parts of an individual plant ~~were~~ was not always the same. ~~alike~~. It was suspected that these differences arose from somatically occurring transposition of Spm, but no tests of this had yet been conducted.

As emphasized above, ~~the~~ an interpretations of the mode of operation of Spm ~~Spm a_1^{m-1} system~~ ~~were~~ was drawn from evidence obtained only from this one isolate of a_1^{m-1}. Others that ~~produced~~ gave quite different variegation patterns ~~phenotypes~~ as described earlier had been isolated, It was therefore necessary to determine to what degree the behavior of each of them would conform with the interpretation that had evolved from study of but one of them. Tests had been conducted with these other isolates ~~them~~ during the summer of 1951 and when the ears produced by these tests were examined, it was realized that the interpretation derived from examination of one of them would apply to all of them. However, it was necessary to keep in mind ~~If it were considered~~ that each isolate of a_1^{m-1}, originally selected because of the modified variegation pattern a kernel carrying it had exhibited, arose from some alteration that had occurred to the original a_1^{m-1}, and that each such alteration was responsible for the type of variegation pattern exhibited in the presence of Spm and

also for the type of expression given in its absence. Some of the evidence for this ~~may~~ will now be reviewed.

14. ~~Substantiation of the~~ Additional evidence supporting the interpretation of the primary mode of action of S_{pm}, ~~and of the individuality of states of a_1^{m-1}~~.

During the summer of 1951, plants were grown from selected kernels on ears produced by cross~~es~~ of the original a_1^{m-1} carrying plant (5371) to those that were homozygous for a_1. Fifty-two plants were derived from kernels that exhibit~~i~~ed the pattern of variegation ~~produced~~ given by this original state of a_1^{m-1} (photo.). Seven were derived from kernels whose aleurone layer was uniformly but lightly pigmented ~~but the intensity of this was low~~. In addition, plants were grown from two kernels, each showing a ~~with very much~~ modified pattern~~s~~ of variegation. One had very many small, A1 ~~deeply pigmented~~ spots in a colorless background. The other had spots of pale pigmentation in a colorless background. ~~had many such spots and, in addition, several large, deeply pigmented areas~~. In addition, kernels were selected from ears produced by crosses conducted with a_1^{m-1} carrying ~~of~~ some of the plants grown in the greenhouse during the winter of 1950-51. Selections were made from the ear~~s~~ produced either by self-pollination of the plant having a_1^{m-1} or by a cross with a plant homozygous for a_1, and ~~involving~~ kernels in the progeny of plants 5700A, 5718, 5719A-1, 5719A-2, and 5720 were so selected. ~~The ratio of kernel types on ears produced by plants 5718, 5719A-1, and 5719A-2 are entered in table 2.~~ Those kernels selected from these plants to be sown in the summer of 1951 are described below. Tests of the plants derived from them will then be considered.

Plant 5700A, derived from a very pale colored kernel, developed intense anthocyanin pigment in stalk, leaf-sheath, and glume~~s~~. It~~s~~ pollen was ~~was~~ used in a cross with a plant homozygous for a_1. ~~and~~ On the resulting ear, half of the kernels were very pale colored and half were colorless. ~~This plant~~ It ~~carried~~ had a derivative of a_1^{m-1} that had been received from the original a_1^{m-1} plant, in one ~~of its~~ chromosome~~s~~ 3 and a_1 in the other chromosome 3. Plants were grown from some of the pale kernels on this ear.

From the self-pollinated ear of plant 5718, some of the variegated kernels were selected and plants grown from them. The pattern of this was small A1 spots in a colorless background (photo —) Plant 5720, described in section 3, had a modified state of a_1^{m-1} in one ~~of its~~ chromosome~~s~~ 3 and a_1 in the other. ~~The modified~~ This state produced a variegation pattern composed both large and small areas in plant and kernel that exhibited only low levels of pigment and intensity in them. (Photo -) Some variegated kernels on the self-pollinated ear and on two ~~from the several~~ ears produced by crosses ~~with it~~ with plants homozygous for a_1 were sown in this summer of 1951.

On the self-pollinated ear of plant 5719A-1 and on that of plant 5719A-2 (A, table 2), and also on ears produced by the cross of ~~these~~ each plant~~s~~ to one that was ~~plants~~ homozygous for a_1, (C, table 1), some variegated kernels appeared that had areas of various sizes exhibiting ~~a pale phenotype~~ anthocyanin pigment of a type similar to that appearing in the pale class of kernels in addition to the deeply-pigmented spots which ~~appeared~~ appear in all variegated kernels. (Photos — + —) However, The number of such kernels among the variegated class was low. The majority of ~~them~~ variegated kernels exhibited only the

with their characteristic diffusion rings

deeply-pigmented spots and these spots ~~that~~ were nearly always small in size. ~~Therefore,~~ selection was made of both types of variegated kernels on ears produced by self-pollination and by the test cross and plants were grown from each type~~, of variegated kernel~~.

Table 9 indicates the ~~is constructed to show the~~ phenotypes of kernels that were selected from ears produced by crosses ~~of~~ conducted with plants 5700A, 5718, 5719A-1, 5719A-2 ~~grown in the greenhouse~~, and 5720, and also the culture number given to the plants derived from each selection.

Discussion will commence with tests conducted with plants derived from selected kernels on the ear produced by use of pollen ~~the cross~~ of plant 5719A-2 on the silks of an ear of a plant ~~to one~~ that was homozygous for a_1. Plant 5719A-2 was a_1^{m-1}/a_1 in constitution. On the ear this cross produced (C, table 2), there were 24 uniformly pale colored kernels, 250 kernels exhibiting dots of deep A_1-type color in a colorless background, and 259 totally colorless kernels. Among the variegated class of kernels, some showed, in addition to the deeply-pigmented dots, areas of light pigmentation, all of which had the same grade of intensity as mentioned above. In a few kernels, ~~xxxxx~~ one of the lightly pigmented areas was large, covering as much as an eighth of the area of the aleurone layer. There was, however, much variation in size of ~~such~~ the pale areas within a single kernel. Some of the kernels exhibiting these areas were selected and the plants grown from them given culture number 6081A.

The frequency of appearance of different classes of kernels on the self-pollinated ears of plants in culture 6081A and on ears produced by reciprocal of them crosses with plants homozygous

for a_1, are given in A, B, and C of table 10, ~~for six of the plants in culture 6081A.~~

The ratio of kernel types appearing on their ears ~~produced by the test crosses~~ ~~with~~ ~~these plants differed greatly from those~~ did not agree with that appearing on ears produced by similar types of test cross conducted with the parent plant, 5719A-2 (A, B, C, table 2). There was a marked reduction in ~~frequency of appearance of the~~ number of variegated ~~class of~~ kernels and an equivalent increase in ~~this~~ number of ~~the~~ pale ~~class~~ colored kernels. ~~In the pale class~~, Pigment intensity in the kernels that were unfoly pale colored was greater when Pr was present than when ~~the kernels were homozygous for pr~~ it was absent. However, the Pr-carrying kernels in the pale class could be distinguished readily from those that exhibited the full or near full A_1 type pigmentation. This is in contrast to the pale, Pr class ~~xxxxxxxx~~ produced ~~by~~ with the state ~~5719A-1~~ of a_1^{m-1} derived from plant 5719A-1 where difficulties were encountered in making this distinction, as described in the previous section.

~~On the basis of~~ From the ratio~~s~~ of kernel types entered ~~given~~ in table 10, the ~~suspected~~ Spm constitution ~~of these~~ in the tested part of the plant~~s~~ ~~with respect to Spm~~ is assumed to be that which is given in the last column of this table. ~~Tests~~ Its constitution appeared to be the same in all tested parts of any one plant, except ~~conducted with different parts of a single plant agreed with the another~~ that which produced the sud ear on the main stalk of plant A-8. ~~in this respect~~. ~~From this~~, It is ~~concluded~~ considered that plants A-2, A-3, A-4, A-6 and parts of plant A-8 had one Spm, whereas plant A-5 had two Spm elements each located at a different position~~s~~ in the chromosome complement.

Nearly all of the variegated kernels on ears produced by use of pollen of ~~1 Spm carrying~~ having one Spm plants on silks of plants homozygous for a_1 (C, table 10) had, in addition to dots of A_1-type pigment, areas of various sizes exhibiting the same grade of pale pigment that is present in the pale class of kernels. In other words, these kernels were similar in phenotype to the kernel from which each plant arose. ~~Some kernels of this type likewise appeared among the variegated class on the ear produced from use of pollen from plant A-5.~~ Among the kernels exhibiting dots of A_1 in a colorless background ~~variegated class of kernels~~ produced by the reciprocal cross, B, table 10, ~~those exhibiting~~ pale areas ~~that were of various sizes were rare~~ were either absent or, if present, were few in number and small in size. ~~Pale areas were present in some kernels but they were small in size and few in number~~. It was learned in the previous section that such pale areas could be expected to appear if, for some reason, the Spm element (s) in them is lost from an endosperm cell during development of the kernel. If one Spm element is present, loss (or inactivation, see section - part -) of it from some cells at various stages in development would result in the appearance of pale areas of various sizes. If two Spm elements were present, simultaneous loss of each or successive losses of them would be required in order that a pale area would appear. Because the female parent contributes two identical nuclei to the endosperm and the male parent only one, the initial Spm number in the endosperms of variegated kernels,

entered in B of table 10, would be at least two whereas the initial Spm number in the majority of those produced by the cross of plants of A-2, A-4, and A-8 in C of this table would be but one. It was obvious from observations of kernel types derived from all crosses entered in table 10 that a relation existed between the number of Spm elements in a kernel and the frequency of appearance and the size range of pale areas in it. The Spm elements was being subjected to some type of modification but the nature of this was not discovered until later.

From the same ear that produced the kernels from which the plants in 6081A were derived, another variegated kernel was selected. It exhibited only the deeply-pigmented dots. No pale areas were present. It had been selected for reasons that do not now concern us. Plant 6081B was grown from it. The types of kernels produced by self-pollination and its reciprocal crosses with plants homozygous for a_1, are entered in table 11. The ratio of kernel types on these ears suggest that this plant had more than two Spm elements in it and these ratios conformed with those obtained from the parent a_1^{m-1} plant, 5719A-2 (A, B, and C of table 2). It would appear, then, that selection of variegated kernels exhibiting pale areas of various sizes in addition to the dots with A_1 type pigment in them, is an effective method for selecting those kernels on an ear that have only one or occasionally 2 Spm elements in them.

A test conducted with plants derived from variegated kernels on the self-pollinated ear of plant 5719A-2 did not negate this.

From the self-pollinated ear of plant 5719A-2, variegated kernels having ~~only~~ dots of A_1 but no pale areas were sown under culture number 6080C. There was one variegated kernel on this ear that exhibited a number of pale areas in addition to the A_1 dots. The plant grown from it was given culture number 6080B. Reciprocal crosses of this plant to plants homozygous for a_1 produced the kernel types entered in table 12. This plant proved to be homozygous for the ~~xxxxx~~ 5719A-2 state of a_1^{m-1}. From the ratio of kernel types on these ears, it may be concluded that plant 6080B had only one Spm element in it. In contrast, among the seven plant in C of this culture that also were homozygous for this state of a_1^{m-1}, only one had a single Spm element in it, and the ratio of kernel types appearing on ears produced by self-pollination of these plants and by reciprocal crosses of them with plants homozygous for a_1, given in A to C of table 13, indicate this.

Tests conducted with some of the progeny derived from plant 5719A-1 were discussed in previous sections. It was obvious from them that plant 5719A-1 had more than one Spm element in its nuclei. Kernels derived from the self-pollinated ear of this plant were grown under culture number 6046. Two plants were grown from the pale kernels on this ear under culture number 6046A. On self-pollination on this ear, there was a small number ~~of variegated kernels~~ among the variegated kernels of plant 5719A-1

and in crosses to plants homozygous for a_1, all kernels were uniformly pale, with that of the kernel from which each arose.

that exhibited some pale areas in addition to ~~the~~ small A_1 spots, ~~with A_1-type pigment in them.~~ Three plants ~~were~~ derived from kernels of this type. Tests of the 3 plants in 6046B, (table 14) ~~them~~ indicated that in two of these three plants one Spm was present in the tested parts of these plants, and in the third, two Spm elements were present in the tested parts of it. ~~as the data in table 14 indicate~~ In contrast, each of the three tested plants in 6046C had 2 Spm elements in the tested parts (Table 14). Again, it was noted that the variegated kernels on ears entered in C of this table were characterized by a variety of the appearance of pale areas in addition to the A_1 spots, whereas these pale areas were rarely exhibited among the variegated class of kernels in B of this table.

Variegated kernels derived from the self-pollinated ear of plant 5718 (A, table 2) were sown under culture number 6045. Although 16 kernels were sown, only 4 plants derived from them survived to maturity. Two of them were self-pollinated and crossed to plants homozygous for a_1. The type of kernels on the resulting ears are shown in A and B of table 15. The pattern of variegation produced by ~~the~~ 5718 state of a_1^{m-1} is very sharply expressed. There are small dots of the A_1 phenotype in a colorless background, as shown in photo 00. In the absence of Spm, this state gives rise to kernels that are only very faintly pigmented. Difficulty was encountered in detecting this pigment in some kernels on the ears entered in table 15, ~~that should be carrying this state of a_1^{m-1} but no Spm.~~ Unless this pigment was undoubtedly present, the kernel was placed in the colorless

class rather than the pale class. Because of the very sharp expression of variegation among the Spm carrying kernels and also because of the faint pigment produced in its absence, this 5718 state of a_1^{m-1} has been useful in a number of studies of the Spm system.

Subsequent tests conducted with plants having state 5718 a_1^{m-1} and Spm have indicated that the appearance of kernels having the A_1 phenotype in its progeny is rare. The number with this phenotype derived from tests of plant 6046B-4 entered in table 15, is unusually high. ~~In this case~~s, The same collection of pollen was used ~~to make both the~~ for self-pollination and for the test cross entered in this table. It is suspected that the tassel of this plant ~~from~~ which pollen was collected had a small mutant A_1 sector, and that the pollen grains ~~xxxxxxxx~~ derived from anthers in this sector, carried the A_1 mutant and were responsible for the appearance of the ~~relatively large~~ unusually high number of kernels exhibiting the A_1 phenotype.

A number of plants were grown from kernels ~~derived~~ ~~on~~ ears produced by crosses conducted with plant 5720. With rare exceptions, the state of a_1^{m-1} in this plant ~~xxxxxx~~ and in its progeny gives rise in plant and kernel to mutant areas that exhibit only low levels of pigment intensity. As mutation inducting events may occur very early in development of ~~either~~ the plant ~~tissues~~ and including its sporogenous cells, ~~or in gametophytic cells, and of the kernel~~, a number of

gametes are formed by plants having this state that carry a mutant of a_1^{m-1}. Therefore, many kernels appear on test cross ears that express this. One grade of pigment intensity is expressed in each but the range of this among the mutant carrying kernels is from very faint to medium dark. (photos - -)

When a plant having this state 5720 of a_1^{m-1} and also Spm is used as a pollen parent in the cross to plants homozygous for a_1, only one of the three chromosomes 3 in the endosperms of kernels on the resulting ear carries this a_1^{m-1}. Among the variegated class of kernels with this constitution, mutant areas appear. Each expresses one particular grade of pigment intensity within it. When, however, the reciprocal cross is made, among the variegated kernels on the resulting ear, such mutant areas ~~may~~ appear but often within them ~~which~~ there are smaller areas exhibiting deeper shades of pigment intensity. This is expected because in these kernels, ~~have this state of~~ state 5720 a_1^{m-1} is carried in two of its three chromosomes 3, ~~and~~ mutation-inducing events occur to each independently of ~~one another~~ the other. Types of kernels appearing one ears produced ~~from~~ by the cross~~es~~ of ~~some~~ plants that were a_1^{m-1} (state 5720)/a_1 to plants homozygous for a_1 are given in table 16. In this table it will be seen that the number of uniformly pigmented kernels is high as ~~well as~~ so the number of colorless kernels. Among the uniformly pigmented class of kernels, not one but many different grades of pigment intensities were represented, each kernel showing one particular grade of them. It was subsequently learned that with state 5720, no anthocyanin

pigment is produced in either plant or kernel when Spm is absent. ~~There~~

The high rate of germinal mutation produced by this 5720 state of a_1^{m-1} in the presence of Spm resembled that produced by the original state of a_1^{m-1} from which it was derived. However, with this original state, the majority of germinal mutations give rise to mutants that express high levels of pigment intensity resembling or approaching that produced by A_1. ~~the full or near full A_1 type expression~~. ~~The~~ those ~~proportion~~ that express ~~lower~~ low levels of pigment intensity ~~are considerably lower~~ produced with much lower frequencies.

Because of the very high rate of germinal mutation given by the original state of a_1^{m-1}, ~~it~~ this state was not considered to be a useful one for analysis of the mode of operation of the Spm system and tests of it were not continued beyond the 1951 season. In contrast, state 5720, which is similar to the original state of a_1^{m-1} in regard to time of occurrence of mutation but not in regard to type, has been quite useful.

5. Individuality of expression of each state of a_1^{m-1} when two different ones are ~~combined~~ present in a plant or kernel.

During the summer of 1951, crosses were made between plants carrying different states of a_1^{m-1} and the type of expression ~~of~~ given by each state ~~in~~ among the kernels on the resulting ear was examined. ~~The Combinations of states were as follows:~~ Crosses were made that would bring together in a single kernel the following states of a_1^{m-1}: state 5719A-1 with state 5720 and with the original state, state 5718 with the original state, state 5720 with the original state, and state 5719A-2 with state 5700A, not previously discussed. In later years, other combinations of states were made, however, no additional information of general interest was gained from study of plants having them.

The most instructive cross ~~of that~~ illustrated the individuality of each state~~s~~ of a_1^{m-1} when combined in a kernel or plant was that made between a plant~~s~~ carrying state 5719A-1 ~~to~~ an one ~~plants~~ carrying state 5720, ~~and~~ The types of kernels appearing on ~~the~~ an ear produced by one such cross will be given. Pollen from plant 6042-9, that carried state 5720, was placed on the silks of a tiller ear of plant 6046C-1 which ~~xxxxxxxxxxxxxxxxxxxxxx~~ was homozygous for state 5719A-1. In order to make clear the results obtained from this cross, it will be necessary to consider other test crosses made with each of these two plants. The first ear of the main stalk of plant 6046C-1 was self-pollinated and on the resulting ear there were 4 uniformly pigmented kernels each exhibiting ~~the~~ A_1-type pigment, 31 kernels that were uniformly ~~pale colored~~ pigmented, but the intensity of this was low, and it was the same in all kernels in this class, ~~and~~ 377 kernels ~~that~~ had small spots of the A_1 type pigment in a colorless background,-- the typical pattern produced by state 5719A-1. In addition there were and 1 kernel that appeared to be totally colorless. Pollen of this plant was ~~xxxx~~ placed on the silks of a plant homozygous for a_1 and on the resulting ear there was 1 ~~kernel~~ kernel exhibiting the A_1 phenotype, ~~uniformly pigmented kernels showing the xxxx of the A_1 type~~,

Since plant 6046C-1 was pr/pr in constitution, the classification of kernel types was readily accomplished

212 kernels that were uniformly pale colored, and 465 that expressed the variegation pattern typically produced by state 5719A-1. Plant 6042-9 had been derived from a variegated kernel on the self-pollinated ear of plant 5720. Pollen from a plant homozygous for a_1 had been placed on the silks of the of a tiller ear of this plant. The kernel types ~~that appeared on the resulting~~ on this ear were as follows: 32 uniformly pigmented kernels, each ~~having~~ showing a particular level of pigment intensity ~~of pigmentation~~ in the aleurone layer but in all of ~~them~~ this level was low, 102 variegated kernels with ~~both~~ large, medium and small areas exhibiting low levels of pigment intensity in them and ~~there appeared~~ in a colorless background, ~~and~~ In addition, 239 kernels were present in which no pigment was observed. When pollen of plant 6042-9, with state 5720, was placed on silks of an ear of a tiller ~~a tiller ear~~ of plant 6046C-1, it was then learned that the pollen parent was homozygous for state 5720 as well he evident shortly. Thus, the cross was made between a plant homozygous for state 5719A-1 and one homozygous for state 5720. There were 216 kernels on the ear this cross produced. Four of them were uniforly pale colored. In 18 others, spots ~~having~~ with A_1-type pigment were present in a ~~uniformly~~ lightly pigmented background and the pattern of the A_1 spots was that characteristically produced by state 5719A-1. The intensity of the background pigment was uniform over the aleurone layer ~~for~~ in each kernel but the level of this differed among these kernels. And, the ranges of these levels were the same as ~~those~~ that ~~are~~ ~~xxxxxxxx~~

appearing among the uniformly pigmented kernels on ears produced by the cross of plants having state 5720 to plants homozygous for a_1. In addition, there were 194 variegated kernels of another type. These kernels had the pattern of A_1 spots produced by state 5719A-1 and also the pattern of lightly pigmented areas characteristically produced by state 5720 but the background was colorless, (see photos). The over-all pattern of variegation exhibited by these kernels was that which ~~could be expected~~ would arise from superposition of the pattern produced by one state ~~over~~ on that produced by the other. Each state was expressing its own type of response to the presence of Spm.

It was assumed that in the 18 kernels showing the variegation pattern produced by state 5719A-1 in a uniformly pigmented background, instead of a colorless one, had been produced by functioning of a male gamete carrying a mutant derived from state 5720, and that this ~~mutant,~~ mutant was stable in the presence of Spm, ~~had been contributed by the parent carrying state 5720.~~ The correctness of this interpretation was made evident in tests of the plants derived from kernels of this type that were conducted in ~~a~~ subsequent years. The plant derived from each carried a mutant of a_1^{m-1} in one chromosome 3, whose expression was stable either in the presence or in the absence of Spm, and the state 5719A-1 of a_1^{m-1} in the homologue, which continued to express its individual variegation pattern in subsequent plant generations. A ~~description~~ discussion of the types of test that established this will be postponed until a description may be given of the means by which such tests are made possible. In contrast, those plants arising from the 2nd class of variegated kernels carried state 5720 a_1^{m-1} in one chromosome 3 and state 5719A-1 in the homologue. When isolated from these plants, neither state appeared to have been affected in any way by its previous association with the other.

As described earlier (page,), plant 5700A was derived from a very pale colored kernel on an ear produced by cross of the original a_1^{m-1} carrying plant to one that was homozygous for a_1. Pollen of plant 5700A was placed on silks of an ear of a plant homozygous for a_1. Two types of kernels appeared on this ear, those that were very pale in color and those that were colorless. An accurate classification of the two types was not attempted as the intensity of pigment in the pale class was so low that it was feared that some belonging in the class would fail to be detected and would be placed with the colorless class. Some kernels that certainly had pigment in them were selected from this ear, and the plants grown from them in the summer of 1951 were given culture number 6078. At least one ear of each plant in this culture received pollen from a plant homozygous for a_1 and sh_2. On all ears so produced, there were only the two classes of kernels; very pale colored and colorless, an ~~and~~ accurate ~~classifications~~ distinction of type for all kernels ~~for each type~~ was also difficult to make on some of these ears. As an example, silks of the first ear on the main stalk of plant 6078-5 received pollen from a plant homozygous for a_1 and sh_2. On the resulting ear, 256 kernels certainly had some pigment in them, but the intensity thus was exceedingly [illegible]. ~~but~~ In the remaining 314 kernels pigment could not be detected by visual examination. ~~appeared to be colorless~~. A tiller ear of this plant was self-pollinated and similar difficulties were encountered in making accurate classifications of the two classes of kernels that appeared on it. Among the 424 kernels

this ear produced, 254 had faint pigment in them but the remaining 170 appeared to be colorless. The silks of an ear on another tiller of ~~this~~ plant 6078-5 received pollen from plant 6080C-7 ~~xxxxx~~ whose constitution ~~was~~ was a_1^{m-1} ~~(state 5719A-2)/a_1~~ in constitution. The kernel types appearing on this ear were surprising. Before describing them, it will be necessary to consider the constitution of plant 6080C-7. ~~(For description of this state, see pages)~~. The first ear on the main stalk of plant 6080C-7 ~~had been~~ was self-pollinated and among the 234 kernels ~~it produced~~ on this ear, one was fully A_1 in phenotype, none were pale, 172 were variegated for dots of A_1 in a colorless background, and 61 were colorless. The second ear on the main stalk received pollen from a plant homozygous for a_1. On the ear this cross produced there were 11 pale colored kernels, 97 showing dots of A_1 in a colorless background (state 5719A-2 variegation pattern), and 127 that were colorless. ¶ Pollen collected from a tiller of ~~this~~ plant 6080C-7 was placed on the silks of an ear ~~produced by a~~ of a ~~second~~ tiller of plant 6078-5. Other crosses with plant 6078-5 were discussed above. As mentioned then, the types of kernels appearing on this ear were surprising. There were 2 kernels exhibiting ~~the~~ full A_1-type pigmentation, 75 kernels that were uniformly pale colored, and 132 that appeared to be colorless. In addition, there were 259 variegated kernels. Eighty-three of them had the well-spaced dots of A_1 in a colorless background--the pattern of variegation associated with state 5719A-2. The remaining 176 variegated kernels exhibited a very dense pattern of A_1 dots as well as some larger ~~a few large~~ areas ~~of~~ with full A_1-type pigment in them. ~~and also very many small spots of this that were situated quite close to one another~~. In some of these

kernels there were a few ~~pale~~ areas and in other a few areas that appeared to be colorless. It was suspected immediately that the plants in culture 6078 had a modified state of a_1^{m-1} but no Spm. Introduction of Spm through a male gamete of plant 6080C-7 revealed the pattern of variegation this state would produce in its presence. Subsequent tests substantiated ~~this~~. They commenced with plants derived from the pale class of kernels on ears of ~~the~~ plants in culture 6078 that were produced by the cross with plants homozygous for a_1 and sh_2. The types of test conducted with these plants will be discussed later. ~~Both they and their progeny carrying this 5700A state of a_1^{m-1}~~ proved to be useful in ~~xxxxxxx~~ examining some aspectes of the Spm system of operation. Plants derived from the newly appearing variegated class of kernels on the ear produced by the cross of 6078-5 by 6080C-7 were also examined. Some of them were a_1^{m-1}(state 5700A)/ a_1 and others were a_1^{m-1}(~~state~~ 5700A)/a_1^{m-1} (state 5719A-2). ~~Both~~ states appeared in the progeny of ~~plants~~ having this latter constitution, each ~~having~~ retained its own properties ~~while~~ together in the nuclei of ~~one~~ plant. ~~Further~~ Discussion of the manner in which these tests were made will be postponed until the methods adopted for them may be considered.

Besides the intercrosses of plants carrying the distinctive states of a_1^{m-1}, described above, crosses were made between plants having the original state of a_1^{m-1} in one chromosome 3 and a_1 in the homologue, with plants having one of the following derived states: state 5718, state 5719A-1, and state 5720. ~~The types of kernels appearing on the ears these crosses produced will not be considered here in detail.~~ As ~~stated~~ mentioned earlier, plants having the original state of a_1^{m-1} gametes each carrying a mutant of a_1^{m-1} give~~s~~ rise to many ~~germinal mutations~~. The majority of ~~kernels and plants that have one such germinal mutation in them exhibit the full A_1-1 phenotype~~. ~~However, other germinal mutations give~~ ~~exxixix~~ ~~lesser~~ grades of pigment intensity ~~both~~ in kernel and plant. Many alterations of a_1^{m-1} that effect their change in gene action ~~of these~~ are stable in the presence of Spm. This ~~could be observed directly~~ was unexpected, initially, by the phenotypes ~~in~~ some kernels on ears produced ~~by the~~ from cross~~es~~ of ~~conducted with~~ plants carrying state 5718 or state 5719A-1 to plants carrying the original state of a_1^{m-1}. Before these phenotypes are discussed, those that appear on ears produced by cross of plants ~~considering this, attention will be given to the behavior of the original~~ having the original state of a_1^{m-1} by plants homozygous for a_1 will be discussed ~~in plants that carrying this state in one chromosome 3 and a_1 in the homologue.~~

In the summer of 1951, 48 plants were grown from variegated kernels appearing on ears produced by cross of the original a_1^{m-1} carrying plant to plants that were homozygous for a_1. These kernels exhibited a pattern of variegation that was common to most of the variegated kernels produced by

test crosses conducted with the orignal a_1^{m-1} carrying plant (phots). The plants derived from these kernels likewise exhibited the same bizarre types of variegation pattern that characterized the appearance of the kernels. It was obvious that change of expression of a_1^{m-1} had ~~was~~ occurred ~~occurring~~ in a number of different cells of a ~~the~~ plant and many of them ~~occurred~~ early in its ~~plant~~ development. These plants were composites of distinct sectors in each of which a particular phenotype was expressed. Many of them exhibited the A_1 phenotype, In others, the pigment was uniformly distributed within the secotr but ~~the~~ its intensity ~~of it~~ was low. Still other sectors were distinguished by the distinctive types of variegation patterns within each ~~them~~. ~~Some~~ Some of these had ~~were expressed as~~ streaks of the A_1 type pigment in a non-pigmented background, ~~and~~ The number and size of these streaks differed among the sectors, each showing its own particular ~~was not the same in all~~ sectors ~~exhibiting~~ such type ~~altered~~ ~~distinctive~~ variegated ~~patterns~~. In a few plants, the type of pattern of variegation exhibited by one of its tiller differed greatly from that exhibited by ~~of~~ the main stalk and by ~~of~~ other tillers of this same plant.

Some of the variegated plants that were a_1^{m-1}/a_1 sh2 sh2 in constitution were used as female parents in crosses with plants homozygous for a_1 and sh_2. The types of kernels appearing on the resulting ears are given in A of table 17. Pollen of two plants were used on silks of plants carrying

a modified state of a_1^{m-1} (state 5718 or 5719A-1). To serve as a control ~~to such crosses~~, part of the pollen collected from each plant was placed on silks of ears of plants that were homozygous for a_1. The kernel types on ~~these~~ ears produced by tests of two plants are shown in B of table 17. In this table, the kernels ~~that appeared to be fully~~ with phenotypes resembling those of wild type A_1 ~~in phenotype~~ are placed under the heading "A_1".

Under the heading of "pale" are placed those kernels that were uniformly pigmented but in which the intensity of ~~this pigment~~ this ~~was~~ is obviously much lower ~~than that produced by A_1~~. Among the kernels Within this class, ~~there was a range in~~ the intensity ranged from very faint~~ly~~ ~~pigmented~~ in some ~~kernels~~ to medium dark ~~for~~ in others. All kernels exhibiting variegation for anthocyanin pigmentation are entered under the heading "variegated". Most of these kernels ~~exhibited~~ had both large and small areas with the A_1 phenotype, ~~and~~ and colorless areas. (Photos --) pale areas. ¶ In the last column of ~~this~~ table 17 are entered the number of kernels that expr~~ssing~~essed a markedly altered pattern of variegation, similiar in types to those ~~that give rise to the~~ altered states that have been considered in previous sections. It may be seen that the number of them is low. However, other changed states, less easy to detect, were being produced. One of them was detected because it was present in ~~the~~ a plant cell whose descendent cells gave rise to an ear on this plant. This ear ~~that~~ had been used in a cross with a plant homozygous for a_1 and sh_2.

The pattern expressed by the variegated kernels on the resulting ear was of one type and it differed from that given by the original state of a_1^{m-1}. This similarity in pattern made it possible to know that an altered state was present in the cells that gave rise to this ear. In the presence of Spm, this altered state produces many small A_1 dots, located very close to each other, and also some larger areas exhibiting the A_1 phenotype (Photo.). To the naked eye, some kernels having this pattern of variegation may appear to be uniformly pigmented. However, microscopic examination of them reveals the pattern of A_1 spots that is responsible for this deception. The dots of A_1 are so close together that there distinctiveness can not be seen except when viewed under magnification. (In all studies of variegation, kernel types on ears are examined under magnification in order that details of importance in them would not be undetected.) In the absence of Spm, kernels in which this state of a_1^{m-1} is present have pigment in them, but this is so light in intensity that detection of it sometimes is difficult. The types of kernels on the ear of the original plant having this state 5996-4 are given in C of table 17. In plant 5996-4, one Spm was present and it was carried in one of its two chromosomes 6. (See footnote to table 17.)

On the ears produced by crosses of plants that were a_1^{m-1} (original state)/ a_1 to plants that carried either state 5718 or 5719A-1/a_1, many of the kernels that received the original state of a_1^{m-1}, or a mutant derived from it, could be recognized. Likewise, those that received a_1 from the plant having the original state of a_1^{m-1} and the derived state of a_1^{m-1} from the other parent also could be recognized. This may be seen from the photograph of kernel types appearing on one such ear (photo.). However, kernels with a ~~xxxxxxxxx~~ new phenotype appeared on these ears. They had the pattern of A_1 dots given by the derived state of a_1^{m-1} but these appeared on a pale pigmented background instead of a colorless background. This suggested that the plant carrying the original state of a_1^{m-1} had contributed a mutant of a_1^{m-1} giving a reduced grade of pigment intensity and that this mutant was stabe in the presence of Spm. Tests of plants derived from such kernels indicated the correctness of this interpretation. In other words, the original state of a_1^{m-1} was giving rise to mutants that were stable in the presence of Spm.

Some of the pale mutants produced by the original state of a_1^{m-1} that are stable in the presence of Spm very much resemble in their phenotypic expression that given by some of the derived states in the absence of Spm. This is strikingly illustrated by one type that resembles that produced by state

5719A-1. In the absence of Spm, kernels having state 5719A-1 are deeply pigmented whenever Pr is present in them. However, when the kernels are homozygous for the recessive allele, pr, the kernels are only lightly pigmented. Some of the stable mutants derived from the original state of a_1^{m-1} give these same phenotypes with the alleles of Pr. It would appear that the production of either a stable mutant or a new state by the original state of a_1^{m-1} is associated with the fate of the controlling element at the a_1^{m-1} locus. Its removal or total inactivation could give rise to the stable mutants whereas a slight shift in its location, without inactivation, may be responsible for the origin of some of the altered states. It is apparent, nevertheless, that the production of stable mutants by the original state of a_1^{m-1} is far more frequent than the production of obviously altered states of the types that have been described in this report.

In the cross of a_1^{m-1}(original state)/ a_1 by a_1^{m-1} (state 5718 or 5719A-1)/ a_1, the ~~number of Spm alleles in the~~ Spm number was known only in the plant carrying the derived state. The Spm number in most plants having the original state could not be determined readily from the types of kernels appearing on ears produced by testcrosses conducted with ~~it~~ each. The frequency of occurrence of germinal mutation was too high. Nevertheless,

the types of kernels appearing on the ears produced by the cross of plants carrying the original state to plants carrying the derived states, whose constitutions were given above, is instructive, and the types of kernels appearing on six ears produced by this type of cross will be given. There was a total of 2175 kernels with the following phenotypes: 277 with the A_1 phenotype, 71 that were uniformly pale colored and some of these obviously had a derivative of the a_1^{m-1} the original state of a_1^{m-1} and introduced by the parent having it. Eighteen other kernels were uniformly pale colored but supperimosed on this were dots or spots of A_1 with a pattern given by the derived state of a_1^{m-1} used in the cross. There were 1207 variegated kernels that fell into two distinct classes: 602 exhibited the pattern that is characteristically produced by the original state of a_1^{m-1} and in some of these, the presence of the derived state was suspected, and 605 that exhibited the dots or spots of A_1 characteristically produced by the derived state and in what appeared to be a colorless background. In addition, there were 602 colorless kernels. Tests of plants derived from kernels exhibiting the variegated pattern of the derived state on a pale pigmented background, and those derived from ones in which both the original state and the derived state were suspected to be preset, confirmed the suspected constitutions of the kernels from which each was derived. From the former,

the presence of a stable mutant in one chromosome 3 and the derived state either 5718 or 5719A-1, as the case may be, in the other chromosome 3. Plants derived from the latter type of kernel had the original state of a_1^{m-1} in one chromosome 3 and the derived state in the other.

Tests of a_1^{m-1} behavior that have been discussed in detail in previous sections of this report were all conducted during the early period of study of a_1^{m-1}. From them was developed an interpretation of the primary mode of operation of the system responsible for control of gene expression at a_1^{m-1}. The origin and behavior of different states of a_1^{m-1} were considered, and the discovery of an independently locted element, Spm, whose mode of action was outlined, was likewise treated. Nevertheless, up to this time in the study of a_1^{m-1}, no previse tests of this interpretation had been conducted.

The interpretation that had been developed implied the following conditions. Spm is ~~an independently located element~~ is the independently located element in the a_1^{m-1} system, and it is subject to transposition from one location to another in the chromosome complement. In its presence, change occurs at the a_1^{m-1} locus and this may lead to one of two main consequences. One of them results in a stable mutant expression; Each such mutant expresses one mode of gene action, recognized by the ~~degree and~~

and degree of production

and kind of anthocyanin pigment that ~~it produces~~ in plant and kernel. The second results in an altered state of a_1^{m-1}, each state expression thereafter one particular type of response to Spm. This is related to control by the altered a_1^{m-1} itself of the time during development when subsequent change will occur to it, the types of mutants that these latter changes will induce, and the number of cells in which such events will occur. The number of Spm elements present in the nuclei of a plant or kernel does not alter these qualities of a particular state of a_1^{m-1}. In the absence of Spm, most states of a_1^{m-1} function in the production of anthocyanin pigment in both plant and kernel, and again, the type of pigment and level of its production is a quality of state of a_1^{m-1}. This function is suppressed when Spm is present in the nuclei in plant and kernel. Removal of Spm from the nucleus of a somatic cell will allow the potentially functional activity of the state of a_1^{m-1} that is present to be expressed in its descendent cells.

The above statements incorporate the primary conditions imposed by the interpretation. ~~More~~ Evidence ~~was required in order to test~~ the general validity of this interpretation was required. Therefore, such tests were conducted during the summer of 1954. There were many ~~such tests~~ and they will be the subject of the following section of this report ~~that follows~~.

~~Establishment of the Validity~~ Verification of the interpretation of mode of operation of the Spm element and of the individuality of state of a_1^{m-1}

The interpretation of mode of control by Spm of gene expression at a_1^{m-1}, outlined in previous sections, required precise verification, and tests devided for this purpose were conducted during the summer of 1954. The interpretation considers that no Spm is present in the uniformly pale ~~colored~~ pigmented kernels on ears derived from crosses entered in tables 2 to 8 and 10 to 15, but that it is present in all kernels exhibiting any pigmented areas in a colorless background. It also considers that each state of a_1^{m-1} will respond to any one isolate of Spm in ~~a~~ its own manner, ~~that is characteristic of the state~~. ~~In other words, it will be the state of a_1^{m-1} that will govern the pattern of variegation when any one~~ with isolated Spm ~~is present~~. To illustrate, if ppollen of a plant homozygous for a_1 and carrying 1 Spm is placed on the silks of ears of a number of plants, each derived from a pale colored kernel and in each of which a different state of a_1^{m-1} is present, then on the ear produced by each plant, one-half of the a_1^{m-1} carrying kernels should be pale colored and half should be variegated. On each ear, ~~the~~ one particular pattern of variegation among ~~the variegated~~ our variegation at a_1^{m-1} kernels should be expressed, and it should be ~~characteristic of~~ that controlled by the particular state of a_1^{m-1} present in the ear bearing plant.

If the pollen parent should have 2 ~~independently~~ non-linked Spm elements,

then on each of the resulting ears there should be a ratio of one pale colored kernel to 3 variegated kernels among ~~the~~ a_1^{m-1} c~~arrying~~ ~~kernel~~s and again, the pattern exhibited by ~~them~~ should be that ~~fixed~~ by the state of a_1^{m-1} that is present.

Several types of test-cross were devised that made it possible to learn whehter or not Spm were present in any one plant, and to demonstrate with certainty the ~~control of phenotype by~~ state of a_1^{m-1}, both in the presence and absence of Spm. These were conducted during the summer of 1954. The plants to be tested were derived from selected kernels on ears produced by crosses made in previous growing seasons. The types of kernels selected, the number of plants derived from each type, and the origin of the ear from which ~~each~~ selection was made, is given in table 18. All kernels ~~derived~~ from one ear were grown under one culture number, that entered in the last column of this table. However, the ~~derived from one ear~~ kernels of each class ~~were separated from one another, and grown under the same culture number but to which was added a distinctive letter of the alphabet.~~ If other genetic markers also were segregating among the kernels on the ear, all ~~these~~ kernels ~~having~~ showing one phenotype were sown separately from those ~~with another~~ having other phenotypes, each class being given the same culture number but appropriately distinguished one from the other by a letter of the alphebet following the ~~culture~~ number.

The most critical types of test-cross were conducted with plants ~~belonging to~~ of three different categories. The plants belonging to the first of these were uniformly pigmented. They were derived from pale colored kernels on ~~the~~ self-pollinated ears of plants each of which had ~~ing~~ one particular state of a_1^{m-1}. Thus each of the tester plants in this first category was homozygous for ~~the~~ one particular state of a_1^{m-1} -- that which was present in the parent plant. They were also homozygous for Sh_2. Within this category, four different states were represented, and these are ~~given~~ entered in part I of table 19. The culture number of each is given, from which the~~ir~~ origin of any one may be traced through table 18, ~~as well as~~ The~~ir~~ constitutions of each, with regard to genetic markers carried in chromosomes 5, 6, and 9, are also given in this table.

If the plants in part I of table 19 are used in making crosses of the following types, only pale colored, Sh_2 kernels should appear on the resulting ears:

(1) Crossed with plants of the standard a_1/a_1 tester stock.

(2) Self-pollinated or sib-crossed

(3) Intercrossed with plants in the same category, in the nucleus of the endosperm of a kernel bringing together two different states of a_1^{m-1}.

(4) Crossed to plants derived from the pale class of kernels in table 18.

(5) Crossed to some of the plants derived from the colorless, sh_2 class of kernels in cultures entered in table 18.

If the plants in part I of table 19 are used in making crosses of the ~~following~~ types given below, both pale colored, ~~Sh_2~~ kernels and variegated, ~~Sh_2~~ kernels should appear on the resulting ears:

(1) Crossed to some of the plants derived from the colorless, ~~sh_2~~ class of kernels in cultures entered in table 18.

(2) Crossed to plants derived from the variegated class of kernels in cultures of table 18 in which the constitution of the plants are ~~is~~ a_1^{m-1} Sh_2/ a_1 sh_2.

From cross (1) immediately above, all the variegated kernels on the resulting ear should exhibit a pattern that conforms with that ~~is~~ expected to be produced by the state of a_1^{m-1} present in the tester plant. ~~Also,~~ If one ear of the a_1/a_1 plant received pollen from a tester plant homozygous for one state of a_1^{m-1} and another ear of the same plant received pollen from a tester plant that was homozygous for another state of a_1^{m-1}, then among the variegated kernels on ~~xxxxxxxx~~ each ear, a distinctive pattern ~~of variegation~~ s ould be expressed, one pattern among the variegated kernels on one ear and another pattern among those on the other ear. The difference in pattern ~~in each~~ on the 2 ears would ~~represent~~ reflect the individual type of response of ~~the~~ each state of a_1^{m-1} of the contributed by the tester stock to the presence of the same Spm element.

From type-cross (2) immediately above, two class of variegated kernels should appear on the resulting ear. One should exhibit the variegated pattern produced by one state of a_1^{m-1} superimposed on~~ver~~ that produced by the other. These would be the kernels receiving a_1^{m-1} from each parent. The second class should exhibit only the pattern that is produced by the state of a_1^{m-1} delivered to it by the tester plant, and these kernels would be those that rece~~iving~~ed a_1 from the plant being tested, and a_1^{m-1} from the tester plant.

On the ears produced by the type-crosses described above, it should be possible to determine the Spm number in that part of the plant that produced the ear used in the cross. This could be deduced from the ratio of pale to variegated kernels that appears on the ear. Also, if the plant being tested were heterozygous for one or more of the genetic markers in chromosomes 5, 6, and 9, given in table 19, then the location of Spm with respect to these markers could be determined, provided that ~~in~~ the tester plant was homozygous for the recessive alleles at ~~used in the cross~~, these markers, were ~~homozygous~~ r~~ecessive~~.

More than 500 ~~The described~~ test-crosses were made using ~~conducted with tester~~ plants ~~in the first category, those~~ of the cultures entered in part I of table 19. From the kernel types on the resulting ears it was possible to determine ~~detect~~ ~~not only~~ the presence or absence of Spm in many plants, ~~whose phenotypes were known,~~ and to correlate this with the phenotype of the plant, either variegated or uniformly pigmented

It was possible to determine ~~but~~ also, ~~when present~~, the number of Spm elements ~~that~~ were present in any one tested part of a plant. In many plants ~~it was also possible to determine~~ the location of Spm with reference to the three given genetic markers, Pr in chromosome 5, Y in chromosome 6 and Wx in chromosome 9. could be determined These tests also ~~served to~~ confirmed the individuality of the different states of a_1^{m-1} in ~~the~~ modes of control of pattern of variegation in the presence of Spm, and also the type of gene expression each gives in its absence. Before evidence of the above statements are ~~of this is~~ presented, the usefulness of tester plants in each of the two remaining categories will be described.

For some types of test, it would have been desirable to use plants that were homozygous for both a_1^{m-1} and sh_2. At the time, no plants of this constitution had been constructed. Therefore, kernels that were a_1^{m-1} sh_2/ a_1 sh_2 appearing on ears produced by the crosses entered in tables 5 and 8 were selected and plants grown from them. All of them had the ~~xxxxx~~ 5719A-1 state of a_1^{m-1}. Four plants were derived from pale colored, sh_2 kernels, and 6 plants were derived from variegated, sh_2 kernels. The ears from which each of these were selected is indicated in table 18. The ~~phenotypes~~ constitution of these plants with respect to Spm and the alleles of Pr, Y, and Wx are entered in parts II and III of table 19.

The plants in Part II of table 19 were all uniformly pigmented. When pollen from any one of them was placed on silks of ears ~~of~~ of plants in the standard a_1 dir tester stocks, one-half of the kernels on the resulting ears were uniformly pale colored, sh_2, and the other half were colorless, sh_2. When the same pollen was placed on silks of ears produced by plants derived from the pale, Sh_2 class of kernels ~~which~~ that had the constitution a_1^{m-1} Sh_2 / a_1 sh_2 (see table 18) the ratio of kernel types on the resulting ears were as follows: 2 pale colored, Sh_2 : 1 pale colored, sh_2 : 1 colorless, sh_2. However, when the pollen was placed on silks of ears of sister plants, derived from the variegated kernels, Sh2 class of both pale and variegated kernels appeared on the resulting ear, not only in the Sh_2 class but also in the a_1^{m-1} carrying sh_2 class. This indicated that the variegated plant carried ~~an~~ Spm to which the a_1^{m-1} in the a_1^{m-1} sh_2 chromosome ~~derived from~~ contributed by the tester ~~stock~~ plant could respond. It was important to compare the ratio of pale to variegated kernels in the Sh_2 class with that in the a_1^{m-1}, ~~carrying~~ sh_2 class in order to learn whether or not Spm was located in the ~~same~~ chromosome 3 that also had a_1^{m-1} and Sh_2. If so, the ratio of variegated to pale kernels in the Sh_2 class would be greater than in the sh_2 class. Tests conducted during the summer of 1954 did not reveal a case of this, but similiar types of test conducted in later years did reveal the presence of ~~an~~ Spm ~~element~~ in chromosome 3 in some plants.

The tester plants in part II of table 19 were also used to determine if the uniformly pigmented plants derived from uniformly pigmented kernels appearing on ears produced by crosses of plants carrying the 5720 state of a_1^{m-1} (see table 18 for selections) carried a stable mutant of five state ~~5720~~ that would not respond to Spm in any manner. These plants had the ~~derivative of~~ state 5720 derivative ~~a_1^{m-1}~~ and Sh_2 in one chromosome 3 and a_1 and sh_2 in the homologue. If Spm were also present in them, to which the mutant ~~was~~ did not responding, then its presence would be ~~clearly~~ revealed by the appearance of variegated kernels within the a_1^{m-1} (state 5719A-1), sh_2 carrying ~~xxxxxxxxx~~ class on ears produced by crosses of them with the tester plants in part II of table 19. This type of test, as well as some others that will be described later, indicated the stability of the mutants derived from state 5720, for some of the plants ~~carrying~~ with such a mutant ~~them~~ also ~~had~~ carried Spm.

The tester plants in Part III of table 19 were particularly useful for introducing the Spm element(s) in them into kernels on ears produced by plants that were derived from pale, Sh_2 ~~kernels~~ plants in table 18. This was especially important when the state of a_1^{m-1} in them was not 5719A-1. It was evident from the phenotypes of kernels on the resulting ears that In all crosses of this type, the state of a_1^{m-1} carried in the plant being

tested would respond to the Spm delivered to the endosperm by the tester plant. If the plant being tested was a_1^{m-1} (any state but 5719A-1) Sh_2/ a_1 sh_2 in constitution, the difference in ~~variegation~~ pattern of variegation exhibited by ~~in~~ the Sh_2 class of kernels when compared with that in the sh_2 class was always evident and this was strikinbly so when the plant being tested had either state 5700A or state 5996-4 (see photos for the pattern each produces). This was another test that confirmed the unique response of each state of a_1^{m-1} to any one Spm element. It was also important for demonstrating the relation of response of the a_1^{m-1} state in the plant being tested to the particular Spm constitution in the tester plant. In one plant, ~~If the~~ Spm were linked with a known gene marker (Y Spm / y + in plant 6666E, table 19), among the kernels on ears produced when its pollen ~~was~~ used to make ~~the~~ a cross ~~showed~~ linkage of the variegated class of kernels with Y and the pale colored class with y was expressed ~~with this marker~~ on all ears where the constitution ~~with respect to this marker~~ of the plant being tested ~~would~~ was y/y. ~~all this to be expressed~~. ~~Also,~~ The ratio of variegated to pale kernels among ~~in both~~ the Sh_2 class ~~kernels~~ and that among the a_1^{m-1} carrying sh_2 class ~~kernels~~ reflected the number of Spm elements that were present in the tester plant (1 Spm in plants 6666E, 6671E, 6673F and 6690 and at least 3 in plant 6680D table 19).

Plants derived from the uniformly pale colored kernels in table 18

developed anthocyanin pigment ~~that~~ but it was weaker in intensity than that produced when A_1 is present. Among the many plants derived from ~~the~~ variegated kernels, two distinctly different types of pigmented areas appeared in a non-pigmented background. One ~~type was composed of~~ had anthocyanin pigment resembling that which is produced when A_1 is present, and the size of these areas in which this pigment was present was nearly if the state of a_1^{m-1} in the plant was 5718, 5719A-1, 5719A-2 or 5999, but they could be large if the state were 5700A, 5996-4, or the original one. always small, being no more than a short streak. The other ~~type was composed of~~ had pigment whose type and intensity was that which the state of a_1^{m-1} produced in the absence of Spm. ~~These~~ The areas of the latter type could be of any size, from one that included a large part of a plant to small ones that appeared as fine streaks. The number and the average size of these areas in a plant was correlated with the number of Spm elements that were present in it: the higher the number, the fewer were these areas, and the smaller their average size. In plants with three or more Spm elements in them, the ~~variegation pattern was~~ pigmented areas ~~produced only by mutation occurring to the~~ a_1^{m-1}, ~~in them~~, whereas if one Spm were present, the ~~variegated~~ pattern of variegation was a composite of the two types of pigmented areas, the pale areas and the areas produced by mutation of a_1^{m-1}. It was learned later that the pale pigmented areas appearing in plants ~~with 1 or~~ having one or two Spm ~~numbers~~ elements ~~are produced because of~~ result from loss of the Spm

from some nuclei during development as a consequence of transposition, or from ~~of~~ loss of its ~~activity~~ effectiveness as a consequence of its inactivation. If only one Spm were present, either of these two events ~~occuring to the Spm element~~ in the occurrence of a nucleus would result in the appearance of pale pigment in its progeny cells. If two or more Spm elements were present in a nucleus, then an event must occur to each of them at one time, or a succession of such events must occur, first to one Spm element and then to the other, in order that a nucleus arise in which there is no Spm activity. Thus, the pattern~~s~~ of variegation exhibited both by kernel (see page 00) and by ~~pal~~ plant may be strikingly different depending upon the Spm number originally present in their nuclei. However, this relationship ~~is~~ was not to an absolute one, ~~for~~ It also depends both upon the time during development when these events occur, and the frequency of their occurrence at any one time, and this is a property of the isolate of Spm present in a kernel or a plant. Spm elements undergo change in state that alter these properties and discussion of this will be given in sections other part devoted to transposition of Spm and to its inactivation. For this reason, not all kernels and plants having one Spm element in them ~~may~~ will exhibit a ~~high frequency of appearance of~~ many pale areas. The Spm element in them may not be ~~subject to~~ undergoing frequently occurring modification of the types described.

the mode of operation of

Discussion of ~~the~~ tests of Spm, conducted during the summer of 1954, will commence with progeny of plants in culture 6629A (table 5) whose constitutions were a_1^{m-1} (state 5719A-1) Sh_2 / a_1 sh_2 and also considered to be Y Spm / y +. The silks of the ears of plants in culture 6629A had received pollen from plants of the standard tester stocks, homozygous for a_1, sh_2 and y. ~~Selected~~ Kernels were selected from ~~on~~ two of the ears ~~of~~ produced by plants 6629A-1 and ~~plant~~ 6629A-7 and from one ear of plants 6629A-4, 6629A-6, and 6629A-9. the types of kernels selected and of ~~were~~ sown are shown in Table 18. The phenotype of some of the kernels on the ear of the tiller of plant 6629A-7 were aberrant. Plants derived from selected kernels on this ear were grown under culture number 6675, and tests of them will be considered separately. ~~following discussion of~~ Those conducted with progeny derived from the five other ears were grown under culture numbers 6665, 6666, 6670, 6673 and 6674.

In table 20 is given the number of plants in each of the above five cultures that were derived from kernels with yellow (Y) or white (y) endosperms among the pale Sh_2, the variegated Sh_2, and the colorless, sh_2 classes of kernels on the parent ears. In addition, one plant was grown from a variegated, sh_2, Y kernel in culture 6666. Four other plants were grown from kernels whose phenotypes differed from others on the

parent ears, as described in the footnote of table 20. Tests to determine the nature of the modification responsible for them will be considered later along with those ~~tests~~ conducted with ~~of~~ other plants derived from similar types of kernels.

All 61 plants derived from the pale, Sh_2 class of kernels, table 20, were uniformly pigmented, ~~and~~ the type of pigment was the same in all but it was lighter than that appearing when A_1 is present. ~~was that produced when Spm is absent~~. Among the 66 plants derived from the variegated kernels, all were variegated except one. This exceptional plant was uniformly pigmented and the type and distribution of pigment was the same as that in plants derived from the pale class of kernels. Tests conducted with this plant gave no evidence of the presence of Spm in it. It was learned subsequently that loss of Spm from a nucleus, either during development of the female gametophyte or during very early embryo development, will give rise to a kernel whose endosperm and embryo differ in Spm constitution, and cases of this will be considered in the section devoted to transposition. Also, inactivation of Spm, [illegible] development of a plant [illegible] the pale [illegible] phenotype, but the presence of the inactive Spm may be detected, as will be indicated in the section [illegible] inactivation of Spm.

Tests conducted with ~~the~~ plants entered in table 20 were both numerous and varied in type. Crosses were made with plants having the following constitutions: the standard tester stocks, homozygous for a_1 and sh_2, the three different ~~types~~ categories of tester plants whose constitutions are given in table 19, and with other plants having states of a_1^{m-1} not

entered in table 19. The ~~tests~~ exact types of test-cross conducted with each plant in table 20 will not be listed here but in order to illustrate the scope of ~~such~~ these tests, those conducted with each ~~of the~~ plant~~s~~ in cultures 6665 and 6666 are given in tables 21 and 22 for plants derived from the Sh_2 classes of kernels in table 22. ~~As indicated previously, these plants were derived from selected kernels on the main ear and on the tiller ear of plant 6629A-1 (see table 5 for kernel types on each of these ears).~~ Including the many ears obtained from crosses conducted with plant 6666E, whose constitution is given in table 19, over 170 ears were produced from test crosses conducted with the plants in these two cultures 6665 and 6666. Because transposition of Spm may occur in some cells during development of a plant, and result in loss of Spm or in change in its number in some somatic nuclei, the kernel types on each ear as well as ~~and~~ the ratio of types, had to be considered with this possibility in mind. Nevertheless, on many ears produced by one type of test-cross, both the phenotypes of kernels and the ratios of these were often much alike. Therefore, in the tables data obtained from such ears ~~many~~ will be summed. On some ears, however, the ratio of phenotypes did not agree with that given by the majority of ears, and the cases where this was noted will be indicated ~~as~~ there deviations from expectancy often proved to be of considerable significance in furthering an understanding of Spm behavior.

There were two objectives for making the test-crosses that are entered in

parts I and II of table 21. One was to establish whether or not Spm were present in a plant, and the second was to determine if the a_1^{m-1} in the plants not having Spm ~~would be~~ were capable of responding to it. If Spm were absent, no variegated kernels should appear on any of the eight ears produced by the test-cross with the standard stock that was homozygous for a_1 and sh_2, and as shown in the first line of table 23, none appeared. Also, if these plants are crossed by plants of tester type I or II, table 19, no variegated kernels should appear on any of the resulting ears, and as lines 2 and 4 of table 23 indicate, none appeared. However, if tester plants of type III, table 19, are used in crosses with these plants, then some variegated kernels in the Sh_2 classes should appear if the a_1^{m-1} in these plants is capable of responding to Spm. These kernels should have pigmented areas in a colorless background. The Spm delivered by the male parent plant to the endosperms of some of the kernels on the ear of the tested plant could allow the a_1^{m-1} in the m, but relatively ~~se latter plants~~ the female parent to exhibit its mode of ~~reaction~~ response to ~~the presence of~~ Spm. The ratio of pale to variegated kernels in the Sh_2 class would depend upon the Spm constitution of the tester plant. In all of the many crosses to pale-pigmented plants conducted with plant 6690 (part II, table 19), and with all states of a_1^{m-1} represented among them, a ratio of approximately 1 pale pigmented kernel to 1 variegated kernel appeared on each ear, and ~~As~~

line 5 of table 23, ~~shows~~, this ratio appeared in the Sh_2 class of kernels entered in

Tester plant 6680D (part a, table 19) also was used in crosses to many plants with the pale phenotype and ~~those~~ many which ~~with~~ different states of a_1^{m-1} were represented. ~~included among them.~~

On all ears so produced, nearly all the Sh_2 carrying kernels were variegated -- pigmented areas in a colorless background. The data obtained from the cross of this plant to plant 6665B-5, line 6, table 23, is an illustration of this. The pollen of plant 6666E, ~~xxxxxxxxxxxx~~ was used on silks of ears of three of the pale, y/y plants in part II of table 21. Its pollen likewise was placed on the silks of ears of many other plants with a pale phenotype and on all ears a ratio approximating 1 pale to 1 variegated kernel appeared. When the plants being tested were y/y in constitution, linkage of the variegated class with Y and the pale class with y was always expressed among the kernels on an ear. It was ~~could be~~ concluded that plant 6666E carried one Spm and that the ~~it~~ was located in its Y bearing chromosome 6. Among the Sh_2 kernels on each of the three ears contributing to the data entered in line 7 of table 23, this likewise was exhibited. Among ~~In~~ the 413 kernels in the pale Sh_2 class, 160 were Y and 253 were y. Among the 306 Sh_2 kernels in the variegated class, 186 were Y and 120 were y.

It is now necessary to show that the a_1^{m-1} in each of the tester plants of type I, table 19, is capable of responding to the presence of Spm. The capacity of the a_1^{m-1} in each of these plants to respond to Spm was strikingly illustrated by the phenotypes of kernels appearing on ears of plants derived from the colorless, sh_2 classes of kernels, table 20, when pollen from a tester plant of Type I was placed on the silks of ~~an~~ ears of these plants. ~~The crosses made with each such plant in cultures 6665 and 6666 are entered in table 22.~~ Although it could be assumed in advance that no evidence of Spm would be ~~detected in~~ obtained from test-crosses conducted with the pale pigmented plants in parts I and II of table 21, and that evidence of its presence would be obtained from tests conducted with the variegated plants, entered in parts III and IV of the table ~~21~~, no such assumptions could be made with regard to any one plant derived from the colorless, sh_2 kernels. They do no have a_1^{m-1} and no anthocyanin develops in either kernel or plant. It would be expected, however, that Spm would be present in some of them but absent in others. Since, in the parent plants of these in the culture entered in table 20, ~~6629A-1~~, Spm was considered to be located in the Y-bearing chromosome 6, it could be anticipated that Spm would be present in more plants derived from the colorless, sh_2 Y class of kernels on this ear than in those derived from the colorless, sh_2, y

class, and this proved to be true.

Tests of plants derived from the colorless, sh_2 classes of kernels were considered to be of first importance for verification of the mode of action of Spm and the response of each state of a_1^{m-1} to ~~it~~ any one Spm. Therefore, many tests were conducted with these plants, not only with those in cultures 6665 and 6666, entered in table 22, but also with all plants derived from the colorless class of kernels that are entered in table 18. The evidence obtained from tests conducted with them bears directly on that already discussed, and also on that obtained from tests of plants entered in parts III and IV of table 21, not yet discussed. For this reason, the tests conducted with plants derived from the colorless, sh_2 kernels in cultur s 6665 and 6666 will be considered now.

An attempt was made to test each of the 31 plants derived from the colorless, sh_2 Y class of kernels and from the 25 plants derived from the colorless, sh_2 y class of kernels in cultures 6665 and 6666 (table 20). This was successfullly accomplished with 30 of the former and with 24 of the latter. The types of test conducted with each plant are entered in table 22. The plants in this table are placed under four sub-headings: that that were Y/y and in which Spm was found to be present (part I) or

absent (part II) and those that were y/y and having Spm (part III) or in which Spm was found to be absent (part IV). The first ear of the main stalk of these plants received pollen from one of the Type I tester plants entered in part I of table 19. The majority of the Y/y plants ~~received~~ were crossed by plants in culture 6638A of the table. All plants in culture 6638A were homozygous for state 5718 a_1^{m-1}, for Sh_2 and also for the recessives, y, pr, and wx. None of them had Spm, as the many tests conducted with each soon illustrated. Similar tests, equally extensive, were conducted with the plants in culture 6641, whose constitutions are entered in lines 2 and 3 of table 19. Each plant was homozygous for state 5719A-1 a_1^{m-1} and none of them had Spm. Pollen collected from plants in this culture was placed on silks of the first ear of the main stalk of some of the plants entered in table 22. Also, as this table shows, pollen collected from pale-pigmented plants having other states of a_1^{m-1} (states 5719A-2, 5700A, 5714F, and 5996-4) was ~~also~~ used on silks of other ears of some of these plants.

As table 22 indicates, with some plants, more than one ear per plant was used in making a test cross, and the pollen parents differed with respect to the state of a_1^{m-1} ~~present~~ in ~~them~~ the ear. The purpose of this multiple test of a single plant is evident. If no Spm were present in the plant, then no variegated kernels should appear on any ear it produces.

If, however, Spm were present, then variegated kernels could be expected to appear on each ear and the pattern of pigmented spots in a colorless background among all of them on any one ears should be similar, -- that controlled by the particular state of a_1^{m-1} that was introduced by the pollen parent. This expectation is based on the interpretation previously outlined of the individual response of each state of a_1^{m-1} to any one Spm. Another relationship could also be anticipated to appear among the kernels on these ears. It could be expected that in the plants derived from the colorless, sh_2, Y, kernels, Spm would be present in some, and in most of them it would be carried in the + bearing chromosome 6. Thus, on ears of these plants, linkage of the variegated class of kernels with Y and the pale class with y could be anticipated, regardless of which state of a_1^{m-1} the pollen parent had introduced. The expectations outlined above were fulfilled in tests of plants in cultures 6665 and 6666, and also, it may be added, in many tests of similar type that were conducted with plants in other cultures.

As stated earlier, the plants in table 22 are sorted into four groups according to their constitutions with respect to the alleles of Y and to the presence or absence of Spm in them, based on results obtained from the above described tests of each. On none of the ears produced

by plants entered in parts II and IV of this table did variegated kernels appear. Only the pale pigmented class of kernels appeared, and on each ear, the pigment in these kernels was ~~of~~ the type that is characteristically produced in the absence of Spm by the state of a_1^{m-1} introduced by the pollen parent. In contrast, on all ears produced by the plants entered in parts I and III of table 22, variegated as well as pale-colored kernels appeared. On any one ear, the type of expression of variegation among all kernels exhibiting it was the same. Similarly, the pattern of variegation appearing among the variegated kernels on a different plants ears was the same provided that the pollen parent used in the cross ~~each case~~ had introduced the same state of a_1^{m-1}.

The ratio of variegated to pale colored kernels on these ears also was instructive, for it indicated the Spm number in each tested plant. The ratio of these two classes of kernels on ears produced by the test crosses conducted with the 15 plants entered in part I of table 22 are given in table 24. It may be seen that on the ears produced by 12 of these 15 plants, one Spm was present and it was carried in the Y bearing chromosome in each plant (Part I, table 24). On the ears produced by plant 6666G-4, part II, table 24, the data were too few to indicate with certainty linkage of Spm with Y although they are suggestive of this. However, the test-cross conducted

with plants 6665G-16 and 6665G-21, Part III of table 24, did not give ~~good~~ certain evidence of linkage of Spm with Y. In order to ~~be certain~~ learn of the location of Spm in these two plants, tests were conducted the following year with plants derived from the variegated, Y class of kernels on each of these ears. Tests of the progeny of plant 6665G-21 showed that the Spm in it was not linked with Y. Similar tests conducted with the progeny of plant 6665G-16 suggested that the Spm in this plant was still carried in chromosome 6 but at a location farther removed from Y than in the parent plant, 6629A-1, ~~and~~ or in the sister plants entered in part I of table 24.

Among the 24 tested plants derived from the colorless, sh_2, y kernels parts III and IV, table 22, only 6 had Spm. One test cross ear per plant was obtained from 3 of these 6 plants and 2 test cross ears per plant were obtained from the remaining 3. The types of crosses conducted with these plants are shown in part III of table 22 and the ratio of pale to variegated kernels/on each ear is given in table 25, among those that carried a_1^{m-1}. The ratio of pale colored to variegated kernels on each of the 9 ears obtained from tests of these six plants indicated the presence of one Spm in all six of them to which states 5718, 5719A-1, 5719A-2 and 5996-4 of a_1^{m-1} responded, each in its own manner.

The tests/of plants derived from the colorless, sh_2 classes of kernels

entered in table 22 clearly expressed the effectiveness of the test methods for revealing Spm constitutions in these plants and for demonstrating the individuality of response of each state of a_1^{m-1} to the Spm that was present in any one plant. With this in mind, consideration may now be given to tests conducted with the sister plants that were derived from the variegated, Sh_2 kernels. The test crosses that were conducted with each of them are entered in parts III and IV of table 21. Those conducted with ~~the~~ plants derived from the variegated, Sh_2, Y class of kernels, part III of table 21, will be considered first.

Of the 17 tested plants in part III of table 21, 15 had one Spm and it was carried in the Y bearing chromosome 6 in each. ~~The plants in cultures 6665 and 6666 having this constitution are entered in column 3 of table 21.~~ The kernel types on the test-cross ears produced by these plants are given in table 26. The ratio of kernel types on the one ear obtained from plant 6666C-1 did not give evidence of linkage of Spm with Y. However, tests conducted with plants derived from the variegated, Sh_2, Y kernels on this ear indicated that the Spm in it was carried in the Y bearing chromosome 6. ~~in this plant~~. Similarly, the ratio of kernel types on the first ear of plant 6666C-2, part II, table 26, did not give evidence of linkage of Spm with Y whereas the kernel types on the tiller ear of this plant, part I, table 26, clearly indicated such linkage.

Therefore, tests were conducted the following year with plants derived from the variegated, Y kernels on the ear of the main stalk of this plant and these established the presence of Spm in the Y bearing chromosome 6 in this part of plant 6662C-2 as well as in the tiller. The ratio of kernel types on the two test-cross ears obtained from plant 6665E-10, part I, table 26, differed from that appearing on all other ears. There were 103 pale-colored, Sh_2 kernels of which 45 were Y and 58 were y, and 234 variegated Sh_2 kernels of which 119 were Y and 115 were y. Obviously, the Spm in this plant was not linked with Y. Two Spm elements could be present in it or one Spm element could be present and carried in the chromosome 3 with a_1^{m-1}. In order to determine the Spm constitution in this plant, tests were conducted the following year with plants derived from the variegated kernels on each of the two ears of plant 6665E-10 and these tests established the Spm constitution of this plant. It had 2 Spm element, neither of which was linked with Y nor with a_1^{m-1}.

The ratio of kernel types appearing on the two test-cross ears of plant 6666C-7 were abberant (parts I and II, table 26). Both ears were partially sterile and the number of kernels on each were few. Tests conducted with 5 plants derived from ~~some of the~~ variegated kernels on the ear entered in part II of this table indicated that a burst of transpositions

of Spm must have occured late in development of this plant. One plant was Y Spm/y +, another had 2 Spm elements, one of which was linked with Y, a third had 1 Spm element linked with Pr in chromosome 5, a fourth had 1 Spm element linked with Wx in chromosome 9, and the fifth had 1 Spm element, not linked with any of these markers. Also, the factor responsible for sterility was not transmitted to any one of these offspring. It is probable, however, that Spm was originally carried in the Y bearing chromosome 6 of plant 6666C-7, as it was linked with Y in two of the five tested progeny plants.

One Spm was present in each of the 6 plants in part IV of table 21. On each test cross ear, a ratio of one pale-colored kernel to one variegated kernel appeared among those having a_1^{m-1} in them, as table 27 indicates.

The test crosses conducted with plant 6666E, part V, table 21, were numerous, as mentioned earlier. It was quite evident from them that the Spm in it was carried in the Y bearing chromosome 6 and evidence of this was given on page 00. Pollen was collected from the main stalk of this plant and from each of its three tillers. Tests conducted with all four parts of this plant indicated that the Spm in each part was carried in the Y bearing chromosome 6.

Altogether, 93 of the 106 plants in the progeny of plant 6629A-1 that were grown in the summer of 1954 under culture numbers 6665 and 6666

were tested for ~~their~~ Spm constitution. Table 28 summarizes the Spm constitutions and locations in the plants as determined by the test of each, given in detail in the preceding pages. Similar types of tests were conducted with plants in cultures 6670, 6673, and 6674, table 20, derived from selected kernels on ears produced by other Y Spm/y + plants in culture 6629A. The results obtained from them were so similar to those already described that a detailed description of the type of test conducted with each plant need not be given here. No Spm was found to be present in the pale pigmented plants derived from the pale colored kernels. However, in all cases where Spm was delivered to an endosperm of a kernel on the ear by means of ~~a~~ cross conducted with a plant of tester type III, table 19, the a_1^{m-1} in ~~them~~ each ~~plants~~ ~~was found to be capable of~~ responded ~~responding~~ to the Spm delivered by the tester plant. ~~An~~ Spm ~~element~~ was found to be present in all variegated plants derived from variegated kernels. In most of them, one Spm was present and in the majority of these derived from the Y class of kernels, it was linked with Y. In several plants, however, the Spm element in them did not give evidence of linkage with this marker Y.

Tests of the plants derived from the colorless, sh_2 classes of kernels were as extensive for cultures 6670, 6673 and 6674 as for cultures 6665, and 6666, just described. Here, also, it was found that when Spm was present in

in any one of them, it was capable of acting upon any state of a_1^{m-1} and each state, in turn, responded to it in its own individual manner. The tests conducted with these plants may be summarized briefly. Of the 59 plants derived from the colorless, sh_2, Y class of kernels in table 20, 56 were successfully tested. In 32 of them, one Spm was present and it was carried in the Y chromosome in 30 of these plants. The Spm in 2 plants did not show evidence of linkage with Y. Of the 63 plants derived from the colorless, sh_2, y kernels, 60 were successfully tested for Spm. It was present in only 17 of these plants and one Spm was present in each. The percent recombination between Y and Spm in the parent plants was 35.3. This same percent of recombination appeared in the test cross ears of ~~the majority~~ most of the progeny plants that were Y Spm/ y + in constitution, as table 29 illustrates. Ears on which the ratio was exceptional, ~~as~~ of the type described earlier, were excluded from the table.

The tests outlined in this section serve to illustrate the manner of examining Spm constitutions in plants and the effect that any one Spm will exert on any one state of a_1^{m-1}. Many of the tests included crosses between plants carrying different states of a_1^{m-1} as well as crosses to plants that were homozygous for a_1, either with or without Spm in them. Figure 1 is constructed to illustrate the ~~xxxxxxx~~ combinations of states

that were made and photo. 00 illustrates the types of kernels appearing on an ear following such a cross. Plants were grown from some of the variegated kernels in which two different states were present, one in each chromosome 3. Some of the tests of them were made by crosses with plants homozygous for a_1 and having no Spm in order to investigate the segregation of the two states to the progeny. Each state segregated from the other in the expected manner as if each were a distinct allele of the other. Photo. 000 of an ear produced by a cross of a plant carrying state 5700A and Sh_2 in one chromosome 3 and state 5719A-2 and Sh_2 in the homologue chromosome by one that was homozygous for a_1 and sh_2 will illustrate this. Again, if, in these plants Spm were linked with a genetic marker, this linkage was expressed in like manner by each state among the kernels on the test cross ear, and a large number of tests of this type were made in examining new locations to which Spm had been transposed.

Part III

TRANSPOSITION OF SPM IN a_1^{m-1} CULTURES

Early in the study of a_1^{m-1} it was realized that the independently located element in the system did not remain constant either in number or in location in the chromosome complement. The first clear evidence of this was given by the ratio of kernel types on ears of plants grown in the summer of 1952 (table 3). At that time, transposition of the controlling elements Ds and Ac was known and it was considered possible that the independently located controlling element in the a_1^{m-1} cultures, comparable to Ac, was also undergoing transposition. In order to determine that change in location of this element was occurring, it was necessary to examine its location in individual plants in the progeny of those in which its number and location was known. ~~This~~ had been determined ~~for Spm~~ in some of the plants of culture 6629 (tables 5 and 8). Therefore, some of the ~~extensive~~ tests of the progeny of ~~some of~~ the plants ~~in this culture~~ were undertaken for this purpose ~~was~~ conducted during the summer of 1954. Those conducted with the progeny of four of the Y Spm / y + plants in culture 6629 were discussed in the preceeding section. It was shown there that in the majority of these Spm carrying progeny ~~plants~~, only 1 Spm was present, and that in ~~the~~ Y / y ~~plants~~, it was carried in the chromosome 6 with Y and at the same location, or certainly close to this, as in the parent plants.

In a few progeny plants, however, Spm was not linked with the Y marker, and in several of them, two Spm elements were present instead of one, one of which was linked with Y in some plants, & neither of them linked with Y in other plants. Some of the cases ~~where such was found~~ of this were ~~mentioned~~ described and the progeny of some of them will be considered later.

~~Most~~ Many of the examined plants, ~~whose constitutions were considered in the last section~~ were derived from kernels on the testcross ears of ~~plants~~ in culture 6629A, entered in table 5. In addition, an ear of ~~the~~ a tiller of one of them, plant 6629A-4 that was Y Spm/y + in constitution, had been self-pollinated. Plants derived from selected kernels on this ear were examined for the Spm constitution in each. In ~~the~~ those that carried both Y and Spm, ~~carrying plants~~, the following constitutions with respect to the alleles of Y and to Spm could be expected to appear:

(1) Y Spm/Y Spm, (2) Y Spm/y Spm, (3) Y Spm/ Y +, (4) Y Spm/y +, and (5) Y +/ y Spm. Among the 18 examined progeny plants having both Y and Spm, 3 had constitution (1), 1 had constitution (2), 3 had constitution (3), 7 had constitution (4), and 1 had constitution (5). In the remaining 3 plants, other constitutions were found. All were Y/y. One plant had two Spm elements, neither of which was linked with an allele of Y. Another had two Spm elements, one of which was linked with Y. The third plant had one Spm but it was not linked with either Y or y.

If no changes in location or in action of Spm occur in plants having two Spm elements at allelic positions in an homologous pair of chromosomes,

then all gametes each plant produces should carry Spm. On the testcross ears of these plants, all kernels would exhibit variegation. However, changes do occur and the extent of this may be judged by the proportion of pale colored kernels that are randomly distributed over the ears they produce. In the Spm/Spm plants, mentioned above, between 10 and 15 percent of the kernels on the testcross ears they produced were uniformly pale colored instead of being variegated. These kernels represent cases in which Spm had been altered, either in location or in action, in cells of the parent plant. insert page 124a to

Examination of the progeny of individual plants of culture 6629 confirmed the Spm constitutions that had been presumed (for each, based on the ratio of) ~~from the~~ kernel types appearing on the testcross ears each produced. However, more precise ~~was~~ information was obtained ~~learned about this~~ from tests conducted with their progeny, and this is summarized in table 30. Spm apparently occupied the same position in chromosome 6 in each of the 4 Y Spm/y + plants (A-1, A-4, A-6, and A-7) whose progeny were examined. At this location Spm does undergoes ~~some~~ change both in location and in type of action. ~~and cases of this were mentioned in the last section of this report.~~ ~~However~~ but, the frequency of appearance ~~occurrence~~ of this in the progeny is much less than that which appears when Spm ~~occurs to Spm when it~~ occuppies other locations in the chromosome complement, ~~and~~ Evidence of this will be given ~~discussed~~ shortly.

The types of testcross conducted with plants grown in the summer of 1954, whose origins are given in table 18, were described in the previous section. Some of them were made to investigate the behavior of different states of a_1^{m-1} whereas others were made to determine Spm constitutions in the progeny of plants whose Spm constitution had been determined. During the summer of 1955, many testcrosses were conducted for the purpose of intestigating transposition of Spm. This required determining the presence or absence of Spm in each kernel on an ear produced by a plant whose Spm constitution was to be determined. For this purpose, it was necessary to use states of a_1^{m-1} that give very clearly defined patterns of mutant spots in the presence of Spm. Therefore, the tester stocks that were used in the summer of 1955 were homozygous for either state 5718 or for state 5719A-1. With each, small spots of the A_1 type pigment appear in a colorless background when Spm is present. In the absence of Spm, state 5718 gives only very faintly pigmented kernels. For tests requiring distinctions between the Pr and pr phenotypes in the pale class of kernels (no Spm) tester stocks carrying state 5719A-1 usually were used. This was done because in the absence of Spm, the intensity of pigment in kernels is deep enough to allow distinctions to be made between the Pr and pr

phenotypes. With state 5718, such distinctions are difficult because of the faintness of pigment in them.

The state of a_1^{m-1} in the plants tested was either 5719A-1 or 5718 unless otherwise stated. The use of these states was important because the frequency of occurrence of germinal mutation is very low for each. However, occasionally a sector will appear on an ear of a plant having state 5719A-1 in which all of the kernels within it exhibit the same mutant phenotype, indicating that a mutation to or toward A_1 had occurred in a cell during development and that its progeny cells were included in a sector on the ear. Such sectors on ears appear only very rarely. In the tables given in this part of the report, kernels having germinal mutations were not included. This was done to allow the data to be presented in a simple form whereby the ratio of the pale class of kernels (no Spm) to the variegated class (Spm present) may be read rapidly. To be meaningful, inclusion of germinal mutations in these tables would also require reference to the state of a_1^{m-1} that was present in each plant, to whether or not it was homozygous for this state or heterozygous with a_1, or whether state 5719A-1 was present in one chromosome 3 and state 5718 in the homologue. Since few kernels with a germinal mutation ~~appears is low for either state~~,

mutation appeared on the testcross ears, it was considered needless to complication the presentation, both in the text and in the tables, by detailed reference to the constitution of each plant with regard to the state of a_1^{m-1} it carried.

In the discussion that follows, the term "testcross" will be used frequently. Unless otherwise state, it will refer to a cross made with a plant whose Spm constitution is to be determined by one that is homozygous for state 5718 or state 5719A-1 of a_1^{m-1}, for Sh_2, and for pr, y, and wx, and in which no Spm is present.

The number of progeny tests that were made for the purpose of examining Spm constitution in each plant ~~them~~ is large. In describing each of these tests it will be necessary to refer to culture numbers under which the different progenies were grown, and to plant numbers within a culture. To lessen confusion that could arise from use of such numbers in the text, a chart was prepared, figure 2, that gives the culture number of the plant whose progeny was tested, the constitution of this plant, and the culture number of its progeny along with the table number that illustrates the Spm constitution in the plants of its progeny. Culture numbers of plant grown in the summer of 1954 are entered in table 18. They run from 6638 to 6706. The culture numbers for the summer of 1955 run from

6861 to 6900. Those for the summer of 1956, given in this section, are few, being 7260, 7261, and 7285. Those for the summer of 1957 given in this section likewise are few. They run from 7330 to 7334.

Another point should be made clear at this time. In considering Spm number in a plant, it must be stated that it is not possible to distinguish the presence of two or more Spm elements when these are located very close to one another in a chromosome. Increase in dose of Spm does not effect change in mutation pattern given by the states of a_1^{m-1} that have been isolated. The same pattern of this appears when either one or more Spm elements are present. One state of a_2^{m-1} allows the different doses of Spm to be distinguished from each other but a state of this type was not isolated early in the study of a_1^{m-1}. Therefore, in this section, when a plant is stated to have one Spm, this does not exclude the possibility that two or more Spm elements were present in one of its chromosomes but located so close to each other that detection of this could not be made. The inheritance pattern among the kernels on a testcross ear would be that of one Spm at one particular location in the chromosome complement.

At times, mention will be made of sectors appearing on some ears in which no Spm activity is given by any of the kernels within the sector. Sometimes the boundaries of the sectors were clearly defined and it was possible to isolate all kernels within it. With others, the kernel types on the ear would not allow the exact boundaries to be determined. However, experience with the forms of sectors appearing on ears allows one to project the boundaries of those sectors that are not accurately defined by kernel phenotype. When such appeared, the boundaries were drawn on the ear by such projections, and the kernels within the sector removed from the ear and sorted separately. Undoubtedly, some errors were made in projecting the boundaries, but the degree of this could not have been great. Inclusion in or exclusion of a few kernels from the sector would not seriously alter the ratio of kernel types that was present on the rest of the ear.

As indicated in table 30, the two Spm elements in plant A-8, and two of the four Spm elements in plant A-2, occupied positions in the Y bearing chromosome 6 in each. Evidence of this, derived from tests conductd with the progeny of plant A-8, will be summarized.

Progeny Test 2, figure 2

The testcross ear of plant 6629A-8 had the kernel types entered in table 5. The Spm constitution of 19 plants derived from the variegated, Y class of kernels on this ear was determined in the manner described in the previous section. Eleven of these plants were Y Spm/y + in constitution. The other 8 plants had at least 2 Spm elements, each carried in the Y bearing chromosome 6. The constitution of these plants will be symbolized as Y Spm Spm/y + +. Eleven plants derived from the Y class of colorless, sh_2 kernels also were examined. Spm was absent from one of them but present in the other 10 plants. In 5 of the ~~latter~~ 10 plants, one Spm was present and it was carried in the Y bearing chromosome 6 in each (Y Spm/y +). In the other 5 plants, more than one Spm was present and in all plants, each of them was located in the Y bearing chromosome 6 (Y Spm Spm/y + +). In addition, thirteen plants derived from the y class of colorless, sh_2 kernels were examined. In 9 of them, no Spm was present. One Spm was present in 3 of the 4 plants having it (line 7, table 31) and two Spm elements were present in the fourth plant (line 8,

table 31).

The ratio of kernel types on the testcross ears of those plants in the progeny of plant 6629A-8 that were Y Spm/y+ in constitution is given in line 2 of table 31. It may be noted that the percent of recombinants in the variegated class of kernels on these ears resembles that obtained from tests of the Y Spm/y + plants in the progeny of plants 6629A-1, A-4, A-6 and A-7, discussed in the previous section and summarized in table 29. Among the plants having more than one Spm in the Y bearing chromosome, different groupings with regard to position of the Spm elements ~~in these plant~~s could be made based on the ratio of phenotypes appearing on the testcross ears produced by each plant. They fell into two main groups, as shown in lines 3 and 4 of table 31. In addition, there were two plants on whose testcross ears the ratio of kernel types did not fit that given either in line 3 or 4 of table 31. The kernel types on the ears these two plants produced are entered in lines 5 to 7 of this table.

From the tests conducted with the progeny of plant 6629A-8, it would appear that this plant had one Spm element which occupied the same position in chromosome 6 as in the four Y Spm/y + plants in culture 6629, and that altho~~gh~~ugh transposition of it away from this location occurs, the frequency ~~of occurrenc~~e of this is not high. The second Spm element

in this plant, also located in the Y bearing chromosome, appeared to undergo more frequent transposition. This ~~often~~ resulted in placement of it usually at new locations within the Y bearing chromosome 6 and less frequently at locations that do not show linkage with Y.

Progeny Test 3, figure 2

Plant 6629A-2 obviously had more than 2 Spm elements, as the ratio of kernel types on its testcross ear, given in table 5, indicate. Kernels were selected both from the main stalk ear and from the tiller ear of this plant and sown in the summer of 1954. Only those plants derived from the colorless, sh_2 classes were examined in detail for the Spm constitution in each. Tests conducted with them established the fact that the parent plant had a high number of Spm elements in it. The ten plants derived from the colorless, sh_2, Y class of kernels on the tiller ear of this plant had the Spm constitutions given in table 32. It was not possible to establish the exact number of Spm elements in plants that obviously had at least 3 of them. More than 3 Spm elements could have been present in some of them. It was clear, nevertheless, that in several plants, 2 Spm elements were present, each of which was carried in the Y bearing chromosome 6.

In addition to these 10 plants, mentioned above, 8 other plants derived from the colorless, sh_2, y class of kernels on the tiller ear of plant 6629A-2 were also examined for Spm constitution. Three plants had

1 Spm and it was not linked with either pr or wx in any one of them. Three other plants had 2 Spm elements. In one of these plants, one of the two Spm elements was located in its wx carrying chromosome 9. The kernel types on the testcross ear of this plant were as follows: 35 pale colored Wx, 8 pale colored wx, 47 variegated Wx, and 80 variegated wx. In each of the remaining two plants, at least 3 Spm elements were present. In one of them an Spm element appeared to be located in the wx carrying chromosome 9. On its testcross ear the following phenotypes appeared among its kernels: 21 pale colored Wx, 2 pale colored wx, 97 variegated Wx, and 117 variegated wx.

Progeny Test 4, figure 2

In order to further investigate the location of the Spm element in the Y bearing chromosome 6 in the progeny given in table 32, twenty kernels were selected from the variegated, Y class on the ear produced by plant 6667F-11, line 2, table 32, which was considered to be Y Spm Spm/y ++. They were sown the following year under culture number 6884. Ninteen of the twenty plants derived from these kernels were variegated, as expected, but one was totally pale colored and in none of the kernels on the testcross ear of this plant was evidence given of the presence of Spm. Testcross ears were obtained from 17 of the 19 variegated plants. They

fell into four groups with regard to Spm constitutions, as shown in table 33. Three plants were Y Spm/ y +. On the testcross ears of two of them, the ratio of kernel types, line 1, table 33, was quite similar to that on testcross ears produced by the Y Spm/y + plants in table 30 and by the majority of their Y Spm/y + progeny, already discussed. On the testcross ear of one plant, however, the ratio of kernel types suggested that the Spm in it was carried in the Y bearing chromosome but at a position closer to Y than in the two Y Spm/y + sister plants (line 2, table 33). Twelve other plants were Y Spm Spm/y + + in constitution (line 3, table 33). The two remaining plants had an Spm in the Y bearing chromosome and in addition, another Spm element not linked with Y (line 4, table 33).

From the ear of the main stalk of plant 6629A-2 (see table 5), only those plant that were derived from the colorless, sh_2, y class of kernels were examined for the Spm constitution in each. These were grown under culture number 6668C. Among the nine plants tested in culture 6668C, two had no Spm. Three plants had 1 Spm and in one of them, plant 6668C-6, this Spm was linked with pr in chromosome 5, as shown in line 1 of table 34. On this ear, accurate classification for the alleles of Pr and pr was not possible for all kernels in the pale (no Spm) class and therefore, both pale phenotypes are combined under the heading of "Pale". In the four

remaining plants, 2 Spm elements were present and they were not linked with each other. In one of them, one of the Spm elements was linked with pr in chromosome 5. The phenotypes of kernels on the testcross ear were as follows: 96 pale colored (both Pr and pr included), 97 variegated, Pr, and 145 variegated, pr. In another of the plants having 2 Spm elements, plant 6668C-3, one of these elements was linked with wx. The kernel types on its testcross ear are given in line 1 of table 35. Subsequent tests conducted with the variegated kernels on this ear will be considered shortly.

Progeny Test 5, figure 2

In order to investigate further the location of Spm in plant 6668C-6 (line 1, table 34), and the stability of it at this location, ten kernels were selected from the variegated, Pr (recombinant) class of kernels on the ear it produced and these were sown in the summer of 1955 under culture number 6877. Nine of the 10 plants derived from these kernels were variegated. One, however, was totally pale pigmented. As will be shown later, an Spm element was present in this plant but it was in its inactive state. Testcross ears were obtained from 6 of the 9 variegated plants in culture 6877. On Spm was present in each but in only 3 of them was it linked with Pr in chromosome 5. The Spm in the other three plants gave no

evidence of linkage with Pr. The types of kernels on the testcross ears produced by each of these 6 plants are given in table 34. Among the 3 plants carrying Spm in chromosome 5, the position of it within this chromosome does not appear to be the same. Certaingly, its location in plant 6877-4 differs from that in either plant 6877-1 or plant 6877-2.

It should be emphasized that the kernels selected from the ear of plant 6668C-6 were in a recombinant class. The recombinant classes arise from two distinctly different events. One is typical crossing over between homologues. The Spm is transfered from one homologue to the other without its undergoing change in location. The second event is premeiotic transposition of Spm which places it at another location in the chromosome complement. Subsequent meiotic segregation may result in its inclusion in a nucleus having the allele of the marker to which it was formerly linked. As a general rule, within the recombinant class, increasingly higher proportions of kernels having a transposed Spm element will ~~be~~ ~~present~~ appear the closer is Spm to the genic marker.

Progeny Test 6, figure 2

As mentioned above, plant 6668C-3 carried two Spm elements, one of which was linked with wx in chromosome 9, as shown in line 1 of table 35. It was desired to obtain plants in which the only Spm present was carried in ch

kernel types on the testcross ears each produced indicated, in table 35. Three plants had 2 linked Spm elements but no evidence was given of linkage of them with either Pr or Wx. One plant had 2 Spm elements, not linked to one another nor to Pr or Wx. One plant had at least 3 Spm elements. There were so few pale colored kernels on the testcross ear of this plant that ~~evidence of~~ linkage with an Spm element with either Pr or Wx could not be ~~estimated~~ determined. The testcross ear produced by another plant had only a very small basal sector in which variegated kernels appeared. All other kernels on this ear were uniformly pale colored, the phenotype produced by a_1^{m-1} when no Spm is present.

A total of 40 ears were obtained from the testcrosses conducted with the variegated plants in culture 6872, just described. Five ears had sectors in them in which all kernels were pale colored (no Spm) and they appeared only on ears of plants in which 1 Spm was present. The rate of appearance of such pale sectors was considerably higher than had been observed on testcross ears produced by those plants in which the ~~having~~ 1 Spm which was carried in ~~the Y-bearing~~ chromosome 6 that were discussed previously. On the ears of these latter plants pale sectors appeared only very infrequently. Obviously, then, the Spm element in some of the plants of culture 6872 was undergoing change ~~at a different time during~~ early in development and this was evident on the ear produced by one of the plants in which it was located in chromosome 9. It was

in chromosome 9. Therefore, 30 kernels were selected from the variegated Wx class on the ear of plant 6668C-3 and grown in the summer of 1954 under culture number 6872. Twenty-nine of the 30 plants derived from these kernels were variegated but one was uniformly pale pigmented and none of the kernels on the testcross ear it produced gave evidence of the presence of Spm in this plant. Testcross ears were obtained from 27 of the 29 variegated plants. It could be concluded that in 19 of these 27 plants, 1 Spm was present but it was not linked with Wx nor with Pr. Three other plants had only 1 Spm and in each it was linked with Wx in chromosome 9, as the

therefore decided to investigate further the behavior of ~~the~~ Spm ~~that was~~ located in chromosome 9.

Progeny Test 7, figure 2

The kernel types on the testcross ears produced by the three plants in culture 6872 in which Spm was located in chromosome 9 are entered in table 35. As may be noted, the percent of the recombinant classes ~~differed~~ varied on all ears and in plant 6872A-12, a decided difference was expressed ~~between that given by~~ on the ear of the main stalk and that of its tiller. It ~~appeared~~ would that the Spm element in plant 6872A-12 ~~was~~ had undergoing change in location early in development. ~~For this reason~~, It was decided then to test the behavior of ~~the~~ Spm ~~in it~~ in the progeny of this plant. ~~subsequent generation~~. ~~Therefore~~, Kernels were selected from the variegated, Wx class on the ear of the main stalk of this plant and sown under culture number 7285 in the summer of 1956. Thirteen plants were obtained from these kernels. Twelve of them were variegated but one was totally pale pigmented, and no evidence of the presence of Spm was obtained from test crosses conducted with it. Since the purpose of this experiment was to determine Spm number and location in different parts of the same plant, all fertile ears produced by each plant were used in the test cross. Pollen from plants not having Spm but which were homozygous for state 5718 a_1^{m-1} and for the recessives, pr, y, and wx, was placed on the silks of each ear of ~~each~~ every plant. Altogether, 26 ears were obtained from the 12 plants having Spm. The Spm constitution and location with respect

Wx is summarized in table 36. In one plant, no evidence was given of linkage of Spm with Wx in any one of the four tested parts of this plant (plant A-7, table 36). Spm was lined with Wx in some part of the other 11 plants but not in all tested parts of each plant. It was obvious that the Spm in these plants was undergoing change in location in somatic cells and that the time of occurrence of this was early in development. For those parts of these plants in which one Spm was present and carried in the Wx bearing chromosome 9, the kernel types on each ear which gave evidence of this is shown in table 37. From the ratio of types on these ears, it could be suspected that the Spm did not occupy the same position in chromosome 9 in all plants or even in different parts of the same plant. The kernel types appearing on each of the 9 other ears obtained from the plants in which Spm was present are given in summary form in table 38.

Progeny Tests 8, 10, 11, and 13, figure 2

The early occurring transposition of Spm in plants in culture 7285 was so strikingly expressed that it was decided to continue investigation of its behavior in plants of the following generation. For this purpose, variegated kernels in the Wx class were selected from the four ears indicated by footnotes in table 37, and these were sown under the

given culture numbers in the summer of 1957. Thirty seven plants were obtained from them. Thirty-six of these plants were variegated. One, however, was totally pale colored and no evidence of Spm appeared among the kernels on the testcross ear it produced. All fertile ears of each plant were used for the testcross. The Spm constitution in the tested parts of these plants is summarized in table 39. Again, in this generation, early occurring transposition of Spm was noted. The phenotypes of kernels on ears produced by those parts of a plant that had Spm, carried in the Wx bearing chromosome 9, are entered in table 40, and a summary of all others is given in table 41.

The behavior of the isolate of Spm that was present in the plants just described, was consistent with respect to time of occurrence of transposition. It was occurring in some cells early in plant development. Other isolates of Spm differ in this respect and, as mentioned above, early occurring transposition of it in the Y Spm/y + plants, previously described, was infrequent. Among 40 Y Spm/y + plants in which more than one part of a plant was tested, for Spm constitution, only 1 case of change in Spm was noted and this was produced by inactivation of it rather than by its transposition. The Spm at the given location in

in chromosome 6 does undergo transposition, however, but the time of occurrence of this was usually late in plant development rather than early in development.

The frequency of occurrence of transposition at any one time appears to differ with different isolates of Spm. For some of them, this is quite infrequent in that only rarely is a case of transposition detected either in the plant or in the gametes it produces. With some other isolates, on the other hand, a burst of transpositions occurs in sporogenous or spore cells. As a consequence, a large fraction of the Spm carrying gametes of such plants have a newly transposed Spm in them. But, before examples of this are discussed, another experiment of small scope, conducted with the Spm element that was present in plants of culture 7285 (tables 36 to 39), will be described.

Progeny Test 9, figure 2

The plants in culture 7330 (table 40) were derived from variegated, Wx kernels on the second ear of the main stalk of plant 7285A-1 (table 37). The Spm in this part of the plant was carried in its Wx bearing chromosome 9. In the tiller of this plant, one Spm element was present but on the testcross ear it produced, no evidence was given of linkage of it with Wx. It was desired to examine the Spm constitution

in different parts of plants derived from variegated Wx kernels on this tiller ear in order to determine if in any of them linkage of Spm with Wx would be found. Eleven plants, all of which were variegated, were grown from such kernels under culture number 7331. (See line 1, table 42 for the kernel types on the ear from which these kernels were selected.) Testcrosses were made with all fertile ears of each of these 11 plants. Only one ear was obtained from 5 plants and one Spm, not linked with Wx, was present in the part of each plant that produced an ear. Another plant produced 4 fertile ears. One Spm was present in the four tested parts of this plant and in no part was it linked with Wx. The kernel types on the ears these 6 plants produced are entered in line 2 of table 42. Some part of each of the five other plants in culture 7331 had more than one Spm element in it, as shown in lines 3 to 8 of table 42. One of the tillers of plant 7331B-5, however, had only one Spm in it.

Except for the ear of one tiller of plant 5, the ratios of kernel types on ears produced by different parts of each plant in culture 7331 that had more than one Spm element in it were very much alike. Differences in this respect were expressed between plants, however. The number of plants tested and the number of tests conducted with each plant are too few to draw definite conclusions regarding the behavior of this Spm following its transposition in a somatic cell of plant 7285A-1 from a position in chromosome 9, giving linkage with Wx, to a new location in the chromosome complement. It is evident, nevertheless, that subsequent transposition of it occured, ~~but the rate of only occurring transpositions appeared to be reduced~~. ~~It is also evident that in none of the plants in culture 7331 did a transposition~~ but in no case did this result in its return ~~it~~ to a position in chromosome 9 that showed linkage with Wx.

Page 137 [illegible] figure 2

That transposition of Spm from ~~a~~ one location ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ to a new location ~~will~~ may result in marked change in time and frequency of occurrence of subsequent transposition of it, was strikingly expressed in one case. In part II of this report, tests conducted with the progeny of the Y Spm / y + plants of culture 6629A were considered, ~~in detail~~. There it was pointed out that the ratio of kernel types on each of the two test cross ears produced by plant 6666C-7 in the progeny of plant 6629A-1 were quite aberrant and

It did not ~~conform~~ agree with ~~those~~ that ~~obtained from~~ appearing on test cross ears obtained from ~~of~~ the majority of plants in this progeny (see ~~parts I and II of~~ table 26). It was decided, therefore, to examine some of the progeny of lant 6666C-7 whose kernel types are that ear entered in ~~part II~~ of table 26. Two variegated kernels in the $\bar{Y}$ class on this ear and 3 variegated kernels in the y classwere grown under culture numbers 6895A and 6895B in the summer of 1955. Tests of the Spm constitution of each of the five plants derived from them gave suprising results. One Spm was present in plant 6895A-1 and it was closely linked to Y. On the test cross ear of this plant there were 167 pale colored kernels of which 10 were Y and 157 were y, and 162 variegated kernels of which 153 were Y and 9 were y. In addition, there was a small sector in which only pale colored kernels app red; 21 kernels in this sector were Y and 26 were y.

Plant 6895A-2 had 2 Spm elements, one of which was carried in its Y bearing chromosome 6. In addition to the one kernel on the ear which had ~~having~~ a mutant of a_1^{m-1}, there were 91 pale colored kernels of which 39 were Y and 107 were y, and 234 variegated kernels of which 130 were Y and 107 were y. No evidence of linkage of ~~the Spm~~ the second Spm element with either Pr or ~~with~~ Wx was given.

Plant 6895B-1 ~~apparently~~ which was y/y, had one Spm, and it was not linked to either Pr or Wx. On its testcross ear there was one kernel with a mutant of a_1^{m-1}. Among the other kernels, 119 were pale colored and 133 were variegated.

Plant 6895B-2 had one Spm element and it was linked with Pr in chromosome 5. Among the kernels on the testcross ear it produced the following phenotypes appeared: 74 pale colored, Pr : 154 pale colored, pr : 131 variegated, Pr : 71 variegated pr.

Plant 6895B-3 had one Spm element and it was linked with Wx. Among the kernels on the test cross ear it produced the following phenotypes appeared: 91 pale colored, Wx : 184 pale colored, wx : 117 variegated, Wx : 75 variegated wx.

~~Although the Spm constitution was determined in~~ plants derived from the only 5 plants in the progeny of plant 6666C-7 were examined, the differences in ~~the~~ Spm constitution and location ~~of it in each plant~~ among them was ~~striking~~ remarkable. Both testcross ears produced by the parent plant were partially sterile in that some ovules did not produce kernels and others produced kernels that were abortive in their development. Also, on both ears, the percentage of kernels having Spm was low. On none of the ears of the 5 progeny plants was sterility expressed, ~~and~~ also, a noticable reduction in proportion of kernels having Spm was exhibited only by plant 6895B-3 and the degree this did not approach that given by the ears of the parent plant. Obviously, there must have been either a burst of transpositions of Spm in the parent plant, most of which occurred late in development, or a succession of such transpositions, leading to the formation

of gametes in which Spm occupied various different location in the chromosome complement. in many of them

Progeny Test is, however

Progeny tests were conducted with plants derived from the variegated kernels on the ears produced by plants 6895A-1, in which Spm was closely linked with Y, and by plant 6895B-3 in which Spm was linked with Wx. other 7261

They showed that ~~With regard to~~ the ~~subsequent~~ behavior of Spm, in these two plants ~~these progeny tests~~ was ~~gave~~ strikingly different, ~~results~~. The Spm in plant 6895A-1 was ~~proved to be~~ relatively stable in its location whereas that in chromosome 6, in chromosome 9 plant 6895B-3 underwent many subsequent transpositions. It may be recalled that the Spm in plant 6666C-7 was derived from the one Spm that (was present) in plant 6629A-1, therefore ~~and that~~ the Spm in all subsequent progeny may be considered to stem ~~be derived~~ from the one Spm, ~~in this 6629A-1 plant~~. It seems evident that transposition of Spm to a new location may result in change in its subsequent behavior and the degree of this with regard to time and frequency of occurrence of subsequent transposition may vary over a wide range. ~~The behavior of this Spm following transposition of it~~ to ~~a new location can differ and over a wide range. with respect to subsequent transpositions that occur.~~ The control of this may reside in the Spm element itself in that some change may occur to it as a consequence of ~~during~~ the transposition process. On the other hand, ~~However,~~ this control may reflect the particular organization of the genetic materials at the site which it occupies at any one time.

Evidence for this latter interpretation was obtained from studies of the Ds - Ac system. Two independently occurring cases of insertion of Ds just to the left of Sh_1 in chromosome 9 resulted in fixation of Ds at this

location. Although many thousands of kernels were examined in any one of which an altered location of Ds could have been detected, not one case of this was found. If there had been only one discovered case of insertion of Ds at this location, just to the left of Sh_1, nothing could be concluded about the factors that are responsible for its stability of location. There were, however, two such cases following which Ds behaved in exactly the same manner, and this suggests that the site in the chromosome where a controlling element resides is an important factor in the control of subsequent transpositions of such an element, be it Ds, Ac, Spm, or any other of this species.

We may now return to give the evidence of the difference in behavior of Spm in plant 6895A-1 when compared with that in the other plant 6895B-3. As stated above, in plant 6895A-1, the Spm element was located close to Y in chromosome 9 as the kernel types on its testcross ear indicated (part I, table 43). Seventeen plants were grown from the variegated Y class of kernels on this ear in the summer of 1956 under culture number 7260. All of the plants were variegated. The silks of each fertile ear of every plant received pollen from a plant in the tester stock which was homozygous for a_1^{m-1} (state 5718), y, pr, and wx and in which no Spm was present. The kernel types on the ears these plants produced are given in parts II and III of table 43.

In 14 plants the location of Spm was the same as in the parent plant~~s~~ and in all tested parts of each plant, as shown by the ratio of kernel types on the ears each produced, part II, table 43. ~~The kernel types appearing on each of the~~ ears these 14 plants produced ~~is given in part II of this table~~. Only 4.5 percent of the kernels on these ears were in the "recombinant" classes. The ratio of kernel types on ~~the~~ ears of the three other plants differed from this in some manner, and the~~se~~ is ~~are~~ ~~given~~ shown in part III of table 43. In plant 7260-2, the location ~~linkage~~ of Spm ~~with~~ in the heavy chromosome Y was expressed by the linkage of the variegated class with Y and the pale class with y ~~ratio of kernel types~~ appearing on the ear of the main stalk ~~although~~ the ratio of the pale colored class to the variegated class deviated in favor of the pale class more on this ear ~~was somewhat higher~~ than on the ears produced by the sister plants, entered in part II, suggest~~ing either~~s that the Spm in it ~~was undergoing~~ underwent more transpositions ~~late in development~~ in the spores and/or did the Spm than in the sister plants. On the ear produced by the tiller of this plant, no evidence was given of linkage of the one Spm in it with Y. On the ear obtained from plant 7260-16, a small sector was present in which all of the kernels were pale colored. On the ~~rest~~ remainder of this ear, however, the ratio of kernel types was the same as that on ears of the sister plants in part II of table 43. The ear produced by plant 7260-17 was partially sterile and from the ratio of kernel types on this ear, it was clear that some abnormality in the Spm carrying Y chromosome was responsible for this sterility. The nature of this abnormality is not known.

If no transposion of Spm occurs during development of the sporogenous or spore cells in a plant~~s~~ having one Spm, then half of the gametes it produces would lack one ~~l~~ Spm and half would have no Spm. As a consequence, half of the kernles on the testcross ear it produces would be variegated and half would be pale colored. However, such transpostions do occ^ur, and and often this results in the appearance of two Spm elements in one nucleus of a sporogenous or gametophytic cell and no Spm in its sister nucleus. Because of this, the proportion of cells with no Spm in the sporogenous or gametophytic cells will depend upon the frequency of occurrence of such transpositions, ~~that had occurred earlier in development~~. Thus, the proportion of kernels on testcross ears that are pale colored will increase as the rate of ~~this~~ such transposition increases, ~~and~~ many progeny tests have ~~indicated the correctness of~~ supported this interpretation as a major factor that is responsible for the ~~of~~ deviation from ~~the~~ a ratio of one pale-colored to one variegated kernel ~~on~~ that often appears testcross ears of plants/hav~~ing~~ing their initially one Spm in their nuclei. Therefore, whenever the ratio of pale colored kernels to variegated kernels deviates from the expected 1 : 1 in favor of the pale class on a testcross ear of a plant having one Spm the cause for this ~~is usually~~ may be suspected to be transposition of Spm that occurred in a number of cells late in development of the tissue sporogenous or of the gametophytic tissues. For this conclusion to ~~apply~~ hold, the pale colored kernels on such ears must be

scattered over the ear an not be clustered. It is obvious that the latter arises from an ~~early occurring~~ event in a single cell early in development, these cars ~~effecting~~ either a transposition of Spm or ~~an~~ inactivation occurring. It is inactivation of Spm that is responsible for the imbalance in the ratio of pale to variegated kernels, rather than ~~results not from~~ transposition of it. ~~Spm but rather from its inactivation in some cells~~. Often ~~Usually,~~ it is possible to distinguish ~~make a distinction~~ between the two types of change in Spm -- either in its location or its action -- that are responsible for the unequal ratio of the two classes of kernels on an ear. How it is possible to do ~~Why~~ this is ~~so~~ will be indicated in the section of this report dealing with inactivation of Spm.

The tests conducted with the progeny of plant 6895A-1, described above, indicated that the Spm in it and in the majority of its progeny did not change its location during early development with any marked degree of frequency. Also, as the ratios of pale to variegated kernels on the testcross ears entered in part II of table 43 indicate, not many transpositions of it were occurring late in development of the sporogenous cells. However, the Spm in the sister plant, 6895B-3, underwent many transpositions and the evidence of this will now be given.

Progeny test 16, figures

The Spm in plant 6895B-3 was located in its Wx bearing chromosome 9, as the kernel types on its testcross ear indicated (see line 1, table 44). It may be noted that the ratio of pale colred to variegated kernels

on this ear (275 pale : 192 variegated) deviated greatly in favor of the pale class. That some of this was due to transposition of Spm was suggested by the Spm constitution in plants derived from the variegated, Wx class of kernels on this ear. The seventeen examined progeny plants were grown under culture number 7261 in the summer of 1956. Sixteen of them were variegated and one was totally pale pigmented. On the testcross ear produced by this latter palnt, none of the kernels gave evidence of the presence of Spm. Twenty-nine testcross ears were obtained from the 16 variegated plant in this culture. In only 5 of them was Spm linked with Wx and then not in all parts of each plant. Many changes, both in location of Spm and in its action, must have been occurring in these plants as the kernel types on the ears they produced indicate, table 44. Also, chromosomal abnormalities may have been produced in some cases when this occurred, as the deficiency in the Wx class of kernels on the tiller ear of plant 7261-5 suggests. Also, on some ears ~~the proportion of~~ the pale class of kernels greatly outnumbered ~~the of the~~ the variegated class. In one plant, 7261-10, an Spm element appeared to be present in the wx bearing chromosome as well as in the homologue with Wx but at a different location in the chromosome. In plant 7261-12, the Spm in it was fully active in the tiller but in the main stalk, it was inactive in a number of kernels ~~produced by both~~ and

on both the ~~xxxxxx~~ the first and the second ear. Among the kernels on the three ears of plant 7261-6 in which Spm was present, a few appeared in which the Spm in them was only weakly active (see section dealing with the Spm-w state of Spm). Also The majority of these kernels were in the wx class.

It is obvious that in comparison with the behavior of Spm in the progeny tests so far outlined, that ~~the Spm~~ in plant 6895B-3 was behaving in an unusually aberrant manner, not only because of the frequent transpositions of ~~th~~ that were occurring, but also because of changes in its action that ~~to~~ took place, and also because of the possible effect it had in plant 7261-6 in introducing a modified type of Spm action in the non-Spm carrying homologue with wx. Unfortunately, further progeny tests were not continued with any one of these plants. Thus, no more was learned of the subsequent behavior of this Spm that originally was present in plant 6629A-2 but had been greatly altered in its mode of behavior in the second generation plant, 6895B-3, and in some of ~~its~~ the progeny of this latter plant, in turn,

At this point in the discussion of transposition of Spm we will pause to review the evidence of this that has been given so far. For this purpose, we will confine the discussion to those that occur in plants having only 1 Spm element in them. In the first place, the appearance of these plants may be considered. In those isolates of Spm that undergo early occurring transposition during development, the effect of this is made visible in the appearance of the plant itself for they have large sectors in them that exhibit the pale pigmented phenotype that ~~arise~~ is produced when ~~no~~ Spm is ~~present~~ absent. If such a sector extends into that part of a plant that produces an ear, the presence of it may be evident among the kernels on the ear following the test cross conducted with it. If the cells that give rise to the ear are derived only from those within the pale sector, then all of the kernels on the testcross ear will be pale pigmented. If, however, only some of the cells within the pale sector contribute to the ear, then a clearly defined sector will appear on the testcross ear in which all of the kernels will be pale pigmented. Again, if a pale sector extends into the tassel, pollen grains collected from anthers within the sector do not contain Spm in them, ~~and~~ when this pollen is used to make a test cross, all of the a_1^{m-1} kernels on the resulting ear are pale pigmented. ~~for they do not have Spm in them.~~ If pollen ~~is~~ collected from the

the variegated parts of the same tassel is used in making a cross, then both ~~the~~ pale colored and ~~the~~ variegated kernels appear on the testcross ear. Tests of this type were conducted and they gave the types of result just described. Thus, the appearance of uniformly pale pigmented sectors in variegated plants, the number of them that appear in any one plant, and the relative sizes of them, reveal the time of occurrence of transposition of Spm, during development as well as the frequency ~~of occurrence~~ of this at any one time. However, inactivations of Spm in some cells of a plant may produce similar patterns of pale pigmented sectors, ~~in variegated plants~~ but often it is possible to recognize the pale pigmented sectors that arise from inactivation, as will be indicated later.

Early occurring transposition may also be detected by the difference in number of Spm elements, or in the location of an Spm element, in different parts of the same plant, ~~and~~ Detailed evidence of this was given in the discussion of the behavior of Spm in plant 6872A-12, and its progeny, that were examined in several successive generations (see pages 69 and tables 36 to 42). A high frequency of late occurring transpositions of Spm may be detected by several means: the type of variegation in ~~appearance of~~ the plant, the ratio of pale to variegated kernels on its testcross ears, and the number and distribution of Spm in its progeny plants. The plant exhibits a pattern of variegation composed only of small streaks ~~exhibiting~~ anthocyanin pigment in a non-pigmented background with the states 5719A-1 and 5718 of a_1^{m-1} that were extensively used in studies of transposition of Spm. These strains are produced either by mutation to or towards A_1 type action, or by loss of Spm from some cells late in plant development. No large pale pigmented sectors usually appear in them. Also, the number and location of Spm is constant in various parts of a single plant. However, on testcross ears of these plants, the ratio of pale to variegated kernels deviates markedly in favor of the pale class. In the progeny

derived from the variegated class of kernels on such ears, many plant may have either two or more Spm elements in them or one Spm at a new location in the chromosome pomplement in comparison to the location it occuppied in the parent plant.

If the Spm in a plant does not undergo frequent transpositinn early in development of the plant ~~nor~~ during development of the sporogenous or spore cells this also may be detected. The appearance of the plant is similar to that just described. ~~quite uniform~~. With states 5719A-1 and 5718 of a_1^{m-1}, small pigmented streaks produced by mutation to or towards A_1 type action appear in a non-pigmented background. On the testcross ears of these plants, however, the ratio of pale to variegated kernels approaches 1 : 1, the deviation in favor of the pale class being small. Also, in the progeny of these plants, few cases of transposition of Spm are detected. On some tests, ~~In some cases~~, the rate of transposition of Spm in a plant may appear to be ~~is~~ low, when this is judged not only from the appearance of the plant itself but also from the number of cases of transposition of it ~~encoun~~ encountered in progeny ~~plants~~ derived from kernels on the ~~its~~ testcross ear produced by the plant. However, when judged due to by the constitution ~~from function of~~ its pollen grains, the rate of transposition may be much greater, examples of this were ~~and such cases have been~~ found. The difference in the proportion of female gametes that carry a transposed Spm element to male gametes having such, may reflect the delay in time of occurrence

of transposition of Spm that is characteristic of the particular Spm present in the plant. ~~under study~~, the cells in the tassel may arise later in development ~~ing lather~~ than those in the ear.

Progeny test 17, figure 2

Examples of transposition of Spm, previously discussed, and those that will be discussed in the future, should be reviewed keeping in mind the conditions associated with it that have been outlined in the preceeding paragraphs. In continuing examination of transposition of Spm, the progeny of a plant having Spm at another site in chromosome 6 will be discussed. The presence of Spm at this site was first detected from the ratio of kernel types on an ear of a plant (6704B-4, see table 18) carrying state 5996-4 a_1^{m-1} and Sh_2 in one chromosome 3 and a_1 and Sh_2 in its homologue, when an ear of this plant had been used in a cross with the tester plant, 6678, whose constitution is given in table 19. The phenotypes of the kernels on the resulting ear indicated that one Spm was present in the ear-bearing plant and that it was carried in its ~~Y bearing~~ chromosome 6 with Y. This is shown in line 1 of table 45. To investigate further the behavior of this Spm, variegated kernels in the Y class were selected from this ear and sown in the summer of 1955 under culture number 6885. In culture 6885A, 15 plants were derived from kernels that had received state 5996-4 a_1^{m-1} from the female

parent and in 6885B, the plants had received a_1 from the female parent and state 5719A-1 from the male parent. All 24 plants were variegated. Testcross ears were obtained from 22 of these 24 plants. In 21 of them, 1 Spm was present and it was linked with Y in 20 of these plants, as shown in table 45. In one of these 20 plants, plant B-8, there was a marked deficiency in the y bearing class of kernels but the reason for this was not determined. It was obvious, nevertheless, that the Spm in it was carried in the Y bearing chromosome 6. Excepting plant B-8, the ratio of the pale class to the variegated class of kernels on the testcross ears of these plants indicated that the Spm in each did not undergo frequent transposition late in development. In one plant, B-8, the single Spm element in it was not linked with Y. In the remaining plant, B-9, table 45, two Spm elements were present and one of them was linked with Y.

The proportion of the recombinant classes of kernels on the ear of the parent plant 6704B-4 and on that of its Y Spm/y+ progeny, entered in table 45, was much the same, and this amounted to approximately 18 percent of the total number of kernels. It will be recalled that the same relative stability of location of Spm was exhibited by the Spm in plants in culture 6629A that were Y Spm/y + (table 5) and by the majority of their Y Spm/y + progeny (table 29). However, in these plants, Spm occupied a position in chromosome 6 more distantly removed from Y. The recombinant classes amounted to approximately 35 percent. This same stability of location was expressed by Spm when it occupied a position in chromosome 6 ~~quite close to~~ Y, and this was shown in plant 6895A-1 and its progeny (table 43). In contrast to this, in the two cases examined in detail where Spm was located in chromosome 9, Spm underwent many transpositions, and many of these, in turn, occurred early in plant development. That the chromosome in which Spm resides may be an important factor is not only in itself the ~~important~~ factor as controlling Spm behavior is possible but it was shown by a case in the a_2^{m-1} cultures in which it was carried in chromosome 9. This case ~~has been~~ was examined more extensively than any other. This Spm, residing at a site close to Wx, remained ~~quite~~ relatively stable in this location, ~~although~~ transpositions of it do occur, although usually late in development of sporogenous or spore cells. Since this case has contributed much to an ~~understanding~~ appreciation of

inactivation of Spm, discussion of it will be postponed until this subject is considered. At this time, however, another case of insertion of Spm in chromosome 9 will be considered as it serves as an excellent illustration of the high proportion of transposed Spm in the Spm carrying recombinant class of kernels that may be present on a test cross ear. It will be necessary to consider first, the origin of the plant having Spm at this location (plant 6671F-2). Progeny Test 18, figure 2

In the case ~~now~~ to be considered, ~~the~~ Spm was located in the wx carrying chromosome 9 of a Wx/wx plant and at a position that was probably very close to wx. It was present at this location in one plant in the tested ~~xxxxxxxxxx~~ progeny of plant 6629A-5 (table 5). In plant 6629A-5 two Spm elements were present one of which was located in its Y bearing chromosome 6. Tests were conducted with progeny derived from kernels on the ear of the main stalk of this plant and on that of its tiller. These plants were grown in the summer of 1954 under culture numbers 6671 and 6672.

From the ear of the main stalk, the Spm constitution was determined in 20 plants derived from colorless, sh_2 kernels, 14 of them from the Y class (culture 6671F) and 8 of them from the y class (culture 6671G). From the tiller ear, 27 plants derived from colorless, sh_2 kernels were examined for Spm constituion, 14 of them from the Y class (culture 6672E) and 13 of them from the y class (culture 6672F). Among the total of 28 plants derived from the Y kernels on these two ears, no evidence of the presence of Spm was given by ~~the~~ any kernel~~s~~ on the testcross ears produced

by 13 of ~~them~~ these plants. Among the 15 plants having Spm, one Spm was present in ~~more~~ 10 of them, ~~and~~ more than one Spm element was present in each of the other five plants. Spm was linked with Y only in two of the ten plants (6671F-1, 6672E3 table 46), having one Spm. and certainly with wx in ~~two~~ one other~~s~~ (Plant 6671F-2 table 47) and possibly with wx in a fourth (Plant 6672E-4, table 47). In 4 of the remaining 6 plants in which one Spm was present, linkage of it with either Pr or wx could not be determined as all these plants were pr/pr, Wx/Wx in constitution. The other two plants were heterozygous for alleles of these two markers but no linkage of Spm with either of them was expressed. Two Spm elements were present in each of 4 of the 5 plants with more than one Spm element in them. Linkage of one of the Spm elements with Y was expressed in one of these 4 plants (Plant 6672E-1, table 46). In the fifth plant that had more than one Spm element in it, at least 3 and probably 4 Spm elements were present.

Of the 19 tested plants derived from the colorless, sh_2, y class of kernels in cultures 6671 and 6672, the testcross ear produced by two of them showed no evidence of the presence of Spm in any one kernel. The testcross ear produced by the remaining 17 plants showed that each had Spm, one being present in 16 of these plants and two being present in the remaining plant. Linkage of Spm with wx could have been detected only in 6 of these plants. Linkage of it with Pr could have been detected in 10 of them. However, no clear evidence of linkage of Spm with these markers was expressed in any one of these plants in which this could have been detected.

On three of the thirty-three ears produced by the Spm carrying plants in cultures 6671 and 6672 a large sector appeared in which all kernels within it were pale colored. This indicated that in each of the three plants on whose ears these sectors appeared a change had occurred to Spm early in development of the plant. ~~However~~, progeny tests were conducted only with one of the plants in the~~se~~ two cultures, that in which Spm was carried ~~in the~~ wx ~~bearing~~ chromosome 9, ~~and showing 19 per~~cent ~~recombination with it~~ (plant 6671F-2, table 47). Six plants were grown from the Y and Wx class of variegated kernels on the testcross ear of this plant under culture number 6873A and six other plants were grown from the y and Wx class of variegated kernels under culture number 6873B. With respect to Spm and the alleles of Wx, all plants were derived from the Spm carrying recombinant class of kernels on this ear. All 12 plants were variegated.

Eighteen test cross ears were obtained from 9 of the 12 plants in culture 6873. One Spm was present in all tested parts of 7 of these plants and in none of them was it linked with Wx (table 47). In one plant, 2 Spm elements were present in the two tested parts of this plant. Neither of them was linked with Wx (table 47). In the remaining plant, at least 3 Spm elements were

present in each of the three tested parts of this plant (plant 6873B-1, table 47). It may be mentioned also that in none of the four tested plants that were Y/y in consitution was evidence given of linkage of the Spm in them with Y.

In the Spm carrying parent plant of those in culture 6873, Spm was closely linked with wx (Plant 6671F-2, table 47). Of the 169 variegated kernels on its testcross ear, only 29 were in the Wx class. As the described tests conducted with plants derived from 9 of these 29 kernels indicate, ~~in~~ none of these 9 kernels represent cases in which their phenotype appeared ~~arose~~ as the consequence of crossing over between Spm and that of ~~and~~ wx. Transposition of Spm was responsible for their appearance in this recombinant class of kernels. It is suspected, therefore, that Spm in the parent plant, 6671F-2, was located very close to wx and that the majority, if not all, of the recombinant classes could have ~~arose~~ arisen as the consequence of a premeiotic transposition~~s~~ of Spm.

Before tests of the Spm constitution in the progeny of plant 6629B-5 (table 30) are considered, those conducted with the second generation progeny of plant 6629A-2 will be presented ~~considered~~. The first generation progeny of this & the plant was considered in detail in the preceding section of this report. This second generation progeny was derived from those plants in the immediate progeny of plant

[illegible] in which a transposed Spm was present

6629A-2 in which a transposed Spm was present. They represented the few cases in which a transposed Spm element was found to be present in the progeny of plant 6629A-2. This plant was Y Spm/y+ as were most of its Y bearing progeny that carried Spm. However, the single Spm in plants 6665G-12 and 6665G-21 was not linked with Y (table 24). Plant 6665E-10 (table 26) had 2 Spm elements, neither of which was linked with Y in the two tested parts of this plant. The ear of the main stalk of plant 6666C-2 had a ratio of kernel types that suggested that the Spm in it was not as closely linked with Y as it was in the tiller of this plant (table 26). Tests of Spm number and location were made with the progeny of each of these plants, and those conducted with that of plant 6666C-2 will be considered first.

Progeny test 20, figure 2

Nine plants were grown from the variegated Y class of kernels on the ear produced by the main stalk of plant 6666C-2. All of them were variegated. A testcross ear was obtained from each. One Spm was present in 8 of these 9 plants. It was linked with Y in 6 of the 8 plants having one Spm, (table 48), and possibly with Y in another (plant 6869-8, table 48), but it was not linked with Y in one plant (plant 6869-2, table 48). In the one remaining plant, 6869-9, two Spm elements were present, neither of which appeared to be linked with Y (table 48).

The ratio of kernel types on all the ears produced by the six plants having 1 Spm linked with Y was not ~~consistent~~ the same. ~~for all of them~~ This, suggest~~ing~~s that the location of Spm in chromosome 6 might not be the same in each of ~~them~~. However, no ~~progeny~~ test~~s~~ that would establish this was conducted with the progeny any one of them.

Progeny Test 21, figure 2

Eleven plants were grown from the variegated Y class of kernels on the testcross ear produced by plant 6665G-16 (table 24) under culture number 6866. Testcross ears were obtained from 9 of these 11 plants. One Spm was present in the tested parts of 7 of these 9 plants and it was not linked with Y in any one of them. The combined ratios of kernel types on the 8 testcross ears obtained from them are given in table 49. The tested part of one plant (6866-2, table 49) had two Spm elements, neither of which was linked with Y. In the remaining plant ~~of this progeny,~~ (plant 6866-5, table 49) 3 Spm elements were present. These ~~evidence obtained from~~ tests of the progeny of plant 6665G-16 ~~established the presence in it of a transposed Spm that~~ confirmed the conclusion drawn from direct tests of it that the Spm in it was not carried in chromosome 6 close enough to show linkage with it.

Progeny Test 22, figure 2

~~Progeny~~ Tests of the progeny of plant 6665G-21 were conducted with 8 plants grown from the Y class of colorless, sh_2 kernels on the self-pollinated ear of one of its tillers under culture number 6863, and ~~from~~ with 17 of the 20 plants in culture 6867 that were derived from the variegated Y class of kernels on the ear where kernel types are entered in table 24. In culture 6863, ~~the kernel types on the test cross ear produced by~~ the test cross ear produced by one plant that was Y/Y gave no evidence of the presence of Spm in it. ~~the tested part of this~~

Five other plants in this culture had one Spm element. Four of them were Y/y, but in none of these plants was evidence given of linkage of Spm with either of these alleles (table 50). The ratio of kernel types on the test cross ear produced by two other plants, both of which were Y/y, suggested that in each of them an Spm element was carried at the same location in each member of an homologous pair.(plants 6863-3 and 6863-9, table 50).

Of the 17 plants derived from kernels on the testcross ear of this same plant, 6665G-21, 16 had one Spm. Clearly, it was not linked with Y in 15 of the 16 plants (table 50) nor with Pr or Wx, which could be determined at the same time on each ~~the~~ testcross ear, ~~of these plants~~. In one of the 16 plants, however, the single Spm in it probably ~~possibly~~ was carried in the Y bearing chromosome 6, as the ratio of kernel types on its testcross ear suggests (plant 6867-9, table 50). Thus, the tests of the progeny of plant 6665G-21 conform with that which could be expected if the Spm element in it had ~~was~~ not been carried in chromosome 6 at a position that would give evidence of this by expression of ~~of~~ linkage with Y. In the one plant in which Spm appeared to be linked with Y, a successive transposition ~~of it~~ could have returned it to a location in chromosome 6 that would express linkage with Y. Two Spm elements were present in the remaining plant (plant6867-18, table 50) neither of which was linked with Y nor with Pr or Wx.

Progeny test 23, figure 2

The kernel types on each of the two testcross ears of plant 6665E-10 indicated that presence of 2 Spm elements in both tested parts of this plant. Neither Spm was linked with Y (see table 26 for kernel types on each of these two ears). Fifteen plants were grown from the class of vareigated kernels on the ear produced by the main stalk of this plant. One testcross ear was obtained from each of these 15 plants. In one plant, both the appearance of the plant and of the kernels on ~~the~~ testcross ear gave no evidence of the presence of Spm ~~in this plant~~. In 11 plants, one Spm was present and it was not linked with Y (plants in culture 6864, table 51), nor with Pr or Wx. Two plants had 2 Spm elements. In one of them, no evidence was given of linkage of ~~an~~ Spm with Y (plant 6864-7, table 51). In ~~other~~ the other, however, the ratio of kernel types suggests linkage of one Spm with Y ~~was probable~~ (plant 6864-3). table 51 In one plant (6864-12) 2 or ~~more probably~~ 3 Spm elements were present and the ratio of kernel types on this ear suggests that one of them may have been carried in the y bearing chromosome 6. All 14 plants derived from the Y, variegated class of kernels on the testcross ear of the tiller of plant 6665E-10 carried Spm. One Spm was ~~carried~~ present in 12 of them and it was not linked with Y (plants in 6865, table 51) nor with Pr or Wx. Two plant (6865-1 and 6865-12, table 51) had two Spm elements, neither of which was linked with Y nor with Pr or Wx;

Two exceptionsl plants appeared among the 28 in the progeny of plant 6665E-10 that were examined. In each of them, at least 2 Spm elements were present in the tested part of the plant. In one plant, one of these appeared to be located in its Y bearing chromosome 6. In the other, one Spm appeared to be carried in the y bearing chromosome 6. No progeny tests were conducted to establish the location of Spm in either plant. Since only one testcross ear was obtained from each plant, the constitution of Spm in other parts of these two plants is not known. However, an early occurring transposition of Spm may have been responsible for insertion of an Spm element into the y bearing chromosome 6 in plant 6864-12. This chromosome, contributed by the tester stock did not have Spm in it. It ~~is evidently, however,~~ appears from the ratio of kernel types on the testcross ears entered in table 51, that plant 6665E-10 did not carry an active Spm in its Y bearing chromosome 6.

Progeny test 24, figure 2

The ratio of kernel types on each of the three testcross ears produced by plant 6629B-5 is entered in table 8. This plant was y/y, Pr/pr, Wx/wx in constitution. From the ratio of pale to variegated kernels on these ears, it could be suspected that this plant had two Spm elements, both of which resided in one chromosome of the complement. The pollen parent

that had been used in making the cross with the first ear on the main stalk and with the tiller ear had been homozygous for a_1, sh_2, y, Wx, and Pr. That used in making the cross with the second ear on the main stalk had the same constitution except that it was homozygous for pr. Although this ear had only a few kernels on it, the ratio of phenotypes among them suggested that the Spm elements in plant 6629B-5 were carried in its chromosome 5 with pr. ~~was linked with Pr~~. Kernels were selected from each of the three ears of this plant and sown in the summer of 1954 under culture numbers 6683 to 6685, as indicated in table 18. From the second ear on the main stalk, kernels having slightly different phenotypes with respect to a, w-1 expression plants were grown from ~~the pale, Sh_2, Pr~~ including ~~class of kernels and~~ 3 that were ~~grown from the~~ variegated, Sh_2, and Pr, these latter 3 were, therefore, "recombinants" with respect to Pr and Spm. ~~class of kernels in addition to the 16 that were derived from the colorless, sh_2 class of kernels on this ear.~~ Because it had been suspected that Spm was carried in chromosome 5 in the parent plant, many ~~a large number of~~ test crosses were conducted with the plants in cultures 6683 to 6685.

The kernel types on the resulting ears ~~produced by these testcrosses established~~ confirmed the assumption of the presence of two Spm elements in the parent plant, 6629B-5, each of which was located in its chromosome 5 with pr and at positions that allowed linkage to be expressed with this marker. ~~the allelos of Prx pr~~. By reason of the difference in constitution of this marker in ~~of of~~ the male plants used in the cross to each of the 3 ears of plant 6629B-5, all plants derived from kernels on the first ear of the main stalk (plants in culture 6683), and from the ear of the

tiller (plants in culture 6685) carried Pr in one chromosome 5. For the same reason, those derived from the second ear of the main stalk had pr in one chromosome 5. As stated above, plant 6629B-5 was Pr/pr. Therefore, the plants in culture 6683 and 6685 could be either Pr/Pr or Pr/pr, and those in culture 6684 could be either Pr/pr or pr/pr.

Seventeen plants were grown from the variegated, Sh_2 class of kernels, were tested in cultures 6683 and 6685. Sixteen of them were variegated but one that was Pr/Pr was totally pale pigmented and no evidence of Spm was given by the kernels on the testcross ear it produced. Among the 16 plants that were variegated, 4 were Pr/Pr and 12 were Pr/pr. One plant (6683A-2), derived from a uniformly palecolored kernel, was variegated and it was Pr/pr.

On the testcross ears ~~of~~ produced by 13 plants among the 35 in cultures 6683 and 6685 that were derived from colorless, sh_2 kernels, no evidence was given of the presence of Spm in any kernel. Twelve of these 13 plants were Pr/Pr and 1 was Pr/pr. ~~However,~~ An active Spm was present in 20 of these 35 plants. Four of them were Pr/Pr and 16 were Pr/pr. In the 2 remaining plants, each of which was Pr/pr, Spm was present but it was in its inactive state in most of the Spm carrying kernels on the testcross ear ~~of~~ produced by each.

The three plants in culture 6684 that were derived from variegated, Sh_2, Pr kernels on the second ear of the main stalk of plant 6629B-5, were, as expected, Pr/pr. Among the 14 examined plants derived from the colorless, sh_2 kernels on this ear, no evidence of Spm was given by

any kernel on the testcross ear produced by 3 of them, each of which was Pr/pr. The other 11 plants had Spm. Two of these plants were Pr/pr and 9 were pr/pr.

From the distribution of Spm and ~~of~~ the alleles of Pr to the progeny of plant 6629B-5, it is evident that Spm was carried in the chromosome with pr in all three tested parts of this plant. Because the Spm carrying ~~the~~ progeny of plant 6629B-5 could be distributed to 11 distinct classes ~~with~~ according ~~respect~~ to the constitution with regard to alleles of Pr and to Spm, charts were constructed to indicate the class into which each plant, or part of a plant, could be placed. For the plants in cultures 6683 and 6685, this is given in figure 3, and for the plants in culture 6684 this is given in figure 4. In table~~s~~ 52 is entered the kernel types appearing on the testcross ears of the Pr/Pr plants in the first three classes given in figure 3. In table 53 is given the kernel types on the test cross ears of the four classes of plants that were Pr/pr in figure 3. Because of the similarities in ratios of kernel types on each of the ears produced by plants in the first 4 classes given in figure 3, the data from all ears are entered in summary form in tables 52 and 53. The ratio of kernel types on all ears produced by plants in class 6 of figure 3 were not alike. Therefore, the phenotypes of kernels on ears produced by each plant are entered separately in table 53. On most of these ears, the percent of recombinants among the variegated class of kernels was similar, averaging about 25, ~~amounting to approximately 25~~. A marked deviation from this was expressed by the ratio of kernel types appearing on the ear produced by the tiller of plant 6683D-2. In this plant, changes

in Spm were occurring early in development as evidenced by the appearance of a sector on this ear in which all of the kernels were pale pigmented and by the fact that the Spm constitution of the tiller differed from that of the main stalk, The latter ~~which~~ was Pr + +/pr Spm Spm. The Spm in the tiller probably had been transposed to a location close to pr, as will be shown shortly. A marked difference in the percent of recombinants was also expressed on the ear of plant 6683D-3 but on this ear, ~~there was a marked deficiency in~~ the number of kernels having ~~with~~ the pr phenotype was much lower than expected.

The kernel types appearing on the testcross ears produced by the Spm carrying plants in culture 6684 are entered in table 54 according to ~~under~~ the constitution of each as shown ~~headings given~~ in figure 4. A number of testcrosses were conducted with one plant, 6684D-1, which was Pr Spm/pr +. The percent of recombinants among the variegated class of kernels on the ear of this plant, and on ~~from~~ those produced by use of the pollen of its tiller is approximately 34. The pollen derived from the main stalk of this plant had many grains in which Spm was absent, as the ratio of the pale to the variegated class of kernels on testcross ears produced by use of it indicate. Tests of the progeny of plant 6684D-1, derived both from the selfpollinated ear of the tiller and of the pollen of this tiller indicate that the Spm in its Pr chromosome could have ~~probably~~ resulted from crossing over rather than transposition. The percent recombinants appearing on the testcross ears of its Pr Spm/pr+ progeny amounted to approximately 25, as will be shown shortly.

From the above described tests of the progeny of plant 6629B-5,

its constitution would appear to be ^{P}r + +/pr ^{s}pm Spm. Relatively little transposition of the Spm elements in it occurred during development of this plant and during development of its ^{s}pm carrying progeny when this is compared with that which occurred in some of the plants previously discussed. On the ear of the tiller of this plant, a few kernels appeared that exhibited only one to several small dots of the A_1 type pigment in a colorless background instead of the expected pattern of many such spots usually produced by either state 5719A-1 or state 5718 of a_1^{m-1} when Spm is present. A few kernels of this type likewise appeared on ears of some of the plants in its progeny that were derived from fully variegated kernels. Tests conducted with plants derived ffom ~~such~~ kernels with altered variegation patterns showed that the Spm in them was behaving in a different manner. Also, one of the Spm elements in plant 6629B-5 entered the inactive phase in some cells. For this reason, some plants that were derived from the pale class of kernels on the ears of plant 6629B-5 had an Spm element in them. Return to the active phase in some cells of these plants occurred, but only very late in development. It should be stated, however, that usually, plants derived from pale kernels do not have Spm in them. These two types of change in Spm action just mentioned, will be considered subsequently. ~~They are~~ Attention is drawn to them ~~mentioned~~ here because initial investigations of change in action of Spm were conducted with plants in the progeny of plant 6629B-5.

Progeny Test 25, figure 2

The ratio of kernel types on the ear produced by the tiller of plant 6683D-2 suggested that the Spm in it occuppied a position closer to pr than in related plants that were Pr +/pr Spm, table 53. In order to verify this, seven kernels were selected from the variegated, Pr class on the ear of the tiller and sown under culture number 6878 in the summer of 1955. The selected kernels were derived from the recombinant class on the ear. As emphasized earlier, if Spm is located close to a gene marker, the Spm-carrying recombinant class is likely to be composed mainly of individuals having a newly transposed Spm element in them. This proved to be true in this case. In 6 of the 7 tested individuals in this class, the Spm in them certainly had been transposed from a position close to pr to another location in the chromosome complement, as the kernel types on the testcross ears obtained from each indicate, table 55. In one plant, 6878A-1, Spm was carried in its chromosome 5 with Pr. The location of Spm with respect to Pr could not be estimated from the ratio of kernel types on the testcross ears it produced because of the preponderance of the pale class of kernels on each. This indicated, nevertheless, that the Spm in this plant had undergone change in a number of cells late in plant development.

In the 6 plants having Spm at a new location, no linkage of it with Wx was expressed on the testcross ears produced by any one of these plants. Neither was it linked with Y in plants 6878A-3 or 6878A-4 in which this could have been detected. The Spm in plant 6878B-3 underwent early occurring transposition, as indicated by the differences in Spm constitution in the main stalk and in the tiller of this plant.

Because at least 6 of the 7 individuals that were derived from the recombinant class in the progeny of the tiller of plant 6683D-2 had a newly transposed Spm element in it, it is concluded that the Spm in the tiller ~~of plant 6683D-2~~ was located very close to pr.

Progeny Test 26, figure 2

A similar type of test to that just described was conducted with plants derived from the variegated class of recombinant kernels on an ear produced by plant 6685F-3. This plant was Pr +/pr Spm, as the kernel types appearing on three of its testcross ears indicate, table 53. The location of Spm in this plant did not appear to be as close to pr as it was in the tiller of plant 6683D-2, just described. It could be anticipated, then, that a larger proportion of individuals in the recombinant class would represent cases in which crossing over between the site of insertion of Spm in chromosome 5 and the locus of pr was responsible for their appearance in this class rather than cases of transposition of it to a new location in the chromosome complement. This appears to be confirmed from tests conducted with variegated plants derived from the recombinant class on the ear of a tiller of plant 6685F-3. The kernel types that appeared on this ear are shown in line 1 of table 56. Ten variegated kernels were selected from the 21 that were ~~variegated and~~ Pr in phenotype, and sown under culture number 6882 in the summer of 1955. Spm was present in 9 of these 10 plants derived from these kernels but no evidence of its presence was given by one plant. One Spm was present In 8 of the 9 plants having Spm, ~~1 Spm was present~~ and it was linked with Pr in four of these 8 plants, as shown in lines 2 to 5 of table 56.

In the other four plants, Spm was not linked with Pr (lines 6 to 10, table 56) nor with Wx, which also could have been expressed on these ears. In one plant, 6882A-2, at least 4 Spm elements were present (lines 10 and 11, table 56).

The percent of recombinants among the variegated class of kernels is given in round numbers in the last column of table 56. Although difference in this on the different ears is to be expected because of transposition of Spm that certainly occurred in some cells of these plants, deviation from that expressed on the ears of the parent plant is not great enough in any one case to indicate with certainty that the location of Spm in chromosome 5 in any one of them differs from that in the parent plant. Only progeny tests of each would allow this to be determined and these were not conducted. However, the Spm element in at least 5 of the 9 plants derived from the recombinant class on the parent ear had been transposed from a location in chromosome 6 that gives linkage with pr to a new location in the chromosome complement.

Progeny Test 27, figure 2

Among the examined progeny of the tiller of plant 6629B-5 there were 3 Pr/Pr plants in which 1 Spm was present (figure 3 and table 52). Among them was plant 6685G-2. With respect to chromosome 3 constitution, this plant was a_1 m-1 (state 5719A-1) Sh_2/ a_1 sh_2. An ear of this plant

had been used in a cross with a plant that was homozygous for state 5719A-1 a_1^{m-1} and for Sh_2, pr, y, and wx and in which no Spm was present. The kernel types that appeared on this ear are entered in the first line of table 57. Variegated

kernels were selected from this ear and sown under culture number 6875 ~~during~~ in the summer of 1955. The 20 plants derived from them were examined for the Spm constitution in each. The pollen used in making the testcross with each was obtained from plants th t were homozygous for state 5718 a_1^{m-1}, and for Sh_2, pr, y, and wx, and in which no Spm was present. The test had been devised for reasons other than to determine if Spm was located in chromosome 5 and for the desired purpose~~s~~, use of pollen from the described tester stock was most suitable. Nevertheless, from these tests it was learned~~, however,~~ that the Spm in plant 6685G-2 was located in chromosome 5. With regard to a_1^{m-1} constitutions the plants in culture 6875 were of two types: homozygous for state 5719A-1 a_1^{m-1} and heterozygous for this state, with the standard a_1 being carried in ~~the homologous~~ one of its chromosome~~s~~ 3. The Pr and pr phenotypes among the pale class of kernels on ears of plants that ~~were~~ are homozygous for state 5719A-1 ~~could~~ may be distinguished readily. However, on the ears produced by the heterozygous plants, only half of the kernels would have state 5719A-1 a_1^{m-1} in them. The other half would receive a_1 from the female parent and state 5718 a_1^{m-1} from the male parent. Kernels having state 5718 a_1^{m-1} and no Spm are only very faintly pigmented. Distinction between those that are purple (Pr) and those that are red (pr) is made only with considerable

effort and this was not attempted in classifying the kernel types on ears produced by plants in culture 6875 that were a_1^{m-1}/a_1 in constitution. For this reason, all kernels in the pale classes on the testcross ears of plants of this constitution are entered in table 57 under the heading "Pale", no distinctions being made between those that were Pr and those that were pr.

Spm in its active state was present in 17 of the 20 tested plants in culture 6875. In three plants, however, although Spm was present, it was totally inactive in most parts of each plant and in most of the kernels having it on the ear each plant produced. One Spm was present in all tested parts of 15 of the 17 plants having an active Spm and it was carried in the chromosome 5 with Pr in 14 of them, as the kernel types on the ears each produced indicate, table 57. The single Spm in one plant was not linked with Pr (Plant B-8, table 57). In two plants, 2 Spm elements were present, one of which was linked with Pr, Plant B-9, and ear on main stalk of plant B-7. However, the tiller of plant 6875B-7 had only 1 Spm and it was linked with Pr.

In this progeny test, no selection of kernel types was made for the purpose of determining the ~~any~~ location or the constitution of Spm in the plants. From the fact that the large proportion of ~~progeny~~ plants in this progeny carried Spm in chromosome 5 and at a location that gave ~~clear~~

clear evidence of linkage of it with Pr, it may be concluded that the Spm in this parent plant did not undergo frequent transposition during development.

Progeny Test 28, figure 2

Tests of the three plants in culture 6684 that were derived from the recombinant class of variegated kernels on the second ear of the main stalk of plant 6629B-5 showed that plant 6684D-1 was Pr Spm/pr + in constitution (figure 4 and table 54). A number of testcrosses were conducted with this plant, including use of its pollen for this purpose. Pollen from its tiller had been placed on the silks of plants that were homozygous for state 5719A-1 a_1^{m-1} and for pr and in which no Spm was present, and also on the silks of ears of some plants that were homozygous for a_1 and for pr and in which no Spm was present. Variegated kernels in the Pr class were selected from an ear produced by the former type of cross and grown under culture number 6880, and selection of kernels of a similar type from an ear produced by the latter cross were sown under culture number 6881. Among the 11 plants in culture 6880, 10 were variegated but one plant was uniformly pale pigmented and no evidence of the presence of Spm in it was given by kernels on its testcross ear. All 10 plants in culture 6881 were variegated. An ear of each plant

was used in a cross with a plant homozygous for state 5719A-1 a_1^{m-1} and for Sh_2, pr, y and wx and in which no Spm was present. The phenotype in each kernel on the ears of these plants in culture 6880 was readily classifiable. However, difficulty was encountered in separating some of the kernels that were pr from those that were Pr in the pale class on the ears of some of the plants in culture 6881. This was because of a previously undetected mutant locus that was segregating in the a_1/a_1 plants used in making the cross with plant 6684D-1. When present, this mutant alters the pigment produced in the pale class of kernels that are homozygous for pr from a light pink to a lavendar shade that is sometimes quite intense. This mutant does not alter the phenotypic expression of A_1. The A_1 dots in the variegated kernels that are homozygous for pr are deep red when this mutant is present. Therefore, in considering the phenotypes of kernels on the testcross ears of plant in culture 6881, given in table 58, all of those in the pale class are combined under the heading "Pale".

Of the 20 plants in cultures 6880 and 6881 that had Spm, one Spm element was present in 19 of them and its was carried in the chromosome 5 having Pr in 17 of these 19 plants, as shown in table 58. In one plant 3 Spm elements were present (plant 6881-5, table 58). In the last

column of table 58 is given the percent of kernels among those that were variegated that were in the recombinant class ~~for~~ on ears of the 17 plants in which Spm was linked with Pr. Although a considerable amount of variation in this was expressed on different ears, the average percent ~~xxxxxxxxxx~~ is greater than that expressed in the progeny of plant 6685G-2 (table 57), suggesting that the location of Spm in chromosome 5 in plant 6684D-1 was not the same as that in plant 6685G-2.

In the progeny derived from use of the pollen of the tiller of plant 6684D-1 there were 3 plants in which transposition of Spm had occurred. In two of them, 1 Spm was present and it was not linked with Pr in either plant. In the third plant, at least 3 Spm elements were present. The appearance of plant with more than 2 Spm elements in them in the progeny of plants having only 1 Spm has been met with on a number of occasions, and examples of this were noted in the progeny tests entered in tables 42, 45, 47, 49 and 56.

Tests of the progeny of plant 6684D-1 were also conducted with plants derived from the variegated Pr class of kernels ~~that appeared~~ on the ear~~s~~ of the tiller. ~~xxxxxxxx~~ This ear was produced by self-pollination. The phenotypes of the kernels that appeared on this ear are entered in the first line of table 59. Of the 16 plants in the progeny derived

derived from this ear, 15 carried Spm in them but in one plant, no evidence was given of the presence in it of Spm. Eleven of the 15 plants having Spm were Pr/pr. In 9 of these 11 plants, one Spm was present and it was carried in the chromosome with Pr/5 in of them (plants under heading Pr Spm/pr + in table 59). It was present in the chromosome with pr in the other two plants (plants under heading Pr+/pr Spm table 59), but in the remaining two plants, no evidence was given of its being carried in chromosome 5. The two other plants that were Pr/pr (plants 6879-11 and 6879-19) may have had an Spm element in each chromosome 5. Of the four plants that were Pr/Pr, two had 1 Spm element (plants 6879-6 and 6879-12, table 59) and the two others may have had an Spm element in each chromosome 5 (plants 6879-1 and 6879-14, table 59) although the ratio of kernel types appearing on the ear of plant 6879-14 suggests that it had two Spm elements that were not at allelic positions in an homologous pair of chromosomes.

The percent of recombinants among the variegated class of kernels on ears of plants in which Spm was carried in chromosome 5 is given in round numbers in the last column of table 59. The average of this is similar to that given by plant 6684D-1 (table 54) and is higher than that expressed by the progeny of this plant entered in table 58.

Conclusions regarding transposition of Spm in the a_1^{m-1} cultures.

The progeny tests described both in this section and in the last section provide some information regarding stability of location of Spm. It is clear from that that the time of occurrence of transposition of Spm during development, and the frequency of this at any one time, is controlled in some manner. Change in this undergone by an Spm element appeared to be associated with transposition, its behavior in the former location and in the new location often being decidedly different. The altered control of its behavior may be an expression of some modification occurring to Spm during the transposition process, or it may reflect participation in this of the particular locus in the chromosome complement at which Spm is inserted. Up to now, no evidence is available from study of Spm favoring one or the other of these interpretations. As mentioned earlier, evidence favoring the second interpretation was obtained from study of transposition of Ds. Evidence of altered behavior of Spm, following transposition of it, was given by several of the described tests. It was shown that following some transpositions, the relative frequency of occurrence of subsequent transposition of Spm, and the time of this during development, could be strikingly different from that which it expressed at its former location. Cases were cited in which it had been

relatively stable when present at one location but became quite unstable after it had been inserted at a new location. Cases in which the reverse of this occurred, also were cited.

It was shown that when Spm resided at a particular site in chromosome 6 in those plants in culture 6629A and in thier progeny which gave approximately 35 percent recombinants with Y (table 29), it remained relatively stable in this location, the frequency of appearance of progeny plants in which Spm occuppied a new location being low. Nevertheless, transposition of it from this location to a new location was observed and several cases of this were subsequently analyzed (Progeny Tests 20 to 23, figure 2). Among them was one bazaar case involving the Behavior of Spm in plant 6666C-7 and its progeny (Progeny Tests 14 to 16, figure 2). In this plant, transposition of Spm occurred at a very high rate. From the type of sterility that was expressed by each of the two testcross ears obtained from this plant, it is suspected that insertion of Spm at some locations in the chromosome complement may result in change in gene action at the site of insertion, and this may cause either lethality for the cell having it at one such site, or it may cause some modification of gene action that alters the capacity of the cell to function normally.

In those cases where its insertion at a new location did not produce such deleterious effects, viable kernels in which Spm occupied a new location were produced. The location and behavior of Spm in the plants derived from each could be analyzed. This was done for five kernels on one of the ears of plant 6666C-7. In the plants derived from each of them Spm occuppied a different location. One transposition had inserted Spm close to Y in chromosome 6 and from this location few subsequent transpositions occurred (Progeny Test 15, figure 2). In contrast, an insertion of it into chromosome 9 resulted in a high frequency of subsequent transpositions, and these occurred both during early and late development of those plants that had it at this location in their zygote nuclei (Progeny Test 16, figure 2). In contrast to this, another case of insertion of Spm into chromosome 9 was followed by subsequent transpositions of it that were confined mainly to the early stages of plant development (Progeny Tests 6 to 13, figure 2).

The mode of examining transposition of Spm did not allow detection of those cases that placed it at a new location in the same chromosome in which it had been residing, when this new location was close to that which it formerly occuppied. Therefore, accurate estimates of rates of transposition of Spm could not be made. Estimates of this may be

formulated only from those detected cases that placed Spm in a new location, either in another chromosome of the complement or at a location in the same chromosome sufficiently distant from its former location to markedly alter the frequency of appearance of recombinants with the gene marker in the chromosome that was used for determining its presence in this chromosome. Even though it is realized that transposition of a controlling element frequently places it at a new location that is not far removed from its former location in the same chromosome, and that in this study estimates of the frequency of occurrence of this could not be made, it was apparent, nevertheless, that differences in rates and times of occurrence of transposition of Spm could be expressed to a striking degree, when measured only by those cases of it that were readily detectible.

The test methods used in this study allowed detection of the location of Spm if it had been inserted into chromosomes 3, 5, 6, or 9, and if it resided close enough to an allele of the markers Sh_2, Pr, Y, or Wx to give evidence of linkage of it with any one of them. Cases of its insertion at different locations in chromosomes 5, 6, and 9 were discussed in this section along with the characteristic behavior of Spm at each location in one of these chromosomes. It is probably only a

coincidence that the examined cases of insertion of Spm at different locations in chromosome 6 were followed by a considerable degree of stability of Spm at each of these locations whereas, in contrast, the examined cases of insertion of it in chromosome 9 were followed by high rates of subsequent transposition. It was also noted that in sequential transpositions of Spm no evidence of preferance of one location over another was exhibited. In other words, if Spm were transposed from a known location to a new location, subsequent transposition of it did not tend to return it to the location it formerly occuppied.

Linkage of Spm with a given gene marker, carried either in chromosome 5, 6, or 9, was examined in a number of plants. In some of the tables in this section is entered the percent of the recombinant classes or the percent of one of them. It is obvious from those given in the tables accompanying the descriptions of Progeny Tests 5, 6, 24, and 26, that such percents do not serve as a measure of crossing over between the site of insertion of Spm in the chromosome and the locus of the gene marker. If the rate of late

occurring transposition is high, then many individuals within the recombinant class carry in them a newly transposed Spm element, as discussed earlier (page). Also, the closer is Spm to the marker, the less reliance may be placed on the given percent of recombination in estimating the location of Spm with reference to the marker. Only by means of progeny tests can an accurate estimate of this be made.

In this study, a number of cases were mentioned in which plants having two or more Spm elements appeared in the progeny of ones in which only one Spm was present. An explanation of the probable origin of cells having two Spm elements in them from ones in which only one was present, and the relation of this to cells having no Spm, was discussed earlier (page000). It might be suspected that cells having more than 2 Spm elements in them could arise from successive transpositions of Spm in the progeny of cells in which two were present. This may be the sequence of events that is responsible for the appearance of some cells having more than 2 Spm elements in them but possibly this explanation may not apply to all of them. Cases of similar type were examined by Brink with the controlling element Mp (= Ac) in which he could not relate all of this type to sucdessive transpositions of Mp. For study of transposition, Ac is much more favorable than Spm because change in dose of it leads to readily recognizable

change in phenotypic expression, each dose being correlated with a particular type of change in expression of the gene whose mutation pattern it controls. The dose of Spm is difficult to determine on the basis of phenotypic pattern produced by a_1^{m-1}. A change in this has no effect on the pattern of mutation but it does have an effect on the frequency of appearance of the pale pigmented areas, either in plant or kernel, that arise from loss or inactivation of Spm. The higher the dose of Spm, the less frequent will cells be formed in which Spm is either absent or inactive.

From the discussions given in this and the previous section, it is evident that the number of Spm elements that will appear in individuals of the progeny of one having a known number of them will depend upon the behavior of the particular Spm elements that are present in the parent. Nevertheless, a summary of the relation between the <u>number</u> of Spm elements in a palnt and that in its progeny may be of some interest and, therefore, table 60 was prepared to illustrate this. In its preparation, the Spm number in the part of the plant that produced the first ear on the main stalk was used. Included in the table are the progeny tests that were conduced during the summers of 1952 to 1955. In this table, no consideration is given to the number of plants in which a newly transposed

Spm element was known to be present. The table merely gives the number of Spm elements that were present in the part of the plant that produced the first ear on the main stalk. Tables 61 and 62 illustrate the agreement with and the differences in the number of Spm elements that were present in different parts of the same plant. In these tables, also, no consideration is given to known differences in location of Spm in different parts of one plant. Only Spm number is considered.

In the studies so far reported, no case was detected of complete stability of location of Spm, thatis, in which Spm remained at one location. ~~Only one case has been found in which no evidence has been given so far of its transposition from a known location in chromosome 5 to a new location in the chro osome complement, and it is a case in which the state of Spm different from that which was present in all plants so far considered.~~ This ~~state of Spm, symbolized~~ Spm-w because of its weakened capacity ~~to suppress gene action at~~ a_1^{m-1} ~~and~~ a_2^{m-1} ~~and to induce mutation~~ to or towards A_1 or A_2, will be considered in the ~~next part of this report.~~

PART IV

Change in Mode of Action of Spm

1. Spm with reduced action capacity: Spm-w

On some of the ears produced by plants in culture 6629, grown in the summer of 1953, a few kernels appeared that had only one or several dots of A_1 type pigment in a non-pigmented background instead of the many spots of this pigment type that were exhibited by most of the variegated kernels on the ears of these plants (see photo -). Kernels of the former type were selected from 8 of the ears (see table 18). Each of the 37 plants derived from them was pale pigmented instead of being variegated for A1 streaks in a non-pigmented background as if no Spm were present in any one of them. On the testcross ears produced by the majority of these plants, only pale pigmented kernels appeared. On the ears of several of them, however, were many kernels ~~appeared~~ showing the same phenotype as that given by the kernel from which the plant arose (see photo). One of them was plant 6683B-2, which was a_1^{m-1} (state 5719A-1) Sh_2/a_1 sh_2, Pr/Pr, y/y, Wx/wx in constitution. An ear of this plant had been used in a cross with a tester plant that was Y/y and was homozygous for state 5719A-1 a_1^{m-1}, and for Sh_2, pr and wx and it had no Spm. This same tester plant had been used in making many crosses during the summer of 1954 and it was known that the a_1^{m-1} in it would respond to Spm by giving the pattern of pigmentes spots shown in photo . On the ear produced by plant 6683B-2, there were both pale colored and variegated kernels but in the variegated class, the number of pigmented spots

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was very low, the majority of kernels having only 1 or 2 such spots. Also, as stated above, plant 6683B-2 was pale pigmented instead of being variegated, as would be expected if Spm were present. The kernels on the testcross ear of plant 6683B-2 were of three types; 169 were uniformly pale pigmented, 118 were colorless except for 1 or several dots of the A_1 type pigment, and 51 were totally colorless. If the last two classes are combined, there is a 1 to 1 ratio of pale colored kernels to those that are colorless, or nearly so. This ratio suggested that in this plants some factor resembling Spm in its action was segregating. It suppressed gene action at a_1^{m-1} in the kernel but not in the plant, and it was much less effective in inducing mutation to or towards A_1 in the kernel. Some of the kernels that had 1 or several small A_1 dots in a colorless background were sown in the summer of 1955 under culture number 6888. Tests conducted with the plants derived from them indicated that the factor responsible for the altered phenotypic expression of a_1^{m-1} had been carried in one of the chromosomes 5 of the parent plant, 6683B-2. It resembled an Spm whose capacity for action had been much weakened and for this reason it was given the symbol Spm-w. Study of this Spm-w extended through 5 generations of plants and these included examination of the effects it produced on four different states of ~~both~~ a_1^{m-1}.

Before these investigations are reported, several other cases will be reviewed briefly in which a modified type of Spm action was detected in the progeny of individual plants in which a fully active Spm was known to be present.

As mentioned above, only a few of the plants derived from kernels having the described modified type of variegation pattern that were grown in the summer of 1954 gave evidence of the presence in them of Spm, either by their appearance or from the phenotypes of the kernels on their testcross ears they produced. At that time, the reason for this was not understood. It was only sometime later that it was learned that one of the types of change in Spm, responsible for the appearance of some of the kernels with only a few A_1 dots in them, may be inactivation of Spm. In plants having a fully active Spm, change from the active to the inactive phase may take place in some cells, and when this is occurring in a kernel, the altered activity may be noted by an altered pattern of variegation within the aleurone layer of the kernel. In plants derived from such kernels, Spm may remain in its inactive phase throught development of the plant. The nature of this type of change in Spm will be described in the section of this report dealing with inactivation of Spm. Change of Spm from fully active to partially active likewise occurs in some cells and the differences in grade of this

may be distinguished. It is these latter changes in Spm that this ~~were not thoroughly appreciated, but progeny tests soon revealed the~~ section will consider.

~~distinctions~~.

On some testcross ears produced by ~~some of the~~ fully variegated plants grown in the summer of 1954, kernels having the above mentioned types of change in Spm were noted. Often, only one to several kernels on an ear exhibited an altered pattern of variegation. On a few ears, however, a large number of them appeared, and this was true of the testcross ear produced by plant 6665E-9 which was a_1^{m-1}(state 5919A-1) Sh_2/a_1 sh_2, Y/y in constitution (see table 18 for origin of plant). Pollen from a plant of the tester stock that was homozygous for a_1, sh_2, pr, and y had been used in making the cross to plant 6665E-9. Among the 169 Sh_2 kernels on the resulting ear, 1 was totally A_1 in phenotype, 38 were uniformly pale pigmented, 84 were fully variegated in that there were many A_1 spots in a colorless background, 40 were colorless except for one or several A_1 dots, and 7 were totally colorless. If the pale colored class and the two latter classes are combined, the ratio of kernels types on this ear suggested that a fully active Spm might be carried in the Y bearing chromosome 6 of plant 6665E-9 because among the pale colored kernels and those with the modified phenotype, 30 were Y and 56 were y, and among the fully variegated class of kernels 45 were Y and 38 were y. In the former group, about one half of the kernels exhibited the modified

phenotype, being colorless or colorless with one or several A_1 dots. This suggested that some factor was present in plant 6665E-9 ~~whose presence~~ was responsible for modification of a_1^{m-1} expression, ~~that~~ it ~~was~~ segregat~~ing~~ed independently of Spm but could be recognized readily only when Spm was absent. It was decided, therefore, to examine plants derived from some of the colorless kernels that had only a few A_1 dots in them and these were grown in the summer of 1955 under culture number 6886. ~~W~~ Spm-w was found to be present in ~~them, and again, it was located in chromosome 5~~.

On the testcross ear produced by plant 6662E-16, that was a_1 sh_2/ a_1 sh_2, Y/y in constitution (see table 18 for origin of this plant), some variegated kernels appeared that exhibited a much reduced number of A_1 dots in a colorless background in addition to ~~fully~~ variegated kernels. The pollen parent that was used in making the cross to plant 6662E-16 was homozygous for state 5718 a_1^{m-1}, for Sh_2, pr, y and wx and it had no Spm. The expected behavior in the presence of Spm of the a_1^{m-1} in this tester plant had been fully attested as it had been used in making many testcrosses to plants having Spm in them. On the ear produced by plant 6662E-16 there were 76 pale colored kernels, 26 of which were ~~Y~~ and 50 were y. In addition, there were 289 variegated kernels, 117 of which

were Y and 112 were y. However, the pattern of variegation among them was not the same. Some were fully variegated but others had a much reduced number of A_1 spots. Nineteen plants ~~were~~ grown from the fully variegated kernels on this ear (under culture number 6870 in the summer of 1955) ~~and each~~ were tested for the presence or absence of Spm-w in them in addition to ~~the fully active~~ Spm's. From these tests ~~conducted with these plants~~ it was learned that ~~a fully active~~ Spm's ~~had been present~~ was located in the Y bearing chromosome 6 in plant 6662E-16 but in addition, an Spm-w element also was present and not linked with it. It appeared in 8 of the 19 ~~It was present in half of the~~ plants derived from the fully variegated kernels on the ear of plant 6662E-16.

The Spm-w in plant 6683B-2

Discussion of Spm-w will commence with the plants in culture 6888, derived from kernels on the testcross ear of plant 6683B-2. As given above, this plant was a_1^{m-1} (state 5919A-1) Sh_2/a_1 sh_2, Pr/Pr, y/y, Wx/wx in constitution and the pollen parent used in making the cross with this plant had been homozygous for state 5719A-1 a_1^{m-1} and for Sh_2, pr, y and wx and it had no Spm (see Table 19). As reported, half of the kernels on this ear were uniformly pale pigmented and half were either colorless or had one to several dots of A_1 in a colorless background. Eight plants were grown from the uniformly pale class of kernels on this ear. Each was uniformly pale pigmented and ~~an~~ ears of ~~each~~ these plants ~~was~~ were used in a cross with a plant that was homozygous for a_1, sh_2, and y and in which one ~~fully~~

~~active~~ Spm was present. This was ~~done in examinex~~ conducted order to ~~learn~~ verify ~~whether or not~~ the capacity of the a_1^{m-1} in each plant ~~would~~ to react ~~normally~~ in the expected manner to Spm.

Ears were obtained from 7 of the 8 plants and the kernel types on these ears are entered in table 63. Half of the a_1^{m-1} carrying kernels on each ear were pale colored and half were variegated, giving the pattern of this expected when a fully active Spm element is present. (Spm-s) Only two variegated kernels on these 7 ears had a reduced number of A_1 dots in them. The kernel types on these ears contrasted greatly with the types that appear~~ing~~ed on the ears of plants in culture 6888 that had been derived from colorless kernels in which only 1 or several A_1 dots were present when the same pollen parents were used in making crosses to them. The kernel types on ~~these~~ ears of these plants are given in table 64. Half of the a_1^{m-1} carrying kernels on ~~these~~ ears were fully variegated but among the remaining half, half of these, in turn, were ~~fully~~ uniformly pale pigmented and half were either totally colorless or were colorless with 1 or several A_1 dots in them. Segregation of the alleles, ~~of~~ Pr and pr, to the uniformly pale kernels and to the colorless kernels with 1 or several A_1 dots left little doubt that the factor responsible for the appearance of the colorless or nearly colorless kernels was ~~carried in the~~ linked with the Pr chromosome 5 ~~in these plants, and it was the chromosome~~ that had been received from the parent plant, 6683B-2

The plants in culture 6888 ~~that gave on their~~ ears the kernels types entered in table 64 were pale pigmented but ~~they~~ ~~did not develop~~ pigment as rapidly ~~as~~ the plants that gave the kernel types entered in table 63. ~~The pigment developed much more slowly in them.~~ In some ~~plants,~~ the intensity of ~~this~~ was not uniform. ~~Sectors~~ Well defined areas appeared in which the intensity of this was much reduced or occasianally incre sed.

In addition to the crosses entered in tables 63 and 64, an ear was obtained from one plant in culture 6888 that had been derived from a ~~near~~ colorless kernel with 1 or several A_1 dots ~~as the result of a cross with a plant~~ by using pollen from a plant that was homozygous for a_1^{m-1} (state 5718), and for Sh_2, pr, y, and wx and ~~it~~ that had had no Spm. On this ear there were 468 kernels; 253 were uniformly pale colored of which 70 were Pr and 183 were pr, 143 were colorless with 1 or several A_1 dots and 112 of these were Pr and 34 were pr, and in addition there were 69 totally colorless kernels. Again, it was clear that the ~~weakened~~ Spm (linked with modification) in this plant was carried in the chromosome 5 that had been received from the parent plant 6683B-2. Ten plants were grown from the uniformly pale colored Pr kernels and ten other plants were grown from the colorless kernels with ~~D~~ one or several dots of A_1 that were Pr in phenotype, under culture numbers 7264A and 7264B in the summer of 1956. All ten plants derived from the uniformly pale colored kernels were themselves, uniformly

pale pigmented. Those derived from the colorless kernels with few A_1 dots in them also were pale pigmented but ~~the xxxxxxf appearance of this pigment was much retarddd as thxxpigmentx~~ the pigment developed very slowly in them. Also, ~~some variation in~~ the intensity of this ~~appeared within~~ was not always uniform in some of these plants, ~~and in~~ this being distinct ~~sectors~~ regions within the plant (in which the intensity was reduced). All plants in culture 7264 were crossed by plants that were homozygous for either state 5719A-1 a_1^{m-1} or state 5718 a_1^{m-1}, and for Sh_2, y, pr, and wx and that had no Spm in them. On ears produced by all plants in A of culture 7264, only uniformly pale pigmented kernels appeared. On all ears produced by plants in B of this culture, pale colored kernels, colorless kernels, and colorless kernels with one or several A_1 dots appeared. Linkage of the latter phenotypes with Pr and the ~~former~~ pale phenotyp with pr was clearly evident on all ears. The phenotypes of kernels on ears of 9 plants in culture 7264B are entered in line 4 of table 65. In one plant, 7264B-6, Spm-w was present and carried in the chromosome 5 with Pr but it was almost completely inactive in many kernels on this ear. The kernel types on this ear are entered in the last line of table 65. ~~The kernels~~ Vars placed in the "inactive " ~~Spm-w~~ class were lightly pigmented and the distribution of this was uneven, giving a mottled appearance to the aleurone layer. This is ~~the~~ a typical appearance of the aleurone layer (in the [illegible]) ~~of the~~ Spm ~~in a~~

is very weakly active.

Continued examination of the Spm-w, originally present in plant 6683B-2, included tests of its presence or absence in plants having a number of different constitutions. In order to facilitate presentation of the evidence obtained from these tests, several charts were constructed, figures 5 to 7. Figure 5 illustrates the origin of the plants in culture 6888 each derived from a kernel on the ear of plant 6683B-2, and the constitution of the pollen parent used in making a cross to each. From the ear of plant 6888D-2 (see 2, under Progeny Grown in Summer of 1955) kernels were selected and plants grown from then given culture number 7264 (see 3, under Progeny Grown in Summer of 1956). The appearance of these plants and the tests conducted with them were described above. Kernels were also selected from both the first and the second ear on the main stalk of plant 6888C-3 (see under 1 of Progeny Grown in Summer of 1955) and the plants grown from them were given culture numbers 7262 and 7263. The phenotypes of the kernels selected from each of these two ears are given in figure 5 under 1 and 2 of Progeny Grown in Summer of 1956.

All plants in cultures 7262 to 7264 were crossed by plants that were ~~either~~ homozygous for ~~either state 5718 or state 5719A-1~~ a_1^{m-1} and for Sh_2, pr, y and wx and they had no Spm in them. Plants homozygous for state 5719A-1 a_1^{m-1} were used for most of the crosses but for a few others, plants homozygous for 5718 were used for this purpose. On the ears produced by plants in culture 7262A and 7264A, no variegated kernels of any type

appeared. All were uniformly pale pigmented. Variegated kernels appeared on the testcross ears of all other plants in these three cultures. Each plant in cultures 7262C and D, in 7263C and D and in 7264B carried Spm-w but not Spm-s, and figure 6 was prepared to show the constitution of these plants with respect to ~~the~~ ~~xxxxxxxxx~~ and the alleles of Pr, ~~and the~~ location of Spm-w. The kernel types that appeared on the two ears of these plants are entered in table 65 according to the constitution given in figure 6. It may be seen that Spmw was carried in chromosome 5 in 22 of the 24 plants that were Pr/pr but in two plants, no evidence was given of linkage of it with this marker in chromosome 5.

The kernels that gave rise to the plants ~~having Spm-s in them~~ ~~(these~~ in B of culture 7262 and in A and B of culture 7263 had Spm-s in them. ~~could not be~~ Selected for the presence or absence of Spm-w ~~in them nor~~ or for the number or location of the Spm-s elements in ears could not be made. In this respect, the plants derived from these kernels ~~they~~ proved to be quite heterogenous. Altogether there were 11 different recognizable constitution among the 21 tested plants, and these are given in figure 7. In 12 plants, no Spm-w was present but It was present in the remaining 9 plants and it was carried in chromosome 5 in each. The male parent of these plants had 1 Spm-s element in it, and it was located in one of its two y bearing chromosomes 6. Thirteen of the 21 plants in figure 7 were Y/y.

In 11 of them, one Spm-s was present and it was linked with y in 10 of these 11 plants. Two Spm-s elements were present in one plant (7263A-3, figure 7)one of which was carried in the y bearing chromosome 6. In the remaining plant that was Y/y (plant 7262B-2), three Spm-s elements were present, one of which was carried in its y bearing chromosome 6.

The types of kernels appearing on the ears of plants entered in figure 7 under the heading "No Spm-w" are given in table 66. They reveal the number of Spm-s elements present in each plant and the location of them with respect to the alleles of Y. In those plants that had an Spm-s element not linked with Y, no evidence was given of its linkage with either Pr in chr mosome 5 or with Wx in chromosome 9. Also, on these ears, only one kernel was present that had a much reduced number of A_1 spots in its aleurone layer. The kernel types on the ears of plants entered in 1 and 2 under the heading "Spm-w present" in figure 7 are shown in table 67, and those entered in 3 and 4 under this heading are given in table 68. From the data ~~given~~ in each of these two tables, it is evident that Spm-s and Spm-w segregated independently of one another, and that in the majority of the Y/y plants, Spm-s was carried in chromosome 6, ~~and~~ Spm-w was carried in the chromosome 5 originally derived from the grandparent plant, 6683B-2. It also was clear that Spm-s is epistatic to Spm-w, all kernels

with Spm-s having many A_1 dots ~~in them~~ regardless of whether or not Spm-w is also present in them.

Response of state 5700A a_1^{m-1} to Spm-w

The following year, 1957, plants were grown from some of the kernels having Spm-w but no Spm-s in order to introduce Spm-w into plants having a state of a_1^{m-1} other than 5718 or 5719A-1. With either of these two st tes, the number of mutations to or towards A_1 is very much reduced when Spm-w is present, there being ~~XXXX~~ only 1/small or several A_1 dots in some kernels or none in others ~~apper~~. It was desired, therefore, to determine to what degree Spm-w wo ld reduce mutation frequency with a state that gives a large number of mutant spots when Spm-s is present. For this test, state 5700A state 5996-4 ~~was~~ selected ~~(see photo. 90)~~. State 5700A produced very many mutant areas both in plant and kernel with Spm-s and a number of mutations occur early in development of both plant and kernel. (see photo 90)

To obtain plants having state 5700A and no Spm in them, pale colored kernels were selected from the self-pollinated ear of plant 6702-2 which was a_1^{m-1}(state 5700A) Sh_2/a_1 sh_2, Pr/pr and it had no Spm in it (see table 18 and 23), and from the pale Sh_2 class of kernels on each of two ears produced by the cross of plant 6702-2 to plants that were homozygous for a_1 and sh_2 and in which no Spm was present. The plants having Spm-w,

grown in the summer of 1957, were derived from Spm-w carrying kernels on the ears of two plants, 7262C-2 and 7262D-4, entered in figure 6 and table 65. Each was Pr Spm-w/pr + and a_1^{m-1} (state 5719A-1) Sh_2/a_1 sh2 in constitution, and the ear of each was produced by a cross with a plant that was homozygous for state 5719A-1 a_1^{m-1} and for Sh_2, y, pr, and wx and in which no Spm was present. Plants were grown from kernels on each ear that had purple spots (Pr/pr) or red spots (pr/pr) in them. Tests were conducted with each plant that was used in a cross with a plant carrying state 5700A a_1^{m-1} in order to determine its constitution. For this purpose, pollen from plants homozygous for state 5719A-1 a_1^{m-1} and for sh_2, pr, y and wx and in which no Spm was present was placed on the silks of these plants. The kernel types on the resulting ears produced by 4 plants that were homozygous for state 5719A-1 a_1^{m-1} and Sh_2 and were Pr Spm-w/pr + are given in table 69. Spm-w was carried in the chromosome 5 with Pr in each of these plants.

Examination of kernel types appearing on the ears produced by intercrosses between plants carrying Spm-w and those having state 5700A indicated that state 5700A a_1^{m-1} responded to Spm-w by producing many fewer mutant spots than it does with Spm-s (see photos 00 and 00). Also, the time of occurrence of mutation was much delayed. Most of the A_1

spots in the kernels having state 5700A were small and this contrasted with the many spots of large size that appear when Spm-s is present. The number of pigmented spots was much greater, however, than that which appeared in kernels having either state 5718 or state 5719A-1 when Spm-w is present.

For further study of the effect of Spm-w on state 5700A a_1^{m-1}, kernels were selected from ears produced by plants that were homozygous for state 5700A in which no Spm was present when crossed by plants that were homozygous for state 5719A-1 and having Spm-w in them. All kernels on these ears had both state 5700A and state 5719A-1 in them. It was necessary to grow plants from kernels having both states of a_1^{m-1} in them and to cross them by plants that were homozygous for a_1 and in which no Spm was present in order to compare the response of each state to the Spm-w present in the plant. Among the kernels on the resulting ears, half should carry state 5719A-1 and the other half should carry st te 5700A. The response of each state to Spm-w could then be compared directly among the kernels on an ear.

For one of the tests conducted ~~with~~ of state 5700 a_1^{m-1} to determine ~~its~~ the response to Spm-w, plants were grown from kernels on an ear produced by the cross of a plant that was Pr/pr and homozygous for state 5700A and Sh_2 and in which no Spm was present, by one that was homozygous for state 5719A-1, Sh_2 and pr and in which 1 Spm-w was present. Half of the kernels on this ear were pale colored and the other half were variegated. The pattern of A_1 spots among the variegated class of kernels resembled that produced by state 5719A-1 when Spm-s is present (see photos). Ten kernels were sown in the summer of 1958 from the pale, Pr class of kernels under culture number 7530A and 10 other kernels were sown from the variegated, Pr class under culture number 7530B. All plants arising from the pale kernels were uniformly pigmented. Those arising from the variegated class showed small streaks of A_1 pigment in a non-pigmented background during early development and the pattern of streaks resembled that produced by state 5719A-1 in the presence of Spm-s. As the plants matured, pigment developed in the background. The pattern of small spots of A_1 in the kernels and of small streaks in the plant most probably were produced by mutation occurring to state 5700A, the contribution to this of state 5719A-1 being small. This was made evident by the kernel types that appeared on the testcross ears of these plants.

It was necessary first to ~~learn~~ verify that the uniformly pigmented plants, arising from the pale class of kernels on the ear just described, had no Spm in them and also to verify that ~~each~~ these plants carried state 5719A-1 in one chromosome 3 and state 5700A in the other chromosome 3, both of which would respond in the expected manner to the presence of Spm-s. Therefore, crosses were made to plants in culture 7530A using for this purpose pollen from plants that were homozygous for a_1 and sh_2. Some of the pollen came from plants that had no Spm in them whereas it was present in other plants from which pollen was collected. The types of kernels appearing on the ears of five plants in culture 7530A, produced by these crosses, are shown in table ~~69~~ 70.

It was ~~obvious~~ clear from these tests that no Spm was present in these plants and also that ~~the two~~ each states of a_1^{m-1} ~~present~~ ~~in each~~ in them would respond in the expected manner to Spm-s. Among the variegated kernels ~~The contrast in the~~ pattern of variegation given by each state was so ~~great~~ distinctive that no difficulties were experienced in ~~separating~~ ~~the~~ kernels having ~~one or the other of these two states~~ state 5700A from those having state 5719A-1.

Plants in B of culture ~~that were variegated~~ were crossed by plants homozygous for a_1 and sh_2 and in which no Spm was present. Seven test cross ears were obtained from these plants and the types of kernels on each ear are given in table 70. All plants in culture 7530B were Pr/pr in constitution. It had been planned to cross these plants by ones that

were homozygous for a_1, sh_2, and pr but all plants of this constitution died in early stages of development due to unusually unfavorable growing conditions in the summer of 1958. Therefore, pollen was collected from plants ~~were used from~~ in a culture in which the alleles of Pr were segregating. Some of these plants were Pr/Pr, others Pr/pr and still others pr/pr. The constitution of any one plant with regard to the alleles of Pr could not be known in advance of test of each. Among ~~Of~~ ~~those~~ used in the crosses to the plants in culture 7530B all three constitutions were represented. It was expected that ~~the~~ Spm-w would be carried in the pr chromosome in the~~s~~ plants in culture 7530B and that linkage of the variegated class with pr would appear among the kernels on the testcross ears they produced. Among the ears given in table 7~~0~~, one pollen parent was Pr/Pr, 4 were Pr/pr and 2 were pr/pr. It was evident that Spm-w was carried in the pr chromosome in each of the plants in culture 7530B entered in table 7~~0~~. On the two ears produced by the cross with a plant that was homozygous for pr, the percent of recombinant kernels ~~with~~ among the variegated class was 33.

Among the variegated class of kernels on the ears entered in table 7~~0~~ two ~~classes~~ types could be distinguished readily. One had many dots of A_1 and the other had only one or several of them. In ~~the~~ total, therewere 659 kernels ~~of~~ the former ~~class~~ type and 579 ~~of~~ the latter ~~class~~ type. In addition, there were 90 colorless kernels. If the colorless kernels are added to

to those in the latter class, a 1 : 1 ~~segregation~~ ratio appears among ~~for the two types of~~ the kernels having Spm-w in them. The latter class resembles in phenotype that appearing with state 5719A-1 and Spm-w and the former type is the same as that in the kernel which gave rise to each plant, and these kernels had both state 5700A and state 5719A-1 in them. Obviously, then, the kernels that have many A_1 dots carry in them state 5700A and those with one or several A_1 dots or are totally colorless ~~with no A_1 dots~~, have state 5719A-1 in them. In other words, half of the kernels on these ears had no Spm-w in them and were uniformly pale colored and half carried Spm-w. Half of these, in turn, carried state 5700A and the other half carried state 5719A-1. It appears evident that Spm-w reduces mutation frequency in a proportional manner, the number of mutant spots that are produced in its presence being a fraction of that which appears when Spm-s is present. This relationship was also found to be true when Spm-w was introduced into plants carrying state 5996-4, which ~~produces~~ gives very many mutant spots with Spm-s but far fewer of them with Spm-w. Before this is considered, another test conducted with state 5700A and Spm-w will be discussed. It was ~~examined~~ made because ~~of~~ in the parent plant having Spm-w a change in action of Spm-w had occurred and this resulted in a ~~that reduced~~ ~~even~~ further reduction in its capacity to induce mutation.

The ear of a plant homozygous for state 5719A-1 and Sh_2 that was Pr +/pr Spm-w was used in a cross with a plant homozygous for state 5700A, Sh_2, and Pr in which no Spm was present. On this ear there were 148 pale colored kernels and 140 colorless kernels with spots of A_1 in them. However, the number of A_1 spots was far fewer than that appearing on ears of other plants produced by similar crosses conducted with ~~the~~ plant carrying state 5700A. Instead of several hundred A_1 dots, the number among the varieg ted kernels on this ear ranged from as low as 15 to as high as approximately 100 with the majority of kernels having about 30 to 50 of them. Some of the variegated kernels were selected from this ear and grown in the summer of 1958 under culture number 7829. The ears of five of these plants were used in the cross with plants that were homozygous for a_1 and in which no Spm was present. The kernel types on these ears are shown in table 72 and the plants are arranged according to the proportion of kernels on their ears that were colorless with no A_1 spots in them. This was done because there was a distinct correlation between the percent of colorless kernels and these ears and the number of A_1 dots that were present in the kernels having state 5700A and Spm-w, the higher the proportion of totally colorless kernels on the ear, the lower the average number of A_1 dots that appeared in the kernels having state 5700A.

However, on all ears, a few kernels appeared with very many dots of A_1 in them or sectors appeared in some kernels in which the number of A_1 dots was very much increased. It appeared that the Spm-w in the parent plant that introduced it into the plants of culture 7529 was less effective in its capacity to induce mutation at a_1^{m-1} either with state 5700A or with state 5719A-1, and also that subsequent change in this was occurring in individual cells leading to a much increased capacity of it to induce mutation. Differences in mutation-inducing capacity of Spm as well as its inhibitory capacity to gene action at a_1^{m-1} have been noted in studies of other Spm-w isolates. Just as Spm-s may undergo change to give Spm-w type action, so may Spm-w undergo change to or toward Spm-s type action.

Change in degree of effectiveness of action of Spm-w may be noted in the plant as well as in the kernel. In some plants, distinct sectors appear in which the capacity of Spm-w to suppress gene action at a_1^{m-1} was increased. The anthocyanin pigment in these sectors was much lighter than in the rest of the plant. Also, some sectors appeared in which no pigment could be detected and within a few of them, small streaks of A_1 type pigment were present. From studies of the type described here and also from those that investigated inactivations of Spm, there seems to be little doubt

that the capacity of Spm to induce mutation is directly correlated with its capacity to inhibit gene expression at a_1^{m-1}. Spm-w represents and intermediate state between a fully active Spm and one that is totally inactive. Its capacity to induce mutation is reduced along with its capacity to inhibit gene expression. It is possible that the apparent double mode of action of Spm--supression of gene action at a_1^{m-1} and a_2^{m-1} and induction of mutation at both of these loci,--is the consequence of a single initial reaction in the cell for which Spm is responsible.

Another factor enetering into consideration of Spm-w will be mentioned here as it has significance in appreciating the relation of Spm-w to Spm-s. A modifier was found to be present in a single kernel on an ear of a plant carrying Spm-s. Its presence is made evident only when Spm also is present. The origin and detailed mode of behavior of it will be considered in the section of this report dealing with the Modifier. When present with either Spm-s or Spm-w, an approximate three-fold increase in mutation frequency is produced with states 5718 and 5719A-1 of a_1^{m-1}. The importance of mentioning it here is to indicate that the mutation increase it induces is the same with either Spm-s or Spm-w. Kernels having in them an Spm with a low grade of action can not be distinguished from ones in which the Spm is fully active whenever the Modifier also is present. However, if Spm is totally inactive, the Modifier has no effect

at all.

Response of state 5996-4 to Spm-w

Tests of the effect of Spm-w, derived initially from plant 6683B-2, on state 5996-4 a_1^{m-1} were conducted at the same time as those with state 5700A, just described. In the presence of Spm-s, state 5996-4 gives an exceedingly high number of small mutant spots in both plant and kernel. The number of them may be so high that a kernel having this state and Spm-s often appears to be totally pigmented. Examination with magnification reveals that this phenotype is produced by the presence of many mutant spots located very close to one another. In some kernels that are purple, (Pr), the diffusion rims about each mutant spot may run together and this may make it difficult or impossible to know from this examination alone whether ~~with certainty if~~ the phenotype arose from a germinal mutation to A_1 or whether it was produced by many mutant spots whose ~~diffusi~~ diffusion rims have run together, making the aleurone layer appear to be totally A_1 in phenotype. From progeny tests, such a destruction could be made. In kernels that are homozygous for pr, however, the diffusion rims are much lighter in shade and in these kernels no such difficulties are experienced. Each of the many A_1 dots, although placed very close to one another, may be detected. ~~By use of~~ With the pr phenotype, it was learned that germinal mutation is infrequent with state 5996-4.

Because state 5996-4 produced many late occurring mutations with a fully active Spm-s, it is a very sensitive indicator of any somatically

occurring change in action of Spm. ~~and this applies to any state of Spm that may be present.~~ Sectors sometimes appear in kernels in which the action of Spm is altered. If the Spm present is undergoing change in a number of cells during development of the kernel, the pattern of mutant spots in the kernel is quite irregular. If Spm undergoes few changes during development the pattern is quite regular. Illustrations of this with Spm-s are shown in photographs 00 and 00. Thus this state very effectively shows the types of change that occur~~ring~~ to Spm-w. Spm-w, initially obtained from plant 6683B-2, reduces the percent of mutations with state 5996-4 as it did with state 5700A, and the mode of testing for this was the same as that just described for state 5700A. In one test, pollen from a plant that was a_1^{m-1} (state 5996-4) Sh_2/a_1 sh_2 was placed on the silks of a plant homozygous for state 5719A-1, and Sh_2 and having one Spm-w. On the resulting ear there were 196 pale colored kernels. No Spm was present in these kernels. In addition there were 86 kernels with many ~~number of~~ A_1 dots and Spm-w indicating the presence of in them ~~that obviously had~~ state 5996-4 and ~~in them~~, 98 kernels with 1 or several A_1 dots ~~and~~ plus 4 kernels that were totally colorless, indicating the presence of state 5719A-1 and a_1^s and Spm-w.

The change in action occurring to Spm-w during the development of the kernels having it was illustrated in a striking manner ~~by~~ in those that had Spm-w and state 5996-4 in them. In the majority of kernels, sectors were present in which many dots of A_1 ~~were present~~ appeared and ~~of~~ the ~~pattern~~ of this was similar

to that given when Spm-s is present. (See photos 00). In the kernels that had only state 5719A-1 in them, sectors appeared with more than the usual number of A_1 dots in them ~~were present~~. It seemed clear that the Spm-w in the tributed by the female parent was undergoing rather frequent change in action copacity during development of the kernel and this occurred early enough in some cells so that their progeny could ~~show~~ reveal the change ~~readily~~ by the altered pattern of A_1 dots in the sector each produced. ~~them.~~

When ~~the~~ pollen from the plant carrying state 5996-4 was placed on the silks of an ear of a plant having an ~~of another~~ Spm-w ~~carrying~~ of similar constitution to that just described, there were 167 uniformly pale pigmented kernels, 92 tha had many ~~a number of~~ dots of A_1 ~~in them~~, 39 that had only 1 or 2 A_1 dots and 62 that were totally colorless. It was obvious from the reduced number of A_1 dots and from the infrequent appearance of sectors in which many A_1 dots appe red, that the Spm-w contributed by the female parent was undergoing very few changes during early development of the kernel. Change in Spm-w was occurring but in individual cells but quite late in development. (See Photos 00). The impression gained from the study of state 5996-4 and Spm-w is that mutation to A_1 will occur with any state of a_1^{m-1} only after some modification has occurred to Spm itslef during development and that the number of mutant spots seen in a kernel with any one state is a reflection of the time of occurrence of change in Spm and the frequency of this occurrence at any one time.

Table 1

Phenotypes of kernels selected from ears produced by cross of original a_1^{m-1} carrying plant to plants that were homozygous for the standard a_1 and for A_2.

	Phenotype of kernel	No. of kernels selected with given phenotype	Culture number of plant derived from selected kernel
1	Uniformly pigmented; full A_1 type	4	5713 A-1 to A-4
2	Uniformly pale colored	5	5713B, 5713C, 5713D, 5719B, 5700A
3	Few small colorless areas in deeply pigmented background	2	5713B-1, 5713B-2
4	Original type of variegation pattern	5	5717D 1 to 5
5	Large areas of deep-pigmentation, and areas with many small spots of deep-pigmentation in colorless background	2	5717B-1, 5717B-2
6	Very many small spots of deep pigmentation in colorless background	1	5713C
7	Small deeply pigmented spots ~~of deep-pigmentation~~ in colorless background; uniformly distributed over aleurone layer	6	5714E, 5715A, 5717A, 5718, 5719A-1, 5719A-2
8	Few small deeply pigmented spots in colorless background	2	5715B-1, 5715B-2
9	Large and small pale areas of different intensities in colorless background	2	5715C, 5720
10	Deeply pigmented areas of various sizes in a lightly pigmented background	1	5714F

Table 2

Types of kernels appearing on ears produced by test crosses of variegated plants entered in row 7 of Table 1. All variegated plants were a_1^{m-1}/a_1, A_1. A. Ears produced by self pollination. B. Ears of variegated plants derived from cross with a plant homozygous for a_1. C. Ears produced when pollen of variegated plant was placed on silks of plants homozygous for a_1 and A_2.

	Culture Number of variegated plant	Phenotype of Kernel: Uniformly pigmented	Small spots of deep pigment in colorless background *	Colorless	Total Number of kernels on
A.	5715A	46	389	118	553
	5714E	2	331	82	415
	5718	0	307	146	453
	5719A-1	7	181	55	243
	5719A-2	2	179	68	249
B.	5715A	20	149	163	332
	5719A-2	8	94	111	213
C.	5714E	13	136	127	276
	5715A	43	485	515	1043
	5717A	22	609	508	1139
	5718	5	135	126	266
	5719A-1	9	181	165	355
	5719A-2	24	250	259	533

* on some kernels pale areas also appeared. the meaning of these will be considered in section of this report.

Table 3.

Phenotype of kernel

♀ Parent Ear no.	Plant no.	Position of ear on plant	♂ parent Ear no.	Plant no.	Sh2 Uniform Pigmented A, type	Sh2 Uniform Pigmented Pale	Sh2 Deeply-Pigmented Spots on Colorless background	Sh2 Colorless	sh2 Uniformly Pigmented Pale	sh2 Deeply-Pigmented Spots on Colorless background	sh2 Colorless	Total no. of kernels
6452-1		main	6338B-18		0	102	92	2	0	0	167	363
		tiller	" -14		2	42	51	0	0	0	92	187
a, sh2			6452-1		0	88	91	0	1	0	162	342
6452-2		main	6338B-18		0	83	79	2	0	1	161	326
		tiller	" " -14		0	73	66	0	0	0	107	246
		tiller	" -16		0	27	24	0	0	0	49	100
6452-3		main	" -18		0	5	136	2	0	0	148	291
a, sh2			6452-3		1	57	168	3	0	0	216	445
6452-4		main	6338B-16		0	105	211	0	0	0	297	613
6452-5		main	6338B-18		0	45	31	2	0	0	81	159
		2nd	" -16		0	20	19	0	0	0	39	78
a, sh2			6452-5		0	160	104	0	0	0	290	554
6452-6		main	6338B-16		0	15	11	0	0	0	22	48
		tiller	" -18		0	91	80	0	0	0	169	340
		tiller	" "		0	115	76	0	0	0	225	416
6452-7		main	" -16		1	127	107	1	0	0	229	465
		tiller	" -18		0	124	97	1	1	0	174	397
		tiller	" "		0	22	22	0	0	0	27	71
6452-8		main	" -16		0	56	56	0	0	0	101	213
		2nd	" -11		0	45	44	0	0	0	82	171
		tiller	" -18		0	59	50	0	0	0	104	213
6453-1		main	" -16		0	35	33	0	0	0	74	142
"		tiller	" -14		0	79	79	0	0	0	136	294
a, sh2			6453-1		0	98	82	0	0	0	177	357
a, sh2			6453-1		0	125	119	0	0	0	199	443
6453-2		tiller	6338B-18		0	70	51	3	1	0	103	228
a, sh2			6453-1		0	116	96	4	0	0	197	413
6453-3		main	6338B-18		0	72	157	1	0	0	206	436
a, sh2			6453-3		0	55	97	2	0	1	161	316
6453-4		main	6338B-18		0	126	130	1	0	0	265	522
		tiller	" "		0	114	91	0	0	0	220	425
		"	" "		0	122	87	0	0	0	196	405
a, sh2			6453-4		0	105	64	0	1	0	156	326
6453-5		main	6338B-18		0	155	130	2	0	1	287	575
		tiller	" "		0	105	83	0	0	0	185	373
a, sh2			6453-5		0	94	99	2	0	0	223	418
6453-6		main	6338B-18		0	102	80	1	0	0	199	382
6453-7		main	" "		0	138	120	0	0	0	231	489
6453-8		main	" "		0	109	118	0	0	0	239	466
		2nd	" "		0	131	123	0	0	2	272	528
		tiller	" "		0	83	91	2	0	0	152	328
6453-9		main	" -16		0	48	78	0	0	0	123	249
		2nd	" -18		0	48	160	2	0	0	215	425
		tiller	" -14		0	18	85	0	0	0	102	205
		Totals			4	3609	3868	33	4	5	7260	14,783

TABLE 4

PHENOTYPES OF KERNELS APPEARING ON EARS PRODUCED BY THE CROSS OF PLANTS HOMOZYGOUS FOR a_1, sh_2, AND y BY PLANTS WHOSE CONSTITUTIONS WERE $a_1^{m-1}\ Sh_2/a_1\ Sh_2;\ Y/y$ (PART I), OR $a_1^{m-1}\ Sh_2/a_1\ Sh_2;\ y/y$ (PART II)

PLANT NUMBER	PARENTAGE IN CROSS	PHENOTYPES OF KERNELS							
		Color in aleurone					Colorless aleurone		
		Pale		Deeply pigmented spots on colorless background		Total			
		Y	y	Y	y		Y	y	Total
Part I:									
6046B-1	♂	107	20	12	89	228	119	113	232
6046B-3	♀	32	1	58	95	186	93	88	181
6046C-2	♀	28	7	55	86	176	75	103	178
6047A-1	♀	30	31	173	162	396	209	228	437
6047A-3	♀	48	82	76	47 1)	253	115	146	261
Part II:									
6047C-1	♀	...	20	...	174	194	...	163	...
6047C-3	♀	...	92	...	97	189	...	203	...
6047C-4	♀	...	58	...	184 2)	242	...	251	...
6047B	♀	...	4	...	398	402	...	391	...
6047B	♂	...	5	...	482	487	...	483	...

1) Kernels selected from this class produced plants in culture 6452, table 3

2) Kernels selected from this class produced plants in culture 6453, table 3

Table 5

Phenotypes of kernels appearing on ears produced by cross of plants homozygous for a_1, sh_2, and y to plants in culture 6629 A having the constitution a_1^{m-1} Sh_2 / a_1 sh_2, Y / y. The kernels entered in the pale columns, were uniformly pigmented. Those entered in the variegated columns exhibited deeply pigmented spots in a colorless background. The symbol I in the end column indicates the position of the upper ear on the main stalk. Symbol II indicates the lower ear on the main stalk.

♀ Parent

Parent

Plant number in culture 6629	Position of ear on plant		Phenotype of Kernel: Sh_2 Y Pale	Sh_2 Y Variegated	Sh_2 Y Colorless	Sh_2 y Pale	Sh_2 y Variegated	Sh_2 y Colorless	sh_2 Y Pale	sh_2 Y Variegated	sh_2 Y Colorless	sh_2 y Pale	sh_2 y Variegated	sh_2 y Colorless	Total
A-1	I	1041-5	36	66	0	58	35	0	0	0	85	0	0	89	369
	II	1041-4	33	51	0	54	36	1	0	1	108	0	1	98	376
A-2	I	1040-1	3	76	1	15	86	0	0	0	91	0	1	82	355
	tiller	1041-4	7	47	0	12	32	0	0	0	37	0	1	34	170
A-3	I	1040-1	34	43	0	52	37	0	0	1	85	1	0	83	336
A-4	I	1041-5	23	56	0	65	36	0	0	0	90	0	0	84	354
A-5	I	1041-4	26	78	0	25	75	0	0	1	122	0	0	101	428
	tiller	1041-4	19	44	0	27	47	0	0	0	66	0	0	53	256
A-6	I	1040-1	34	78	0	67	37	0	0	1	86	0	0	113	416
A-7	I	1040-1	29	58	4	59	36	1	0	0	105	0	0	100	392
	tiller	1041-8	49	1	2	58	3	0	0	0	56	1	0	62	232
A-8	I	1041-5	19	66	0	56	53	0	0	0	101	0	0	87	382
A-9	I	1041-8	39	49	0	41	38	0	1	0	79	0	0	90	337
	tiller	1040-5	41	50	0	58	34	1	0	0	79	1	0	115	379
	Totals		392	763	7	647	585	3	1	4	1183	3	3	1191	4,782

note: In addition to kernels entered in this table there were 2 kernels, each on a different ear, that expressed the full A_1 phenotype. Both were Sh_2, Y, and pr

(spin-w types - infrequent [not mentioned])

Table 6

The degree of association of the pale phenotype with Y and the variegated phenotype with y on ears of plants entered in table 5 that exhibited a ratio of 1 pale to 1 variegated kernel among those kernels having anthocyanin pigment.

Plant number in culture 6629	Position of ear in plant	Phenotype of Kernel: Pale		Deeply-Pigmented Spots in Colorless Background		Total
		Y	y	Y	y	
A-1	I	36	58	66	35	195
	II	33	54	52	37	176
A-3	I	34	53	44	37	168
A-4	I	23	65	56	36	180
A-6	I	34	67	79	37	217
A-7	I	29	59	58	36	182
A-9	I	40	41	49	38	168
	tiller	41	59	50	34	184
Totals		270	456	454	290	1470

Table 7

Plant number in culture 6629	Position of ear on plant	Phenotype of Kernel: Pale		Deeply-pigmented spots in colorless background		Total
		Y	y	Y	y	
A-2	I	3	15	76	87	181
	tiller	7	12	47	33	99
A-5	I	26	25	79	75	205
	tiller	19	27	44	47	137
A-7	tiller	49	59	1	3	112
A-8	I	19	56	66	53	194

Table 8

Phenotypes of kernels on ears of plants in B of culture 6629 produced by cross with plants homozygous for a_1, sh_2 and y. The constitution of the plants in 6629B was: $a_1^{m}\ Sh_2 / a_1\ sh_2,\ y/y$.

Plant number in Culture 6629	Position of ear on Plant	Phenotype of Kernel						Total
		$Sh_2\ y$			$sh_2\ y$			
		Pale	Variegated	Colorless	Pale	Variegated	Colorless	
B-1	I	184	171	0	0	0	353	708
	II	43	38	0	0	0	54	135
	tiller	45	58	0	0	0	90	193
B-2	I	52	158	1	0	1	232	444
	tiller	24	51	0	0	0	84	159
B-3	I	91	88	0	0	0	194	373
B-4	I	91	134	0	0	0	210	435
B-5	I	87	104	0	0	0	186	377
	II	8	25	0	0	0	42	75
	tiller	47	97 + 6*	5	0	0	157	312
B-6	I	64	171	0	0	0	231	466
	II	47	122	2	0	0	163	334
B-7	I	126	110	0	0	0	208	444
B-8	I	14	20	0	0	0	29	63
	II	16	7	0	0	0	33	56
	tiller	23	54	0	0	0	68	145
B-9	I	30	135+15*	5	0	0	181	366
	II	38	110 + 3*	0	0	2	127	280
	tiller	24	129 + 12*	21	0	0	144	330
B-10	I	112	136	0	0	0	249	497

* These kernels showed only one or several very small dots of deep pigment in an otherwise colorless kernel.

Note: In addition to the kernels entered in this table, there were 3 deeply-pigmented kernels, A, type, that were Sh and pr.

Table 9

Phenotypes of kernels on ears of plants grown in the greenhouse during the winter of 1950-51 from which plants were grown in the summer of 1951.

Culture Number of a_1^{m-1} carrying plant	Type of Cross conducted with a_1^{m-1} plant: Female	Male	Phenotype of Kernels Selected from Ear	Culture Number of Plants Derived from Selected Kernels	Number of Plants in Culture
5700A	a_1/a_1	5700A	Aleurone lightly pigmented	6078	9
5718	Self-pollinated (see table 2)		Dots of A_1 pigment in colorless background	6045	4
5719A-1	Self-pollinated (See table 2)		Uniformly pigmented aleurone	6046A	3
			Dots of A_1 in colorless background	6046C	9
			Dots of A_1 and some pale areas in colorless background	6046B	3
	a_1/a_1 (See table 2)	5719A-1	Dots of A_1 in colorless background	6047A, B, C	14
5719A-2	Self-pollinated (See table 2)		"	6080C	14
			Dots of A_1 and pale areas in colorless background	6080B	1
	a_1/a_1 (See table 2)	5719A-2	"	6081A	8
			Dots of A_1 in colorless background. No pale areas	6081B	1
5720	Self-pollinated		Pale areas of various intensities in colorless background	6042	12
	5720	a_1/a_1	" "	6043A, B	4
	a_1/a_1	5720	" "	6044	9

Table 10.

Phenotypes of kernels on individual ears produced by test crosses of plants in culture 6081 A whose constitution were a_1 (state 5719A-2) / a_2. A. Ear derived from self-pollination. B. Ear derived from cross of 6081A ♀ × a_1/a_1 ♂. C. Reciprocal of B.

Phenotype of Kernel

	Plant number	(A1) uniform deeply pigmented	pale	Deeply-pigmented Dots in colorless Background	Colorless	Total	Spm Constitution
A.	A-2 I	1	74	166	75	316	1
	A-3 (I)	0	89	244	99	432	1
	A-4 (I)	0	76	257	109	442	1
	A-8 (I)	0	62	188	75	325	1
	Totals	1	301	855	358	1515	
B.	A-4 (II)	0	99	110	214	423	1
	A-5 (I)	0	7	23	32	62	2 (?)
	A-6 I	0	123	136	262	521	1
	A-8 (II)	0	8	30	38	76	2 (?)
	A-8 (I)	0	65	72	131	268	1
C.	A-2	0	110	131	272	513	1
	A-4	0	124	127	258	509	1
	A-5	1	88	238	290	617	2
	A-8	0	114	151	264	529	1

Table 11.

Phenotypes of kernels appearing on individual ears produced by plant 6081 B whose constitution was a_1^{m1} (state 5719A-2) / a_1. A. Ear derived from self-pollination B. Ears derived from cross of 6081B4 × a_1/a_1 07. C. Three ears derived from reciprocal cross.

Phenotype of Kernel

	Part of plant 6081B tested	Deeply (A_1) pigment, uniform over aleurone layer	Uniformly Pale	Dots of A_1 type pigment in colorless Background	Colorless	Total
A	First ear mainstalk	3	0	170	57	230
B	Second ear, main stalk	0	12	96	111	219
	Tiller Ear	0	5	136	141	282
C	Pollen	0	38	191	245	474
	"	0	32	198	258	488
	"	0	24	167	192	383
	Totals	0	94	556	695	1345

Table 12

Phenotypes of kernels on ears of plant 6080B, which was homozygous for state 5719A-2 $\underline{a}_1^{m-1}$. Line 1: Kernel types on ear derived from cross of 6080B ♀ x $\underline{a}_1/\underline{a}_1$ ♂. Lines 2 and 3: Kernel types on ears derived from reciprocal cross.

	Phenotype of Kernel		
$\underline{A}_1$	Uniformly Pale Pigmented	Dots of $\underline{A}_1$ in Colorless Background	Total
1	186	154	341
0	226	187	413
0	273	202	475*

* One colorless kernel was present in addition to those given in the table.

Table 13

Phenotypes of kernels on individual ears produced by test crosses conducted with plants in culture 6080C that were homozygous for the state 5719A-2 of a_1m-1.
A. Ears derived from self-pollination. B. Ears derived from cross of 6080C ♀ by a_1a_1 ♂.
C. Reciprocal of B.

	Plant number	Part of plant tested	Phenotype of Kernel: A_1	Pale	Dots of A_1 in Colorless Background	Total	Remarks
A	C-3	I	1	2	124	127	
	C-5	I	3	2	272	277	2 dark color plus A_1 dots
	C-6	I	3	2	205	210	1 light pale plus A_1 dots
	C-8	I	0	62	133	195	1 Spm
B	C-2	I	0	78	246	324	2 Independently located Spm elements
	C-3	II	0	14	264	278	
	C-4	I	0	0	14	14	
	C-4	tiller	0	0	18	18	
	C-5	II	0	1	278	279	
	C-8	II	0	51	44	95	1 Spm
	C-11	I	1	2	216	219	
C	C-2	pollen	0	159	350	509	2 Independently located Spm elements
	C-3	"	2	60	492	554	
	C-5	"	0	34	410	444	
	C-6	"	7	100	422	529	
	"	"	1	74	396	471	
	C-8	"	0	279	220	499	1 Spm

Table 14

Phenotypes of kernels on individual ears produced by test cases conducted with plants in B+C of culture 6046. A. Ears derived by self-pollination. B. Ears derived by cross of 6046B♀ × a_1/a_1 ♂. C. Reciprocal of B. Plants B-1 and B-2 were a_1 m-1 (state 5719A-1)/a_1 and plant B-3 was homozygous for state 5719A-1 a_1 m-1.

	Plant number	Part of plant tested	Phenotype of Kernel: A_1	pale	spots of A_1 in colorless background	Colorless	Total	Spin constitution
A	B-2	I	1	46	121	0	168	1
	B-3	tiller	2	14	217	85	318	2
	C-1	I	3	33	376	0		2
	C-11	I	3	32	371	0		2
B	B-2	II	0	117	110	0	227	1
	B-3	I	1	33	153	181	368	2
	C-2	tiller	0	35	141	178		2
C	B-1	Pollen	0	137	140	269	546	1
	B-1	"	1	137	101	232	471	1
	B-2	"	0	172	173	0	345	1
	B-2	"	0	210	197	0	407	1
	C-1	"	1	212	465	0		2

Table 15

Phenotypes of kernels derived from ears produced by tests of plants in culture 6045.

Plant 1 was a_1^{m1} (state 5718) $/a_1$. Plant 4 was homozygous for state 5718 a_1^{m-1}. A. Ears produced by self pollination. B. Ears produced by cross a_1/a_1 ♀ × 6045 ♂.

	Plant number	Phenotype of kernel: A_1	very pale color	Date of A_1 in colorless background	colorless	Total
A	1	0	73	207	83	363
	4	6	26	387	5 (?) 1)	424
B	1	0	57	112	238 (?) 2)	407
	4	6	72	407	112 (?) 1)	597

1) these kernels most probably belong to the pale class.

2) about 40 % these kernels probably belong to the pale class.

Table. 16

a_1^{m-1} (5720) | $a_1 S$ × a_1/a_1

♀	♂	Phenotype of kernel: Uniformly pale. Various grades of intensities or hues	pale areas in colorless background	colorless	Total
6044-3	6041B-5	56	36	242	334
6044-4	" -6	90	34	301	397
6044-6	" "	68	64	398	530
a_1/a_1 6038-71	6044-6	112	54	429	595
6044-7	6041B-6	88	55	434	577
6044-8	" "	51	15	170	236

Uniformly pigmented class. Intensity ranged from very faint to dark pale

Variegated class: in plants where a_1^{m-1} was ♀: few kernels with pale background instead of colorless

Pale areas could have areas of darker intensity in them

Thus not explained by reciprocal cross. Reason due to $2a_1^{m1}$ in ♀ cross, only 1 in ♂.

Table 17

A. Phenotypes of kernels on ears produced by cross a_1^{m-1} (original state) Sh_2 / a_1 Sh_2 ♀ x a_1 sh_2/a_1 sh_2 ♂. B. Reciprocal of A.

		Phenotypes of Kernels					
A. Culture	Plant Number	A_1	pale pigment	Variegated	Apparently colorless	Total	Number of kernels with new state
5994	8	68	56	186	332	642	0
5994	10	38	91	113	264	506	0
5994	12	60	11	163	266	500	0
5995	1	63	3	140	315	521	1
5995	2	51	12	193	290	546	0
5995	10	76	42	70	329	517	0
5995	12	71	16	176	402	665	1
5996	1	16	44	54	159	273	0
5996	2	24	1	169	214	408	0
5996*	4	10	107	120	280	517	1
5996	10	48	68	43	203	362	0
5997	2	63	18	73	229	383	0
Totals		588	469	1500	3283	5840	3
B.							
5994	2	57	10	97	278	442	0
5994	12	57	75	96	303	531	0

*The part of the plant that produced this ear had an altered state of a_1^{m-1}.

It is refered to in this report as state 5996-4 a_1^{m-1}.

Table 18

Origin of Plants Grown in the Summer of 1954

State of a_1^m-1	Origin of Ear ♀	Origin of Ear ♂	Test Reference	Phenotypes of Kernels selected from ears. Pale Sh_2	Var. Sh_2	Pale sh_2	Var. sh_2	Color-less, sh_2	Odds	1954 Culture Number
5718	6045-4	Self.Poll.	Table 15	8	8					6638
5719A-1	6046A-1	$a_1 sh_2$	Page	30						6639
	6046B-2	" "	Table 14	28						6640
	6046C-1	Self-Poll.	" "	9						6641
	6046C-4	" "	" "	2						6642
	a_1 sh_2	6047B	Table 4		9					6697
	6047B	$a_1 sh_2$	" "		10					6698
	6628-2	Contam.	Page		1					6658
	6628-5	a_1 sh_2	"	19						6659
	6628-6	" "	"	22						6660
	6628-8	" "	"	20						6661
	6629A-4 t	Self.Poll.	"	0	10	1		39		6662
	" B-2t	6629A-4t	"	6	10			20		6663
	" B-6t	" "	"	6	10			27		6664
	" A-1 I	a_1 sh_2	Table 5	13	13			33		6665
	" " II	" "	" "	11	12		1	23		6666
	" A-2 t	" "	" "		19			22		6667
	" A-3	" "	" "			1	1		2*	6669
	" A-4 I	" "	" "	13	12			20		6670
	" A-5 I	" "	" "	12	12		1	22		6671
	" A-5t	" "	" "	7	11			30		6672
	" A-6 I	" "	" "	12	17		1	35	1†	6673
	" A-7 I	" "	" "	12	11			11	3*	6674
	" " " t	" "	" "	9		1		38	6*	6675
	" A-8 I	" "	" "	4	20			24		6676
	" A-9t	" "	" "			1				6678
	" B-1 I	" "	Table 8	10	9			12		6679
	" B-2 I	" "	" "	10	8		1	25	4†	6680
	" " " t	" "	" "	5	4			14		6681
	" B-4 I	" "	" "		8			11		6682
	" B-5 I	" "	" "	5	9			13	2*	6683
	" " " II	" "	" "	3	3			16	2*	6684
	" B-5t	" "	" "	8	9			27	7*	6685

Table 18, continued

State 5719A-1

Origin ♀	♂	Text Reference	Phenotypes of Kernels Selected from Ear: Pale Sh_2	Var. Sh_2	Pale sh_2	Var. sh_2	Colorless sh_2	Odds	1954 Culture Number
6629B-6 I	a_1 sh_2	Table 8	10	10					6686
" B-7 I "	"	" "	11	6			16		6687
" B-8 I "	"	" "		10			16	6 *	6688
" B-9t "	"	" "		9				10 *	6689
" " " II"	"	" "				1			6690

State 5719A-2

6080B	a_1 sh_2	Table 12	10	10			Colorless Sh_2		6691
a_1 sh_2	6080B	" "	5	7					6692
6080C-2	a_1 sh_2	" 13	5	6					6693
" C-3 II"	"	" "	3	11					6694
6080C-8 I	Self.Poll.	" "	4						6643
6081A-6	a_1 sh_2	" 10	4	10			13		6695
a_1 sh_2	6081B	" 11	4	9			12		6696

State 5700A

6078-3 I	Self.Poll.	Page	8						6699
" "II	6041B-15	"	5						6700
" -5	Self. Poll,	"	8						6701
" "	6041B-18	"	10						6702

State 5996-4

5996-4	6041B-14	"	10	8					6704

Original State

5996-2	6041B-6	Table 17		9					6705

State 5999

5999t	Self. Poll.	Page		8					6706
" I	6041B-2	"	10	8			10		6707

Table 18 continued

Origin ♀	Origin ♂	Text Reference	Phenotypes of Kernels Selected from Ear: Pale Sh_2	Variegated Sh_2	Colorless Mutant Sh_2	1954 Culture Number
State 5713B-2						
5713B-2 I Self.Poll.		Tables 1 and 2		10		6644
a_1 Sh_2	5713B-2	Table 2			12	6645
State 5714F						
a_1 Sh_2	5714F	Table 2	3	6		6646
"	" "	" "		8		6647
State 5715A						
5715A Self. Poll.		Table 2		10		6648
a_1 Sh_2	5715A	" "		9		6649
" "	"	" "		4		6650
State 5720						
6042-3	a_1 sh_2	Page		5	5	6651
" -7	" "	"		5	5	6652
6044-1t	" "	"		5	10	6655
" -7	" "	Table 16		8	9	6657
Combinations of states:						
5700A x 5719A-2:					Colorless Sh_2	
6078-5t	6080C-3	Page		20	14	6703
5720 x Original State						
6042-8t	5995-10	Page		7		6653
6043A-1t	5994-2	"		6		6654
6044-6t	5995-10	"		4		6656

*Colorless kernels with 1 or several small A_1 dots.

†Spm entering inactive phase in some cells of kernel

Table 18

Origin of plants grown in summer of 1954

State	Origin		Text Reference	Phenotypes of kernel from which plant arose: Pale Sh2	Var. Sh2	pale sh2	Var. sh2	Colorless sh2	odds.	1954 Cutting no.
5718	6045-4	self-poll.	Table 15	8	8					6638
5719A-1	6046A-1	a1 sh2		30						6639
	6046B-2		Table 14	28						6640
	6046C-1	self poll.	Table 14	9						6641
→	6046C-4	" "	Table 14	2						6642
	6628-2	contam.	[illegible]		1					6658
	" -5	a1 sh2	" "	19						6659
	" -6	"		22						6660
	" -8	"		20						6661
Y Spm/y+	6629A4-I	self poll.	"	9	10	1		39		6662
	" B-2-I	6629A-4-I	" "	6	10			20		6663
	" B-6-I	6629A-4-I		6	10			27		6664
Y Spm/y+	" A-1-I	a1 sh2	Table 5	13	13			33		6665
Y Spm/y+	" A-1-II	"	" "	11	12		1	23		6666
Y Spm/y+ 2 Spm	" A-2-I	"	" "		19			22		6667
Y Spm/y+	" A-3	"	" "			1	1		2 1)	6669
Y Spm/y+	" A-4-I	"	" "	13	12			20		6670
Y Spm/y+ 1 Spm	" A-5-I	"	" "	12	12		1	22		6671
see ear	" A5-I	"	" "	7	11			30		6672
Y Spm/y+	" A-6-I	"	" "	12	17		1	35	1 2)	6673
Y Spm/y+	" A-7-I	"	" "	12	11			11	3 1)	6674
	" A-7-I	"	" "	9		1		38	6 1)	6675
Y Spm/y+ 1 Spm	" A-8-I	"	" "	4	20			24		6676
Y Spm/y+	" A-9-I	"	" "			1				6678
1 Spm	" B-1-I	"	Table 8	10	9			12		6679
2 Spm	" B-2-I	"	" "	10	8		1	25	4 1)	6680
2 Spm	" B-2-I	"	" "	5	4			14		6681
1 Spm	" B-4-I	"	" "		8			11		6682
2 Spm (1 [illegible])	" B-5-I	"	" "	5	9			13	2 1)	6683
2 Spm	" B-5-II	"	" "	3	3			16	2 1)	6684
2 Spm	" B-5-I	"	" "	8	9			27	7 3)	6685
2 Spm	" B-6-I	"		10	10			12		6686
1 Spm	" B-7-I	"	" "	11	6			16		6687
1 Spm	" B-8-I	"	" "		10			16	5 1)	6688
2 Spm	" B-9-I	"	" "		7				10 1)	6689
2 Spm	" B-9-II	"	" "				1			6690
								Colorless Sh2		
5719A-2	6080B	a1 sh2	Table 12	10	10					6691
	a1 sh2	6080B	" 12	5	7					6692
	6080C-2	a1 sh2	" 13	5	6					6693
	6080C-3-II	"	" 13	3	11					6694
	6081A-6	"	" 10	4	10			13		6695
	a1 sh2	6081B	" 11	4	9			12		6696
5719A-1	a1 sh2	6047B	"		9					6697
	6047B	a1 sh2	" 9		10					6698
	6080C-8-I	self poll	" 13	4						6643

Test 1954

State	Origin		Reference	Pale Sh2	Var. Sh2	Colorless Sh2	Mutant Sh2			Center No.
5700A										
	6078-3-I	self-poll.	page –	8						6699
	" 3 II	6041B-15	" –	5						6700
	" -5	self-poll.	" –	8						6701
	" -5	6041B-8	" –	10						6702
5996-4										
	5996-4	6041B-11	" –	10	8					6704
original stato										
	5996-2	6041B-6	Table 14		9					6705
5999										
	5999 I	self-poll.	page –		8					6706
	5999-I	6041B-2	–	10	8	10				6707
5713B-2										
	5713B-2-I	self-poll.	Table 1+2		10					6644
	a, Sh2	5713B-2	" 2				12			6645
5714F										
	a, Sh2	5714F	Table 2	3	6					6646
	"		"		8					6647
5715A										
	5715A	self-poll.	Table 2		10					6648
	a, Sh2	5715A	" "		9					6649
	" "	"	" "		4					6650
5720										
	6042-3	a, sh2	page –		5		5			6651
	" -7	" "	" "		5		5			6652
	6044-1 I	" "	Table		5		10			6655
	" -7	" "	"		8		9			6657
Combinations of States										
5700A × 5719A-2										
	6078-5 I	6080C-3	page –		20	14				6703
5720 × original state										
	6042-8-I	5995-10	page –		7					6653
	6043A-1 I	5994-2	"		6					6654
	6044-6-I	5995-10	"		4					6656

Table 19

Constitution of tester plants whose culture numbers are given in last column

Part I. Homozygous for a_1^{m-1} and Sh_2

State of a_1^{m-1}	Chromosome 5	Chromosome 6	Chromosome 9	Spm	1954 Culture Number
5718	pr/pr	y/y	wx/wx	0	6638A
5719A-1	pr/pr	Y/y	wx/wx	0	6641A
5719A-1	pr/pr	y/y	wx/wx	0	6641B
5719A-1	pr/pr	Y/Y or Y/y	wx/wx	0	6642
5719A-2	pr/pr	Y/Y	wx/wx	0	6643
5700A	Pr/Pr	y/y	sh_1 wx/sh_1 wx	0	6701-2

Part II a_1^{m-1} sh_2/a_1 sh_2, no Spm (state 5719A-1 in all plants)

	Pr/pr	y/y	wx/wx	0	6662C
	Pr/pr	y/y	Wx/Wx	0	6675G
	Pr/pr	y/y	Wx/Wx	0	6678
	Pr/pr	y/y	Wx/wx	0	6669C

Part III a_1^{m-1} sh_2/a_1 sh_2 (state 5719A-1 in all plants)

	Pr/pr	Y/y	Wx/Wx	Y Spm/y +	6666E
	Pr/pr	Y/y	Wx/wx	1 Spm	6671E
	Pr/pr	Y/y	[illegible]	1 Spm	6673F
	Pr/pr	y/y	Wx/wx	3 Spm	6680D
	pr/pr	y/y	Wx/wx	1 Spm	6690

Table 20

Phenotypes of kernels from which plants were grown under culture number indicated in column 1

1954 Culture Number	Cross that produced ear from which kernels were selected	Phenotypes of kernels: Pale Sh_2 Y	Pale Sh_2 y	Variegated Sh_2 Y	Variegated Sh_2 y	Colorless Sh_2 Y	Colorless Sh_2 y	Odds
6665	6629A-1 x 1041-5	6	7	10	3	21	12	
6666	6629A-1 x 1041-4	5	6	7	5	10	13	1*
6670	6629A-4 x 1041-5	6	7	7	5	6	14	
6673	6629A-6 x 1040-1	6	6	12	5	17	18	1†
6674	6629A-7 x 1040-1	5	7	7	4	5	6	3‡
	Totals	28	33	43	22	59	63	5

* This kernel was variegated, sh_2, Y

† Kernel was variegated for pale and colorless areas with few dots of A_1 pigment within the colorless areas; Sh_2, y.

‡ Kernels were colorless with 1 or 2 small dots of A_1 type pigment; Sh_2, y.

Table 21

Constitution of ♂ used in cross

♀ in cross

Culture	Plant no.	Constitution Spm + excision	a. sh2 stock	Tester I	Tester II	Tester III	Self-pollinated
				From table 19 Culture numbers			
I Pale Sh2 Y			no. of ears tested per plant.				
6665 A	-1	0		6702-2 (see table 18 for state			
" A	-2	0	1			6690	
" A	-5	0	1		6678		
II Pale Sh2 y							
" A	-3	0	1				
" B	-3	0				666E	
" B	-4	0	1			6690	
" B	-5	0		6638A		6680D	
" B	-6	0				6666E	
" D		0	2				1
6666 B	-1	0				6666E	
" B	-2	0			6678		
" "	4	0	1				
"	5	0	1				
III From Var. Sh2 Y kernels.							
6665 E	1	Y Spm/y+	1				1
"	2	"	1	6638A	6678		
"	3	"	2				
"	4	"	1	6638A			
"	5	"	1	6638A			
"	6	"	1				
"	7	Y Spm/y+	1				
"	8	Y Spm/y+	1	6638A			
"	9	"	1				
"	10	Y/y; 2 spm	2				
6666 C	1	Y Spm/y+	1				
"	2	"	1	6638A			
"	3	"	2				
"	4	"	1				
"	5	"	1	6638A			
"	6	"	1	6638A			
"	7	["] 1)	1	6638A			

1) see text

Cultivar	Plant no.	Spin no.	Anthery stock	Tester I (Table 19)	Tester II (Table 19)	Tester III (Table 19)	Self-pollinated	odds		
From var. Sh2 y hemb										
6665 F	- 1	1	2	6641A						
"	- 2	1	1							
"	- 3	1			6678					
6666 D	- 1	1		6641A						
"	- 2	1		6641A						
"	- 3	1	2	6641A						
"	- 4	1		6638A				state 5/20		
"	- 5	1	1	6641A						
From var. sh2 Y hemb										
6666 E	many crosses, see discussion in text.									
		Spin/y+								

Table 22

Test crosses conducted with plants in culture 6665G and H and culture 6666G and H derived from colorless, sh_2 kernels on ears of plant 6629A-1. Plants in Parts I and II were Y/y in constitution. Those in parts III and IV were y/y. Each plant was used as the ear parent in the cross.

Culture and Plant number	Source of pollen used in making test cross: Tester type I, Table 19, States		Pale plants with states other than those in table 19
Part I Y/y Spm present: 15 plants			
6665G-1	5718	5700A	5719A-2
6666G-4	5718	5719A-2	
6665G-7	5718	5718	
6665G-2,-5,-6,-12,-13,-16,-21	5718		
6666G-2, -5, -6, -9, -10	5718		
Part II Y/y, No Spm: 15 plants			
6665G-9	5718	5700A	5719A-2
6665G-3	5718	5700A	
6665G-10	5718	5714F	
6665G-14	5718	5719A-2	
6665G-8, -11, -17, -18, -19, -20	5718		
6666G-1, -3, -8,	5718		
6665G-11, -15	5719A-1		
6666G-7	5719A-1		
Part III y/y, Spm present: 6 plants			
6666H-6	5718	[redacted]	5996-4
6665H-5	5719A-1	[redacted]	
6666H-10, -13	5718	5719A-2	
6666H-2, -12	5718		
Part IV y/y, No Spm present: 18 plants			
6666H-9	5718		5719A-2
6665H-3	5700A		
6665H-1, -4, -10	5718		
6666H-1, -3, -8, -11	5718		
6665H-6, -7, -8, -9, -11, -12	5719A-1		
6666H-4, -5, -7	5719A-1		

Table 23.

Types of kernels appearing on ears of pale colored plants in cultures 6665 and 6666 that were $a_1 m_1 Sh_2 / a_1 m_2 sh_2$ in constitution.

Constitution of	Culture number of	number of ears.	Phenotypes of kernels: Pale		Variegated		Colorless		Totals
			Sh_2	sh_2	Sh_2	sh_2	Sh_2	sh_2	
$a_1 sh_2 / a_1 sh_2$ stock.		8	1123	1	0	0	5	1110	2239
Tester I Table 19	6638A-1	1	428						428
$a_1 m_1$ (5700A) $Sh_2 / a_1 sh_2$ pale plant.	6702-2	1	176	0	0	0	0	53	229
Tester II, Table 19	6678	2	299	128	0	0	0	156	583
Tester III, Table 19	6690	2							
	6680D	1	9	1	164	88	2	93	
	6666E	3	413 [1]		306 [2]				

[1] 160 Y : 253 y
[2] 186 Y : 120 y

$a_1^{m1}Sh_2 / a_1 sh_2$ pale plants enter Y/y or yy.

I By $a_1 sh_2$ sstock =

6665 A-2 I ✓
6665 A-5 I ✓
6665 A-3 ✓
6665 B-4 I ✓
6666 B-4 I ✓
6665 B-5 - I ✓

8

6665 D I ✓
" " I ✓

II By a_1^{m1} (5718) Sh_2 homo. pale 6638 A-1 = 6665 B-5 I ✓

By a_1^{m1} (5700A) $Sh_2 / a_1 sh_2$ pale 6702-2 = 6665 A ① ✓

III By $a_1^{m1} sh_2 / a_1 sh_2$ pale plant

6665 A-5 × 6678 ✓
6666 B-2 × 6678 ✓

IV ① By $a_1^{m1} sh_2 / a_1 sh_2$ var plant 6690

6665 A-② - I
6665 B-④ - I

② plant 6680 D

6665 B-5

③ 6666 E

6665 B-③ I
6665 B-⑥ I
6666 B-① I

Pale var. colorless

no. of	Sh2		sh2		Sh2		sh2		Sh2	sh2				
ears.	Y	y	Y	y	Y	y	Y	y						
6665B-3	49	93	42		60	55	39	15	0	126	- [illegible]			
" B-6	56	88	36	16	72	32	22	28	0	98	- OK			
6666B-1	55	72	56		54	33	45		1 Y	134	- [illegible]			
Totals	160	253			186	120			1	358				
	413		150		306		149							

Table 24

Phenotypes of kernels appearing on ears of 15 plants in cultures 6665G and 6666G in which Spm was present. The constitution of these plants was a_1 sh_2 / a_1 sh_2, Y/y, [redacted]. The pollen used to produce these ears was from plants in culture 6638A or 6701 of table 19, or from a plant ~~xxxxxxxxx~~ 6693A-2 whose constitution was a_1^{m-1} (state 5719A-2) Sh_2/a_1 sh_2 Y/y, no Spm.

Part I. Phenotypes of kernels on ears ~~xxxxxxxx xxxxxxxxx~~ of plants whose constitution was Y Spm/y+. Part II Phenotypes of kernels on ~~xxxx~~ two ears of a plant whose constitution was probably Y Spm/y +. Part III. Phenotypes of kernels appearing on an ear of each of two plants ~~whose~~ in which Spm did not appear to be linked with Y.

♀	♂	Phenotype of Kernels on ear					
		Pale Sh2		Variegated Sh2		Others	Total
		Y	y	Y	y		
Part I							
One ear per plant:							
6665G-2,5,6,12,13	6638A						
6666G-2,5,6,9-10		640	1118	1033	614		3405
2 ears per plant							
6665G-7 main	6638A-1	70	143	135	88		436
6665G-7 tiller	6638A-7	18	49	50	14		131
3 ears per plant							
6665G-1 main	6638A-3	67	130	141	78		416
6665G-1 tiller	6701-2	60	140	120	91		411
6665G-1 tiller	6693A-2	61	26	63	11	[illegible] Sh2	300
Part II							
6666G-4 main	6638A-1	18	27	27	21		93
6666G-4 tiller	6693A-2	4	1	6	1	[illegible] Sh2	[illegible]
Part III							
6665G-16 *	6338A	30	40	47	41		158
6665G-21 †	6638A	66	57	79	75		277

* Tests in succeeding generation indicated that Spm was loosely linked with Y, see table

† Tests in succeeding generation indicated no linkage of Spm with Y, see table

Table 25

Phenotypes of kernels appearing on ears produced by test crosses entered in part III of table 22. Tester plant 6693A-2 was a 1m (state 5719A-2) Sh2/a1 sh2 in Spm. Tester plant 6704C-4 was a 1m (state 5996-4) Sh2/a1 sh2, in Spm.

Culture no. of ♀ plant	Culture no. of ♂	Phenotypes of kernels: Pale Sh2	Variegated Sh2	Others	Totals
One test cross ear per plant:					
6665 H-5	6641A-5	204	179		383
6666 H-2	6638A-1	209	185		394
6666 H-12	"	211	240		451
Two test cross ears per plant					
6666 H-6 main ear	6638A-3	175	182		357
H-6 2nd ear	6704C-4	71	86	1 pale sh2, 164 colorless sh2	322
6666 H-10 main ear	6638A-3	223	258		481
" tiller ear	6693A-2	52	38	92 colorless sh2	90
6666 H-13 main ear	6638A-1	209	201		410
" tiller ear	6693A-2	41	55	91 colorless sh2	187

Table 25

Phenotypes: kernels appearing on ears of variegated plants in cultures 6665 and 6666 that were $a_1 m_1 Sh_2/a_1 sh_2$ Y y in constitution. The few kernels that were A, are not included in the tables.

Constitution of ♂ in ears.	Constitution of ♀	No. of ears.	Pale Sh2 Y	Pale Sh2 y	Pale sh2 Y	Pale sh2 y	Variegated Sh2 Y	Variegated Sh2 y	Variegated sh2 Y	Variegated sh2 y	Colorless Sh2	Colorless sh2	Totals
I													
1) a_1, sh_2, y tester stock	Y Spm/y +	15	534	533		2	818	534	1	1	2	2745	5470
2) 6665 E-10-I	Y/y 2 Spm 1)	1	32	34	0	0	64	61	0	0	0	211	402
" E-10-C	" "	1	13	24	0	0	55	54	0	0	0	158	304
3) 6666 C-1-I (see ☒ below)	[Y/y 1 Spm]	1 2)	43	47	0	0	31	35	0	0	1	142	299
4) 6666 C-2 tiller	Y Spm/y +	1	40	74	0	0	71	41	0	0	0	227	453
5) 6666 C-7 tiller ☒	[Y Spm/y +]	1	18	26	1		6	3	0	0	0	55	109
II ♂ $a_1 m_1 Sh_2$ pale plant State 5718	Y Spm/y +	6	311	587			579	307			0		1784
6666 C-2-I	[Y/y 1 Spm 4)]	1	122	129			144	121			0		516
6666 C-7-I ☒	Y/y 1 Spm 3)	1	39	31			10	17			0		97
III ♂ $a_1 m_1 sh_2/a_1 sh_2$ pale plant. 6678													
6665 E-2-I	Y Spm/y +	1	54	70	23	31	66	48	33	20	0	130	475
IV 6665 E-1 tiller self-pollinated	Y Spm/y +	1	34	23	0	0	131	30	0	0	0	75	293

1) = Y Spm/y + in next generation (= 6869)
2) = Y Spm/M + in next generation = (6868)
Tassels present = (6895) = all transposition - I

3) Confirmed in next generation (6868, 6869)

6665 E 6666 C. Y y

I of $a_1 sh_2$ y

Y spm | y +

6665 E - ① ✓
" E - ② I ✓
" E ③ I ; I ✓
" E ④ I ✓
" E ⑤ I ✓
" E - 6 - I ✓
" E - 7 I ✓
" E - 8 - I ✓
" E - 9 - I pr ✓
✓ " E - 10 I - + I (- spm) ✓

6666 C

C - ① I
C ② II Y | y 1 spm (see I below)
C ② I Y spm | y + ✓
C ③ - I ✓
C ③ - I ✓
C - 4 - I ✓
C 5 - I ✓
C - 6 - I ✓
C - 7 - I ✓

II of $a_1^m sh_2$ 5718

6665 E ② I ✓
6665 E ④ I
6665 E ⑤ I
6665 E ⑧ I

6666 C ② I ✓
6666 C - ⑤ I
6666 C - ⑥ I
6666 C - ⑦ I - pr ✓

III of $a_1 m^{-1} sh_2 / a_1 sh_2$ 6678 ✓

6665 E - 2 I

IV self - pollinated

6665 E ① I

Table 27

Types of kernels appearing on ears of variegated plants in cultures 6665 and 6666 that were $a_1^{m-1}Sh_2 / a_1 sh_2$, y/y in constitution. The few kernels with the A₁ phenotype are not included in the table.

Constitution of	Spm constitution of ♀	No. of ears	Phenotype of kernel: Pale		Variegated		Colorless		Totals
♂ in cross			Sh_2	sh_2	Sh_2	sh_2	Sh_2	sh_2	
I $a_1 sh_2$ tester stock	1 Spm	6	566	1	507	0	1	1147	2222
II $a_1^{m-1}Sh_2 / a_1^{m-1}Sh_2$ state 5718 [Tester I Table 19]	1 Spm	1	114		82				196 + [illegible]
state 5719A-1 [Tester I Table 19]	1 Spm	5	502		517				1019
III $a_1^{m-1}Sh_2 / a_1 sh_2$ pale plant 6678 [Tester II, Table 19]	1 Spm	1	101	37	96	45	0	98	377

var. $a_1^{m1}sh_2/a_1sh_2$ y/y cultures 6665 F and 6666 D

I by a_1 sh_2 tester stock

6665 F ① I

" F ① τ

" F ② I

6666 D ③ - I

" D ③ - τ

6666 D - ⑤ I

II by a_1^{m1} sh_2 pole

state 5718

6666 D - 4 - τ

III by a_1^{m1} sh_2 pole

state 5719A-1

6665 F ① τ

6666 D ① I

6666 D ② I

6666 D ③ II

6666 D ⑤ τ

IV By a_1^{m1} sh_2/a_1 sh_2 pole

6665 F ③ I × 6678

Table 28

Spm constitution of plants derived from selected kernels on ears produced by plant 6629A-1.

Phenotype of kernel from which plant arose	Number of plants tested	Appearance of plant	Number of plants having Spm	Spm number in plants having it and its location with respect to the alleles of Y in Y/y plants.
Pale, Sh_2, Y	3	Uniformly pigmented	0	-------
Pale, Sh_2, y	10	Uniformly pigmented	0	--------
Variegated, Sh_2, Y	17	Variegated	17	16 Y Spm / y + 1, 2 Spm, neither linked to Y
Variegated, Sh_2, y	8	Variegated	8	1 Spm in all 8 plants
Variegated, sh_2, Y	1	Variegated	1	Y Spm / y +
Colorless, sh_2, Y	30	Non-pigmented	15	14 Y Spm / y + 1 with 1 Spm, not linked to Y
Colorless, sh_2, y	24	Non-pigmented	6	1 Spm in all 6 plants

Table 29

Recombination between Y and Spm in test crosses of Y Spm/y+ parents and their offspring that were a_1 sh_2/a_1 sh_2, Y Spm / y + .

Cultures	Number of ears	Phenotypes of Kernels					Percent Recombination
		Pale		Variegated		Totals	
		Y	y	Y	y		
6629A (See table 20)	5	155	303	309	180	947	35.3
6665G, 6666G, 6670E, 6673F*, 6674F	26	1653	2922	2838	1530	8943	35.5

*On 7 ears produced by 6 plants in culture 6673G a partical inhibitor of Y expression was segregating among the kernels. Although linkage of Spm with Y was certain, exact classification for Y in every kernel could not be made. The kernel types on these ears are excluded from the table. There were a total of 2359 kernels on these 7 ears, 1244 were pale and 1115 were variegated.

Table 30

Spm number and location in plants of culture 6629 as determined by tests of the progeny of each.

Plant Number in Culture 6629	Spm Number and Location
A-1	Y Spm/y +
A-2	Y Spm Spm / y + + and 2 other Spm, one linked to pr in main stalk but not linked to pr in tiller
A-3	Y Spm / y +
A-4	Y Spm / y +
A-5	Y Spm / y + and 1 Spm, location not determined
A-6	Y Spm / y +
A-7	Y Spm / y +
A-8	Y Spm Spm / y + +
A-9	Y Spm / y +
B-1	y Spm / y + *
B-2	y Spm / y + * and 1 other Spm not located
B-3	1 Spm; location not determined but not linked to pr
B-4	1 Spm; location not determined but not linked to either pr or wx
B-5	Pr + + / pr Spm Spm
B-6	2 Spm; locations not determined but neither linked with pr
B-7	1 Spm; location not determined but not linked to pr or wx
B-9	3 Spm; locations not determined but none linked with either pr or wx. One probably in a_1^{m-1} carrying chromosome 3

*Determined from tests of progeny in next generation after introduction of Y

Table 31

Spm number and location, in progeny of plant 6629A-8 (culture 6676)

Spm Constitution	Approximate Ratio Pale:Var.	number of Plants	number of Ears	Phenotypes of Kernels carrying Ai^{Ca-1} Pale Y	Pale y	Variegated Y	Variegated y	Total	Y	y
Parent Plant 6629A-8 Y Spm Spm/y++	1:2	1	1	19	56	66	53	194	85	109
Culture 6676										
Y Spm/y +	1:1	14	18	655	1508	1330	647	4140	1985	2155
Y Spm Spm/y++	1:2-	3	4	35	296	411	169	911	446	465
Y Spm Spm/y++	1:2+	13	14	224	475	864	690	2253	1088	1165
Y Spm Spm/y++ 6676B-7 1st ear, main stalk				46	59	88	71	264		
Y Spm/y+ 2nd " " "				37	62	49	39	187		
Y Spm/y++ 6676C-4 1st ear, main stalk				48	147	181	84	460		
y/y 1 Spm	1:1	3	3	–	568	–	552	1120		
y/y 2 Spm	1:3	1	1	–	35	–	93	128		

Table 32

Spm constitution in plants derived from colorless, ab2, Y class of kernels on tiller ear of plant 6629A-2

Culture 6667 plant	Spm constitution	Phenotype of kernels having a, m-1 Pale Y	Pale y	Variegated Y	Variegated y	Totals	Y	y
F-8	Y Spm / y +	54	119	127	50	350		
F-11	Y Spm Spm / y ++	6	102	121	39	268	127	141
F-9	Y / y; 2 non-linked Spm	42	62	135	142	381		
F-1	Y Spm / y +; plus 1 Spm	33	57	133	100			
G-11	Y Spm Spm / y ++ plus 1 Spm	16	57	157	108			
F-5	" " + 2 Spm	2	21	120	107			
F-2	3 Spm; 1 probably in Y cls.	11	32	162	148			
F-6	" " " " "	13	30	149	129			
F-3	3 Spm	26	17	118	126			
F-10	3 Spm	5	4	45	44			

Table 33

Progeny from variegated kernels derived from Y class on ear of plant 6667 F-11 (Culture 6884)

Spm Constitution	No of plants	no. of ears	Phenotypes of kernels having a, m-1 Pale Y	Pale y	Variegated Y	Variegated y	Totals	Y	y
Y Spm / y +	2	2	95	210	185	77	567	280	287
Y Spm / y +	1	1	31	200	163	29	423	194	229
Y Spm Spm / y ++	12	12	138	868	1330	616	2952	1468	1484
Y Spm / y + and 1 non-linked Spm	2	2	55	137	260	230	682	315	367

Plants from the a1 b2 y kernels.

6667 G ①	23 pale : 214 var	3 Spm	no kulep Pr or Wx
" G ②	38 " : 109 var	3 Spm	
" G ③	159 " : 163 var	-1 Spm	- " "
" G ④	128 " : 184 "	- 2 kulet Spm	" "
" G ⑥	35 pale Wx : 8 pale un : 47 var Wx : 80 var. un		Wx + 1 un Spm + Spm
" G ⑦	177 pale : 154 var.	no kulep Pr or Wx	1 Spm
" G 8	170 " : 304 var	" " "	-2 Spm
" G 9	155 " : 144 "	" "	1 Spm
" ~~G~~ "			

1 Spm = G ③ G ⑨ ⑦ = 3

2 Spm = G ⑥ (1 kulet to un) G ④ G ⑧ = 3

3 Spm = G ①, G ②,

Table 34.

Linkage of Spm with Pr in a plant of progeny of 6629A-2; plant 6668C-6, and in progeny of this plant in culture 6877.

Spm constitution	Parentage in test cross.	No. of ears.	Phenotype of a.m.-1 kernels on ear. Pale		Variegated		Total	Recombinants
			Pr	pr	Pr	pr		
Pr+ pr Spm 6668C-6	♀	1	257		24	195		12
6877A-1	♀	1	33	170	156	26	385	15.3
	♂	2	36	196	157	18	407	13.2
	♂	2	251		170	36	457	
6877A-2	♀	1	28	255	294	25	602	8.8
	♂	2	30	202	161	14	407	10.8
6877A-4	♀	1	61	124	126	58	369	32.2
Pr/pr; 1 Spm								
6877A-3	♀	1	142	137	112	112	503	0
" A-5	♀	1	116	118	83	77	394	0
" B-3	♀	1	125	125	122	121	493	0

Table 35

Linkage of Spm with wx in plant 6668C-3 in the progeny of plant 6629-A-2 and its location in the progeny of plant 6668C-3

Spm Constitution	Phenotypes of grain kernels on test cross ear: Pale Wx	Pale wx	Variegated Wx	Variegated wx	Total	Percent Recombinants
Wx + / wx Spm + 1 non-lethal *						
6668C-3	100	30	123	212	465	
Wx Spm / wx +						
6872A-8	40	193	160	28	421	16.1
6872A-12 main ear.	26	196	197 ‡	18	438	10.4
" " 12 tiller ear	38	81	89	29	237	28.2
6872A-15 main ear *	63	185	153	48	449	24.7
" A-15 tiller ear. †	55	148	129	41	373	25.7

* Two sectors on this ear in which all kernels were pale, each on upper part of ear and 2 rows wide; 34 kernels, 17 wx : 17 wx

† Pale sects at base of ear; 7 wx : 6 wx

‡ Origin of culture 7285 - [illegible] and 7330-34

6872 = 30 plants tested:

1 = [Sm activated Spm] or no Spm

1 = only small sector in which non-kernels appeared: 49-7A, kernels in it

19 = 1 Spm, not linked to Wx or Pr

3 = 1 Spm, linked to Wx - in table

3 = 2 linked Spm elements, not with Pr or Wx

1 = 2 non-linked Spm elements

1 = 3 Spm elements

pale sectors on 5 of the 41 ears obtained from the 29 plants with Spm

Table 36

TABLE 36. *Spm* Constitution and Location in Different Plants of a Culture and in Different Parts of Individual Plants

Plant No. in Culture 7285	No. of Ears Tested per Plant	Position of Ear in Plant	*Spm* Constitution and Linkage with *Wx*
A-6, B-1, and B-6	1	1st ear, main stalk	1 *Spm;* linked with *Wx*
B-4	1	1st ear, main stalk	2 *Spm;* one linked with *Wx*
A-5	2	1st and 2nd ears, main stalk	2 *Spm;* one linked with *Wx* (both ears)
B-2 and B-5	2	1st ear, main stalk; tiller ear	1 *Spm;* linked with *Wx* (both ears)
A-1	3	1st and 2nd ears, main stalk	1 *Spm;* linked with *Wx*
		Tiller ear	1 *Spm;* not linked with *Wx*
A-3	3	1st and 2nd ears, main stalk	2 *Spm;* one linked with *Wx*
		Tiller ear	1 *Spm;* linked with *Wx*
A-4	3	1st and 2nd ears, main stalk	1 *Spm;* not linked with *Wx*
		Tiller ear	(all three ears)
A-2	3	1st ear, main stalk	1 *Spm;* linked with *Wx*
		Ear on one tiller	1 *Spm;* linked with *Wx*
		Ear on another tiller	No *Spm*
A-7	4	1st and 2nd ears, main stalk; ear on each of two tillers	1 *Spm;* linked with *Wx* (all four ears)

Table 37

Phenotypes of kernels on testcross ears of plants in culture 7285 that were Wx Spm / wx + in constitution.

Plant Number	Position of ear in plant	Phenotypes of kernels on ear: Pale colored Wx	Pale colored wx	Variegated Wx	Variegated wx	Total
A-1	First ear, main stalk	25	63	73	15	176
A-1	Second ear, main stalk	40	116	123 [1]	26	305
A-2	First ear, main stalk	27	99	78	19	223
A-2,	Second tiller	4	63	51 [2]	8	126
A-3	Tiller ear	22	72	78	16	188
A-6	First ear, main stalk	32	92	67	41	232
A-7	First ear, main stalk	23	95	93	18	229
A-7	Second ear, main stalk	28	120	136	15	299
A-7	Tiller ear	16	79	93 [3]	21	210
A-7	Tiller ear	19	57	51	22	149*
B-1	First ear, main stalk	8	103	114	17	242
B-2	First ear, main stalk	37	134	123	17	311
B-2	Tiller ear	23	92	62	22	199
B-5	First ear, main stalk	53	158	164	50	425
B-5	Tiller ear	46	110	103	33	292
B-6	First ear, main stalk	15	86	103 [4]	16	220

*There was a large sector on this ear in which only pale kernels were present. They are not included in the table.

1) origin of plants in culture 7330
2) origin of plants in culture 7332
3) origin of plants in culture 7333
4) origin of plants in culture 7334

Table 38

culture 7285

TABLE 7. Phenotypes of Kernels on ~~Two Ears of 1 Plant (A), and on~~ Twenty-Five Ears Produced by 12 Plants ~~in Its Progeny (B)~~ culture 7285

~~Kernels in A derived from cross of ♀ a_1^{m-1}/a_1, Wx/wx × ♂ a_1^{m-1}/a_1^{m-1}, wx/wx, no *Spm*; in B, from cross of~~ ♀ a_1^{m-1}/a_1^{m-1} or a_1^{m-1}/a_1, Wx/wx × ♂ a_1^{m-1}/a_1^{m-1}, wx/wx, no *Spm*.

No. and Location of *Spm* in ♀ Parent	Phenotype of Kernel: Deep Color (germinal mutation)		Pale Color (no *Spm*)		Colorless with Spots of A_1 (*Spm* present)		Total No. of Kernels
	Wx	*wx*	*Wx*	*wx*	*Wx*	*wx*	
~~A~~							
~~1 *Spm*; linked with *Wx*~~	~~0~~	~~1~~	~~26~~	~~196~~	~~197~~	~~18~~	~~438~~
	~~0~~	~~0~~	~~38~~	~~81~~	~~89~~	~~29~~	~~237~~
~~B~~							
1 *Spm*; linked with *Wx*	1	0	418	1539	1512	356	3826
2 *Spm*; one linked with *Wx*	0	0	79	267	594	323	1263
1 *Spm*; not linked with *Wx*	0	0	190	168	140	174	672

Cultures 3330, 3332-3334

Table 39

TABLE ~~12~~ *Spm* Constitution and Location in Different Plants and in Different Parts of Individual Plants

No. of Ears Tested per Plant	Position of Ear in Plant	No. of Plants	*Spm* Constitution and Linkage with *Wx*	No. of Plants with Given Constitution
1	1st ear, main stalk	13	1 *Spm*, linked with *Wx*	9*
			2 *Spm*, neither linked with *Wx*	3
			No *Spm*	1
2	1st and 2nd ear, main stalk	1	1 *Spm*, linked with *Wx*	1
2	1st ear, main stalk Tiller ear	15	1 *Spm*, linked with *Wx*, in both ears	10
			1 *Spm*, linked with *Wx*, in 1st ear; 1 *Spm*, not linked with *Wx*, in tiller	1
			1 *Spm*, linked with *Wx*, in 1st ear; 2 *Spm*, one linked with *Wx*, in tiller	1
			2 *Spm*, one linked with *Wx*, in both ears	1
			1 *Spm*, not linked with *Wx*, in both ears	2
3	1st and 2nd ear, main stalk Tiller ear	6	1 *Spm*, linked with *Wx*, in all three ears	3
			1 *Spm*, linked with *Wx*, in 1st and 2nd ears, main stalk; 2 *Spm*, neither linked with *Wx*, in tiller	1
			2 *Spm*, one linked with *Wx*, in 1st ear; 1 *Spm*, linked with *Wx*, in 2nd ear; no *Spm* in tiller	1
			2 *Spm*, one linked with *Wx*, the other linked with *Pr*, in all three ears	1
3	1st ear, main stalk Ear on each of two tillers	2	1 *Spm*, linked with *Wx*, in all three ears	2

* One ear with sector in which *Spm* was absent.

Table 1C

Phenotypes of kernels on ears, ~~in which the cells given ears were~~ % plants in cultures 7330, 7332 & 7334.

W+ Sp/ wx + ~~in constituent~~ Position of ear: I, First, main stalk; II second ear, main stalk, T = tiller ear.

Phenotypes of kernels

Culture	Plant no.	Position of ear	Constituent	W+	wx	W+	wx	Total		
7330-1		I	W+Sp/wx +	35	27	90	13	235		
		II	" "	27	67	83	20	197		
		T	" "	8	23	28	13	72		
7330-2		I	" "	29	101	87	26	243		
7330-3		I	" "	30	125	109	17	281		
		T	" "	13	82	78	7	180		
7330-6		T	" "	24	63	74	15	176		
7330-7		I	" "	9	95	117	7	228		
7330-8		I	" "	24	103	80	11	218		
		II	" "	2	25	20	2	49		
7330-9		I	" "	54	113	106	33	306		
		T	" "	25	85	82	21	213		
7330-11		I	" "	29	110	118	28	285		
	2	I	" "	42	89	88	21	240	*	
	5*	I	" "	4	8	9	4		ear = nearly all pale	
7332	1	I	" "	19	153	153	20	345		
	1	T	" "	17	62	91	9	179		
	2	I	" "	26	67	33	13	139		
	4	I	" "	20	77	98	16	211		
	4	T	" "	6	77	74	10	167		
	7	I	" "	4	29	28	3	64		
	7	II	" "	20	72	65	20	177		
	7	T	" "	12	50	53	15	130		
	8	I	" "	8	41	35	9	93		
	8	T	" "	48	145	118	33	344		
				29	96	83	31	239		
7333	1	I		11	80	72	13	176		
	1	T		8	43	34	9	94		
	1	T		10	29	42	13	94		
	2	I		34	111	130	20	295		
	3	I		23	122	131	17	293		
	4	II		11	68	60	14	153		
	9	I		24	143	138	12	317		
	9	T		5	60	41	9	115		
	9	T		13	29	37	15	94		
7334	1	I		14	101	85	17	217		
	1	T		10	40	34	6	90		
	2	I		23	144	111	15	293		
	2	T		29	102	91	32	254		
	5	I		7	25	23	3	58		
	6	I		12	51	48	5	116		
	6	T		17	55	74	5	151		
	7	I		19	51	64	12	146		
	7	T		2	20	17	3	42		
	7	T		8	32	37	3	80		
	8	I		10	154	184	15	363		
	8	T		4	37	44	5	94		

SWC

3334-	9	=	4	55	44	7	110
	9	t	26	104	89	34	253

Wx spm / wx + plus 1 spm		Pall		var.		Total
		Wx	wx	Wx	wx	
(1) 7330-2	tiller ear.	8	51	72	33	164
(3) 7330-10	I	4	42	99	46	191
" -10	II	5	51	92	43	191
(5) 7332-5	I	23	47	60	56	186
" -5	tiller	6	26	34	21	87
(6) 7333-4	I	6	28	90	51	175
(11) 7334-3	I *	14	69	150	87	320
" -3	II	0	3	7	4	14
" -3	tiller.	16	39	93	51	199
Totals		82	356	697	392	1527
Wx/wx 2 Spm						
(3) 7330-4	I	44	50	87	78	259
(4) 7330-10	tiller	32	38	70	72	212
	Totals	76	88	157	150	471
(9) 7333-7	I	24	31	67	64	186
(12) 7334-4	I	11	29	65	58	163
		35	60	132	122	349
Wx/wx 1 Spm						
(8) 7333-6	I	67	55	55	57	234
" 6	tiller	27	30	24	35	116
(10) " -10	I	69	75	55	71	270
" -10	tiller	54	64	48	50	216
(13) 7334-5	tiller	39	61	39	31	170
	Totals	256	285	221	244	1006
no spm						
(7) 7333-4	tiller	15	16			31

Table 41 A

Summary of Spm constitutions of plants in cultures 7330, 7332-34.

Spm constitution	No. of Ears	Phenotypes of kernels on testcross ears: Pale Wx	Pale wx	Variegated Wx	Variegated wx	Totals
Wx Spm / wx +	48	884	3703	3625	697	8909
Wx Spm / wx + plus 1 Spm	9	82	356	697	392	1527
Wx / wx ; 1 Spm	5	256	285	221	244	1006
Wx / wx ; 2 Spm, not linked	2	35	60	132	122	349
Wx / wx 2 Spm, linked	2	76	88	157	150	471

table 41 B

Summary of Linkage of Spm with Wx in successive years.

Wx Spm / wx +	Culture	Year				Totals	% recombinants
	6872	1955	222	747	784	164	1917	20.1
	7285	1956	418	1512	1539	356	3825	20.2
	7330	1957	351	1178	1160	234	2923	20.0
	7332	"	209	869	831	179	2088	18.2
	7333	"	139	685	685	122	1631	16.0
	7334	"	185	971	949	162	2267	15.3

Table 42.

Culture	Spin constitution			No. of Ears	Phenotype of Kernels on test cross ears: Pale Wx	Pale wx	Variegated Wx	Variegated wx	Total
Parental ear: 7285 A-1 tillers	Wx/wx	1 Spm		1	25	26	30	26	107
Progeny: 7331	Wx/wx	1 Spm	1 ear from 5 plants; 4 ears from 1 plant		567	557	499	561	2178
7331-B-5	Wx/wx	2 Spm (linked)	I and 1 tiller	2	58	60	117	150	385
	Wx/wx	1 Spm	tiller	1	46	51	39	35	171
7331-A-2	Wx/wx	2 Spm (linked)	I, II, I	3	90	90	204	213	597
7331 B-3	Wx/wx	3 Spm		1	19	13	77	85	194
7331 A-6	Wx/wx	3 Spm (2 linked)	I, II, I	3	46	60	247	224	577
7331 B-2		3 Spm (2 linked)	I, I	2	34	32	145	145	356

Table 43.

Spin constitution and location in the progeny of plant 6895 A-1

Part II
Culture
7260

Phenotype of aim kernels on Testaceous ear

Plant No	Position of Ear	Pale Y	Pale y	Variegated Y	Variegated y	Total
1	I	5	117	110	0	232
	t-1	12	103	120	9	244
	t-2	8	125	130	9	272
3	I	2	72	58	2	134
	II	2	104	87	0	193
	t-1	5	77	71	3	156
	t-2	7	55	56	4	122
4	I	0	126	131	4	261
	II	9	117	140	1	267
	t	5	146	116	4	271
5	I	1	34	26	0	61
	II	1	21	22	2	46
6	I	9	133	162	8	312
	II	6	146	134	4	290
	t	2	88	68	1	159
7	I	5	119	119	6	249
	t	12	133	138	12	295
8	I	3	131	116	13	313
	II	2	124	125	17	268
	t-1	6	131	100	6	243
	t-2	5	144	129	2	280
10	I	9	131	130	2	272
	II	3	95	88	5	191
	t	7	92	77	4	180
11	I	6	159	148	4	317
	II	6	156	166	5	333
	t	8	153	122	4	287
12	I	5	172	163	1	341
	II	12	124	122	2	260
	t-1	7	170	170	6	353
	t-2	4	82	85	3	174
14	I	18	137	127	9	291
	t	6	134	124	3	267
15	I	7	116	110	5	238
	t-1	8	99	93	6	206
	t-2	4	87	102	6	199
18	I	7	122	125	2	256
19	I	4	139	110	2	255
	t-1	10	108	96	4	218
	t-2	4	111	104	7	226
Totals			4908	4551		

Table 43, continued

Part III

Plant no. in culture	Portion of Ear		Pale		Variegated			Totals		
			Y	y	Y	y				
7260 2	I		25	203	171	11		410		
	E		65	47	48	59		219		
16	I		3	68	78	2		151		
	sector:		2	7	3	3		15		
17	I		1	91	20	1		113		
Part I	Kernel type on the [illegible] ears produced by plant 6895 A-1									
			10	157	153	9		229		

Table 44

Spm constitution in the progeny of plant 6895B-3

Plant Number in culture	Position of ear in plant	Phenotype of kernels on test-cross ear. Pale Wx	Pale wx	Variegated (Spm-fully active) Wx	Variegated (Spm-fully active) wx	Variegated (Spm-partially active) Wx	Variegated (Spm-partially active) wx	Total	Comments
Parent plant 6895B-3	I	91	184	117	75			467	
Progeny Plants Culture 7261									
Wx Spm/wx + in some part of plant									
2	I	89	140	124	55			408	
5	I	83	102	117	77			379	
	tiller	15	26	35	43			119	Deficiency in Wx class
6	I	46	98	76	47	0	3	270	
	II(no Spm)	49	64	0	0	0	0	113	
	Tiller-1	22	24	38	25	1	8	118	
	Tiller-2	31	60	51	30	6	9	187	
8	I	64	77	66	43			250	
	Tiller	12	29	33	20			94	
16	I	87	120	94	64			365	
Wx Spm/wx + plus one Spm									
10	I	96	16	103	147			362	Spm in wx dominant
	Tiller	21	47	100	105			273	
1 Spm, not linked with Wx									
1	I(see text) Tiller	95	91	76	83			345	
3	I	84	88	100	93			365	
	Tiller	63	63	68	83			277	
9	I	62	75	46	36			219	
12	I and II, see text	38	23	50	41			162	
	Tiller	103	90	92	89			374	
15	I	99	93	64	69			325	
17	I	51	61	47	53			212	
18	I	102	87	90	95			374	
19	I	85	90	98	94			367	
1 Spm in one part of plant, 2 Spm in other part									
11	I	50	55	45	32			182	
	Tiller	76	65	132	130			403	
2 Spm in two parts of a plant									
7	I	27	22	100	90			239	
	Tiller	20	33	59	60			172	

Table 45

Spin constitution in the progeny of plant 6704B 4 That was Y Spin/y +

Phenotypes of a [illegible] carrying kernels on [illegible] ear

Cultivar	Plant Number		Pale Y	Pale y	Variegated Y	Variegated y		Total		
Part I										
6704B	-4		30	178	170	38			[illegible]	
Part II										
6885A	1		38	132	114	44		328		
	2		27	161	144	27		359		
	4		31	172	154	17		374		
	5		28	186	150	18		382		
	6		48	125	130	32		335		
	7		40	234	222	54		550		
	8		30	196	151	34		411		
	9 *		51	238	230	46		565		
	10		37	174	174	53		438		
	11		32	157	149	25		363		
	12		43	[illegible]	125	40		321		
	13		41	153	155	32		381		
	14		34	164	199	51		448		
	15		45	161	155	38		399		
6885B	1		20	156	139	24		339		
	4		23	136	154	34		347		
	5		35	192	164	44		435		
	6		28	142	153	31		354		
	7		52	172	171	40		435		
	Totals		683	3164	3033	684		7564		18.7% recombination
Part III										
6885B	2		117	112	101	100		430		
✓	8 †		9	17	63	29		118		
	9		30	101	252	152		535		

→

* a sector in which all kernels were pale was present on this ear. The kernels in this sector are not included in the table

† There is a deficiency in the y class of kernels on this ear for [illegible] unknown

Table 46

Phenotypes of kernels on test cross ears.

Plant number		no. of ears.	Pale		Variegated			Total		
			Y	y	Y	y				
6671 F-1		1	28	66	66	29		189		
6672 E-3		1	89	217	185	65		556		
6672 E-1		1	43	66	159	135		403		

Table 47

Plant number		Number of Ears		Phenotype of kernels on Test Cross ear: Pale Wx	Pale wx	Variegated Wx	Variegated wx		Totals
6671F-2		1		156	40	29	140		365
6672E-4		1		128	89	85	119		421
Progeny from recombinants Cross on ear of 6671F-2 6873A-1,3, B-2,3,4,5,6 13 spm		13		1152	1216	995	1003		4366
6873A-3 2 Spm		2		52	66	197	208		523
6873B-1 3 Spm		3		89	79	572	561		1301

Table 48

Number and location of Spm in ~~the progeny~~ plants derived from the variegated, Y class of kernels on testcross ear of ~~the~~ main stalk of plant 6666C-2

Plant Number in culture 6869	Phenotype of a_1^{m-1} carrying kernels on testcross ears				
	Pale		Variegated		
	Y	y	Y	y	Total
1 Spm, linked with Y					
1	66	109	112	35	322
3	98	157	188	89	532
4	81	103	145	87	416
5	45	137	130	72	384
6	84	136	107	102	429
7	93	107	109	92	401
1 Spm, not linked with Y					
2	52	42	35	41	170
8	74	84	76	63	297
2 Spm, neither linked with Y					
9	36	38	69	58	201

Table 49

Spm constitution in progeny of plant 6665G-16 derived from the Y, variegated class of kernels on its testcross ear.

Culture Number	Phenotypes of kernels on test cross ear				Totals
	Pale		Variegated		
	Y	y	Y	y	
6866 (7 plants)	581	713	628	543	2466
6866-2	51	171	170	175	467
6866-5	16	15	95	110	236

Table 50

The Spm constitution in the progeny of plant 6665G-21.
Plants in culture 6863 were derived from the Y class of kernels on the self-pollinated ear of a tiller of plant 6665G-12. Plants in culture 6869 were derived from the Y variegated class of kernels on the testcross ear of plant 6665G-21.

Culture Number of tested plants	Phenotypes of kernels on testcross ears				
	Pale		Variegated		
	Y	y	Y	y	Total
6863-1, -2, -4, -6	477	500	455	462	1894
6863-7	199	0	169	0	368
6863-3, -9	3	4	259	281	547
6867 (15 plants)	1536	1664	1544	1654	6398
6867-9	68	92	82	61	303
6867-18	82	75	203	201	561

Table 51

Spm constitution in progeny derived from the Y, variegated class of kernels on ear of the main stalk of plant 6665E-10 (culture 6864) and from the ear of a tiller of this plant (culture 6865)

Culture Number	Phenotypes of kernels on testcross ear				
	Pale		Variegated		
	Y	y	Y	y	Total
1 Spm, not linked with Y					
6864 (11 plants)	1075	1113	1045	1036	4269
6865 (12 plants)	1023	1052	979	1026	4080
2 Spm, neither linked with Y					
6864-7	66	80	146	146	438
6864-12	51	29	150	193	428
6865-1	68	54	165	176	463
6865-12	39	40	113	121	313
2 Spm, one linked with Y					
6864-3	27	70	160	117	375

2 Spm, one linked with y (?)

Table 52

Proportion of pale colored to variegated kernels on the testcross ears produced by the Pr/Pr plants in culture 6683 and 6685 entered in 1, 2, and 3 of figure 3

Spm Constitution	Number of Plants	Number of Testcross Ears	Phenotypes of a_1^{m-1} carrying kernels		
			Pale	Variegated	Total
1 Spm	5	5	687	651	1338
2 linked Spm	5	7	694	1030	1724
3 Spm	1	3	170	593	763

Table 53

Phenotypes of kernels on testcross ears produced by plants entered in 4 to 7 of figure 3

Spm constitution	Number of Plants	Number of Testcross Ears	Phenotypes of a_1^{m-1} carrying kernels					
			Pale		Variegated			
			Pr	pr	Pr	pr	Total	
Pr + +/pr Spm Spm	16	20	1410	336	996	2018	4760	
	2	2	230		95	238	563	
Pr +/pr Spm plus 1 non-linked Spm	1	1	89	26	180	224	519	
Pr +/pr Spm								
6683D-2 tiller ear*	✗	1	92	13	19	90	214	17
6683D-3	✗	1	96	33	32	52	213	38
6683E-8	✗	1	195	69	74	193	531	27
6685F-3	✗	3	275	91	67	214	647	23
6685F-4	✗	1	90	33	28	96	247	23
6685G-3	✗	1	80	31	23	70	204	24
6685H-5	✗	1	176		41	115	332	26
6685H-10	✗	1	101		29	61	191	32
Pr/pr; 1 Spm								
6685H-24	1	1	85	122	100	109	416	

% of Recombinants

*45 pale-colored kernels in a "No Spm" sector on this ear were excluded from the table.

Table 54

Phenotypes of kernels on testcross ears produced by plants entered in figure 4

Spm Consitution	Number of Plants	Number of Testcross Ears	Phenotypes of a_1^{m-1} carrying Kernels				
			Pale		Variegated		
			Pr	pr	Pr	pr	Total
Pr Spm/pr +							
Ears of 6684D-1		2	50	90	91	48	279
Pollen of main stalk, 6684D-1		2	80	188	114	46	428
Pollen of tiller, 6684D-1		6	128	228	208	107	671
Pr Spm Spm/pr + +							
6684D-2, Ear on main stalk			11	62	81	29	183
" ", Ear of tiller			22	73	93	34	222
6684D-3		1	5	43	54	22	124
6684E-5		1	140		134	56	330
6684E-6		1	161		141	54	356
pr/pr; 2 linked Spm							
6684A		1		83		106	189
6684E-8		1		155		234	389
6684E-9		1		116		248	364
6684E-11		1		151		222	373
pr/pr; 1 Spm							
6684E-2		1		246		235	481
6684E-3		1		145		162	307
6684E-4		1		134		140	274
6684E-12		1		159		163	322
6684E-13		1		233		222	455
6685E-15		1		192		218	410

Table 55

Spm constitution of Pr/pr progeny of tiller of plant 6683D-2

Plant Number in culture 6878	Spm Constitution	Number of Ears	Phenotype of a_1^{m-1} carrying kernels on ears: Pale Pr	Pale pr	Variegated Pr	Variegated pr	Total
A-1, Ear	Pr Spm/pr +	1	61	129	99	40	329
Pollen	" " " "	2	73	124	106	31	334
A-3, Ears	Pr/pr; 1 Spm	3	393		140	143	676
A-4, Ears	Pr/pr; 1 Spm	2	490		195	221	906
Pollen	" " " "	2	213		79	92	384
B-2, Ears	Pr/pr; 1 Spm	2	152	145	120	123	540
Pollen	" " " "	2	406		72	105	583
B-3, 1st ear, main stalk	Pr/pr; 1 Spm		51	51	43	44	190
2nd ear, main stalk	" " " "		35		17	17	69
Tiller ear	Pr/pr; 2 Spm		25	23	78	78	204
B-4, Ears	Pr/pr; 1 Spm	2	140	131	117	117	505
B-1, Ear main stalk	Pr/pr; 2 linked Spm		100	101	137	149	487
Tiller ear	Pr/pr; (1 Spm) Deficiency in pr class		70	40	61	39	210

Table 56

Spm constitution and location in progeny of plant 6685F-3

Plant Number and Constitution	Number of Ears	Phenotypes of a_1^{m-1} carrying kernels on ear				Totals	Percent of Recombinants in variegated class
		Pale		Variegated			
		Pr	pr	Pr	pr		
Pr+/pr Spm							
6685F-3, tiller ear		87	30	21	74	212	22
Pr Spm/pr +							
6882A-4	1	55	201	177	44	477	20
6882A-5	1	40	166	160	26	392	14
6882A-7	1	45	143	139	31	358	18
6882B-3	1	9	40	34	12	95	24
Pr/pr; 1 Spm							
6882A-2	1	82	83	94	92	351	
6882A-3	1	154	141	88	93	476	
6882A-6	1	85	66	66	69	286	
6882B-1, pollen	3	185	171	134	152	642	
Pr/pr; 4 Spm							
6882A-2, Ear on main stalk		15	14	235	246	510	
Tiller ear		9		50	54	113	
Pr/pr; No Spm							
6882B-2							

Table 57

Spm constitution and location in [redacted] progeny of plant 6685G-2

Plant Number and Spm Constitution	Number of Ears	Phenotypes of a_1^{m-1} carrying kernels on ears: Pale Pr	Pale pr	Variegated Pr	Variegated pr	Totals	Percent Recombinants in variegated class
Parent Plant							
Pr Spm/Pr +							
6685G-2	1	132	0	137	0	269	
Progeny, Culture 6875							
Pr Spm/pr +							
A-4	2	75	296	274	70	715	20
A-5	1	39	165	170	37	411	18
B-3	2	81	277	228	49	635	18
B-4*	3	77	345	305	69	796	18
B-5†	2	109	335	334	126	904	27
B-10	2	53	228	201	64	546	24
A-1	1	191		160	26	377	14
A-2	2	264		177	49	490	21
A-3	1	184		126	30	340	19
A-6	1	266		230	44	540	16
A-7	1	253		202	60	515	23
B-6	1	207		173	42	422	19.5
B-7, Tiller ear		93		69	11	173	13.6
B-12	1	167		160	33	360	17
B-13	1	173		132	46	351	26
	Totals	3878		2941	756	7575	20.4
Pr Spm/pr +; plus 1 Spm,							
B-9	1	49	105	209	148	511	
B-7, Ear of main stalk		128		132	87	347	
Pr/pr; 1 Spm							
B-8	1	281		114	132	527	
Pr/pr; Inactive Spm, location not determined							
B-1, B-2, B-11							

*On the second ear of the main stalk there was a sector at the base of the ear in which all kernels were pale colored in the upper part and in which variegated kernels appeared in the lower part, these being distributed equally between the Pr and pr classes. The kernels within this twin sector were excluded from the data given for this ear.

†There was a sector in the middle of the ear of the tiller in which all kernels were pale colored. These kernels were excluded from the data given for this ear.

Table 58

Spm constitution and location in progeny of plant 6684D-1. Spm received from tiller of plant 6684D-1. Only one testcross ear obtained from each progeny plant.

Spm Number and location in plants of cultures 6680 and 6681	Phenotypes of a_1^{m-1} carrying kernels on testcross ears: Pale Pr	Pale pr	Variegated Pr	Variegated pr	Total	Percent Recombinants among Variegated class of kernels
Pr Spm/pr +						
6880-1	57	148	137	53	395	28
" -3	40	114	120	23	297	16
" -4	57	125	121	52	355	30
" -5	53	192	172	58	475	25
" -6	41	131	118	23	313	16
" -7	75	161	166	73	475	30
" -8	40	169	142	30	381	17
" -10	26	63	69	17	175	20
" -11	32	71	96	37	236	28
Totals	421	1174	1141	366	3102	24.2
6881-1	198		106	48	352	31
" -3	175		95	34	304	26
" -4	58		42	26	126	38
" -6	125		59	26	210	31
" -7	77		45	21	143	32
" -8	197		117	45	359	28
" -9	201		117	37	355	24
" -10	58		35	14	107	28
Totals	1089		616	251	1956	28.0
Pr/pr; 1 Spm						
6880-2	67	73	71	77	288	
6881-2	234		98	99	431	
Pr/pr; 3 Spm						
6881-5	31	36	167	176	410	
No Spm						
6880-9						

Table 59

Spm constitution and location in progeny derived from self-pollinated ear of tiller of plant 6684D-1

Spm Constitution and Location	Phenotypes of a_1^{m-1} carrying kernels on testcross ears					Percent of Recombinants in Variegated class of kernels
	Pale		Variegated			
	Pr	pr	Pr	pr	Total	
Parent Plant Pr Spm/pr +						
6684D-1, ear of tiller, self-poll.	38	32	142	28	240	
Progeny, Culture 6879						
Pr Spm/pr +						
6879-3	51	73	77	49	250	34
" -4	13	36	53	16	118	23
" -16	14	25	24	7	70	22
" -7	170		88	55	313	38
" -18	147		94	28	269	23
Totals	529		336	155	1020	31.5
Pr +/pr Spm						
6879-20	73	52	32	66	223	33
" -13	138		46	79	263	35
Pr/pr; 2Spm (allelic positions ?)						
6879-11 Ear, main stalk	13	24	132	130	299	
Tiller ear	5	12	73	76	166	
6879-19	32	32	100	70	234	
Pr/pr; 1 Spm						
6879-5	27	18	19	17	81	
" -10	202		88	81	371	
Pr/Pr; 1 Spm						
6879-6	184		127		311	
" -12*	59		40		99	
Pr/Pr; 2 Spm (allelic positions ?)						
6879-1	35		257		292	
" -14	93		249		342	
No Spm						
6879-9						

*Spm was inactive in a few kernels on this ear.

Table 60

Spm number in progeny of plants having either 1 or 2 or 3 non-linked Spm elements in them. The Spm number given in this table is that which was present in the part of a plant that produced the first ear on the main stalk. Only those progenies that were grown in the summers of 1952 to 1955 are included.

Number of Spm in Parent Plant	Number of Plants in Progeny having 1, 2, or 3 Spm Elements			
	1 Spm	2 Spm	3 or more Spm	Total
1 Spm	285	22	6	313
2 Spm	89	28	11	128
3 Spm	36	31	26	93

Table 61

~~Spm number in different parts of individual plants.~~ ~~A.~~ Correspondence of Spm number in all tested parts of plant. ~~B. Non-correspondence of Spm number in all parts of a plant.~~

Parts of Plant Tested	Number of Plants with Stated Spm Number in Each Part Tested			
	1 Spm	2 Spm	3 or more Spm	Total
Ears I and II, main stalk	6	5	0	11
Ear I, main stalk, and tiller ear	45	18	5	68
Ear I, main stalk, and pollen	13	3		16
Ears I and II, main stalk, and tiller ear	3	4	1	8
Ear I, main stalk, and ears of two tillers	9	1	1	11
Ears I and II, main stalk, and pollen	1			1
Ear I, main stalk, ear of tiller, and pollen	8	1		9
Ear I, main stalk, ears from two tillers, and pollen	1			1
Totals	86	32	7	125

Only plants grown in the summers of 1952, ~~and~~ 1955 are included in this table.

Table 62

Non-correspondense of Spm number in different parts of a plant. Only those plants that were grown in the summers of 1952 to 1955 are included in the table. Parts of plants in which Spm was absent, or in which it was absent in a segment within the part tested, are also excluded from the table.

Plant Number	Part of Plant Tested		
	Spm Number in Main Stalk	Spm Number in Tiller	Spm Number in Second Tiller
6452-3	3	2	
6453-9	2	2	3
6676B-7	2	1	
6684F-1	2	1	
6872-2	2	1	
6874B-3	1	2	
6874B-10	3	2	
6875B-7	2	1	
6876-8	1	2	
6878B-1	2	1	
6878B-3	1	2	

Table 63

Phenotypes of kernels appearing on testcross ears of plants in culture 6888 that were derived from uniformly pale colored kernels on ear of plant 6683B-2. Pollen parent used in making cross was homozygous for a_1 and sh_2 and carried 1 active Spm.

Constitution of Plant in Culture 6888	Number of Plants	Phenotypes of kernels on ear					
		Pale Sh_2	Variegated Sh_2		Colorless Sh_2	Colorless sh_2	Totals
			Many Spots of A_1 in colorless background	1 or several spots of A_1 in colorless background			
$a_1^{m-1}Sh_2/a_1^{m-1}Sh_2$	2	419	471	1	0	0	891
$a_1^{m-1}Sh_2/a_1\ sh_2$	5	596	597	1	1	1142	2337

Table 64

Phenotypes of kernels appearing on ears of plants in culture 6888 that were derived from kernels on ear of plant 6683B-2 that had only 1 or several dots of A_1 in a colorless background. The pollen parent used in making the cross was homozygous for a_1, sh_2, and pr and had 1 active Spm. (See Figure 5)

Constitution of Plants in Culture 6888 (All were Pr/pr)	No. of Plants	Phenotypes of kernels on Ear: Pale Sh_2		Variegated Sh_2				Colorless Sh_2	Colorless sh_2	Totals
		Pr	pr	Many Spots of A_1 in colorless background		1 or several Spots of A_1 in colorless background				
				Pr	pr	Pr	pr			
$a_1^{m-1}Sh_2/a_1^{m-1}Sh_2$	2	75	102	170	177	97	56	31	0	708
" "	1	91		131	118	52	43	49	0	484
$a_1^{m-1}Sh_2/a_1\ sh_2$	5	101	169	283	256	163	67	36	1033*	2108

*In addition, there were 3 sh_2 kernels with many spots of A_1 in a colorless background.

Table 65

Location of Spm-w in progeny of plants in culture 6888 as judged by kernel phenotypes appearing on testcross ears each produced. The pollen parent used to make each cross was homozygous for a_1^{m-1}, Sh_2, and pr and it had no Spm. (state 5719A-1 or state 5718)

Constitution of Tested Plants	Number of Ears	Phenotypes of Kernels on Ear: Pale Colored Pr	Pale Colored pr	1 or several A_1 dots in colorless background Pr	1 or several A_1 dots in colorless background pr	Colorless	Total
Pr Spm-w/pr +							
Culture:							
7262C, D	5	206	769	437	116	390	1918
7263C, D	5	298	782	403	138	457	2078
7264B	9	431	1207	702	232	602	3174
Totals	19	935	2758	1542	486	1449	7170
Pr +/pr Spm-w							
Culture:							
7263D	3	475	203	124	229	323	1354
Pr/pr; 1 Spm-w							
Culture:							
7263C	2	170	166	76	88	192	692
Pr/Pr; 1 Spm-w							
Culture:							
7263C	2	284	--	143	--	142	569
Pr Spm-w/pr +							
Delayed time of activation of Spm							
Plant 7264B-6	1	142	154	30	8	85	419
"Inactive" Spm+ u^r		60	25				85
						Total	504

Table 66

Phenotypes of kernels on testcross ears of "No Spm-w" plants in figure 7.

Plant Number	Phenotype of kernel: Uniformly Pale pigmented		Many A_1 Spots in Colorless background		Total
	Y	y	Y	y	
Y +/y Spm-s :					
7262B-4	169	6	3	225	403
7263A-1*	9	13	6	20	48
" A-4	124	24	18	123	289
" A-5	67	16	8	60	151
" A-6(ear I)	166	55	37	172	430
" " "(" II)	87	27	17	100	231
" A-7	149	59	44	137	389
Totals for plants in Culture 7263	602	194	130	612	1538
Y +/y Spm-s plus 1 Spm-s:					
7263A-3†	135	28	81	194	438
Y +/y Spm-s plus 2 Spm-s :					
7262B-2	51	3	152	193	399
y/y; 1 Spm-s :					
7263B-3	--	159	--	162	321
" B-6	--	206	--	204	410
" B-9	--	105	--	85	190
y/y; 2 Spm-s :					
7263B-2	--	107	--	297	404

* Ear was partially sterile.

† One Y, Pr kernel on ear had only few A_1 dots in colorless background.

Table 67

Phenotypes of kernels appearing on testcross ears of plants in 1. and 2. of figure 7 under heading "Spm-w present".

Phenotype of kernel with Regard to a_1^{m-1} action:	Plant Number	Pr Y	pr Y	Pr y	pr y	Totals
Pale color (no Spm-s, no Spm-w)						
	7262B-1	28	51	0	3	82
	" B-3	20	41	0	2	63
	" B-5	18	54	2	2	76
	7263A-8	32	54	7	5	98
	Totals	98	200	9	12	319
	7263A-2	42		37		79
Many A_1 spots in colorless background (Spm-s present)						
	7262B-1	9	6	74	92	181
	" B-3	0	5	74	66	145
	" B-5	3	4	102	82	228
	7263A-8	4	4	110	102	220
	Totals	16	19	360	342	737
	7263A-2	30	45	48	97	153
One or several A_1 dots in colorless background (Spm-w, no Spm-s)	7262B-1	56	24	2	1	83
	" B-3	41	15	4	2	62
	" B-5	62	11	1	3	77
	7263A-8	53	19	4	3	79
	Totals	212	69	11	9	301
	7263A-2	20	5	11	5	41

Colorless; no A_1 dots (Spm-w, no Spm-s)	7262B-1	18	1	19
	" B-3	3	0	3
	" B-5	21	0	21
	7263A-8	14	4	18
	Totals	56	5	61
	7263A-2	19	18	37

Total number of Kernels: 1728

Summaries of plants 7262B-1, B-3, B-5 and 7263A-8:

737 Spm-s (376 Pr : 361 pr; 35 Y : 702 y)
362 Spm-w; no Spm-s (223 Pr : 78 pr; 337 Y : 25 y)
319 no Spm-s, no Spm-w (107 Pr : 212 pr; 298 Y : 21 y)

29.8 % recombination between Pr and Spm-w
5.7 % recombination between y and Spm-s

Table 68

Phenotypes of kernels appearing on testcross ears of plant in 3 and 4 of figure 7 under heading "Spm-w present".

	Phenotype of kernel							
	Pale		Many A_1 dots in colorless background		1 or several A_1 dots in colorless background		Colorless	
Plant Number	Pr	pr	Pr	pr	Pr	pr		Totals
7263B-1								
Part of ear with Spm-s	29		20	20	10	5	7	91
Part of ear with no Spm-s	69		0	0	52	2	21	144
7263B-4	17	30	45	44	16	9	3	164
7263B-8	17	42	52	58	29	9	21	228
Totals	204 Pale		117	122	107	25	52	627
7263B-7	20	51	183	217	30	11	20	532

Table 69

Phenotypes of kernels appearing on ears of plants that were homozygous for state 5719A-1 a_1^{m-1} and were Pr Spm-w/pr +, when crossed by plants homozygous for state 5719A-1 a_1^{m-1} and pr that had no Spm in them.

Plant Number of Female parent in Cross	Phenotype of Kernel: Pale Colored		Spots of A_1 in Colorless Background *		Colorless	Total
	Pr	pr	Pr	pr		
7347A-2	46	110	79	50	4	289
7347A-3, tiller-1	53	125	90	43	11	322
" " -2	36	66	65	39	3	209
7347A-4, tiller-1	43	63	66	23	6	201
" " -2	25	44	40	19	3	131
7348A-1, main ear	37	47	35	17	29	165
" tiller ear	51	95	89	32	21	238
Totals	291	550	464	223	77	1605

No Evidence of Spm: 841 34.6% are recombinants

Spm present: 764 32.4% among variegated class are recombinants

*The number of A_1 spots in most kernels was low, being only 1 or several. On the ear of plant 7347A-2 one kernel appeared with and Spm-s type variegation pattern, and another kernel that had nearly as many dots of A_1. Also, therewere several kernels that had sectors within them in which many dots of A_1 appeared.

Table 70

Phenotypes of kernels appearing on ears of plants in culture 7530A that were $\underline{a}_1^{\underline{m}-1}$ (state 5700A)/ $\underline{a}_1^{\underline{m}-1}$ (state 5719A-1) produced by cross with plants homozygous for $\underline{a}_1$ and having no Spm (Part I) or in which 1 Spm-s was present (Part II).

Plant Number in Culture 7530A	Position of Ear on Plant	Culture Number of ♂ parent	Phenotype of Kernel: Pale Colored	State in Variegated Kernel* 5719A-1	5700A	Total
A-1	First ear, main stalk	7510-14	178	0	0	178
A-2	Second ear, main stalk	7510-14	491	0	0	491
A-4	First ear, main stalk	7532D-4	549	0	0	549
Part II						
A-1	Second ear, main stalk	7532D-6	109	68	45	222
A-2	"	" D-1	92	33	33	158
A-3	First ear, main stalk	" D-2	261	137	129	527
"	Tiller ear	" D-6	10	10	8	28
A-5	First ear, main stalk	" D-1	135	61	65	261
"	Second ear, main stalk	" D-6	86	50	38	174
	Totals		693	359	318	1370

* ~~For~~ under state 5719A-1 kernels had many A_1 dots (see photo.). ~~For~~ under state 5700A, the number of A_1 dots in a kernel was far in excess of those under heading 5719A-1 (see photo). in kernels

Table 71

Phenotypes of kernels appearing on ears of plants in culture 7530B that were a_1^{m-1} (state 5700A)/a_1^{m-1} (state 5719A-1), **Pr** +/pr Spm-w in constitution produced by cross with plants homozygous for a_1 and having no Spm.

Plant Number in Culture 7530B	Position of Ear in Plant	Phenotype of Kernel: Pale colored	Many A_1 spots in colorless backgroud (state 5700A)	1 or several A_1 spots in colorless background (state 5719A-1)	Colorless	Total
1	First ear, main stalk	243	122	101	22	488
"	Tiller	150	103	69	11	333
2	First ear, main stalk	244	108	123	11	486
"	Second ear, main stalk	35	28	17	0	80
3	First ear, main stalk	253	144	112	17	526
4	"	74	39	38	8	159
5	"	265	115	119	21	520
Totals		1264	659	579	90	2592

Table 72

Kernel types on ears of plants in culture 7529 that were a_1^{m-1} (state 5700A) Sh_2/ a_1^{m-1} (state 5719A-1) Sh_2, Pr +/pr Spm-w in constitution when crossed by plants homozygous for a_1 and sh_2 and having no Spm. Pollen parent used in making cross to six of the ears was homozygous for pr. That used in making cross to 7th ear (first ear, main stalk, plant 7529-4) was homozygous Pr.

Plant Number in Culture 7529	Phenotypes of Kernels on Ear: Pale Colored	Small dots or specks of A_1 (from approximately 10 to several hundred) in colorless background (state 5700A)*	1 or 2 dots or specks of A_1 in colorless background (state 5719A-1)	Colorless (state 5719A-1)	Totals
4, Ears I and II	369	180	95	83	727
5, Ear I	285	140	43	69	537
3, Ears I and II	221	108	30	77	436
2, Ear I	293	33	17	34	377
1, Ear I	261	101	33	61	456
Totals	1429	562	218	324	2533

Totals, state 5719A-1: 542

of kernels having A_1 dots in colorless background

On ears produced by cross with plants that were pr/pr, 37.5% were Pr and 62.5% were pr.

* [illegible]

Part V . Origin and Behavior of $\underline{a}_2^{\underline{m}-1}$

In the progeny derived from self-pollination of a plant that had undergone the chromosome type of breakage-fusion-bridge cycle in early development, an unstable expression of a gene concerned with chlorophyll development appeared. The locus responsible for this was designated luteus-mutable although the location of it in the chromosome complement was not known. During the early study of lu^m, a number of sister plants carrying it were self-pollinated. Some of these plants were C/c in constitution and a ratio of three fully pigmented to one colorless kernel was expected to appear on their ears. This ratio was found among the kernels on ears of all but one of these plants. On the ear of the exceptional plant, plant number 3908-5, in addition to fully pigmented and colorless kernels there were some kernels that had spots of deep anthocyanin pigmentation in a colorless background and the pigment type in them suggested that a gene locus resembling either A_1 or A_2 in action was responsible for this. On this ear there were 214 fully pigmented kernels, 105 totally colorless kernels, and 35 kernels that had pigmented spots in a colorless background. The pattern of variegation among the latter kernels was not alike. The majority of them had some large areas of deep pigmentation and a number of smaller spots of this. Some kernels, however, had only small spots of deep pigmentation and among them, the number of spots was not the same.

The following winter, five plants were grown from the variegated kernels on the ear just described under culture number 4062A and four plants were grown from the colorless kernels under 4062B. Four of the five plants in 4062A were self-pollinated, crossed to plants homozygous for c, and to plants carrying other gene markers. Simil r tests were conducted with three of the four plants in B culture of 4062. On the self-pollinated ear of these the plants in 4062B, all kernels were totally colorless. Two of these plants were C/C and one was C/c. Among the four tested plants in 4062A, derived from variegated kernels, three were C/C and one was C/c (plant 4062A-1). The types of kernels that appeared on the self-pollinated ears of these plants are given in table 1. Fully pigmented kernels, variegated kernels and colorless kernels appeared on all ears. These kernel types suggested that the gene responsible for instability of expression of anthocyanin pigmentation was undergoing mutation to give either a full expression of the gene or a null expression of it.

The following summer, plants were grown from more of the variegated kernels on the ear of plant 3908-5 and also from kernels on the ears produced by crosses of plants 4062A-3 and A-4 and 4062B-1. The variegated kernels were graded according to the pattern of pigmented spots ~~in ear~~, from those that had a number of large pigmented areas to those

that ha~~ving~~ only a few small pigmented spots. The plants derived from the variegated kernels were themselves variegated. Note was taken of the type of this in each plant. It was obvious from these observations that some component was controlling the pattern of mutation and that this ~~xxx~~ component was undergoing change during plant development. Clearly defined sectors appeared in these plants in which the rate of mutation was distinctive, each sector exhibiting one particular type of this. The differences were expressed in number of ~~xxxxxx~~ pigmented streaks ~~of pigmentation~~ in a non-pigmented background, and in the size of these streaks. These plants were tested in various ways including crosses with plants derived from the totally colorless kernels on the self-pollinated ear of plant 4062B-1 and to plants homozygous for the standard recessives of a_1 in chromosome 3, a_2 in chromosome 5, and a_3 in chromosome 10; These tests revealed that the locus responsible for the variegation expression was A_2 in chromosome 5. Some change had occurred at this locus in a cell of a plant carrying lu^m, and this was responsible for the subsequent unstable expression of ~~xxxx~~ A_2. The modified locus was therefore given the designation $\underline{a}_2^{\underline{m}-1}$.

Study of a_2^{m-1} was continued for several more growing seasons but from the tests of it that were made, no clear interpretation ~~of its mode~~

of the mode of operation of the system responsible for control of its expression. During this period, the kernel carrying a_1^{m-1} appeared on an ear of a plant in these a_2^{m-1} cultures. Examination of its behavior, outlined in sections 2, ~~to~~ 3 and 5, made evident the system that was responsible for control of its expression. Realizing that a_1^{m-1} had arisen in a plant in which the a_2^{m-1} system was operating and that it was possible that both a_1^{m-1} and a_2^{m-1} might be controlled by the same system, study of a_2^{m-1} was recommenced in the summer of 1955. Evidence obtained during this summer ~~of 1955~~ made it clear that a_2^{m-1} also was controlled by ~~a system involving~~ a Suppressor-mutator system but this Spm in the a_2^{m-1} cultures was behaving in a manner distinctly different from ~~that~~ the Spm element in the a_1^{m-1} cultures. ~~However~~, However, some of the crosses made during the summer of 1955 indicated that a_2^{m-1} would respond to the Spm element ~~in~~ the a_1^{m-1} cultures in the same manner that a_1^{m-1} responds to it. Tests were then commenced to establish the common type of response of a_1^{m-1} and a_2^{m-1} to the Spm elements ~~that were present in the a_1^{m-1} cultures~~ and the evidence of this is reviewed in detail in part VI of this report. There is no longer any doubt that both a_1^{m-1} and a_2^{m-1} belong within the same Suppressor-mutator system. The question arises, then as to why this system was not ~~realized~~ recognized in the earlier study of a_2^{m-1}. There were

two main reasons for failure to recognize this. One of them involves cyclically ~~occurring~~ changes in phase of action of Spm which were occurring in the a_2^{m-1} at times during development of the plant that obscured recognition of ~~its~~ the presence of Spm. The other was the appearance of a state of a_2^{m-1} that differed from all other isolated states, either of a_1^{m-1} or of a_2^{m-1}. It gives rise in both plant and kernel to variegated patterns of anthocyanin pigmentation but in contrast to other states, these do no result from mutation at a_2^{m-1}. When attention was directed to the possible control of a_2^{m-1} by an Spm element, and thus, when tests to determine this were conducted, the nature of this state was quickly revealed. Subsequently, it proved to be a most important state for examining the cyclically occurring changes in phase of activity of Spm.

The early tests of a_2^{m-1} behavior and some of those conducted in 1955 and later will not be reviewed here. Nevertheless, all of them have been useful in interpreting a_2^{m-1} behavior in one way or another. Many of them illustrate change in phase of activity of Spm but until this behavior was recognized, the tests with a_2^{m-1} lacked the preciseness that is required to establish this. Therefore, in this section, only some selected tests of a_2^{m-1} will be discussed.

Part VII

Identity of System Controlling Expression of a_1^{m-1} and a_2^{m-1}

During the summer of 1955 when tests of of the behavior of a_2^{m-1} were resumed, evidence was obtained indicating that an Spm-type element w was responsible for control of gene action at a_2^{m-1}. As pointed out in the last section, the expression of this Spm element was obscure and this contrasted with the clearity of this in the a_1^{m-1} cultures. However, several test crosses were made during the summer of 1955 the result$ of which ~~indicated~~ suggested that the Spm¢ element in the a_1^{m-1} cultures ~~would~~ control gene action at a_2^{m-1} ~~in as sharply~~ expressed a manner as it was ~~doing~~ known to do in the a_1^{m-1} cultures. Tests were then initiated to ~~determine if this could be~~ demonstrate¢ ~~unambiguously~~. Some of these ~~tests~~ will be ~~outlined~~ considered below. Before doing so, it will be necessary to outline the previous history of the plants.

During the summer of 1949, a plant that was homozygous for a_2^{m-1} had been crossed to one homozygous for the standard recessive, a_2. On the ear this cross produced, there weremany uniformly pale colored kernels and some variegated kernels that ~~showing~~ showed spots or specks of A_2 in a colorless background. In 1950, some of the kernels on this ear were sown under culture number 5303, and those in 5303C were derived from pale colored kernels in which there were one or several colorless areas within which specks of the A_2 phenotype were present. One plant

in culture 5303C, plant number 3, was variegated in that small streaks of the A_2 phenotype appeared in a non-pigmented background. This plant was a_2^{m-1}/a_2 in constitution. The first ear on the main stalk was self-pollinated. Among a total of 455 kernels this ear produced, 150 were uniformly pale colored, 195 were variegated and the pattern of ~~this~~ ranging from ~~one that had~~ spots of A_2 in a colorless background to tiny specks of A_2, either throughout the kernel or ~~in~~ restricted to colorless areas in an otherwise pale-colored kernel. In addition, there were 110 colorless kernels. An ear of a tiller of this plant was used in a cross with a plant homozygous for a_2. This ear was sectorial with regard to ~~the~~ expression ~~of~~ a_2^{m-1}. Nearly all the a_2^{m-1} kernels within a well defined sector, extending a distance of about 2/3rds of the ear and covering several rows, were uniformly pale colored. Only 3 kernels within this sector were variegated. They had tiny specks of the A_2 phenotype in a colorless background. On the rest of this ear, the a_2^{m-1} kernels segregated in a 1 : 1 ratio ~~of~~ uniformly pale colored ~~to~~ variegated. Among the variegated kernels, the pattern of A_2 mutant areas ranged from spots of A_2 in a colorless background in some kernels to specks of this in other kernels. Pollen of plant 5303C-3 was placed on the silks of an ear of a plant homozygous for a_2.

Among the a_2^{m-1} carrying kernels on the resulting ear, a ratio ~~of~~ approximating 1 uniformly pale colored kernel to 1 variegated kernels appeared and the patterns of variegation among the kernels in the variegated class were similar to those of the reciprocal cross, just described. Kernels from this ear were sown in the summer of 1955 under culture number 6908. Tests conducted with one plant in this culture will be described.

Plant 6903A-3 was derived from a pale colored kernel on the ear mentioned above.. ~~The plant proved to be variegated in that very small streaks of A_2 appeared in a non-pigmented background.~~ Pollen of this plant was placed on the silks of ears of three different plants, each homozygous for a_2. Two of these three plants ~~xxxx~~ belonged to the regular a_2 tester stock. The third had quite a different history. It was derived from a colorless kernel on an ear produced by the cross of the the original plant carrying a_1^{m-1} to a plant that had a_2 but was homozygous for A_1. The original a_1^{m-1} carrying plant was a_1^{m-1}/a_1, A_1/a_2 in constitution and it carried a number of active Spm elements. The colorless kernels on this ear of the cross just described should be a_2/a_2 and either A_1/a_1^{m-1} or A_1/a_1 in constitution, and ~~it~~ the majority of them should have ~~several~~ one or more active Spm elements. ~~in it~~. The a_2/a_2 plant ~~to which~~ used in the cross with plant 6903A-3 was ~~made proved to be~~ A_1/a_1, as later tests showed. The types of kernels on the ears

produced by crosses with the two a_2 tester plants and with this a_2 plant were strikingly different. Among the 482 kernels on the ears produced by the former cross, all but 23 of the a_2^{m-1} coming kernels were uniformly pale colored. Of the 23 odd kernels, 11 were variegated for small specks of the A_2 phenotype in a colorless background and 12 were sectorial for such areas in an otherwise pale colored kernel. Among the 383 kernels produced by the latter cross, 183 were totally colorless (the a_2's/a_2 class) and 200 were variegated for A_2 spots in a colorless background and the pattern of ~~variegation~~ spots was quite similar ~~among all of~~ in all of the kernels ~~expressing it~~. ~~Spots of the A_2 phenotype appeared in a colorless background~~ (Photo.). It was suspected that the Spm elements in the a_2/a_2 parent of this cross ~~was~~ were responsible for the uniformly expressed variegated ~~expression of~~ pattern in these kernels and that the Spm elements ~~in it~~ were the same as those that control gene action at a_1^{m-1}. Therefore, both ~~the~~ variegated kernels and colorless kernels on this ear were sown in the summer of 1956 under culture number 7113 and tests of the plants derived from ~~them~~ such were commenced in order to obtain evidence for the supposed identity of the system responsible for control of gene action at both a_1^{m-1} and a_2^{m-1}.

Plants derived from variegated kernels on the ear just described were sown under culture numbers 7113A and 7113 B. Those derived from

the colorless kernels were sown under 7113C and 7113D. A number of different types of test were conducted with the plants of culture 7113 Included among them were crosses of the a_2^{m-1}/a_2 mutant plants in A and B of culture 7113 to plants homozygous for a_2 and A_1 derived from the standard tester stocks. ~~These tester plants were A_1/A_1 in constitution.~~ The types of kernels appearing on the ears produced by these test crosses are entered in table 1. Some of the plants in culture 7113 were also crossed by plants homozygous for a_1^{m-1} (state 5718) and for A_2 in which no Spm was present. This was done in order to determine the constitution of the plants in culture 7113 with respect to the allele of A_1 and also the presence in them of Spm elements capable of ~~altering~~ controlling behavior of a_1^{m-1} in the ~~usual~~ expected manner. Some plants in culture 7113 proved to be A_1/A_1 and others proved to be A_1/a_1. In all plants of the latter phenotype, one or more active Spm elements were present as shown by the ratios of kernel types on ears so produced, these entered in table 2. Comparison of ratios of uniformly pale kernels (no active Spm present) to variegated kernels (active Spm present) for a_2^{m-1} and for a_1^{m-1} ~~where this could be made~~ in the same plant is summarized in table 3. Similar ~~Conformity of~~ ratios were seen ~~of types is evident~~ in both tests.

In order to make quite ~~expand~~ evidence the ~~of~~ Spm control of both a_2^{m-1} and a_1^{m-1}, kernels were selected from ears of some of the crosses entered in table 2

and plants grown from them in the summer of 1957. These plants were tested in various ways. ~~now to be described~~. The phenotypes of those kernels that gave rise to the plants that were tested, as well as the number derived from each type, are shown in table 2 along with the 1957 culture number given to them. A description of these tests will commence with the plants in culture 7299, derived from the kernels on the ear produce by plant 7113C-5, table 2. From the ratio of pale colored to variegated kernels on this ear, it could be concluded that 7113C-5 carried one active Spm element. All plants derived from the pale colored kernels on this ear should be a_1^{m-1}/a_1, A_2/a_2. Those derived from the uniformly pale colored kernels should have no active Spm element in them whereas those derived from the variegated class of kernels should contain an active Spm element. All plants derived from the pale class of kernels were themselves uniformly pigmented, indicating the absence of an active Spm element in them. All plants derived from the variegated kernels were variegated for small streaks of the A_1 phenotype in a non-pigmented background, indicating the presence in them of an active Spm element. To test for the ~~response of a_2^{m-1} to either~~ the presence or the absence of ~~the~~ an Spm element that controls gene action at a_2^{m-1}, one or more ears of each plant were used in a cross with A_1/A_1 plants that were either a_2^{m-1}/a_2 or a_2^{m-1}/a_2^{m-1} and

in which no evidence of the presence of an Spm element was given either by the appearance of the plant or by the ~~appearance~~ phenotype of kernels on ears produced by crosses of ~~one of~~ them to a_2/a_2 ~~tester~~ other tester stock plants. Among these a_2^{m-1} carrying plants, ~~three~~ four different states of a_2^{m-1} were represented. One group of plants used as pollen parents in ~~these~~ test crosses carried the class II state of a_2^{m-1} in one chromosome 5 and a_2 in the homologue. A second group of plants carried a class I state of a_2^{m-1} in one chromosome 5 and a_2 in the homologue. This state ~~produce~~ gives early occurring mutations to A_2 or a_2 in the presende of an active Spm element. ~~The~~ A third group of plants carried this state of a_2^{m-1} in one chromosome 5 and another class I state in the homologue. This latter state gives many late occurring mutations to A_2 in the presence of an active Spm element.

Thirty ears were obtained from crosses of these a_2^{m-1} carrying plants to the 23 uniformly pigmented plants derived from the ear of plant 7113C-5 (table 2). On none of these ears did any variegated kernels appear. All the $a_2^{m-1}/a_2/a_2$ kernels exhibited either a full A_2 expression with the class II state of a_2^{m-1} or a uniformly pale pigmented phenotype with the class I states of a_2^{m-1}. In crosses of these same tester plants to the 18 variegated plants in culture 7299, thirty ears were obtained. On all ears, variegated kernels appeared. The $a_2^{m-1}/a_2/a_2$ kernels on

A fourth group of plants carried a class I state of a_2^{m-1} on chromosome 5 and a_2 in the homologue. This state produces a number of small spots of the A_2 phenotype and also some spots of this in the presence of an active Spm element (see photo –). This was also the state of a_2^{m-1} that was present in the a_2^{m-1} carrying plants of cultivar 7113.

these ears were either uniformly pigmented or they were variegated for A_2 spots in a colorless background and the ratio of these two classes of kernels approached 1 : 1 on the majority of ears. ~~Gene action at both a_1^{m-1} and a_2^{m-1} was controlled by an Spm element in these plants.~~ ~~Thus, tests of the plants in culture 7299~~ thus supported for the assumption that ~~the~~ a fully active Spm element in the a_1^{m-1} cultures was capable of controlling gene action at a_2^{m-1} and in the same manner that it does with a_1^{m-1}, ~~for~~ with the class I states of a_2^{m-1} this Spm induces mutation patterns that are quite consistent among the kernels carrying any one particular state of a_2^{m-1}. In other words, the mutation patterns produced by each state are clearly defined in the presence

The same types of test as those just described were conducted with the progeny of plant 7113C-8 and 7113D-5, table 2. As shown in this table, the ratio of pale to variegated kernels on the ear produced by each of these two plants indicated that each of them carried more than one active Spm element. With respect to the presence or absence of Spm, capable of controlling gene action at both a_1^{m-1} and a_2^{m-1}. The results obtained from tests of the 43 progeny plants were similar to those just described, with the exception of two plants. The results obtained from tests of these two plants will be described shortly. Sixteen of the 17 plants derived from uniformly pale colored kernels were themselves uniformly pigmented. On ears produced by these 16 plants in crosses with the a_2^{m-1} tester plnats,

Thus, these tests showed that the response of a_1^{m-1} and a_2^{m-1} to the presence or absence of Spm in the same plant was alike. Those plants having an Spm capable of controlling gene action at a_1^{m-1} likewise had an Spm capable of controlling gene action at a_2^{m-1}. Conversely, those plants that had no Spm to which a_1^{m-1} would respond also had no Spm to which a_2^{m-1} would respond.

no variegated kernels appeared. All 26 plants derived from variegated kernels were themselves variegated for streaks of the A_1 phenotype in a non-pigmented background. The ears produced by 25 of these plants in crosses with the a_2^{m-1} tester plants indicated the presence in each of one or more active Spm elements capable of controlling gene expression at a_2^{m-1}. One fully active Spm element was present in 11 plants, two such elements were present in 8 plants and three or more were present in 6 plants, the number of Spm elements being ~~given by~~ estimated from the ratio of uniformly pale colored kernels to variegated kernels among these that were A_1, $a_2^{m-1}/a_2/a_2$ in constitution.

The two exceptional plants, mentioned above, are important for this study ~~for~~ as ~~xxxx~~ the tests conducted with them and with their progeny serve to confirm the precise control of a_1^{m-1} and a_2^{m-1} behavior ~~by~~ and in ~~the same~~ manner ~~for each~~ that is the same for both by ~~one particular~~ Spm element. One of the plants, 7470A, derived from a uniformly pigmented kernel on the ear of plant 7113D-5 (table 2), had an Spm with altered action. It proved to be Spm-w that undergoes frequent but late occuring changes to Spm-s. The second exceptional plant, 7467-1, derived from a variegated kernel on the ear produced by plant 7113C-8 (table 2), carried an Spm element that was undergoing cyclical change ~~to the inactive~~ in activity phase. The types of test conducted with these two plants and with their progeny

will be considered at the end of this section.

Plants 7113B-1 and B-9, table 2, were A_1/a_1, a_2^{m-1}/a_2 in constitution. From the ratio of ~~xxxxxxxx~~ pale to variegated kernels on the ears produced by the cross entered in this table, two or more active Spm elements were present in each. Tests conducted with the plants derived from the uniformly pale colored kernels and from the variegated kernels on these ears will now be considered. The 11 plants derived from the uniformly pale colored kernels were themselves uniformly pigmented. Fifteen test cross ears were obtained from these 11 plants, the type of cross being the same as that outlined above. On each of these ears, all $a_2^{m-1}/a_2^{s}/a_2^{s}$, $a_2^{m-1}/a_2^{m-1}/a_2$, or $a_2^{m-1}/a_2^{m-1}/a_2^{m-1}$ kernels were uniformly pigmented. None were variegated. Of the 8 plants derived from the variegated kernels (culture 7298, table 2) all were variegated. On the 10 testcross ears obtained from them, both uniformly pale colored kernels and variegated kernels appeared, among those that were either homozygous for a_2^{m-1} or heterozygous for it with a_2. ~~The ratio of these two types~~ From the ratio of these two phenotypes on the di ferent ears, it was concluded that one active Spm element was present in 5 plants, two active Spm elements were present in 3 plants, and three or more active Spm elements were present in ~~xxx~~ 1 plant. Again, these tests showed that plants having no Spm as judged by a_1^{m-1} behavior had no Spm as judged by a_2^{m-1} behavior

and those having Spm as judged by a_1^{m-1} behavior likewise had Spm as judged by a_2^{m-1} behavior.

Extensive tests were made with plants derived from the A_1, A_2 kernels entered in table 2. These kernels were selected from ears of plants in culture 7113 that had a_2^{m-1} in them. Each selected kernel had an area in it in which A_2, delivered by the male parent , had been lost in a mature cell during development of the endosperm. This allowed the presence of a_2^{m-1}, delivered by the female parent, to be revealed in the descendant cells. In 17 of these kernels, this area had spots of A_2 in a colorless background, indicating the presence in the kernel of both a_2^{m-1} and of Spm. In one kernel, the a_2^{m-1} area was uniformly pale colored, suggesting that this kernel had received a_2^{m-1} from the female parent but no Spm element. Thus, all 18 plants derived from these selected kernels should be A_1/a_1^{m-1}, A_2/a_2^{m-1} in constitution and in 17 of them, Spm also should be present. Each of the 17 plants in which Spm was assumed to be present were used in making crosses with plants homozygous for A_1 and for a_2 in which no Spm was present and also with plants that were homozygous for a_1 and A_2 and/or homozygous for a_1^{m-1} and A_2 in which no Spm was present. The phenotypes of kernels on the ears produced by test crosses of each of these 17 plants are entered in table 4, and The Spm constitution of each is summarized in table 5.

Only two of the 17 plants had ~~1~~ one Spm element in them. All other plants had more than ~~1~~ one. ~~Spm element~~. In one of the two plants having ~~1~~ one Spm element, plant 7296A-2, this Spm element ~~was~~ appears to be located close to a_2^{m-1} in chromosome 5. It will be noted that the ~~discrepancy in~~ ratio of uniformly pigmented kernels (no Spm) and variegated kernels (Spm present) is very ~~marked~~ different in the tests ~~of~~ with a_1^{m-1} and with a_2^{m-1}, ~~behavior~~. Plant 7296A-2 was a_2^{m-1} Pr/ a_2 pr in constitution. The a_1^{m-1} tester plants used in making crosses with this plant was homozygous for pr. On the~~se~~ ears produced by use of them in test crosses with plant 7296A-2, the distribution of Pr and pr to the uniformly pale pigmented kernels and to the variegated kernels indicated that the single Spm in plant 7296A-2 was located in the chromosome 5 carrying Pr and at a distance that was approximately 30 crossover units from Pr. The standard percent crossing over between Pr and A_2 is approximately 28 percent. Thus, the evidence from the two sets of test crosses would place~~s~~ Spm very close to a_2^{m-1} in plant 7296A-2.

Plant 7297A-2 had ~~2~~ two Spm elements in it . It was Wx/wx and in the cross with the a_1^{m-1}/a_1^{m-1}, no Spm tester plant that also was wx/wx, linkage of one of the two Spm elements with Wx was made evident. Among the kernels ~~on the kernels~~ on the ear that were homozygous for a_1^{m-1} there were 111 pale colored kernels (no Spm) of which 27 were Wx and 84 were wx. Among the 288 variegated kernels, 167 were Wx and 121 were wx.

In tests of plant 7468A-2, evidence was given of the presence of 3 Spm elements in the cells that gave rise to each of the two tested ears of this plant. Pollen collected from a tassel of this plant was used on silks of ears of plants that were A_1/A_1, a_2/a_2 no Spm and also on ears of plants that were a_1^{m-1}/a_1^{m-1}, A_2/A_2 in which no Spm was present. The ratio of variegated to pale kernels on the ears these plants produced indicated that in the part of the plant that produced the tassel from which pollen was collected, only 2 Spm elements were present.

Plant 7298A, derived from an A_1, A_2 kernel in which an area was present that exhibited a pale phenotype was suspected to be A_1/a_1^{m-1}, A_2/a_2^{m-1} in constitution and in which no active Spm element was present. It was used in crosses with plants that were A_1/A_1, a_2/a_2 in which no Spm was present and with plants that were a_1^{m-1}/a_1^{m-1}, A_2/A_2 in which no Spm was present. On the ears produced by these crosses, no variegated kernels appeared, A and C, table 6. In order to show that the a_2^{m-1} in this plant would respond to an active Spm element, the ear produced by the main stalk and an ear of a tiller were used in crosses with plants homozygous for A_1 and a_2 in which 1 Spm was present. (For tests of the presence of one Spm in each of these plants, 7308D-1 and 7308D-2, see page .) The types of kernels appearing on each of these ears is

given in B of table 6. It was clear ~~from these tests~~ that plant 7298A had no active Spm element in it to which either a_1^{m-1} or a_2^{m-1} could respond. ~~It was also~~ evident that the a_2^{m-1} in this plant would have responded to Spm had it been present. It was also known that the a_1^{m-1} delivered by the a_1^{m-1}, no Spm tester stock would have responded to Spm had it been present as these same tester plants had been unsed in many other crosses an these had clearly demonstrated its capacity to respond to Spm.

Altogether, 121 plants were tested in the summer of 1957 ~~for~~ the response of a_1^{m-1} and a_2^{m-1} ~~to the presence or absence of Spm when~~ the selection of plants to be tested ~~for its presence or absence~~ was based on the known response of only one of them, either a_1^{m-1} or a_2^{m-1}. In all tests, ~~the response of a_1^{m-1} and a_2^{m-1} were~~ quite ~~alike to the~~ presence or absence of Spm, and to the number of ~~them, if~~ present. There were no exceptions to this. The two plants among the 121, plant 6467-1 and 7470A-5, in which a single Spm with modified action was present, only served to strengthen ~~the~~ evidence of the common type of response of a_1^{m-1} and a_2^{m-1} to the same Spm element.

Plant 7467-1 was derived from a variegated kernel on the ear produced by plant 7113C-8, table 2. Its constitution was a_1^{m-1}/a_2, A_2/a_2^{m-1} (spotted). The plant derived from it was expected to be variegated for

A_1 streaks in a non-pigmented background. The main stalk of the plant, however, was uniformly pigmented as if no Spm were present in it. The tiller, ~~however~~, was ~~sectorial for areas~~ in which small streaks of A_1 appeared in a non-pigmented background. ~~The appearance of plant 7467-1~~ suggested that ~~it had~~ an inactive Spm element ~~in it~~ that was undergoing change to the active phase in some cells of the tiller. The silks of the first ear on the main stalk received pollen from a tester plant that was A_1/A_1, a_2^{m-1} (early) Bt/a_2^{m-1}(late) bt in which no Spm was present. Among the 393 kernels on this ear, 193 were fully pigmented, that is, A_2, and 200 were $a_2^{m-1}/a_2/a_2$. Among the latter, 133 were uniformly pale pigmented, as if no Spm were present in them, and 67 were variegated. However, in only 4 of these 67 variegated kernels was the type of variegati that expected to appear in the presence of a fully active Spm element. In the remaining 63 kernels, Spm was active only in a sector in the kernel (small specks of A_2 in a colorless area of an otherwise pale pigmented kernel) or was weakly active throughout the kernel (small specks of A_2 in a colorless background throughout the kernel).

The silks of the ear produced by the tiller received pollen from a plant that was A_1/a_1, a_2^{m-1}(spotted) Bt/a_2 bt in which no Spm was present. There were 156 kernels on this ear and 49 of them were fully pigmented

(A_1, A_2). In addition, there were 83 kernels that were either colorless or pale pigmented and 24 that were variegated. Among the latter, 7 were variegated for spots of A_1 in a colorless background, 11 had spots of A_2 in a colorless background, and 7 had a type of variegation that could be expected if the kernels had ~~neither A_1 or A_2 in them but only~~ a_1^{m-1} and a_2^{m-1}, ~~each~~ undergoing mutation to A_1 and A_2 respectively. The cross was made to obtain just these kernels in order to test the type of response of a_1^{m-1} and a_2^{m-1} to the ~~same~~ Spm element in the plants derived from ~~them.~~ each.

From the ear of the main stalk, seven plants were grown from kernels that had small A_2 specks in a colorless background under culture number 7577A, and 3 plants were grown from the 4 variegated kernels in which a fully active Spm element appeared to be present under culture number 7577B. All 7 plants in culture 7577A were darkly pigmented except for a few areas in which pigment was absent, and in some of these areas, small streaks of the A_2 phenotype appeared. Obviously, these plants had an Spm element in them that was undergoing change in phase of activity, from inactive to active in some cells during the development of the plant. The appearance of the 3 plants in B of culture 7577 were similar. The plants in both A and B

of this culture were tested by crossing with plants homozygous for a_1^{m-1} (state 5719A-1) and A_2 in which no Spm was present and also with plants homozygous for A_1 and a_2 in which no Spm was present. The appearance of the kernels on the ears these crosses produced is shown in table 7. It was obvious that the Spm element in each of these plants was behaving as it had done in the parent plant, 7467-1. It was in its inactive phase during much of the early development of the plant, changing to the active phase in some cells only late in development. The response of both a_1^{m-1} and a_2^{m-1} to the activity phases of Spm was exactly alike.

Four plants were grown under culture number 7578A from kernels on the ear of the tiller of plant 7467-1 that appeared to have Spm and and both a_1^{m-1} and a_2^{m-1} ($a_1^{m-1}/a_1^{m-1}/a_1^{m-1}$ or $a_1^{m-1}/a_1/a_1$ and $a_2^{m-1}/a_2/a_2$). In addition, six plants were grown under culture number 7578B from kernels that were uniformly pale pigmented, the type of pigment indicating that they were A_1, $a_2^{m-1}/a_2/a_2$ in constitution. The six plants in culture 7578B will be considered first. Five of them gave no evidence of the presence of Spm in them either from the appearance of the plant or from tests that were conducted with each. One plant, 7578B-4, however, had a few sectors in which small A_2 streaks appeared in a non-pigmented background. The remainder of this plant was uniformly pigmented.

It was obvious that this plant had an Spm element in it that was in its inactive phase in most parts of the plant, turning to the active phase in a few cells rather late in development. Thus, the pattern of Spm activity resembled that in the parent plant, 7467-1. The first ear of plant 7578B-4 which was A_1/a_1^{m-1}, a_2^{m-1}/a_2 in constitution, was used in a cross with a plant that was homozygous for A_1 and a_2 in which no Spm was present. On the resulting ear, there were 210 uniformly pale pigmented kernels, 215 totally colorless kernels, and one kernel that was variegated in part. Three-quarters of the aleurone layer of this kernel had spots of A_2 in a colorless background and one-quarter was uniformly pale pigmented. This was the only kernel on the ear that gave evidence of the presence of Spm in it ~~the female parent~~. The Spm in this kernel had changed from the inactive to the active phase early in development of the endosperm. The second ear of the main stalk of plant 7578B-4 was used in a cross with a plant homozygous for a_1^{m-1} (state 5719A-1) and for A_2 in which no Spm was present. This ear produced 460 kernels, half of which were homozygous for a_1^{m-1}. In 79 of these latter kernels, evidence was given of the presence of Spm in them but in none of these kernels was Spm fully active. In most of them, Spm had changed from the inactive to the active phase rather late in development of the kernel.

Two other plants in culture 7578B were tested for the presence in them of an inactive Spm element by crosses of each with plants that were homozygous for A_1 and a_2 in which one or more active Spm elements were present. The usefulness of this test for revealing an inactive Spm element has been described elsewhere. An ear of plant 7578B-2 was used in a cross with a plant of the constitution given above in which one active Spm element was present (plant 7538-4, see page). On the resulting ear, there were 212 totally colorless kernels and 226 kernels carrying a_2^{m-1}. Among the latter, 152 were uniformly pale pigmented and 74 were colorless with spots of the A_2 phenotype and in nearly all of them large areas exhibiting the pale phenotype also were present. Had plant 7578B-2 carried an inactive Spm , half of the variegated kernels would have had no pale areas or only a few small pale areas. It could be concluded, then, that plant 7578B-2 had no Spm element in it. This same conclusion was drawn from a similar type of test of plant 7578B-3. An ear of this plant was used in a cross with plant 7538-6 which was homozygou for A_1 and a_2 and also for Spm (see page for discussion of the constitution of this plant). On the ear produced by this cross, 196 kernels were totally colorless and 186 carried a_2^{m-1}. Among the latter, 22 were uniformly pale pigmented and 164 had spots of A_2 in a colorless background. In the majority of the variegated kernels, large pale areas

also were present. Obviously, plant 7578B-3 had no Spm element in it. Thus, of the six tested plants in culture 7578B, only plant number 4 gave evidence of the presence of Spm in test crosses with either or both a_1^{m-1} and a_2^{m-1}.

Each of the four plants in culture 7578A had an Spm element in it. The kernels that gave rise to these plants were selected from the tiller ear of plant 7467-1 because the Spm element in each appeared to have undergone change in phase of activity considerably earlier than in the other Spm carrying kernels on this ear. If this change from inactive to active phase had occurred before gamete formation, an Spm with a new pattern of cyclical changes in phase of activity could be expected to appear in the plant derived from a kernel in which this had occurred. This proved to be ~~the case~~ for two of the four plants in culture 7578A (7578A-3 and A-4). The tests conducted with each of these four plants is shown in table 8. In plants number 1 and 2, the Spm element in each underwent change in phase from inactive to active in a manner that resembled the pattern of this ~~given by it~~ in the parent plant, 7467-1. In plant number 3, Spm was active in most parts of the plant, undergoing change to inactive phase in a ~~few~~ some cells, early in plant development. In plant number 4, Spm was active in nearly all parts of the plant, undergoing change to inactive phase quite late in development, ~~and only in some cells~~.

The described tests of the progeny of plant 7467-1 clearly indicated that both a_1^{m-1} and a_2^{m-1} would respond ~~xxxxx~~ in like manner to ~~the~~ ~~activity phase of Spm and the~~ phase of activity of Spm changes in ~~this~~ that occurs in a plant or in a kernel. Thus, these tests serve as an additional proof of the identity of the system controlling gene action at a_1^{m-1} and a_2^{m-1}. Similar evidence was obtained from tests of the progeny of plant 7470A-5, to be described below.

Plant 7470A-5 was derived from a uniformly pale pigmented kernel on the ear produced by the cross of plant 7113D-5 (table 2). It carried an Spm element but the action of this elementswas weak (Spm-w) in most parts of the plant. Change from Spm-w to Spm-s occurred in some cells but only late in development. of the plant and of the endosperm tissue. This plant was a_1^{m-1} (state 5718)/ a_1, A_2/a_2 in constitution. The first ear of the main stalk was used in a cross with a plant that was A_1/A_1, a_2^{m-1}/a_2 and in which no Spm was present. The state of a_2^{m-1} was one that gives early occurring mutations to A_2 and to colorless in the presence of a fully active Spm element. On the ear this cross produced, there were 127 kernels that were uniformly deeply pigmented (A_2) and 69 that were totally colorless ($a_2/a_2/a_2$). There were 64 kernels that were $a_2^{m-1}/a_2/a_2$ in constitution. Thirty-three of them were uniformly pale pigmented and

31 were variegated. In only one of the latter kernels was the pattern of variegation that which appears when a fully active Spm is present (see photo.). In all other kernels, only small spots of the A_2 phenotype appeared in a colorless background (photo.). Nine plants were grown from these kernels under culture number 7580A. The single kernel that had large A_2 and colorless areas (variegation pattern with Spm-s) was sown under culture number 7580B. This plant, however, died during the very unfavorable growing condutions of the spring of 1958.

The types of test cross conducted with the plants in culture 7580A are shown in table 9. Each had an Spm-w element in it. Both a_1^{m-1} and a_2^{m-1} responded in like manner to this Spm-w element. The state of a_1^{m-1} used in the test cross gives only one or a few spots or specks of A_1 or none at all in the presence of Spm-w. In the presence of Spm-s, it gives many small spots of A_1 (compare photo. with photo.). The state of a_2^{m-1} responds to Spm-w by producing a number of small spots of A_2 in a colorless background. With Spm-s, it gives many large areas of A_2 as well as a number of smaller areas (compare photo. with photo.). On all testcross ears, some kernels were present with sectors within which a pattern of variegation appeared resembling that produced by Spm-s

(photos). The time during development of change of Spm-w to Spm-s was so late that very few kernels were produced that exhibited an Spm-s type of response of a_1^{m-1} or a_2^{m-1} throughout the kernel. Nearly all such changes occurred during endosperm development, and the majority of these took place rather late in its development. Evidence of this was given by the response of both a_1^{m-1} and a_2^{m-1} to these changes in degree of activity of Spm.

The ear of the tiller of plant 7470A-5 was used in a cross with a plant that was A_1/a_1, a_2^{m-1}(spotted)/a_2 in which no Spm was present. On the ear this cross produced, there were 58 fully pigmented kernels (A_1 and A_2), 133 colorless kernels, 32 lightly pigmented kernels and 62 kernels tha had spots of deep pigmentation in a colorless background. Among the variegated kernels, 10 appeared to be a_1^{m-1}, A_2 in phenotype, 11 appeared to be A_1, a_2^{m-1} in phenotype and 41 were nearly totally colorless, only a small spot or speck of deep pigment being seen in these kernels. Six plants were grown from the variegated kernels that appeared to be a_1^{m-1}, A_2 under culture number 7581A and five plants were grown from the kernels that were nearly colorless, under culture number 7581B. All plants in A of this culture were variegated in that some small streaks of deep anthocyanin pigment appears in a non-pigmented background. The plants in

B of this culture were nearly completely non-pigmented. Only an occasiona very small streak of anthocyanin pigment appeared in them. The test crosses conducted with the plants in culture 7581 and the results obtained from them are entered in table 10. In three of the five tested plants in A of this culture, one Spm-w element was present. It was behaving much as it had done in the Spm carrying parent plant. Changes from Spm-w to Spm-s were occurring but only late in development. Plants 7581A-1 and A-4 had 2 Spm elements in then. One of these had the Spm-w state and the other was Spm-s. This latter appeared to be undergoing change in phase of activity from active to inactive in some cells, late in development.

The four tested plants in B of culture 5781 all had an Spm-w element i them and it was behaving much as it had dome in the parent plant. These plants probably were a_1^{m-1}, a_2^{m-1} although tests for this were conducted only with plant B-4. The Spm-w in these plants was changing to Spm-s in some cells of the kernels having it but usually, only la e in developmen of the kernel. In plant 5781B-4, tests were conducted of the response of a_1^{m-1} and a_2^{m-1} to the Spm in it. The states of each were much alike and the pattern of spots each produced in the kernel in the presence of the Spm in this plant was much alike. Each produced only a few deeply pigmented spots in the presence of the Spm-w element in this plant. Also, each responded in like manner to change of Spm-w to Spm-s.

With both a_1^{m-1} and a_2^{m-1}, Spm-w reduces the frequency of occurrence of mutation in comparison to Spm-s and also retards the time of their occurrence. With the two a_2^{m-1} states examined (early and spotted) the effect produced by Spm-w was the same as that which given by similar states of a_1^{m-1}, reviewed in section IV.

The common response of a_1^{m-1} and a_2^{m-1} to the same Spm elements was revealed by other tests conducted during the summer of 1958. In all cases, both a_1^{m-1} and a_2^{m-1} responded in like manner to the Spm element or elements in a tested plant. Since the tests reported in this section reveal this common response, the additional tests need not be reviewed here

7113 A and B. Table 1

a_2^{m1} BI | a_2^{s} BI × a_2^{s} BI ; A_1/A_1

Plant No.	Parentage Mass	a_1^{m1} carrying kernels: A_2 Kernels	Pale Kernels	Pale-Speckled Sectoral	Fully Variegated	a_2/a_2 kernels: Colorless		Totals		
7113A-2	♀	1	4	0	11	7		23		
" A-3	♀	0	7	1	25	25		58		
7113A-5 main	♀	1	17	3	137	186		344		
" A-5t	♀	0	3	1	105	166		275		
" A-6	♀	4	10	1	126	167		298		
" "	♂	6	41	1	354	443		845		
7113A-7	♀	0	2	0	6	14		22		
" "	♂	2	15	3	385	465		870		
" A-8	♀	0	4	0	5	5		10		
" B-1I	♀	0	11	0	127	108		236		
" B-1t	♀	0	3	0	63	83		149		
" B-4t	♀	1	3	0	124	117		245		
" B-4I	♀	0	4	0	36	28		68		
" B-6	♀	0	4	0	37	44		85		
" B-7	♀	0	12	0	40	45		97		
" B-8	♀	1	7	0	39	38		85		

Table 2

A-B. Tests of Spun Constitutors in plants of cultures 7113 that were A_1/a_1 by more with plants homozygous for a_1 mutation (7181), A_2, and having nonspun. Summer, 1956

A. 7113 A_1/a_1 a_2^m/a_2

			A_1	nonspun pollen	spun pollen Addition outcross backcross	1957 cultures numbers			1958 cultures
7113B-1	Ville Cor		118	3	141				
Tests of plants, Summer 1957			3	2	0	cultures 7297			
7113B-4	Ville Cor		179	8	208				
7113B-8			138	26	105				
Tests of plants, Summer 1957			3	9	8	cultures 7298		From	7551 From 7298B
B 7113	A_1/a_1 ; a_2^s/a_2^s								
7113C-5	main Cor		194	83	80				
tests of plants, Summer 1957				23	18	cultures 7299			
7113C-7			117	5	129				
" C-8	ear Cor		185	13	166				
tests of plants, Summer 1957				8	17	cultures 7300 and 7467			7567-1 = 7572, 7578; 7567-7 = 7579
7113D-3	main Cor		183	12	191				
" D-5			214	10	164				
tests of plants, Summer 1957				9	9	cultures 7470			7470A-5 = 7580, 7581
" D-7			15	3	14				
C A. A_1, a_2^m/a_2									
7113A-2			all A_1						
Plants tested, Summer 1957			10			cultures 7296 and 7467			7296A-2 = 7550, 7296A-1 = 7549, 7549
7113A-7			all A_1						
" B-7			all A_1						
Plants tested, Summer 1957			2			cultures 7465			
D A_1A_1 a_2^s/a_2^s									
7113C-1			all A_1						
" C-4			all A_1						

Table 3

Comparison of rations of pale (no. of spm) to variegated (active spm) for a_2m-1 and a_1m in same plant

	a_2m-1		a_1m-1						
	pale	variegated	pale	var.					
7114 B-1	13	190	3	141					
" B-4	7	160	8	208					
" B-8	7	39	26	105					

Table 4

A_1/a_1^{m1} ; A_2/a_2^{m1} By a_2^s/a_2^s A_1/A_1 ; no spm

By A_2/A_2 a_1^{m1}/a_1^{m1} a_1^s/a_1^s A_1/A_1 ; 25 spm

Plant number	Female type in bloom	Total A_2	Total a_2^{m1}	Phenotypic ratio (no spm) pale	Phenotypic ratio (no spm) colored	Total A_1	Total a_1^{m1}	Phenotypic ratio (25 spm) pale	Phenotypic ratio (25 spm) colored
I 15 spm				(no spm)	(no spm)			(no spm)	(25 spm)
7469A-1	♀	211	217	114	103	80	95	45	50
	♂	524	513	258	255	246	224	121	103
1) 7296A-2	♀					118	118	65	53
	♂	462	546	11	535	286	313	156	157
II 25 spm 2) 7297A-2	♀	14	16	2	14				
	♂	678	680	178	502	374	399	111	288
7298B	♀	224	254	66	188	211	193	46	147
	♂	533	652	187	465	251	241	56	185
7298C	♀	25	38	10	28	156	187	40	147
	♀	172	186	47	139				
	♂	150	134	40	94	214	190	47	143
7468A-1	♀	35	34	9	25				
	♂	531	502	153	349	217	250	73	177
III 35 spm or more than		3)							
7297A-1	♀	154	153	6	147				
	♂	571	473	37	436	124	131	8	123
7297A-3	♀	186	166	16	150				
	♂	458	528	57	471	160	182	16	166
7296B-1	♀	237	208	23	185				
	♂	605	533	85	448	140	151	35	116
7296B-3	♂	417	466	63	403	407	400	35	365
7469A-2	♀	176	188	7	181	154	204	16	188
	♂	348	376	6	370	174	159	23	136
3) 7296B-4	♀	124	118	3	115				
	♂	481	440	32	408	178	129	31	98
3) 7296B-6	♀	156	175	15	160				
	♂	483	473	39	434	331	361	96	265
7296A-1	♀	182	174	5	169				
	♂	522	423	23	400	102	109	16	93
7296B-2	♀	206	173	6	167	170	182	23	159
	♂	518	547	12	535	279	285	14	271
7296B-5	♀	168	189	5	184	94	95	4	91
	♀	95	96	2	94	121	133	3	130
	♂	612	627	24	603	229	216	12	204
4) 7468A-2	♀	187	167	28	139	191	170	27	143
	♂	367	354	92	262	416	317	87	230

1) Spm located close to a_2^{m-1} in chromosome 5. See Text

2) one Spm carried in chromosome 9, linked with Wx

3) one Spm probably located in a_2^{m-1} carrying chromosome 5

4) 3 Spm present in cells that gave rise to tested ears.
2 Spm in tassel from which pollen was collected and used in making test crosses.

Table 5

Spm constitutions in plants derived from fully pigmented hemis. Plant constitutions: A_1/a_1^{m-1}; A_2/a_2^{m-1}.

From plant										
7113B-1										
7297	A-1	3 Spm								
"	A-2	2 Spm, one linked with Wx in chromosome 9								
"	A-3	3 Spm								
From ear of plant 7113B-8										
7298	A	no Spm	(see table 6)							
"	B	2 Spm		[see 1958 7551]						
"	C	2 Spm								
From ear of plant 7113A-2										
7296	A-1	3 or more Spm								
"	A-2	1 Spm, close to a_2^{m-1} in chromosome 5						(27% CO with Pr)		
"	B-1	3 Spm								
"	B-2	3 or more Spm		[see 1958 7550 & 7549]						
"	B-3	3 Spm								
"	B-4	3 Spm, one linked to a_2^{m-1} in chromosome 5								
"	B-5	3 or more Spm								
"	B-6	3 Spm, one linked to a_2^{m-1} in chromosome 5								
7469	A-1	1 Spm	not in ear							
"	A-2	3 Spm								
From ear of plant 7113B-7										
7468	A-1	2 Spm								
"	A-2	3 Spm in ears	; 2 Spm in pollen							

Table 6.

Tests of plant 7298 A A_1/a_1^{m1}; A_2/a_2^{m1} no Spm.

A. Crosses to A_1/A_1; a_2/a_2 no Spm.

Parentage			A_2	pale	variegated		Total			
m Cross										
♂			205	217	0					
B crosses to A_1/A_1; a_2/a_2 1 Spm										
♀ 1st ear, main stalk x 7308 D-1 ♂			193	99	104					
♀ tiller ear. + 7308 D-2 ♂			163	79	79					
C. Crosses to a_1^{m1}/a_1^{m1}; A_2/A_2 no Spm										
♀ tiller ear			97	98	0					
♂			106	97	0					

Table 7

7577 A. A_1/a_1^{m1} or A_1/a_1^{s} ; a_1^{m1}/a_1^{s}

B

By a_1^{m1}/a_1^{m1} A_2/A_2 no spec

By A_1/A_1, a_2^{s}/a_2^{s} no spec

7577A-1	car I	all a_1^{m1} knees pale								
" A-2	car II	" " " "				car I	all a_1^{m1} knees			use pale
" A-3	II	" " "				" I	" " "			" "
" A-4	I pale, pale-yellow cast, yellow					II pale, pale-yellow cast, yellow				
" A-5	II all pale except 2 knees					I all pale except 2 knees				
✓ " A-6	I	"	few Rhodium			II " " "	1 knee			
" A-7	I	" " "	few "			II all pale				
7577B-1	I all pale					II all pale I " " except 2 knees				
" B-2	II " "					I all pale				
" B-3	I all pale except 1 knee					II and I all pale.				

Table 8. Phenotypes of kernels on ears produced by crosses of plants in culture 7578A that were a_1^{m}/a_1^{s}, a_2^{m-1}/a_2^{s} to plants having no spm that were: (1) a_1^{m}/a_1^{m-1} (stock 5714A-1) A_2/A_2, (2) A_1/A_1, a_2/a_2, (3) A_1/A_1, a_2^{m}/a_2^{m+1} (stock), and (4) A_1/A_1, a_2^{m} (stock) $/a_2$

Plant	Type of cross (see above)	Part of plant tested		uniformly pale pigmented	Pale-speckled	pale-speckled colored	Dark green	White		
7578A-1	(1)	♀ ear I		370	2	14	0	0		
	(2)	♀ ear II		170	0	—	8	196		
	(4)	♀ tillers		103	0	9	13	20		
	(1)	♂		166	0	2	92	0		
	(2)	♂		67	—	—	18	109		
7578A-2	(2)	♀ ear I		154	0	0	23	156		
	(1)	♀ ear II		124	4	3	75	6		
	(1)	♂		166	0	8	60	0		
	(2)	♂		154	0	4	54	240		
7578A-3	(1)	♀ ear I		273	19	13	167	0		
	(2)	♀ ear II		108	0	2	6	113		
	(3)	♀ tillers		120	0	0	122	0		
	(1)	♂		187	0	9	101	0		
	(2)	♂		25	—	—	15	61		
7578A-4	(2)	♀ ear I		27	—	1	17	44		
	(1)	♀ ear II		99	2	5	68	0		
	(1)	♂		164	0	0	148	0		
	(2)	♂		211	0	0	203	393		

Table 9

Tests of Spm in plants of culture 7580A that were A_1/a_1^{m1} or a_1^{s}; a_2^{m1}/a_2^{s}

A. 7580A ♀ x A_1/A_1, a_2/a_2 no Spm

Plant number	Location of Ear	Phenotype of Kernel: uniformly pale pigmented	spots of pigment in colorless background	colorless	
A-2	I, main	97	77	189	
A-4					
A-5	I, main	66	60	117	
A-6	II, main	62	73	181	
A-7	I, main	90	83	175	
A-8	I, main	66	54	116	
A-9					
Totals		38[illegible]	347	778	

B. 7580A ♀ x a_1^{m1}/a_1^{m1}; A_2/A_2, no Spm

Location of Ear	Phenotype of Kernel: Fully pigmented	pale pigmented	Spots of A_1 in colorless background	Colorless
I, main	273	144	102	2
I, main	210	118	97	1
tiller	131	70	57	5
I, main	242	98	147	5
	856	430	4[illegible]3	[illegible]3

1) State 5718

3) State 5719A-1

2) State [illegible]

TABLE 10

7581A $a_1^{m1}(5718)/a_1^{s}$ ♀ × $a_1^{m1}(5719A\text{-}1)/a_1^{m-1}$ no spm ♂

A_2/A_2

(Spots of A_1 in colorless background)

A.

Plant	Gear used in cross		pale	"Breakdown"	$a_1 \to A_1$	colorless				
A-1	main, I		155	6	269	8				
A-3	main, I		255	0	248	8				
A-4	main, I		198	0	210	0				
A-4	main, II		147	24	195	15				
A-5	main, I		182	0	207	5				
A-6	main I		130	0	165	10				
7581B		A_1	pale	"Breakdown"	$a_1 \to A_1$	colorless				
B-1	main, I	207	117	0	80	6				
B-2	main, I	200	97	1	104	0				
	main, II	110	58	0	48	5				
B-3	main, I	0	175	0	66	84				
B-4	main I	247	107	0	129	0				

B.

7581B-4 Tiller × a_2/a_2 no spm

pale	$a_2 \to A_2$	colorless
66	69	140

[illegible] no linkage with [illegible]

Introduction

operator + regulator in bacteria

Relation to systems of c.e. in maize

general mode of action Spm system at a_2^{m-1}, a_1^{m-1}, m^{m-8}

states of operator element. Class I + class II states

states of Spm. mutant types, transposition

Cyclical changes in phase of Spm.

Differences of Spm in a_2^{m-1} + a_1^{m-1} cultures.

Experimental Procedures.

I general results of tests -

Progeny of 7109 - origin of 7109

7109 crosses - Table 1

7109B-2 tiller ⊗ ear.

Table 2 - tests of 7109B-1 progeny. Symbols.

II. Types of test crosses. - Outlined

Types of test crosses - Types 1, 2, 3

Progeny of ear I of 7109B-1 Types of test crosses - Table 5

" " " I of 7109C-4 " " Table 6

Kernel types on ears of 7308A-4: Example of results obtained. Table 7

Kernel types on no Spm plants of 7308A and 7456

Type-1 + 2 vs type-3 test cross.

Kernel types on ears of plants in culture 7455 - Tables 8, 9

" " " " " Spm " " " 7456 Table 10, 11, 12

Active / inactive Spm - behavior, segregation

Effectiveness of active/inactive Spm for identifying presence of inactive Spm - Tables 13, 14

III Progeny 97109B-1 Tiller-1 Table 15, ~~Table 16~~

IV " " " " -2 Table 16

11/15/60

CYCLICAL CHANGE IN PHASE OF ACTIVITY OF THE SUPPRESSOR-MUTATOR CONTROLLING ELEMENT IN MAIZE.

The nature and mode of action of controlling elements in maize has been discussed in a number of publications by the author and by others. Two or more elements may operate as a unit in the control of action of a specific gene, and each such set of interrelated controlling elements forms a system. Each system, in turn, operates quite independently of all others. Systems of controlling elements in maize were originally discovered because the individual members within each transposed from one location to another in the chromosome complement without losing their identifying characteristics in the process. By this means, it was possible to distinguish different systems of controlling elements and the manner by which each system operates in the control of gene action. Likewise, because of transposition of ~~the~~ component elements of a system, it ~~was likewise~~ is possible to examine the operation of a particular system at a number of different gene loci and conversely, to examine the operation of different systems at the same gene locus. It should be emphasized, however, that although transposition of controlling elements in maize made it possible, originally, to recognize their presence and their modes of operation, such transposition need not characterize the behavior of all controlling elements, for it is known

th t a controlling element that had previously undergone transposition may become fixed in location in the chromosome complement.

Recent discovery of systems of "controlling elements" in bacteria (Jacob, et al., 1960 a b) whose modes of control of gene action resemble those of some systems already examined in maize, eases the task of discussing controlling elements in maize. The systems described by Jacob, are composed of two elements each. One of them, called the "operator", is located adjacent to the "structural gene". The latter, when activated, is responsible for the amino acid sequence of a specific protein whereas the former serves to control the activation of the adjacent "structural gene". The second element of the system, termed the "regulator", may be located close to the "structural gene" or it may be located elsewhere in the bacterial chromosome. It is responsible for the production of a repressor substance, -- not a protein --, that appears in the cytoplasm. The "operator" element, responds to changes in degree of effective action of the repressor substance by controlling the degree of activity of the structural gene in accordance with such changes. Each system is highly specific, for each operates quite independently of all others.

The resemblance of the "operator-regulator" systems in bacteria to

the systems of controlling elements in maize appears to be more than coincidental. The "Operator" in bacteria may be homologized with the controlling element in a system in maize that is located adjacent to the "structural gene". The "~~repressor~~ regulator" element in bacteria may be homologized with the element of a system in maize that is independently located in the chromosome complement. As in the bacteria, the element at the locus of the structural gene responds to ~~it~~ altered activity of the "regulator" element by inducing modification of ~~the~~ action of the structural gene. In maize, the response of the "operator" element to change in the effective action of the "~~repressor~~ regulator" element may result in controlled types of mutation at the locus of the "structural gene", or, in some cases, it may respond merely by "turning on" or "turning off" the action of the structural gene. That these two apparently quite different types of effects produced by the "operator" in response to the "regulator" are merely two aspects of the type of control of gene action by a single "operator" will be made evident in this report. It is probable, therefore, that the basic mechanism of action of controlling elements is alike in all organisms, even though the responses of the structural gene to such controls may appear to be quite diverse. It is expected that the nature of this basic mechanism will be revealed in further studies of the bacterial systems as it is possible to examine this with a greater degree of precision, both at the chemical and the genetic level, than is usually

possible in many of the higher organisms.

It is the purpose of this report to consider a type of control of gene action by a system in maize ~~whose mode of action~~ that resembles that of some reported ~~cases~~ systems in bacteria. An "operator" controlling element is present at the locus of the gene $\underline{A}_2$ (associated with production of anthocyanin pigment in plant and kernel) in the short arm of chromosome 5. The independently located element of this system, comparable to the "~~repressor~~ regulator" element, discussed above, has been designated Suppressor-mutator and symbolozed as Spm. This system was first discovered when the operator was present at a gene locus associated with development of chlorophyll and locus was then designated $\underline{lu}^m$ for mutable luteus. Transposition of the operator element to the locus of $\underline{A}_2$ occurred in a plant having $\underline{lu}^m$. Following its insertion there, the locus was designated $\underline{a}_2^{m-1}$, as it was the first case of mutability arising at the $\underline{A}_2$ locus in the Cold Spring Harbor cultures. Subsequently, the operator element appeard at the locus of $\underline{A}_1$ in the long arm of chromosome 3 in a kernel on the ear of a plant in ~~the~~ $\underline{a}_2^{m-1}$ culture and the modified locus was designated $\underline{a}_1^{m-1}$. Recently, the operator was inserted at the Wx locus in the short arm of chromosome 9 and it first appeared in a kernel on the ear of a plant carrying $\underline{a}_2^{m-1}$. This case received the symbol $\underline{wx}^{m-8}$ as it is the eighth case of instability

Revised.

arising at the Wx locus ~~that has arisen and~~ ~~been examined~~ that has whose mode of operation has been investigated in the Cold Spring Harbor cultures. It has been possible, then, to examine the ~~mode of~~ operation of the Spm system at four different gene loci. It has been determined that the operator element, adjacent to the structural gene, controls the type of action of the gene that will be expressed in the presence of Spm and also the type that will be expressed in its absence. Basically, the mode of operation of this system is the same at all four gene loci (lu^m, a_2^{m-1}, a_1^{m-1}, a_1^{m-2}, a_1^{m-5} (Feb, 1961) and wx^{m-8}). The original isolate, in each case, exhibited some degree of gene action in the absence of Spm and this action remained the same in successive cell and plant generations as long as Spm was absent. In the presence of Spm (in its active phase), however, gene action was suppressed until a mutation-inducing event occurred. With each of the original isolates, this event occurred in some cells, early in plant or kernel development, and there were two main consequences of it: mutation to an ~~stable~~ allele of the gene concerned that is stable in this system in that ~~its response~~ control of its action is now independent of the Spm system, or a modification, probably affecting the operator element at the locus, that is reflected in subsequent cell and plant generations by altered responses of the locus both in the presence and in the absence of Spm. In the past, the latter modification has been termed "change in state" of the locus. In the presence of Spm, the altered states are distinguished, one from the

other, by difference in the time of occurrence of mutation-inducing events during development of a tissue, by the frequency of their occurrence at any one time, and by differences in types of stable alleles that result from the mutation-inducing events. They are also distinguishe one from the other, by the type of gene action that occurs in the absence of Spm, and among the many different states of a_1^{m-1} and a_2^{m-1} that have been isolated, a wide range is exhibited in type and intensity of anthocyanin pigment in plant and kernel in the absence of Spm, from no pigment with one state to near normal or to apparently ~~near normal or quite~~ normal A_2 type pigment production with others. Illustrations of this are given in figure 1. All those states that respond to Spm by producing stable mutations are grouped under the heading of the class I states. In addition, a state, designated class II, has arisen on several independent occasions from the original state of a_2^{m-1}. This state has been of considerable significance in the study of controlling elements in that its behavior mimics that of some of the described gene control systems in bacteria. In the absence of Spm (or when it is present but in its inactive phase, see below) this state of a_2^{m-1} produces anthocyanin pigment in plant and kernel that ~~is comparable to~~ approaches in type and intensity that produced by the A_2 locus before the operator element entered it. When Spm is present and fully active, no anthocyanin is produced either in plant or kernel.

However, in contrast to the class I states, no gene mutations occur and no evidence has been found of removal of the operator from the locus by transposition, as occurs with the class I states. This statement is based on an analysis of the class II state in hundreds of plants and through 7 successive plant generations. Thus, ~~The~~ state appears to be quite stable. The action of the A_2 gene is "turned on" in the absence of Spm and "turned off" when it is ~~in its~~ present and fully active ~~te~~. It cannot be aruged successfully that the "turning off" of gene action, that is, the absence of pigment in plant and kernel when Spm is present and active, occurs at the level of the gene and under the direct control of the operator. It is clear, ~~xxxxxxx~~ nevertheless, that the operator is necessary for the observed effect as no "turning off" of gene action occurs in the presence of Spm when ~~an unmodified~~ the "wild-type" A_2 locus is present. ~~Then~~ ~~ha~~ normal A_2 locus is present, and also an active Spm element the plants and kernels are fully pigmented.

The behavior of the Spm element likewise has been examined in detail. It undergoes mutation, transposition, and cyclically occurring change in phase of activity. ~~that is, active to inactive and return to active.~~ Some of the mutations of Spm result in a weakening of its capacity to induce mutation with the class I states without inducing a corresponding weakening of its suppressive action. ~~Others result in a weakining of~~

Others result in a weakening both of its capacity to suppress gene action and its capacity to induce mutation with the class I states. Some of these mutants are highly stable whereas others are quite unstable, in that a return to full Spm expression occurs in some somatic cells during development both plant and kernel. Illustrations of these mutant types are given in figure 2. Several different methods have been used to examine transposition of Spm and these are reviewed elsewhere (McClintock, 1956). It has been learned that different isolates of Spm undergo transposition at different times in plant development. One isolate, extensively examined through three successive plant generations, undergoes transposition early in plant development. Other isolates, on the other hand, may rarely undergo transposition, either during sporophytic or gametophytic development. Still other isolates may undergo transposition only late in plant development. It has been learned that a change from a fully active Spm to one that is weakly active, or the reverse, arises as the consequence of a single (mutational) event affecting Spm itself. It is not yet known, however, whether a mutational event is responsible for the expressed differences in time of occurrence of transposition of Spm during plant development and the frequency of this at any one time.

The third mentioned modification of Spm relates to its alternating cycles of activity within a plant and a description of this will be the main subject of this report. For example, a fully active Spm may be introduced into a zygote. As the plant develops from this zygote, the activty of Spm may be "turned off" completely in some cells. No evidence will be given of its presence in the descendent cells until, in some of them, Spm activity is "turned on" again. The presence of Spm will then be made evident in the descendents of these latter cells. The duration of any one phase of activity of Spm, -- either active or inactive -- may be long in some cases, or short in others. In some cases, the duration of one phase may extend over a number of plant generations whereas in others a rather frequenty succession of alterations in phase of activity may occur during the development of an individual plant. When a class I state of either a_1^{m-1} or a_2^{m-1} is present, and also an Spm with a long duration of its active phase, a ~~very regular~~ particular pattern of anthocyanin streaks in a non-pigmented background appears in the plant, and these streaks arise from mutation. The particular pattern, ~~in any one case, is a reflection of~~ produced reflects the particular state of either a_1^{m-1} or a_2^{m-1} that is present in the plant. If, however, the Spm element is undergoing frequent change in its phase of activity during the development of the plant, the pattern of anthocyanin distribution in the mature plant may be exceedingly irregular. Pigment will appear in those areas

resulting from mutation - underlying events at either a_1^{m-1} or a_2^{m-1}, whichever may be present

of the plant in which Spm is in its inactive phase. Pigmented streaks in a non-pigmented background will appear in those areas of the plant in which Spm is in its active phase. However, the patterns of these pigmented streaks ~~in a non-pigmented background in these latter areas~~ may be quite different within different areas of the same plant. This is because no mutational events will occur at either a_1^{m-1} or a_2^{m-1} until Spm enters its active phase. If it enters this phase early in plant development, large pigmented areas may appear in a non-pigmented background with some of the class I states. If, however, it enters the active phase rather late in development, only small pigmented streaks will appear in a non-pigmented background. ~~If, however,~~ If now, the class II state of a_2^{m-1} is present in a plant, the distribution of pigmente and non-pigmented areas reflect for each area, regardless of its size, the particular phase of activity of Spm that is present in the cells of the area. In the non-pigmented areas, Spm is in its active phase and in the pigmented areas, Spm is in its inactive phase. Often, within a large nonpigmented area, a number of similiar sized, uniformly distributed pigmented ~~xxxxx~~ streaks appear, each arising as the consequence of a "turning off" of Spm activity. ~~Again~~ Again, within a large pigmented area, a number of similar sized non-pigmented streaks, often uniformly distributed ~~non~~pigmented ~~xxxxx~~ ~~streaks~~ area may appear. Thus, such patterns of pigment distribution reflect the time of occurrence of change in phase of activity of Spm and frequency of the ~~occurrence~~ this any any one time ~~of a change in phase of activity of Spm~~,

from active to inactive in the former example ~~and~~ from inactive to active in the latter example. Thus, the class II state of a_2^{m-1} has been particularly useful in examining cyclically occurring changes in phase of activity of Spm.

The Spm ~~element~~ isolate, whose cyclically occurring changes in phase of activity have been examined in considerable detail, was ~~the~~ one that was present in a plant of ~~the original culture~~ having the class II state of a_2^{m-1}. ~~Its behavior has been followed~~ It was followed through 7 successive plant generations but its behavior was intensively ~~so~~ examined only during the last 4 of these ~~7~~ generations. Originally, it was located in the short arm of chromosome 9 and was closely linked with ~~the~~ gene marker Wx. ~~No~~ Very few ~~established~~ cases of early occurring transposition of this Spm isolate have ~~yet~~ been detected, ~~in tests of different parts of a large number of plants~~. However, it does transpose, and the time of occurrence of this appears to be confined mainly to late stages in sporophytic and gametophyt development. The frequency of occurrence of transposition is not very high, as will be ~~indicated~~ made evident later.

Before considering the experimental results that ~~serve to indicate~~ have made it possible to detect the alternating changes in phase of activity ~~phase cycles~~ of Spm, some mention should be made of the earlier studies of a_2^{m-1} and a_1^{m-1} and of the reasons for the differences encountered in ease of detection of the control system associated with each. Study of a_2^{m-1}

was undertaken before that of a_1^{m-1}. ~~However~~, ~~no~~ an ~~clear~~ understanding ~~evidence~~ ~~was obtained~~ of the mode of operation of the system ~~that was~~ responsible for control of gene action at a_2^{m-1} was not reached in the early studies. In contrast, progress in this respect was relatively rapid in the study of a_1^{m-1}. The reasons for this difference in ease of detection of the control system in the two cases ~~became clear~~ was more evident when it was realized that the Spm element in the original a_1^{m-1} culture had a very long duration of its active ~~xxxxxxxx~~ phase whereas the Spm ~~element~~ in the a_2^{m-1} cultures was undergoing frequent change in phase of activity during plant development. Confirmation of ~~these~~ this differences in behavior of the Spm elements in the two cultures was obtained through interchange of ~~Spm~~ this elements between the a_2^{m-1} and a_1^{m-1} cultures, and also by isolation of Spm derivatives within each culture whose behavior was modified, either toward greater stability of a phase of activity or towards more frequently occurring changes in its phase of activity.

EXPERIMENTAL ~~PROBLEMS~~ Procedures

Experiments aimed at elucidating the peculiar behavior of Spm commenced in the summer of 1956, utilizing for this purpose both the class I and class II states of a_2^{m-1}. This report will concentrate on those studies that utilized the class II state, and for reasons outlined above. In earlier studies of this ~~class II~~ state, it ~~had been~~ was learned that an apparently full A_2 gene expression would appear in plant and kernel in the absence of Spm, and that gene action would be suppressed in its presence. However, pigmented areas did appear in plants and kernels having this state of a_2^{m-1} and Spm. It was also realized that, in general, the pattern of such pigmented ~~xxxxx~~ areas reflected the number of Spm elements that were present: the more Spm elements that were present, the fewer and smaller were the pigmented areas. Removal of Spm from some cells during development by the transposition mechanism might have been invoked to account for the appearance of the pigmented areas. However, the patterns of pigment distribution made it evident that removal of Spm ~~by transposition~~ could not be responsible for many of the pigmented areas that appeared. This was because within a fully pigmented area, smaller nonpigmented areas were often present and within some of these latter, in turn, pigmented streaks appeared. One set of tests that ~~have~~ made it possible to understand the way in which ~~these~~ patterns ~~phenomena~~ arose

commenced in the summer of 1956 with progeny of plants in culture number 7109, to be described below.

The plants in culture number 7109 originated from variegated kernels (pigmented spots in a colorless background) on an ear of a plant that had the following constitution: a_2^{m-1} (class II st te) Bt/a_2 bt in chromosomes 5, Wx +/wx Spm in chromosomes 9, and one additional Spm not linked to m rkers in either of these chromosomes. The silks of this ear had received pollen from a plant that was homozygous for a_2, bt, and Wx and had no Spm. Among the a_2^{m-1} carrying class of kernels on the ear, there were fully pigmented kernels and variegated kernels, that is, those that had spots of anthocyanin pigment in a colorless background. Some of the v riegated kernels showed only specks of pigment and were thought to have received both of the Spm elements that were present in the female parent, ~~and~~ other had a number of larger spots of pigment and the kernels showing this pattern were thought to have received only one of the two Spm element that were present in the female parent. Plants were grown from the two classes of variegated kernels, 5 from kernels of the first type and 6 from kernels of the latter type. A number of diffe ent types of test crosses were conducted with e ch plant. Confirmation was obtained from these tests of the presence of two Spm elements in the plants derived from the former mentioned type of

variegated kernel and of the presence of one Spm in each of the six plants derived from the latter type of variegated kernel. This report will consider mainly the tests that were conducted in successive years with ~~prog~~ progeny stemming from three of these latter six plants, that is, those that arose from kernels that showed many pigmented spots in a colorless background. The constitution of these three plants proved to be as follows: two plants were a_2^{m-1} Bt/a_2 bt, Wx +/wx Spm (plants 7109B-1 and B-2) and one plant (7109C-4) was a_2^{m-1} Bt/a_2 bt, Wx/wx, and had 1 Spm, not carried in the short arm of chromosome 9.

The appearance of the kernels on ears produced by the six plant in culture 7109 B and C (that is, those that ~~were considered to~~ had one Spm ~~in each~~) when crossed reciprocally with plants homozygous for a_2, bt, and Wx and having no Spm, are entered in table 1. A clearly expressed 1 : 1 ratio of fully pigmented kernels to kernels that showed pigmented spots in a colorless background appeared on the ears produced by all tillers of these plants except that of tiller-1 of plant C-1. However, a pronounced deviation in favor of the pigmented class appeared among the kernels on the ear produced by the main stalk of plants 7109B-1 and 7109C-3, and to a lesser extent on this ear produced by plants 7109C-1

and C-2. Many of the kernels in the pigmented class were uniformly and deeply pigmented but in some kernels placed in this class in the table, the intensity of pigment over the aleurone layer was not uniform. Lightly pigmented areas or even some colorless areas were present but sharply defined borders between areas with different pigment intensities, or between pigmented and nonpigmented areas were not usual. This gave the kernels a diffusly-mottled appearance (see photo, figure). At the time of observation of these kernels, no attempt was made to place in a separate class those kernels exhibiting different grades of this diffusely-mottled phenotype as it was evident that this class graded into the fully and uniformly pigmented class. Subsequent tests proved, however, that all of the plants derived from the diffusley-mottled kernels carried an ~pm element in them as did some of the plants derived from kernels on these ears that were uniformly and deeply pigmented.

The ear of tiller-1 of plant 7109B-2 was self-pollinated. Among the 367 Bt kernels on the resulting ear only 23 were completely colorless. Sixteen of these colorless kernels were Wx and 7 were wx. Among the remaining 344 Bt kernels, 87 were ~~uniformly~~ deeply and uniformly pigmented of which 84 were Wx and 3 were wx. One Bt kernel exhibited the diffuse-mottled phenotype, described above, and it was Wx. All of the remaining 256 Bt kernels were variegated in that pigmented spots appeared in a colorless background. These kernels ~~were~~ could be divided, roughly, into three classes: those that showed only a few specks of pigment, of which 11 were Wx and 20 were wx, those that had a number of larger spots as well as some specks of pigment, of which 105 were Wx and 42 were wx, and those that exhibited some quite large pigmented areas as well as a number of smaller pigmented ~~areas~~ spots, of which 64 were Wx and 14 were wx. Other crosses conducted with plants 7109B-1 and 7109B-2 that need not be outlined here, had indicated that in both ~~plants~~ of them one Spm was present and that it was located close to wx in chromosome 9. On the self-pollinated ear of the tiller of plant 7109B-2 the ratio of 84 Wx : 3 wx among the uniformly pigmented kernels and of 180 Wx to 76 wx among the variegated class was in conformity with this placement of Spm.

In the summer of 1957, plants were grown under culture number 7308, from some of the kernels in the uniformly

pigmented Bt, Wx class, from some of the variegated kernels in the Bt, Wx, and in the Bt, wx classes and from 5 kernels in the colorless, bt, wx class. Plants derived from the latter class of kernels were expected to be homozygous for a_2, bt, and wx, and to carry Spm at a known location in chromosome 9. Only two of the five plants survived. In both of them, a single Spm element was present, and subsequent tests indicated that it was located close to wx in one chromosome 9. These two plants, 7308D-1 and D-2, were extensively used as pollen parents in crosses to plants carrying not only the class II state of a_2^{m-1} but also to plants carrying a class I state of a_2^{m-1}. The behavior in subsequent generations of the Spm element in each of these two plants (see C and D of table 3) has contributed much to an understanding of cyclical changes in phase of activity of Spm, as will be made evident later.

Because hundreded of plants have been tested to determine whether or not Spm was present in them, and if so, the phase of its activity in different parts of the same plant, it will not be feasible to give a detailed account of the results obtained from each such test. Therefore, examples will be chosen that will illustrate the nature of the tests that were conducted with these plants and the conclusions that may be drawn from each. Before doing so, the reader is advised to inspect table 2

which summarizes the results obtained from tests that were conducted through successive generations with the Spm element that was present in plant 7109B-1. This plant had one Spm element closely linked with wx in the short arm of chromosome 9. The Spm element was in its inactive phase in the cells that gave rise to the ear of the main stalk. This was indicated by the uniform distribution of anthocyanin pigmentation in the main stalk of this plant and also by the phenotypes of the kernels on the ear it produced (table 1). However, the phenotypes of a few of the kernels on this ear indicated that Spm was present in the cells that contributed to this ear and that it had entered its active phase very early in development of a few of them, or had entered the active phase later in development in some cells of other kernels. In the cells that gave rise to the ear on each of the three tillers of plant 7109B-1, Spm was in its active phase. This was made evident not only by the appearance of these tillers, in that they exhibited streaks of anthocyanin pigment in a nonpigmented background, but also by the ratio of kernel types on the ears produced by each (table 1). The pollen of the main stalk of plant 7109B-1 was also used in making crosses and it was made evident from the types of kernels on the resulting ears that some grains carried Spm in its active phase whereas some others carried Spm in its inactive phase.

Table 2 included the results of tests only of those progeny of plant 7109B-1 that carried Spm. A number of progeny plants that did not carry Spm was also tested and the methods used to determine whether Spm is absent in a plant or is present in its inactive phase will be considered shortly. In this table, the symbol "-" indicates that Spm was inactive not only in the cells that gave rise to the ear, but also in th cells that gave rise to the aleurone layer in all kernels on the ear. The symbol "vd" (very delayed return to the active phase) indicates that Spm was inactive in the cells that gave rise to the ear and also in those that gave rise to nearly all of the kernels on the ear; a return to the active phase was seen only in some parts of a few kernels on these ears. The symbol "d" (delayed return to the active phase) indicates that the Spm element was inactive in the cells that gave rise to the ear, but that it had changed to the active phase in a number of kernels on the ear, being in its active phase in some of them at the start of endosperm development. The symbol "+" indicates that Spm was in its active phase in the cells that gave rise to the ear, turning to its inactive phase in some cells during endosperm development. The symbol (+ -) indicates that a part of the ear arose from cells in which Spm was in its active phase whereas another part arose from cells in which Spm was in its inactive phase. Ears of this type exhibited sharply defined sectors

with Spm active in one sector and inactive in the other.

Table 2 reveals that the inactive phase of Spm, present in the main stalk of plant 7109B-1, remained in this phase in the tested parts of plants over four successive plant generations, and exhibited the same pattern of behavior in each generation. In plants having this inactive Spm, return of it to the active phase was very much delayed. In general, visual evidence of this in the plant was given only by tillers. In some tillers, the change of Spm from inactive to active was exhibited by the presence of nonpigmented sectors in an otherwise pigmented tiller, and within some of these latter sectors, in turn, small pigmented streaks were present.

In this study of alternating changes in phase of activity of Spm, a number of tests were conducted to determine whether or not the presence of an active Spm in the same nucleus with an inactive Spm would effect a change in the latter. Evidence obtained from tests of this type indicate that the active Spm does not initiate change in phase of the inactive Spm nor does it appear to alter the duration of an inactive phase. One such test, conducted with the inactive Spm originally present in the main stalk of plant 7109B-1, is recorded in A of table 2 under culture number 7780A, Year 1960. The plants in this culture arose from a_2^{m-1} carrying kernels

on an ear of plant 7599B-4 (see Year 1958, Table 2 A) that was a_2^{m-1} (class II) Bt/ a_2 bt, Wx +/wx Spm-inactive in constitution when crossed by a plant that was homozygous for a_2, bt, and wx, and that had an active Spm linked with wx in one chromosome 9. The plants in culture 7780A grew from kernels selected from this ear because each had received the inactive Spm from the female parent (originally derived from the main stalk of plant 7109B-1) and the active Spm element from the male parent (this Spm originally derived from tiller-1 of plant 7109B-2). The plant in B of culture 7780 were derived from kernels that had received the active Spm from the male parent but no Spm from the female parent. As the table indicates, the inactive Spm, originally present in the main stalk of plant 7109B-1, appeared in the progney plants of culture 7780A and exhibited quite the same behavior with respect to phase as it exhibited in the ancestor plants in which it was the only Spm element that was present.

The same Spm element that was in an inactive phase in the main stalk of plant 7109B-1 was in an active phase in the cells that gave rise to the ear of each of the tillers of this plant (table 1). The activity phases of this Spm in cells giving rise to ears in successive generations of plants are recorded in B of table 2. In the table, the letter T (transposition) before the plant number indicates that the plant carried this

Spm at a new location in the chromosome complement. The plants in B of culture 7306 (Year 1957) were derived from the very few kernels on the ear of tiller-1 that were suspected to have received more than one Spm element from the 7109B-1 parent plant, the additional Spm having arisen through the transposition mechanism. The plants in culture 7560 (Year 1958) were derived from the recombinant class of kernels on the second ear of the main stalk of plant 7306A-1. As indicated in a previous publication (McClintock, 1956) the phenotypic recombinant class may be a composit of individuals some of which represent the true crossover class and other of which carry a transposed Spm element, and do not represent the true crossover class. It will be noted that the behavior of Spm derived from tiller-1 of plant 7109B-1, whether in its original location or transposed, with regard to phase of activity in the cells that gave rise to the tested ears in B of table 2, is quite different from that of the same Spm element in an inactive phase, derived from the main stalk of plant 7109B-1 and registered in A of this table. Change from the active to the inactive phase occurred in some cells early in plant development, but in many other parts of the plant, such change was delayed, occurring in some cells only late in plant development.

Similar types of test as those outlined above, were conducted with the Spm carrying progeny of tiller-2 of plant 7109B-1. Spm was in its active phase in the cells that gave rise to the ear of this tiller. Its behavior in successive generations is recorded in C of table 2. In general, its behavior was similar to that in tiller-1. Only two comments regarding this need be made here. Firstly, it may be pointed out that tests of Spm location in eight plants derived from the recombinant class, entered in cultures 7561, and 7562, Year 1958, did not reveal a case of transposition among them. The second comment is directed to the first ear of the main stalk of plant 7561-4. The constitution of this plant was a_2^{m-1} (class II) Bt/a_2 bt, Wx Spm/wx +. The silks of the first ear of the main stalk of this plant received pollen from a plant homozygous for a_2, bt, and wx, and in which no Spm was present. The resulting ear was sectorial. Spm was in its active phase in all parts of this ear except for a sector in the middle of the ear in which no evidence of Spm was given by any of the a_2^{m-1} carrying kernels within it. Kernels with a_2^{m-1} that were also Bt and Wx and having an active Spm in them, derived from that part of the ear in which Spm was active, were sown in 1960 under culture number 7777A and B. Fully pigmented (a_2^{m-1}) carrying kernels that were Bt and Wx were sown under

C and D of culture 7777. All of the plants in culture 7777 carried Spm in the Wx chromosome contributed by the female parent. However, it was totally inactive in all of the cells that contributed to each of the tested ears of plants in C and D of culture 7777 and remaind in the inactive phase during development of all but a very few kernels on these ears. In the leaves of these plants, several small sectors were present in which Spm had changed from its inactive to its active phase in the cell that gave rise to each such sector. In most of the plants, these small sectors appeared only in tillers or in parts of the support roots of the main stalk. It was obvious, however, that the duration of this particular inactive phase was long. In contrast to this the same Spm element in the plants of A and B of culture 7777 was undergoing frequent change in phase of its activity.

As mentioned earlier, the pollen taken from the tassel produced by the main stalk of plant 7109B-1 contained some grains in which Spm was in its inactive phase and others in which it was in its active phase. It is presumed that the tassel was sectorial with regard to phase of activity of Spm. Tests of the phase of activity of Spm in progeny produced by use of this pollen is given in D of table 2.

In order to obtain evidence of Spm activity in cells that gave rise to the ears summarized in table 2, it was necessary in making the cross to each ear to use pollen from a plant having a particular combination of markers. With regard to such marker, the tested plants were of two main types: those that were homozygous for a_2 and bt (and also for some other markers that need not be considered at this time), and those that carried in their chromosome 5 a class I state of a_2^{m-1} (three different class I states selected for this purpose), or a class II state of a_2^{m-1}, and also bt. These a_2^{m-1} carrying tester plants were homozygous for wx and they had no Spm. The tester plants, homozygous for a_2 and bt, wereof three main types: homozygous for wx and having no Spm (type-1), homozygous for wx and having no Spm (type-2), and homozygous for wx and carrying one or more Spm elements each in its active phase (type-3). Most of the latter plants carried one Spm, linked with wx in one chromosome 9. Some had two Spm elements located close to wx in each chromosome 9 (designated Spm/Spm in the tables) or two Spm, one located close to wx in one chromosome 9 and the other located elsewhere in the chromosome complement (designated Spm + Spm in the tables), the latter having been transposed from a location close to wx to a new location. Each type of tester plant served a purpose in examining Spm behavior.

In this study, it is important to detect the time of occurrence of change in phase of activity of Spm and to derive progeny from a cell in which this occurred. For this reason, the majority of tests of Spm behavior were conducted with ears of plants rather than with pollen because cell lineages are more evident in them. Each plant had a limited number of fertile ears that could be used for test purposes and a decision had to be made in the test of any one plant regarding the type of tester plant that should be used as pollen parent in the cross to each ear of the plants whose Spm was desired to be examined. If the appearance of the stalk and leaves of the plant indicated that it had started its development with an active Spm, a cross was usually made with it using pollen of a plant having no Spm that was homozygous for a_2 and bt, and either Wx or wx, depending on the constitution of the ear-bearing plant. If the appearance of the plant indicated that Spm was in its inactive phase in most parts of the plant, then a cross using pollen of a plant homozygous for a_2, bt, and carrying an active Spm was indicated for at least one of the fertile ears of the plant, and for reasons that will be made evident shortly. When possible, another ear of this same plant was used in a cross with a plant homozygous for a_2 and bt and having no Spm. Ears of some plants having either an initially active Spm or an initially inactive Spm in them

were used in crosses with plants that carried a class I state of a_2^{m-1} and bt, but in which no Spm was present, in order to examine the response o the chosen class I state of Spm that was contributed by the ear-bearing parent. Since many of the tested plants were a_2^{m-1} (class II) Bt/a_2 bt in constitution, the direct response of the class I state to Spm in the femal parent could be observed among the bt class of kernels on the resulting ear, as the large majority of them receive a_2 and bt from the ear-bearing parent.

In the summer of 1957, the only plants homozygous for a_2, bt, and wx and having an active Spm in them were plants 7308D-1 and D-2. The origin of these two plants from the a_2, bt, wx class of kernels on the self-pollinated ear of tiller-1 of plant 7109B-2 was described earlier. Both plants produced three tillers. Pollen collected from the tassel of main stalk and from that of each tiller was used in making crosses to a large number of plants having either a class I or ~~xxxxxx~~ the class II state of a_2^{m-1} and carrying either no Spm or one or more Spm elements in the active or the inactive phase in different parts of the plant. The phenotypes of kernels on the ears these crosses produced indicated that plants 7308D-1 and D-2 each had one Spm and that in the pollen derived from all parts of each plant, the Spm was in its active phase in nearly all of the pollen

grains that carried it. From the phenotypes of the kernels on some of these ears, it was first learned that it was possible to distinguish whether or not a uniformly pigmented, ear-bearing plant had no Spm in it or had an Spm that was in its inactive phase. This is because Spm in its inactive phase, although unable alone to effect suppression of gene action with the class I and calss II states of a_2^{m-1}, and to induce mutation with the class I states, behaves as if it were in its active phase when it is in the same nucleus with an Spm that is in its active phase. However, this association does not induce an alteration in the phase of activity of eithe Spm. When the active and inactive Spm elements are separated into different nuclei by the meiotic process, the active Spm element continues in its active phase whereas the previously inactive Spm element reappears in its inactive phase. This type of test is so effective that it has been used extensively in succeeding years to determine whether or not an inactive Spm is present in a part of a plant that exhibits no evidence of the presence of Spm by the phenotype of its stalk, leaves, or tassel. Use of this test has made it possible to insert the "-" symbol in many of the places where it appears in summary tables 2, 3 and 4. Illustrations may now be given of the types of test that were conducted with each plant in a culture and the effectiveness of each test in determining the presence

or absence of Spm in a plant and its phase of activity in the various tested parts of a plant, should Spm be present in it. For this purpose, tests of the progeny derived from the ear of the main stalk of plant 7109B-1 (see tables 1 and 2) and from the ear of the main stalk of plant 7109C-4 (see tables 1 and 4) may be described first.

Kernels were selected from the first ear of the main stalk of plant 7109B-1, which was a_2^{m-1} (class II) Bt/a_2 bt, Wx +/wx Spm in constitution, and the plants grown from them in the summer of 1957 received culture number 7456. The plants in A, B, and E of this culture were derived from uniformly pigmented kernels, those in A and B from the Bt class and those in E from the bt class. Plants derived from Bt kernels exhibiting the "diffuse-mottled" phenotype were grown under C of culture

7456, and those derived from Bt kernels that ~~xxxxxxxxxxxxxxxxxx~~ showed small spots or specks of pigment in a non-pigmented background were grown under D of culture 7456. The types of test cross conducted with 22 of the plants in this culture are entered in table 5. In table 2A, under Year 1957, is recorded the behavior of Spm in the cells giving rise to the tested ears in each of the Spm carrying plants in culture 7456. For each ear, the given symbol referring to activity phase of Spm was based upon the phenotypes of kernels appearing on the ears derived from the crosses entered in table 5.

In table 6 are given the types of test cross that were conducted with plants in culture 7455 that were derived from selected kernels on the first ear of the main stalk of plant 71090-4 (see table 1). This plant was Wx/wx and carried 1 Spm that was not linked to either of these alleles. The plants in A, B, and D of culture 7455 were derived from Bt kernels that exhibited the "diffuse-mottled" phenotype. Those in C of culture 7455 were derived from Bt kernels that had spots or specks of color in a colorless background. As summary table 4 indicates, each of the 18 tested plants in culture 7455 had an Spm element in it, and it was in its inactive phase in the cells that gave rise to all tested ears except that of the tiller of plant 74550-4.

Before considering the phenotypes of the kernels on the ears entered in tables 5 and 6, those produced from test crosses types 1, 2, and 3 ~~to~~ with a plant of the constitution a_2^{m-1} (class II) Bt/a_2^{m-1} Bt; Wx +/wx Spm-(active), will be considered, as the data obtained ~~from crosses~~ from them ~~with it~~ may be compared with those obtained from the ~~crosses of~~ same types of cross conducted with the plants entered in tables 5 and 6. This plant, 7308A-4, was derived from a kernel on the self-pollinated ear of tiller-2 of plant 7109B-2, where kernel types were described on page . The appearance of ~~this~~ plant 7308A-4 indicated that it had started development with an Spm in its active phase. The phenotypes of the kernels on the three tested ears of this plant produced from use of pollen of tester plants types 1, 2, and 3, are given in table 7. Silks of the first ear of the main stalk received pollen from plant 7308D-2 (type-3 tester) that was a_2 bt/$a_2$bt, wx +/wx Spm-(active) phase in constitution. On this ear, a 1 : 3 ratio was given of uniformly pigmented kernels to colorless kernels with spots or specks of pigment in them. Among the latter, there were three distinguishable classes with respect to number and size of pigmented areas: those that exhibited a numerous pigmented spots, ~~a~~ some ~~number~~ of which covered a large area ("1 Spm" pattern) (see figure -), those that exhibited a number of pigmented ~~areas~~ spots, all of which were small in area ("2 Spm" pattern") (see figure -), and those that exhibited only small specks of pigment, and often very few of them per kernel ("High dose Spm pattern") (see figure -). The distribution of Wx and wx among the 4 classes of kernels on this ear

indicated that plant 7308A-4 carried an ~~active~~ Spm that was ~~closely~~ linked with wx. and that it was in its active phase in the cells that gave rise to this ear It also demonstrates the effect of dose of Spm on pattern of pigmented spots. The class with the "1 Spm" pattern received its Spm from the male parent. The class with the "2 Spm" pattern received its Spm elements from the female parent, as the female contributes two haploid nuclei to the primary endosperm nucleus. The class with the "high dose Spm" pattern received two Spm elements from the female and one Spm element from the male. Within each of these classes there could be a few misclassifications with regard to this presumed origin of Spm as ~~the~~ cross types 1 and 2 will illustrate.

Cross type-2, conducted with the second ear on the main stalk of plant 7308A-4, again showed the presence of an active Spm in the cells that gave rise to this ear and ~~in this plant~~ that was ~~closely~~ linked with wx. Among the 129 variegated kernels on this ear, two exhibited the "high dose Spm" pattern. Tests of plants arising from kernels of this type on ears of plants having one Spm have demonstrated that usually they carry more than one Spm in them. The origin of the extra Spm may be atrributed to the transposition mechanism.

The tiller ear of plant 7308A-4 was used in a cross with tester type-1. A ratio of 1 uniformly pigmented : 1 variegated kernel appeared on this ear. Among the variegated kernels, one exhibited the "1 Spm" pattern. It is quite probable that the cells of the endosperm of this kernel have

only 1 Spm in them because only one of the two nuclei delivered by the female gametophyte to the primary endosperm nucleus carried an Spm. The other nucleus ~~may~~ could have ~~had~~ lost Spm through the transposition mechanism during gametophytic development.

If a plant has no Spm in it, all parts of the plant are pigmented, ~~and~~ Also, ~~then~~ with testcross types 1, and 2, all a_2^{m-1} (class II) carrying kernels are uniformly dark pigmented. No variegated kernels appear on these ears. If, however, the tester plant is ~~of~~ type 3, then apparently half of the a_2^{m-1} kernels are uniformly dark pigmented and half are variegated: colorless with spots of pigment in them. The phenotype of the kernels on ears of "no Spm" plants in culture 7456 (table 5) and of 4 such plants in culture 7308A, when crosses with tester plants of type 3 (that is, plants 7308D-1 or D-2) are given in ~~A~~ of table 8. On the ears of the two plants (7308A-1 and A-2) that were a_2^{m-1} Bt/a_2^{m-1} Bt there were 432 uniformly dark colored kernels and 404 kernels that showed colored areas in a colorless background. Among the latter, 402 exhibited many pigmented spots, some of which were large in area (1 Spm pattern). Within these large pigmented areas, smaller colorless spots were present (see figure). Two of the variegated kernels exhibited only small spots ~~or specks~~ of pigment (2 ~~or~~ Spm pattern). Among the 953 a_2^{m-1} Bt carrying kernels derived from the cross of the a_2^{m-1} Bt/a_2 bt plants to the tester type-3 plants in A of table 8, 475 were uniformly dark pigmented and 478 were colorless with spots of pigment in them. In 468 of these latter,

there were many pigmented areas, a number of which were large (1 Spm pattern) and in the remaining 10 variegated kernels, there were fewer pigmented areas and all of them were small ~~in area~~ (more than 1 Spm). Among the total of 1789 a_2^{m-1} Bt kernels in table 8A, 907 were uniformly pigmented and 882 were variegated; 870 of the variegated kernels exhibited the "1 Spm" pattern and 12, or 1.35%, exhibited a pattern expressed when more than one Spm is present in the endosperm. It is evident that among the Spm carrying pollen grains produced by plants 7308D-1 and D-2, (the tester type-3 plants) the ~~vast majority~~ had only one Spm in each. It is also evident ~~clear~~ that in nearly half of the pollen grains ~~these plants produced had an active Spm in them~~ an Spm in its active phase was present. Among a total of 5040 pollen grains that could be tested for this in crosses to 28 plants that had no Spm in them, 2577 ~~pollen grains~~ gave no evidence of Spm in any one of them whereas the remaining 2463 pollen grains ~~had an~~ carried ~~active~~ Spm ~~in them of which~~ and among them approximately 98 percent had but one Spm. The remaining 2 percent had more than 1 Spm in each.

The types of kernels appearing on the ears of plants in culture 7455 (table 6), when crossed by tester plants of type-3 (plants 7308D-1 and D-2), are entered in B of table 8. Among the a_2^{m-1} carrying kernels on these ears, an approximate 1 : 1 ratio was given of uniformly pigmented kernels to those that had pigmented spots or specks in a colorless backgroun

The latter kernels could readily be distributed, on the basis of pattern of pigmented spots, into two main classes: those that exhibited a number of spots of pigment, some of which were large in area (the "1 Spm" pattern) and those that exhibited a pattern that is known to appear when more than 1 Spm is present (see figures). The ratio of these two classes ~~closel~~ approximated 1 : 1 on the majority of the ears, as shown in the table. That Spm was present in these plants but in its inactive phase in most parts of the plant was made evident by the appearance of some sectors (usually small in area, in the stalks, leaves and tassels) and usually found only in the tillers. In these sectors, ~~which~~ Spm was in ~~had changed from its inactive to~~ its active phase. These sectors were either totally non-pigmented or non-pigmented with some small streaks within them in which pigment was present.

Among the ears of plants in culture 7455 that were used in making test cross types 1 and 2 (see table 6), there was no evidence of the presence of Spm among the kernels of 6 of the 14 ears. Its presence was made evident in some kernels on the ~~xxxxxxxxxx~~ remaining 8 ears (table 9). Only in the cells that produced the ear of the tiller ~~ear~~ of plant 7455C-4 was Spm in its active phase. In the cells producing all other ears, Spm was in its inactive phase, ~~and~~ but it had ~~was~~ changed to ~~Spm entered~~ the active phase ~~only~~ in some cells late in development of the ear or in some cells during development of some of the kernel.

The symbols describing the behavior of Spm in different parts of the plants in culture 7455, placed in table 4 (Year 1957), are based on the

phenotypes of the kernels derived from the test crosses described above. That the designations of Spm phase in this table are based on correct interpretations of the origins of the phenotypes on the ~~described testcross~~ ears produced from the described test crosses, comes from similar types of test conducted with the plants in culture 7456 (table 5). In the crosses conducted with plants in culture 7455, no evidence was given of linkage of the inactive Spm with ~~Wx~~ wx in those plants that were Wx/wx in constitution. However, such evidence was given by the Wx/wx, Spm carrying plants in culture 7456. The parent plant (7109B-1) was known to be Wx +/wx Spm in constitution and ~~many~~ the majority of the Wx/wx plants in culture 7456 should ~~also~~ also be Wx +/wx Spm in constitution. The appearance of the kernel from which each plant in culture 7456 arose was described on page . Twelve tested plants were derived from uniformly dark ~~colored~~ pigmented kernels (those in A, B, and E of this culture). Nine of these twelve plants were Wx/ Wx and in none of them was any evidence given, either by the appearance of the plant or by the appearance of the kernels derived from test crosses with each, of the presence of Spm in them. The phenotypes of kernels appearing on the ears of these plants, ~~following a~~ produced by ~~cross with tester type~~ test cross-3, was discussed earlier, and the data obtaind from each such cross ~~was~~ is entered in A of table 8. Among the 12 ears were obtained from testcross types 1 ~~and~~ or 2, ~~of the~~ (never) a_2^{m-1} Bt/$a_2$bt, Wx/Wx plants, among the kernels on these ears, no

evidence whatsoever was given of the presence of Spm in any one of them. There was a total of 3107 kernels; 1484 were uniformly dark pigmented (1415 Bt : 69 bt) and 1533 were totally colorless (79 Bt : 1454 bt). That these plants carried the class II state of a_2^{m-1} that was capable of responding to the presence of an active Spm was shown by testcross type-3 conducted with 6 of these 7 plants (A, table 8). The remaining 3 of the 12 tested plants that arose from the uniformly dark pigmented kernels were Wx/wx. No evidence of the presence of Spm was given by plant 7456B-6, either by the appearance of the plant or by testcross type-1 conducted with the one fertile ear it produced. Both of the other two plants (B-5 and E-2) were Wx +/wx Spm. All 4 of the plants in 7456C and all 6 of the plants in 7456D carried Spm. Eight of these 10 plants were Wx +/wx Spm in constitution and 2 (C-1 and D-4) were Wx/Wx. Both of the latter 2 plants had one Spm. It is probable that the Spm in each of them was located close to Wx in one chromosome 9 but progeny tests would be required to determine this, and these were not conducted.

Testcross type-3 was conducted with an ear of 5 of the 10 ~~xxxxxxxxxxxx~~ Wx/wx plants in culture 7456 and with each of the 2 plants that were Wx/Wx and carried Spm (plants C-1 and D-4). In table 10A is given the phenotypes of the kernels on ears produced by the 5 a_2^{m-1}Bt/a_2 bt, Wx/wx plants

that were subjected to testcross type-3, and in B of table 10 is given the phenotypes of kernels on the ears of the two Wx/Wx plants carrying Spm that were subjected to this test. On each ear in A of table 10, approximately half of the a_2^{m-1} carrying kernels were fully pigmented and half were variegated in that they showed either many spots of pigment in a colorless background ("1 Spm" pattern) or a few small spots of specks of pigment in a colorless background ("high dose" Spm pattern). The distribution of Wx and wx among these two classes of variegated kernels is strikingly unequal. The great majority of the Wx kernels exhibited the "1 Spm" pattern of pigmented spots whereas the great majority of wx kernels exhibited the "high dose" Spm pattern. It will also be noted that the majority of kernels exhibiting the "diffuse-mottled" phenotype were wx (2 Wx to 17 wx). If the latter kernels are combined with the uniformly pigmented class of kernels, the ~~rxxxo~~ frequency of kernel ~~of~~ types would be: 207 uniformly pigmented, Wx, ~~xxxxxxx~~, 206 uniformly pigmented wx, 200 variegated kernels exhibiting the "1 Spm" pattern of spots (178 Wx to 22 wx) and 209 kernels exhibiting the "high dose" Spm pattern of pigmented spots (24 Wx : 185 wx). It is quite evident that a factor ~~closely~~ linked with wx (11 crossover units) in these plants is responsible for the "high dose" Spm pattern of pigmented spots in those kernels that received an active Spm from the type-3 tester

pollen parent. That this is Spm in its inactive phase in the cells that gave rise to these ears could be suspected as the parent plant, 7109B-1, was Wx +/wx Spm in constitution and Spm was ~~closely~~ linked with wx. Also, the ~~crossover~~ percent recombination between wx and this inactive Spm is similar to that given by plants derived from the tillers of plants 7109B-1 and B-2 that were Wx +/wx Spm (active) and illustrated ~~late~~ earlier in tests conducted with plant 7308-4, entered in table 7. That this factor is Spm is also shown by the phenotypes of the kernels on ~~the~~ ears of these and other Wx/wx plants in culture 7456 that were produced from testcross type-2. The types of kernels on the ears this cross produced are entered in table 11. It will be noted in this table as well as in table 12 (from testcross type-1) that the kernels on ears produced by the main stalk of these plants gave either no evidence of Spm in any one of them or its presence was made evident in only a very few kernels on an ear. On the ears produced by the tillers, many more kernels showed the presence of Spm in them and the number of ~~them~~ ears increased progressively, the later the emergence of the tiller from the base of the plant. In other words, the younger tillers had more such kernels. Among the kernels exhibiting Spm, linkage of it with wx was clearly expressed, and it could be located approximately 10 ~~crossover~~ distant units from wx.

The evidence obtained from the testcrosses described above makes it obvious that union in the primary endosperm nucleus of two nuclei contributed by the female gametophyte, in each of which an inactive Spm is present, with a nucleus contributed by the male gametophyte in which Spm is active, will give rise to a kernel whose aleurone layer will exhibit a pattern of pigmented specks in a colorless background that mimics the pattern produced when 3 active Spm elements are introduced into the primary endosperm nucleus. As indicated earlier in this report, the inactive Spm under these circumstances, does not undergo that particular type of genetic alteration which is responsible for a true change of its phase of activity. It expresses, following meiotic segregation from the active Spm, the same inactive phase that it previously had expressed before being associated with the active Spm. At present, there is no evidence to indicate the level ~~of expression of~~ ~~the~~ at which complementation occurs ~~that~~ between an inactive and an active Spm ~~exert on one another~~. However, it is evident that this must occur at some level in these cells, and the fact that it does ~~this occurs~~ has made it possible to test for the presence of an inactive Spm in parts of plants that otherwise ~~would~~ give no evidence of the presence in them of any Spm element. Tables 13 and 14 summarize the effectiveness of this test, conducted with the test type-3 plants (7302 D-1 and D-2), obtained from crosses made with these plants during the summer of 1957.

The tests considered so far have dealt with the behavior of Spm in subsequent generations following two cases of change in phase of its activity from active to inactive-- and registered originally in the main stalk of plant 7109B-1 and of plant 7109C-4. The subsequent behavior of the inactive Spm in the second and third generation progeny, is summarized in A of table 2 for that originally present in the main stalk of plant 7109B-1 and in table 4 for that originally present in the main stalk of plant 7109C-4. The origin of the plants entered in these tables is indicated at the base of each table, along with ~~as well as~~ the appearance of the kernel from which each plant arose. It may be seen that the Spm ~~in both cases~~ derived from the main stalk of each of these plants continued in its inactive phase in subsequent generations and that return of it to the active phase was infrequent, ~~much delayed in the progeny plants,~~ the event responsible for this occurring only in a few ~~some~~ cells, and often restricted to those of the tillers.

The behavior of Spm in ~~derived from~~ tiller-1 and tiller-2 of plant 7109B-1 contrasted greatly with to ~~the~~ behavior ~~of this same Spm that was present in kernels on the ear of~~ in the main stalk of this plant, and this difference continued to be expressed in subsequent generations. Comparison of A with B and C of table 2 will make this evident. It should be stated here that pollen collected from the same plant was used in making crosses to each of the ears of plant 7109B-1 and thus, the difference

in behavior of Spm in the progeny derived from kernels on the ears of this plant cannot be attributed to some modifying factors introduced by the male parent. In the Spm carrying progeny derived from kernels on the ear of the main stalk of plant 7109B-1, Spm was in its inactive phase in the cells that gave rise to ears in all tested parts of each plant and remained in this phase in successive generations as shown in A, table 2, under Years 1957, 1958, and 1960. In contrast to this, Spm was in its active phase in the cells that gave rise to the ear of each of the tillers of this plant (table 1) and it was in the active phase in the cells that gave rise to many of the ears in the Spm carrying progeny of tillers-1 and -2, as shown in B and C of table 2.

In B, table 2, under subheading Year 1957, culture 7306, is shown the phase of activity of Spm in the cells that produced ears on eight Spm carrying plants, each plant was derived from a kernel on the ear of tiller-1 of plant 7109B-1 that showed spots of pigment in a colorless background. The plants in A of culture 7306 grew from kernels that had many small spots of pigment in a colorless background. The two plants in B of culture 7306 were derived from the two kernels on this ear that exhibited only a few specks of pigment in a colorless background. Each of the six plants in A of culture 7306 had one Spm and itswas linked with wx in

five of these plants but was not linked with it in one plant. Both of the plants in B of culture 7306 had two Spm elements, one of which was Y linked with wx. In plant 7306B-1, the additional Spm was located close to a_2^{m-1} in chromosome 5. Spm was in its active phase in the cells that gave rise to 15 of the 17 tested ears of the plants in culture 7306. Testcross type-2 produced some of these ears and the phenotpyes of kernels on the ears produced by this cross are entered in table 15.

In table 15 likewise are entered the kernel types appearing on the ears of six plants in culture 7560, each of which was derived from a variegated, Bt, Wx kernel on the first ear of the main stalk of plant 7306A-1. In two of the six plants, Spm was linked with Wx. The one fertile ear produced by plant 7560-2 gave no evidence among its kernels of the presence of Spm in any one of them. The phenotype of the plant,nevertheless, indicated that Spm was present in this plant. In the remaining three plants, derived from the recombinant class on the parent ear, Spm was not linked with Wx and in one plant (7560-4) two Spm elements were present, both in the active phase in the cells that produced the two fertile ears of this plant. Neither of these Spm elements was linked with Wx, however. From the locations of Spm in the plants in culture 7560, it appears that the rate of transposition of Spm

in the parent plant, 7306A-1, was much higher than encountered in plants of related cultures. The percent of the recombinant classes of kernels on the ears produced by plants in culture 7306A was high, being 18.5 and this may be a reflection of the high frequency of occurrence of premeiotic transposition of Spm that occurred in these plants.

In 1957 plants were grown under culture number 7307 from kernels on the ear of tiller-2 of plant 7109B-1 and the phase of activity of Spm in the cells giving rise to tested ears of these plants, having Spm is shown in C of table 2. The plants in A of culture 7307 were derived from Bt, wx kernels that exhibited a number of small spots of pigment in a colorless background. The plant derived from each was expected to have one Spm elementin its cells. Those in B of culture 7307 were derived from the four kernels on this tiller ear that showed only a few specks of pigment in a colorless background. These plants could have more than one Spm element in them. Spm was in its active phase in the cells that gave rise to all but one of the twenty-six ears that the plants in culture 7307 produced. The six plants in A of culture 7307 each had one Spm and it was linked with wx in the five plants that were wx/wx (line 1, A, table 16). Plant B-1 had only one Spm and it also was linked with wx.

Plants 7307B-3 and B-4 each had two Spm elements, one of which was linked with wx (lines 2 and 3, A table 16). The phenotype of the Spm carrying kernels on the ears produced by plant 7307B-2 was similar to that of the kernel from which this plant arose. Only a relatively few small spots or specks of pigment in a colorless background appeared in them following testcross types 1 and 2. Spm was linked with wx in this plant (line 4, A, table 16) but the recombination frequency was greater than that given by sister plants. Also, change in phase of Spm from active to inactive during development of both plant and kernel occurred later than it did in sister plants.

Variegated kernels were selected from the second ear of the main stalk of plant 7307B-2 and grown in 1958 under culture number 7572. Again Spm in most of these plants behaved in the same manner as it had behaved in the parent plant. This was shown by the late time of occurrence of change in phase of Spm, -- from active to inactive --, as well as by the same degree of increased frequency of recombination between Spm and wx (line 9, A, table 16).

On the ear of the main stalk of plant 7307A-3 and of that of plant 7307A-5, some kernels exhibiting spots of pigment in a colorless background that were in the recombinant class (wx) were grown in 1958 under culture numbers

7561 and 7562. The phase of activity of Spm in the cells giving rise to the tested ears of the plants in these two cultures is recorded in C of table 2 under Year 1958. As indicated by the data entered in lines 5 and 6 of A, table 16, Spm in these plants was linked with Wx.

The first ear of the main stalk of plant 7561-4 was sectorial. In the cells giving rise to eight adjacent rows of kernels, Spm was in its ~~xx~~active phase and it was linked with Wx (line 6, A, table 16). In the remaining four rows of kernels, no evidence was given of the presence of Spm in any one kernel (line 7, A, table 16). In the summer of 1960, plants were grown from variegated, Bt, Wx kernels on this ear under A and B of culture 7777. Fully pigmented, Bt, Wx kernels from within that part of the ear that gave no evidence of Spm, were sown under C and D of culture 7777. Each of the sixteen plants in culture 7777 had one Spm which was linked with Wx (C, table 2, Year 1960). All plants in C and D started development with Spm in its inactive phase. Change ~~xxxxxxxx~~ to the active phase was much delayed as evidenced by the appearance of these plants. A few small sectors of nonpigmented tissue were present in a few of the leaves on the main stalks of some of these plants. The tillers of these plants, however, had more such sectors. Following testcross type-2, ten ears were obtained from the plants in 7777C and D but in only ~~xxxx~~ 9 of the

1085 $\underline{a}_2^{\underline{m}-1}$ carrying kernels on these ears was evidence given of the presence of Spm, and 5 of these 9 kernels were located within a small sector on one of these ten ears (ear of tiller-2 of plant 7777C-2). All 9 kernels were Wx. Testcross type-3, conducted with these plants, indicated that each had one Spm and that it was linked with Wx. Among 596 $\underline{a}_2^{\underline{m}-1}$, $\underline{Bt}$ kernels on these ears that received Spm from the pollen parent, 296 showed the "1 Spm" pattern of pigmented spots in a colorless background of which 7 were Wx and 289 were wx, and 300 showed only a few specks of pigment in a colorless background, the "high dose" Spm pattern, of which 284 were Wx and 16 were wx. The percent recombination between Spm and Wx, based on the ratio of Wx to wx within each of these two classes of variegated kernels, is 3.6. Testcross type-2, conducted with the plants in A and B of culture 7777, in which Spm was in its active phase in the cells that gave rise to some ears of these plants, likewise showed that Spm was linked with Wx in these plants and that the percent recombination was low. On sixteen ears produced by testcross type-2, there was a total of 858 $\underline{a}_2^{\underline{m}-1}$ carrying kernels in which the presence of Spm was evident. Among them, 832 were Wx and 26 were wx, thus giving 2.9 percent recombination between Spm and Wx. This very low percent of recombination was exhibited on the ears of all plants in culture 7777 regardless of the phase of activity of Spm in the cells that

gave rise to an ear.

Pollen collected from plant 7109B-1 was used in making a number of crosses. Plants were grown during the summer of 1957 only from kernels on ears derived from two such crosses. The behavior of Spm in the plants ~~that carried it~~ is shown in D of table 2 under Year 1957, culture numbers 7312 and 7313. The plants in culture 7312 came from kernels on an ear of a plant that was a_2^{m-1} Bt/a_2 bt, Wx/wx, in which no Spm was present. The a_2^{m-1} in this plant belonged to class I, and its state was one that gives rise to uniformly pale-pigmented kernels when Spm is absent or when it is present but in its inactive phase. In the presence of Spm in its active phase, no pigment appears in either plant tissues or in the aleurone layer of the kernel until a mutation-inducing event occurs which gives rise to a higher allele of A_2 that is thereafter stable in expression in the presence of an active Spm or when Spm is absent. These mutations occur late in development of the plant tissues and also late in development of the endosperm. As a consequence, the frequency of appearance of kernels having a germinal mutation is low on the ears of plants carrying this state of a_2^{m-1}. The Bt, Wx kernels from which the plants in culture 7312 grew, exhibited the presence in each of the class I state of a_2^{m-1}, derived from the female parent, and the class II state of a_2^{m-1}, derived from plant 7109B-1, derived from plant 7109B-1, and each had Spm in it. From the appearanc

of the plants in culture 7312, it was evident that each carried Spm. However, the tested ear of plant #1 and of plant #3 gave no evidence of the presence of Spm among the kernels on each ear. The tested ears of plants number 4, 5, and 6, however, did show the presence of Spm in some kernels on each ear. Plant numbers 5 and 6 proved to be a_2^{m-1} (class I) Bt/ a_2^{m-1} (class II) Bt, Wx +/wx Spm in constitution. This was shown for plant number 5 by the phenotypes of the kernels on the one fertile ear it produced in a cross with a plant homozygous for a_2, bt, and wx and having no Spm. Among the 128 Wx kernels on this ear, 117 were uniformly pigmented; 62 pale pigmented kernels carrying the class I state of a_2^{m-1} and 55 deeply pigmented kernels carrying the class II state of a_2^{m-1}. The remaining 11 Wx kernels were variegated. Seven of these had the class I state of a_2^{m-1} and 4 had the class II state of a_2^{m-1}. Among the 124 wx kernels on this ear, 7 were uniformly pigmented. Five of these were pale pigmented and 2 were deeply pigmented. The remaining 117 kernels in the wx class were all variegated. In 68 of these, the class I state of a_2^{m-1} was present and in 49 of them the class II state of a_2^{m-1} was present. Linkage of Spm with wx was evident and 7.6 percent of the variegated kernels on this ear were in the recombinant classes.

In 1958, five plants were grown under culture number 7547A from the variegated Wx class of kernels on the above described ear that carried the class I state of a_2^{m-1}. In addition, 3 plants were grown under culture number 7547B and C from the variegated Wx kernels that had the class II state of a_2^{m-1}. Each plant in culture 7547 carried Spm, linked with Wx, and the phase of activity of this Spm in the cells giving rise to the tested ears of these plants is given in D of table 2. It will be noted that only in 5 of the 14 ears obtained from plants in culture 7547 was Spm fully active in the cells that produced these ears. The phenotypes of the kernels on these ears are given in A of table 17. In 5 other ears, the presence of Spm was exhibited in only some of the kernels on each ear, as shown in B of table 17.

The second ear of the main stalk of plant 7547A-1 was used in a cross with a plant homozygous for a_2, bt, and wx, and carrying one Spm in its active phase (plant number 7538-3). The phenotypes of the kernels on this ear are entered in C of table 17. Among the a_2^{m-1} (class I) carrying kernels, 70 were uniformly pale pigmented of which 37 were Wx and 33 were wx. Among the 70 kernels that showed the presence of Spm in them, 38 were Wx and 32 were wx. However, the pattern of pigmented areas in a colorless background in most of the Wx

kernels different from that of most of the wx kernels. In the wx class, there were a number of deeply pigmented spots representing mutations to A_2 and they were rather uniformly distributed over the aleurone layer. In a few of these kernels, ~~xxxxxxxxxx~~ a very small pale pigmented spot was ~~xxxxxxxxx~~ also present. In the majority of wx kernels, in addition to deeply pigmented spots in a non-pigmented background arising from mutation, there were also many areas exhibiting the pale pigmented phenotype in none of which was there a deeply pigmented spots. Small colorless areas appeared with ~~in~~ most ~~xxxx~~ of these larger pale areas and in a few of these latter colorless areas, a small speck of deep pigment was observed. This is the ~~xxxxxxxxxx~~ phenotype that ~~would be~~ is expected to appear if the majority of wx kernels have only the one Spm in them, that which was delivered by the male parent. The pale areas with colorless spots within them would represent the alternating phases of activity of Spm during development of the kernel, from the active phase at the initiation of kernel development, to the inactive phase in a cell early in endosperm development, and then a return to the active phase in a descendent cell, later in development of the endosperm. The phenotype exhibited by the majority of kernels in the wx class is one that appears when three active Spm elements are present in the endosperm. Few if any pale pigmented spots would be made evident in them, ~~those that would appear would be~~ as they would be so small and so light in color that detection of them would be difficult.

~~With regard to the pale areas~~, The phenotypes of these two classes of variegated kernels carrying the class I state of a_2^{m-1}, are directly comparable to the phenotypes of the two classes of variegated kernels exhibiting the "1 Spm" and the "3 Spm" patterns that appear following a similar type of cross with plants carrying the class II state of a_2^{m-1}. The pale phenotype with the class I state and the fully pigmented phenotype with the class II state are comparable expressions of the two states of a_2^{m-1} in the absence of Spm or when it is present and in its inactive phase. That the interpretation given above of the Spm constitution in each of the two classes of variegated kernels on the ear of plant 7547A-1, entered in C of table 17, is correct is shown by the distribution of Wx and wx among the a_2^{m-1} carrying kernels on the ear of tiller-1 of this plant following testcross type-2: 1 pale Wx : 22 pale wx : 14 variegated Wx : 1 variegated wx. Although there were few kernels on this ear, the distribution of Wx and wx to the pale and variegated kernels leaves no doubt regarding the close linkage of Spm with wx in this plant.

~~The~~ Spm in this plant was in its inactive phase in the cells that gave rise to the first ear of the main stalk. All of the 218 a_2^{m-1} carrying kernels on the ear, produced by testcross type-2, were uniformly pale pigmented; 110 of them were Wx and 108 were wx. That ~~it~~ Spm was in its inactive phase in the cells that

produced the second ear of the main stalk is shown by the kernel types entered in C of table 17. An active Spm appears only in those kernels that received Spm from the pollen parent. However, The two distinct phenotypes among these variegated kernels reveal the presence of the inactive Spm, delivered by the ear bearing parent,, that was closely linked with wx.

Plant 7312-6, under Year 1957, D, table 2, had a constitution similar to that of plant 7312-5, described above. However, Spm in this plant was in its inactive phase in the cells giving rise to all three tested ears. Following testcross type-2, conducted with the ears of two tillers of this plant, only 7 kernels exhibited the presence of Spm in them. Six of these kernels were wx and one was wx. This suggested that the plant was wx +/wx Spm in constitution. Testcross type 1 had been conducted with the first ear of the main stalk of this plant. Only one kernels on the resulting ear showed the presence of Spm in it and it had received the class II state of a_2^{m-1} from the ear bearing parent. In order to obtain better evidence of the location of Spm in plant 7312-6, this kernel was sown in 1958 under culture number 7582A. On the ear of plant 7312-6, three pale colored (class I state of a_2^{m-1}), wx kernels were found ~~in~~ each ~~of~~ having ~~which~~ a small spot of wx, ~~appeared~~, ~~arising~~ ~~from~~ This wx spot arose following spontaneous chromosome breakage resulting in loss of wx in a cell during development of the kernel. The three kernels each with a wx spot were shown

under culture number 7582B. It was expected that the plants derived from them would carry Spm and that it would be linked with wx, and also that Spm would be in its inactive phase at the beginning of plant development. This proved to be true. Testcross types 1 and 3 were conducted with plant 7582A and 7582B-2, and testcross type 3 was conducted with an ear of each of the plants in culture 7582. Plant 7582A, carrying the class II sector of a_2^{m-1}, was fully pigmented except for a few small streaks in which no pigment was present. The plants in 7582B likewise were fully pigmented except for some small nonpigmented sectors within which small streaks of deep pigmented appeared. The types of kernels appearing on the testcross ears of these plants in culture 7582 are given in table 18. All tested ears were produced by cells in which Spm was in its inactive phase. However, as testcross type-3 indicates, the inactive Spm in each of these plants was linked with wx.

The plants in culture 7313 were derived from colorless, Bt, wx kernels that showed pigmented spots or specks on an ear of a ~~in the cross of~~ a plant that was A_2 Bt/a_2 bt, Wx/wx when pollen from plant 7109B-1 had been used in making the cross. The types of testcross conducted with these plants in culture 7313, and the results obtained from each, are entered in table 19. The designated constitutions of these plants, entered in D of table 2, are based upon these testcross results. Plant B-4 illustrates one of the

very few cases in this study in which the Spm number and location was found to differ in different parts of the same plant.

Table 3 summarizes the behavior ~~of Spm~~ in successive generations of Spm ~~that was~~ derived from plant 7109B-2. ~~As table 1 indicates~~, Spm was in its active phase in the cells that gave rise to the first ear of the main stalk of this plant (table 1) and also in those that gave rise to the ears of tiller-1 and tiller-2. The ear of tiller-1 was self-pollinated and the kernels types appearing on this ear were described earlier (see page). Plants were grown from kernels on the ear of the main stalk of this plant and also from those on the self-pollinated ear of tiller-1.

The plants in culture 7309 A (A, table 3) were derived from kernels that were ~~colorless~~ Bt, and Wx ~~kernels showing~~ and showed spots of pigment in a colorless background. ~~their aleurone layer that were~~ present on the ear of the main stalk of plant 7109B-2. Plants derived from the uniformly pigmented, Bt, Wx class of kernels on this ear were grown under B of culture 7309. None of the plants in ~~B of culture~~ 7309B ~~carried~~ had Spm but each of the nine tested plants in 7309 A ~~of this culture~~ carried it, in them ~~and~~ its position ~~locus~~ was determined in 6 of these 9 plants and in each of these 6 it was linked with wx, ~~in each~~. In only six of the sixteen tested ears of these plants in culture 7309A was Spm fully active in the cells that produced these

ear. Testcross type-2 was conducted with five of these six ears. The phenotypes of the kernels on each of these five ears is entered in table 20. ~~Close~~ Linkage of Spm with wx was expressed by the ratio of kernel types on each ear. Linkage of Spm with wx was also shown by the kernel types of the ears of plants A-6 and A-9 ~~following testcross type-2~~. Among the a_2^{m-1} carrying kernels on the ear produced by testcross type-2, of plant A-9, 104 were uniformly pigmented (81 Wx : 23 wx), 18 were diffusely-mottled, wx, and 57 had small spots of pigment in a nonpigmented background of which 1 was Wx and 56 were wx. Testcross type-2 produced the kernels on the first ear of the main stalk of plant 7309A-6. Among the a_2^{m-1} carrying kernels on this ear, 244 were uniformly pigmented (127 Wx : 117 wx) and 19 gave evidence of the presence of Spm in each. Among these, 1 was Wx and 18 were wx.

From the evidence given above, it appears that Spm probably occupied the same location in chromosome 9 in both plant 7109B-1 and 7109B-2. However, the phase of activity of Spm in the main stalk of these two sister plants was not the same, and the behavior of Spm in the immediate progeny of each likewise was different. Spm in plants derived from kernels on the main stalk of plant 7109B-1 remained in the previously initiated inactive phase in most parts of the ~~se~~ progeny plants whereas Spm derived from kernels on the ear of the main stalk of plant 7109B-2

underwent change from the active to the inactive phase early in development in some plants. A comparison of A, table 2 (culture 7456) with A table 3 (culture 7309) makes this evident. No progeny was grown from kernels on the ears of plants in culture 7309. Tests in successive generations were conducted, however, with progeny of Bpm carrying plants derived from kernels on the self-pollinated ear of tiller-1 of plant 7109B-2, as indicated in B, C, and D, of table 3.

Kernels derived from the uniformly pigmented, Bt, Wx class ~~of~~ on the self-pollinated ear of tiller-1 of plant 7109B-2 were sown under culture number 7308A. Bt, Wx kernels showing small spots of pigment in a colorless background were sown under B of culture 7308,

and colorless, Bt, wx kernels ~~with~~ showing only specks of pigment in a colorless background ~~in the aleurone layer~~ were ~~grown~~ sown under C of culture 7308. The plants in D of this culture were derived from totally colorless, bt, wx kernels.

Of the nine tested plants in A of culture 7308, seven had no Spm. Two plants, however, did have Spm (plants 7308A-4 and A-5). The tests conducted with the three fertile ears ~~of~~ producing plant 7308A-4 were considered earlier, and the kernel types on each were entered in table 7. Plant 7308A-5 was homozygous for a_2^{m-1} (class II) and Bt and ~~was Wx +/wx Spm~~ it had one Spm, linked with wx. Although no ~~fertile~~ ear was obtained from this plant, pollen from it was used in crosses to two (no Spm carrying) plants each of which was homozygous for a_2, bt, and wx, ~~and having no Spm~~ neither had Spm. Among the total of 327 kernels on these ears, 198 were uniformly pigmented 10 were diffusely-mottled, and 119 ~~xxxxxxxxxxxxxx~~ had spots of pigment in a colorless background. Knowledge of the ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ linkage of Spm with wx in plant 7308A-5 came from tests of 4 plants derived from the diffusely-mottled class of kernels on one of these ears. There were ~~and~~ grown under culture number 7554A (Year 1958, B, table 3). Spm was in its inactive phase in most parts of these plants and also in the cells that gave rise to all tested ears. From testcross types 2 and 3, it was possible to learn of the ~~presence~~ location of Spm in these plants, ~~and of its linkage with wx. (table 21)~~.

Testcross type 2 was conducted with 1[illegible] of the ears of these plants and in 9 of them, a few kernels on each ear showed the presence of Spm in them ~~and~~ Among them, linkage of Spm with wx was clearly expressed (A, table 21). The silks of one ear of plant 7554A-3 received pollen from a plant homozygous for a_2, bt, and wx, and also for Spm in its active phase. From the ~~distribution~~ assortment ~~ratio~~ of Wx to wx ~~in~~ Farmers the kernels showing many spots of pigment (one Spm from male parent) to the assortment of Wx + wx among those having only a few specks of pigment (two inactive Spm from female and one active Spm from male) it was ~~obvious~~ evident that the inactive Spm in ~~this~~ plant 7554A-3 was linked with wx.(B, table 21).

The plant used as the pollen parent (plant 7538-1) in the cross that gave rise to the kernel types entered in table 21 B was derived from a kernel on the self-pollinated ear of plant 7308D-2. As described earlier, plant 7308D-2 was homozygous for a_2, bt, and wx. ~~and~~ ~~and~~ It had one Spm was ~~present~~ which was, in its active phase, ~~It was present~~ ~~In~~ ~~the~~ approximately half of the pollen produced by the main tassel of this plant and also ~~in that of~~ each of its three tillers. (Seven) ~~carried an active~~ Spm. (Twenty-one) plants were grown in 1958 from kernels on the self-pollinated ear of plant 7308D-2 under culture number 7538 and for the purpose of obtaining plants that would serve as tester type-3 ~~plants~~. Since neither the appearance of the kernels nor that of the plants derived from them indicated whether or not Spm was present ~~or was absent~~ in ~~them~~ any one, it was not possible to know in advance of a test which of the plants in culture 7538 carried Spm. ~~This could be~~

A large number of crosses were conducted with each of the 21 plants in culture 7538 and with plants carrying either a class I or the class II state of a_2^{m-1} and either ~~with~~ having no Spm or ~~with~~ having one or more Spm elements in either the inactive or the active phase. The results obtained from these crosses (see D, table 3) indicated that Spm was present in 13 of the 21 plants in culture 7538. No evidence of its presence was given by these tests conducted with 8 plants. Thus, all crosses conducted with these latter 8 plants were testcross type-2 rather than the desired testcross type-3. Among the 13 plants in culture 7538 in which Spm was present, 7 had one active Spm element (plants -1, -6, -10, -R-2, -R-4) and 6 had two active Spm elements. In five of the latter plants, the Spm element was located in a pair of homologues, most probably chromosome 9, and also most probably at allelic positions in the members of this pair. In one plant (7538-2), the two Spm elements were not located at allelic positions in a pair of chromosomes. Each Spm element was inherited as if located in one member of each of two different pairs of chromosomes.

The kernel types entered in D of table 21 came from a cross in which the pollen parent (7537-1) was homozygous for a_2, bt, and wx, and for Spm in allelic positions in a pair of chromosomes, ~~(plant 7538-1)~~. It will be noted that 26 of the 219 kernels on this ear gave no evidence of the presence of Spm in any one of these. ~~xxxx~~ Such kernels with such a phenotype are to be expected.

A few such kernels appear because the Spm, delivered by the male parent, had entered the inactive phase before fertilization. Others, however, arose from the functioning of a sperm in whose nucleus Spm was absent, the removal of Spm having taken place earlier through the transposition mechanism. Kernels showing no evidence of the presence of Spm in them appeared on nearly all ears produced by crosses of plants having two active Spm elements, apparently located at allelic positions in a pair of homologues. The frequency of appearance of such kernels on ears produced by crosses conducted with 10 such plants is given in table 22. On the ears produced by crosses with plants carrying the class II state of a_2^{m-1}, the number of kernels that showed no Spm in them was always directly correlated with the number of kernels whose phenotypes expressed the presence of more than the expected number of Spm in them: the more ~~frequent~~ ~~the~~ uniformly pigmented kernels on ~~the~~ an ear, the more kernels there were that showed a "high Spm dose" pattern of variegation. Examples of this are given in table 22.

Testcrosses made of Spm activity in progeny derived from each of the three ears produced by plant 7308A-4 (~~table 7 and~~ B, table 3). The type~~s~~ of cross that produced each ear and the phenotypes of the kernel ~~types that appeared on them~~ on each ear are given in table 7. The first ear of the main stalk of this plant was crossed by ~~the~~ a sister plant, 7308D-2, which was homozygous for a_2 bt and wx

and carried an Spm in its active phase, ~~which was considered likely to~~ it was considered likely that this Spm be ~~closely linked to one of the wx alleles.~~ was located close to wx in one chromosome. ~~Three types of~~ Bt, wx kernels showing pigmented spots in a colorless background were selected from this ear, and the plants grown from them were given culture number 7570. Those in A of culture 7570 came from kernels that exhibited many pigmented spots a number of which were large in area. They were considered to possess only the Spm element delivered by the male parent (7308A-2) and barring cases of transposition of Spm, should be wx +/wx Spm in constitution. Kernels that showed a number of small spots of pigment in a colorless background were sown under B of culture 7570. These were considered to have received Spm only from the female parent (7308A-4) and barring transposition, if so, these plants should be wx Spm/wx + in constitution. ~~The~~ A Bt wx kernel ~~on the ear~~ that exhibited only specks of pigment in a colorless background was ~~grown~~ sown under C of culture 7570. It was considered to have received Spm from both parents. Again, barring transposition as a cause of the 3 dose Spm pattern, in this female, the plant came from it should be wx Spm/wx Spm. The constitutions of the plants in culture 7570, as determined by testcrosses conducted with ~~them~~ each, are entered in B of table 3 under Year 1958. Ten of the 12 plants had the expected constitution. In two plants, 7570A-7 and A-8, a transposed Spm was present. Spm was in its active phase in the cells that gave

rise to the majority of the ears of the plants in culture 7570 and in this respect, behavior very much resembled that ~~behavior~~ of Spm in the majority of plants in the present culture. Only in the cells that gave rise to 3 of the 34 tested ears was Spm in its inactive phase (first and second ear of main stalk of plant 7570A-1 and first ear, main stalk, of plant 7570~~B-4~~).

The types of testcross conducted with the plants in culture 7570 are entered in table 23. The phenotypes of the kernels on ears produced by testcross type-2 is given in A of ~~this~~ table 24 and for testcross type-3, in B of ~~the~~ table 24. ~~Included in this table are the testcross conducted~~ with the plants that were Wx +/wx Spm, Wx Spm/ wx +, and Wx Spm/wx Spm. The kernels on the first and second ear of the main stalk of plant 7570A-1, and those on the first ear of the main stalk of plant 7570A-4 are not included as only 16 kernels among a total of 100 a_2^{m-1} carrying on the ears gave evidence of the presence of Spm in them of which 1 was Wx and 15 were wx. On the ears of plant 7570A-7 and A-8 few kernels were produced. However, among those on the ears of plant 7570A-7 no evidence of linkage of Spm with wx appeared. Twenty-one of the a_2^{m-1} carrying kernels were uniformly pigmented (14 Wx : 7 wx) and 36 were variegated (16 Wx : 20 wx). Among the a_2^{m-1} carrying kernels on the ears of plant 7570A-8, 59 were uniformly pigmented (53 Wx : 3 wx) and 132 were variegated (39 Wx : 93 wx).

From the second ear of the main stalk of plant 7308A-4, Bt, Wx kernels showing spots of pigment in a colorless background were selected and grown in 1958 under culture number 7563. A single Spm element was present in each of the 7 tested plants in this culture and it was in its active phase in the cells that gave rise to all 21 tested ears (B, table 3). In 6 of the 7 plants, Spm was linked with Wx but in one plant (7563A-2) it was not linked with Wx. Testcross type-2 was conducted with 19 of the 21 ears and produced the kernel types shown in A of table 25. Testcross type-3 was conducted with an ear of two of the plants that were Wx Spm/wx +$_a$. The kernel types on these two ears are entered in B of table 25.

The ear of the tiller of plant 7308A-4 had been used in a cross with a plant that was homozygous for a_2, bt, and Wx and had no Spm. Bt, Wx kernles on this ear that had spots of pigment in a nonpigmented background were sown in 1958 under culture number 7546. Among the 12 tested plants in this culture, one was Wx/Wx and had one Spm. The remaining 11 plants were wx/wx and in 10 of them, one Spm was present and it was linked with wx in each plant. ~~The remaining plant~~ One wx/wx plant had two Spm elements, neither of which was linked with wx nor with one another. Spm was in its active phase in all but one of the 25 tested ears of plants in culture 7546. Testcross type-2 was conducted with 20 of the 26 ears and testcross

type-3 was conducted with 6 of them (second ear, main stalk of plants -1,-2, -5, -7, -9, and -12). The types of kernels on the ears of these plants are entered in A, B, and C of table 26. In B and C of this table, linkage of Spm, contributed by the 7546 parent, with wx is exhibited not only by the ratios of kernels types within the Sx and wx classes, but also by the pattern of pigmented spots in those having Spm. The majority of wx kernels exhibited the "1 Spm" pattern and the majority of the wx kernel exhibited the "high dose Spm" pattern.

Spm in plant 7308A-4, derived from tiller-1 of plant 7109B-2, and in the progeny of plant 7308A-4 (plants in cultures 7570B, 7570C, 7563, 7546) exhibited a long duration of the active phase. This could be seen in the plants themselves in that they showed relatively few large sectors in which Spm was in its inactive phase. Among the ears produced by the plants in these cultures, only ~~xxe~~ the (first ear, on the main stalk of plant 7546-2) was derived from ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ cells in which an early occurring change of Spm, from active to inactive, had occurred during development of the plant. The long duration of the activephase of Spm likewise characterized its behavior in other plants in culture 7308, as shown in B of table 3. However, as was pointed out earlier, if selection is made of kernels on an ear that have in them an Spm that has recently

entered the inactive phase, then the duration of this inactive phase may be examined in the progeny as was done with the plants in culture 7554A, each of which was derived from such a kernel.

The results obtained from tests conducted with plants in B and C of culture 7308 may be described briefly. Testcross type-2 was conducted with 7 of the 9 ears produced by plants in B of culture 7308. Testcross type-1 was conducted with two ears (first ear, main stalk, plants B-1 and B-3). Testcross type-1 was conducted with the ears of all plants in C of culture 7308. The kernel types appearing on all ears, except that of the first ear of the main stalk of plant 7308B-1, are entered in table 27. The first ear of the main stalk of plant 7308B-1 had 146 bt kernels of which 95 were uniformly pigmented, 37 were colorless with many small specks of color, and 14 were totally colorless. In addition, there were 151 bt kernels. Seven of these were uniformly pigmented and one had small specks of pigment in a colorless background. No pigment was detected in the remaining 143 bt kernels.

The Spm designations given to the plants in 7308B and C are based on the kernels entered in table 27. In the plants that were homozygous for a_2^{m-1} and Bt, some kernels appeared that showed no pigment spots. Tests of plants derived from such kernels have shown that the endosperms

of such kernels have high doses of Spm, six or more being present in some of them. In table 27, it will be noted that the proportion of such kernels is greatest on the ears of those plants that have two or more Spm in them. The ear of plant 7308J-2 is conspicuous in this respect. No tests of its progeny were conducted however.

Tests were conducted with the progeny of plant 7308J-6. On the basis of the kernel types on the ears of this plant, three Spm elements were considered to be present in it. Two of them occupied presumedly allelic positions in a pair of homologues. It would be expected that each would be located close to wx in each chromosome 9. The additional Spm was inherited independently of these two. From the first ear of the main talk of plant 7308J-6, Bt, Wx kernels showing only a few specks of pigment in a colorless background (high dose Spm pattern) were sown under culture number 7573A. Other Bt, Wx kernels showing many small spots of pigment in a colorless background (2 Spm pattern) were sown under B of culture 7573. The constitution of the tested plants in this culture, with respect to Spm number, location, and activity, is indicated in B table 3 under Year 1958.

Table 1

Phenotypes of kernels on ears ~~of plants~~ produced by cross of plants in culture 7109 that were a_2^{m-1} (class II)* Bt/ a_2 bt in constitution, ~~which were produced~~ from ~~cross~~ with plants homozygous for a_2, bt, and Lx and having no Spm.

Plant Number	Part of plant tested	Phenotype of Kernel: Deeply pigmented		Spots of pigment in non-pigmented background		Colorless	
		Bt	bt	Bt	bt	Bt	bt
7109B-1 Car	main stalk	101	9	19	0	6	133
	" tiller-1	99	3	85	2	8	217
	" tiller-2	90	8	95	2	4	145
	" tiller-3	121	5	128	3	7	234
7109B-2 Car	main stalk	123	13	114	4	19	221
	" tiller-2	124	8	133	8	22	251
	pollen	77	7	91	3	12	185
7109C-1 Car	main stalk	142	7	81	6	10	216
	" tiller-1	91	5	69	2	11	156
	" tiller-2	124	4	125	7	17	233
	" tiller-3	73	5	78	2	11	168
7109C-2	main stalk	168	13	81	5	23	271
	" tiller-1	134	7	120	9	15	222
	pollen	176	7	153	12	23	337
7109C-3 Car	main stalk	214	15	7	1	12	228
	" tiller-1	127	4	111	4	7	243
	" tiller-2	114	2	105	3	5	226
	pollen	77	4	38	o	5	137
7109C-4 Car	main stalk	127	7	96	3	12	222

* state = "A_2"

Year 1958 tests.

Table

Cross Type	No. of Cars	Colorless BI with: uniformly dark color BI		Colorless BI with: Many spots of color		Colorless BI with: Few spots or specks of color		Colorless bt with spots or specks of color		Colorless BI		Colorless bt		Totals
		BI	bt							BI	bt			
I	8	664	56	621		7		42		96	1258			2744
II	1	1	1	41		0		3		6	32			84
III	11	1130	78	577		563		74		154	2351			4927
IV	3	40	4	172		193		27		38	376			850
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx
V	8	324	330	29	29	245	37	40	233	21	25	57	53	1240	2663
VI		228	41	32	3	197	42	58	411	23	56	70	66	914	2141
VII	2	7	65	1	1	3	65	129	16	4	3	16	7	256	573
VIII	4	285	46	25	4	29 (2 spm)	152	13 (4 spm)	139	12	21	18	26	736	1506
IX	1	9	4	0	2	42	5	16	56	5	5	5	2	150	301

Cross types:

	$a_2^{m1}(A_2)$ BI / a_2^s bt ♀	♂ a_2 bt / a_2 bt ; wx / wx
I	no spm	1 active spm
II	no spm	spm-active / spm-active (2 active spm at allelic positions)
III	1 inactive spm, not linked to wx	1 active spm
IV	1 inactive spm, not " to wx	spm-active / spm-active (" " " "
V	Wx+ / wx spm-inactive	1 active spm
VI	Wx+ / wx spm-active	1 active spm
VII	Wx spm-active / wx +	1 active
VIII	Wx+ / wx spm plus 1 inactive spm	no spm

1958 A2 M-1 cultures. For Tables 2-4 References

Key to cultures in Tables

Table 2-4

	Reference		
~~7536~~	3 D page 1		
7544			
7545			
7546	3 B pg 2		
7547	2 D		
7548			
7549			
7550			
7551			
7552			
7553			
7554	3 B, page 2		
7555			
7556	3 C page 2		
7557			
7558			
7559			
7560	2 B		
7561	2 C, page 1		
7562	2 C, page 1		
7563	3 B, page 1		
7564	3 C page 1		
7565	" " " "		
7566	" " " "		
7567	" " " "		
7568	" " " "		
7569	3 D page 1		
7570	3 B page 1		
7571	3 D page 1		
7572	2 C page 1		
7573	3 B page 2		
7574			
7575	3 D page 1		
7576	3 B page 2		
7577			
7578			
7580			
7581	3C		
7582	2 D		
7583	3 D page 2		
7584			
7585	3 C page 2		
7586			
7587			
7588	3 C page 1		
7589			
7590			
7591	3 D page 3.	Table 4 page 2	
7592	4 page 1		
7593	4 page 1		

7594		Table 4, page 3	
7595		Table 4 " 2, Table 3D, page 3	
7596		Table 4, page 3	
7597		" 4, page 2, Table 3C, page 2	
7598		Table 2 A, page 1	
7599		" " " " 1	
7600		" " " " 1	
7601		" 3C, page 1	
7602		" 3 D, " 2	
7603			
7604			
7605		3 C, page 1	
7606			
7607		3C, " 2	
7608			
7609			
7610		3D, " 2	
7611			
7612			
7613			
7614			
7615			
7616			
7617			

1960 References

Culture	Derived from Cultures	Reference
7777	(7561)	2C, page 2
7778	(7562 A)	3C, " 3
7779	(7569)	3 D, " 4
7780	(7599)	2A, " 1
7781	(7601)	3C " 3
7782	(7545)	
7783	(7545 + 7538-3)	3 D " 5
7784	(7602)	3 D " 5
7785	(7602)	3 D " 5
7786	(7613 + 7538-14)	3 D " 5
7816	(7570C)	3 D " 4
7817	(7570C)	3 D " 4
7818	(7570C + 7538-14)	3 D " 4

1957

			From	
7306		Table 2 B	7109B-1	Tillers-1
7307		" 2 C	" "	tillers-2
7308		" 3 B	7109B-2	4-1
7309		Table 3 A	7109B-2	I
7312-13		Table 2 D	7109 B-1	pollen
7455		Table 4	7109C-4	
7456		Table 2 A	7109 B-1	I

Table 2 A

Spm activity in cells producing ears and pollen of plants derived from kernels on ear of main stalk of plant 7109B-1

Plant Number	Spm location	Activity of Spm: First ear, main stalk	Second ear, main stalk	Ear of Tiller 1	Ear of Tiller 2	Ear of Tiller 3	Pollen
Year 1957							
7456B-5	Wx +/wx Spm	-		d	d		
" C-1	Wx/Wx; 1Spm	-		d			
" C-2	Wx +/wx Spm	-	vd				
" C-3	Wx +/wx Spm	-	vd	d	d	d	
" C-4	Wx +/wx Spm	-	-	-			d
" D-1	Wx +/wx Spm	-	-				
" D-2	Wx +/wx Spm	vd	-	d	d		
" D-3	Wx +/wx Spm	-					
" D-4	Wx/Wx; 1 Spm	vd		vd	d		
" D-5	Wx +/wx Spm	-	-	vd	d	d	d
" D-7	Wx +/wx Spm	-		vd	vd		d
" E-2	Wx +/wx Spm	-					vd
Year 1958							
7600-1	Wx +/wx Spm	-					
" -2	Wx/Wx; 1 Spm	vd					
" -3	Wx +/wx Spm	-	-				
" -4	Wx +/wx Spm	(+ -)					
" -5	Wx +/wx Spm	-					
" -6	Wx/Wx; 1 Spm	-	-				
" - 7	Wx +/wx Spm	-	-				
" -8	Wx/Wx; Spm	-					
" -9	Wx +/wx Spm	-	-				
" -11	Wx +/wx Spm	-	-				
" -12	Wx +/wx Spm	-	vd				
7598-7	Wx +/wx Spm	vd					
" -8	Wx/Wx; 1 Spm	-					
7599A-1	Wx +/wx Spm	-					
" A-2	Wx +/wx Spm	-	d				
" A-3	Wx +/wx Spm	d					
" A-4	Wx +/wx Spm	-					
" A-5	Wx/Wx; 1 Spm	-					
" A-6	Wx +/wx Spm	-	-				
" B-1	Wx +/Wx Spm	vd	-	d			
" B-2	Wx +/wx Spm	vd					
" B-3	Wx +/Wx Spm	d					
" B-4	Wx +/Wx Spm	-					
Year 1960							
7780A-1	Wx Spm/wx Spm	- +					
" A-2	Wx Spm/wx Spm	- +					
" A-3	Wx Spm/wx Spm	- d					
" A-4	Wx Spm/wx Spm	- +		+ +	+ +		
" A-5	Wx Spm/wx Spm	- d					
" A-6	Wx Spm/wx Spm	- +		d +			
" A-7	Wx Spm/wx Spm	- (+ -)		+			
" A-8	Wx Spm wx Spm						
" A-9	Wx Spm/wx Spm		- +	- +			
" A-10	Wx Spm/wx Spm	- d	- +				
" B-1	Wx +/wx Spm	d		+	+		
" B-2	Wx +/wx Spm	+		+			
" B-3	Wx +/wx Spm						
" B-4	Wx +/wx Spm	vd	+	+			
" B-5	Wx +/wx Spm	+					
" B-6	Wx +/wx Spm	d	d	+	+		
" B-7	Wx +/wx Spm	+	+				
" B-8	Wx +/wx Spm						

Origin of plants in A of table 2

Culture 7456: From kernls on first ear of main stalk of plant 7109B-1

Cross: 7109B-1 a_2^{m-1} (class II) Bt/a_2 bt; Wx +/wx Spm ♀ x a_2 bt/a_2 bt wx/Wx, no Spm ♂.

Plants in B: From uniformly dark pigmented, Bt, Wx kernels.

C: From diffuse-mottled, Bt, Wx kernels.

D: From colorless, Bt, Wx kernels with small spots of deep pigment.

E: From uniformly pigmented, bt, Wx kernels.

Culture 7600: From uniformly deep pigmented kernels on ear of tiller-1 of plant 7456C-3.

Cross: a_2^{m-1}(class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx, no Spm ♂.

Culture 7598: From uniformly dark pigmented, Bt, Wx kernels on first ear of main stalk of plant 7456D-5.

Cross: a_2^{m-1}(class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx, no Spm ♂.

Culture 7599: From kernels on ear produced by cross of a_2 bt/a_2 bt, Wx/Wx, no Spm ♀ x 7456D-5 ♂ (see culture 7598).

Plants in AB From diffuse-mottled, Bt, Wx kernels.

B: From colorless, Bt, Wx kernels with spots or specks of pigment.

Culture 7780: From kernels on first ear of main stalk of plant 7599B-4.

Cross: a_2^{m-1} (class II) Bt/a_2 bt, Wx +/ Wx Spm ♀ x a_2 bt/a_2 bt, wx +/wx Spm ♂.

Plants in A: From colorless, Bt, Wx kernels with only a few specks of pigment.

B: From colorless, Bt, Wx kernels with both large and small pigmented areas.

Table 2 B

Spm

Spm activity in cells producing ears and pollen of plants derived from kernels on ~~the~~ ear of tiller-1 of plant 7109B-1

Plant number	Spm location	Activity of Spm: First ear, main stalk	Second ear main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	Pollen
Year 1957							
7306A-1	Wx +/wx Spm	+	+	+			
" A-2	Wx +/wx Spm	-					
T " A-3	Wx/wx; 1 Spm	-		+			
" A-4	Wx +/wx Spm	+					
" A-5	Wx +/wx Spm	+					
" A-6	Wx +/wx Spm	+	+				
T " B-1	Wx + /wx Spm						
	plus 1 Spm	+ +	+ +	+ +	+ + + +		
T " B-2	"	+ +		+ +			
Year 1958							
7560-1	Wx Spm/wx +	+		+	+		
" -2	(Wx Spm/wx +)	-					
T " -3	Wx/wx; 1 Spm	vd	vd	+			
T " -4	Wx/wx; 2 Spm	+ +	+ +				
" -5	Wx Spm/wx +	+					+ anel d
T " -6	Wx/wx; 1 Spm	+					

Origin of plants in B of table 2

Culture 7306: From kernels on ear of tiller-1 of plant 7109B-1.

Cross: $\underline{a}_2^{\underline{m}-1}$(class II) $\underline{Bt}/\underline{a}_2$ $\underline{bt}$, $\underline{Wx}$ +/$\underline{wx}$ $\underline{Spm}$ ♀ x $\underline{a}_2$ $\underline{bt}/\underline{a}_2$ $\underline{bt}$, $\underline{Wx}/\underline{Wx}$, no $\underline{Spm}$ ♂.

Plants in A: From colorless, $\underline{Bt}$, $\underline{Wx}$ kernels with a number of spots of pigment.

B: From colorless, $\underline{Bt}$, $\underline{Wx}$ kernels with only a few specks of pigment.

Culture 7560: From kernels on second ear of main stalk of plant 7306A-1.

Cross: $\underline{a}_2^{\underline{m}-1}$ (class II) $\underline{Bt}/\underline{a}_2$ $\underline{bt}$, $\underline{Wx}$ +/$\underline{wx}$ $\underline{Spm}$ ♀ x $\underline{a}_2$ $\underline{bt}/\underline{a}_2$ $\underline{bt}$, $\underline{wx}/\underline{wx}$, no $\underline{Spm}$ ♂.

Plants derived from colorless, $\underline{Bt}$, $\underline{Wx}$ kernels with a number of small pigmented spots.

Table 2 C

Activity of Spm in cells producing ears and pollen. Spm derived from kernels on ear of tiller-2 of plant 7109B-1

Plant number	Spm location	Activity of Spm: First ear main stalk	Second ear main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	pollen
Year 1957							
7307A-1	Wx/Wx; 1 Spm	d					
" A-2	Wx +/wx Spm	+		+	+		
" A-3	Wx +/wx Spm	+	+				
" A-4	Wx +/wx Spm	+		+			
" A-5	Wx +/wx Spm	+	+	+			
" A-6	Wx +/wx Spm	+					
" B-1	Wx +/wx Spm	+	+	+			
" B-2	Wx +/wx Spm	+	+	+			
T " B-3	Wx +/ wx Spm plus 1 Spm	+ +	+ +	+ +	+ +	+ +	
T " B-4	Wx +/wx Spm plus 1 Spm	+ +		+ +	+ +		
Year 1958							
7561-1	Wx Spm/wx Spm	–					
" -2	Wx Spm/wx +	vd	vd				
" -3	Wx Spm/wx +	+	+				
" -4	Wx Spm/wx +	(+ –)	–	+			
" -5	Wx Spm/wx +	+					
7562-1	Wx Spm/wx +	+	+				
" -2	Wx Spm/wx +	+					
" -3	Wx Spm/wx +	–		+			
7572-1	Wx +/wx Spm	+					
" -2	Wx +/wx Spm	+		+			
" -3	Wx +/wx Spm	+	+				
" -4	Wx/Wx; Spm	vd					
" -5	Wx +/wx Spm	vd	d				
" -6	Wx +/wx Spm	+					
" -7	Wx +/wx Spm	+					
Year 1960							
7777A-1	Wx Spm/wx +	(d)	(d)	+	(d)	+	
" A-2	Wx Spm/wx +	+		+			
" A-3	Wx Spm/wx +	(d)					
" A-4	Wx Spm/wx +	+		+			
" B-1	Wx Spm/wx +	d		+			
" B-2	Wx Spm/wx +	d		+	+		
" B-3	Wx Spm/wx +	d					
" B-4	Wx Spm/wx +	d	d	+			
" C-1	Wx Spm/wx +	–					
" C-2	Wx Spm/wx +	vd		(+ –)			
" C-3	Wx Spm/wx +	vd		vd			
" C-4	Wx Spm/wx +	–					
" D-1	Wx Spm/wx +	–		–	–		
" D-2	Wx Spm/wx +	–					
" D-3	Wx Spm/wx +	–		–			
" D-4	Wx Spm/wx +	–		–			

Origin of plants in C of table 2.

Culture 7307: From kernels on ear of tiller-2 of plant 7109B-1.
Cross: a_2^{m-1} (class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx, no Spm ♂.
Plants in A: From colorless, Bt, Wx kernels with a number of small pigmented spots.
B: From colorless, Bt, Wx kernels with only a few small specks of pigment.

Culture 7561: From kernels on first ear of main stalk of plant 7307A-3.
Cross: a_2^{m-1} (class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, wx/wx, no Spm ♂.
Plants derived from colorless, Bt, Wx kernels with a number of small spots of pigment.

Culture 7562: From kernels on first ear of main stalk of plant 7307A-5.
Cross: a_2^{m-1}(class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, wx/wx, no Spm ♂.
Plants derived from colorless, Bt, Wx kernels with a number of small pigmented spots.

Culture 7572: From kernels on second ear, main stalk, of plant 7307B-2.
Cross: a_2^{m-1}(class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx, no Spm ♂.
Plants derived from colorless, Bt, Wx kernels with only few specks of pigment.

Culture 7777: See text, page for description of origin of plants in this culture.

Table 2 D

Activity of Spm in cells producing ears and pollen. Spm derived from pollen of plant 7109B-1

Plant number	Spm location	Activity of Spm: First ear main stalk	Second ear main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	pollen
Year 1957							
7312-1	Not tested	-					
" -3	" "	-					
" -4	" "	+					
" -5	Wx +/wx Spm	+					
" -6	Wx +/wx Spm	vd		vd	vd		
7313A-1	Not tested	vd					
" A-2	Wx +/wx Spm	vd		+			
" B-1	Wx +/wx Spm	d					
" B-2	Not tested	vd					
" B-3	Wx +/wx Spm	vd					
T " B-4	Wx/wx; 2 Spm, main Wx +/wx Spm, tillers-2	+ +		+	+		
" B-5	Wx/Wx; 1 Spm	+	+				
Year 1958							
7547A-1	Wx Spm/wx +	-	-	+	d		
" A-2	Wx Spm/wx +	+		+			
" A-3	Wx Spm/wx +	+					
" A-4	Wx Spm/wx +	-					
" A-5	Wx Spm/wx +	-	vd				
" B	Wx Spm/wx +	-		d			
" C-1	Wx Spm/wx +	d					
" C-2	Wx Spm/wx +	+					
7582A	Wx +/wx Spm	-		-			
" B-1	Wx +/wx Spm	-					
" B-2	Wx +/wx Spm	-	-				
" B-3	Wx +/wx Spm	-					

Origin of plants in D of table 2.

Culture 7312: From kernels on ear produced by
Cross: $\underline{a}_2^{\underline{m}-1}$(class I) Bt/$\underline{a}_2$ bt, Wx/wx, no Spm ♀ x plant 7109B-1 ♂.
Plants derived from Bt, Wx, kernels having Spm and both the class I and class II states of $\underline{a}_2^{\underline{m}-1}$.

Culture 7313: From kernels on ear produced by
Cross: $\underline{A}_2$ Bt/$\underline{a}_2$ bt, Wx/wx, no Spm ♀ x 7109B-1 ♂.
Plants in A and B derived from colorless, Bt, Wx kernels with some pigmented spots and specks.

Culture 7547: From kernels on first ear of main stalk of plant 7312-5.
Cross: $\underline{a}_2^{\underline{m}-1}$ (class I) Bt/ $\underline{a}_2^{\underline{m}-1}$(class II) Bt, Wx +/wx Spm ♀ x $\underline{a}_2$ bt/$\underline{a}_2$ bt, wx/wx, no Spm ♂.
Plants in A: From variegated, Bt, Wx kernels having the class I state of $\underline{a}_2^{\underline{m}-1}$.
B and C: From colorless, Bt, Wx kernels with small spots pigment (class II state).

Culture 7582: From kernels on first ear, main stalk of plant 7312-6.
Cross: $\underline{a}_2^{\underline{m}-1}$(class I) Bt/ $\underline{a}_2^{\underline{m}-1}$(class II) Bt, Wx +/wx Spm ♀ x $\underline{a}_2$ bt/$\underline{a}_2$ bt, Wx/Wx, no Spm ♂.
Plants in A: From colorless, Bt, Wx kernels with small pigmented spots (class II state).
B: From uniformly pale pigmented (class I state), Bt, Wx kernels.

Table 3 A

Activity of Spm in cells producing e rs. Spm derived from kernels on ear of main stalk of plant 7109B-2

Plant number	Spm location	Activity of Spm				
		First ear, main stalk	Second ear, main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3
Year 1957						
7309A-1	(Wx +/wx Spm)	-	-			
" A-2	(Wx +/wx Spm)	-				
" A-3	Wx +/wx Spm	+		+		
" A-4	Wx +/wx Spm		-	+	vd	
" A-5	Wx +/wx Spm	d		+	+	
" A-6	Wx +/wx Spm	vd	vd			
" A-7	(Wx +/wx Spm)	-				
" A-8	Wx +/wx Spm	+				
" A-9	Wx +/wx Spm	d				

Culture 7309: From kernels on first ear of main stalk of plant 7109B-2

Cross: 7109B-2, a_2^{m-1} Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx, no Spm ♂.

(Cross II)

Plants in A: From colorless, Bt, Wx kernels with small s ots of deep pigment.

Table 3 B

Activity of Spm in cells producing ears and pollen. Spm derived from self-pollinated ear of tiller-1 of plant 7109B-2

Plant Number	Spm location	Activity of Spm: First ear, main stalk	Second ear, main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	pollen
Year 1957							
7308A-4	Wx +/wx Spm	+	+	+			
" A-5	Wx +/wx Spm						+
" B-1	Wx +/wx Spm	d		+	+	+	
" B-2	Wx +/wx Spm	+					
T " B-3	Not tested (~~plus Spm~~) 2 Spm	+ +					
" B-4	Wx +/wx Spm	+		+	+		
T " C-1	Wx Spm/wx ~~+~~ plus Spm	+ +	+ +	+ +	+ +		
" C-2	wx Spm/wx Spm plus 2 Spm (?)	+ +					
" C-3	wx Spm/wx Spm	+ +	+ +				
T " C-4	wx Spm/wx + plus 1 Spm	+ +					
" C-5	wx Spm/wx Spm	+ +					
T " C-6	wx Spm/wx Spm plus 1 Spm	+ + +	+ + +	+ + +			
" D-1	wx +/wx Spm						+
" D-2	wx +/wx Spm						+
Year 1958							
7570A-1	Wx +/wx Spm	d	d	+	+	+	
" A-2	Wx +/wx Spm	+	+	+	+		
" A-3	Wx +/wx Spm	+	+				
" A-4	Wx +/wx Spm	d		+	+		
" A-5	Wx +/wx Spm	+		+	+		
" A-6	Wx +/wx Spm	+	+	+			
T " A-7	Wx/wx; 1 Spm	+	+				
T " A-8	Wx +/wx Spm plus 1 Spm	+ +	+ +				
" B-1	Wx Spm/wx +	+	+	+			
" B-2	Wx Spm/wx +	+	+				+
" B-3	Wx Spm/wx +	–		+	+		
" C	Wx Spm/wx Spm	+ +	+ +		+ +		+ +
7563A-1	Wx Spm/wx +	+		+	+		
T "A-2	Wx/wx; 1 Spm	+	+				
" A-3	Wx Spm/wx +	+	+	+			
" A-4	Wx Spm/wx +	+	+	+	+		
" A-5	Wx Spm/wx +	+	+				
" B-1	Wx Spm/wx +	+		+			
" B-2	Wx Spm/wx +	+	+	+	+	+	
7546-1	Wx +/wx Spm	+	+				
" -2	Wx +/wx Spm	vd	+				
" -3	Wx +/wx Spm	+	+	+			
" -4	Wx +/wx Spm	+					
" -5	Wx +/wx Spm	+	+	+			
" -6	Wx/Wx; 1 Spm	+	+	+			
" -7	Wx +/wx Spm	+	+	+			
T " -8	Wx ~~+~~/wx ~~Spm~~ plus 2 Spm	+ +	+ +				
" -9	Wx + ~~+~~/wx Spm ~~Spm~~	+	+				
" - 10	Wx +/wx Spm	+					
" - 11	Wx +/wx Spm	+					
" -12	Wx +/wx Spm	+	+				
7554A-1	Wx +/wx Spm	(~~+~~) vd	vd	vd			
" A-3	Wx +/wx Spm	–		–			

T " B-3	Not tested (~~[illegible]~~ 2 Spm)	+ +						
" B-4	Wx +/wx Spm	+			+	+		
T " C-1	WxSpm/wx ~~S~~ + plus Spm	+ +	+ +	+ +	+ +			
" C-2	wx Spm/wx Spm plus 2 Spm (?)	+ +						
" C-3	wx Spm/wx Spm	+ +	+ +					
T " C-4	wx Spm/wx +, plus 1 Spm	+ +						
" C-5	wx Spm/wx Spm	+ +						
T " C-6	Wx Spm/wx Spm plus 1 Spm	+ + +	+ + +	+ + +				
" D-1	wx +/wx Spm							+
" D-2	Wx +/wx Spm							+
Year 1958								
7570A-1	Wx +/wx Spm	d	d	+	+	+		
" A-2	Wx +/wx Spm	+	+	+	+			
" A-3	Wx +/wx Spm	+	+					
" A-4	Wx +/wx Spm	d		+	+			
" A-5	Wx +/wx Spm	+		+	+			
" A-6	Wx +/wx Spm	+	+	+				
T " A-7	Wx/wx; 1 Spm	+	+					
T " A-8	Wx +/wx Spm plus 1 Spm	+ +	+ +					
" B-1	Wx Spm/wx +	+	+	+				
" B-2	Wx Spm/wx +	+	+					+
" B-3	Wx Spm/wx +	-		+	+			
" C	Wx Spm/wx Spm	+ +	+ +		+ +		+ +	
7563A-1	Wx Spm/wx +	+		+	+			
T "A-2	Wx/wx; 1 Spm	+	+					
" A-3	Wx Spm/wx +	+	+	+				
" A-4	Wx Spm/wx +	+	+	+	+			
" A-5	Wx Spm/wx +	+	+					
" B-1	Wx Spm/wx +	+		+				
" B-2	Wx Spm/wx +	+	+	+	+	+		
7546-1	Wx +/wx Spm	+	+					
" -2	Wx +/wx Spm	vd	+					
" -3	Wx +/wx Spm	+	+	+				
" -4	Wx +/wx Spm	+						
" -5	Wx +/wx Spm	+	+	+				
" -6	Wx/Wx; 1 Spm	+	+	+				
" -7	Wx +/wx Spm	+	+	+				
T " -8	Wx ~~+~~/wx ~~Spm~~ ~~plus~~ 2 Spm	+ +	+ +					
" -9	Wx + ~~+~~/wx Spm ~~Spm~~	+	+					
" - 10	Wx +/wx Spm	+						
" - 11	Wx +/wx Spm	+						
" -12	Wx +/wx Spm	+	+					
7554A-1	Wx +/wx Spm	~~(+ -)~~ vd	vd	vd				
" A-3	Wx +/wx Spm	-		-				
" A-4	Wx +/wx Spm	-	vd	vd				
" A-5	Wx +/wx Spm	-		vd	vd			
7573A-1	Wx + Spm/wx Spm plus 1 Spm	d d						
" A-2	"	+ +	+ +					
" A-3	"	+ +	+ +					
" A-4	"	+ +						
" A-5	"	+ +						
" A-6	"	+ +						
" B-1	Wx +/wx Spm	+						
" B-3	Wx +/wx Spm	vd	d	+				
" B-4	Wx +/wx Spm	+	+					
" B-5	Wx +/wx Spm	d						
7576	Wx +/wx Spm	+	+	+				

Key to Table 3. Parts A and B.

A Table 3.

Culture 7309 From ear of main stalk of plant 7109B-2. (a_2 m (class II) BI/a_2 bt; Wx+/wx+ ♀ × a_2 bt Wx no Spm ♂

Plants in A from colorless, BI, Wx kernels with spots of color

B, Table 3
Year 1957
Culture 7308 From self-pollinated ear of tiller-1 of plant 7109B-2

Plants in A derived from uniformly pigmented, BI, Wx kernels
" " B " " colorless BI, Wx kernels with many spots of pigment
" " C " " colorless BI wx kernels with few specks of pigment
" " D " " " bt wx kernels.

Year 1958
Culture 7570. Kernels selected from first ear of main stalk of plant 7308 A-4 (a_2 m (class II) BI/a_2 bt; Wx+/wx Spm) which was used in ~~when~~ crossed ~~of~~ ~~plant~~ with plant 7108 D-2 (a_2 bt/a_2 bt, wx+/wx Spm)

Plants in A derived from colorless, BI, Wx kernels showing "1 Spm" pattern of pigmented spots

" in B " " colorless BI, Wx kernels showing "2 Spm" pattern of pigmented spots.

" " C " " colorless BI Wx kernel showing only specks of A_2 pigment.

Culture 7563 From 2nd ear of plant 7308-4 (main stalk) produced by cross with a plant homozygous for a_2, bt, + wx and having no Spm

Plants in A + B derived from colorless, BT, Wx kernels ~~showing~~ showing small spots of A_2 pigment.

Culture 7546. From taller ear of plant 7308-4 produced from cross with a plant homozygous for a_2, bt, and Wx and having no Spm

Plants derived from colorless, BT Wx kernels showing small spots of A_2 pigment.

Culture 7554: From ear of ~~an~~ plant homozygous for a_2, bt, and Wx and having no Spm when pollen from plant 7308A-5 was used in making the cross.

Plants in A derived from BT Wx kernels exhibiting the "diffuse-mottled" phenotype.

Culture 7573: From second ear on first ear, main stalk of plant 7308C-6 which was a_2^{m1} (class II) BT / a_2^{m1} (class II) wx Spm / wx Spm + 1 Spm in constitution, when crossed by a plant homozygous for a_2, bt, and Wx and having no Spm

Plants in A derived from colorless, BT, Wx kernels showing few specks of A_2 pig

" " B " " " " " " " " in any small spots of " "

Culture 7576 From 2nd ear, main stalk of plant 7308C-6 when crossed by plant homozygous for a_2, bt. and Wx and having no Spm.

7576 = from Denel with 1 completely colorless, RI Wx alleuro layer but showing pigmented spots in em go area.

Table 3 C

Phase of activity in successive generations of the Spm derived from plant 7308D-1 (see table 3 B) which was a_2 bt/a_2 bt, wx +/wx Spm (active) in constitution.

Plant number	Spm location	Activity of Spm: First ear main stalk	Second ear main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	pollen
Year 1958							
7564-1	Wx +/wx Spm	+		+	+		
" -2	Wx +/wx Spm	+		+			
" -3	Wx +/wx Spm	+					
" -4	Wx +/wx Spm	+		+			
" -5	Wx +/wx Spm	+					
7565A-1	Wx/wx	-					
" A-2	Wx +/wx Spm	d					
" A-3	Wx +/wx Spm	(+ -)	+	+			
" A-4	Wx +/wx Spm	vd					
" A-5	Wx +/wx Spm	+					
" B-1	Wx +/wx Spm	vd		vd			
" B-2	Wx/wx Spm	vd					
7566A-1	Wx +/wx Spm	(+ -)		+			
" A-2	Wx +/wx Spm	+					
" A-3	Wx +/wx Spm	d					
" A-4	Wx +/wx Spm	+		+			
" A-5	Wx +/wx Spm	+		+	+		
T " B	Wx +/wx Spm plus 2 Spm	+ + +					
T 7567	Wx +/wx Spm plus 2 Spm	+ + +					+ + +
7568	Wx/wx; no Spm	0					0
7601B-1	Wx +/wx Spm	+					
" B-2	Wx +/wx Spm	d					
" B-3	Wx +/wx Spm	(+ -)					
" B-4	Wx +/wx Spm	+					
" B-6	Wx/wx	vd					
" B-7	Wx +/wx Spm	+	+				
" B-8	Wx +/wx Spm	+					
" B-9	Wx +/wx Spm	+					

6705A-1	wx/wx; 1 Spm	+		
" A-2	" " 1 " Spm	+		
" A-3	" "	vd	vd	
" A-5	" " 1 Spm	+		
" B	" "	-		
" C	" "	vd		
7607-1	" " 1 Spm	+		
" -2	" "	vd		
" -3	" "	vd		
" -4	" "	-		
" -5	" " 1 Spm	+		
" -6	" "	d		

7585A-1	Wx +/wx Spm	vd		+	
" A-2	Wx +/wx Spm	+			
" A-3	Wx +/wx Spm	vd			
" A-4	Wx +/wx Spm	vd		+	
" A-5	Wx +/wx Spm	+			
" A-8	Wx +/wx Spm	d	vd		
" B-1	Wx +/wx Spm				
	plus 1 Spm	d -		+ +	+ -
" B-2	Wx +/wx Spm	+			
" B-3	Wx +/wx Spm	-	-		
" B-4	Wx +/wx Spm	vd			
" B-5	Wx +/wx Spm	+	+		
" B-6	Wx +/wx Spm	vd			
7588A-1	Wx/wx	-			
" A-2	Wx +/wx Spm	vd	vd		
" B-1	Wx +/wx Spm	+		+	+
" B-2	Wx +/wx Spm	+	-		
" C-1	Wx +/wx Spm				
	plus 1 Spm	+ -			
" C-2	"	+ -	+ -	+ -	
" D-1	Wx +/wx Spm	+		+	
" D-2	Wx +/wx Spm	vd			

	7597A-1	Wx +/wx Spm						
		plus 1 Spm	+	-				
	" A-2	Wx +/wx Spm	vd					
	" A-3	Wx +/wx Spm	d					
	" A-4	Wx +/wx Spm						
		plus 1 Spm	+	d			-	d
	" A-5	"	+	-	+	-		
	" A-6	Wx/wx	vd					
	" A-7	Wx +/wx Spm	vd					
	" B-1	Wx +/wx Spm	d					
	" B-2	Wx +/wx Spm	+					
T	" B-3	Wx/wx; 1 Spm	+					
T	" B-4	Wx/wx; 1 Spm	d					
	" B-5	Wx +/wx Spm	d					
	" B-6	Wx/wx	-					
	7556	Wx +/wx Spm						
		plus 1 Spm	+	+			+	+
	Year 1960							
	7778A-1	wx/wx	-				vd	
	" A-2	"	-				-	-
	" A-3	"	-					
	" A-4	"	-					
	" A-5	"	-				vd	
	" A-6	"	-					
	" A-7	"	-				-	-
	" A-8	"	-					
	" B	"	-				-	-
	" C-2	"	vd					
	" C-3	"	-				-	
	" C-4	"	-					
	" C-5	"	-					
	" D	"	d				+	+
	7781A	Wx Spm/wx +	+				+	+ +

Key to part C of Table 3. Year 1958. 1960

♂ parent in all crosses was 7107D-1 = a_2bt/a_2bt wx+/wx Spm-active

Culture number	Culture number of Ear parent.	Constitution of ear parent.	Type of kernels selected
7564	7305D-1 Tiller-3	a_2^{m1} (class I) BI/a_2bt Wx/Wx; no Spm	colorless, BI, Wx with mutant A_2 spots and large pale areas Fully active Spm
7565	7459A-1	" "	A = Fully active Spm B = colorless BI Wx with only ~~mutant A_2 spots and~~ small A_2 mutant spots (delayed action Spm)
7566	7456A-1	a_2^{m1} (class II) BI/a_2bt Wx Wx no Spm	A = From colorless, BI, Wx kernels with "1 Spm" pattern of A_2 spots B = From colorless, BI, Wx kernel with "High dose Spm" pattern of A_2 specks
7567	7456A-2	a_2^{m1} (class II) BI/a_2bt Wx Wx no Spm	From colorless, BI, Wx kernel with "high dose Spm" pattern of A_2 specks.
7568	7456A-3	"	From colorless, BI, Wx kernel with "2 Spm" pattern of A_2 spots.

culture	♀ parent	Constitution of ♀	Phenotype of kernels selected
7588	7316 D-3, 1 stem main stalk	a_2^{m-1}(class II) BI/a_2 bt Wx Wx 1 inactive Spm	A. + B = colorless, BI Wx with specks of A_2 pigment B and + D = colorless BI Wx with large areas + small area of A_2 pigment
7601	7320 A-2	a_2^{m-1}(class I) BI/a_2 bt Wx wx no Spm	B = from colorless, BI, Wx kernels with many mutant A_2 spots
7605	7320 B-1	a_2^{m-1}(class I) BI/a_2^{m-1}(class I) bt wx wx no Spm	A + B + C = from colorless BI wx kernels with mutant A_2 spots
7607	7320 B-6	a_2^{m-1}(class I) BI/a_2^{m-1}(class I) bt wx wx no Spm	From colorless, BI, wx kernels with many mutant A_2 spots
7585	7459 A-3	a_2^{m-1}(class I) BI/a_2 bt Wx wx; 1 inactive Spm	A. From colorless BI Wx kernels with many mutant A_2 areas but no pale areas B. From colorless BI Wx kernels with many mutant A_2 areas and also large + small pale areas
7597	7455 C-2	a_2^{m-1}(A_2) BI/a_2 bt Wx Wx; 1 inactive Spm	A. From colorless, BI, Wx kernels with "high dose Spm" pattern of A_2 specks B. From colorless BI Wx kernels with "1 Spm" pattern of A_2 specks.

Culture	♀ parent	Constitution	Kernels selected
7556	7303-6	a_2^{m1} (class I) BI/a_2 bt Wx ux; 2 active spm	colorless BI Wx kernel with many ~~A2~~ mutant A_2 spots.

Year 1960

7778 From First ear, main stalk of plant 7566 A-1 which was a_2^{m1} (class II) BI/a_2 bt; Wx+/ux spm from ears with plant homozygous for a_2, bt, and ux, and having no spm.

A: from A_2 BI ux kernels in inactive sector

B: " colorless BI ux kernel with specks of A_2 that was within the inactive sector

C and D. from colorless, BI ux kernels showing spots of A_2 in "active spm" sector on ear.

7781 From 7601 B-3, first ear, main stalk × a_2 bt ux no spm ♂
a_2^{m-1} (class I) BI/a_2 bt
Wx+/ux spm (from 7308 D-1)

A = 1 colorless BI Wx kernel with many mutant A_2 spots.

Table 3, D Progeny of plant 7308 D-2 a_2bt/a_2bt, $wx+/wx$ Spm

Year 1958

Plant no.	Position of Spm	Ears I	Ears II	Ears t-1	Ears t-2	Ears t-3	Pollen		
I 7538	From self-pollination of 7308 D-2 (t-1 × t-2)								
7538-1	Spm | Spm	+ +					+ +		
" -2	Spm + Spm	+ +					+ +		
" -3	1 Spm	+					+		
" -4	1 Spm	+					+		
" -5	1 Spm	+					+		
" -6	Spm | Spm	+ +					+ +		
" -9	1 Spm	+					+		
" -10	Spm | Spm	+ +					+ +		
" R-2	Spm | Spm	+ +					+ +		
" R-4	Spm | Spm	+ +					+ +		
" -12	1 Spm	+					+		
" -13	1 Spm	+					+		
" -14	1 Spm	+					+		
II	From cross of no Spm ♀ × 7308 D-2 ♂								
7569	From cross of 7308 A-1 ♀ × 7308 D-2 ♂								
T -1	Wx+ | wx Spm + 1 Spm	+ −		+ +					
-2	Wx+ | wx Spm	+	+	+					
-3	" " "	(+−)		+	+				
-4	" " "	+	+						
T -5	Wx | wx, 1 Spm	d							
-6	Wx+ | wx Spm	+		+	+				
-7	Wx+ / wx Spm	vd	(+−)						
7571	From 7465 A-1 Ears × 7308 D-2 ♂								
-1	Wx+ | wx Spm	vd	+	+	+				
-2	" " "	+							
-3	Wx | wx no Spm	o		o	o				
-4	Wx+ | wx Spm	+		(+−)	+				
-5	" " "	+	+	+					
7575	From 7310-2 × 7308 D-2 ♂								
A	Wx+ / wx Spm	d		+					
B	" " "	+							
C-1									
2									
3									
4									
5									

Table 3 D - continued.

Plant Number	Position of Spm	Ears I	Ears II	Ears t-1	Ears t-2	Ears t-3	Pollen		
7602	From 7320 A-4 ♀ × 7308 D-2 t-1 ♂								
-1	Wx + / wx Spm	+							
-2	" " "	+							
T -3	Wx / wx, 2 Spm	+							
-4	Wx wx, no test for Spm	vd							
-5	Wx + / wx Spm	vd	vd	+					
III	From cross of Spm-active ♀ × 7308 D ♂								
7570	From 7308 A-4 × 7308 D-2. See under Year 1958, B, Table 3								
7610	From 7322 A-7 × 7308 D-2 t-1								
A-1	Wx + / wx Spm + 1 Spm	+ +							
A-2	" " " "	+ +							
A-3	" " " "	d d	+ +						
A-4	" " " "	d −	d +						
A-5	Wx + / wx Spm	d	vd						
A-6	Wx + / wx Spm	d −	+ +	+ +	+ +				
B-1	Wx / wx	−							
B-2	Wx + / wx Spm	+							
B-3	Wx / wx	vd							
B-4	Wx + / wx Spm	vd							
B-6	Wx + / wx Spm	vd							
C-1		−							
C-2	Wx wx, 1 Spm	+	d						
IV	7308 D-2 ♂ to ♀♀ plants bearing inactive Spm, not crossed with Wx or wx								
7583	From 7305 C-4 t-1 ♀ × 7308 D-2 ♂								
A-1	wx wx, 1 Spm	+							
-2	Wx + / wx Spm	+	+	+					
-3	Wx + / wx Spm	+							
-4	Wx + / wx Spm	−		+					
-5	Wx + / wx Spm	+							
B-1	Wx + / wx Spm	+							
-2	Wx + / wx Spm	+							
-3	Wx + / wx Spm	+	d						
-4	Wx + / wx Spm		+						
-5	Wx + / wx Spm	+							

Table 3-D (cont.)

Plant Number	Position of Spm	Ears I		Ears II		Ears t-1		Ears t-2		Ears t-3	Pollen
7583C-1	W++/wxSpm +1Spm	+	−			+	+				
" C-2	W++/wxSpm +1Spm	+	d								
" C-3	W++/wxSpm +1Spm	+	d								
" C-4	W++/wxSpm +1Spm					+	+				
" C-5	W++/wxSpm +[1Spm]	+	[−]								
" C-6	W++/wxSpm ["]	+	[−]								
" D-1	W++/wxSpm +1Spm	+	d								
" D-2	W++/wxSpm [+1Spm]			+	[−]						
7591	From 7455 B-2, 1st ear, main stalk (see Table 4) ♀ × 7308 D-2, tiller-1 ♂										
		♂	♀	♂	♀	♂	♀	♂	♀		
" A-1	W++/wxSpm + 1Spm	−	−	−	−	+	−				
" A-2	W++/wxSpm +1 "	+	−								
" A-3	" " " "	+	−								
" A-4	" " " "	+	−								
" A-5											
" A-6	[" " " "	+	−								
" A-7	W++/wxSpm	+									
" A-8	" "	+	0								
" B-1	W++/wxSpm	+	0	+	0						
" B-2	W++/wxSpm	−	[0]	+	0						
" B-3	W++/wxSpm	−	[0]	−	[0]	+	0	+	0		
T " B-4	W+/wx; 1Spm	+	0	+	0						
" B-5	W++/wxSpm	+	0								
7595	From 7455 C-5, 1st ear, main stalk (see Table 4) × 7308 D-2, tiller-1										
" A-1	W++/wxSpm+1Spm	+	−	+	−						
" A-2	W+ wx	~~vd~~		vd							
" A-3	W+ wx	−									
" A-4	W++/wxSpm	~~vd~~	−	−	+						
" A-5	" "	[+−]									
A-6	W++/wxSpm +1Spm	d	−	+	−	+	+				
" A-7	" " " " "	+	−								
" B-1											
" B-2	W++/wxSpm	+	0								
B-3	" "	+	0								
B-4	" "	+	0								
B-5	" "	+	0								
B-6	" "	+	0								

Table 3 D. Continued

Year 1960

		Ears I	II	t-1	t-2	t-3	Pollen
7816	From colorless BZ un kernels on ear of 7570C allel-1 (see B, table 3) × a_2bt, a_2bt, un un, no Spm ♂						
" -1							
" -2	$a_2^{m}/(A_1)$ BZ/a_2bt Hetero Spm = 3			+ + +			
" -3	un un, 1 Spm			+	+		
7817	From colorless BZ un kernels on first ear, main stalk of 7570C (see B, Table 3) × a_2bt/a_2bt, un/un, no Spm ♂						
1	1 Spm			+	+		
2							
3	1 Spm			+	+		
4	1 Spm	+					
7818	From colorless un kernels on 2nd ear, main stalk of 7570C (see B, Table 3) × a_2bt, a_2bt, un + (7539-14) / un Spm ♂						
A-1	Spm/Spm			+ +	+ +		
A-2	1 Spm			+			
B-1	1 Spm			+			
" -2	1 Spm			+			
- 3	Spm/Spm			+			
- 4	Spm/Spm						+ +
" 5	Spm/Spm						+ +
" 6							
" 7	1 Spm			+	+		
" 8	1 Spm			+	+		+
" 9	Spm/Spm	+ +					+ +
" 10	1 Spm	+		+			+
" 11	Spm/Spm	+ +					
7779	From second ear, 7569-3 (see II Table 3-D, Year 1958) × a_2bt/a_2bt, un/un, no Spm ♂.						
A- 1	un un	vd					
- 2	" "	vd					
- 3	" "	—		—			
- 4	" "			—	—		
- 5	" "			—			
- 6	" "	vd		d			
B- 1	" "	vd					
2	" "	vd	vd				
3	" "			—			
4	" "	vd	—				
5	" "	d					
6	" "	vd	vd	vd			

Table 3 D, Continued
Year 1960

Plant number	Position of Spm		Ears. I	II	E-1	E-2	E-3	Pollen		
7780	From interior, main stalk of 7599 B-4 (see A, Table 2, Year 1958) × a2bt/a2bt ms+/ms Spm ♂ 7538 14									
	See Table-2, A, Year 1960									
7783	From 7545 A-4 E-1 × 7538-3 a2bt/a2bt									
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
7784	From 7602-2 × a2bt ms no Spm ♂									
A										
B										
C 1										
2										
3										
4										
7785	From 7602-3 × a2bt ms no Spm ♂									
A-1	W+ms, 2Spm				+	+				
2										
3	W+ms, 2Spm		+	+	+	+				
B 1										
2										
3										
4										
5	W+ms									
7586	From 7613 B-7 × a2bt/a2bt, ms+/ms Spm ♂ 7538 14									
A-1										
2										
3										
4										
B-1										
2										
3										

Table 4. Tests of Spm activity in progeny of plant 7109C-4.

			Activity of Spm in cells that gave rise to					
1956			First ear main stalk	2nd ear main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	pollen
7109C-4	Wx wx;	1 Spm	d					
Year 1957								
7455	(From kernels on ear of plant 7109C-4)							
A-1	Wx wx;	1 Spm	–		d			
A-2	Wx wx;	1 Spm	–		vd	vd	vd	
A-3		1 Spm	–	vd				
A-4	Wx wx;	1 Spm	vd		vd	d		
B-1	Wx wx	1 Spm	d					
B-2	Wx Wx;	1 Spm	–	–	d			
B-3	Wx wx;	1 Spm	–	–				
B-4	Wx Wx;	1 Spm	–					
B-5	Wx wx;	1 Spm	–	–				
B-6	Wx Wx	1 Spm	–					
C-1	Wx Wx;	1 Spm	–					d
C-2	Wx Wx;	1 Spm	–					
C-3	Wx Wx;	1 Spm	d					+
C-4	Wx wx;	1 Spm	–		+			
C-5	Wx wx;	1 Spm	–	–	vd			
D-1	Wx Wx	1 Spm	–					
D-2	Wx wx	1 Spm	–					
D-3	Wx wx	1 Spm	–					vd
Year 1958								
7592	(from kernels on 2nd ear, main stalk of plant 7455 B-2)							
2	Wx wx;	1 Spm	–					
3	Wx wx;	1 Spm	–					
6	Wx wx;	1 Spm	–	–				
7593	(from kernels on tiller ear of plant 7455 B-2)							
A-1	Wx Wx;	1 Spm	vd	vd				
2	Wx Wx;	1 Spm	vd					
3	Wx Wx	1 Spm	–					
4	Wx Wx	1 Spm	–					
5	Wx Wx	1 Spm	–					
B-1	Wx Wx	1 Spm	–					
B-2	Wx Wx			d				
B-3	Wx Wx	1 Spm	–		–			
B-4	Wx Wx	1 Spm	d					
B-5	Wx Wx	1 Spm	d					
B-6	Wx Wx							

Table 4, continued

7591.	(From kernels on first ear, main stalk, of plant 7455 B-2)											
		q spm I	ot spm	q II	ot	q t-1	ot	q t-2	ot	q t-3	ot	pollen
A-1	Wx+/wx spm plus 1 spm	–	–	–	–	–	+					
A-2	" " " " "	–	+									
A-3	" " " " "	–	+									
A-4	" " " " "	–	+									
A-5	" " " " "	–	+									
A-6	" " " " "	–	+									
A-7	" " " " "	–	+									
A-8	" " " " "	–	+									
TB-1	Wx wx, 1 spm in I, Wx+/wx spm in II	0	+	0	+							
B-2	Wx+/wx spm	0	–	0	+							
B-3	Wx+/wx spm	0	–	0	vd	0	+	0	+			
T B-4	Wx wx, 1 spm	0	d	0	+							
B-5	Wx+/wx spm	0	+									
7597	(From first ear, main stalk of plant 7455 C-2)											
A-1	Wx+/wx spm + 1 spm	–	+									
A-2	Wx+/ " " " "	–	d									
A-3	" " " "	–	d									
A-4	" " " "	–	d									
A-5	" " " "	–	+	–	+							
A-6	" " " "	–	(–+)									
A-7	" " " "	–	vd									
B-1	Wx+/wx spm	0	d									
2	" "	0	+									
T 3	Wx wx, 1 spm	0	+									
T 4	" "	0	d									
5	Wx+/wx spm	0	d									
6												
7595	(from first ear, main stalk of plant 7455 C-5)											
A-1	Wx+/wx spm plus 1 spm	–	+	–	+							
A-2	Wx+/wx spm		–		vd							
A-5	Wx+/wx spm + 1 spm	–	(+–)									
A-6	" " " "	–	d			+	+					
A-7	" " " "	–	d									
TB-1	Wx wx, 1 spm	0	d		+							
2	Wx+/wx spm	0	+									
3	" "	0	+									
4	" "	0	+									
5	" "	0	+									
6	" "	0	+									

Table 4 (cont.)

				First ear main stalk	2nd ear main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Pollen
7594 (from kernels on 2nd ear, main stalk, of plant 7455 C-4)									
4	w+ wx	1 Spm		—					
8	w+ w+	1 Spm		—					
7596 (from kernels on ear of tiller of plant 7455 C-5)									
A-1	w+ wx	Spm		vd					
A-2	" "	"		—					
A-3	" "	"		—		—			
B-1	" "	1 Spm		—		vd			
C-1	wx wx	1 Spm		—					
C-2	" "	Spm		—					

Key to Table 4.

Culture 7455: From diffuse-mottled, BI, Wx kernels on first ear, main stalk of plant 7109C-4

Cross: 7109C-4, $a_2 m^{-1}$ (class II) BI/$a_2$bt, Wx/wx, 1 spm ♀ × $a_2$bt/$a_2$bt, Wx/Wx, no spm ♂

Culture 7592: From uniformly pigmented kernels on 2nd ear, main stalk of plant 7455 B-2

Cross: ~~7455 B~~ ② $a_2 m^{-1}$ (class II) BI/$a_2$bt, Wx/Wx, spm ♀ × $a_2$bt/$a_2$bt, wx/wx, no spm ♂

Culture 7593: From kernels on ear of tiller of plant 7455 B-2

Cross: $a_2 m^{-1}$ (class II) BI/$a_2$bt, Wx/Wx, spm ♀ × $a_2$bt/$a_2$bt, Wx Wx, no spm ♂

Plants in A: From diffuse-mottled, BI Wx kernels

" " B: From colorless, BI, Wx kernels with spots of deep pigment.

Culture 7591: From kernels on first ear, main stalk of plant 7455B-2

Cross: $a_2 m_1$ (class II) BT/a_2 bt, Wx/Wx, Spm ♀ × a_2 bt/a_2 bt, m_4+/m_4 ♂ (7308D-2)

Plants in A: From colorless, BT, Wx kernels with few specks of pigment

" " B: From " " " " with large and small pigmented areas

Culture 7597: From kernels on first ear, main stalk, of plant 7455C-2.

Cross: $a_2 m_1$ (class II) BT/a_2 bt, Wx/Wx; Spm ♀ × a_2 bt/a_2 bt, m_4+/m_4 Spm (7308D-1) ♂.

Plants in A: From colorless, BT, Wx kernels with few specks of pigment

" " B: " " " " " with large + small area of pigment.

Culture 7595: From kernels on first ear main stalk of plant 7455C-5.

Cross: $a_2 m_1$ (class II) BT/a_2 bt, Wx/m_4, Spm ♀ × a_2 bt/a_2 bt m_4+/m_4 Spm (7308D-2) ♂

Plants in A: From colorless, BT, Wx kernels with few specks of pigment

" " B: " " " " " " large + small pigmented areas

Culture 7594: From kernels on sud ear, main stack, of plant 7455C-5.

Cross: a_2^{m-1} (class II A_2) Bt/$a_2$bt, Wx/ux, 1 spm ♀ × $a_2$bt/$a_2$bt, ux/ux, no spm ♂

Plants: From uniformly pigmented, BI, Wx kernels on ear.

Culture 7596: From kernels on ear of tiller of plant 7455C-5.

Cross: a_2^{m-1} (class II) BI/$a_2$bt, Wx/ux, spm ♀ × $a_2$bt/$a_2$bt, ux/ux, no spm ♂.

Plants in A: From diffuse-mottled, BI, Wx kernels

Plant in B: From colorless, BI, Wx kernel with specks of pigment

Plants in C: from " " ux " " " " "

Table 5.

Test crosses conducted with plants in culture 7456 (see A, table 2).

Constitution of tester plants:

Type-1 a_2 bt/a_2 bt, Wx/Wx, no Spm.

Type-2 " " wx/wx, no Spm.

Type-3 " " wx +/wx Spm (active phase)

Plant Number	Constitution of plant	Type of tester used as pollen parent in cross to: First ear, main stalk	Second ear, main stalk	Ear of tiller 1	Ear of tiller 2	Ear of tiller 3	Pollen of plant 7456 to tester type
A-1	Wx/Wx, no Spm	3	2	1			
A-2	Wx/Wx, no Spm	3					
A-3	Wx/Wx, no Spm	3					1
A-4	Wx/Wx, no Spm		2	1	2		
B-1	Wx/Wx, no Spm	3		1			
B-2	Wx/Wx, no Spm	3		2			
B-3	wx/ Wx,no Spm	3		1			
B-5	Wx +/wx Spm	3		1	2		
B-6	Wx/wx, no test for inactive Spm	1					
C-1	Wx/Wx, 1 Spm	3		1			
C-2	Wx +/wx Spm	3	1				
C-3	Wx +/wx Spm	3	2	1	2	2	
C-4	Wx +/wx Spm	3	2	1			1
D-1	(Wx +/wx Spm)	1					
D-2	(Wx +/wx Spm)	1	1	1	1		
D-3	(Wx +/wx Spm)	1					
D-4	Wx/Wx, 1 Spm	1		3	2		
D-5	Wx +/wx Spm	1	2	3	2	2	1
D-7	Wx +/wx Spm	1		1	2		1
E-1	Wx/Wx, no Spm	2		3			1
E-2	Wx +/wx Spm	3					1
E-3	Wx/Wx, no Spm	1	3	1	3		1

~~Table 5 - Continued~~ B Table 6

Type of pollen parent used in cross to

7455	Constitution of Plant as determined by test crosses		First ear main stalk	2nd ear main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Pollen to plant type
A-1	Wx wx;	1 Spm	2		3			
A-2	Wx wx;	1 Spm	2		1	3	3	
A-3	Wx Wx;	1 Spm	3	1				
A-4	Wx wx;	1 Spm	2		3	1		
B-1	Wx wx;	1 Spm	2					
B-2	Wx Wx;	1 Spm	3	2	1			
B-3	Wx wx;	1 Spm	3	1				
B-4	Wx Wx;	1 Spm	3					
B-5	Wx wx;	1 Spm	3	1				
B-6	Wx Wx;	1 Spm	3					
C-1	Wx Wx;	1 Spm	3					1
C-2	Wx Wx;	1 Spm	3					
C-3	Wx Wx;	1 Spm	3					1
C-4	Wx wx;	1 Spm	3		1			
C-5	Wx wx;	1 Spm	3	1	2			
D-1	Wx Wx;	1 Spm	3					
D-2	Wx wx;	1 Spm	3					
D-3	Wx wx;	1 Spm	3					1

1. Types of test cross conducted with plants derived from kernels on ear of plant 7109C-4.

Plants in A, B, and D of culture 7455 derived from diffuse-mottled kernels.

" " C of culture 7455 derived from colorless kernels with spots or specks of pigment.

Constitution of pollen parent in cross:

1 = a_2bt/a_2bt, Wx Wx

2 = a_2bt/a_2bt; wx wx

3 = a_2bt/a_2bt; wx +/ wx Spm - active phase.

Table 7

(class II)

Phenotypes of kernels on testcross ears of plant 7308A-4 that was a_2^{m-1}(class II) Bt/ a_2^{m-1} Bt; wx +/wx Spm-active in constitution.

Part of plant 7308A-4 tested	Constitution of male in cross	Phenotype of Kernel: Uniformly pigmented		Colorless with spots or specks of pigment: 1 Spm pattern		2 Spm pattern		High dose Spm pattern		Colorless
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	
First ear main stalk	Type 3	70	6	69	9	10	68	3	75	0
Second ear, main stalk	Type-2	107	14	0	0	12	115	0	2	0
Tiller ear	Type-1	142	-	1	-	135	-	4	-	0

Constitution of male:

Type-1: a_2 bt/a_2 bt; Wx/Wx; No Spm [Plant 4308D-2]

Type-2: " " ; wx/wx; no Spm

Type-3: " " ; wx +/wx Spm-active

Table 8 A. Fe[illegible] A

	Position		Uniformly dark colored	Colorless with spots of color. BT ~~Pattern~~		Colorless	Uniformly dark colored	Colorless with spots of color	Colorless
♀	of Ear	♂	BT	1 Spin	2 or more spin	BT	bt	bt	bt
7456A-1	I	7308D-1	33	45	2	2	3	5	60
I " A-2	I	"	75	53	1	5	4	6	134
" A-3	I	"	82	75	1	11	6	3	145
" B-2	I	"	16	17	0	3	0	2	35
" B-3	I	"	89	84	2	14	5	3	168
II " E-1	tiller-1	"	0	0	0	0	80	78	142
" E-3	II	"	0	0	0	0	9	10	24
" E-3	tiller-2	"	0	0	0	0	73	57	117
III 7456B-1	I	7308D-2	47	53	0	7	5	4	95
I 7308A-1	I	"	220	195	0	0	0	0	0
" A-2	I	"	212	207	2	0	0	0	0
" A-3	I	"	99	106	3	12	10	6	184
II " A-6	I	"	34	35	1	0	0	0	0
Table 8 B.									
7455A-3	I	7308D-1	138	61	53	15	13	5	277
" B-4	I	"	176	86	63	30	14	17	294
" B-5	I	"	64	47	34	8	3	0	122
" B-6	I	"	117	51	56	27	14	10	220
" C-2	I	"	96	47	49	18	7	6	139
7455A-1	tiller	7308D-2	52 1)	30	55	10	5	2	118
" A-2	tiller-2	"	112	61	61	15	7	5	227
" " "	" -3	"	157	79	83	21	7	7	321
" " 4	" -1	"	105 2)	73	92 3)	22	6	16	250
" B-2	I	"	74	36	35	12	9	7	146
" " -3	I	"	65	32	33	14	9	4	130
" C-1	I	"	68	25	31	4	3	2	109
" C-3	I	"	103 4)	50	86	29	9	17	256
" C-4	I	"	116	44	46	9	8	5	212
" C-5	I	"	66	31	34	11	5	6	145
" D-1	I	"	72	33	31	16	5	7	151
" D-2	I	"	102	52	52	18	7	13	179
" D-3	I	"	40	22	22	15	8	3	116

1) Some "diffuse-mottled" phenotypes included
2) 19 " " " kernels "
3) 3 very late " " " + specks of A2 in colorless area
4) 15 "diffuse-mottled" " kernels included

Table 9.

A.

Phenotypes of Kernels

Plant Number	Part of plant tested ~~Position~~ of Ear.	Uniformly Pigmented BT	Uniformly Pigmented bt	Diffuse-Mottled BT	Diffuse-Mottled bt	Colorless spots or Specks of Color BT	Colorless spots or Specks of Color bt	Colorless BT	Colorless bt	Totals
7455 A-1	1st ear main stalk	166	26	0	0	0	0	21	200	
" A-2	" "	233	12	0	0	0	0	17	220	
" " "	tiller-1	150	11	38	0	39	0	15	208	
" A-3	2nd ear main stalk	7	0	1	0	1	0	0	4	
" A-4	1st ear main stalk	140	17	10	1	2	0	11	138	
" " "	tiller-2	27	3	6	0	14	1	2	42	
" B-1	1st ear main stalk	136	4	25	4	24	2	7	183	
" B-2	2nd ear main stalk	38	4	0	0	0	0	3	33	
" " "	tiller	91	3	17	0	58	7	16	176	
" B-3	2nd ear main stalk	83	10	0	0	0	0	7	93	
" B-5	2nd ear main stalk	61	3	0	0	0	0	3	61	
" C-4	tiller	108	4	0	0	91	4	13	214	
" C-5	2nd ear main stalk	98	13	0	0	0	0	10	93	
" " "	tiller	137	16	9	1	3	1	11	170	
B										
7455C-1	pollen of tiller	{115 / 88} =203	{1 / 4} =5	{11 / 9} =20	{0 / 0} =0	{32 / 40} 72	{0 / 2} 2	{8 / 9} =17	{165 / 134} =297	
" C-3	" " "	27	3	0	0	28	5	4	53	
" D-3	" " "	179	14	2	1	7	1	22	207	

Heading:

A. Phenotypes of kernels on ears of plants in culture 7455 produced from test cross types 1 and 2 entered in table 6.

B. Phenotypes of kernels on ears produced by reciprocal cross.

Table 10 A

Phenotype of Kernel on ear		♀ → 7456B-5 ×	7456C-2 I	7456C-3 I	7456C-4 I	7456D-5 t-1 ×		10 B 7456D-4 t-1
	♂ →	7308D-1	7308D-1	7308D-2	7308D-2	7308D-2	Totals	7308D-1
Uniformly Pigmented. BI	Wx	49	64	27	21	31	192	128
	wx	44	52	25	25	22	168	–
" " bt	Wx	7	4	1	0	1	13	7
	wx	7	3	3	5	3	21	–
Diffuse-mottled. BI	Wx	1	0	0	0	1	2	3
	wx	6	0	0	0	10	16	–
" " bt	Wx	0	0	0	0	0	0	
	wx	0	0	0	0	1	1	–
Colorless, Spots of color BI 1 Spm pattern & spots	Wx	39	46	10	34	33	162	59
	wx	10	2	4	4	0	20	–
more than 1 spm pattern of spots.	Wx	7	7	2	1	5	22	79 *
	wx	39	48	20	32	34	173	–
" " bt 1 Spm pattern	Wx	6	4	1	3	2	16	6
	wx	2	0	0	0	0	2	–
" " more than 1 spm pattern	Wx	2	0	0	0	0	2	4
	wx	4	3	2	1	2	12	–
Colorless BI	Wx	18	10	2	4	5	39	13
	wx	16	12	3	3	4	38	–
Colorless bt Wx and wx.		211	244	102	138	144	839	236

% "recombination" Spm-inactive + wx based on BI variegated class: [illegible]

Phenotypes of kernels on ears resulting from:

Heading:

A. Test cross type-3 conducted with a_2^{m1} (class II) BI / a_2^s bt; Wx+/wx Spm plants in B, C, and D, of culture 7456.

B. Test cross type-3 conducted with a_2^{m1} (class II) BI / a_2 bt; Wx Wx; 1 Spm plant 7456C-1 and 7456D-4.

Table 11

Phenotype of kernel on ear		7456B-5 t-2	7456C-3 II	7456C-3 t-2	7456C-3 t-3	7456C-4 II	7456D-5 II	7456D-5 t-2	7456D-5 t-3	7456D-7 t-2	Totals
		7321B-6	7321B-1	7321A-3	7321B-4	7321B-1	7321B-4	7321A-3	7321B-4	7321B-4	
Uniformly pigmented BT	Wx	85	52	61	79	12	77	99	62	47	574
	wx	35	29	17	10	13	68	45	6	42	265
bt	Wx	15	2	1	3	1	10	5	3	3	43
	wx	3	0	0	0	0	5	0	0	4	12
Diffuse-mottled BT	Wx	2	6	6	0	0	0	0	0	0	14
	wx	24	30	46	13	0	0	24	24	5	166
" " bt	Wx	-	1	0	1	0	0	0	0	0	2
	wx	-	1	1	0	0	0	0	2	0	4
colorless, spotted BT	Wx	8	2	4	9	0	0	0	3	1	27
	wx	37	6	28	43	0	0	26	37	1	178
" " bt	Wx	0	0	0	0	0	0	0	0	0	0
	wx	8	1	0	3	0	0	1	0	0	13
Colorless BT	Wx	6	3	9	4	0	6	9	2	2	41
	wx	10	5	5	0	2	8	12	3	3	48
Colorless bt	Wx + wx	209	141	166	152	31	150	192	109	114	1264
	Totals										

Heading: Phenotypes of kernels on ears resulting from test cross type-2 conducted with a_2 m-1 (class II) BT/a_2 bt, Wx+/wx Spm plants in B, C, and D of culture 7456.

% recombination Spm to wx based on variegated BT class = [illegible] 10.6%

Tester Type-2 plant = $a_2$bt/$a_2$bt; wx wx No Spm.

Table 12

Phenotype of Kernel

Plant Number	Position of ear in Plant.	Uniformly Pigmented BI	Uniformly Pigmented bt	Diffuse-Mottled BI	Diffuse-Mottled bt	Colorless, with spots of color BI	Colorless, with spots of color bt	Colorless BI	Colorless bt	Total
7456B-5	tiller-1	101	13	13	1	19	1	16	113	
" C-1	tiller	6	1	1	1	2	0	1	12	
" C-2	2nd ear main stalk	191	14	8	0	3	0	11	214	
" C-3	tiller-1	106	6	31	1	59	6	10	198	
" C-4	tiller	118	8	0	0	0	0	8	136	
" D-1	1st ear main stalk	145	11	0	0	0	0	11	137	
" D-2	1st ear main stalk	128	6	2	0	0	0	9	123	
" "	2nd ear main stalk	166	13	0	0	0	0	13	164	
" "	tiller-1	40	2	8	0	17	0	1	50	
" "	" -2	240	20	19	1	2	0	15	265	
" D-3	1st ear main stalk	38	2	0	0	0	0	2	51	
" D-4	1st ear main stalk	132	7	0	0	2	0	15	137	
" D-5	1st ear main stalk	60	3	0	0	0	0	4	56	
" D-7	1st ear main stalk	89	6	0	0	0	0	3	69	
" " "	tiller-1	138	8	7	0	6	0	6	149	

Heading: Phenotypes of kernels on ears produced from test cross type-1 conducted with plants in cultivar 7456 that were a_2m (class II) BI/a_2bt; Wx+/wx spm or test cross types 1 and 2 to Wx/Wx 1 spm plants of cultivar 7456.

Type-1 plant = a_2bt/a_2bt, Wx/Wx; no spm

" -2 " = " " wx/wx; no spm.

Table 13

Phenotypes of kernels on ears ~~produced from cross~~ of ~~female~~ plants with constitutions designated in first column when crossed by ~~male~~ plants with the constitution a_2 bt/a_2 bt; wx +/wx Spm-active: Plant 7308D-1 or 7308D-2.

Constituion of female (cross I)	Number of plants	Number of ears	Phenotypes of kernels: Uniformly dark colored Bt	Uniformly dark colored bt	Colorless with: Many colored spots "1 spm" pattern Bt	Many colored spots "1 spm" pattern bt	Colorless with: ~~Only specks of color~~ "Underdone" Spm pattern Bt	~~Only specks of color~~ "Underdone" Spm pattern bt	Colorless Bt	Colorless bt	Totals
a_2^{m-1} Bt/a_2^{m-1} Bt; Wx/Wx; no Spm	3	3	466	-	437	-	4	-	0	-	907
(class V) a_2^{m-1} Bt/ $a_2$bt; Wx/Wx or Wx/wx; no Spm	12	12	812	57	749	42	21	0	101	1606	3388
		Sub-totals, 1) and 2)	1335		1228		25				
a_2^{m-1} (class II) bt/a_2 bt; Wx/Wx; no Spm	11	13	-	1242	-	1210 *)	-	*		2559	5011
a_2^{m-1} (class I) Bt/a_2 bt; Wx/Wx or Wx/wx; 1 inactive Spm, not linked with wx	16	18	1621	126	773	66	768	41	249	3062	6706
a_2^{m-1} (class I) Bt/a_2 bt; Wx +/wx Spm-inactive	5	5	378	35	179	18	198	14	77	839	1738
a_2^{m-1} (class I) bt/a_2 bt; Wx +/wx Spm-inactive	1	1	-	120	-	41	-	44	-	258	463
		Sub-totals 4), 5) 6)	2280		1077		1065				

Table 14

Distribution of Wx and wx among phenotypes of kernels on ears entered in cross 4), 5), and 6) of tables .

Type of cross, Table	Phenotypes of Kernels: Uniformly dark colored				Colorless with: Many spots of color				Colorless with: Specks of color				Colorless		
	Bt		bt		Bt		bt		Bt		bt		Bt		bt
	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx
4)	342	340	23	23	181	165	10	16	167	176	9	5	55	41	1336
5)	194	184	13	22	162	17	16	2	25	173	4	10	39	38	839
6)	-	-	64	56	-	-	36	5	-	-	5	39	-	-	258

Table 15

Phenotypes of Kernels

A.

Plant Number	Number of Ears	Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Colorless with spots of pigment BI Wx	Colorless with spots of pigment BI wx	Colorless with spots of pigment bt Wx	Colorless with spots of pigment bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx and wx	Totals	% recombinants between spm and bz
7306A	3	101	23	4	3	22	104	0	1	2	7	248	515	18.5
7306B-1*	4	33	7	1	0	176	205	6	11	13	21	469	942	
" B-2	1	28	2	1	0	24	60	1	1	7	1	133	258	
7560-1,-5	4	18	255	1	11	291	29	17	1	23	17	561	1224	7.8
7560-3,6	2	53	52	5	3	50	59	2	0	8	9	190	431	0
7560-4	2	30	31	1	1	164	132	4	5	6	16	371	761	0

* In the variegated BI class of kernels there were 208 showing the "25 spm" pattern (139 Wx : 69 wx) and 173 showing the "left arm" spm pattern (34 Wx : 139 wx).

B.

Plant number	Number of Ears	Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Diffuse-mottled BI Wx	Diffuse-mottled BI wx	Diffuse-mottled bt Wx	Diffuse-mottled bt wx	Colorless spots of pigment BI Wx	Colorless spots of pigment BI wx	Colorless spots of pigment bt Wx	Colorless spots of pigment bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx+wx	Totals
7560-3	1st ear, main stalk	70	56	2	4	7	15	0	1	12	10	0	1	4	6	185	373
"	2nd " " "	33	44	4	3	0	0	0	0	0	1	0	0	3	4	85	177
7560-5	pollen	33	104	2	7	8	1	10	0	111	7	6	0	2	5	241	527

Heading:

A. Phenotypes of kernels on ears of plants in cultures 7306 and 7560, entered in B of table 2, in which spm was in its active phase in cells that produced the ears.

B.

all plants in culture 7306 and 7560 were a_2^{m1} (class II) BI/a_2 bt; Wx/wx in constitution. All crosses of these plants were made with plants homozygous for a_2, bt, and wx, and having no spm.

Table 16

Phenotypes of Kernels

A.

Plant number	Number of ears	Uniformly pigmented BT Wx	Uniformly pigmented BT wx	Uniformly pigmented bt Wx	Uniformly pigmented bt wx	Colorless with spots of pigment BT Wx	Colorless with spots of pigment BT wx	Colorless with spots of pigment bt Wx	Colorless with spots of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx	Colorless bt wx	Totals	% Recombination
7307A, B-1	10	543	73	31	3	67	537	8	41	40	53	1201		2597	11.5
7307B-2	3	145	27	13	6	35	165	2	9	12	19	372		805	17.4
7307B-3	4	140	15	11	1	137	266	8	10	18	23	565		1154	
7307B-4	2	97	7	8	2	120	164	5	4	14	29	386		831	
7561-3,4,5	4	34	315	2	26	295	18	21	0	23	29	657		1420	7.6
7561-4 1st ear, main stalk 8 rows.		7	61	1	8	43	3	5	0	4	1	87		220	8.5
4 rows		26	20	1	4	0	0	0	0	2	0	51		104	
7562	4	26	203	1	12	186	5	7	1	18	12	456		927	7.4
7572	6	281	58	18	2	60	285	2	13	29	25	674		1447	16.9

B

Plant number	Position of ear	Uniformly pigmented BT Wx	Uniformly pigmented BT wx	Uniformly pigmented bt Wx	Uniformly pigmented bt wx	Diffuse-mottled BT Wx	Diffuse-mottled BT wx	Diffuse-mottled bt Wx	Diffuse-mottled bt wx	Colorless, spots of pigment BT Wx	Colorless, spots of pigment BT wx	Colorless, spots of pigment bt Wx	Colorless, spots of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx	Colorless bt wx	Totals
7561-1	1st ear, main stalk																	
7561-2	1st ear, main stalk	98	78	11	7	8	0	0	0	0	0	0	0	11	10	180		403
" -2	2nd ear, main stalk	92	101	11	10	1	0	0	0	2	1	0	0	14	12	187		431
7562-3	1st ear, main stalk	9	22	4	2	0	0	0	0	0	0	0	0	1	2	27		67
7572-4	1st ear, main stalk	108	-	10	-	13	-	0	-	15	-	0	-	16	-	140		302
7572-5	1st ear, main stalk	58	64	7	5	0	0	0	0	1	0	0	0	6	8	121		270
" "	2nd ear, main stalk	94	47	9	4	0	7	0	0	4	29	0	2	7	13	176		387
7307A-1	1st ear, main stalk	75	-	13	-	7	-	0	0	27	-	1	-	13	-	136		272

Heading: Phenotypes of kernels on ears of plants entered under Years 1957 and 1958 of C of Table 2. All plants were a_2^{m-1} (class II) BT/a_2 bt and all except plants 7307A-1 and 7572-4 were Wx/wx. The latter two plants were Wx/Wx. Pollen used in making each cross came from a plant homozygous for a_2, bt, and wx and having no spots.

Table 17

Phenotypes of Kernels

A.

Plant Number	Number of Ears	Uniformly Pigmented BT Wx	Uniformly Pigmented BT wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Colorless with spots of deep pigment BT Wx	Colorless with spots of deep pigment BT wx	Colorless with spots of deep pigment bt Wx	Colorless with spots of deep pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Total	% Recombination
7547A	4	28	241	3	21	261	14	28	1	33	28	494	1152	7.7
" C-2	1	0	25	0	2	28	2	1	0	2	1	49	110	5.1

B.

Plant No.	Position of Ear	Uniformly Pigmented BT Wx	Uniformly Pigmented BT wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Diffuse-mottled BT Wx	Diffuse-mottled BT wx	Diffuse-mottled bt Wx	Diffuse-mottled bt wx	Colorless spots of deep BT pigment Wx	Colorless spots of deep BT pigment wx	Colorless spots of deep bt Wx	Colorless spots of deep bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Total
7547A-1	tiller - 2	12	43	0	4	11	0	0	0	21	1	0	0	2	1	89	184
" A-5	2nd ear, main stem	17	9	0	2	0	0	0	0	1	0	0	0	1	1	17	48
7547B	tiller	12	41	0	1	7	0	0	0	17	1	1	0	2	1	60	143
" C	1st ear, main stem	79	89	7	6	6	1	2	0	3	0	0	0	5	1	161	360
Totals		131	254	10	26	27	2	2	0	109	3	10	0	23	14	472	1083

C

	Uniformly pale pigmented BT Wx	Uniformly pale pigmented BT wx	Uniformly pale pigmented bt Wx	Uniformly pale pigmented bt wx	Colorless with spots of deep pigment. Few or no pale areas seen BT Wx	Colorless with spots of deep pigment. Few or no pale areas seen BT wx	Colorless with spots of deep pigment. Few or no pale areas seen bt Wx	Colorless with spots of deep pigment. Few or no pale areas seen bt wx	Colorless with spots of deep pigment and some pale areas BT Wx	Colorless with spots of deep pigment and some pale areas BT wx	Colorless with spots of deep pigment and some pale areas bt Wx	Colorless with spots of deep pigment and some pale areas bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Total
7547A-1 2nd ear main stem × 7583-3 ♂	33	27	4	6	36	1	2	0	0	30	0	1	6	8	131	285

Heading:

Table 18

Phenotypes of Kernels

A

Plant number	Position of Ear	Type of ♂ in cross	Uniformly Pigmented BI Wx	Uniformly Pigmented BI ex	Uniformly Pigmented bt Wx	Uniformly Pigmented bt ex	Colorless, spots of pigment BI 1 Spm Wx	Colorless, spots of pigment BI 1 Spm ex	Colorless, spots of pigment BI High dip Spm Wx	Colorless, spots of pigment BI High dip Spm ex	Colorless bt Wx	Colorless bt ex	Colorless BI Wx	Colorless BI ex	Colorless bt Wx and ex	Totals
7582A	1st ear, main stalk	Type-2	113	88	11	10	0	0	0	0	0	0	9	5	185	421
" "	tiller	Type-3 1 Spm	45	29	1	1	36	3	1	42	0	3	11	6	138	316
" B-1	1st ear, main stalk	Type-3 1 Spm	34	45	1	1	29	4	4	45	1	2	3	5	140	314
" B-2	"	"	65	64	3	8	56	4	9	58	9	6	15	11	266	574
Totals, Type-3, 1 Spm ♂			144	138	5	10	121	11	14	145	10	11	29	22	544	1204

291 [illegible] 8.5% recombination

Table 18

B

Plant number	Position of Ear	Type of ♂ in cross	Uniformly Pigmented BI Wx	Uniformly Pigmented BI ex	Uniformly Pigmented bt Wx	Uniformly Pigmented bt ex	Colorless, spots of deep pigment BI Wx	Colorless, spots of deep pigment BI ex	Colorless, spots of deep pigment bt Wx	Colorless, spots of deep pigment bt ex	Colorless BI Wx	Colorless BI ex	Colorless bt Wx and ex	Total
7582B-3	1st ear main stalk	Type-3 spot Spm	27	24	2	0	75*	98†	6	10	16	28	225	511

* A number of these kernels showed large pale areas

† Very few of these kernels exhibited pale areas.

Table 19

Phenotypes of Kernels

Plant number	Location of tested Ear	Type of Test cross ♂	Uniform pigmented BI Wx	Uniform pigmented BI ny	Uniform pigmented bt Wx	Uniform pigmented bt ny	Colorless, spots of pigment BI Wx	Colorless, spots of pigment BI ny	Colorless, spots of pigment bt Wx	Colorless, spots of pigment bt ny	Colorless BI Wx	Colorless BI ny	Colorless bt Wx and ny	Total	[illegible]
7313															
A-1	1st ear, main stalk	Type-1	123	-	5	-	26	-	1	-	6	-	164		
A-2	"	Type-1	256	-	11	-	6	-	2	-	16	-	234		
A-2	tiller	Type-2	83	5	2	1	6	67	0	3	3	3	193		7.1%
B-1	1st ear, main stalk	Type-2	53	22	6	2	5	18	0	1	3	2	121		
B-2	1st ear, main stalk	Type-1	195	-	15	-	5	-	2	-	22	-	226		
B-3	"	Type-2	81	54	6	3	0	13	0	1	2	2	135		
B-4	"	Type-2	29	24	1	0	74	58	4	1	5	7	206		
B-4	tiller-1	Type-1	64	-	4	-	46	-	2	-	4	-	125		
B-4	tiller-2	Type-2	25	2	1	0	8	35	0	0	1	0	45		
B-5	1st ear, main stalk	Type-1	101	-	10	-	98	-	4	-	17	-	228		
B-5	2nd ear, main stalk	Type-2	53	-	5	-	45	-	0	-	6	-	100		

Table 20

Phenotypes of kernels

Plant number	Position of ear	uniformly pigmented BI Wx	uniformly pigmented BI ux	uniformly pigmented bt Wx	uniformly pigmented bt ux	Colorless with spots of pigment BI Wx	Colorless with spots of pigment BI ux	Colorless with spots of pigment bt Wx	Colorless with spots of pigment bt ux	Colorless BI Wx	Colorless BI ux	Colorless bt Wx and ux	Totals
7309A-3	1st ear, main stalk	38	11	0	1	5	32	1	2	4	4	93	191
" " "	tiller	45	11	3	0	7	41	0	3	7	3	112	232
" A-4	tiller-1	57	2	1	0	8	60	0	4	2	5	118	257
" A-5	tiller-1	76	10	5	1	11	68	2	3	4	5	158	343
" A-8	1st ear, main stalk	41	2	4	0	5	34	0	6	4	6	98	200
Totals		257	36	13	2	36	235	3	18	21	23	579	1223

12.8% recombination

[illegible] A-9 cross
A-6 "

Heading:

Phenotypes of kernels on ears of plants in culture 7309A, which were a_2m^1 (class II) BI/$a_2$bt, Wx+/ux Spm in constitution, produced by a cross with a plant homozygous for a_2, bt, and ux, and having no Spm.

Table 21

A.

Plant number	number of ears.	a_2^{m-1} carrying kernels. no evidence of Spm in kernel: Wx	wx	Spm ~~present~~ active in all or in part of kernel: Wx	wx	Totals
7554A-1	3	279	249	1	16	545
" A-3	1	22	15	0	0	37
" A-4	3	125	122	1	14	262
" A-5	3	180	160	1	12	353

% recombination: 6.6

B.

		Uniformly Pigmented		Colorless with: Many specks of pigment		Few specks of pigment		
		Wx	wx	Wx	wx	Wx	wx	Total
7554A-3	1	14	12	86	12	18	77	219

% recombination: 15.5

Heading: A Phenotypes of a_2^{m-1} carrying kernels on ears of plants in cultures 7554A produced by cross with plants homozygous for a_2, bt, and wx and carrying no Spm

B. Phenotypes of a_2^{m-1} carrying kernels on first ear of main stalk of plant 7554A produced by cross with a plant homozygous for a_2, bt, and wx and for Spm in its active phase.

Table 22

Plant Number	Direction of Cross	No evidence of Spm in kernel	Spm present in kernel	
7538-1	♀	2	75	
	♂	62	482	
7538-6	♀	19	238	(228 kernels with "2spm" pattern to 10 kernels with "4spm" pattern)
	♂	34	346	
7538-10	♀	7	182	
	♂	175	1484	
7538 R-2	♀	28	207	(190 kernels with "2spm" pattern to 17 kernels with "4spm" pattern)
7538R-4	♀	2	304	(all kernels have "2spm" pattern)
	♂	93	769	
7570C	♀	7	197	(189 kernels with "2spm" pattern : 8 kernels with "4spm" pattern)
	♂	10	325	
7818A-1 Tiller-1	♀	11	201	
" " Tiller-2	♀	5	94	
7818 B-3	♀	5	213	
	♂	19	164	
7818 B-4	♂	28	429	
" B-5	♂	14	310	
7308C-3 I	♀	12	174	(159 with "2spm" pattern : 15 with "4spm" pattern)
" " II	♀	6	156	(153 " " " : 4 " " ")

Heading:

Number of kernels showing no evidence of Spm to those exhibiting its presence on ears produced by crosses of no Spm plants with those that carried two active Spm elements, located in ~~xxxxxx~~ a pair of homologous chromosomes and probably at allelic position in each member of the pair. Plants in cultures 7538 and 7818 were homozygous for a_2 and were crossed with no Spm plants that carried either a class I or the calss II state of a_2^{m-1}. Plant 7570C carried a_2^{m-1} (class II) and it was crossed reciprocally with plants homozygous for a_2 in which no Spm was present.

Plant 7308 C-3 carried a_2 m-1 (Class II) and its two ears were used in a cross with a plant homozygous for a_2 and having no Spm.

	no S pm	2S pm	4S pm
7538-6	19	228	10
" R-2	28	190	17
" R-4	2	304	0
7570C	7	~~313~~ 197	8
7308C-3-I	12	159	15
" -3 II	6	152	4
Totals	74	~~1346~~ 1230	54
	" ~~5.2%~~		" ~~3.9%~~

Total = ~~1401~~ 1358

Table 23 Types of test cross conducted with plants in Cultivar 7570

Plant number	Spm Constitution and location	Position of ear in plant: 1st ear main stalk	2nd ear main stalk	ear of tiller-1	ear of tiller-2	ear of tiller-3	Pollen used in cross to tester type
7570 A-1	Wx+/wx Spm	2	2	2	3	3	
" A-2	" "	2	2	2	3		
" A-3	" "	2	2				
" A-4	" "	2		2	3		
" A-5	" "	2		2	2		
" A-6	" "	2	2	2			
" A-7	Wx+/wx; 1 Spm	2	2				
" A-8	Wx+/wx Spm plus 1 Spm	2	2				
" B-1	Wx Spm/wx+	2	2	2			
" B-2	" "	2			self-pollinated		2 and 3
" B-3	" "	2		2	2		
C	Wx Spm/wx Spm	2	3	2	2		2

Tester type-2 : a2bt/a2bt, wx/wx, no Spm

" " -3 : " " " " 1 or 2 active Spm.

Table 24

Phenotypes of kernels.

A.

Culture number	Direction of cross ↓ number of ears	Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Pigmented spots in colorless background BI Wx	Pigmented spots in colorless background BI wx	Pigmented spots in colorless background bt Wx	Pigmented spots in colorless background bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx and wx	Totals
7570A ♀	13	318	50	46	11	62	319	9	40	75	65	698	1693
7570B ♀	6	19	224	3	28	253	15	42	3	35	29	505	1156
7570B-2 ♂	6	41	459	3	56	462	51	41	3	61	66	987	2230
7570C ♀	3	3	3	1	0	87	84	15	11	15	27	210	456
" C ♂	4	5	4	1	0	139	157	16	13	23	24	303	685
B.													
7570A-1, A-4 tillers 1)		36	4	4	1	56	78	3	20	22	24	128	376
7570B-2 pollen ♂ 2)		3	39	1	1	72	36	7	2	6	4	155	326
7570C 2nd ear main stalk 3)		0	0	0	0	55	59	6	5	2	2	81	

Heading:

Phenotypes of kernels on ears produced by testcrosses of a_2^{m-1} (class II) Bt/ a_2 bt plants in culture 7570. that were Wx +/wx Spm (7570A), Wx Spm/wx + (7570B), and Wx Spm/wx Spm (7570C).

A. Kernels on ears produced by testcross type-2.

B. Kernels on ears produced by testcross type-3 in which the tester plants carried one Spm in its active phase.

1) Patterns in Variegated, BI kernels: 1 Spm = 44 Wx : 5 wx; high dose Spm = 12 Wx : 73 wx

2) " " 1 and 2 Spm = 32 Wx 34 wx; high dose Spm pattern = 40 Wx 2 wx

3) " " 1 Spm = 3 wx, 2 Spm = 29 Wx : 29 wx, 3 Spm = 26 Wx : 27 wx

Table 25

A.

Spm Constitution and location	number of ears	uniformly pigmented BI Wx	uniformly pigmented BI ux	uniformly pigmented bt Wx	uniformly pigmented bt ux	spots of pigment in colorless background BI Wx	spots of pigment in colorless background BI ux	spots of pigment in colorless background bt Wx	spots of pigment in colorless background bt ux	colorless BI Wx	colorless BI ux	colorless bt Wx and ux	Totals	% Recombination
Wx Spm/ ux +	17	141	1419	20	124	1484	121	93	10	132	147	3121	6812	8.5
Wx/ux; 1 Spm (7563A-2)	2	96	84	7	3	80	85	2	2	6	13	324	702	0

B.

Wx Spm/ ux + (7563 A 4 tiller-1)	1	2	32	1	0	64	31	2	2	2	3	108	247
(" B-1 tiller)	1	5	33	0	1	71	50	2	1	14	4	148	329
Totals		7	65	1	1	135	81	4	3	16	7	256	576

Heading: A. Phenotypes of kernels on ears of plants in culture 7563 that were a_2 m-1 (Class II) BI/a_2 bt in constitution produced by the cross with plants homozygous for a_2, bt, and ux and having no spm.

B. Phenotypes of kernels on two ears produced by cross with plants homozygous for a_2, bt, and ux and having one spm in its active phase.

(Heading - over)

Table 26 — Phenotype of Kernel

A Spm constitution and location	Number of Ears	Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bf Wx	Uniformly Pigmented bf wx	Spots of pigment in colorless background BI Wx	Spots of pigment in colorless background BI wx	Spots of pigment in colorless background bf Wx	Spots of pigment in colorless background bf wx	Colorless BI Wx	Colorless BI wx	Colorless bf Wx and wx	Totals
Wx+/ wx+ Spm	13	696	85	53	5	98	708	12	40	62	75	1643	3477
Wx+/Wx+, 1 Spm	3	258	-	12	-	207	-	17	-	34	-	478	1006
Wx+/wx+, 2 Spm	2	44	28	3	1	113	111	3	7	13	15	306	644
Wx++/wx+ Spm (7546-7, 1 ear in main stalk)	1	41	40	2	6	0	3	0	0	6	3	87	
B Plant number ♀ ♂													
7546-1 7538-3	1	43	4	1	0	39	78	1	1	7	6	190	370
" -2 7538-13	1	32	3	7	1	48	105	4	3	5	6	198	412
" -7 7538-14	1	36	4	2	1	22	49	1	2	4	3	105	229
Totals for B	3	111	11	10	2	109	232	6	6	16	15	493*	1011
C ♀ ♂													
7546-5 7538-2	1	16	5	2	0	51	62	4	6	4	5	175	330
" -9 7538-2	1	33	5	1	0	71	89	6	7	12	13	189	426
" -12 7538-2	1	8	0	0	1	35	40	2	3	3	2	64	158
Totals for C	3	57	10	3	1	157	191	12	16	19	20	428*	914

* A few kernels carrying a_2 wx-1 and a high dose of Spm may be included in this class.

Heading:

A. Phenotypes of kernels on ears produced by plants in culture 7546 in cross with plants homozygous for a_2, bt, and wx, and having no Spm.

B. Phenotypes of kernels on ear of each of three Wx +/wx Spm plants in culture 7546 produced by cross with a plant homozygous for a_2, bt, and wx, and carrying one active Spm.

C. Phenotypes of kernels on ear of each of three Wx +/ wx Spm plants in culture 7546 produced by cross with a plant homozygous for a_2, bt, and wx, and carrying two non-linked, ~~and~~ active Spm elements.

Table 27

Phenotypes of kernels

A.

Plant number	Position of ear	Uniform Pigmented BT Wx	Uniform Pigmented BT wx	Uniform Pigmented bt Wx	Uniform Pigmented bt wx	Pigmented spots in colorless background BT Wx	Pigmented spots in colorless background BT wx	Pigmented spots in colorless background bt Wx	Pigmented spots in colorless background bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx + wx	Totals	% Recombination
7308B-2	1st ear, main stalk	186	32	-	-	23	162	-	-	0	1	-	404	
" B-4	" " "	21	1	-	-	0	15	-	-	0	0	-	37	
" " "	tiller-1	28	2	-	-	2	26	-	-	0	0	-	58	
" " "	tiller-2	13	4	-	-	0	11	-	-	1	0	-	29	
Totals, 7308B-4		62	7	-	-	2	52	-	-	1	0	-	124	
7308B-1	tiller-1	46	10	2	1	6	64	1	2	5	6	63	226	
	tiller-2	29	10	3	1	4	39	2	4	3	6	89	190	
	tiller-3	17	2	2	1	3	18	0	1	0	2	47	93	
Totals, 7308B-1		92	22	7	3	13	121	3	7	8	14	219	509	

B.

Phenotypes of kernels

		Uniform Pigmented BT	Uniform Pigmented bt	Colorless with spots of pigment BT 2 spm pattern	Colorless with spots of pigment BT Hilldale spm pattern	Colorless with spots of pigment bt	Colorless BT	Colorless bt	Totals
7308B-3	1st ear, main stalk	4	5	75	43	8	36	176	347
7308 C-1	" " "	52	6	49	42	10	12	132	303
C "	2nd ear, " "	8	3	24	5	3	6	45	94
" "	tiller-1	40	3	53	36	11	20	143	306
" "	tiller-2	12	2	40	41	6	27	38	216
Totals for C-1		112	14	166	124	30	65	408	919
7308C-2	1st ear, main stalk	0	-	6	68	-	51	-	125
" C-3	" " " "	10	2	149	15	10	15	166	367
" "	2nd " " "	6	0	149	4	3	10	163	335
Totals for C-3		16	2	298	19	13	25	329	702
" C-4	1st ear, main stalk	45	3	59	34	10	28	169	348
" C-5	" " " "	0	-	0	6	-	10	-	16
" C-6	" " " "	8	-	158	158	-	4	-	328
" " "	2nd " " "	5	-	95	114	-	5	-	219
" " "	tiller	2	-	41	59	-	0	-	102
Totals for C-6		15	-	294	331	-	9	-	649

Heading: (over)

Heading:

Phenotypes of kernels on ears of plants in B and C of culture 7308.

A: produced by testcross type-2

B: produced by testcross type-1

Plants B-2, B-4; C-2, C-5, C-6 were homozygous for a_2^{m-1} (class II) and Bt. Plants B-1, B-3, C-1, C-3, and C-4 were a_2^{m-1} (class II) Bt/ a_2 bt in constitution.

Table 28

A- Plant		uniform pigment				colorless, spots of pigment				colorless			
		BT		bt		BT		bt		BT		bt	
number		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx	Total
7573A-1	1st ear, main stalk	47	30	3	4	40	57	4	2	3	8	162	
7573A-2	2nd ear, main stalk	47	4	1	0	44	73	5	6	11	9	211	411
" A-3	1st ear, " "	49	8	3	2	70	101	2	10	8	5	166	418
" A-4	" " " "	30	4	4	0	49	66	3	2	9	4	156	327
" A-5	" " " "	31	3	1	0	33	66	3	0	3	7	122	269
" A-6	tiller	26	2	5	0	40	44	4	3	5	9	90	228
Totals		183	21	14	2	236	350	17	21	36	34	739	1653
B.													
7573A-2	1st ear, main stalk	46	3	25	1	52	92	38	75	1	1	50	
7573A-3	2nd " " "	37	4	13	0	83	113	38	69	1	3	129	
C													
7573B-1	1st ear, main stalk	27	4	2	1	3	34	0	2	6	0	63	142
" B-3	tiller	42	4	2	1	2	32	0	4	5	2	85	179
" B-4	2nd ear, main stalk	90	5	5	0	3	71	0	4	6	7	151	342
Totals		159	13	9	2	8	137	0	10	17	9	299	663
D.													
7573B-4	1st ear, main stalk	66	7	9	0	8	72	5	50	2	1	43	

Table 29

A.

Plant number	Position of ear		BI Wx	BI ex	bT Wx	bT ex	BI Wx	BI ex	bT Wx	bT ex	BI Wx	BI ex	bT Wx and ex	Total	
7576	1st ear, main stalk		55	14	5	0	6	70	0	3	3	7	129	292	
"	2n " "	"	54	5	3	2	3	68	0	3	4	7	112	261	
Totals			109	19	8	2	9	138	0	6	7	14	241	553	10.39%

B

7576 tiller

Table 30 A

a_2m1 ♀ (class I) × 7308 D-1 ♂
no Spm

Plant number	Position of Ear		no Spm	Spm	Year 1958 Culture no
7305 C-3	tiller		61	57	
" D-1	tiller-3		107	102	7564
7320 A-2	1st ear,	main stalk	109	106	
" B-1	" "	" "	87	85	7601
" B-6	" "	" "	126	105	7605
7321 B-7	" "	" "	31	28	7607
7459 A-1	" "	" "	53	52	7565
7465 A-1	tiller		39	20	
" A-2	1st ear,	" "	25	45	
" A-3	" "	" "	11	9	
7466 A-3	" "	" "	119	107	
" B-3	tiller		109	86	
Totals			877	802	

a_2m1 (class II) ♀ × 7308 D-1 ♂
no Spm

Plant number	Position of ear		no Spm	Spm	1957 culture number
7309 B-4	1st ear,	main stalk	108	123	
7310-1	tiller-2		108	128	
" -3	1st ear,	main stalk	127	122	
7314 A-3	" "	" "	70	71	
7316 A-1	" "	" "	89	52	
" D-2	" "	" "	216	172	
7456 A-1	" "	" "	36	52	756
" A-2	" "	" "	79	60	756
" A-3	" "	" "	88	79	756
" B-1	" "	" "	16	19	
" B-3	" "	" "	94	89	
" E-1	tiller		80	78	
" E-3	2nd ear	" "	9	10	
Totals			1120	1055	

Totals = 1997 no Spm ; 1857 with Spm

Heading:

Number of a_2m1 carrying kernels on ears of no Spm plants that received no Spm (or an inactive Spm) and Spm from the pollen parent 7308 D-1 (A of table) or 7308 D-2 (B of table). Plants were grown in 1958 from the undetermined class of kernels under the culture number given in the last column.

Table 30 B

a_2m1 (class I) no spur ♀ × 7308 D-2 ♂

Plant no. ♀	Ear	no Spur	Spur	Year 1958 Cutter number
7305C-2	tiller	139	120	
" D-2	I	149	146	
" E	tiller	105	123	
7320A-3	I	34	24	
" A-4		139	illegible	7662
7465A-1	tiller	96	89	7571
" B-1	tiller-1	25	31	
7466A-1	tiller	126	103	
" A-2	I	97	104	
" A-3	tiller	83	78	
" B-1	tiller	126	129	
Totals		1119	1063	

7461B-2 I not included: poor classification

a_2m-1 (class II) ♀ no spur × 7308 D-2

Plant no ♀	Ear	no Spur	Spur	%
7308A-1	I	220	195	75
" A-2	I	212	210	
" A-3	I	109	110	
" A-6	I	34	36	
7309B-1	I	143	137	
" B-2	I	58	52	
" B-3	I	131	130	
7310B-1	I	94	96	
" B-2	I	99	81	75
7311-1	I	121	109	
" -2	I	91	87	
7314A-1	I	79	79	
" A-2	I	121	113	
7316A-2	I	89	52	
" D-4	I	36	31	
7456B-1	I	52	57	
" E-3	tiller-2	73	57	
Totals		1762	1632	

Total = 2881 no spur : 2695 spur

Break-down, pale-sph. sectorials, late sph.

1957

7305 E
" H
7306 B - from late sph. for "A₂" state
7316 B " breakdown " " "
" C " " "
7319 C
7455 A, B, D
7456 C
7459 B
7460 B
7461 B
" C
" D
7463 C
" D

1958
7544 B - see
7545 B
" C
7551 B
7554 A - from 7308 A (5) or
7578 A
7582 A - from 7316 - (6) see 7582 B
7565 B - from 7308 D (1) or 1 up
7584 A - " 7305 C (4) t
" B " "
7586 A " 7463 E (5) I
" B
" C
" D
" E
7587 B from 7463 E (5) t-2
" C
7592 A From 7455 B (2)
7593 A " " } important
B
7594 I
7596 A
B
C
7598
7599 A

Use Like 7109 B-1 in parts but A₂ m+/pale-spotted

Tests of a_{2m-1} (A-) from "Breakdown" kernels. 1958

7554 A = A ① ③ ④ ⑤ = Wx + / wx Spm - inactive,
A ② = Wx Wx wx Spm [From heterofertilization?]

7582 A = Wx + / wx Spm - inactive in most of plant.
" B = from pale Wx wx kernels = inactive Spm in most of plant

7590 = From "Breakdown" kernels in class of $a_2 bt_p$ Wx × 7316 D ⑤
no evidence of Spm.

7593 A From "Breakdown" kernels in class of 7455 B ② [illegible] × $a_2 bt_p$ Wx wx [illegible]

7596 A " " " " " 7455 C ⑤ [illegible] × $a_2 bt_p$ wx wx Spm

B " spl "

C " " "

7599 A From "Breakdown" kernels in class of 7293 (65) × 7456 D ⑤

Tests of a_2^{m-1} (spotted) from Breakdown or colorless, few A_2 specks 1958

7544 B = no evidence of Spm in plants

7545 B = inactive Spm

" C = no evidence of inactive Spm

7459A-1 × 7308D

Imp 7565B = From $a_2 \to A_2$ few A_2 specks only. Cross of a_2^{m-1} BI / a_2^{s} bt × 7308D. gave only few var. kernels in tests.

Delayed action Spm from ♀ parent, probably. not from ♂.

No evidence of Spm in

7584 A From pale, irregular colored kernels 7305C(4)$^{t-2}$ × 729336

" B From "Breakdown" kernels, few A_2 specks. gave same results as 7565B.

7586 A From pale kernels of 7463 E(5)^{I} × 7293(17)

" B " Breakdown kernel - no evidence of active Spm in plants.

" C " pale-spk sectorials - Plants sectorial. Ears = no Spm seen

" D " late spk kernels. - var pale plants - no evidence of Spm action

" E = " dotted (small) " - sectorial plants - ears like 7565B

7587 B = From kernels with few specks - 7463 E(5)^{t2} × a_2 bt pr wx no Spm

no evidence of Spm in plant or in kernels on ear

" C = From "Breakdown" kernel = no evidence of Spm in plant.

7603A From pale-spk sectorial. [pale-early state]

7610C " " " "

Very delayed action Spin - Long inactive Cycle

7455 B(2) - see 7592 A (2)(3)(6). Plants = all A_2

Compare with 7591 A + B.

" " 7593 A all Plants = A_2

7593 B " " A_2 except few small sectors in B(5). [illegible]

7455 C(5)II - See 7594. all plants A_2 Compare with 7595 A + B.

7596. " " are A_2

7455 C(2) - See 7597

Tests of changes in spm - in a_2s plants

use - 7538 Tests

7614

7615

7816-7818

7308 D① + D② crosses.

Late transposition

spm from 7109 culture - changes mainly to inactive. Rarely to spm^w.

spm " a_1 m-1 " - changes mainly to spm^w. Rarely to spm - inactive.

Early or late transpositions.

I Illustrations.

1. States of a_2^{m-1} with and without Spm.
2. Mutant types of Spm with different states of a_2^{m-1} or a_1^{m-1}
   Spm^w - stable; Spm^w returning to full activity in some cells.
   use a_2^{m-1} (pale-spotted) + a_2^{m-1} (early).

3. Kernels with a_2^{m-1} (class I) + different patterns of pigment distribution
   With Spm: 1 Spm, 2 Spm, 3 Spm, diffuse mottled.

Sequence 7113A-5 to 7587 a_2^{m} (pale-dotted)

1957			I	II	t-1	t-2	t-3	pales
7113A-5			+ + (some d)		+	0		
1957								
7463 - From selected kernels on ear I of 7113A-5								
A			+ + (sound)	+ + (sound)	+ + (sound)	+ + (sound)	+ + (sound)	
B-1			–		–	–		
2			vd	vd	vd			
C			–	–	vd	vd		
D-1			–		–			
D-2			–					
E-1			+ + +	+ + +	+ + +	+ + +		
2			vd vd	vd vd	+ d (sound)	+ + (sound)		
3			– d		+ +			
4			–	–	d			
5			d	+	+ (sound)	±		
6			d d		+ +			
1958								
7587	From selected kernels on ear I of 7463 E-5							
A-1	no spun		0					
A-2	no spun		0	0				
A-3	no spun		0	0				
A-4	no spun		0	0				
A-5	(" ")							
A-8			–		vd	vd		
A-9			–	–				
A-10			–	vd				
B			–	–	–			
C-1			–					
2			–					
3			–					
D-1			–					
4			–	–				
E-1			–					
2			–	–				
3			vd	vd				

			I	II	C-1	C-2	E-3	pollen
7587	From selected kernels on ear of tiller-2 of 7463E-5							
A-1			+ +		+ +			
2			+					
3			nd	+				
4			+ +					
5			+					
6			+	+				
7			+ + +	+ + +				
8			+					
9			+ +					
10			+	+				
B			−		−	−		
C			−					

7113 A-5 From cross of 6914E-8 × 6908A (3)
(A1/a1s) a2BI/a2BI a2m-1 (pale dotted) BI / a2s BI A2A1

" variegated plant - small streaks of A2

7463 = 7113A-5 I × 7102 (5) a2bt pr y Wx no Spm

7463 A = from A2 BI kernel. Plant = var.

" B = From pale BI kernels

" C = " pale-sph sectorial kernel

" D = " " " sectorial "

" E = " a2 → A2 spotted kernels

7586 From 7463 E (5) I × 7293 (17) a2bt pr y Wx no Spm

A = from pale BI kernels

B = From "Breakdown" kernel BI

C = from pale-sph sectorials BI

D = from late sph kernels BI

E = from a2 → A2, small dots. BI

7587 From 7463 E (5) t-2 × 7321 B (4) a2bt pr y wx no Spm

A = From a2 → A2 spotted pattern BI

B " " few A2 specks BI

C " Breakdown plus few A2 specks.

7314 = 7110 A ③ $a_2^{m-1}(A_2)$ BE fr / a_2^s BE Pr ♀ × a_2 bt pr W × ♂ — = × 7308 D① or D②
no spm

	I	II	t-1	t-2	t-3	pollen
7314 A-1	no spm	no spm				
2	no spm					
3	no spm					
4	no spm					
5	no spm					no spm
" B-1	+	+	+			
B-2						
B-3						

7315 From 7110 A-5 $a_2^{m-1}(A_2)$ BE / a_2^s BE 2 spm ♀ × a_2 bt pr W × no spm ♂

2	(+	−)	+	−	+	−
3	+	−	+	d	+	−)
4	+		+			

7316 From 7110 B-4 II $a_2^{m-1}(A_2)$ BE / a_2^s BE 1 spm × 7273 a_2^{m-1}(pale "late") bt / a_2 BE — = early mutt. spm ♀

A-1	no spm					
2	no spm	no spm				
B	(medium spm)					
C	−					
D-1	no spm	no spm				
2	no spm					
3	−	−	=	−		−
4	no spm					
E-1	+		+			
2	+		+ +	+ + +		
3	+ + +					
4	+ +					
F 1	+ −					
2	+					
G 1	−					
2	+					

— . x7305 D① ⇒ D②

7305 = 7113A-6 a_2 m-1 (pale-spotted BT Pr / a_2 s BtPr
1 spin from a_1 m-1 culture + 1 spin from a_2 m-1 culture

			I	II	t-1	t-2	t-3	pollen
7305A			+ d	+ −	+ +			
" B-1			+ −		+ d			
2			+		+			
3			+ −	+ d	+ +	+ +		
			∅ ∅					∅ ∅
C-1			no spin		no spin			no spin
C-2			no spin		no spin			no spin
C-3			no spin	no spin	no spin			
C-4			vd		− vd	vd		
D-1			no spin		no spin	no spin	no spin	
D-2			no spin		no spin			
✓ E	from pale-sph.	Plant-spun seedlings	no spin		no spin			
F 1			+ + +		+ + +			
2			d	d	+			
G 2			+ +	+ d	+ −			
3				+				
4			+ +					
1			+		+			
5			+ +	+ +				
6			+ d					
H			+ +		+ +	+ +		

Table 2 Tests of 7308C-6 wx Spm/wx Spm +1 Spm a_2^{m-1} BT/a_2^{m-1} BT ♀ × a_2 bt/a_2 bt, bt/bt? no Spm ♂

		uniformly dark pigmented	colorless with spots of color	colorless with few specks of color	colorless
7308C-6	1st ear main stalk	8	158	157	5
	2nd " " "	5	95	113	6
	ear of tiller	2	41	59	0
	Totals	15	294	329	11

7573A-3	uniformly dark pigmented BT Wx	wx	Colorless BT spots Wx	wx	pigmented specks Wx	wx	Colorless BT Wx	wx	pigmented bt Wx	wx	Colorless, bt pigmented spots or specks Wx	wx	Colorless bt Wx and wx
7573A-5 I	30	4	42	29	7	37	9	4	4	0	3	2	156
" A-6 I	26	2	34	23	6	21	5	9	5	0	4	3	90
Totals	56	6	76	52	13	58	14	13	9	0	7	5	246
7573B-1 I	27	4	3	34	0	0	6	0	2	1	0	2	63
" B-3 I	42	4	2	32	0	0	5	2	2	1	0	4	85
" B-4 II	90	5	3	71	0	0	6	7	5	0	0	4	151
Totals	159	13	8	137	0	0	17	9	9	2	0	10	299

7308C-3 ♀ Spm/Spm. × a_2^{m-1} (class II) × a_2 bt no Spm ♂

		unif pig.	pallid 2 Spm ♀	pallid 3 Spm	colorless BT	A_2 bt	var bt	colorless bt
	ear I	10	149	15				
	" II	6	149	4				
7570C	I	0	92 = 2 Spm	0	21	0	17	100
	t-1	1	1: 128	2 = Spm	43	0	2	40
	t-2	5	1 Spm 43	2 Spm 6	19	1	7	70
	pollen	6	211	4	32	230	23	223

$a_2$bt/$a_2$bt Spm/Spm ♀ × a_2^{m-1} (class II) no Spm ♂

7538-6 ♀	19	228	30
" R-2 ♀	28	190	17
" R-4 ♀	2	304	0

7570C for 1 Spm pallid

Spm | Spm ♀ × a_2^{2n-1} (class II) no Spm ♂

		Unifenz pigmented	1 spin ♂♀ pattern	2 spin ♀ pattern
308C	3 I ♀	10	149	15
"	3 II ♀	6	149	4
538-6	♀	19	228	30
" R-2	♀	28	190	17
" R-4	♀	2	304	0
570C	I ♀	0	109	?
" C	t-1	1	31	?
" C	t-2	6	56	?
" C	♂	3	128	2
		3	83	2
		total 6	211	4

· include in account.

1. Reason why the maize controlling elements differ in some respects -- that is in producing variegation + mutation -- rests on the selective methods. Those producing variegation easily identifies

2. Why most plants were maintained heterozygous for a_2^{m-1}

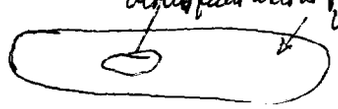
3. Tester stocks with a_2^{m-1} states - reason.

4. Inprogeny of 7308 D② with long duration of active phase of Spm, phase not altered by transposition.
This applies to transposed Spm in 7563A①, 7546⑧ + ⑨, also from ④ ear of 7109B②$^{t-1}$

5. Controlled times of change in phase of activity of Spm -
Examples from tables - from inactive to active
" active to inactive.

6. The contribution of the class I states to change in activity of Spm - { If only 1 Spm present class I states are evident for examining activity phase of Spm.

7. Relation of change in activity of Spm to control of subsequent change in phase - 7779; sector



From 7308D① ← 7778; sector of active Spm in 4 rows of 12 round ear
← 7777 " " inactive Spm in middle of ear

8. Independence of cycle of each Spm when combined in same plant.
1958 from ♀ inactive × ♂ active
1960 - 7780A plants.

9. Spm must be in the active phase for transposition to occur.

10. Cross of no Spm ♀ × active Spm ♂ : immediate action of Spm.
a_2^{m-1}

11 Selected kernels in class I states ~~[illegible]~~ each of vd type for behavior in them: Usefulness of class I states.

pale-dotted sequences -

1. shows grade of Spm activity
2. sectors in plants show grade of activity and what rate change in Spm occurs as individual event
3. Sectors in kernels shows change in grade of activity occurs in individual cells.

4. 7463 E-5 sequence: (7586-87)
   a) what rates grade change in tiller from - to + (full) is inherited. Arose from change of Spm
   b) Shows change from + to weak or - is result of event in single cell = the early sectorials.

$a_2^{m1}(A_2)$ BI | a_2^{3} bt no spin ½ + 7538 1 spin

of no. of years.		uniformly dark colored		colorless with many colored spots		Few species		colorless		Totals
		BI	bt	BI	bt	BI	bt	BI	bt	
538-9	6	494	33	439		6	= 44	75		

Control of dose of Spm on Time of cycle change of Spm - Use of pale-early asterter

♀ spm/spm - % fully active spm : breakdown

~~7816~~ - 7818 spm/spm♀ = 21 pale : 1 Breakdown (= 0.2%) : 507 fully active Spm

7816 - 7818 1 Spm = 1251 pale : 82 " (= 6.0%) ; 1269 " " Spm

1. germ line vs. soma -

a) inactive in germ line when rapid changes in soma from inactive → active → inactive.

Lack of correspondence between cob variegation and kernel types

Weak acting spm, turned on in kernels but irregular + weak + often late in dev.

Pollen - period of turning on -

Side branches " " " "

b) Active in germ line → active in ear regardless of on - + off in leaf + cob

include - Tests of spin in 7108 cultures - pale - spotted $a_2 m_1$

" details of 7312 crosses.

Ratios of spin to no spin produced by crosses of 7308 D① × D②

Types of var. produced by each.

Test crosses of 7538 - to no spin

to Wx spin / Wx +

to Wx + / Wx spin

to Wx Wx ; 1 spin

active × inactive.

$a_1 sh_2 / a_1 sh_2$ + Spm Crosses 7965

		Date	Spm number	
7965A-1	7940A-1		2 Spm	
7957-4	7965A-1			
7958A-2	" "	7/24		
7965A-2	7972A-1		many spm	
7963C	7965A-2			
7965A-3	7955A-3		3 Spm	
7965A-4	7939A-4		2 Spm	
7958B-4	7965A-4			
7957-5	" "	7/30		
7958A-4	" "	7/24		
7967-6	" "	8/4		
7965A-5	7972A-4	8/8	4 or 5 Spm	
7955A-1	7965A-5	7/31		
7957A-1	" "	8/1		
7965B-1	7940A-3		High no. Spm	
" " C	7967-3			
7970A-1	7965B-1			
7972A-1	" "			
" " -3	" "			
7965B-2	7971A-3		1 Spm	
7965B-3	7972B-1		2 Spm	
7951A-4	7965B-3			
7973C-4	" "	8/2		
7965B-4	7973B-4		High no. Spm	Pr pr
7965B-5	7940A-3		4 Spm	Pr pr
7939A-4	7965B-5			
7940A-2	" "			
7951A-2	" "			
7958B-1	" "			
7972B-1	" "			
7973B-1	" "			

a1 sh2/a1 sh2 + Spm Culture 7966

♀	♂	date	Spm number		
7966-1 7874A-1	7971A-3 7966-1		+ Pr/Spm pr plus 2 Spm		C sh ♀ ex/C Sh Bz ex
7966-2 7973A-3	7973C-3 7966-2		1 Spm, not limited to pr		
7966-3	7973B-2		1 Spm	pr pr	Sh1 ex/sh1 ex
7966-4 7972A-4	7972B-1 7966-4		3 Spm	pr pr	
7966-5 " " t 7973C-5 7977B	7972A-1 7968-3 7966-5 " "		1 Spm	+ Pr/Spm pr	Sh1 ex/sh1 ex
7966-6 " " t 7973C-2 7969-20	7971A-4 7973B-2 7966-6 mean " " tube	8/24 8/7 7/30 7/13	1 Spm 2 Spm 1 Spm 2 Spm	Pr pr + Pr/Spm pr + 1 Spm	
7966-8	7972A-4		2 Spm		
7966-10 " -10 t	7973C-3 7968-3		3 Spm 3 Spm	pr pr	
7966-11 " " t " " t 7941-3 7953B-4 7956A-2 " A-6 t 7971A-1 7968-6 t	7971A-4 7972A-4 7973B-2 7966-11 " " " " " " " " " "		1 Spm	+ Pr/Spm pr	Sh Bz ex/sh ♀ ex
7966-12 " " 7942A-1 7971A-4	7973B-2 7973C-3 7966-12 " "		no Spm		
7966-13	7972A-4		2 limited Spm		

1957 Ext

A_2 kernels selected from ears of a_2^{m-1} (pale-spotted)

From pollen

7301 A

" B①

" B②

" B③

From ess parent:

7304 A = A_2 Bt p_2 / a_2 bt p_1. Stable with Spm

7305 A = var. plant. a_2^{m1} (pale-spotted) BI p_2 / a_2^s bt p_2

" B① = " " a_2^{m1} (" ") BI p_2 / a_2^s bt p_2

" B② =

" B③ = " " a_2^{m1} (pale-spotted) BI p_2 / a_2^s bt p_2

7463 A = " " a_2^{m1} (" ") BI p_2 / a_2^s bt p_2

7464 A = A_2 BI p_2 / a_2 bt p_2. Stable A_2 with Spm

---

2 A_2 : 4 a_2^{m-1} . Mutations to A_2 occur late. Few occur somewhat earlier. Expect difference in spermes if mutation occurs late

Spm - Origins

From a_1^{m-1}

Cuetenes

7296 - 7301

7302
7303
7304
7305 F+G
7317
7463 E
7464
7465
7467
7468
7469
7470

7544
7545 A (Spm^w - from Spm^s in A ④)
7548
7549 (Spm^w in 7549 D; from Spm^s)
7550
7551
7552 B
7553
7556 (+ 1 Spm from a_2^{m-1})
7557
7558
7559
7574
7579
7580 - Spm^w from Spm^s
7581 " " "
7608 (+ Spm from a_2^{m-1} possible)
7609 (+ " " " ")

From

a_2^{m-1}

7306
7307
7308
7309
7312
7313
7314
7315
7316
7318
7319
7320
7322
7455
7456
7457
7458
7459
7460
7461
7462
7463 C + D prob

7546
7547
7552 A
7554
7555
7560
7561
7562
7563
7564
7565
7566
7567
7568
7569
7570
7571
7572
7573
7575
7576
7577 - prob.
7578 - prob.
~~7580 - prob~~
7582

7583
7584
7585
7586 - prob.
7587 "
7588
7589
7590
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7592
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7601
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7614
7615
7616
7617

~~7308 D crosses TO "A2" state~~

1956	1957	1958
7113 B(7)^{II} (+)	7302	7302 A(3)^{t} × a2bt pyWx = 7553 7302 A(1)^{I} (+) = 7542
7113 B(7) × 7102 (7)	7303	7303 (6)^{t} × a2bt pyWx = 7552
7113 A(6) × 7103 (4)	7305	7305 D(1)$^{t-3}$ × 7308 D(1)$^{t-1}$ = 7564 " C(4)$^{t-1}$ × " D(2) = 7583 " " $^{t-2}$ × 7293 (36) = 7584
Wx+1 ex spm 7109 B(1)^{I} × 7102 (12)	7306	7306 A(1)^{II} × 7321 A(2) = 7560
7109 B(1)^{t} × 7102 (12)	7307	7307 A(3)^{I} × 7321 B(8) = 7561 7307 A(5)^{I} × " B(1) = 7562 7307 B(2)^{II} × 7293 (52) = 7572
7109 B(1)^{I} × 7102 (10)	7456	7456 A(1) × 7308 D(1) = 7566 7456 A(2) × " (1)$^{t-1}$ = 7567 7456 A(3) × " " = 7568 7456 C(3)$^{t-1}$ × 7293 (15) = 7600 7456 D(5)^{I} × " " = 7598 7293 (65) × 7456 D(5) = 7599
7271 B(2) × 7109 B(1)	7312	7312 (5) × 7321 B(1) = 7547 7312 (6) × 7293 (36) = 7582
Wx+1 ex spm 7109 B(2)$^{t-1}$ (+)	7308	[For 7308 D crosses, see separate sheet] 7308 D(2)$^{t-1}$ × $^{t-2}$ = 7538 7322 D(3) × 7308 D(2)$^{t-2}$ = 7539 7320 B(6) × 7308 D(1)$^{t-1}$ = 7543, " " × " D(1) = 7607 7308 A(1) × 7308 D(2) = 7569 " A(4)^{t} × 7293 (31) = 7546 " " (4)^{II} × 7321 B(4) = 7563 " " (4)^{I} × 7308 D(2) = 7570 7308 C(6)^{I} × 7293 (48) = 7573 " C(6)^{II} × " (17) = 7576 7293 (5) (40) × 7308 A(5) = 7554 " (37) × " " " = 7555
7103 (2) × 7109 B(2)	7310	7310 (2) × 7308 D(2) = 7575
7110 B(4)^{II} × 7273	7316	7316 D(3)^{I} × 7308 D(1) = 7588 " " (3)^{t} × " D(2)$^{t-1}$ = 7589 7293 (2) × 7316 D(3) = 7590
7113 C(8)^{I} × 7110 A(3)	7317	7317 C(9)^{t} × 7320 B(1) = 7608 " B(2)^{II} × " B(2) = 7609
7271 B(4) × 7273	7320	See 7308 D sheet; 7317 7320 C(3)^{I} × 7293 (48) = 7603

1956		1957		1958
7109C(4)^{I}	× 7102(3)	7455		7455B(2)^{I} × 7308D(2)$^{t-1}$ = 7591
				" " (2)^{II} × 7321B(1) = 7592
				" " (2)^{E} × 7293(39) = 7593
				7455C(2) × 7308D(1)$^{t-1}$ = 7597
				" C(5)^{II} × 7293(31) = 7594
				" C(5)^{I} × 7308D(2)$^{t-1}$ = 7595
				" C(5)^{E} × 7321B(6) = 7596
7108B(3)	× 7107(10)	7459		7459A(1) × 7308D(1) = 7565
				" A(3) × 7308D(1) = 7585
7113A(5)	× 7102(5)	7463		7463E(5)^{I} × 7293(17) = 7586
				" E(5)$^{t-2}$ × 7321B(4) = 7587
7113B(1)^{E}	× 7102(17)	7465A(1)		7465A(1)^{E} × 7308D(3)$^{t-1}$ = 7571
7113B(5)	× 7103(2)	7466		7470A(5)^{E} × 7466B(3) = 7581

1. Wx+1 wx Spm - counts in progeny of 7109D-1 x B_2

Behavior of Spm.

2. Inactive Spm selections

a) Counts in tests

b). Types of kernels in crosses with 7308D (A_2 state)

3. No Spm ♀ x 7308D - Kernel Types.

Tests of plants - ① "Spm" pattern

② High dose Spm pattern [Test of kernels: cultures 7566B, 7567, 7568

Changes in activity phase of Spm in kernels leaving 1 Spm.

What expected in plant.

4. Tests of plants from No Spm ♀ x 7308D ♂

Cultures - 7564 (pale) ~~7565 (pale)~~

7565 (pale)

7566 (A_2)

7569 (A_2)

7571 (pale)

7575 (A_2)

7601 (pale)

7602 (pale)

7605 (pale) → 7603 (pale)

6707 (pale)

5. Tests of plants from crosses of active spm x 7308D.

7570 (A_2) 7610 (pale)

6. Tests of plants from crosses of inactive spm x 7308D

7583 (pale) [illegible]

7585 pale - see

7588 (A_2) [illegible]

7591 (A_2) [illegible]

7595 (A_2) [illegible]

7597 (A_2)

7. With above (6) Tests of plants derived from same parents without spm from 7308D. See cultures in rep.

Direct tests of Spun from 7308D. "pale" states.

I "pale - early"; no Spun x 7308D

7601
7602
7605
7607

II "pale - spotted"; no Spun

7564
7565
7571

"H_2" state no spin × 7308 D

7566 : 7308 D①

7567 : " ①$^{t-1}$

7568 : " "

7569 : " D②

7575 : " D②

"pale" no spin × 7308 D

7564 : " D①$^{t-1}$

7565 : " D①

7571 : " D②$^{t-1}$

7601 : " D①$^{t-2}$

7602 : " D②$^{t-1}$

7605 : " D①$^{t-2}$

7607 : " D①

---

motive or delayed spin × 7308 D

7588 : × 7308 D①

7589 : × " D②$^{t-1}$

7591 : × " D②$^{t-1}$

7595 : " D②$^{t-1}$

7597 : " D①$^{t-1}$

7583 : " D②

7585 : " D①

♀ active spin × 7308 D

7570 : 7308 D②

7556 : 7308 D①

7610 " D②$^{t-1}$

Tests of spm action in progeny of different parts of same plant.

1956 - 7109B(1) + (2). See 1957 outlines.

1958 - ear I vs. tillers of 7463(5) = Cultures 7586, 7587
ear I vs II of 7455B(2) = " 7592, 7593

ear I vs pollen = 7598 vs. 7599.

7308A(4) I = 7562
II = 7563
I = 7546

7303(6) I = 7556
I = 7552

7308C(6) I = 7573
II = 7576

Tests of spm derived from 7308 D.① + ② using the "A_2" state.

1. no spm ♀ × 7308 D① ♂ — no spm ♀ × 7308 D②

7566 - A vs B

7567 - high dose spm

7568 - " "

7569 - 1 spm

7575 - [illegible]

2. Wx + /wx spm-active ♀ × 7308 D② ♂

7570 A to C

3. Wx Wx; 1 inactive spm × 7308 D① ♂ — by 7308 D②

7597 1 + 3 dose spm

7588

7591

4. Wx wx; 1 inactive spm × 7308 D②

7595.

Direct test of Spm from 7308D $a_2^{mi}(A_2)$ state

I. 7308A ① × 7308D ② = 7569 $a_2 = A_2$ 1 spm pattern
No Spm
Normal.

7569 = 7 plants. all var.

Plants ② ③ ⑤ ⑥ ⑦ = heavy var = 1 spm pattern

① ④ = 2 spm pattern.

① = I W×+/ w× spm spm - active sectional plant.
t " " " - active

② = I W×+/ w×spm - active II × 7538 ② not similar
t " " " "
~~II × 7538~~

③ = I W×+/ w×spm active only in sector.

t-1 " " "

t-2 " " "

④ I W×+/ w×spm - active. Very uniform pattern
II × 7538 (13) 1 spm - good

⑤ I W×/w× 1 spm not linked to w×. Transposed.

⑥ I W×+/ w×spm slightly delayed active
t-1 × 7538 ②
t-2 W×+/ w×spm active.

(7) I lox +/ ex spm in active

II " " " active in part. sector of "no spm" or inactive

7308C crosses for doses of Spm

7315

Test of action of inactive Spm in $a_{2^{m-1}}$ (pale) + active Spm –

Very delayed action Spm × 7308D = classes with large pale spts vs 0 pale spts

7273 $a_{2^{m-1}}$ = throws early mutation type.

Some component derived from 7108 culture that causes change in Spm activity

See 7458 to 7461, (1957) and 7565 + 7585, (1958)

See 7610 tests

Special selections 1958

7544 B -

7545 B - (pale-spotted) Breakdown = inactive Spm

" C - colorless, few A_2 specks = no Spm

7552 B -

7553 = colorless endosperm;

7554 B = altered chr. 5

7555 = " " "

7556 = a_2^{m-1}-spotted → early [check pale kernel for intensity of color]

7557 = " " → " kernel. Plant and kernels on ear = "a_2^{m-1} - pale-spotted

7558 = " " → " " " " " " "

7559A = " " → " " , Plant: early mut. pattern. Kernels = Early mutations

---

7559B = $a_2 \to A_2$. new mutant bt, like sh,

7565 B = few A_2 specks only from a_2^{m-1} (pale-spotted) no Spm × 7308D① 1 Spm

① = no evidence of Spm

② = delayed action Spm. Transposed Spm, [~~or~~ from 7308D①

7566 B, From: 1 "$a_2 \to A_2$" 2 Spm pattern from 7456A① no Spm × 7308D① =

Wx + 1 ux Spm + 2 Spm. See plant character. green + small A_2 streaks

[~~or Wx~~]

7567 From: 1 "$a_2 \to A_2$" high dose Spm kernel from 7456A② no Spm × 7308D①$^{t-1}$

Wx ux 3 Spm. See plant character = green + small A_2 streaks.

7568 From: 1 "$a_2 \to A_2$" 2 Spm kernel from 7546A③ no Spm × 7308D①$^{t-1}$

Plant A B^s. No Spm

7570 A to C = special selections for Spm dose 1 : 2 : 3 Spm selection from

Wx + 1 ux Spm - active × 7308D② ux + 1 ux Spm

7572 High dose Spm kernels. See Wx + 1 ux Spm Spm

See plant ④ c.o. - altered Spm action = delayed. See plant character

" " ⑤

" " ⑦ - regularity of pattern.

7573 A = "4 Spm pattern" From "$a_2 \to A_2$"; ux Spm/Spm + 1 Spm
B = "2 Spm " "

7576. From Spm/Spm + 1 Spm plant. Colorless (A_2 state) Quasi-spm: A_2 embryo.
Plant Wx + 1 ux. Spm

7577 - 7581

7582 A From 7312 (6) Wx + 1 ux Spm inactive except for "$a_2 \to A_2$" late sph. pale kernel = 7582 A.
Plant = very dark "A_2 B^s" plant. with green sectors in stalk + leaf (= inactive → active)
I = completely inactive Spm
II = " " " (× 7538 (14) 1 Spm)
Wx + 1 ux Spm - inactive

7603 A. pale-sph sectorial kernel From 7320 C (3) I × 7293 (48)

7610 C - pale-sph sectorial kernels. From 7322 A (7) × 7308 D (2) I-1

1957 - special selections · pale states of a_2^{n-1}

7305 E pale-spk sectorial kernel. Plant = no spin of any type

7305 H changed state

7316 C from "breakdown"

7459 B - pale-spk sectorial kernel

7460 B - " " " "

7461 B - " " " "

C to F.

7463 C + D = pale-spk sectorial kernels.

1958

Sectors showing changed Spm activity on ear.

7547 A ① t-2 $a_2^{m'}$(pale-spotted) / a_2^s × 7535 (31) a_2^s bt ... y ux
w+Spm / ux+

Ear shows many small sectors with different grades of Spm activity

---

7561 ④ I $a_2^{m'}$(A_2) BI / a_2^s bt w+Spm / ux+ × 7535 (19)

Large sector, running from base to tip, 4 rows in which Spm is inactive or absent.

7566 A ① $a_2^{m'}$(A_2) BI / a_2^s bt; w++ / ux Spm × 7535 ②

Sector of 4 rows, from base to tip of ear, in which Spm is active. inactive in remainder of ear

---

7569 ③ I $a_2^{m'}$(A_2) BI / a_2^s bt; w++ / ux Spm × 7535 (11)

Small sector in middle of ear in which Spm is active.

7569 ⑦ II $a_2^{m'}$(A_2) BI / a_2^s bt w++ / ux Spm × 7535 (30)

Basal sector of 4 rows. Extends half way up ear. No evidence of Spm in sector

---

7571 ④ t-1 $a_2^{m'}$(pale-spotted) BI / a_2^s bt w++ / ux Spm × 7538 ④ t-1

6 rows = active Spm : 4 rows, no Spm or inactive

7595 A ⑤ J $a_2^{m'}$(A_2) BI / a_2^s bt w+ ux Spm × 7535 ⑤

Basal sector, small, with active Spm

7597 A ⑥ $a_2^{m'}$(A_2) BI / a_2^s bt w+ ux 1 Spm × 7535 ④

2 small sectors in which Spm is active

7600 (4) I a_2^{m-1} (A_2) BI / a_2^s bt to x+ / no spin x 7535 (19)

Large sector, 5 rows (+6 in numerous ears) in which spin is inactive
(in remainder of ear, spin is delayed in action).

7601 B (3) I (a_2^{m-1} (pale-early) BI / a_2^s bt x 7535 (2)

7616 D^D (1) II a_2^{m-1} (pale-early) bt / a_2^s BI x 7540 (6) a_2^s BI no spin

Large pale sector on ear

7564 (4) I x 7535 (2) Basal sector of late acting spin
7565 A (3) I x (2) late sectoring on ear

7608 A (2) I x 7535 (35)

Ear sectors - 1957

7305 F(2) I × 7293 (26) Sector at tip of ear segregating "late mutation" pattern. Rest of ear = no spm sectors

7461 D (5) × 7293 (30) large basal sector - inactive spm

" E (2) × 7321 B (5) large sector - inactive spm

" F (1) I × 7293 (71) 1/2 of ear = inactive spm

7322 A (1) I × 7293 48

1. Compare Spin from a_2^{m+} culture with that from a_2^{m-1}

7112 compared to 7113.

2. Original state - 7271 (from 6902C-1)

7274

3. States used in 1958 tests -

Early - 7606, 7604, 7543

spotted - 7542

late - 7537C-1

"A_2"

Tests on a_2^s/a_2^s + Spin.

4. Photos - state changes from early - ears.

5. a_2^{m} BI / a_2^{m} bt cuts a_2^s + Spin

(~~[illegible]~~ early) (late)

7320

6 Transposition of Spin -

W & Spin / ut + tests.

Derivatives of 7109 B-1

Summer 1957

From tiller = 7306

" " = 7307

" pollen = 7312, 7313

" Gar I = 7456

Summer 1958

7312-5 = 7547

7312-6 = 7582

7306A-1 = 7560

7307A-3 = 7561

7307A-5 = 7562

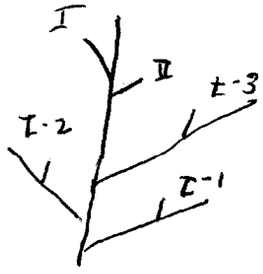
7307B-2 = 7572

7456D-5 = 7598
7599

7456C-3 = 7600

1956

7109 B-1



Ear I. 1957

I × 7102-10 a_2 bt pr y Wx. inactive Spm until late.
"A_2"

7456 A = Deep A_2 color = 4 plants tested = no Spm

7456 B = From "A_2" light color = 5 plants tested. 4 no Spm : 1 Wx x/no Spm delayed

7456 E = " A_2 bt. = 3 tested. 2 no Spm : 1 delayed actum Spm.

Breakdown

7546 C = 4 plants tested delayed actum Spm.

From "$a_2 \to A_2$"

7546 D = 6 plants tested - delayed actum Spm.

Conclusion.

All plants in cultures derived from ear I. Spm behaves as in parent plant. Cycle of change - inactive in mam, active in little

Tests of progeny in 1958

7546D-5 ear I × ~~7598~~ × 7293 (15) a_2 bt pr y Wx

gave 7598. A_2 kernels selected. 8 plants tested

7 plants = no Spm

1 " = Wx Wx inactive Spm to active late.

7456C-3 $^{t-1}$ x 7293-15

Wx+/wxSpm - delayed action. Like 7109B-1 in type.

gave 7600 1958. Late but uniform sph kernels chosen

Behavior as in 7109B-1 = inactive Spm in main, active in tiller. 11 plants tested. all Wx+/wx Spm

---

Tiller ear of 7109B-1 Active Spm (Wx+/wxSpm).

1957 = 7306

A = $a_2 \to A_2$ 2 Spm endogenous. 6 plants.

Plants A① ④ ⑤ ⑥ Active Spm

A②, A③ = like parent Spm in action

Plant 7306A-3 = has transposed Spm

1958. From 7306A-1 = Wx+/wxSpm active = 7560

7306A-1^{II} x 7321A-2 a_2 bt pr wx no Spm

7560 = from "$a_2 \to A_2$" 2 Spm kernels. Wx kernels

6 Plants = all variegated, all tested

1 = delayed action Spm in I

2 plants = C.O. = Wx Spm/wx+

2 " = Transposed Spm { 1 = 1 Spm = delayed action like parent 7109B
1 = 2 Spm.

7306B = from "4 spm" kernels = 2 plants. Both have 2 active Spms

---

From Tiller-2 = 7307 : 7109B-1I × 7102-2 a_2 bt pr y Wx

A = from $a_2 \to A_2$, 2 spm underspms : 6 plants. ~~all have~~

~~active Spm~~. 5 = Wx+/ wx Spm check action phase

1 = Wx/ Wx 1 Spm.

1958 = 7307A-3^{I} ~~Wx/wx 1 Spm~~ Wx/wx Spm × 7321B-8 a_2 bt pr y wx kernel

gave culture 7561 from $a_2 \to A_2$, 2 Spm kernels. Wx kernels

5 plants tested: ① = inactive Spm in I

② = Wx Spm/ wx+ = delayed active Spm

③ " " active

④ " " " in I + 2. no increase in II

⑤ = " " active.

1958 = 7307A-5 gave 7562.

From 7307A-5^{I} × 7321B-1 a_2 bt pr y wx

7562 from 3 $a_2 \to A_2$ 2 Spm Wx kernels.

all were Wx Spm/ wx +. in ③, no increase of Spm in I

active in tiller

7307 B = from $a_2 \to A_2$, 4 Spm pattern = 4 plants.

B-1 = W++/ w+ Spm

B-2 = W+++/ w+ Spm Spm

B-3 = W++/ w+ Spm +1 Spm

B-4 = " " " " +1 "

Summer 1958 = 7572 from 7307B (2)^{II} x 7293 (52) a_2 bb pg Tex

From "$a_2 \to A_2$" high dose Spm. : 7 plants.

Plants (1), (2), (3) (6) (7) = W+ +/ w+ Spm Spm

" (4) = W+ W+ delayed action Spm

(5) = W++/ w+ Spm = delayed action Spm

7312 = From 7271B-2 × 7109B-1
a_2^{m1} (spotted) BI / a_2 sbt

6 plants from a_2^{m1} ♀ / a_2^{m1} ♂ that have active spm.

Plants ①, ②, ③, ④, ⑥ = like parent 7109B-1 for spm

" ⑤ = W++ / ux spm active. ✓✓

1958 = 7547 From 7312 ⑤ × 7321B ① a_2 bt pr yex
W+ / ux spm

A from $a_2 \to A_2$ (pale) state = 4 plants.

Plants ① ② ③ = W+ spm / ux+
active

Plant ④ ⑤ = inactive spm in most of plant.

B from "$a_2 \to A_2$" (A_2) state = 1 plant = W++ / ux spm active
Like 7109B-1 in spm action.

C " " " " = 2 plants.

7312. From 7271B-2 × 7109B-1 pollen
a_2^{m-1} (spotted) BT / a_2 bt

6 plants from a_2^{m-1} ♀ / a_2^{m-1} ♂

Plants ①, ②, ③, ④, ⑥ = Spm acts as in parent, 7109B-1
Plant ⑤ = Wx + / wx Spm. nearly all kernels having Spm show active phase.

1958 = 7547 From 7312-5 × 7321B-1 a_2 bt pr y wx

A = a_2^{m-1} (spotted) BT Wx kernels.

Active in many Wx Spm / wx + = A ②

Inactive in I = A ①, A ④ - A ⑤ Sectorials

Delayed action in I = A ③.

B = from a_2^{m-1} (A_2) BT Wx kernels.
C = " " " " "

Inactive in I = B
Delayed in I = C - ①
Active in I = active in I

1958 = 7582 From 7312-6 × 7293-30 a_2 bt pr y Wx
Wx / wx Spm - delayed action

A = from "$a_2 \to A_2$" (A_2) BT pr Wx late spl kernel.
I = very delayed action Spm
I = delayed action Spm.

B = from pale BI pr y Wx (spot of ex) 3 plants

Pale main stalk, var. tillers for ① + ③

No evidence of Spm in ②. Very delayed action Spm possible

7313 = From 7270①^{I} A_2BI/a_2sBI × 7109B-1 from main stalk pollen

A. from $a_2 \to A_2$ (1 dose Spm)

A① = like 7109B-1 in Spm action

✓✓A② = fully active Spm

B from $a_2 \to A_2$ (high dose Spm)

①, ②, ③, ④ = like 7109B-1

④ = 2 Spm in I, 1 Spm in I^{-1} ; Wx + / Wx Spm in I^{-2}

1958

Derivatives of 7109 B-2 = W++/wx Spun - active

7308 D-1 [illegible] plants in F_1 [illegible] in spun activity. matches [illegible]

7543 t-2 7605

7556 " 7607

m 7564 { large pale areas - active spun

m 7565 { A - large pale areas - " "
B - speckling.

m 7566 { A - large pale areas - some delayed action
B - 2 spun pattern

t-1 7567 - high dose spun

t-1 7568 - 2 dose spun [1 exp.]

m 7585 { A - no pale areas - delayed action spun [illegible]
B - large " "

m 7588

t-1 7597

t-2 7601

7308 D-2

7538

7539

m 7569

m 7570 - C important

t-1 7571

m 7575

m 7583

t-1 ~~7589~~

t-1 7591

7595 - [illegible]

t-1 - 7602

t-1 7610 [illegible]

7308 A-4

7546 - active spun

7563 - " "

7570 " " (some delay in I) in 2 plants

7308 C-6

7573 ✓✓

7576 - 1 active spun

7308 A-5

7554 - 7555

7310-2 (+7380 D-2)

7575

7308 A ①

7569 - some delayed action in ③ ⑤ ⑦

1957 Derivatives of 7109 B-2

7309 - from ear I

7308 - " " II

7310 } from pollen
7311 }

Effect of Spin on pattern of var. use pole-leaf state of a_2^{m-1}

a_2^s / a_2^s ♀ x 7606 A ♂ = shows spin timing

Spin^w –
delayed action –
Fully active –

Type of Spin in 7538 plants =
pole-leaf a_2^{m-1} ♀ x 7538 ♂
no Spin

Pax 1958
rest of inactive Spm

Wx Spm ♀

7543B (2) I
7543
7545C (1) (2) clear
7571 (3)
7584A (3)
" A (6)
" A (7)
7586A - do
" B - do

Inactive Spm ♀

7544B - check
7545B
7547A (1) - use Wx Spm inact / wx + good
7574 (5)
[7584B (2)]
7585B (3)
7586C
7586D
7587C
7603C (4)

Wx+/wx Spm - active

7583A I II (2) T x 7538 (14) 1 Spm

Tables -

Wx+ / ux Spm - active

7306 A - 1, 2

7370 A - 2 3 4 5 6

B - 1, 2

Transposition

Wx ux; 1 Spm

7306 A ③ I

7560 ③, ⑥

Wx ux - 2 Spm

7313 B 4

Wx + / ux Spm plus ~~2~~ 1 Spm

7306 B - 2

7307 B ③ ④

7307 A ② I

7307 B ② = Wx+ / ux Spm Spm

Wx + / ux Spm + 2 Spm

7306 T - 2

Wx Spm / ux +

7561 ③ ④ ⑤

7562 ①, ②, ③

7572 ① ② ③ ⑤ ⑥ ⑦

7777 A.

Year 1958 · · Class II state. $a_2 m^1 (A_2)$ BI / a_2 bt ; Wx+ / wx spur-active ♀ × a_2 bt wx no spur ♂

Plant No		uniformly Pigmented BI Wx	BI wx	bt Wx	bt wx	var. BI Wx	BI wx	bt Wx	bt wx	Colorless BI Wx	BI wx	bt Wx+wx		Totals
7546 ① I		64	10	1	0	4	66	0	1	6	6	137		295
" ③ I		96	5	5	0	12	88	0	8	8	8	209		439
" ③ II		84	10	6	1	9	74	0	2	5	15	155		361
" ③ I		54	8	8	0	4	40	2	4	3	3	93		219
" ④ I		70	4	7	0	9	83	1	7	7	6	159		353
" ⑤ I		20	10	3	0	6	25	0	2	7	8	75		156
" ⑤ I		15	3	4	0	3	26	0	0	2	1	49		103
" ⑦ I		39	6	0	0	6	35	2	3	6	7	100		204
" ⑦ I		31	1	2	0	4	21	0	1	1	2	46		109
" ⑩		46	5	2	2	4	54	1	3	3	4	118		242
" ⑪ I		65	5	3	2	10	64	1	3	3	4	156		316
" ⑫ I		66	9	4	0	10	57	3	2	4	6	167		328
Totals	12 ears	650	76	45	5	81	633	10	36	55	70	1464		3125

695 A_2 Wx : 81 A_2 wx ; 91 var Wx : 669 var wx = 1536 11.2 % recombination

7566 A ② I		89	9	8	4	4	93	1	6	8	14	173		409
" A ④ I		86	13	18	2	5	83	1	11	11	11	179		420
" A ④ I		66	12	8	3	12	77	1	14	12	13	128		346
Totals.	3 ears.	241	34	34	9	21	253	3	31	31	38	480		1175

275 A_2 Wx : 43 A_2 wx : 24 var Wx : 284 var wx = 626 10.7 % recombination

7569 ② I		24	6	8	0	2	31	0	4	3	3	64		145
" ② I		104	15	9	0	13	100	1	19	17	5	187		470
" ③ t-2		48	14	7	0	8	31	3	3	8	5	114		241
" ④ I		43	10	9	0	10	56	1	7	10	9	117		272
" ⑥ I		41	9	2	1	4	33	0	6	5	6	88		195
" ⑥ t-2		41	4	5	1	8	45	0	7	11	6	88		216
Totals		301	58	40	2	45	296	5	46	54	34	658		1539

341 A_2 Wx : 60 A_2 wx : 50 var Wx : 342 var wx = 793 13.8 % recombination

Plant No.		Uniform Pigmented BI Wx	Uniform Pigmented BI wx	Uniform Pigmented bt Wx	Uniform Pigmented bt wx	Variegated BI Wx	Variegated BI wx	Variegated bt Wx	Variegated bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx and wx		Totals
7572 ①I		91	13	3	1	22	99	1	2	4	1	219		456
" ②I		47	10	4	1	8	45	1	2	11	11	114		254
" ②II		24	10	2	0	6	30	0	0	0	6	65		143
" ③I		59	17	2	0	14	73	0	7	11	3	154		340
" ⑥I		7	1	0	0	4	4	0	0	0	1	26		43
" ⑦		53	7	7	0	6	34	0	2	3	3	96		211
Totals		281	58	18	2	60	285	2	13	29	25	674		1447
299	A2 Wx : 60 A2 wx : 62 var. Wx : 298 var. wx = 719											16.9	recombination	
7573 B ①I		27	4	2	1	3	34	0	2	6	0	63		142
" B③II		42	4	2	1	2	32	0	4	5	2	85		179
" B④II		90	5	5	0	3	71	0	4	6	7	151		342
Totals	3 ears.	159	13	9	2	8	137	0	10	17	9	299		663
168 A2 Wx : 15 A2 wx : 8 var. Wx : 189 var. wx = 338												6.8%	recombination	
7575 A II		81	7	3	0	11	72	0	1	6	2	151		334
"														
		84 A2 Wx : 7 A2 wx : 11 var. Wx : 73 var. wx = 175											= 10.3% recombination	
7575 B		-	-	69	6	-	-	11	96	-	-	191	= 9.3% recombination	
7576 I		55	14	5	0	6	70	0	3	3	7	129		292
" II		54	5	3	2	3	68	0	3	4	7	112		261
Totals	2 ears	109	19	8	2	9	138	0	6	7	14	241		553
117 A2 Wx : 21 A2 wx : 9 var. Wx : 144 var. wx = 291												10.3%	recombination	

		Uniformly Pigmented				Variegated				Colorless			
		Bt		bt		Bt		bt		Bt		bt	
Plant no		Wx	ex	Wx	ex	Wx	ex	Wx	ex	Wx	ex	Wx + ex	Totals
7588 B ①^{II}		56	2	2	0	11	43	0	1	1	2	95	213
" B ①^{I}		75	13	3	0	9	72	0	4	5	5	163	349
" B ①$^{I-2}$		34	4	2	0	6	47	1	1	1	6	86	188
" B ②^{II}		21	1	2	0	3	16	0	1	3	2	43	92
" C ①^{I}		60	12	2	0	0	67	0	8	8	4	163	324
" C ②^{I}		34	7	1	0	6	31	0	1	1	1	66	148
" C ②^{II}		55	10	4	0	16	43	0	3	5	7	147	290
" C ②^{I}		43	4	2	2	18	45	0	6	1	4	102	220
" D ①^{I}		81	11	12	0	10	81	2	5	2	9	189	402
" D ①^{I}		70	4	5	1	8	83	0	6	5	7	152	341
Totals	10 ears	529	68	35	3	80	528	3	36	32	47	1206	2567

564 A2 Wx : 71 A2 ex : 83 var. Wx : 564 var. ex = 1282 12.0% recombination

7591 A-②^{I}		51	6	8	2	4	47	1	8	8	4	112	251
" A ④^{I}		29	4	2	0	2	37	0	4	11	3	82	174
" A ⑥^{I}		15	1	2	0	3	16	0	2	1	1	38	79
" B ①^{II}		11	0	0	0	1	7	0	0	2	1	20	42
" B ②^{II}		49	9	2	0	2	39	0	6	4	8	111	230
" B ③$^{I-1}$		43	9	8	1	7	47	0	3	9	3	109	239
" B ⑤^{I}		17	2	1	0	6	15	0	2	4	4	44	95
Totals	7 ears	215	31	23	3	25	208	1	25	39	24	516	1110

238 A2 Wx : 34 A2 ex : 26 var. Wx : 233 var. ex = 531 = 11.3% recombination

7595 A-①^{I}		11	0	4	0	3	8	0	1	5	1	28	61
" A-①^{I}		50	5	9	3	5	46	1	8	11	7	130	275
" A ⑥^{I}		16	3	1	1	1	14	0	1	5	1	36	79
" A ⑦^{I}		7	1	1	0	0	13	0	2	3	0	27	54
" B ②		4	2	0	0	0	4	1	0	0	0	3	14
" B ③		5	0	0	0	1	3	0	1	1	1	13	25
" B ④^{I}		43	4	2	3	3	35	1	4	4	5	74	178
" B ⑤^{I}		22	2	1	0	2	15	0	2	4	3	35	86
Totals	8 ears	158	17	18	7	15	138	3	19	33	18	346	772

176 A2 Wx : 24 A2 ex : 18 var. Wx : 157 var. ex = 375 = 11.2% recombination

		Uniform Pigmented				variegated				Colorless				
		BI		bt		BI		bt		BI		bt		
Plant no.		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx		Total
7597A ① I	7308D ① I-1	82	8	9	2	8	81	2	6	6	8	196		408
" A ⑤ I		87	10	4	1	1	88	2	3	5	6	183		390
" B ② I		28	2	2	0	4	24	0	0	2	0	49		111
Totals	3 ears	197	20	15	3	13	193	4	9	13	14	428		909

212 A_2 Wx : 23 A_2 wx : 17 var. Wx : 202 var. wx = 454 = 8.8% [illegible]

Summary table. Wx + / wx Spm- ♀ × a_2 bt wx no Spm ♂

a_2^{m-1} (A_2) active

Phenotype of a_2^{m-1} carrying kernels.

Culture	no of ears	Origin	Uniformly Pigmented Wx	Uniformly Pigmented wx	Variegated Wx	Variegated wx	Totals	% recombination
7306-7313	22		1133	171	157	1134	2595	12.6
7308A+B	5		355	53	37	331	776	11.8
7563B③	2		312	70	42	318	742	15.2
7546	12	7308A ④	695	81	91	669	1536	11.2
7566	3	7308D①	275	43	24	284	626	10.7
7569	6	7308D②	341	60	50	342	793	13.8
7572	6	7308B②	299	60	62	298	719	15.5
7573B	3	7308C⑥	168	15	8	147	338	6.8
7575A	1	7308D[illegible]	84	7	11	73	175	10.3
" B	1		69	6	11	96	182	9.3
7576	2	7308[illegible]	117	21	9	144	291	10.3
7588	10	7308D①	564	71	83	564	1282	12.0
7591	7	[illegible]	238	34	26	233	531	11.3
7595	8	[illegible]	176	24	18	157	375	11.2
7597	3	[illegible]	212	23	17	202	454	8.8
Totals			5038	739	646	4992	11,415	
7570A		[illegible]	364	61	71	359	855	15.4

$a_2^{m-1}(A_2)$ = class II

Summary table 1958 Wx spin-active / wx + × a_2 bt wx no spin

	no ears		uniformly pigmented Wx	uniformly pigmented wx	variegated Wx	variegated wx	Total	% recombination		
7547	1		0	27	29	3	59	5.1		
7560	4		19	266	308	30	623	7.8		
7561	4		36	341	316	18	711	7.6		
7562	4		27	215	193	6	441	7.4		
7563	17		161	1543	1577	131	3412	8.5		
7570B	12		66	767	798	72	1703	8.1		
Totals	42		309	3159	3221	260	6949			

Year 1958

Culture 7570 $a_2^{m'}(A_2)$ BI / a_2 bt (class II) ♀ × a_2 bt wx no spm ♂

A. Wx+ / wx spm - actual

Plant no.		uniformly pigmented BI Wx	BI wx	bt Wx	bt wx	variegated BI Wx	BI wx	bt Wx	bt wx	colorless BI Wx	BI wx	bt Wx + wx		Totals
7570 A ①$^{t-1}$		12	0	4	0	3	6	0	1	6	3	18		53
" A ②^{I}		57	6	4	2	6	58	1	4	8	9	109		264
" A ②^{II}		23	1	2	1	3	15	0	1	1	3	50		100
" " $^{t-1}$		36	3	2	0	10	27	1	5	4	3	70		161
" A ③^{I}		16	3	1	0	1	14	0	2	2	4	24		67
" " ③^{II}		30	4	5	0	5	25	0	4	2	2	25		102
" A ④$^{t-1}$		9	2	2	0	1	11	0	0	2	3	31		61
" A ⑤^{I}		13	4	5	1	2	15	0	1	6	0	45		92
" A ⑤$^{t-1}$		44	12	7	1	11	40	3	4	15	15	101		253
" A ⑤$^{t-2}$		47	7	9	4	13	58	0	11	13	19	110		291
" A ⑥^{I}		6	2	0	0	2	15	0	1	3	2	23		54
" A ⑥^{t}		18	3	5	1	3	28	1	3	10	2	72		146
" A ⑦^{II}		7	3	0	1	2	7	3	3	3	0	20		49
Totals	13 ears.	318	50	46	11	62	319	9	40	75	65	698		1693

364 A₂ Wx : 61 A₂ wx : 71 var. Wx : 359 var. wx = 855 15.4% recombination

B. Wx spm / wx$_I$ +

7570 B-①^{I}		3	63	0	7	64	3	11	0	7	1	118		277
" B ①^{I}		10	61	1	6	71	4	8	0	9	5	121		296
" B ①^{t}		1	16	0	2	18	0	6	0	3	7	41		94
" B ②^{I}		2	25	0	1	31	2	5	0	2	4	71		143
" B ②^{t} pollen		5	70	0	6	70	9	3	0	13	12	114		302
" " "		10	113	0	16	88	14	10	1	10	14	214		490
" " "		9	105	1	18	110	10	11	0	21	23	266		574
" " "		4	79	0	5	85	4	4	0	4	5	130		320
" " "		8	48	0	5	65	8	2	1	7	6	142		292
" " "		5	44	2	6	44	6	11	1	6	6	121		252
" B ③$^{t-1}$		0	6	1	1	4	1	3	0	1	0	15		32
" B ③$^{t-2}$		3	53	1	11	65	5	9	3	13	12	139		314
Totals.	12 ears	60	683	6	84	715	66	83	6	96	95	1492		3386

66 A₂ Wx : 767 A₂ wx : 798 var. Wx : 72 var. wx = 1703 8.1% recombination

Year 1958 a_2^{m1} (Class II A_2) BI / a_2 bt Wx spm - active / wx + ♀ × a_2 bt wx no spm ♂

Plant no.		uniformly pigmented BI Wx	BI wx	bt Wx	bt wx	variegated BI Wx	BI wx	bt Wx	bt wx	colorless BI Wx	BI wx	bt Wx and wx		Totals
7547C-2		0	25	0	2	28	2	1	0	2	1	49		110
0 A_2 Wx : 27 A_2 wx : 29 var. Wx : 3 var wx = 59												5.1% recombination		
7560 ①I		3	78	0	5	78	8	4	0	7	5	166		354
" ①t-1		7	98	0	5	113	10	8	1	9	7	218		476
" ①t-2		1	0	1	0	2	0	0	0	0	0	1		5
" ⑤I		7	79	0	1	98	11	5	0	7	5	176		389
Totals	4 ears	18	255	1	11	291	29	17	1	23	17	561		1224
19 A_2 Wx : 266 A_2 wx : 308 var. Wx : 30 var. wx = 623												7.8% recombination		
7561 ③I		13	97	2	7	92	5	10	0	9	10	201		446
" ③II		3	71	0	6	76	4	2	0	6	5	161		334
" ④t		9	63	0	1	65	7	3	0	1	5	141		295
" ⑤I		9	84	0	12	62	2	6	0	7	9	154		345
Totals	4 ears.	34	315	2	26	295	18	21	0	23	29	657		1420
36 A_2 Wx : 341 A_2 wx : 316 var. Wx : 18 var. wx = 711												7.6% recombination		
7562 ①I		10	74	0	5	56	0	5	0	8	6	154		318
" ①II		6	37	0	1	50	2	1	1	1	1	95		195
" ②		6	62	0	5	50	2	1	0	7	3	129		265
" ③t		4	30	1	1	30	1	0	0	2	2	78		149
"														
Totals	4 ears	26	203	1	12	186	5	7	1	18	12	456		927
27 A_2 Wx : 215 A_2 wx : 193 var. Wx : 6 var. wx = 441												7.4% recombination		

		Uniformly pigmented				variegated				Colorless					
		BI		bt		BI		bt		BI		bt			
Plant No.		Wt	wt	Wt	wt	Wt	wt	Wt	wt	Wt	wt	Wt and wt		Totals	
7563A ①I		5	71	2	9	79	3	7	0	9	5	160		350	
" ①t-1		7	96	2	11	102	3	5	1	9	11	207		454	
" ①t-2		2	92	3	5	91	6	7	0	6	8	220		440	
" A ③I		5	67	1	9	79	8	6	0	8	7	139		329	
" " ③II		10	97	1	6	83	7	3	2	6	10	202		427	
" " ③I		15	91	0	3	105	13	6	0	8	3	199		493	= 443
" " ④I		15	108	2	7	106	9	11	1	11	4	260		534	
" ④II		8	117	1	6	110	6	5	1	8	10	228		500	
" " ④t-1		4	71	1	5	72	6	5	2	7	10	132		315	
" " ⑤I		1	86	1	6	100	5	7	0	6	11	216		439	
" " ⑤II		0	13	0	0	17	1	1	0	2	0	20		54	
" B ①I		13	112	2	12	113	13	4	0	7	9	215		500	
" " ②I		12	107	1	15	96	16	6	1	12	8	224		498	
" " ②II		10	41	1	6	68	6	4	1	6	10	129		282	
" " ②t-1		13	87	1	6	99	5	7	0	9	10	173		410	
" " ②t-2		11	85	0	11	90	9	8	0	8	20	223		465	
" " ②t-3		10	78	1	7	74	5	1	1	10	11	174		372	
Totals	17 vars	141	1419	20	124	1484	121	93	10	132	147	3121		6812	

161 Ar Wt: 1543 Ar wt: 1577 var. Wt: 131 var. wt = 3412 8.5% recombination

Year 1958

	Unif. Pigmented BI Wx	Unif. Pigmented BI wy	Unif. Pigmented bt Wx	Unif. Pigmented bt wy	Variegated BI Wx	Variegated BI wy	Variegated bt Wx	Variegated bt wy	Colorless BI Wx	Colorless BI wy	Colorless bt Wx+wy	Totals
7570A ⑧ I	22	3	3	0	25	41	4	9	9	8	85	209
" " II	27	0	4	0	9	38	1	5	5	9	70	168
Totals	49	3	7	0	34	79	5	14	14	17	155	377

~~Totals~~ 56 A_2 Wx : 3 A_2 wy : 39 var. Wx : 93 var. wy = 191

7569-① I	37	6	8	0	13	40	2	6	4	5	82	
" ① II	29	5	6	1	13	38	1	2	12	16	95	
7567 I	10	12	0	0	81	89	6	6	36	20	227	487
" pollen	25	4	2	0	99	85	12	11	11	10	240	499
	22	9	2	0	94	84	3	0	16	14	215	459
Totals pollen	47	13	4	0	193	169	15	11	27	24	455	958

51 A_2 Wx : 13 A_2 wy : 208 var. Wx : 180 var. wy = 452

1/8 = 56.5

7566 B	31	3	6	0	54	58	12	9	35	24	166	398
7573A ② II	47	4	1	0	44	73	5	6	11	9	211	411
" A ③ I	49	8	3	2	70	101	2	10	8	5	160	418
" A ④ I	30	4	4	0	49	66	3	2	9	4	156	327
" A ⑤ I	31	3	1	0	33	66	3	0	3	7	122	269
" A ⑥ I	26	2	5	0	40	44	4	3	5	9	90	228
Totals	183	21	14	2	236	350	17	21	36	34	739	1653

197 A_2 Wx : 23 A_2 wy : 253 var. Wx : 371 var. wy = 844 1/4 = 211

obs 220 A_2 : 624 var. approximately 1/2 of var wx class = 25 pm pattern } see cards.
exp 211 " : 633 var " " " " " " = 4 " " }

7560 ④ I	7	13	0	0	76	56	2	1	1	8	161	325
" ④ t-1	23	18	1	1	88	76	2	4	5	8	210	436
Totals	30	31	1	1	164	132	4	5	6	16	371	761

31 A_2 Wx : 32 A_2 wy : 168 var. Wx : 137 var. wy = 368

		7546⑧ I ×	7546⑧ II	7546⑨ I	7566B ×	7567 I ×	7535-10 ×	7536-9 ×	7569-① I	7569 ① I
		7535-31	7535-31	7535-31	7535-2	7535 4	7567	7567	7535-13	7535-2
Uniformly pigmented BI										
	Wx	35	9	46	31	10	25	22	37	29
	wx	16	12	9	3	12	4	9	6	5
" " bt										
	Wx	3	0	8	6	0	2	2	8	6
	wx	0	1		0	0	0		0	1
Reflexus - mottled BI										
	Wx	0	0	0	0	0	0			
	wx	0	0	0	0	0	0			
" " bt										
	Wx	0	0	0	0	0	0			
	wx	0	0	0	0	0	0			
$a_2 \to A_2$ BI 2 spw										
	Wx	48	29	13	18	28	89	94	13	7
	wx	44	19	40	8	26	37	84	40	11
4 spw										
	Wx	10	26	4	36	53	10			6
	wx	30	18	35	50	63	48			27
" bt	Wx	3	0	2	12	6	12	3	2	1
	wx	5	3	4	9	6	11	0	6	2
Colorless BI										
	Wx	9	4	7	35	36	11	16	4	12
	wx	9	6	5	24	20	10	14	5	16
Colorless bt.	Wx + wx	190	116	179	166	227	240	215	82	95

Transposed spin from Wx + / wx spin parent. $a_2^{m'}(A_2)$ BI / a_2 bt × a_2 bt wx no spin
" C.O. selected

	Uniformly pigmented BI		bt		Diffuse-mottled BI		bt		$a_2 \to A_2$ BI		bt		Colorless BI		bt		
	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx		
7560 ③ I	70	56	2	4	7	15	0	1	12	10	0	1	4	6	185		
" ③ II	33	44	4	3	0	0	0	0		1			3	4	85		
" ③ I	22	21	1	0	0	0	0	0	22	23			2	4	54 + discard		
7560-6	31	31	4	3	0	0	0	0	28	36	2	0	6	5	136		
7563-2 I	58	46	3	1	0	0	0	0	52	57	1	0	4	7	198		
" -2 II	38	38	4	2	0	0	0	0	28	28	1	2	2	6	126		
7569 ⑤ I	27	28	4	0	1	4	4	7	14	13			11	10	75		
7570 A-7 I	6	3	1	0	0	0	0	0	11	7	0	3	3	1	20		
" " 7 II	7	3	0	1	0	0	0	0	2	7	3	3	3	0	20		
	Wx, Wx plus 1 spin, not linked to wx or Wx																
7591 B ④ I	43	43	2	4	0	0	0	0	12	14	4	0	5	6	110		
" ④ II	19	20	1	0	0	0	0	0	24	21	2	3	5	6	104		
7597 B-3	48	45	2	4	0	0	0	0	48	45	5	1	8	8	175		
" B-4	47	57	10	5	6	7	0	0	31	30	0	2	11	8	145		

Wx wx plus 1 spin

7777 A+B a_2^{m1} (A_2) BI / a_2 bt Wx Spm / Sm49 × a_2 bt wx ko Spm ♂

		uniformly Pigmented BI		bt		Brecheiden BI		bt		variegated $a_2 \to A_2$ BI		bt*		Colorless BI		bt		Totals
♀	♂	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx		
7777A-1 I	7815-7	83	136	9	8	10	0	0	0	18	1	1	0	9	12	241		
" A-1 II	7815-33	10	12	0	0	0	0	0	0	7	0	0	0	0	1	20		
" 1-t-1	7814-12	1	83	0	4	8	0	0	0	61	1	5	0	2	2	157		
" 1 t-2	7815-8	sectorial ear, see below																
" 1 t-3	7815-	9	93	2	4	15	0	1	0	71	3	2	0	12	5	158		
" A-2 t	7815-33	3	32	0	2	1	0	0	0	38	2	2	0	3	4	61		
" A-3 I	7815-33	32	73	6	10	13	1	0	0	22	1	3	0	10	12	161		
" A-4 t	" -13	4	51	1	2	3	0	0	0	52	5	2	0	8	4	96		
" B-1 t	7815-8	0	28	0	1	0	0	0	0	18	0	0	1	1	0	63		
" B-2 I	" -13	20	111	0	3	12	1	1	0	75	3	5	0	12	11	229		
" B-2 t-1	" -33	3	82	1	1	0	0	0	0	79	1	4	1	3	5	182		
" B-2 t-2	" "	2	74	0	6	0	0	0	0	90	1	5	0	6	4	157		
" B-3 I	" "	12	50	0	2	3	0	0	0	29	0	2	0	2	5	126		
" B-4 I	" "	27	103	0	5	17	0	1	0	56	3	6	0	11	6	211		
" B-4 II	" "	29	58	4	5	5	0	1	0	21	0	2	0	4	3	120		
" B-4 I	" -8	1	35	0	1	0	0	0	0	55	1	1	0	3	3	92		
sectorial Ear.																		
7777A-1 t	retrospin	0	3	0	0	4	0	0	0	4	0	1	0	0	2	8		
	anetrospin	34	30	2	2	0	0	0	0	0	0	0	0	1	2	58		

7777 Wx + spm / wx + 4 ♀ ♂ bt wx 1 spm ♂ 2 spm / spm ♂

		7777A-2 ♀ x	7777A-4 ♀ x 7/26	7777B-1 ♀ x 7/21		7777C-1 ♀ x 7/26	7777D-1 ♀ x 7/26	7777D-3 ♀ x 7/26		7777D-4 ♀ x 7/21	
		7818B-5 7/21 Spm/Spm ♂	7818B-8 1 spm ♂	7818B-5 Spm/Spm ♂	Totals	7818B-8 1 spm	7818B-8 1 spm	7818B-8 1 spm	Totals	7818B-4 Spm/Spm	Totals
Uniformly Pigmented	BT										
	wx	3	51	4		76	38	51	165	0	
	wx	2	38	4		71	31	52	154	8	
" "	bt										
	wx	0	5	1		1	2	5	8	0	
	wx	0	8	0		3	7	4	14	0	
Diffuse-mottled	BT										
	wx	0	1	1		0	0	0	0	0	
	wx	0	0	0		0	0	0	0	0	
" "	bt										
	wx	0	0	0		0	0	0	0	0	
" "	wx	0	0	0		0	0	0	0	0	
Var. BT	1 spm										
	wx	3	1	1	5	2	0	0	2	2	4
	wx	58	28	74	158	69	37	36	142	91	233
	2 3 spm										
	wx	58	32	98	188	51	30	32	113	113	226
	wx	3	3	2	8	4	0	2	6	7	13
" bt	1 spm										
	wx	0	0	0	0	1	0	0	1	0	1
	wx	0	2	1	3	3	3	5	11	4	15
	2+3 spm										
	wx	3	3	4	10	–	1	–	1	8	9
	wx	1	0	–	1	–	0	–	0	0	0
Colorless	BT										
	wx	2	6	3	11	7	7	10	24	2	26
	wx	2	4	7	13	6	5	7	18	5	23
Colorless bt	wx + wx	161	171	181		233	134	163	530	215	

7777C, D. a_2 mi (A2) BI / a_2 bt W+5pm / m4 + 9 × a_2 bt m4 m5pm o7

		A2 BI		bt		affine-mated BI		bt		variegated BI		bt		Colorless BI		bt	
9	o7	W+	m4	W+	m4	W+	m4	W+	m4	W+	m4	W+	m4	W+	m4	W+ + m4	Totals
7777C-2[I]	7815-33	111	114	6	4	0	0	0	0	1	0	0	0	3	12	187	
" -2[II]	7814-12	68	56	3	2	1	0	0	0	4	0	0	0	2	4	144	
" C-3	7815-33	69	69	3	4	0	0	0	0	1	0	0	0	6	5	152	
" C-3[I]	" -18	22	21	0	0	1	0	0	0	1	0	0	0	0	2	46	
" C-4[I]	" -3	88	87	5	4	0	0	0	0	0	0	0	0	3	9	158	
" D-1[t-1]	" -18	23	22	1	3	0	0	0	0	0	0	0	0	2	1	57	
" D-1[t-2]	" -18	23	22	2	0	0	0	0	0	0	0	0	0	1	0	29	
" D-2	" -33	104	71	6	7	0	0	0	0	0	0	0	0	5	5	192	
" D-3[I]	" -18	27	19	1	0	0	0	0	0	0	0	0	0	0	1	28	
" D-4[I]	" -33	2	7	0	0	0	0	0	0	0	0	0	0	0	0	8	
Totals		537	488	27	24	2	0	0	0	7	0	0	0	22	39	1001	

7306 B-1 $\frac{\text{Spur } \cancel{B2}\ (A_2)\ \text{BI } P_2}{+\ q_2^s\ bt\ p_2}$ Wx+/wx Spur

Part of plant	Type of Cross		Uniformly Pigmented BI Wx	BI wx	bt Wx	bt wx	variegated BI Wx	BI wx	bt Wx	bt wx	Colorless BI Wx	BI wx	bt Wx+wx	
I	1		9	-	0	-	181	-	10	-	13	-	185	398
II	2		4	3	1	0	68	80	3	3	2	7	189	360
tiller-1	2		7	2	0	0	69	63	2	3	4	10	152	312
tiller-2	2		19	1	0	0	8	22	0	0	3	0	42	95
tiller-3	2		3	1	0	0	31	40	1	5	4	4	86	175
Totals-	type-2		33	7	1	0	176	205	6	11	13	21	469	942

variegated BI

		2 Spur Wx	2 Spur wx	4 Spur Wx	4 Spur wx	Total
7306B-(I)	II	51	22	17	58	148
"	t-1	54	15	12	51	132
"	t-2	8	16	10	6	30
"	t-3	26	16	5	24	71
Totals		139	69	34	139	381
Totals, nurses t-2		131	53	34	133	351

Work Tables

7312 a_2^{m1}(pale) BI / a_2^{m1}(A_2) BI

7312
7313
7582
Tables.

Plant number	Position of Ear	Type of cross	Uniform pale Wt	Uniform pale wt	Uniform A_2 Wt	Uniform A_2 wt	var. pale state Wt	var. pale state wt	var. A_2 state Wt	var. A_2 state wt				
7312-1	I	1	9	-	9	-	0	-	0	-				
" - 3	I	1	95	-	89	-	0	-	0	-				
" - 4	I	1	3	-	1	-	5	-	3	-				
" - 5		2	62	5	55	2	7	68	4	49				
" - 6		1	31	-	27	-	0	-	1	-				
" - 6	Tiller-1	2	16	23	22	21	0	0	0	1				
" - 6	Tiller-2	2	33	26	35	26	1	3	0	1	plus 1 Breakdown wt (A_2) state			
Totals, t-1 + t-2			49	49	57	47	1	3		2	1	"		

Plant no.	Type of Cross	Ear location	Pigmented BT Wx	Pigmented BT wx	Pigmented bt Wx	Pigmented bt wx	Colorless spots or specks of pigment BT Wx	Colorless spots or specks of pigment BT wx	Colorless spots or specks of pigment bt Wx	Colorless spots or specks of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx + wx
7313A-1	1	1st ear, main stalk	123	-	5	-	26	-	1	-	6	-	164
" A-2	1	"	256	-	11	-	6	-	2	-	16	-	234
" " "	2	tiller	83	5	2	1	6	67	0	3	3	3	193
" B-1	2	1st ear, main stalk	53	22	6	2	5	18	0	1	3	2	121
" B-2	1	"	195	-	15	-	5	-	2	-	22	-	226
" B-3	2	"	81	54	6	3	0	13	0	1	2	2	135
" B-4	2	"	29	24	1	0	74	58	4	1	5	7	206
" " "	1	tiller-1	64	-	4	-	46	-	2	-	4	-	125
" " "	2	tiller-2	25	2	1	0	8	35	0	0	1	0	45
" B-5	1	1st ear, main stalk	101	-	10	-	98	-	4	-	17	-	228
" B-5	2	2nd ear, main stalk	53	-	5	-	45	-	0	-	6	-	100
7582A	2	1st ear, main stalk	113	88			0	0	0	0	9	5	185
7582A-I	3 1 spm	tiller	45	29	1	1	1 spm 36	3	0	0	11	6	138
					3 spm =		1	42	0	3			
7582B-1	3 1 spm	1st ear, main stalk	34	45	1	1	33	49*	1	2	3	5	140
" B-2	3 1 spm	"	65	64	3	8			9	6	15	11	266
					1 spm		56		4				
					3 spm		9		58				
7582B-3 I	3 spm + spm	"	27	24	2	0	75	98*	6	10	16	28	225

~~Table 20~~

Phenotype of kernel

A.

Plant number	Position of ear	uniform pig BI Wx	uniform pig BI ux	uniform pig bt Wx	uniform pig bt ux	variegated BI Wx	variegated BI ux	variegated bt Wx	variegated bt ux	colorless BI Wx	colorless BI ux	colorless bt Wx + ux	Totals		% recombination
7309A-3	1st, main	38	11	0	1	5	32	1	2	4	4	93	191		
" A-3	tiller	45	11	3	0	7	41	0	3	7	3	112	232		
" A-4	tiller-1	57	2	1	0	8	60	0	4	2	5	118	257		
" A-5	tiller-1	76	10	5	1	11	68	2	3	4	5	158	343		
" A-8	1st, main	41	2	4	0	5	34	0	6	4	6	98	200		
Totals		257	36	13	2	36	235	3	18	21	23	579	1223		12.8%

~~Table 21~~ A

♀ a_2^{m-1} (class II) BI | a_2^{m-1} (class II) BI Wx+/ux spm x ♂ $a_2$bt/$a_2$bt, ux/ux, no spm

7308A-4	2nd, main	107	14	-	-	12	117	-	-	0	0	-	-	250	
" B-2	1st, main	186	32	-	-	23	162	-	-	0	1	-	-	404	
" B-4	1st, main	21	1	-	-	0	15	-	-	0	0	-	-	37	
" B-4	tiller-1	28	2	-	-	2	26	-	-	0	0	-	-	58	
" B-4	" -2	13	4	-	-	0	11	-	-	1	0	-	-	29	
Totals		355	53	-	-	37	331	-	-	1	1			778	11.5%

B.

♀ a_2^{m-1} (class II) BI | $a_2$bt; Wx+/ux spm x ♂ $a_2$bt/$a_2$bt, ux/ux, no spm

7308B-1	tiller-1	46	10	2	1	6	64	1	2	5	6	83	226		
" B-1	tiller-2	29	10	3	1	4	39	2	4	3	6	89	190		
" B-1	tiller-3	17	2	2	1	3	18	0	1	0	2	47	93		
Totals		92	22	7	3	13	121	3	7	8	14	219	509		15.3%

Table 21 D

		A2		Colorless, spots of A2						
				BI		bt	Colorless			
		BI	bt	2 spm	High dose spm		BI	bt		Totals
7308B-3	1st, main	4	5	75	43	8	36	176		347
" C-1	1st, main	52	6	49	42	10	12	132		303
" C-1	2nd, "	8	3	24	5	3	6	45		94
" C-1	tiller-1	40	3	53	36	11	20	143		306
" C-1	tiller-2	12	2	40	41	6	27	88		216
	Totals for C-1	112	14	166	124	30	65	408		919
" C-2	1st, main	0	–	6	68	–	51	–		125
" C-3	1st, main	10	2	149	15	10	15	166		367
" "	2nd	6	0	149	4	3	10	163		335
	Totals for C-3									
" C-4	1st, main	45	3	59	34	10	28	169		348
" C-5	1st, main	0	–	0	6	–	10	–		16
" C-6	1st, main	8	–	158	158	–	4	–		328
" "	2nd, main	5	–	95	114	–	5	–		219
" "	tiller	2	–	41	59	–	0	–		102
	Totals C-6	15	–	294	331	–	9	–		649

7554A - a_2 m' (A_2) BI / a_2 bt ; Wx + / wx Spm - inactive ♀ × $a_2$bt/$a_2$bt, wx/wx, no Spm ♂

Plant number	Ear location	A_2 BI Wx	A_2 BI wx	A_2 bt Wx	A_2 bt wx	Break-down BI Wx	Break-down BI wx	Break-down bt Wx	Break-down bt wx	Colorless spots of pigment BI Wx	Colorless spots of pigment BI wx	Colorless spots of pigment bt Wx	Colorless spots of pigment bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx + wx	Total
7554A-1	1st, main stack	109	103	8	3	0	4	0	0	0	1	0	0	8	2	196	
" -1	2nd " "	74	73	7	1	1	1	0	0	0	1	0	0	2	2	144	
" -1	tiller	78	67	3	2	0	7	0	0	0	2	0	0	3	4	179	
Totals		261	243	18	6	1	12	0	0	0	4	0	0	13	8	519	
7554A-3	tiller	21	15	1	0	0	0	0	0	0	0	0	0	1	0	29	
7554A-4	1st, main	88	92	0	5	0	0	0	0	1	0	0	0	9	4	160	
" "	2nd, "	12	16	1	1	0	0	0	0	0	4	0	0	1	0	43	
" "	tiller	24	8	0	0	0	3	0	1	0	6	0	0	1	1	49	
Totals - A-4		124	116	1	6	0	3	0	1	1	10	0	0	11	5	252	
7554A-5	1st, main	52	32	4	2	0	0	0	0	0	0	0	0	6	4	106	
" "	tiller-1	107	104	3	7	0	3	1	0	0	3	0	1	11	5	209	
" "	tiller-2	12	15	2	0	0	3	0	1	0	1	0	0	1	1	33	
Totals, A-5		171	151	9	9	0	6	1	1	0	4	0	1	18	10	348	
Totals	1 Spm kernels					1	21	1	2	1	18	0	1	= 3 Wx :	42 wx =	6.6%	Recombination

	A_2 BI Wx	A_2 BI wx	A_2 bt Wx	A_2 bt wx	$a_2 \to A_2$ BI 1 Spm Wx	$a_2 \to A_2$ BI 1 Spm wx	$a_2 \to A_2$ BI high dose Wx	$a_2 \to A_2$ BI high dose wx	bt 1 Spm Wx	bt 1 Spm wx	bt high dose Wx	bt high dose wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx + wx
7554A-3 I ♀ × 7538 ① ♂ $a_2$bt wx Spm-active	14	10	0	2	81	11	16	72	5	1	2	5	1	4	185

For table 3 A

Type of cross

1 = a_2 bt Wx no Spm
2 = " wx " "
3 = a_2 bt wx Spm

Cross

7309	ear		I	II	tiller-1	tiller-2	tiller-3	pollen		
A-1			2	2						
A-2			2							
A-3			2		2					
A-4				2	2	2				
A-5			2		2	1				
A-6			2	2						
A-7			2							
A-8			2							
A-9			2							
B-1			3		1			1		
B-2			3					1		
B-3			3					1		
B-4			3					1		

For Table 3 B

Type of cross

1 = a₂bt Wx no Spm
2 = " " wx " "
3 = " " " spm

7308

Cross

			I	II	t-1	t-2	t-3	pollen		
A-1			3	1						
A-2			3							
A-3			3		2					
A-4			3	2	3					
A-5								1		
A-6			3							
B-1			1		2	2	2			
B-2			2							
B-3			1							
B-4			2		2	2				
B-5	(no spm)		2		1	2				
C-1			1	1	1	1				
C-2			1							
C-3			1	1						
C-4			1							
C-5			1							
C-6			1	1	1					
7570										
A-1			2	2	2	3	3			
A-2			2	2	2	3				
A-3			2	2						
A-4			2		2	3				
A-5			2		2	2				
A-6			2	2	2					
A-7			2	2						
A-8			2	2						
B-1			2	2	2					
B-2			2			⊗		many - are to 2, 3		
B-3			2		2	2				
C			2	3	2	2		-2		

7554 Type of cross of

Type - 1 = a_2 bt Wx no Spm
" - 2 = " " my " "
" - 3 = " " " Spm
" - 4 = a_2 m-1 bt my no Spm

Ears

			I	II	t-1	t-2	t-3			
A-1			2	2	2					
A-2	no Spm ♀		3	3						
A-3			3		2					
A-4			2	2	2					
A-5			2		2	2				
B-1			2	2	2					
7563										
A-1			2		2	2				
A-2			2	2						
A-3			2	2	2					
A-4			2	2	3	2				
A-5			2	2						
B-1			2		3					
B-2			2	2	2	2	2			
B-3	contamination		2		2	3				
7546										
1			2	3						
2			2	3						
3			2	2	2					
4			2							
5			2	3	2					
6			2	2	2					
7			2	3	2					
8			2	2						
9			2	3 do						
10			2							
11			2							
12			2	3						
7573 A-1			2							
" A-2			4	2						
" A-3			2	4						
" A-4			2							
" A-5			2							
" A-6			2							
" B-1			2							
" B-2			2							
" B-3			4	4	2					
" B-4			4	2						
" B-5			2							
7576			2	2	3					

Spm/spm

♀ × a_2^{m-1} no spm ♂

a_2bt/a_2bt			Unif. pigmented	Breakdown	var.					% no spm
7538-1	(pale ♂)		2	0	75					
" -6	(A_2 ♂)		19	0	238	(228 = 2spm: 10 = "4spm")				
" -10	(pale ♂)		7	0	182					
" R-2	(A_2 ♂)		28	0	207	(190 = 2spm: 17 = "4spm")				
" R-4	(A_2 ♂)		2	0	304	all = 2spm endosperm				
7818A ① $^{z-1}$	(pale ♂)		11	1	200					
" A-① $^{z-2}$	(pale ♂)		5	0	94					
" B-③ $^{z-1}$	(pale ♂)		5	0	213					

To a_2^{m-1} no spm ♀ × 7538 spm/spm ♂

7538-1			62	-	482
" -6			34	-	346
" -10			175	-	1484
" -R-4			93	-	769

a_2^{m-1} no spm ♀ × 7818 spm/spm ♂.

7818B-3			19		164
7818B-4			28		429
7818B-5			14		310

7570C	♀		7		322
" C	♂		10		329

spm/spm plants · From 7308D-2
7570C.

1958										
7538-1										
" -6										
" -10										
" -R-2										
" -R-4										
7570C										
1960										
7818A-1										
" B-3										
" B-4										
" B-5										
" B-9										
" B-11										

7570C

a_2m-1 BE Pr / a_2 bt pr Wx + Spm / wx Spm

			uniform pigmented				colorless, spots of pigment				colorless				
			BT		bt		BT		bt		BT		bt		
♀	♂	date	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx		Totals
7570 C-I	7535-2	8/5	0	0	0	0	53	39	11	6	9	12	100		230
" C II	7538-14	8/8	0	0	0	0	55	59	6	5	2	2	81		210
" t-1	7536-34	8/15	0	1	0	0	14	16	1	1	0	3*	40		76
" t-2	7536-34	8/15	3	2	1	0	20	29	3	4	6	13	70		151
Totals			3	3	1	0	142	143	21	16	17	30	291		667

* 1 plant grown from 3 kernels (7816-2) = a_2m1 BE / a_2 bt plus 3 Spm.

means I, t-1, t-2 BE class of variegated kernels: 0 Spm 1 Spm 2 Spm kiln dried Spm

	0 Spm	1 Spm	2 Spm	kiln dried Spm
ear I	0	0	92	0
t-1	1	1	17	3
t-2	6	1	42	6

			A2		colorless, spots of pigment		colorless	
♀	♂	date	Bt	bt	BT	bt	BT	bt
7535-6 I	7570C	8/6	3	0	130	12	16	122
" -24	"	8/6	3	0	86	11	16	101
" -28	"	8/6	0	0	25	5	6	23
" -29	"	8/6	3	1	58	2	10	55
Totals			9	1	299	30	48	301

A. Table ~~24~~ Phenotypes of kernels on ears of plants in culture 7570 resulting from test cross type-2.

Row I ♀ a_2 m-1 (class II) BI / a_2 bt; Wx + / wx Spm (active) ; Row II, + III Wx Spm / wx +

Plants	Number of ears.		Uniformly pigmented				Spots of pigment in non-pigmented background				Colorless			Totals	% recombination
numbers.			BI		bt		BI		bt		BI		bt		
			Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx		
7570A	13		318	50	46	11	62	319	9	40	75	65	698	1693	15.4
7570B (1st) ♀	~~12~~ 6		19	224	3	28	253	15	42	3	35	29	505	1156	6.8
7570B-2 ♂	6		41	459	3	56	462	51	41	3	61	66	987	2230	8.7
7570C ♀	3		3	3	1	0	87	85	15	11	15	27	210	457	—
" ♂	4		5	4	1	0	139	157	16	13	23	24	303	685	—
7570A-7	2		13	6	1	1	13	14	3	6	6	1	40		
7570A-8	2		49	3	7	0	34	79	5	14	14	17	155		

B.		Uniformly pigmented				Diffuse-mottle				Variegated				Colorless		
		BI		bt		BI		bt		BI		bt		BI	~~bt~~	bt
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx
7570A-1	1st ear	7	3	0	1	1	2	0	0	0	3	0	2	2	1	20
" A-1	2nd "	22	10	1	1		2	0	0	0	3	0	1	2	3	23
" A-4	1st ear.	14	16	5	4	0	1	0	0	0	0	0	1	2	3	47

Plant		uniformly pigmented BI		bt		Colorless, spots of pigment. BI				bt		Colorless BI		bt		
Number						1 spin		Hulless spin								
		Wx	ui	Wx	ui	Wx	ui	Wx	ui	Wx	ui	Wx	ui	Wx + ui		
7570A-1	tiller-3	18	2	4	0	25	3	4	38	3	14	11	18	68		
" A-4	tiller-2	18	2	0	1	19	2	8	35	0	6	11	6	60		
TOTals		36	4	4	1	44	5	12	73	3	20	22	24	128		

Tester type-3, 1 active spin, as pollen parent in cross

Rt bt wx 1spm ♀ x 7570B-2 ♂

♀	Date	uniformly pigmented Bt		bt		spots of pigment in colorless background BT 1spm or 2		~~2 or~~ 3 ~~[illegible]~~ spm		bt		colorless BT		bt		
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx		
7538-13	7/10	2	23	1	1	22	22	30	0	3	2	3	1	98		
" -14	8/9	1	16	0	0	10	12	10	2	4	0	3	3	57		
	Totals	3	39	1	1	32	34	40	2	7	2	6	4	155		

7570 A-7, A-8 I × a₂ bt wx no spm

7570C

			uniformly pigmented				spots of pigment in colorless background				Colorless				
			BI		bt		BI		bt		BI		bt		
q	♂	date	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx		Totals
7570 C-I	7535-2	8/5	0	0	0	0	53	39	11	6	9	12	100		230
" C-t-1	7536-34	8/15	0	1	0	0	14	17	1	1	0	2	40		76
" C-t-2	" "	8/15	3	2	1	0	20	29	3	4	6	13	70		151 ~~457~~
	Totals		3	3	1	0	87	85	15	11	15	27	210		~~763~~ 457
7535-6 tiller	7570C	8/6	2	1	0	0	61	69	5	7	8	8	122		
" -24	"	8/6													
" -28	"	8/6													
" -29	"	8/6													
Totals															
7570A-7 I	7535-31	8/7	6	3	1	0	11	7	0	3	3	1	20		
" " II	7535-37	8/10	7	3	0	1	2	7	3	3	3	0	20		
	Totals		13	6	1	1	13	14	3	6	6	1	40		
7570A-8 I	7535-37	8/10	27	0	4	0	9	38	1	5	5	9	70		
" " II	" -31	8/7	22	3	3	0	25	41	4	9	9	8	85		
	Totals		49	3	7	0	34	79	5	14	14	17	155		

Summary tables.

Phenotype of Kernel.

Year 1957 Origin	Year 1958 Culture	No. of ears.	Uniformly Pigmented BT Wx	Uniformly Pigmented BT wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Colorless, spots of pigment BT Wx	Colorless, spots of pigment BT wx	Colorless, spots of pigment bt Wx	Colorless, spots of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Totals	Percent Recombination
(From 7109B-2)															
7308A-4 ♀	7546	12	650	76	45	5	81	633	10	36	55	70	1464	3125	11.1
	7570B	12	60	683	6	84	715	66	83	6	96	95	1492	3386	8.1
" II	7563	17	141	1419	20	124	1484	121	93	10	132	147	3121	6812	8.5
7308D-1	3	16	967	122	84	15	114	974	10	76	76	99	2114	4651	11.0
7308D-2	5	35	1073	163	130	23	158	1033	18	131	207	143	2369	5448	13.2
7308C-6	7573B	3	159	13	9	2	8	137	0	10	17	9	299	663	[illegible]
	7576	2	109	19	8	2	9	138	0	6	7	14	241	553	10.[illegible]
	Totals	5	268	32	17	4	17	275	0	16	24	23	540	1216	8.4
(From 7109B-1)															
7306 A-1 II	7560	4	18	255	1	11	291	29	17	1	23	17	561	1224	7.8
7307A-3 II	7561	4	34	315	2	26	295	18	21	0	23	29	657	1420	7.6
7307A-5 II	7562	4	26	203	1	12	186	5	7	1	18	12	456	927	[illegible] 4
7307B-2	7572	6	281	58	18	2	60	285	2	13	29	25	674	1447	16.9

Linkage of Spm with Wx or wx in Wx Spm/wx + or Wx+/wx Spm plants;

a_2^{m1} BT/a_2 bt ♀ × $a_2$bt/$a_2$bt; wx/wx, no Spm or

Class II state

From 7109B-2 — Wx + Spm | wx + and Wx + | wx Spm. Class I and class II ratio of 9_2 wx-1

	number of Cons.	uniformly Pigmented BT Wx	BT wx	BT Wx	BT wx	colorless, spots of pigment BT Wx	BT wx	BT Wx	BT wx	Colorless BT Wx	BT wx	Total	% Recombination	
7309A	5	257	36	13	2	36	235	3	18	21	23	579	1223	12.8	
7308A,B	5	355	53	-	-	37	331	-	-	0	1	-	-	777	11.8	
" B-1	3	92	22	7	3	12	121	3	7	8	15	219	509	14.9	
7546	12	650	76	45	5	81	633	10	36	55	70	1464	3,125	11.2	
7570B	12	60	683	6	84	715	66	83	6	96	95	1492	3,386	8.1	
7563	17	141	1419	20	124	1484	121	93	10	132	147	3121	6,812	8.5	
7308C-6															
7573B	3	159	13	9	2	8	137	0	10	17	9	299	663	6.8	
7576	2	109	19	8	2	9	138	0	6	7	14	241	553	10.3	
7308D-1	16	967	122	84	15	114	974	10	76	76	99	2114	4651	11.0	"A" state
" "	21	1220	177	101	19	157	1245	12	115	133	126	2820	6148	11.9	[illegible]
	3	171	14	117	9	18	168	7	114	-	-	-	620	7.7	[illegible]
7308D-2	35	1073	163	130	23	158	1033	18	131	207	143	2369	5448	13.2	"A" state
	18	409	59	47	3	54	412	4	47	75	53	977	2145	11.5	[illegible]
	2	144	23	103	16	15	160	18	143	-	-	-	624	11.5	
7768															
7769	1	74	17	9	0	9	100	1	12	21	21	205	469	7.7	
7780B	14	301	29	39	4	26	260	4	33	52	53	576	1377	9.0	
7781A (7308D-1)	4	114	182	0	17	183	12	25	1	29	48	421	932	6.2	[illegible]

Summary of recombination values for Spm linked to wx allele derived from plant 7109B-2

7456 B-5 a_2 m-1 (class II) Bt | a_2 bt; Wx + | wx Spm (Table C)
7456 C-3

	7456B-5 Intear; ♀	7456B-5 t-1 ♀	7456B-5 t-2 ♀	7456C-3 I × 7308D-2	II ×	t-1 ×	t-2 ×	t-3 ×
Phenotype of kernel	7308D-1 ♂	a_2 bt Wx no Spm ♂	a_2 bt wx no Spm ♂	a_2 bt wx 1 Spm	a_2 bt wx no Spm	a_2 bt Wx no Spm	a_2 bt wx no Spm	a_2 bt wx no Spm
Uniformly dark pigmented kernels.								
Bt Wx	49	101	85	27	52	106	61	79
Bt wx	44	–	35	25	29	–	17	10
bt Wx	7	13	15	1	1	6	1	3
bt wx	7	–	3	3	0	–	0	
"Diffuse-mottled" kernels (see figure-)								
Bt Wx	1	13	2	0	6	31	6	0
Bt wx	6	–	24	0	30	–	46	13
bt Wx	0	1	0	0	0	1	0	1
bt wx	0	–	0	0	1	–	1	0
Colorless with large and small (see figure-) pigmented areas.								
Bt Wx	39	0	0	10	0	0	0	0
Bt wx	10	–	0	4	0	–	0	0
bt Wx	6	0	0	1	0	0	0	0
bt wx	2	–	0	0	0	–	0	0
Colorless with only specks of pigment (see fig-)								
Bt Wx	7	19	8	2	2	59	4	9
Bt wx	39	–	37	20	6	–	28	43
bt Wx	2	1	0	0	0	6	0	0
bt wx	4	–	8	2	1	–	0	3
Colorless Bt								
Wx	18	16	6	2	3	10	9	4
wx	16	–	10	3	5	–	5	0
Colorless bt, Wx and wx	211	113	209	102	141	198	166	152

Table D. 7455 A ② and C ⑤ a_2 mk (class II) BI / a_2 bt wx ux ; 1 spm

	7455A ②I x	7455A ② t-1 ♀	7455A-2 t-2 ♀	7455A-2 t-3 ♀	7455C-5 ‡ ♀	7455C-5 ‡	7455C-5 litter ♀
	a_2 bt ux no spm ♂	a_2 bt wx no spm ♂	7308D-1 a_2 bt ux 1 spm	7308D-2 a_2 bt ux 1 spm	7308D-2 ♂	a_2 bt wx no spm ♂	a_2 bt ux no spm ♂
Uniformly dark pigmented							
BI wx	233	150	53	73	27	97	137
BI ux		—	48	84	39	—	
bt wx	12	11	7	7	5	13	6
bt ux		—				—	
"Riffus-Wolka" pigment							
BI wx	0	38	4		0	0	4
BI ux	0	—	7		0	—	5
bt wx	0		0		0	0	
bt ux	0	—	0		0	—	
Colorless with both large and small areas of color							
BI wx	0	0	26	44	31	0	0
BI ux	0	0	35	35		—	0
bt wx	0	0	1	[illegible]	4	0	0
bt ux	0	0				—	0
Colorless with only small spots or speckling pigment							
BI wx	0	39	32	42	34	0	3
BI ux	0	—	29	41		—	
bt wx	0	0 1)	[illegible]	1	2	0	1
bt ux	0	—				—	
Colorless BI							
wx	17	15	8	17	6	10	6
ux		—	7	4	5	—	5
Colorless bt, wx and ux	220	208	227	321	145	93	170

Table E

Phenotype of kernel	7308B-1 I ♀ a-bt-wx wo spm ♂	7308B-1 t-1 ♀ a-bt-wx wo spm ♂	7308B-1 t-2 ♀ a-bt-wx wo spm ♂	7308B-1 t-3 ♀ a-bt-wx wo spm ♂	7308B-2 I ♀ a-bt-wx wo spm ♂	7308B-4 I ♀ a-bt-wx wo spm ♂	7308B-4 t-1 ♀ a-bt-wx wo spm ♂	7308B-4 t-2 ♀ a-bt-wx wo spm ♂
Uniformly colored pigmented								
BI Wx	95	46	29	17	186	21	28	13
BI wx	–	10	10	2	32	1	2	4
bt Wx	7	2	3	2	–	–	–	–
bt wx	–	1	1	1	–	–	–	–
"Diffuse-mottled" pigment								
BI Wx	0	0	0	0	0	0	0	0
BI wx	0	0	0	0	0	0	0	0
bt Wx	0	0	0	0	–	–	–	–
bt wx	0	0	0	0	–	–	–	–
Colorless with lax and small pigmented areas								
BI Wx	0	0	0	0	0	0	0	0
BI wx	–	0	0	0	0	0	0	0
bt Wx	0	0	0	0	–	–	–	–
bt wx	–	0	0	0	–	–	–	–
Colorless with small spots or speckling pigment								
BI Wx	37	6	4	3	23	15	2	0
BI wx	–	64	39	18	162	0	26	11
bt Wx	1	1	2	0	–	–	–	
bt wx	–	2	4	1	–	–	–	
Colorless BI								
Wx	14	5	2	2	1	0	0	1
wx	–	6	7		0	0	0	0
					–			
Colorless bt Wx and wx	143	83	89	47	–	0	–	–

~~table 5 - C~~ active spm in ♀

7308 = shows high rate of transposition in tiller of 7109B ②. t-1

		I	II	t-1	t-2	t-3	pollen
✓ 7308A-4	Wx+/wx spm	3	2	~~2~~ 1			X
7308A-1	Wx Wx no spm	3	1				
" A-2	Wx wx; no spm	3					
" A-3	Wx wx; no spm	3			2		
" A-6	Wx Wx; no spm	3					
" B-1	Wx+/wx spm	1		2	2	2	
" B-2	" "	2					
" B-4	" "	2		2	2		
" B-5	" "	2		1	2		
7308C-6		1	1	1			

♂ in cross: 1 = a_2bt/a_2bt Wx Wx no spm

2 = " " wx wx no spm

3 " " wx+/wx spm - active phase

Crosses of a_2^{m1} BI / a_2^s bt no spur plants of culture 7456
to a_2 bt no spur testers.

		A2		Colorless						
Plant no		BI	bt	BI	bt		Totals			
7456A-1	II	193	10	8	206		417			
" -1	t	154	11	10	154		329			
" A-3	pollen	178	6	10	195		389			
" "	"	100	6	6	72		184			
" A-4	II	184	6	10	163		363			
" "	t-1	88	3	9	98		198			
" "	t-2	156	8	8	195		367			
" B-1	t	3	0	0	1		4			
" B-2	t	166	7	5	156		334			
" B-3	t	116	8	5	137		266			
" B-6		77	4	8	77		166			
Totals		1415	69	79	1454		3017			

Phenotypes of

Table 7. Test crosses conducted with ears of plant 7308A-4 that was a_2 m-1 (class II) BI / a_2 m-1 (class II) BI ; Wx + / ex Spm

Phenotypes of kernels.

Part of plant tested	Constitution of or in test cross.	Uniformly Pigmented.		Colorless with spots or specks of Color: 1 Spm pattern		2 Spm pattern		Highdose Spm ~~3 Spm~~ pattern.		Colorless.
		Wx	ux	Wx	ux	Wx	ux	Wx	ux	
First ear, main stalk.	a_2 bt ux 1 active Spm.	70	6	69	9	10	68	3	75	0
2nd ear, main stalk	a_2 bt ux no Spm	107	14	0	0	12	115	0	2	0
tiller ear	a_2 bt Wx no Spm.	142	—	1	—	135	—	4	—	0

↙ From 7308D ①$^{t-1}$

Wx + 1 wx Spm - active + 1 inactive Spm ♀ × a_2 bt wx no Spm ♂

	7595A ⑥I	7597A ①I	7597A ⑤I	7597A ⑤II		Totals
	7535-14	7535-4	7535-2	7535-14		
Uniformly dark pigmented BI						
Wx	27	82	87	89		285
wx	7	8	10	21		46
" " " bt						
Wx	6	9	5	5		25
wx	1	2	1	0		4
$a_2 \to A_2$ BI 2 Spm						
Wx	16	5	1	7		29
wx	27	43	45	37		152
" BI 4 Spm						
Wx	6	3	0	4		13
wx	22	38	43	36		139
$a_2 \to A_2$ bt						
Wx	7	2	2	1		12
wx	7	6	3	5		21
Colorless BI						
Wx	2	6	5	5		18
wx	5	8	6	7		26
Colorless bt Wx + wx	123	196	183	234		736
Totals	256	408	391	451		1506

= 333

331 A_2 BI : 181 var BI "2 Spm" : 152 var BI "4 Spm" : 44 colorless BI
29 A_2 bt : 33 var BI* : 736 colorless bt.

* some "4 Spm" kernels in var. class not easily detected.

7538 crosses to $a_2^{m1}(A_2)$ BI | a_2 bt

Cross.	No. of ears.	Uniform dark color Bt	Uniform dark color bt	Colorless BI with: Many spots of color	Colorless BI with: Few spots or speck of color	Colorless bt with colored spots	Colorless BI	Colorless bt	Totals
1 7538-9	1 spm (6 ears) ♀ no spm	494	44	439	6	33	75	898	1989
2 " -12	1 spm (2 ears) ♀ no spm	170	12	182	1	9	21	360	755
♀ W+W+ 1 inactive spm (7 ears)	♂ = 1 spm	771	60	389	405	55	107	1629	3416
♀ W+ ex; 1 inactive spm (4 ears)	♂ = 1 spm	359	18	188	158	19	47	722	1511
♀ W+ W+ or W+ ex; ♂ = spm/spm (3 ears)	1 inactive spm	40	4	172	193	27	38	376	850
♀ no spm	♂ spm/spm (1)	1	1	41	0	3	6	32	84

	Wx	ex	Wx	ex	Wx	ex	Wx	ex	Wx	ex	Wx	ex	Wx+ex	
♀ W+ +1 ex spm - inactive ♂ = 1 spm (8 ears)	324	330	29	29	245	37	40	233	21	25	57	53	1240	
♀ W+ +1 ex spm - active ♂ = 1 spm	228	41	32	3	197	42	58	411	23	56	70	66	914	2141
♀ W+ active spm / ex + ♂ 1 spm (2 ears)	7	65	1	1	3	65	129	16	4	3	16	7	256	
♀ W+ +1 ex spm inactive ♂ spm/spm	9	4	0	2	42	5	16	56	5	5	5	2	150	301
♀ W+ +1 ex spm - active + 1 inactive (24 ears) ♂ no spm	285	46	25	4	2 spm 29	152	4 spm 13	139	12	21	18	26	736	1506

Table.

Crosses to or by a_2 bt pr y W+ no Spm.

a_2 m1 (A_2) BT | a_2 s bt

Plant	Location of ~~ear~~ part tested	1956 Kernel type: Colored	colorless with colored spots	colorless	Culture no. 1957	1958	1960
7109B-1	1st ear, main stalk [W++/wx Spm]	110	19	139	7456		
	ear, first tiller	102	87	225	7306		
	ear, 2nd tiller	98	97	149	7307		
	ear, third tiller	127	130	241			
	pollen from tiller	89	82	191			
7109B-2	1st ear, main stalk [W++/wx Spm]	136	118	240	7309		
	ear, 2nd tiller	132	141	273			
✓✓	ear, tiller-1, self pollinated	88	259		7308		
	pollen from main stalk	250	256	559	7310, 7311		
7109C-1	1st ear, main stalk	149	87	226			
	ear, tiller-1	96	71	167			
	ear, tiller-2	128	132	250			
	ear, tiller-3	78	80	179			
7109C-2	1st ear, main stalk W+/W+	181	86	294			
	ear, tiller	141	129	237			
	pollen from tiller	183	165	360			
7109C-3	1st ear, main stalk	229	8	240			
	ear, tiller-1	131	115	250			
	ear, tiller-2	116	108	231			
	pollen from main stalk	192	103	323			
7109C-4	1st ear, main stalk	134	99*	234	7455		

* pattern is "delayed" action type - breakdown - spk with specks appearing first in ~~[illegible]~~ side of kernel [illegible]

7455 = From 7109C ④ I × a_2 bt pr Wx no Spm ♂ | Very long inactive cycle of Spm.
Plants in culture were non-vaccinated.

7455 A From early "breakdown" class:

A ① I × a_2 bt pr Wx = all A_2
t × 7308 D ② t-2 = inactive Spm in A① is partially active

A ② I × a_2 bt pr Wx = all A_2
t-1 × " " " Wx = delayed action Spm from ♀
t-2 × 7308 D ② t-1 = very " " " " ♀ - good closing, cats
t-3 × " D ② t-2 = " " " " " " - " "

A ③ I × 7308 D ① t-2 = inactive Spm in ♀
③ II × a_2 bt pr Wx no Spm = very delayed action " " ♀

A ④ I × a_2 bt pr Wx = very delayed action Spm in ♀
t-1 × 7308 D ② t-1 = delayed action " " ♀
t-2 × a_2 bt pr Wx = " " " " ♀

7455 B = from advanced Breakdown kernels.
B ① I × a_2 bt pr Wx no Spm = delayed action Spm = see for pattern [like some pale a_2's]

B ② I × 7308 D ② t-1 1 inactive Spm in ♀ see 7591 - see plant [illegible]
② II × a_2 bt pr Wx no Spm " " " " ♀ see 7592 - [illegible]
② t × " " " Wx " " late acting Spm in ♀ see 7593 see plant [illegible]

B ③ I × 7308 D ① inactive Spm in ♀
II × a_2 bt pr Wx no Spm inactive " " "
B ④ I × 7308 D ① t-2 very delayed action Spm in ♀
B ⑤ I × " " " delayed action Spm in ♀
II × a_2 bt pr Wx no Spm = inactive Spm in ♀

7455 B(6)^{I} × 7308 D(1)$^{t-1}$ = inactive Spm in ♀

7455 C = from $a_2 \to A_2$ kernels – "2 Spm" pattern

C(1)^{I} × 7308 D(2)$^{t-1}$ = inactive Spm in ♀

pollen to a_2 bt fr Wx no Spm = late acting Spm (delayed)

C(2)^{I} × 7308 D(1)$^{t-1}$ inactive Spm in ♀ See 7597

C(3)^{I} × " D(2)$^{t-2}$ delayed acting Spm in ♀

pollen of t to a_2 bt fr Wx active Spm in ♂

C(4)^{I} × 7308 D(2)$^{t-2}$ nearly inactive Spm in ♀

t × a_2 bt fr Wx no Spm = active Spm with few Breakdown kernels

---

C(5)^{I} × 7308 D(2)$^{t-1}$ inactive Spm in ♀ See 7595 { all plants but A(3) are var.

^{II} × a_2 bt fr Wx inactive Spm in ♀ See 7594 no plants are var.

t × " " " wx very delayed acting " " ♀ See 7596 { no evidence of Spm in plants

---

D = from early Breakdown kernels.

(1)^{I} × 7308 D(2)$^{t-1}$ inactive Spm in ♀

(2)^{I} × " D(2)$^{t-1}$ inactive Spm in ♀

(3)^{I} × " D(2)$^{t-1}$ inactive " " ♀

(3) pollen to a_2 bt fr Wx = inactive " " ♀ + few very delayed acting kernels.

Class II

a_2^{m-1} (A_2) BI / a_2 bt

Wx + / wx Spm - active

Progeny of 7308 D-1

Year 1958

Culture	no. of Ears		uniformly pigmented A_2 BI Wx	BI wx	bt Wx	bt wx	colorless, spots of color BI Wx	BI wx	bt Wx	bt wx	colorless BI Wx	BI wx	bt Wx and wx	Totals	Recombination
7566A	3		241	34	34	9	21	253	3	31	31	38	480	1175	10.7 %
7588	10		529	68	35	3	80	528	3	36	32	47	1206	2567	12.0
7597A	3		197	20	15	3	13	193	4	9	13	14	428	909	8.8
Totals	16		967	122	84	15	114	974	10	76	76	99	2114	4651	

1051 A_2Wx : 137 A_2 wx : 124 var. Wx : 1050 var. wx = 2362 = 11.0 % recombination

" " 10.5 % of variegated class

Progeny of 7308 D-2

7569	6		301	58	40	2	45	296	5	46	54	34	658	1539	[illegible]
7575A	1		81	7	3	0	11	72	0	1	6	2	151	334	10.3
7591	7		215	31	23	3	25	208	1	25	39	24	516	1110	[illegible]
7595	8		158	17	18	7	15	138	3	19	33	18	346	772	11.2
7570A	13		318	50	46	11	62	319	9	40	75	65	698	1693	[illegible]
Totals	35		1073	163	130	23	158	1033	18	131	207	143	2369	5448	

1203 A_2Wx : 186 A_2 wx : 176 var. Wx : 1164 var. wx = 2729 = 13.2 % recombination

" 13.1 % of variegated class.

♀ a_2^{m-1} (class II) BI / a_2 bt × a_2 bt / a_2 bt, wx / wx, no Spm ♂

Wx + / wx Spm

class I

a_2 tm (pale-spotted) BI / a_2 bt ♀ spm from 7308 D-1

Wx+ / wx spm-active

Plant			uniform pale				colorless; spots of deep pigment				colorless				
		A_2BI	BI		bt		BI		bt		BI		bt		
number	Ear		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx	Totals	
7564-①	I	1 wx	29	2	0	0	2	41	0	4	4	2	63	148	
" -①	t-1	1 wx	46	4	4	0	3	37	0	4	2	0	89	190	
7564 ②	I	3 wx	75	11	1	1	6	60	0	3	9	6	137	312	
" ③	I	1 wx	73	16	3	4	6	76	0	6	4	4	150	343	
" ④	I	1 Wx	37	3	8	0	6	44	1	1	4	3	106	214	
" ④	I	1 Wx : 1 wx	48	15	3	2	4	60	1	5	4	11	120	275	
" ⑤	I	3 wx	42	3	2	0	3	39	0	1	1	4	107	205	
Totals		2 Wx : 10 wx	350	54	21	7	30	357	2	24	28	30	772	1687	
371	pale Wx :	61 pale wx :			32 var.		Wx :	381 var.			wx = 845		= 11.0% recombination		
♀ 7564-①	t-2 ♂ × 7538-14 1 spm.	1 wx	41	4	0	0	59	106	3	1	8	3	234	460	
7564-② I	× 7537C-1	0	43	5	30	2	4	49	2	36	2	0	35	208	= 7.6% recomb.
7565A-③ II	× 7537C-1	0	57	7	40	3	7	57	3	35	1	2	43		9.5% recomb.
" -3	teller	1 Wx : 3 wx	80	7	-	-	8	71	0	4	3	5	166	348	
" A-5	I	0	83	4	4	0	6	112	0	7	8	5	184	413	
A-5 teller / A-5 Totals		1 Wx : 3 wx	163	11	4	0	14	183	0	11	11	10	350	761	7.0% recomb.
7585 A-1	teller	0	19	0	0	0	3	18	0	0	4	1	25	70	
" A-2	I	0	40	2	7	0	6	56	1	6	3	6	104	231	
" A-5	I	0	66	14	12	0	7	61	0	9	11	4	146	330	
" B-1	teller-2	2 wx (1 bt)	43	7	2	0	12	40	0	3	9	8	137	263	
" B-5	I	0	83	9	6	0	5	92	0	8	9	8	178	398	
	Totals	2 wx 1 BI 1 bt	251	32	27	0	33	267	1	26	36	27	590	1292	10.3% recomb.
7585B-3 II	7538-2 ♂ spm + spm	0	25	21	3	0	66	77	5	8	6	12	149		
7585B-1 t-1	× 7537C-1 ♂	4 Wx	29	13	23	7	70	78	50	60	4	3	34		
" B-5 II	× 7537C-1 ♂	1 BI wx 1 bt Wx	71	2	47	4	7	62	2	43	2	0	38		

Progeny 7308D-1 cont.

			uniform pale.				colorless with A_2 spots				colorless				
		A_2	BI		bt		BI		bt		BI		bt		
q	Ear		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx	Totals	
7601B-(1)	I	0	69	11	3	2	8	69	0	8	11	9	196	386	
7601B-3	I sector	0	13	3	1	1	1	26	1	1	4	0	35	86	
	"		76	91	5	7	0	0	0	0	7	9	186	381	
7601B-4	I	1 BI wx	110	10	7	1	9	101	0	8	12	14	236	509	
7601B-7	I	1 BI wx : 1 bt wx	59	8	10	3	7	38	2	6	14	11	120	280	
" B-7	II	1 BI wx	63	12	9	2	12	51	2	12	3	6	134	307	
" B-8	I	0	70	22	11	2	27	74	4	11	5	11	194	431	
" B-9	I	1 BI wx	72	14	8	1	16	79	0	8	9	8	193	409	
Totals (minus - sector)		4 BI wx : 1 bt wx	456	80	49	12	80	438	9	54	58	59	1108	2408	15.3%

Summaries

Totals for cross of A_2 bt wx, no Spur

	A_2 BI Wx	A_2 BI wx	A_2 bt Wx	A_2 bt wx													
7564	2	10	0	0	350	54	21	7	30	357	2	24	28	30	772	1687	11.0
7565	1	3	0	0	163	11	4	0	14	183	0	11	11	10	350	761	7.0
7585	0	1	0	1	251	32	27	0	33	267	1	26	36	27	590	1292	10.3
7601	0	4	0	1	456	80	49	12	80	438	9	54	58	59	1108	2408	15.3
Totals	3	18	0	2	1220	177	101	19	157	1245	12	115	133	126	2820	6148	11.9

Totals for cross with 7537C-1

															Totals		
7564-2 I	0	0	0	0	43	5	30	2	4	49	2	36			171		
7565A(3) II	0	0	0	0	57	7	40	3	7	57	3	35			209		
7585B(5) II	0	1	1	0	71	2	47	4	7	62	2	43			240		
Totals	0	1	1	0	171	14	117	9	18	168	7	114			620		7.7%

a_2^{m1} (pale) BI / a_2 bt

Summaries Wx+ / wx Spm - from 7308 D-2

Year 1958

I ♂ = a_2 bt wx no spm

	A2 BI		A2 bt		pale BI		pale bt		Colorless spots of A2 BI		Colorless spots of A2 bt		Colorless BI		Colorless bt		%
	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx	Totals	Recombination
7571	0	0	0	0	106	18	13	2	14	109	1	18	17	10	205	513	12.4
7583	1	1	0	0	214	20	25	1	33	212	1	21	47	32	531	1139	10.8
7602	1	1	1	0	89	21	9	0	7	91	2	8	11	11	241	493	13.1
Totals	2	2	1	0	409	59	47	3	54	412	4	47	75	53	977	2145	11.5

II ♂ = 7537C-1

7571	0	2	0	0	144	23	103	16	15	160	18	143			Totals 624		11.5

III a_2^{m1} (class II) BI / a_2 bt

× a_2 bt wx ♂					1073	163	130	23	158	1033	18	131	207	143	2369	5448	13.2

a_2 m-1 (pale-spotted) BI / a_2 bt
Wx +/ wx Spm-act inf

Progeny of 7308 D-2

			uniformly pale				colorless, spots of A_2				colorless				
		A_2	BI		bt		BI		bt		BI		bt		
♀	Ear		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx	Totals	
7571-1	II	0	19	1	3	0	1	19	0	2	4	2	25	76	
" -1	t-1	0	10	1	3	0	1	9	0	3	4	3	26	60	
" -1	t-2	0	23	3	2	1	4	47	1	7	4	1	66	159	
7571-2	I	0	16	2	2	0	0	5	0	0	0	0	13	38	
7571-4	I	0	1	0	0	0	0	1	0	0	1	0	4	7	
7571-4	teller Sectoral brows	0	28	24	0	2	0	0	0	0	2	1	50	107	
	brows	0	33	10	3	1	8	20	0	5	2	2	61	145	
7571-5	I	0	0	1	0	0	0	1	0	0	2	1	4	9	
" -5	II	0	4	0	0	0	0	7	0	1	0	1	6	19	
Totals (mus - sector)		0	106	18	13	2	14	109	1	18	17	10	205	513	12.4% recombinations
7571-4 t-2	x 7537C-1	2BI wx	59	12	36	5	3	53	6	62	1	0	33	272	
7571-5 t-1	x "		85	11	67	11	12	107	12	81	3	2	48	439	11.9%
Totals		2BI wx	144	23	103	16	15	160	18	143	4	2	81	711	11.5
7583A-2	I	1BI wx	10	2	2	0	6	13	0	0	4	2	26	66	
" "	II	0	54	4	9	0	13	55	0	8	13	9	147	312	
" A-3	I	1BI Wx	31	6	9	1	1	22	1	5	12	8	73	170	
" A-4	teller	0	2	0	0	0	0	1	0	0	0	0	0	3	
" A-5	I	0	12	1	1	0	0	9	0	0	0	2	22	47	
" B-2	I	0	60	4	2	0	10	74	0	3	10	7	173	343	
" B-4	I	0	27	0	1	0	2	19	0	3	4	4	50	110	
" B-5	I	0	18	3	1	0	1	19	0	2	4	0	40	88	
Totals		1Wx : 1wx	214	20	25	1	33	212	1	21	47	32	531	1139	
7583A-2 t	x 7538-14	1BI Wx	22	5	7	1	33	54	6	14	16	17	131	306	
	1Spm	1BI wx													
7602-1		0	17	6	2	0	1	17	1	2	1	1	68	116	
" -2 sec		1BI Wx 1bt Wx 1 wx	72	15	7	0	6	74	1	6	10	10	173	377	
" -3 sec	Totals	2Wx : 1wx	89	21	9	0	7	91	2	8	11	11	241	493	13.1% = record

1957 $a_2^{m'}(A_2)$ BI / a_2^s bt Wx+/ wx-spm actuae × a_2 bt wx no spm ♂.

♀		Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Colorless spots of BI color Wx	Colorless spots of BI color wx	Colorless spots of bt Wx	Colorless spots of bt wx	BI Colorless Wx	BI Colorless wx	bt		Totals	
7306A①^{II}		31	7	0	2	10	38	0	1	1	1	77		168	% recomb. 18.3%
" " I		63	13	1	0	11	58	0	0	1	5	156			
" A⑥^{II}		7	3	3	1	1	8	0	0	0	1	15			
7307A②$^{t-1}$		71	8	5	0	7	58	0	4	4	6	152			
" A②$^{t-2}$		23	4	1	0	2	20	0	1	0	1	58			
" A③^{I}		80	12	6	0	16	77	0	10	11	10	187			13.9% c.o.
" A④		74	8	7	2	5	97	4	4	5	6	214			
" A④^{t}		63	5	1	0	8	57	0	7	3	7	116			
" A⑤^{I}		42	2	1	0	3	33	0	1	0	2	62			6.1% c.o.
" A⑤^{II}		43	13	1	0	6	39	0	2	3	4	76			
" A⑥		47	7	2	0	5	59	0	3	4	5	130			
" B①^{I}		39	4	1	0	9	40	1	4	6	7	79			
" B①^{t}		61	10	6	1	6	57	3	5	4	5	127			
7308B①$^{t-1}$		46	10	2	1	6	64	1	2	5	6	83			
" B①$^{t-2}$		29	10	3	1	3	39	2	4	3	7	89			
" B①$^{t-3}$		17	2	2	1	3	18	0	1	0	2	47			
7309A②^{I}		38	11	0	1	5	32	1	2	4	4	93			
" A③^{t}		45	11	3	0	7	41	0	3	7	3	112			
" A④$^{t-1}$		57	2	1	0	8	60	0	4	2	5	118			
" A⑤$^{t-1}$		76	10	5	1	11	68	2	3	4	5	158			
" A⑧^{I}		41	2	4	0	5	34	0	6	4	6	98			
7313A②^{t}		83	5	2	1	6	67	0	3	3	3	193			
7313A②^{t} Totals	no. gens = 22	1076	159	57	12	143	1064	14	70	71	101	2359.			

1133 A Wx ; 171 A_2 wx : 157 var. Wx : 1134 var. wx. = 2595 $a_2^{m'}$ kernels
= 12.6% recombination

$a_2^{m'}(A_2)$ BI / $a_2^{m'}(A_2)$ BI Wx+/ wx spm actuae × a_2 bt wx no spm ♂

1957

											Totals	
7308A④^{II}	107	14	-	-	12	117	-	-	(colorless wx)		~~Tot~~ 250	= 10.4% c.o.
" B②^{I}	186	32			23	162			1		404	
" B④^{I}	21	1			0	15					37	
" B④$^{t-1}$	28	2			2	26					58	
" B④$^{t-2}$	13	4			0	11					28	
Totals	355	53			37	331			1		777	

11.8% recombination

1958

7563B③	146	27			6	136					315.	
" B③$^{t-1}$	166	43			36	182					427	
Totals	312	70			42	318					742	

15.2% recombination

For reference to B of table 2. Year. 1957 a_2 mi BI / a_2 bt Wx+/wx spm - active + a_2 bt wx no spm.

		Uniformly Pigmented BI		bt		Variegated BI		bt		Colorless BI		bt			
Plant no.		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx		Totals	
7306A-1 II	+ a_2 bt wx no spm	31	7	0	2	10	38	0	1	1	1	77		168	
" " 1 I	" "	63	13	1	0	11	58	0	0	1	5	156		308	
" " 6 II	" "	7	3	3	1	1	8	0	0	0	1	15		39	
Totals	3 ears.	101	23	4	3	22	104	0	1	2	7	248		515	

105 A_2 Wx : 26 A_2 wx ; 22 var. Wx : 105 var. wx = 258 = 18.5% recombination

7306A-3 I		7	7	0	1	5	7	1	0	1	1	33			

~~7306B-1 4 ears. + a_2 bt wx 07~~ =

For reference to B of table 2. Year 1957

	uniformly Pigmented Bt		bt		var.		colorless			
	Wx	wx	Wx	wx	Bt	bt	Bt	bt		Totals
7306B ① II × a₂bt wx, no spm	4	3	1	0	148	6	9	189		
" ① t-1	7	2	0	0	132	6	14	152		
" ① t-2	19	1	0	0	30	0	3	42		
" ① t-3	3	1	0	0	71	6	11	86		
Totals	33	7	1	0	381	18	37	469		
7306 B ① I × a₂bt Wx no spm	9	–	0	–	181	10	13	185		
	Wx	wx	Wx	wx	Wx wx	Wx wx	Wx wx			
7306B ② t × a₂bt wx, no spm	28	2	1	0	24 60	1 1	7 1	133		
7306B ② I × a₂bt Wx no spm	34	–	4	–	151 –	8 –	16 –	205		
Totals	64		5		235	10	24	338		

For Table 2 - C Year 1957

a_2 mi BI / a_2 bt Wx + / wx spm - active ♀ × a_2 bt wx no spm ♂

Plant no.		uniformly Pigmented BI Wx	BI wx	bt Wx	bt wx	variegated BI Wx	BI wx	bt Wx	bt wx	Colorless BI Wx	BI wx	bt Wx + wx		Totals
7307A(2)	t-1	71	8	5	0	7	58	0	4	4	6	152		315
" "	t-2	23	4	1	0	2	20	0	1	0	1	58		110
" A-3	I	80	12	6	0	16	77	0	10	11	10	187		409
" A-4	I	74	8	7	2	5	97	4	4	5	6	214		426
" "	t	63	5	1	0	8	57	0	7	3	7	116		267
" " 5	I	42	2	1	0	3	33	0	1	0	2	62		146
" "	II	43	13	1	0	6	39	0	2	3	4	76		187
" " 6	I	47	7	2	0	5	59	0	3	4	5	130		262
" B-1	I	39	4	1	0	9	40	1	4	6	7	79		190
" "	t	61	10	6	1	6	57	3	5	4	5	127		285
Totals	10 ears	543	73	31	3	67	537	8	41	40	53	1201		2597

574 A_2 Wx : 76 A_2 wx : 75 var. Wx : 578 var. wx = 1303 = 11.5% recombination

Wx ++ / wx spm spm ♀ × a_2 bt wx no spm ♂

7307B-2	I	74	15	8	5	19	90	1	4	4	14	206		440
" "	t-1	28	4	3	1	6	29	1	5	4	5	63		149
" "	t-2	43	8	2	0	10	46	0	0	4	0	103		216
Totals	3 ears	145	27	13	6	35	165	2	9	12	19	372		805

158 A_2 Wx : 33 A_2 wx : 37 var. Wx : 174 var. wx = 402 = 17.4 % recombination

Wx + / wx spm plus 1 spm

7307B-3	I	24	4	6	1	31	50	1	4	3	5	155		284
"	II	33	2	1	0	32	50	2	1	5	4	151		281
" "	t-2	25	2	1	0	19	33	2	2	2	4	70		160
" "	t-3	58	7	3	0	55	93	3	3	8	10	189		429
Totals	4 ears	140	15	11	1	137	226	8	10	18	23	565		1154

151 A_2 Wx : 16 A_2 wx : 145 var. Wx : 236 var. wx = 548

7307B-4	I	45	4	4	0	52	70	3	0	6	14	159		357
" 4	t-1	47	3	4	2	68	94	2	4	8	15	227		474
Totals	2 ears	92	7	8	2	120	164	5	4	14	29	386		831

100 A_2 Wx : 9 A_2 wx : 125 var. Wx : 168 var. wx = 402

7307B(4)	t-2 × a_2 bt Wx no spm	53	–	3	–	145		11		29		232		473

7307B-2 : varegated kernels have specks only of A_2 with few exceptions.

7307B-3 and B-4. : 2Spm and 4Spm patterns - all 4Spm patterns, few specks of A_2 only.

Linkages - BT kernels in 7307B ③ I ear =

	2 Spm pattern		4 Spm pattern	
	Wx BT	wx BT	Wx BT	wx BT
7307B ③ I	21	26	10	24
7307B ④ I	42	12	10	58
" ④ t-1	58	16	10	78
Totals 7307B ④	100	28	20	136
	128		156	

Reference for D, Table 2. a_2 m-1 BI / a_2 s bt Wx + / wx spm - active + a_2 bt wx no spm

		uniformly Pig. BI		bt		var. BI		bt		colorless BI		bt		
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx		Totals
7313 A-2 t		83	5	2	1	6	67	0	3	3	3	193		366
" B-4 t-2		25	2	1	0	8	35	0	0	1	0	45		117
Totals		108	7	3	1	14	102	0	3	4	3	238		483

111 A_2 Wx : 8 A_2 wx : 14 var. Wx : 105 var wx = 238 9.2% recombination

Year 1957

Reference for A, table 3.

a_2 mi BI / a_2 bt Wx+/wx Spin - active × a_2 bt wx no Spin

		Uniformly Pigmented				Variegated				Colorless				
		BI		bt		BI		bt		BI		bt		
Plant no.		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx		Totals
7309A-3	I	38	11	0	1	5	32	1	2	4	4	93		191
" " 3	I	45	11	3	0	7	41	0	3	7	3	112		232
" " 4	I-1	57	2	1	0	8	60	0	4	2	5	118		257
" " 5	I-1	76	10	5	1	11	68	2	3	4	5	158		343
" " 8	I	41	2	4	0	5	34	0	6	4	6	98		200
Totals	5 ears	257	36	13	2	36	235	3	18	21	23	578		1223

270 A_2 Wx : 38 A_2 wx : 39 var. Wx : 253 var. wx = 600 12.8 % recombination

Table 15

Year 1957

a_2 m1 (Class II) BI | a_2 bt Wx + / wx Spm-activator ? x a_2 bt wx No Spm 07

a_2 m1 BI (Class II) BI | a_2 m1 (Class II) BI " " " x "

(7308 A-4, B-2, B-4)

	Table	No. of	Uniformly Pigmented BI		bt		Colorless, spots of color BI		bt		Colorless BI		bt		%
Culture	reference.	ears.	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx	Totals	Recombination
7456	A, Table 2	see Table (10A)													11.1
7306A	B Table 2	3	101	23	4	3	22	104	0	1	2	7	248	515	18.5
7307A, B-1	C Table 2	10	543	73	31	3	67	537	8	41	40	53	1201	2597	11.5
7307B-2	" "	3	145	27	13	6	35	165	2	9	12	19	372	805	17.4
" B-3	" "	4	140	15	11	1	137	226	8	10	18	23	565	1154	
" B-4	" "	2	97	7	8	2	120	164	5	4	14	29	386	831	
7313	D " "	2	108	7	3	1	14	102	0	3	4	3	238	483	9.2
7306B-2	B Table 2	1	28	2	1	0	24	60	1	1	7	1	133	258	
7309A	A, Table 3	5	257	36	13	2	36	235	3	18	21	23	579	1223	12.8
7308A4, B-2, B-4	B Table 3	5	355	53	—	—	37	331	-	-	0	1	—	777	11.8
7308B-1	B Table 3	3	92	22	7	3	12	121	3	7	8	15	219	509	14.9
	" "														

7572

	uniform pigmented BE		bt		variegated - BE Wx		wx		var. bt*		colorless BE		bt		Totals
	Wx	wx	Wx	wx	2Spm	BSpm	2Spm	BSpm	Wx	wx	Wx	wx			
7572-1	91	13	3	1	1	21	3	96	1	2	4	1	219		456
" -2	47	10	4	1	0	8	0	45	1	2	11	11	114		254
" -2	24	10	2	0	0	6	0	30	0	0	0	6	65		143
" -3	59	17	2	0	0	14	0	73	0	7	11	3	154		340
" -6	7	1	0	0	0	4	0	4	0	0	0	1	26		43
" -7	53	7	7	0	0	6	0	34	0	2	3	3	96		211
Totals	281	58	18	2	1	59	3	282	2	13	29	25	674		1447

299 A_2 Wx: 60 A_2 wx : 6 a var Wx : 298 var wx = 719 16.9 % recombinant wx

7572-3 F x 7537 C-1 a_2 wx (class 2) bt / a_2 bt, wx wx, no Spm

all other sheet

		uniform Pigmented				variegated				Colorless					
		BI		bt		BI		bt		BI		bt			
Plant no.		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx		Totals	
7560-1 I		3	78	0	5	78	8	4	0	7	5	166			
" -1 II		7	98	0	5	113	10	8	8	9	7	218			
" -5 I		7	79		1	98	11	5		7	5	176			
Totals															
7560-3 ~~pollen~~ t		22	21	1	0	22	23	0	0	2	4	54*			
7560-6		31	31	4	3	28	36	2	0	6	5	136			
	Totals	53	52	5	3	50	59	2	0	8	9	190			
75604-I		7	13	0	0	76	56	2	1	1	8	161			
" -4 I-1		23	18	1	1	88	76	2	4	5	8	210			
Totals		30	31	1	1	164	132	4	5	6	16	371			

all other pollen

7

F02

Table 15

	Uniformly Pigmented BI		bt		var. BI		bt		Colorless BI		bt			%
	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx+wx		Totals	c.o.
7313A② t	83	5	2	1	6	67	0	2	3	3	193		365	7.8
7313B-4 I	39	14	1	0	74	58	4	1	5	7	206		409	
" B-4 t-2	25	2	1	0	7	35	0	0	1		45		116	
Totals	64	16	2	0	81	93	4	1	6	7	251		525	
7312-5	117 1)	7 2)	–	–	11 3)	117 4)	–	–	0	0	– –		252	7.1
7547A① t-1 (a2 w/c pale-spotted)	1	21	0	1	12	1	0	0	1	2	23		62	
" A② I	11	75	0	4	101	7	11	1	9	8	184		411	
" A② t	5	73	0	3	78	4	8	0	10	8	142		331	
" A③ I	11	72	3	13	70	2	9	0	13	10	145		348	
Totals.	28	241	3	21	261	14	28	1	33	28	494		1152	7.7
31 pale Wx :	262 pale wx : 289 var Wx : 15 var. wx = 597													
7547C② (A2)	0	25	0	2	28	2	1	0	2	1	49		110	5.1

1) 55 A2 : 62 pale
2) 2 A2 : 5 pale
3) 4 A2 state : 7 pale state
4) 49 " " : 68 " "

Table 16

Phenotypes of Kernels

Culture	Table 3 reference	Number of Ears	Uniformly Pigmented BT Wx	Uniformly Pigmented BT wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Colorless with spots of pigment BT Wx	Colorless with spots of pigment BT wx	Colorless with spots of pigment bt Wx	Colorless with spots of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Total	% Recombination Span-Wx
7309 A	A, Table 3	5	257	36	13	2	36	235	3	18	21	23	579	1223	12.8
7308 A-4 B-2, B-4	B, Table 3	5	355	53	-	-	37	331	-	-	0	1	-	777	11.8
7308 B-1	B, Table 3	3	92	22	7	3	12	121	3	7	8	15	219	509	14.9
7563 A, B	B, " 3	17	141	1419	20	124	1484	121	93	10	132	147	3121	6,812	8.5
" A-2	" " "	2	96	84	7	3	80	85	2	2	6	13	324	702	0
7546	" "	12	650	76	45	5	81	633	10	36	55	70	1464	3,125	11.2
7546-8	" " "	2	44	28	3	1	113	111	3	7	13	15	306	644	
7546-9	" " "	1	46	9	8	0	17	75	2	4	7	5	179	352	
7573 A	" " "	5	183	21	14	2	236	350	17	21	36	34	739	1653	
7573 B	" "	3	159	13	9	2	8	137	0	10	17	9	299	663	6.8
7576	" "	2	109	19	8	2	9	138	0	6	7	14	241	553	10.3
7570 B		12	60	683	6	84	715	66	83	6	96	95	1492	3,386	8.1

Table ~~18~~ A A + B a_2^{m1} BI/a_2^s bt Wx spm/wx + q x $a_2$bt/$a_2$bt, wx/wx or no spm

		Uniformly Pale BI		bt		Colorless with spots of A_2 pigment BI		bt		Colorless BI		bt	Totals	
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx		odds.
7547A-1	tiller-1 ✓	1	21	0	1	12	1	2	0	1	2	23	64	
" A-2	1st ear main stalk ✓	11	75	0	4	101	7	11	1	9	8	184	411	2 A_2BI
" A-2	tiller ear ✓	5	73	0	3	78	4	8	0	10	8	142	331	
Totals		17	169	0	8	191	12	21	1	20	18	349	806	
		Uniformly dark pigmented												
7547C-2		0	25	0	2	28	2	1	0	2	1	49	110	
Totals		17	194	0	10	219	14	22	1	22	19	398	916	

No spm Wx = 17 Spm Wx = 241 Total = 477 6.7% recombination
No spm wx = 204 Spm wx = 15

Table 18 B

		Uniformly pigmented BI		bt		Diffuse-mottled BI		bt		Colorless, spots of A_2 pigment BI		bt		Colorless BI		bt	Totals
		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx and wx	
7547A-1	tiller-2	12	43	0	4	11	0	0	0	21	1	0	0	2	1	89	184
✓ " A-3	1st ear, main stalk	11	72	3	13	3	1	0	0	67	1	9	0	13	10	145	348
" A-5	2d ear "	17	9	0	2	0	0	0	0	1	0	0	0	1	1	17	48
Totals		40	124	3	19	14	1	0	0	89	2	9	0	16	12	251	580
7547B	tiller	12	41	0	1	7	0	0	0	17	1	1	0	2	1	60	143
" C	1st ear main stalk	79	89	7	6	6	1	2	0	3	0	0	0	5	1	161	360
Totals		91	130	7	7	13	1	2	0	20	1	1	0	7	2	221	503
Grand Totals		131	254	10	26	27	2	2	0	109	3	10	0	23	14	472	1083

3.2% recombination

Table 18 C

		Uniformly pale BI		bt		Colorless with spots of A_2 pigment. no pale spots BI		bt		Colorless with spots of A_2 pigment and pale areas BI		bt		Colorless BI		bt	total
♀ 7547A-1, 2nd ear main stalk		Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx	wx	Wx + wx	
+ 7538-3	$a_2$bt/$a_2$bt wx/wx 1 spm.	33	27	4	6	36	1	2	0	0	30	0	1	6	8	131	285
♂																	

17 Work Table - Delayed action Spm: Plants entered in Table 2, B, C, D; Table 3 A, B

Plant Number	Uniformly Pigmented BT Wx	Uniformly Pigmented BT wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Diffuse-mottled BT Wx	Diffuse-mottled BT wx	Diffuse-mottled bt Wx	Diffuse-mottled bt wx	Colorless spots of pigment BT Wx	Colorless spots of pigment BT wx	Colorless spots of pigment bt Wx	Colorless spots of pigment bt wx	Colorless BT Wx	Colorless BT wx	Colorless bt Wx and wx	Totals	Remarks.
Table 3 B, C, D.																	
7309A-4 t-2																	
7309A-5 I																	
7309A-6 I	117	108	10	9	1	11	0	1	0	6	0	0	15	4	229		
" A-9 I	74	23	7	0	0	17	0	1	1	51	0	5	3	5	198		
~~7313B-3 I~~																	
7546-2 I	41	40	2	6	0	0	0	0	0	3	0	0	6	3	87		
7570A-1 I	7	3	0	0	1	2	0	0	0	3	0	2	2	1	20		
" -1 II	22	10	1	1	0	2	0	0	0	3	0	1	2	3	23		
" A-4 I	14	16	5	4	0	1	0	0	0	0	0	1	2	3	47		
7573A-1 I	47	30	3	4	0	4	0	1	40	53	4	1	3	8	162		
Table 2, A + BC, D																	
7560-3 I	70	56	2	4	7	15	0	1	12	10	0	1	4	6	185		
" " II	33	44	4	3	0	0	0	0	0	1	0	0	3	4	85		
7561-2 I	98	78	11	7	8	0	0	0	0	0	0	0	11	10	180		
" 2 II	92	101	11	10	1	0	0	0	2	1	0	0	14	12	187		
7572-4 I	108	—	10	—	13	—	0	—	15	—	0	—	16	—	140		
7572-5 I	58	64	7	5	0	0	0	0	1	0	0	0	6	8	121		
" " II	94	47	9	4	0	7	0	0	4	29	0	2	2	13	176		
7313A-1	123	—	5	—	0	0	0	—	26	—	1	—	6	—	164		
" A-2	256	—	11	—	0	—	0	—	6	—	2	—	16	—	234		
" B-1 I	53	22	6	2	0	0	0	0	5	18	0	1	3	2	121		
" B-2 I	195	—	15	—	3	—	0	—	2	—	2	—	22	—	226		
" B-3 I	81	54	6	3	0	0	0	0	0	13	0	1	2	2	135		
7547A-5 II	17	9	0	2	1	0	0	0	0	0	0	0	1	1	17		
" BC	12	41	0	1	7	0	0	0	17	1	2	0	2	1	60		
" C I	76	89	7	6	6	1	2	0	3	0	0	0	5	1	161		

Table ~~26~~

A.

Spm Constitution and location.	number of ears.	Uniformly Pigmented BI Wx	Uniformly Pigmented BI wx	Uniformly Pigmented bt Wx	Uniformly Pigmented bt wx	Spots of pigment in colorless background BI Wx	Spots of pigment in colorless background BI wx	Spots of pigment in colorless background bt Wx	Spots of pigment in colorless background bt wx	Colorless BI Wx	Colorless BI wx	Colorless bt Wx and wx	Total	% Recombinat.
Wx+| wx Spm	12	650	76	45	5	81	633	10	36	55	70	1464	3125	11.2
Wx|Wx 1 Spm. (7546-6)	3	258	-	12	-	207	-	17	-	34	-	478	1006	
Wx+| wx ~~Spm~~ 2 Spm ~~plus 1 Spm~~ (7546-8)	2	44	28	3	1	113	111	3	7	13	15	306	644	
Wx++| wx Spm Spm (7546-9)	1	46	9	8	0	17	75	2	4	7	5	179	352	

B.

7546-1 I x 7538-3		43	4	1	0	39	78	1	1	7	6	190	370	
" -2 II x " -13		32	3	7	1	48	105	4	3	5	6	198	412	
" -7 II x " -14		36	4	2	1	22	49	1	2	4	3	105	229	
Totals		111	11	10	2	109	232	6	6	16	15	493*	1011	

For change in spin action in 7538 spin plants. Crossed to a_2^{m-1}
class I, no spin ♀

7538 (1) to 7545 C (2) I

7538 (3) to 7584 A (3) I
7586 A (3) I
7586 B I
7603 C (4) I
7616 A (4) I

7538 R (4) t-1 to
7584 A (7) I
7586 A (2)

7538 (9) to
7615 B (1) I
7616 B (1) I
7616 C I

7538 (10) to
7616 A (3) I
7616 B (4) I

7538 (12) to
7584 A (3) I
7616 A (3) II

7538 (13) to
7586 A (4) I
7614 E (2) II see

7538 (14) to
7586 A (1) I
" A (2) II
" A (7) t-2
7614 E (1) II
7616 B (5) I

pale spotted states

7547A	W+Spm/ w+	From 7312 (5) ✓
7556	W+ +/ w+Spm (+1 spm fm ?)	" 7308 D (1) ✓
7564	W+ +/ w+Spm	" " D (1) t-1 ✓
7565	W++/ w+Spm	" " D (1) ✓
7571	" " "	" " D (2) t-1 ✓
7578		From 7467 (1) I
7579		" " (7) I
[7580 pale-early]		" 7470A (5)
7581		" " A (5) I
7582B	W++/ w+spm (from 7312 (6))	
7583AB	W++/ w+spm	from 7308 D (2) ✓
7584B	From 7305C (4) t-2	
7585	W++/ w+Spm	From 7308 D (1) ✓
7586	From 7463 E (5) I	
7587	" " E (5) t-2	

pale-early

7559A	
7601	From 7308 D (1) t-2 ✓ (W++/w+Spm)
7602	" 7308 D (2) t-1 ✓
7603	" 7320C (3) I
7605	" 7308 D (1) t-1 ✓
7607	" 7308 D (1) ✓
→	
7608	" 7317C (9) I
7609	" " B (2) II
7610	" 7308D (1) t-1 ✓
7611	" 7322A (1)
7612	" " A (2)
7613	" " A (4)

Wx+/ur spm-active	Wx Spm/ur+ active	Wx+/ur spm+ 1 spm	Wx+/ur spm+ 2 spm	T Wx ur + 1 spm	T Wx ur 2 spm
1957	1958				
	~~7547~~	7306B-2	7306B-1	7306-3	7560-4
7306A-1	7560-1	7307B-3 4		7560 3	
" -4	" -5	7308B-3		" 6	
" -5	7561 3 4 5	7573A 2 3 4 5		7563A 2	
" -6	7562 1 2 3	7556		7546 8 [9]	
7307A 2 3 4 5 6	7777A 1 2 4				
" B-1 2	" B 1 2				
7572 1 2 3 5 6 7					
7312 5	7547A-1 2 3				
	" B 2				
7309A 3	7563A 1 3 4 5				
	" B 1 2				
7308A 4 5	7546 1 2 3 4 5				
" B 1 2 4	7 10 11 12				
7573B 4					
7588A BCD					
7585B					
7566A					
7564					
7583A					

Figure 7. Combinations of states.

		Original		5700A		5713B-2		5714F		5715A		5718		5719A-1		5719A-2		5996-4		5999		5720		w/spu	w/o spu (all non-variegated plants)
		P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	C	V		
5720	C											+		+	+							+	+	+	+
	V		+	+								+	+	+	+								+	+	
5999	P			+								+		+	+					+	+			+	+
	V											+		+	+						+			+	
5996-4	P											+		+	+			+	+					+	+
	V											+		+					+					+	
5719A-2	P		+									+	+	+	+	+	+							+	+
	V		+	+								+	+	+			+							+	
5719A-1	P		+	+	+	+	+	+	+		+	+	+	+	+									+	+
	V		+	+		+		+				+	+		+									+	
5718	P	+	+	+	+	+	+	+	+		+	+	+											+	+
	V		+										+											+	
5715A	P																							+	
	V										+													+	
5714F	P							+	+															+	+
	V								+															+	
5713B-2	P					+	+																	+	+
	V						+																	+	
5700A	P		+	+	+																			+	+
	V				+																			+	
Original	P																							+	
	V		+																					+	

P = pale plant
V = variegated plant
C = non-pigment plant, state 5720 with w/o spu

Fig. Part III

Figure 2

KEY TO PROGENY TESTS: TRANSPOSITION OF Spm IN THE a_1^{m-1} CULTURES

1. Progeny of self-pollinated ear of plant 6629A-4 (Y Spm/y +). Page

2. Progeny of plant 6629A-8 (Y Spm Spm/y + +) = culture 6676 Table 31

3. Progeny of plant 6629A-2 (Y Spm Spm/y + +, plus 2 non-linked Spm)

   Tiller ear = culture 6667, Table 32

   First ear, main stalk = culture 6668, Table 34

4. Progeny of plant 6667F-11 (Y Spm Spm/y + +) = culture 6884, Table 33

5. Progeny of plant 6668C-6 (Pr +/pr Spm) = culture 6877, Table 34

6. Progeny of plant 6668C-3 (Wx +/wx Spm plus 1 non-linked Spm), = culture 6872, table 35

7. Progeny of plant 6872A-12 (Wx Spm/wx +) = culture 7285, tables 36 to 38

8. Progeny of second ear, main stalk of plant 7285A-1 (Wx Spm/wx +) = culture 7330, Tables 39 to 41

9. Progeny of ear of tiller of plant 7285A-1 (Wx/wx; 1 Spm) = culture 7331, table 42

10. Progeny of second ear, main stalk ofplant 7285A-2 (Wx Spm/wx +) = culture 7332, tables 39 to 41

11. Progeny of tiller ear of plant 7285A-7 (Wx Spm/wx +) = culture 7333, tables 39 to 41

13. Progeny of first ear, main stalk, of plant 7285B-6 (Wx Spm/wx +) = culture 7334, tables 39 to 41

14. Progeny of plant 6666C-7 (See table 26) = culture 6895. See pages

15. Progeny of plant 6895A-1 (Y Spm/y +) = culture 7260, table 43

16. Progeny of plant 6895B-3 (Wx Spm/ wx +) = culture 7261, table 44

17. Progeny of plant 6704B-4 (Y Spm/y +) = culture 6888, table 45

18. Progeny of plant 6629A-5 (Y Spm Spm/y + + plus 1 Spm, not linked to Y) = cultures 6671, 6672, table 46

19. Progeny of plant 6671F-2 (Wx +/wx Spm) = culture 6873, table 47

20. Progeny of plant 6666C-2 from first ear of main stalk. See Table 26 = culture 6869, table 48

21. Progeny ofplant 6665G-16 (Y/y; 1 Spm) (See table 24) = culture 6866, table 49

22. Progeny of plant 6665G-21 (Y/y; 1 Spm) (See table 24)

From self-pollinated ear of tiller = culture 6863, table 50
From testcross ear = culture 6867, table 50

23. Progeny of plant 6665E-10 (Y/y; 2 Spm) (See table 26)

From first ear, main stalk = culture 6864, table 51
From ear of tiller = culture 6865, table 51

24. Progeny of plant 6629B-5 (y/y; Pr + +/pr Spm Spm)

From first ear, main stalk = culture 6683, tables 52 and 53
From second ear, main stalk = culture 6684, table 54
From ear of tiller = culture 6685, tables 52 and 53

25. Progeny from ear of tiller of plant 6683D-2 (Pr +/pr Spm) = culture 6878, table 55

26. Progeny from ear of tiller of plant 6685F-3 (Pr +/pr Spm) = culture 6882, table 56

27. Progeny ~~from~~ of plant 6685G-2 (Pr Spm/Pr +) = culture 6875, table 57

28. Progeny of plant 6684D-1 (Pr Spm/pr +)

From pollen = cultures 6880 and 6881, table
From self-pollinated ear of tiller = culture 6879, table

29. Progeny of plant 6680F-4 (See text, page) = culture 687~~5~~4, table

30. Progeny of plant 6703E-10 (See text, page) = culture 687~~4~~6, table

31. Progeny of plant 6680C-2 (See text, page) = culture 6861, table

32. Progeny derived from self-pollinated ear of plant 6665G-13 (Y Spm/y +) (See table 24) = culture 6862, table

Figure 3

Constitution of plants in cultures 6683 and 6685

1. Pr/Pr; 1 Spm

   Plants in culture 6683: D-1, [redacted], [redacted], E-13
   Plants in culture 6685: F-1 tiller ear, G-2, H-6

2. Pr/Pr; 2 linked Spm
   Plants in culture 6683: D-4, D-5, E-7
   Plants in culture 6685: F-1 first ear of main stalk, H-3

3. Pr/Pr; 2 linked Spm plus 1 Spm, not linked to others
   Plant 6683C-4

4. Pr + +/pr Spm Spm
   Plants in culture 6683: A-2, C-1, C-2, C-3, D-2 ear of main stalk, E-9, E-10
   Plants in culture 6685: F-5, G-1, H-4, H-9, H-14, H-15, H-17, H-18, H-20, H-21, H-25

5. Pr +/pr Spm plus 1 non-linked Spm
   Plant 6683E-4

6. Pr +/pr Spm
   Plants in culture 6683: D-2 ear of tiller, D-3, E-8
   Plants in culture 6685: F-3, F-4, G-3 first ear main stalk, H-5, H-10

7. Pr/pr; 1 Spm not linked with pr or very loosely linked with it.
   Plant 6685H-24

Figure 4

Constitution of plants in culture 6684

1. Pr Spm/pr +

   Plant 6684D-1

2. Pr Spm Spm/pr + +

   Plants D-2, D-3, E-5, E-16

3. pr/pr; 2 linked Spm

   Plants 6684A, E-8, E-9, E-11

4. pr/pr; 1 Spm

   Plants 6684E-2, E-3, E-4, E-12, E-13, E-15

Figure 5

Summer 1954

Plant 6683B-2 ♀ x 6641A-5 (See table 19) ♂

a_1^{m-1} (state 5719A-1) Sh_2/a_1 sh_2 — a_1^{m-1} (state 5719A-1) $Sh_2/$ a_1^{m-1} (state 5719A-1) Sh_2

Pr Spm-w/Pr + — pr/pr

y/y — Y/y

Wx/wx — wx/wx

← Progeny grown in summer of 1955 under culture number 6888: Plants either a_1^{m-1} Sh_2/a_1^{m-1} Sh_2 or a_1^{m-1} Sh_2/a_1 sh_2

6888 A and B = plants derived from uniformly pale colored, Pr, Y Wx kernels (see table 63)

6888C = Plants derived from colorless kernels with few A_1 dots, Pr, Y, Wx (see table 64)

6888D = Plants derived from colorless kernels with few A_1 dots, Pr, y, Wx (see table 64)

1. All but 1 plant in culture 6888 was crossed by one of four plants in culture 6861

Constitution of plants in culture 6861: All were a_1 sh_2/a_1 sh_2, y Spm-s/y +, Wx/Wx

Plants 6861- 1 ~~and 8 were~~ was Pr/pr

Plants 6861-5, -7 and -8 were pr/pr

Plant 6861-1 crossed to plants 6888A-1, B-3, C-1, C-3 2nd ear main stalk, D-4

" 6861-5 crossed to plants 6888A-4, C-2, C-3 1st ear main stalk, C-4, C-5 1st and 2nd ear, main stalk, D-1, D-3, D-5

" 6861-7 crossed to plant 6888B-1

" 6861-8 crossed to plants 6888A-3, A-5, B-2, D-6

2. Plant 6837-1, a_1^{m-1} (state 5718) Sh_2/a_1^{m-1} (state 5718) Sh_2, pr/pr, y/y, wx/wx, crossed to plant 6888D-2 (see text, page 00)

Figure 5 (continued)

Progeny of plants in culture 6888 grown in the summer of 1956

1. Culture 7262 from kernels on ear of plant 6888C-3 (1st ear, main stalk ♀) x 6861-5 ♂ (see above for constitution)
   $\underline{a_1}^{\underline{m}-1}$(state 5719A-1)$\underline{Sh_2}/\underline{a_1}^{\underline{m}-1}$(state 5719A-1) $\underline{Sh_2}$
   $\underline{Pr}$ $\underline{Spm}$-$\underline{w}/\underline{pr}$ +
   $\underline{Y}/\underline{y}$

   7262A: From kernels that were uniformly pale colored, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{y}$
   7262B: From kernels that had many $\underline{A_1}$ spots in colorless background, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{Y}$ (see figure 7)
   7262C: From kernels that were colorless with few $\underline{A_1}$ spots, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{Y}$ (see figure 6 and table 65)
   7262D: From kernels that were cololrless with few $\underline{A_1}$ spots, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{y}$ (see figure 6 and table 65)

2. Culture 7263 from kernels on second ear, main stalk ♀ of plant 6888C-3 (see above for constitution) x 6861-1 ♂ (see above for constitution).
   7263A: From kernels that had many dots of $\underline{A_1}$ in colorless background, $\underline{Pr}$, $\underline{Y}$ $\underline{Sh_2}$ (see figure 7)
   7263B: " " " " " " " " " " " , $\underline{Pr}$, $\underline{y}$ $\underline{Sh_2}$ (see figure)
   7263C: From colorless kernels with few $\underline{A_1}$ dots, $\underline{Pr}$, $\underline{Y}$ $\underline{Sh_2}$, (see figure 6 and table 65)
   7263D: " " " " " " " , $\underline{Pr}$, $\underline{y}$ $\underline{Sh_2}$, (see figure 6 and table 65)

3. Culture 7264 from kernels on ear produced by cross of plant 6888D-2 ♀ x 6857-1 ♂ (see above for constitution).
   $\underline{a_1}^{\underline{m}-1}$(state 5719A-1) $\underline{Sh_2}/\underline{a_1}^{\underline{m}-1}$(state 5719A-1) $\underline{Sh_2}$
   $\underline{Pr}$ $\underline{Spm}$-$\underline{w}/\underline{pr}$+
   $\underline{y}/\underline{y}$
   $\underline{Wx}/\underline{wx}$

   7264A: From kernels that were uniformly pale colored, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{Wx}$ (see text: p 200)
   7264B: From kernels that were colorless with few $\underline{A_1}$ dots, $\underline{Sh_2}$, $\underline{Pr}$, $\underline{Wx}$ (see figure 6 and table 65)

Figure 6

Constitution of plants in cultures 7262 to 7264 having Spm-w but no Spm-s. The types of kernels appearing on the testcross ears of these plants are entered in table 65.

Pr Spm-w/pr + : Plants 7262C-1, C-2, D-1, D-2, D-4
7263C-2, C-4, C-6, D-1, D-2
7264B-1 to B-10

Pr +/pr Spm-w : Plants 7263D-3, D-4

Pr/pr; 1 Spm-w : Plants 7262C-5, C-7

Pr/Pr; 1 Spm-w : Plants 7263C-1, C-3

Figure 7

Constitutions of plants having Spm-s in cultures 7262 and 7263

No Spm-w in plant (see table 66)

1. Y +/y Spm-s; Pr/Pr Plant 7263A-5
   Pr/pr Plants 7262B-4; 7263A-1, A-4, A-6, A-7

2. Y +/y Spm-s plus 1 Spm-s; Pr/Pr Plant 7263A-3

3. Y +/y Spm-s; ~~Pr Spm-s/pr +;~~ plus 2 Spm-s; Pr/pr Plant 7262B-2

4. y/y; 1 Spm-s; Pr/Pr Plant 7263B-6
   Pr/pr Plants 7263B-3, B-9

5. y/y; 2 Spm-s; Pr/pr Plant 7263B-2

Spm-w present in plant

1. Y +/ y Spm-s; Pr Spm-w/pr + Plants 7262B-1, B-3, B-5; 7263A-8 (table 67)

2. Y/y; 1 Spm-s; Pr Spm-w/pr + Plant 7263A-2 (table 67)

3. y/y; 1 Spm-s; Pr Spm-w/ pr + Plants 7263B-1, B-4, B-8 (table 68)

4. y/y; 2 Spm-s; Pr Spm-w/pr + Plant 7263B-7 (table 68)

Photographs

1. States of $a_1^{m_1}$ with + without Spin - kernels
2. States of $a_2^{m_1}$ " " " - kernels.
3. The Interfer of Spin + $a_1^{m_1}$ action - kernels

Table 1. Crosses of plants in culture 7109 that were a_2 w-1 BT/a_2 bt tester plants equal genotypes for a_2 and bt and having no spots.

Phenotype of kernels on ear

1958

Plant Number	Part of plant Tested	Aleurone color* Pigmented BT	Pigmented bt	Colored spots in colorless background BT	bt	Colorless BT	bt	Culture numbers*
7109B-1	~~Fat~~ ear, main stalk	101	9	19	0	6	133	7456
	Ear, tiller-1	99	3	85	2	8	217	7306
	" " -2	90	8	95	2	4	145	7307
	" " -3	121	5	128	3	7	234	
Pollen of 7109B-2	main stalk							
	~~Fat~~ ear, main stalk	123	13	114	4	19	221	7309
	Ear, tiller-2	124	8	133	8	22	251	
	pollen, main stalk	77	7	91	3	12	185	7310, 7311
7109C-1	~~Fat~~ ear, main stalk	142	7	81	6	10	216	
	Ear, tiller-1	91	5	69	2	11	156	
	" " -2	124	4	125	7	17	233	
	" " -3	73	5	78	2	11	168	
7109C-2	Ear, main stalk	168	13	81	5	23	271	
	" tiller-1	134	7	120	9	15	222	
	pollen, main stalk	176	7	153	12	23	337	
7109C-3	Ear, main stalk	214	15	7	1	12	228	
	" tiller-1	127	4	111	4	7	243	
	" " -2	114	2	105	3	5	226	
	pollen, main stalk	77	4	38	0	5	137	
7109C-4	Ear, main stalk	127	7	96	3	12	222	7455

* On ears that gave clear cut ratios of 1 pigmented to 1 colorless kernel in the a_2 w-1 cross, almost all of the pigmented kernels had a phenotype resembling that produced by a recessive a_2 gene. On the ears in which the pigmented class had a value closer to many kernels were "differing mottles". Key to for observation of the pigment distribution in this class of kernels.

* Culture numbers given to plants growing the following year from kernels in the underlined classes.

Table 2. 7

A. Tests of Spm activity in progeny derived from kernels on the first ear of main stalk of plant 7109B-1.

Plant no.	Spm location in plant	Spm activity in cells giving rise to: Ear-I main stalk	Ear-II main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Pollen
Year 1956							
7109B-1	Wx++ / un Spm	d		+	+	+	main stalk: + and −
Year 1957							
7456B-5	Wx++ / un Spm	−		d	d		
" C-1	Wx Wx; 1 Spm	−		d			
" C-2	Wx++ / un Spm	−	vd				
" C-3	Wx++ / un Spm	−	vd	d	d	d	
" C-4	Wx++ / un Spm	−	−	−			d
" D-1	Wx++ / un Spm	−	−				
" D-2	(Wx++ / un Spm)	vd	−	d	d		
" D-3	(Wx++ / un Spm)	−					
" D-4	Wx Wx; 1 Spm	vd		vd	d		
" D-5	Wx++ / un Spm	−	−	vd	d	d	d
" D-7	Wx++ / un Spm	−		vd	vd		d
" E-2	Wx++ / un Spm	−					vd
Year 1958							
7600 (From kernels on tiller-1 ear of Plant 7456C-3)							
1	Wx++ / un Spm	−					
2	Wx Wx; 1 Spm	vd					
3	Wx++ / un Spm	−	−				
4	Wx++ / un Spm	(+−)					
5	Wx++ / un Spm	−					
6	Wx Wx; 1 Spm	−	−				
7	Wx++ / un Spm	−	−				
8	Wx Wx; Spm	−					
9	Wx++ / un Spm	−	−				
11	Wx++ / un Spm	−	−				
12	Wx++ / un Spm	−	vd				
7598 (From kernels on first ear, main stalk, of plant 7456 D-5)							
7	Wx++ / un Spm	vd					
8	Wx Wx; 1 Spm	−					
7599 (From kernels on ear produced from cross with pollen of plant 7456 D-5)							
A-1	Wx++ / un Spm	−					
2	Wx++ / un Spm	−	d				
3	Wx++ / un Spm	d					
4	Wx++ / un Spm	−					
5	Wx Wx; 1 Spm	−					
6	Wx++ / un Spm	−	−				
B-1	Wx++ / un Spm	vd	−	d			
2	Wx++ / un Spm	vd					
3	Wx++ / un Spm	d					
4	Wx++ / Wx Spm	−					

Table 2 A, Continued

Year 1960	Spm number and location		First ear main stalk ♀	First ear main stalk ♂	2nd ear main stalk ♀	2nd ear main stalk ♂	Ear tiller-1 ♀	Ear tiller-1 ♂	Ear tiller-2 ♀	Ear tiller-2 ♂
	(From First ear, main stalk of plant 7599 B-4)									
7780 A-1	W+ Spm	m+ Spm	−	+						
2	" "	" "	−	+						
3	" "	" "	−	d						
4	" "	" "	−	+			+	+	+	+
5	" "	" "	−	d						
6	" "	" "	−	+			d	+		
7	" "	" "	−	(+−)			+	?		
8	" "	" "	−				d			
9					−	+	−	+		
10			−	d			−	+		
7780 B										
1	W+ +	m+ Spm		d				+		+
2	"	"		+				+		
3	"	"								
4	"	"		d		+		+		
5	"	"		+						
6	"	"		d		d		+		+
7	"	"		+		+				
8	"	"								
9	"	"				d				
10	"	"		d				+		+

Table 2 B activity of Spm, derived from tiller-1 of plant 7109B-1, in successive generations.

		Spm activity in cobs giving rise to					
		First Ear main stem	Second Ear, main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Pollen
Year 1957							
7306 (from kernels on tiller ear of 7109B-1, see table 1)							
A-1	Wx++ / wx Spm	+	+	+			
2	Wx++ / wx Spm	−					
T 3	Wx Wx ; 1 Spm	−		+			
4	Wx++ / wx Spm	+					
5	Wx++ / wx Spm	+					
6	Wx++ / wx Spm	+	+				
T B-1	Wx++ / wx Spm plus 2 Spm	+ + *	+ + *	+ + *	+ + *	+ + *	[02 cbz. 5 Spm]
T 2	Wx++ / wx Spm plus 1 Spm	++		++			
Year 1958							
7560 (From kernels on ear of main stalk of plant 7306 A-1							
1	Wx Spm / wx +	+		+	+		
2	Wx Spm / wx +	−					
T 3	Wx wx ; 1 Spm	vd	vd	+			
T 4	Wx wx ; 2 Spm	+ +	+ +				
5	Wx Spm / wx +	+					+ Cud −
T 6	Wx wx ; 1 Spm	+					

Table 2 C. Behavior in successive generations of Spm derived from tiller-2 of plant 7109 B-1

Spm activity in cells giving rise to

Year 1957		First Ear	2nd Ear	Ear	Ear	Ear	Pollen
		main stalk	main stalk	tiller-1	tiller-2	tiller-3	
7307 (derived from kernels on ear of tiller-2, table 1)							
A-1	Wx Wx ; Spm	d					
2	Wx+ / wx Spm	+		+	+		
3	Wx+ / wx Spm	+ 7561	+				
4	Wx+ / wx Spm	+		+			
5	Wx+ / wx Spm	+ 7562	+	+			
6	Wx+ / wx Spm	+					
B-1	Wx+ / wx Spm	+	+	+			
2	Wx++ / wx Spm	+ *	7572 + *	+ *			
T 3	Wx+ / wx Spm plus 1 Spm	+ +	+ +	+ +	+ +	+ +	
T 4	Wx+ / wx Spm plus 1 Spm	+ +		+ +	+ +		
Year 1958							
7561 (From kernels on first ear of main stalk of plant 7307 A-3)							
1	(Wx Spm / wx +)	−					
2	Wx Spm / wx +	vd	vd				
3	Wx Spm / wx +	+	+				
4	Wx Spm / wx +	(+ −) 7777	−	+			
5	Wx Spm / wx +	+					
7562 (From kernels on first ear, main stalk, of plant 7307 A-5)							
1	Wx Spm / wx +	+	+				
2	Wx Spm / wx +	+					
3	Wx Spm / wx +	−		+			
7572 (From kernels on second ear, main stalk, of plant 7307 B-2)							
1	Wx+ / wx Spm	+					
2	Wx+ / wx Spm	+		+			
3	Wx+ / wx Spm	+	+				
4	Wx Wx ; Spm	vd					
5	Wx+ / wx Spm	vd	d				
6	Wx+ / wx Spm	+					
7	Wx+ / wx Spm	+					

Table 2-C continued

Year				Ears						
1960				I	II	t-1	t-2	t-3		
7777	(From kernels on first ear, main stalk, plant 7561-4									
A-1	W+Spm)	wx +		(+-)	(+-)	+	(+-)	+		
A-2	" "	"		+		+				
A-3	" "	"		(+-)						
A-4	" "	"		+		+				
B-1	" "	"		d		+				
B-2	" "	"		d		+	+			
B-3	" "	"		d						
B-4	" "	"		d	d	+				
C-1	" "	"		—						
" 2	" "	"		vd		(+-)				
" 3	" "	"		vd		vd				
" 4	" "	"		—						
D-1	" "	"		—		—	—			
" 2	" "	"		—						
" 3	" "	"		—		—				
" 4	" "	"		—		—				

Table 2 D. Behavior of Spm in successive generations derived from pollen of plant 7109B-1

		~~Ears test of~~ Spm activity in cells giving rise to					
		First ear	2nd Ear	Ear	Ear	Ear	
Year 1957 Culture number or leaf	Spm number and location	Main stalk	main stalk	Tiller 1	Tiller 2	Tiller 3	pollen
7312 (From cross of 7109B-1 ♂ to ♀ a_2^{m-1} (clone I) Bz/a_2bt Wx+ m+ no Spm ♀)							
1	not tested	−					
3	" "	−					
4	" "	+					
5	Wx+/m+ Spm	+					
6	Wx+/m+ Spm	vd		vd	d		
7312 (From cross of A_2Bz/a_2bt Wx+ m+ no Spm ♀ × 7109B-1 ♂)							
A-1	not tested	vd					
2	Wx+/m+ Spm	vd		+			
B-1	" " "	d					
2	not tested	vd					
3	Wx+/m+ Spm	vd					
4	Wx+ m+, 2 Spm I; Wx+/m+ Spm I-1	+		+	+		
5	Wx Wx 1 Spm	+	+				
Year 1958							
7547 (From 7312-5 ♀ × a_2bt/a_2bt m+/m+ no Spm ♂)							
A-1	Wx Spm/m+	−	− × 7535-3	+	d		
2	Wx Spm/m+	+		+			
3	Wx Spm/m+	+					
(4	Wx Spm/m+)	−					
5	(Wx Spm/m+)	−	vd				
B-	Wx Spm/m+	−		d			
C-1	Wx Spm/m+	d					
2	Wx Spm/m+	+					
7582 (From 7312-6 ♀ × a_2bt/a_2bt, Wx Wx no Spm ♂							
A	Wx+/m+ Spm	−		−			
B-1	Wx+/m+ Spm	−					
B-2	Wx+/m+ Spm	−	−				
B-3	" " "	−					

Table 3 A. First ear, main stalk, 7109B-2

$\underline{a}_2$ m' (class II) $\underline{BI}$ / $\underline{a}_2$ $\underline{bt}$; $\underline{Wx}$ + / $\underline{wx}$ $\underline{spm}$ × $\underline{a}_2$ $\underline{bt}$ $\underline{Wx}$ no spm ♂

Plant Number	Location of spm		I	II	t-1	t-2	t-3	pollen		
Year 1957										
T309A-1	[Wx+ / wx spm]		−	−						
" A-2	"	"	−							
" A-3	Wx+ / wx spm		+		+					
" A-4	" "	"		−	+	vd				
" A-5	" "	"	d		+	+				
" A-6	" "	"	vd	vd						
" A-7	[" "	"]	−							
" A-8	Wx+ / wx spm		+							
" A-9	" "	"	d							

Table 3 B From 7109 B ② t-1 self-pollinated. a_2^{m1} (clone II) BI | a_2 bt
Wx + | wx Spm

Plant number	Position of Spm	Ears I	II	t-1	t-2	t-3	pollen	
Year 1957								
7308 A-4	Wx + | wx Spm	+ (7570)	+ (7563)	+ (7546)			+ (7554)	
" A-5	" " "							
" B-1	" " "	d		+	+	+		
" B-2	" " "	+						
T " B-3	not tested	+ +						
" B-4	Wx + | wx Spm	+		+	+			
" C-1	wx wx; Spm/Spm	+ −	+ +	+ −	+ +			
T " C-2	wx wx 3 Spm	+ + +						
" C-3	wx wx Spm/Spm	+ +	+ +					
" C-4	wx wx " "	+ −						
" C-5	wx wx " "	+ +						
T " C-6	wx Spm | wx Spm " + 1 Spm	+ + + (7573)	+ + + (7576)	+ + +				
" D-1	wx + | wx Spm						+	many cultures - see D, table 3
" D-2	wx + | wx Spm						+	" " - " D " 3
Year 1958								
7570 From cross of 7308 A-4, first ear, main stalk, by 7308 D-2, $a_2$bt/$a_2$bt, wx + | wx Spm								
A-1	Wx + | wx Spm	d	d	+	+	+		
A-2	" " "	+	+	+	+			
A-3	" " "	+	+					
A-4	" " "	d		+	+			
A-5	" " "	+		+	+			
A-6	" " "	+	+	+				
A-7	Wx + | wx; 1 Spm	+	+					
A-8	Wx + | wx Spm + 1 Spm	+ +	+ +					
B-1	Wx Spm / wx +	+	+	+				
B-2	" " " "	+	+				+	
B-3	" " " "	−		+	+			
C	Wx Spm | wx Spm	+ + (7817)	+ + (7812)		+ + (7816)		+ +	
7563. From cross of 7308 A-4, 2nd ear main stalk, by $a_2$bt/$a_2$bt, wx/wx, no Spm ♂								
A-1	Wx Spm | wx +	+		+	+			
T A-2	Wx + | wx; 1 Spm	+	+					
A-3	Wx Spm | wx +	+	+	+				
A-4	" " " "	+	+	+	+			
A-5	" " " "	+	+					
B-1	" " " "	+		+				
B-2	" " " "	+	+	+	+	+		

Table 3B, continued.

Plant number	Position of Spm	Ears I	Ears II	Ears t-1	Ears t-2	Ears t-3	Pollen		
7546	From cross of tiller of 7308A-4 by a2bt/a2bt, Wx/Wx, no Spm ♂								
-1	Wx + / wx Spm	+	+						
-2	" " "	vd	+						
-3	" " "	+	+	+					
-4	" " "	+							
-5	" " "	+	+	+					
-6	Wx/Wx, 1Spm	+	+	+					
-7	Wx + / wx Spm	+	+	+					
T -8	Wx + / wx Spm + 1Spm	+ +	+ +						
T -9	Wx + + / wx Spm Spm	+ +	+ +						
-10	Wx + / wx Spm	+							
-11	" " "	+							
-12	" " "	+	+						
7554	From cross of ♀ a2bt/a2bt, Wx/Wx, no Spm × 7308A-5 ♂								
A-1	Wx + / wx Spm	(+-)	-	d					
A-3	" " "	-		-					
A-4	" " "	-	vd	vd					
A-5	" " "	-		vd	-				
7573	From cross of 1st ear, main stalk of plant 7308C-6 by a2bt/a2bt, Wx/Wx, no Spm ♂								
T A-1	Wx + / wx Spm + 1Spm	d + d							
A-2	Wx + / wx Spm + 1Spm	+ +	+ +						
A-3	" " " " "	+ +	+ +						
A-4	" " " "	+ +							
A-5	" " " "	+ +							
A-6	" " " "	+ +							
B-1	Wx + / wx Spm	+							
B-3	" " "	vd	d	+					
B-4	" " "	+	+						
B-5	" " "	d							
7576	From cross of 2nd ear, main stalk, of plant 7308C-6 by a2bt/a2bt, Wx/Wx, no Spm ♂								
	Wx + / wx Spm	+	+	+					

Table 3 C. 7308 D-1 progeny. Year 1958

a_2bt | a_2bt, w_x + | w_x Spm.

I ♀ parent, no spm × 7308D-1

Cars.

7564-65 7588 7588 7597 7601 7605 7607 7778 7781

Position of Spm

Plant No.			I	II	t-1	t-2	t-3	pollen		
7564-1	W_x + | w_x	Spm	+		+	+				
" -2	" "	"	+		+					
" -3	" "	"	+							
" -4	" "	"	+		+					
" -5	"	"	+							
7565A-1	W_x | w_x		−							
" A-2	W_x + | w_x	Spm	d							
" A-3	"	"	(+ −)	+	+					
" A-4	"	"	vd							
" A-5	"	"	+							
" B-1	"	"	vd		vd					
" B-2	W_x | w_x,	Spm	vd							
7566A-1	W_x + | w_x	Spm	(+ −)		+					
" A-2	" "	"	+							
" A-3	"	"	d							
" A-4	"	"	+		+					
" A-5	"	"	+		+	+				
" B	W_x + | w_x Spm + 2 Spm		+ + +							
7567	W_x + | w_x Spm + 2 Spm		+ + +					+ + +		
7568	W_x w_x, no Spm									
7588A-1	W_x w_x		−							
" A-2	W_x + | w_x	Spm	vd	vd						
" B-1	"	"	+		+	+				
" B-2	"	"	+	−						
" C-1	"	" + 1 Spm	+ −							
" C-2	"	" + 1 Spm	+ −	+ −	+ −					
" D-1	"	"	+		+					
" D-2	"	"	vd							
7601B-1	"	"	+							
" B-2	"	"	d							
" B-3	"	"	(+ −)							
" B-4	"	"	+							
" B-6	W_x | w_x	Spm	vd							
" B-7	W_x + | w_x	Spm	+	+						
" B-8	"	" "	+							
" B-9	"	"	+							
7605A-1	w_x w_x	1 Spm	+							
" A-2	" "	1 Spm	+							
" A-3	" "		vd	vd						
" A-5	" "	1 Spm	+							

Table 3C, continued

Plant Number	Position of Spm		I	II	t-1	t-2				
7605 B	wx wx		−							
" C	" "		vd							
7607-1	" "		+							
" -2	" "		vd							
" -3	" "		vd							
" -4	" "		−							
" -5	" "		+							
" -6	" "		d							
II ♀ with delayed action			Spm ×	♂ 7308 D-1						
7585A-1	Wx+/ wx Spm		vd		+					
A-2	" " "		+							
A-3	" " "		vd							
A-4	" " "		vd		+					
A-5	" " "		+							
A-6	" " "		d	vd						
" B-1	" "	+1 Spm	d −		+ +	+ −				
B-2	Wx+/ wx Spm		+							
B-3	" " "		−	−						
B-4	" " "		vd							
B-5	" " " "		+	+						
B-6	" " "		vd							
Insert 7588										
7597 = From 7455C-2 (see Table 4) ♀ × 7308 D-1 Tiller-1 7/26										
7597A-1	Wx+/ wx Spm	+1 Spm	+ −							
A-2	" " "		vd							
A-3	" " "		d							
A-4	" " "	+1 Spm	+ d		− d					
A-5	" " " " "		+ −	+ −						
A-6	[" " ,]		vd							
A-7	Wx+/ wx Spm		vd							
B-1	" " "		d							
B-2	" " "		+							
T] B-3	Wx+/wx+;	1 Spm	+							
T] B-4	Wx wx;	1 Spm	d							
B-5	Wx+/ wx Spm		d							
B-6	Wx/wx		−							
7556	Wx+/ wx Spm	+1 Spm	+ +		+ +					

Table 3-C

Year 1960

Year 1960			Ears I	II	t-1	t-2				
7778 A-1	wy wy		–		–					
A-2					–	–				
A-3			–							
A-4			–							
A-5					–					
A-6			–							
A-7			–		–	–				
A-8			–							
" B			–		–	–				
" C-2			vd							
3			–		–					
4			–							
5			–							
" D			d		+	+				
7781 A	W + Spm	wy +	+	+						

Table 3 A 1957 cultivar

7109B ② Fat lar on main stalk x a2bt yWx no Spm of

7309 A			I	II	t-1	t-2	t-3	pollen		
①	[Wx + | wx spm]		−	−						
②	[Wx + | Wx spm]		−							
③	Wx + | wx spm		+		+					
④	"	"		−	+	vd				
⑤	"	"	d		+	+				
⑥	"	"	vd	vd						
⑦	["	"]	−							
⑧	Wx + | wx spm		+							
⑨	"	"	d							

Table 3B

Ear on tiller-1

From 7109 B ② t-1 self pollinated Wx+/wx Spm - active.

1957

7308			I	II	t-1	t-2	t-3	pollen		
A-4	Wx+/wx Spm		+ (7570-4 ear 1958)	+ (7568-4 ear 1958)	+ (7546-4 ear 1958)					
A-5	" "	see 7554						+		
B-1	"	"	d		+	+	+			
B-2	"	"	+							
B-3	not tested	I+2 Spm	+ +							
B-4	Wx+/wx Spm		+		+	+				
C-1	wx wx	2 Spm	+ +	+ +	+ +	+ +				
C-2	" "	Spm/Spm+1 Spm	+ +							
C-3	" "	Spm/Spm	+ +	+ +						
C-4	" "	Spm/Spm	+ +							
C-5	" "	" "	+ +							
C-6	" "	Spm/Spm+1 Spm	+ + + (7573 4 ear 1958)	+ + +	+ + +					
D-1	wx wx	wx+/wx Spm						+	see separate chart, C Table	
D-2	" "	" "						+	see " " D " 3	

1958

C.D	From kernels on 2nd ear, main stalk, 7308 A-4									
7563 A ①	Wx Spm/wx+		+		+	+				
T " ②	Wx wx; 1 Spm		+	+						
" ③	Wx Spm/wx+		+	+	+					
" ④	" "		+	+	+	+				
" ⑤	" "		+	+						
B-①	" "		+		+					
B-②	" "		+	+	+	+	+			
	From kernels on tiller ear of 7308 A-4									
7546 ①	Wx+/wx Spm		+	+						
②	" "		vd	+						
③	" "		+	+	+					
④	" "		+							
⑤	" "		+	not needed	+					
⑥	Wx Wx; 1 Spm		+	+	+					
⑦	Wx+/wx Spm		+	+	+					
T ⑧	Wx+/wx Spm+1 Spm		+ +	+ +						
T ⑨	Wx++/wx Spm Spm		++	not needed						
⑩	Wx+/wx Spm		+							
⑪	" "		+							
⑫	" "		+	not needed						
	From kernels on first ear, main stalk of plant 7308 C-6									
7573 A ①	Wx+/wx Spm (Transfer)		d							
②	Wx++/wx Spm+1 Spm		+ +	+ +						
③	" " " "		+ +	not needed						
④	" " " "		+ +							
⑤	" " " "		+ +							
⑥	" " " "		+ +							
B ①	Wx+/wx Spm		+							
②			new kernel							
③	Wx+/wx Spm		vd	d	+					
④	" " "		+	+						
⑤	" " "		d							

Table 3 C

7308 D ① wx + / wx Spm - active. Behavior of Spm in subsequent generations

A = 1958 cultures.

A. main stalk pollen - 7/15/57

Plant	Spm location	I	II	t-1	t-2	t-3	pollen		
		Ceanstested							
number.									
7588 A 2	wx + / wx Spm	vd	–						
B-1	wx + / wx Spm	+		+	+				
B-2	wx + / wx Spm	+	–						
C-1	wx + / wx Spm	+							
C-2	wx + / wx Spm	+							
D-1	o wx + / wx Spm	+							
D-2	o [wx + / wx Spm]	vd							
main pollen 7/16/57									
7556	o wx + / wx Spm	d	do						
main pollen 7/21/57									
7565 A-1	o [wx + / wx Spm]	–							
2	o wx + / wx Spm	d							
3	o wx + / wx Spm	d	+	+					
4	o wx + / wx Spm	d							
5	o wx + / wx Spm	+							
7585 A-1	wx + / wx Spm	d		+					
2	wx + / wx Spm	+							
3	wx + / wx Spm	vd							
4	wx + / wx Spm	vd		+					
5	wx + / wx Spm	+							
8	wx + / wx Spm	d	d						
B-1	o " "	do		do	+				
2	o " "	+							
4	o	vd							
5	o " "	+		+					
6	o	vd							
main pollen 7/22/57									
7566 A-1	o wx + / wx Spm	(+ –)		+					
		7776 Year 1960							
2	o " "	+							
3	o " "	d							
4	o " "	+		+					
5	o " "	(+ –)							
pollen m 7/26/57									
7607 -1	o wx wx 1 Spm	+							
2	o " "	vd							
3	o " "	vd							
4	o " "	–							
5	o " " 1 Spm	+							
6	o " " 1 Spm	+							
pollen - 1 7/24/57									
7605 A-1	o wx wx 1 Spm	+							
2	o " " 1 Spm	+							
3	o " "	vd	vd						
5	o " " 1 Spm	+							
C	o " "	vd.							

	♀	♂	I	II	t-1	t-2	t-3	pollen		
7610 A-1	1 spm	Wx+/m spm	+							
2	"	" "	+							
3	"	" "	d	+						
4	"	" "	d	d						
5		" "	vd	vd						
6	"	" "	d	+	+	+				
B-1	"	[" "]	−							
2	"	Wx+/m spm	+							
3	"	" "	(+−)							
4	"	[" "	vd							
6	"	[" "]	vd							
pollen t-1	7/26/57									
7564-1	0	Wx+/m spm	+		+	+				
2	0	" "	+		+					
3	0	" "	+							
4	0	" "	+		(+−)					
5	0	" "	+							
7597 A-1			+							
2		" "	vd							
3		" "	d							
4		" "	d		+					
5		" "	+	+						
6		[" "]	(+−)							
7		Wx+/m spm	vd							
B-1	0	" "	vd							
2	0	" "	+							
T 3	0	Wx m; 1 spm	+							
T 4	0	" " ; 1 spm	d							
5	0	Wx+/m spm	vd							
6	0	[" "]	−							
pollen, t-2	7/24/57									
7601 B-1	0	Wx+/m spm	+							
2	0	" "	+							
3	0	" "	(+−)							
			7781	Year 1960						
4	0	" "	+							
6	0	" "	(+−)							
7	0	" "	+	+						
8	0	" "	(+−)							
9	0	" "	+							

B. 1960 Cultures

7778	constitution	I	II	t-1	t-2				
A-1	ur ur	–		–					
2	" "			–	–				
3	" "	–							
4	" "	–							
5	" "			–					
6	" "	–							
7	" "	–		–	–				
8	" "	–							
B		–		–	–				
C - 2	" "	vd							
3	" "	–		–					
4	" "	–							
5	" "	–							
D	" "	d		+	+				
7781 A	to+spm/ ur +	+							

Table 3 D

Progeny of 7308 D ② wx+/wx spm-active · Summer 1958

	Parent up ♀	♂	I	II	t-1	t-2	t-3	pollen		
main 7/20		spm 7308D-2								
7583 A-1	wx wx 1 spm		+							
2	Wx+/wx spm		+	+	+					
3	" "		+							
4	" "		−		+					
5	" "		+							
B-1	" "		+							
2	" "		+							
3	" "		+	+						
4	" "			+						
5	" "		+							
C-1	" "		+		+					
2	" "		+							
3	" "		+							
T 4	" "				+					
5	" "		+							
6	" "		+							
T D-1	Wx++/wx spm spm				+ +					
2	Wx+/wx spm			+						
main 7/21										
7569										
T* ①	Wx+/wx spm		+		+ +					
2	Wx+/wx "		+		+					
3	" "		(+−)		+	+				
			7779							
4	" "		+	+						
T 5	Wx wx, 1 spm		d							
6	Wx+/wx spm		+			+				
7	" "		−	(+−)						
main 7/23										
7575 A	Wx+/wx spm		d		+					
B	" " "		+							
7570 A	♀ spm	♂ spm	♀ ♂	♀ ♂	♀ ♂	♀ ♂	♀ ♂			
1	Wx+/	wx spm	d	d	+	+	+			
2	" "	" "	+	+	+	+				
3	" "	" "	+	+						
4	" "	" "	d		+	+				
5	" "	" "	+	+	+	+				
6	" "	" "	+	+	+					
T 7	Wx wx,	wx spm	+	+						
T 8	" "	" " + 1 spm	+ +	+ +						
B-1	Wx spm	wx +	+	+	+			+		
2	" "	" "	+	+				+		
3	Wx spm	wx +	−		+	+				
C	Wx spm	wx spm	+ +	+ +		+ +		+ +		

* [illegible] " c − [illegible]

7308 D-2 cont.

			I	II	t-1	t-2	t-3	pollen		
Tiller -1	7/23/57									
7571-1	0	W++/unspun	d	+	+	+				
2	0	" "	+							
4	0	" "	+		(+-)	+				
5	0	" "	+	+	+					
Tiller -1	7/26/57									
7602-1	0	W++/unspun	+							
2	0	" "	+							
T 3	0	W+un; 2spun	+ +							
4	0	[W++/unspun]	nd							
5	0	W++/unspun	nd	nd	+					
Tiller -1	7/27/57									
75917-1	1	W+ ++/unspun	−	−	+					
2	1	" "	+							
3	1	" "	+							
4	1	" "	+							
5		[" "]	d							
6		" "	+							
7		" "	+							
8		" "	+							
T B-1	0	W+un; 1spun	+	+						
2	0	W++/unspun	−	+						
3	0	" "	−	vd	+	+				
T 4	0	W+un; 1spun	+	+						
5	0	W++/unspun	+							
7595A-1	1	W++/unspun	+	+						
2		[ ]	−	nd						
5		W++/unspun	(+ −)							
6	1	" "	+							
T B-1	0	W+un; 1spun	+	+						
2	0	W++/unspun	+							
3	0	" "	+							
4	0	" "	+							
5	0	" "	+							
6	0	" "	+							
1960	Number alters = nonproducts		From inactive → active in refer.							
4779 A-1	un un									
2	" "									
3	" "									
4	" "									
5	" "									
6	" "									
B 1	" "		nd							
2	" "		nd	nd						
3	" "		−	−	−					
4	" "		−	−						
5	" "									
6	" "		nd		nd					

Plants from

1958 7308 D ⊗ t-1 ear × t-2 pollen

	Spm constitution	I	II	t-1	t-2	t-3	pollen		
7538									
1	Spm | Spm	+ +					+ +		
T 2	Spm + Spm	+ +					+ +		
3	1 Spm	+					+		
4	1 Spm	+							
5	1 Spm	+					+		
6	Spm | Spm	+					+		
9	1 Spm	+					+		
10	Spm | Spm	+					+		
12	1 Spm	+					+		
13	1 Spm	+					+		
14	1 Spm	+					+		
R-2	Spm | Spm	+ +					+ +		
R-4	Spm | Spm	+ +					+ +		

Table 3 E. 1960 cultures From

7570C

W+ spm-active / w+ spm-active

(from c.o. 7308A④±) (from 7308D②)

7816
7817
7818

Spm From 7308D② hab			I	II	t-1	t-2	t-3	pollen		
7816 -1										
" -2	3 spm				+ + +					
" -3					+	+				
spm from 7308D③ hab										
7817 -1										
" -2										
" -3					+	+				
" -4				+						
" -5										
spm from 7308D② hab.										
7818A-1	Spm/spm				+ +	+ +				
A-2	1 spm				+					
B-1	1 spm				+					
2	1 spm				+					
3	Spm/spm				+ +			+ +		
4	Spm/spm							+ +		
5	Spm/spm							+ +		
6										
7	1 spm				+					
8	1 spm				+	+		+		
9	Spm/spm							+ +		
10	1 spm				+					
11	Spm/spm							+ +		

Ear 1958

a_2 m-1 (pale - dotted) BI / a_2 bt Wx+ / wx spm - from 7308 D ①

From 7308 D ① m			♂ I ♀	II	t-1	t-2	t-3			
7556	Wx+ / wx spm + 1 spm		d +							
From 7308 D ① t-1										
7564-1	Wx+ / wx spm		+		+	+ x7537 (14)				
" -2	" "		+		+ 7537C ①					
" -3	" "		+							
" -4	" "		+		+ [illegible]					
" -5	" "		+							
From 7308 D ① m										
7565-A1	[Wx+ / wx spm]		−							
" A-2	Wx+ / wx spm		d							
" A-3	" " "		d [illegible]	+ 7537C ①	+					
" A-4	" " "		vd							
" A-5	" " "		+							
" B-1	[" "]		vd		−					
" B-2	Wx wx spm		vd							
From 7308 D ① main										
7585 A-1	Wx+ / wx spm		vd		+					
" A-2	" "		+							
" A-3	" "		vd							
" A-4	" "		vd		+					
" A-5	" "		+ [illegible]							
" A-8	" "		d	vd						
" B-1	" " [+ 1 spm] t-1		d d		+ +	+				
" B-2	" "		+ x7537 C-1							
" B-3	Wx wx		− [illegible]	− [illegible]						
" B-4	Wx+ / wx spm		vd x7537 C-1							
" B-5	" " "		+	+ x7537C-1						
" B-6	" "		vd.							

a_2 m1 (pale-early origin) BI / a_2 bt spm from 7308D①

From 7308D① t-2			I	II	t-1	t-2	t-3			
7601 B①	Wx+ / wx	spm	+							
" B-2	"	" "	d							
" B-3	"	"	(+−)							
" B-4	"	"	+							
" B-6	["	"]	vd							
" B-7	Wx+ / wx	spm	+	+						
" B-8	"	"	+							
" B-9	"	"	+							
From 7308D① t-2										
7605 A-1	wx wx	1 spm	+							
" A-2	" "	1 spm	+							
" A-3	" "		vd	vd						
" A-5	" "	1 spm	+							
" B-1	" "		−							
" C	" "		vd							
From 7308D① main										
7607 -1	wx wx	1 spm	+							
" -2	wx wx		vd							
" -3	" "		vd							
" -4	" "		−							
" -5	" "	1 spm	+							
" -6	" "		d							
From 7308D① t-1 (?)										
7610 B-1	Wx wx		−							
" B-2	Wx+ / wx	spm	d							
" B-3	Wx wx		vd d							
" B-4	Wx+ / wx	spm	vd							
" B-6	" "		vd							

Year 1958

$a_2^{m'}$ (pale-spotted) BI/$a_2$bt spm from 7308 D-②

From 7308 D② t-1		I	II	t-1	t-2	t-3			
7571 [illegible]	Wx+/wx spm	vd ×7537 C①	+	+	+				
" -2	" " "	+							
" -3	Wx wx ~~wx~~ spm	0	0	0 ×7538 ⑭	0				
" -4	Wx+/wx spm	+		(+ −)	+				
" -5	" " "	+	+	+ ×7537C ①					
From 7308 D② main									
7583 A-2	Wx+/wx spm	+	+	+ ×7538 ⑭					
" A-3	" "	+							
" A-4	" "	−		+					
" A-5	" "	+							
" B-1	[" "]	+							
" B-2	Wx+/wx spm	+							
" B-3	" " "	d	d ×7537C ①						
" B-4	" " "	+							
" B-5	" "	+							

			I	II	t-1	t-2	t-3			
From 7308 D (2) t-1										
7602-1	W+ + | w+ Spm see		+							
" - 2	" " " see		+							
" - 3	W+ w+ ; 2 Spm		+ +							
" - 4	[W+ + | w+ Spm]		vd							
" - 5	W+ + | w+ Spm		(+ −)	vd	+ × 7538 (14)					

$a_2^{m'}$ (pale-dotted) BI | a_2^{s} bT From 7312 (5)

W+Spu | ex + Ear

			I	II	t-1	t-2	t-3			
7547 A-1	pale-spotted		−	x7538-3 1Spu	+	d				
" A-2	" "		+		+					
" A-3	" "		d to +							
" A-4	" "		−							
" A-5	" "		−	vd						
" B. =	A_2 state		−		d to +					
" C-1	" "		vd							
" C-2	" "		+							

For table 2

Spm from ear II of 7109B①. + from pollen of ~~[illegible]~~ 7109B④

– = inactive spm
vd = " " except for 1 or several kernels
d = delayed action spm
+ = fully active spm.

A = from ear I

Ears tested.

	Location of Spm	I	II	t-1	t-2	t-3	pollen tested		
7109B①	I 1956	vd 7456B-5							
7456 B-5	W+H m spm 1957	–		d	d				
" C-1	W+W+ 1 spm	–		d					
C-2	W++1 m spm	–	vd						
C-3	" " " "	–	vd	d	d	d			
C-4	" " " "	–	–	–			d		
D-1	W+ " " "	–	–						
D-2	" " " "	vd	–	d	d				
D-3	[" " "]	–							
D-4	W+W+ 1 spm	vd		vd	d				
D-5	W++1 m spm	–	–	vd	d	d	d		
D-7	" " " "	–		vd	vd		~~vd~~		
#-2	" " " "	–					vd		
	1958								
7600 (from 7456C③ t-1)	① W++1 m spm	–							
②	W+W+ 1 spm	vd							
③	W++1 m spm	–	–						
④	W++1 m spm	– ~~vd~~ + sector							
⑤	" "	–							
⑥	W+W+ 1 spm	–	–						
⑦	W++1 m spm	–	–						
⑧	W+W+ spm	–							
⑨	[W++1 m spm]	–	–						
⑩	W++1 m spm	–	–						
⑫	" " " "	–	vd						
7598 (from 7456 D⑤ I									
⑦	W+ m 1 spm	vd							
⑧	W+W+ 1 spm	–							
7599 from pollen of 7456 D⑤									
A ①	W++1 m spm	–							
②	" " "	–	d						
③	" " "	d							
④	" " "	–							
⑤	W+W+ 1 spm	–							
⑥	[W++1 m spm]	–	–						
B ①	W++1 m spm	vd	–	d					
②	" " "	vd							
③	" " "	d							
④	W+~~W~~+ spm	*7538-14	–						
1960	(active spm not valued – not recorded here).								
7780H①	(Important) W+ m W+ m 2 spm	+ d spm		q spm	r spm	Reference in chart.			
②	W+ spm m spm	+							
③	" "	–	–						
④	" " " "	– +		+	+	+	+		
⑤	" " " "	– d							
⑥	" " " "	– +		d	+				
⑦	" " " "	(–) (+–1)		–					
⑧	" " " "	–		d					

			I ♀	I ♂	II ♀	II ♂	t-1 ♀	t-1 ♂	t-2	t-3	pollen		
7580A (9)	W+Spm / wx Spm		−	+	−	+	d	+					
" " (10)	" "	" "	−	d			~~d~~	+					
1957 D table 2		Pollen = aerosol action.											
7312 - 1	From pollen of 7109B (1)		−										
2													
3			−										
4			d										
5	W+ + / wx Spm		(+)										
6			vd				vd		vd				
1958													
7547 c.e.	From 7312 (5) I												
A (1)	W+ Spm / wx +		−		−		+		~~d~~ [illegible] = (+−) many small sectors.				
(2)	" "	" "	+				+						
(3)	" "	" "	+										
(4)	W+ wx	[illegible]	−										
(5)	W+ wx	[illegible]	−		vd								
B	W+ Spm / wx +		−				d						
C (1)	" "	" "	d										
(2)	" "	" "	+										
1957													
7313	from pollen of 7109B (1)												
A (1)			vd										
(2)			vd				+						
B (1)			d										
(2)			vd										
(3)			vd										
(4)			+				+		+				
(5)			+		+								
Complete			♂ Spm		♂ Spm		♂ Spm		♂ Spm				
7780 B-1	W+ + / wx Spm		~~d~~						+				
B-2			+										
B-3													
B-4	"	"	d		+		+						
B-5	"	"	+										
B-6	"	"	d		d		+		+				
B-7	"	"	+		+								
B-8													
B-9	"	"	~~d~~										
B-10	"	"	d				+		+				

Table-2

B

7109B ① t-1 ear = active spur

+ = active spur
vd = very few kernels show active spur.

1957			I	II	t-1	t-2	t-3	pollen		
7306A-	1	Wx+/wx spur	+	+ (7560 year 1948)	+					
	2	" "	−							
T	3	Wx wx; 1 spur	−		+					
	4	Wx+/wx spur	+							
	5	" "	+							
	6	" "	+	+						
T B	1	Wx+/wx spur + 2 spur	+ ✱ +	+ ✱ +	+ ✱ +	+ +	+ ++			
T	2	" " + 1 spur	++		++					
1958										
7560 c.o	①	Wx spur / wx +	+		+	+				
	②	[" " ; " "]	−							
T	③	Wx wx; 1 spur	vd	vd	+					
T	④	Wx wx; 2 spur	+ +	+ +						
	⑤	Wx spur / wx +	+					+		
T	⑥	Wx wx; 1 spur	+							

Table-2

C. 7109 B ① E-2 ear. active spun

+ = active spun
d = delayed active spun in scup
(±) = sectors of + and −
(+ d −) = lights vertical ear.

1957			I	II	I-1	E-2	E-3	pillars		
7307A	①	W+W+	spun	d						
	②	W+ + lin	spun	+		+	+			
	③	" "	"	+	+					
	④	" "	"	+		+				
	⑤	" "	"	+	+	+				
	⑥	" "	"	+						
B	①	" "	"	+	+	+				
	②	neu " (blue ++)	exp	+	+	+				
T	③	W+ + lin	Spun + 1 spun	+ and +	+ +	(±) +	+ +	+ +	changed active spun	
T	④	" "	" " "	+ and +		+ +	+ +			
1958										
7561 c.o.	①	[W+ Spun	lin +]	−						
	②	W+ Spun	lin +	vd	vd					
	③	"	"	+	+					
	④	"	"	(±)	−	+				
	⑤	"	"	+						
7562 c.o.	①	"	"	+	+					
	②	"	"	+						
	③	"	"	−		+				
7572 (Gu	①	W+	lin Spun	+						
	②	"	" "	+		+				
	③	"	" "	+	+					
	④	W+W+	"	vd						
	⑤	W+ +	lin Spun	vd	d					
	⑥	"	"	+						
	⑦	"	"	+						
1960								Frequent changes in phase		
7777A	①	W+Spun	lin +	(+ d −)	(∓)	+	(±)	(±d)		
	②	"	"	+		+				
	③			(+ d −)						
	④	"	"	do		+				
B	①	"	"	[illegible]		+				
	②	"	"	(±d)		+	+			
	③			(±)						
	④	"	"	(±)	(±)	+				
C	①	"	"	−						
	②	"	"	−	−					
	③	"	"	−		−				
	④	"	"	−						
D	①	"	"	−		−	−			
	②	"	"	−						
	③			−		−				
	④	"	"	−		−				

(1) = a2 bt Wx no Spm
(2) = " " " "
(3) - a2 bt Wx+/Wx Spm - art ip
7308 D-1 or D-2

Type of cross conducted with parts of plant

7456				First ear main stab	Second ear main stab	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Pollen to
A-1	Wx Wx		no Spm	3	2	1			
A-2	Wx Wx		no Spm	3					1
A-3	Wx Wx		no Spm	3					
A-4	Wx Wx		(no Spm)	no ear	2	1	2		
B-1	Wx Wx		no Spm	3		1			
B-2	Wx Wx		no Spm	3		2			
B-3	Wx Wx		no Spm	3		1			
B-5	Wx+/Wx Spm			3		1	2		
B-6	Wx Wx	no test for Spm		1					
C-1	Wx Wx 1 Spm			3		1			
C-2	Wx+/Wx Spm			3	1				
C-3	Wx+/Wx Spm			3	2	1	2	2	
C-4	Wx+/Wx Spm			3	2	1			1
D-1	Wx+/Wx Spm			1	3				
D-2	(Wx+/Wx Spm)			1	1	1	1		
D-3	(Wx+/Wx Spm)			1					
D-4	Wx Wx 1 Spm			1		3	2		
D-5	Wx+/Wx Spm			1	2	3	2	2	1
D-7	Wx+/Wx Spm			1		1	2		1
E-1	Wx Wx		no Spm	2		3			1
E-2	Wx+/Wx Spm			3					1
E-3	Wx Wx		no Spm	1	3	1	3		1

Origin of plants in ~~Key to~~ cultures ~~of~~ A, ~~of~~ table 2

Culture 7456: From kernels on first ear of main stalk of plant 7109B-1.

Cross: 7109B-1 a_2^{m-1} (class II) Bt/a_2 bt; Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/ Wx, no Spm ♂

Plants in B: From uniformly darkpigmented, Bt, Wx kernels

C: From diffuse-mottled, Bt, Wx kernels

D: From colorless, Bt, Wx kernels with small spots of deep ~~color~~ pigment.

E: From uniformly pigmented, bt, Wx kernels.

Culture 7600: From uniformly deep pigmented kernels on ear of tiller -1 of plant 7456C-3.

Cross: a_2^{m-1} (class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx no Spm ♂

Culture 7598: From uniformly dark pigmented Bt, Wx kernels on first ear of main stalk of plant 7456D-5

Cross: a_2^{m-1} (class II) Bt/a_2 bt, Wx +/wx Spm ♀ x a_2 bt/a_2 bt, Wx/Wx no Spm ♂

Culture 7599: From kernels on ear produced by cross of a_2 bt/a_2 bt, Wx/Wx, no Spm ♀ x 5456D-5 ♂ (see culture 7598)

~~Culture 7780: From kernels on first ear of main stalk of plant 7599~~

Plants in A from diffuse-mottled, Bt, Wx kernels

Plants in B from colorless, Bt, Wx kernels with spots or specks of pigment.

Culture 7780: From kernels on first ear of main stalk of plant 7599B-4

Cross: a_2^{m-1} Bt/a_2 bt, Wx +/Wx Spm ♀ x a_2 bt/a_2 bt, wx +/ wx Spm ♂

Plants in A from colorless, Bt, Wx kernels ~~showing~~ with only few specks of pigment

Plants in B from colorless, Bt, Wx kernels ~~shwoing~~ with both large and small pigmented areas.

Table 5.

7456	Constitution of plant as determined by test crosses.		Type of pollen Parent in Cross to: First ear main stalk	2nd Ear main stalk	Ear of tiller-1	Ear of tiller-2	Ear of tiller-3	Type of tester used ear parent: pollen to plant type
A-1	Wx Wx	no spm	3	2	1			
A-2	Wx Wx	no spm	3					
A-3	Wx Wx	no spm	3					1
A-4	Wx Wx	(no spm)		2	1	2		
B-1	Wx Wx	no spm	3		1			
B-2	Wx Wx	no spm	3		2			
B-3	Wx Wx	no spm	3		1			
B-5	Wx+ / wx spm		3		1	2		
B-6	Wx wx	no test for inactive spm	1					
E-1	Wx Wx	no spm	2		3			1
E-3	Wx Wx	no spm	1	3	1	3		1
E-2	Wx+ / wx spm		3					1
C-1	Wx Wx	1 spm	3		1			
C-2	Wx+ / wx spm		3	1				
C-3	Wx+ / wx spm		3	2	1	2	2	
C-4	Wx+ / wx spm		3	2	1			1
D-1	(Wx+ / wx spm)		1					
D-2	(Wx+ / wx spm)		1	1	1	1		
D-3	(Wx+ / wx spm)		1					
D-4	Wx Wx	1 spm	1		3	2		
D-5	Wx+ / wx spm		1	2	3	2	2	1
D-7	Wx+ / wx spm		1		1	2		1

Heading:

A. Test crosses conducted with plants in culture 7456 (derived from selected kernels on the first ear of the main stalk of plant 7109 B-1.) See table 2 A)

Constitution of the tester plants:

1 = a_2bt/a_2bt Wx/Wx no spm

2 = a_2bt/a_2bt, wx/wx no spm

3 = a_2bt/a_2bt wx+/wx spm - active phase (either plant 7808 D-1 or D-2)

Plants in A, B, and E of culture 7456 derived from uniformly pigmented kernels
" " C " " " " " diffuse-mottled kernels or specs.
" " D " " " " " colorless kernels with spots of pigment in them

Key to table 2.

A of table:

7109B-1 ear I, main stalk a_2^{m1} (class II) BI/a_2^s bt Wx+/wx Spm ♀ × a_2 bt/a_2 bt Wx/Wx no Spm ♂

Plants in ~~A~~ derived

7456 B from unfoy pigmented BI Wx kernels

" C from diffusy-mottled BI Wx

" D " colorless BI Wx kernels with small speck of pigment in them

" E " unfoy pigmented bt Wx kernels.

7600. ~~From~~ cross of 7456C-3, t^{-1} a_2^{m1} (class II) BI/a_2^s bt Wx+/wx Spm ♀ × a_2 bt/a_2 bt Wx/Wx no Spm ♂

Plants derived from colorless BI Wx kernels with a number of speck of pigment in them

7598. ~~From~~ ~~Cross of~~ 7456D(5)^{I} a_2^{m1} (class II) BI/a_2 bt Wx+/wx Spm ♀ × a_2 bt/a_2 bt Wx/Wx no Spm ♂

Plants derived from fully pigmented BI Wx kernels.

7599 From cross of ♀ a_2 bt/a_2 bt, Wx/Wx no Spm ♀ × 7456D(5) ♂.

Plants in A derived from diffusy-mottled BI Wx kernels

" " B " " colorless kernels with few spks and dots of pigment.

7380. See page - in text for origin of plants in this culture

From cross of 7599 B(4)^{I} Wx+/Wx Spm a_2^{m1} (class II) BI/a_2 bt, ♀ × 7538-14 a_2 bt/a_2 bt wx+/wx Spm ♂

A = From var. kernels with high dose Spm pattern of pigmented spots in colorless background

B = From " " " large + small spots of pigment in colorless background

B of table 2.

~~Culture~~ 7306 From 7109B(1) tiller-1 a_2^{m1} (class II) BI/a_2^s bt, Wx+/wx Spm ♀ ×

a_2 bt/a_2 bt, Wx/Wx no Spm ♂.

Plants in A derived from colorless BI Wx kernels with a number of spots of pigment

" " B " " " " " " with only a few speck of pigment.

7560 From cross of 2nd ear, main stalk of plant 7306 A-1, ♀

a_2^{m1} (class II) BI/a_2 bt Wx+/wx Spm × a_2 bt/a_2 bt, wx/wx no Spm ♂

Plants derived from colorless BI Wx kernels with a number of small pigmented spots.

C, Table 2

7307 From 7109 B-1, tube-2: a_2^{m-1}(class II) BI/$a_2$bt Wx+/wx Spin ♀ × $a_2$bt/$a_2$bt, Wx/Wx no Spin ♂.

Plants in A derived from ~~Wx kern~~ colorless BI Wx kernels with a number of small spots of pigment.

Plants in B derived from colorless BI Wx kernels with only several specks of pigment in them

7561. From first ear, main shaft of 7307 A-3: $a_2^{m'}$(class II) BI/$a_2$bt, Wx+/wx Spin ♀ × $a_2$bt/$a_2$bt, wx/wx, no Spin ♂.

Plants derived from colorless BI Wx kernels with a number of small spots of pigment.

7562 From first ear, main shaft of plant 737 A-5: $a_2^{m'}$(class II) BI/$a_2$bt Wx+/wx Spin ♀ × $a_2$bt/$a_2$bt, wx/wx, no Spin ♂

Plants derived from colorless, BI, Wx, kernels with a number of small pigmented spots.

7572 From 2nd ear, main shaft of plant 7307 B-2: $a_2^{m'}$(class II) BI/$a_2$bt, Wx+/wx Spin ♀ × $a_2$bt/$a_2$bt, Wx/Wx, no Spin ♂

Plants derived from colorless, BI, Wx kernels with few specks of pigment.

7447 See text, page –, for description of ~~this~~ origin of plants in this culture

D, table 2

7312 From cross of a_2^{m1} (class I) BI/$a_2$bt, Wx/ux no Spm ♀ × 7109 B-1 ♂
Plants derived from BI Wx kernels having both a_2^{m1} (class I) and a_2^{m1} (class II) ~~states of~~ and Spm.

7313 From cross of A_2 BI/$a_2$bt, Wx/ux no Spm ♀ × 7109 B-1 ♂
Plants in A, B derived from colorless BI Wx kernels with some pigmented spots + specks.

7547: From cross of plant 7312 ⑤: a_2^{m1} (class I) BI/a_2^{m-1} (class II BI,
Wx + /ux Spm ♀ × $a_2$bt/$a_2$bt, ux/ux, no Spm ♂.
Plants in A derived from variegated BI Wx kernels having class I state of a_2^{m-1}
Plants " B+C " " colorless BI Wx kernel with ~~some~~ small spots of pigment.
and carrying the class II state of a_2^{m-1}.

7582 From 7312-6 I ♀ × $a_2$bt Wx no Spm ♂
a_2^{m1} (A_2) BI/a_2^{m-1} BI Wx + /ux Spm
A = from colorless, BI, Wx kernel with small specks of A_2 pigment (class II state) (pale-spotted)
B from ~~col~~ unfeeling pale colored (class I state) BI Wx kernels with small ux spot. (for Wx ux constitution of plant.

included in report

6638B(6) + 6669C

6644(2) + 6669C

6644(8) + 6662C

6644(10)I + 6669C

6648(3) + 6669C

6649A(2) + 6669C

6652B(3) + 6678

6655A(3)I + 6680D

6655B(1) + 6690

6666D(4)I + 6655B(2)

6683A(3) + " "

6655C(2)I + 6690

6662B(4) + D(10)

" B(5) + "

" D(10) + D(6)

6664B(3)I + 6693A(2)

" "(9) + " "

6665F(3) + 6678

6660(9) + 6666E I

6666B(1) + "

6669C - see card for cars with 6670B(3)

6670C(7)I (x)

6672E(12)I + 6638A(3) sectional car

6673B(9)I + 6704C(3)

6703 - changed states Spm-w. Frequency. Imp.

6673C(1) × 6662C

6673F [illegible]

6675G Crosses - see card (to 6704B(3), 6680E(6)', 6651B(3))

6680D Crosses (6665B(5)t, 6704C(4), C(1)', 6670A(2), 6655A(3), 6651A(3)t)

6680E(6)t × 6675G

6683D(2)t × 6641A(5) sector

6685 - delayed action spur

6687A(1) × 6673F

6688C(8)t × 6702(2) Imp

6690 Crosses (6665A-2, 6665B(4), 6670A(4)(5), 6655C-(2))

6691B(1)t × 6701(2) -
(5719A-2) (5700A)

6692B(3)t × 6701(1)

6693A(1) × 6702(7)
" A(2) - see card (to 6664A(1), A(4)) + others

6664B(3)(9)t × 6693A(2)

6694B(7) - pollen from pale + var. sectors I imp

6697(5)t × 6678

6698(2)(4)(5) ×

Linkage of spur with pr - 6698

6704B(3)^{I} + 6675 G

" B(4) + 6678 - Good, unl

" C (1) + 6680D

6673B(2) + 6704C(3)

6704 C(4)^{t} + 6666E^{tw}

6707A(3)^{t} + 6638A(1) Sectorial ear.

6679 B(3) + 6707C(3)

6707D + 6702(1) - tests see under 6707

6679B(3) + 6707C(3)

6666 D(4) + 6650 E(2) - [illegible]

$a_1^{m-1} a_1 b_2$ no spin				$a_1^{m+k_2} / a_1 b_2$ spin				
6675G	6662C	6669C	6678	6666E	6673F	6680D	6690	6671E
6651B-5	6644-8	6638B-6	6651B-3	6638A-3	$a_1 b_2$	6651A-3	6655B-1	6639-22
6680E-6	6673C-1	6644-2	6652B-3	6651A-1	(x)	6655A-3	6655C-2	
6704B-3	6704C-9	6644-10	6665A-5	6660-9	6675B-1	6664A-3	6665A-2	
6707C-2	6704C-10	6648-3	6665E-2	6661-19	6672E-2	6665B-5	6665B-4	
	6707C-4	6649A-2	6665F-3	6659-12	6683A-4	6670A-2	6670A-4	
		6670B-3	6666B-2	6665B-3	6685C-1	6704C-1	6670A-6	
		6703D-2	(x)	6665B-6	A-1	6704C-3	6675A-4	
		6666E	6697-5	6666B-1	A-3	6707C-5	6675A-2	
			6698-2	6670B-4	A-6	6707C-7		
			6698-4	6662A-1	6687A-1	6707C-6		
			6698-5	6683A-2				
			6704A-2	6683B-1				
			6704B-4	6684A				
			6707D-10	6704C-4				
				(x)				
				$a_1 b_2$ "				

Tests of Spin - other states -

$a_1^{m} \cdot h_2 / a_1 h_2$ vs Spin - To states other than 571917-1

" " 1 Spin - to poles " " "

Summer - 1954 Mutants

A1 mutants

6638 B - 6

6649 A - 4

6650 A -

6653 B - 1

6654 - 2

6654 - 3

6706 B - 3

Pab mutants - from strain 5720.

6651 A - 1

" A - 3

6655 A - 1 to 4

" B - 1 - 2

Summer 1954

var. plants from pale hernia
Pale " " var. hernia

Pale plant from var. hernia

var. plant from pale hernia

Plant									
6673D - 2					6641B - 4 (from ⊗)				
6676B - 5					6683A - 2				
6685F - 2									
6686D - 3									
6688A - 5									

Homozygous a_i^{m-1} | a_i^{m} tested Summer 19[illegible]

6638 B (3) B (4) B (5) B (6) B (7) state 5718

6648 (3) (4) (5)

6658 state 5719A-1

6662 D (2) D (9)

6664 B (2) B (9)

6703 A (5) state 5700A | 5719A-2

" (6)

" B (2)

" C (5)

6706 A (3), A (4) A (5) $a_i^{m'}$ | $a_i^{m'}$ state 5999

Y Spm / y + From Y Spm / y + parent

♀	♂		Pale Sh2 Y	Pale Sh2 y	Pale sh2 Y	Pale sh2 y	Var. Sh2 Y	Var. Sh2 y	Var. sh2 Y	Var. sh2 y	Colorless Sh2	Colorless sh2		
6662D-1	6632-9		34	48	0	0	69	30	0	0	1 ♀	181		
" D-8	" -4		34	66	0	2	62	32	2	1	0	166		
6662E-3	6638A-5		62	115			91	64						
6662E-4	" " -7		15	45			45	14						
" E-9	" " "		14	35			25	"						
6664C-2	" 1		71	102			102	68						
" C-4	" " -4		36	110			129	45						
6665E-2	" 7		39	96			95	25						
" E-3	6632-23		25	43	0	0	39	21	0	0	0	139		
" E-4	6638A-1		84	152			144	74						
" E-5	" "		66	131			135	80						
" E-8	" "		61	90			106	75						
" G-2	" " -3		81	130			126	73						
" G-5	" -1		78	102			107	72						
" G-7	" " -1		70	143			135	88						
" G-7t	" "		18	49			50	14						
✓ " G12	" "		43	166			105	43						
" G-13	" "		85	145			121	65						
6666C-2	6632-18		40	74	0	0	71	41	0	0	0	227		
" C-3	" -16		34	62	0	0	50	31	0	0	0	211		
" C-3t	" -18		26	66	0	0	58	22	0	0	0	187		
" C-4	" -11		55	74	0	0	66	45	0	0	0	226		
" C-6	" -18		29	51		1	68	32	0	0	2	214		
6670C-1	6632-2		28	65	0	0	66	21	0	0	0	188		
" C-2	6638A-1		34	90			97	57						
" C-3	6632-2		33	63	0	0	55	37	0	0	0	212		
" C-5	-18		36	77	0	0	76	35	0	0	0	211		
✓ " C-6t	6638A-5		53	133			126	41						
" C-7t	" " "		48	85			55	24						
6673C-3	6632-2		26	57	0	0	61	33	1	0	0	187		
" C-3t	6638A-2		75	115			119	52						
" C-6t	" "		26	75			68	31						
" G-3	6641B-2		74	112			118	65						
" G-4	6638A-1		39	83			75	36						
" G-16	" A-2		76	141			129	90						
6674F-5	" A-2		79	136			145	68						
F-5t	" A-6		29	93			88	21						
	Y+/y Spm													
6630C-6	6662D-10		68	37	0	0	26	69	0	0	0	207		
6632-35	" "		55	25	1		9	55	1			117		
[illegible]	[illegible]		[illegible]											

6676

I Y Spm | y +

II Y Spm Spm | y ++ vor

			Pale											
			Sh2		sh2		Sh2		sh2		Colorless			
♀	♂		Y	y	Y	y	Y	y	Y	y	Sh2	sh2		
6676B-1	6634B-1		73	37	0	0	59	35	0	0	0	200		
" B-1	6638A-1		38	141			125	52						
" B-2	6632-7		45	64	0	0	53	28	0	0	0	203		
" B-3	6638A-2		44	137			99	63						
" B-9	" A-7		49	100			97	44						
" C-3	6632-7		50	83	0	0	80	35	0	1	0	266		
" C-6	6638A-2		48	124			102	45						
" C-9	6634B-10		20	48			49	19				147		
" C-9	6638A-2		38	97			116	37						
" D-10	" 4		25	63			60	20						
" E-4	" -2		43	149			103	60						
II														
6676B-6	6634B-10		6	56	0	0	86	40	1	0	0	151		
" 6	6638A-7		12	108			139	60						
" B-8	6632-8		29	59	0	0	78	58	0	0	0	233		
✓ " C-2	" -34		1	46	0	0	77	33	0	0	0	201		
" C-4	6638A-2		48	147			181	84						
" C-10	6632-34		18	42	0	0	80	45	0	0	0	174		
" D-11	6638A-2		46	75			173	127						
" E-1	" A "		29	47			120	85						
" E-2	" A-1		45	98			126	102						
" E-3	" A-2		10	27			78	68						
III Y Spm	y +	plus 1 Spm												
6676C-8	6634B-10		13	45			89	83				242		

6704

			Pale				Vol				Colorless			
			Sh2		sh2		Sh2		sh2					
?	?		Y	y	Y	y	Y	y	Y	y	Sh2	sh2		% rec.
6704A-2	6678		40	74	22	35	61	42	42	29		93		38.5
" A-4	6632-10		59	70	0	0	70	48	[illegible]	[illegible]	0	2.45		
✓ " B-3I	6675 G		44	58	24	34	57	56	42	24	0	92 (46Y; 46y)		
" B-4	6678		20	113	10	65	111	30	59	8	0	149 (77Y; 72y)		16.3

Summer 1951 Plants with Spm on whose test cross cobs all kernels were classified

		1 Spm	Spm/Spm	2 non-linked Spm	Sm Spm + +	3 Spm	Spm L. white to Y.	Spm L. white to Pa	Spm L. white to W+a cy
6638 B	-3		✓						
" B	-4			✓					
" B	-5		✓						
" B	-6		✓						
" B	-7			✓					
6644	-2		✓						
"	-4				✓				
"	-8		✓						
"	-10		✓						
6648	-3								
"	-4	✓							
"	-5		✓						
6649 A	-2					✓			
6651 B	-1						✓		
" B	-1	✓							
" B	-3 F	✓							
" B	-5	✓							
6652 B	-3	✓							
6655 A	-2	✓							
6655 B	-1								
" B	-2	✓							
" C	-1	✓							
" C	-2	✓							
" C	-4	✓							
6657 B	-3	✓							
6658		✓							
6662 D	(1)						✓		
" D	(2)						✓		
" D	(3)								
✓ " D	(5)								
" D	(6)						✓		
" D	(7)	✓							
" D	(8)						✓		
" D	(9)						✓		
" D	(10)						✓		
6662 E	- 11	plants	see				✓		
" E	- 8	"	"	"					
6664 B	-3						✓		
" B	-9	✓							
6 " D	-3					✓			
6665 C to F	44	plants	see				✓		
6666	36	"	"	"			✓		
6667 F + G	18	"	"	"			✓		✓
6668	7	"						✓	✓
6670 C to F	29	"	"	"			✓		
6671 D to G	13	"	see cards	+			✓	✓	✓
6672 E - F	20	"	"	"	+				✓
6673 C, D, F	10	"	"	"	+				
6673 G - H	14	"	see				✓		
6674 C	2	"	see cards				✓		
" F - G	5	"	see						

						Spm in Y cbr	Spm in Pr cbr	Spm limited to very cbr		
6676	B to E	34 plants, see folder				✓				
6679	B to D	6 " " "								
6680	C to	16 " " cards						✓		
6682	B	7 " " folder								
6683	C to E	16 " " "					✓			
6684	A to E	15 " " "					✓			
6685	F to H	21 " " "					✓			
6686	E	5 " " cards								
6687	C to D	8 " " folder								
6688	C	11 " " "								
6690		1								
6691	B	1								
6692	B	1								
6693	B	1								
6694	B	1								
6695	B to D	5	see cards + folder				✓	✓		
6696	B	11	" "			✓		✓		
6697		1	" "							
6698		6	" "				✓			
6703	A to E	18	see folder							
6704	A to C	9	see folder			✓				
6706	A + B	5	see cards							
6707	A to D	11	see cards and folder			✓				

in which all kernels on Test cross ears were examined

Total number of plants examined in which Spm was present = 464 ✓

examined from crosses of above plants

Total number of ears to 10/31/59 = 547

Linkage of Spinwalk 1 in plants that were Y Spinly +

Culture		no. of ears		Pale Y	Pale y	var. Y	var. y	Total	% recombination
6665G	x 6638	7		442	865	785	433	2525	34.6
"	x 6701-2	1		60	140	120	91	411	
6666G	x 6638H	6		371	602	601	382	1956	38.5
6670E		4		168	441	403	171	1183	28.6
6673G		4		277	482	450	260	1469	
6674F-3		1		115	91	127	43	376	
6674F-4		1		112	72	119	61	364	
6674F		2		108	229	233	89	659	30.0
		26		1653	2922	2838	1530	8943	35.5

4491 Y : 4452 y

1) [illegible]

2) [illegible]

[illegible]				[illegible]	[illegible]		Total		
[illegible]		7		[illegible]	[illegible]		2359		

6704C-3 a₁ᵐ (5793-(4)) Sh₂/a₁sh₂ 1% [illegible] 10 Spm

				Pale	var	colorless		odds		
				Sh₂	Sh₂	sh₂				
6704C-3 t		6632-8	a₁sh₂	131	0	104				
6634B-4		6704C-3		62	0	54		1 pale sh₂		
6673B-2 t										
a₁ᵐ (5719A-1) Sh₂/a₁sh₂		6704C-3		266	0	108				
6666H (6) t	a₁sh₂ 15 pm.		x 6704C-3	71	86	164		1 pale sh₂		
6673G (1) t	x 6704C-3			53	48	101				
6683E (12) t	x " "			86	98	225				
				Pale		var		colorless	odds	
				Sh₂	sh₂	Sh₂	sh₂	sh₂		
6704C-3	x 6608D	a₁ᵐ (5719A-1)	sh₂/a₁sh₂	17	11	245	118	131		
6704C-4 t	x 6666E	tw		43	17	72	23	55		

6693H-2 [illegible] Yy [illegible] Wx cy
in Spm

			Pale Sh2		Vari Sh2		Colorless		
♀	♀ [illegible]		Y	y	Y	y	Sh2 Yy		
6665G-1t	[illegible] Y Spa/y+		61	26	63	11	139		
6666(4)t	" "		4	1	6	1	12		
6666H-10t	" " y/y 1 Spm		56		38		92		
" -13t	" " "		41		55		91		
6665G+H	W Spm								
6666G+H									
6665G9t			pale		0				
" G(14)t			"		0				
6666H(9)t			"		0				

Testing for Spm. Types.

I pale. a_1^{m1} Sh2 (any state) / a_1^{m1} Sh2 (any state) Tests:

1. by a_1 sh2 tester stock - all pale
2. sib + intercross
3. intercross between states - from pale plants = all pale
4. to a_1 sh2 derived from spm carry plants - Tests

State 5718 -
State 5719A-1
[State 5719A-2] -
[State 5996-4]
State 5700A Homo = 6701 (2) { ♀ Spm = 2, ♀ no Spm = 2
[State 5999 (letter)]
[State 5714 F.]

II pale. a_1^{m1} Sh2 (any state) / a_1 sh2

1. By a_1 sh2 stock - 1 pale Sh2 : 1 colorless sh2
2. a_1^{m1} sh2 / a_1 sh2 pale = 2 pale Sh2 : 1 pale sh2 : 1 colorless sh2
3. a_1^{m1} sh2 / a_1 sh2 var. ♂
   ♂ 1 spm = 1 pale Sh2 : 1 var Sh2 : 1 pale sh2 : 1 var sh2 : 2 colorless sh2
   with all states in ♀
   ♂ Y spm / y + = Linkage of above any alleles of Y
   ♂ Pr Spm / pr + = " " " " " "
   ♂ 3 spm = Ratios of var to pale in curves to pale of all states.

4. To $a_1 sh_2$ Spin or no Spin from parent having Spin
1 pale Sh_2 to 1 colorless sh_2 if no Spin in $a_1 sh_2$ plant
pale and var in Sh class if Spin in $a_1 sh_2$ plant

State 5719A-2 = 6693A

State 5996-4 = 6704C

State 5700A = 6701 (1) 6702 (2)

State 5999 = 6707C.

State 5714F = 6642B [$sh_2 sh_2$]

III a_1^{m1} Sh_2 / $a_1 sh_2$ varegated (any state)

1. by $a_1 sh_2$ from stock - seg pale + var. ratios; linkages;

2. a_1^{m1} sh_2 / $a_1 sh_2$ pale plant - (state 5719A-1)
pale Sh_2; var Sh_2; pale sh_2 to var. sh_2 : colorless sh_2
Ratios; linkages.

3. By a_1^{m1} (different state Sh_2 / a_1^{m1} Sh_2 homo for state Pale
Segregations - 2 types of pale - ratios, linkages
2 types of var. -

IV a_1^{m1} var plant - pale sector.
Pollen from pale sector in tassel to $a_1 sh_2$ = all pale in Sh_2
" " var part of tassel to $a_1 sh_2$ =

Consider -

1. Pollen from pale sector vs var sector

2. 6701 (2) - to $a_1 sh_2$; to $a_1 sh_2$ Spm; to a_1^{m1} (5719A-2) Spm
to a_1^{m1} (5719A-1), Spm and no Spm

3. $a_1^{m1} sh_2 / a_1 sh_2$ no Spm to $a_1^{m1} sh_2 / a_1 sh_2$ Spm
to " " no Spm

4 $a_1^{m1} sh_2 / a_1 sh_2$, Spm to $a_1^{m1} sh_2 / a_1 sh_2$ states other than 5719A-2
(5719A-1)

5. Gear sectors

6. pale mutants of 5720 × a_1^{m1} spm; $a_1 sh_2$ Spm.

7. Delayed action Spm - 6685 culture 6675

8. Spm-w - (6688C (8) I × 6702 (2) I wp).

9. Spm number in progeny of 1 Spm, 2 Spm, 3 Spm parent

10. Original plant Y + / y Spm; Pr Spm / pr +

11. A_1 mutants - 6638B (6) 6706B (3)

12 High rate of sectoring - 6707 culture

13. Var plants from pale kernels. Pale plants from var kernels

14 6675 - see

Homozygous Ustera. no Spin

$a_1 m_1$ (5718) Sh_2 y pr ux = 6638 A

$a_1 m_1$ (5719A-1) Sh_2 Y y pr ux = 6641 A, 6642 A

y pr ux = 6641 B

" (5719A-2) Sh_2 Y pr ux = 6643

" (5700A) Sh_2 yy Pr Pr a_1 ux = 6701 (2) sh_1

$a_1 m_1$ (5719A-1) sh_2 | a_1 sh_2 no Spin

6662C yy Pr pr wx ux

6675G yy Pr pr Wx Wx

6678 yy Pr pr Wx Wx

6669C yy Pr pr Wx ux

$a_1 m_1$ (5719A-1) sh_2 | a_1 sh_2 Spin

6666 E Y Spin | y+ Pr pr Wx Wx

6669 B - no tests

6671 E Yy Pr pr Wx ux 1 Spin

6673 F Yy Pr pr 1 Spin

6680 D yy Pr pr Wx ux 3 Spin

6690 yy pr pr Wx ux 1 Spin

many pole sectors

6662D , 6576B (v. C, ace) ; 6689 (mg : parallelism, [illegible]).

var pole = 6670H ①

From 6629A(4) & (4)

6662 var. Sh Y kernels. 6662D.

YY = 3 all Spm/Spm (D(2), D(6), D(9))

Yy = 6 { Y Spm / y + = 2 (D(1), D(8))
Y + / y Spm = 2 (D(7), D(10))
Y/y; 1 Spm = 2 (D(3), D(5)?)

6662 a, sh2 Y kernels.

YY = 3 3 with 1 Spm

Yy = 8 Y Spm / y + = 4
Yy Spm/Spm = 1
Y Spm / y + plus 1 Spm = 1
Y/y ; 2 non-hulled Spm = 6.

Yy no Spm = 3

6662 a sh2 y kernels = 17 plants
9 = no Spm
2 = Spm/Spm
1 = Spm/+ ; Spm +
5 = 1 Spm

Progeny of [illegible] [illegible]
Y Spm/y +

Tests.

var. $a_1^{m}Sh_2/a_1 sh_2$	Y/y :								
Y Spm/y + =	6665E	6666C	6670C	6673C	6674C	–	Totals		
	8	7	6	6	0		27		
Poor test for Y, 1 Spm	1	0	0	2	0		3		
Y/y 1 Spm					2		2		
Y/y 2 Spm	1						1		
var. $a_1^{m}Sh_2/a_1 sh_2$ yy	6665F	6666D	6670D	6673D	6674D				
1 Spm	3	5	4	1	1	13	14		
var. $a_1^{m}sh_2/a_1 sh_2$		6666E		6673F	6				
Y Spm/y +		1				1	1		
poor test for Y, 1 Spm				1		1	1		
$a_1 sh/a_1 sh_2$ Y/y	6665G	6666G	6670E	6673G	6674F		Totals		
no Spm	11	4	2	5	2		24		
Y Spm/y +	7	6	4	10	3		30		
Y/y, 1 Spm	2	0	0	0	0		2		
$a_1 sh_2/a_1 sh_2$ yy	6665H	6666H	6670F	6673H	6674G				
no Spm	10	8	8	13	4		17		
1 Spm	1	5	5	4	2		43		

Summary Totals from Yy plants that had Spm = 65:

58 Y Spm/y +
4 Yy, 1 Spm
1 Yy, 2 Spm
4 1 Spm. Poor classification for y.

Total 67

Totals for yy with Spm
57. all had 1 Spm

Sheet 11

Oregon, 1953

Culture No. 1954	A-1-I 6665	A-1-II 6666	A-3-I 6669	A-4-I 6670	A-6-I 6673	A-7-I 6674	Totals
Pale Sh2 Y Plants in field	4	5		5	6	5	25
No. Tested	3	0		3	—	—	
Pale Sh2 y Plants	8	6		7	6	7	34
No. Tested	6	4		2	—	1	
Pale Sh2 Y Tested							
Pale Sh2 y Tested			1				1 (0)
Var. Sh2 Y Plants	10	7		8	12	7	44
No. Tested	10	7		6	8	2	33
Var. Sh2 y Plants	3	5		5	5	4	22
No. Tested	3	5		4	1	1	14
Var. Sh2 Y, Tested		1	1		1		3 (0)
Var. Sh2 y, Tested							
Colorless Sh2 Y Plants in field	21	10		6	17	5	59
No. Tested	20	10		6	15	5	56
Colorless Sh2 y Plants in field	12	13		14	18	6	63
No. Tested	11	13		14	17	6	60

Tests of pale plants

6665A-2	x	6690	$a_1^{m1}sh_2$ / a_1sh_2 yy	1 Spm							
6665B-3	x	6666E	"	"	1 Spm / y +						
6665B-4	x	6690									
6665B⑤ᵀ	x	6680D	"	"	yy	3 Spm					
6673B②ᵀ	x	6704C-3	$a_1^{m1}sh_2$ (state	)	x a_1sh_2	pale					
6666E-①		6666E									

1954

Tester plants

6638 A a_1^{m1}/a_1^{m1} pp yy mm (state 5718) no Spm. From 6045 (4) (x) A Table 13

6639 $a_1^{m1}/a_1^{sh_2}$ (state 5719A-1) pp Yy no Spm; From 6046 A (1) x $a_1 sh_2$ yWx YY a_1^{m1}/a_1^{m1} ~~B, Table 13~~ ~~A, Table 14~~

6640 a^{m1} (5719A-1) $sh_2/a_1 sh_2$ pp Yy Wx mm. From 6046B (2)^{II} x 6041B (8) no Spm B, Table 14

6641 A a_1^{m1} (5719A-1) sh_2/a_1^{m1} (5719A-1) sh_2 Yy pp mm. From 6046C-1 (x) no Spm A Table 14

" B " " yy pp mm no Spm

6642 A a_1^{m1} (5719A-1) sh_2/a_1^{m-1} (5719A-1) sh_2 Yy pp mm no Spm From 6046C-4^{I} (x)

" B " " yy " " " " A. Table 14

6643 a_1^{m1} (5719A-2) sh_2/a_1^{m1} (5719A-2) sh_2 YY pp mm. From (x) of A, Table 13 6080C (8)^{I}

6662 C 1 pale (5719A-1) $sh_2/a_1 sh_2$; yy, P.pr mm From 6629A (4)^{I} (x)

[6665 C 1 pale (5719A-1) $sh_2/a_1 sh_2$ yy pp] no ears

6666 E 1 a_1^{m-1} (5719A-1) $sh_2/a_1 sh_2$, Pr pr Wx Wx Y Spm/y + From 6629A (1)^{II} x D1041 (4) Table 5

6669 B

6669 C 1 pale (5719A-1) $sh_2/a_1 sh_2$ Pr pr yy Wx mm no Spm. From 6629A-3 x D1040 (1) Table 5

6671 E 1 a_1^{m1} (5719A-1) $sh_2/a_1 sh_2$ Yy Pr pr Wx mm 1 Spm " 6629A (5)^{I} x D1041 (4) Table 5

6673 F $a_1^{m'}$(5719A-1) sh_2 / a_1 sh_2 Pr pr 1 Spm From 6629 (6) × D 1040 (1)
Table 5

6675 G 1 pale (5719A-1) sh_2 / a sh_2; Pr pr y y Wx Wx From 6629 A (7)^{I} × ^{D} 1041 (8)
no Spm Table 5

6678 1 pale (5719A-1) sh_2, Pr pr y y Wx Wx From 6629 A-(9)^{I} × D 1040-5
no Spm Table 5

6680 D 1 $a_1^{m'}$(5719A-1) sh_2 / a_1 sh_2 Pr pr y y Wx Wx From 6629 B (2)^{I} × D. 1040 (1)
Table 8
3 Spm

6690 1 $a_1^{m'}$(5719A-1) sh_2 / a_1 sh_2 pr pr y y Wx wx 1 Spm From 6629 B (9)^{II} ×
Table 8 D. 1041 (4)

Summer 1954.

Tests of interpretation drawn from previous studies as outlined required –

1. Tests of the absence of Spm in plants derived from pale clay kernels in course indicated tables 5 and 8

2. Tests of the presence of Spm and its location and mar in plants derived from in variegated kernels derived from those in table 6 that were Y Spm/y+.

3. Tests of number of Spm + location in plants derived from var kernels in table 7 in which more than 1 Spm was present

4. Tests of Spm number and location in the colorless sh 2 classes of kernels in ears of tables 5 and 8

5. Introduction of Spm into plants derived from pale kernels to show that $a_1 m-1$ in them would be capable of responding to Spm

---

Tests of pale clay derived from various states of $a_1 m-1$

Tests of var " " " " " " for presence of Spm

Tests of segregation of states in plants have 2 different states

Tests of stability of genuine mutations in presence of Spm

Tests of plants from the kernels with marked change in var pattern –

Tests of Transposition of Spm

Interceptor - to test for Spin induction [illegible]

5700A	
5713B-2	
5714F	
5715A	
5718	
5719A-1	
5719A-2	
5996-4	
5999	

Table 17

Phenotypes of kernels on ears produced by ears of plants carrying the original state of a_1^{m-1} in one chromosome and a_1 in the homologue, with plants homozygous for a_1 and sh_2. All kernels on resulting ears were sh_2.

A. Various classes of kernels appearing on same ear.

Culture	plant no.	A_1	pale (different [illegible])	variegated	apparently colorless	Total	No. of kernels in variegated class with clearly expressed altered state
5994 -	8	68	56	186	332	642	0
" -	10	38	91	113	264	506	0
" -	12	60	11	163	266	500	0
5995 -	1	63	3	140	315	521	1
" -	2	51	12	193	290	546	0
" -	10	76	42	70	329	517	0
" -	12	71	16	176	402	665	1
5996 -	1 (tiller ear)	16	44	54	159	273	0
" -	2	24	1	169	214	408	0
" -	10 (tiller ear)	48	68	43	203	362	0
5997C -	2	63	18	73	229	383	0
Totals		578	362	1380	3003	5323	2
		[illegible]	469	[illegible]	[illegible]	[illegible]	[illegible]

B. new state of a_1^{m-1} in cells that gave rise to ear

5996 -	4	10	107	120	280	517	1 (Spin linked to Y.)
P 5999	× a_1 sh_2	2	73	176	238	489	
5999 self pollinated		8	4	225	274 (some are pale)		

C. stable pale mutant in cells that gave rise to ear

5994 -	6 1st ear	217 "A_1"	30	—	258	510	

B. and 4 [illegible] reciprocal cross a_1/a_1 × [illegible]

5994 -	2	57	10	97	278	442	
5994 -	12	57	75	96	303 [illegible]	531	

See revision

Table 22

Crosses conducted with plants in cultures 6665 and 6666 derived from the colorless, ab_2 Y chlorophyll mutants, plants in these cultures used as male parents in crosses to Pollen from Tester Plant. Other crosses

Culture and Plant	Tester I Table 22, cm	Pale plants with other stock		Self pollinated				
I y/y 15 Plants with Spm:								
6665 G-1	5718	5700A	5719A-2					
6665 G-7	5718	5718						
6661 G-4	5718	5719A-2			1 ear			
6665 G-13, G-21,	5718			1 ear				
6665 G-2, -5, -6, -12, -15, 6666 G-2, -5, -9, -16,	5718							
6666 G-6	5718				1 ear			
II 15 y/y plants with no Spm								
6665 G-9	5718	5700A	5719A-2					
" G-3	5718	5700A						
" G-10	5718	5714F						
" G-14	5718	5719A-2						
" G-20	5718			1 ear				
" G-8, -17, -18, -19, 6666 G-1, G-3, G-8	5718							
6665 G-11, -15, 6666 G-7	5719A-1							
III 6 y/y plants with Spm								
6666 H-6	5718		5996-4					
6665 H-5	5719A-1							
6666 H-10, H-13	5718	5719A-2						
6666 H-2, H-12	5718							
IV 18 y/y plants with no Spm								
6666 H-9	5718	5719A-2						
6665 H-10, 6666 H-1, H-8	5718			1 ear				
6665 H-8	5719A-1			1 ear				
6665 H-3	5700H							
6665 H-1, H-4, 6666 H-3, H-11	5718							
6665 H-6, H-7, H-9, H-11, H-12, 6666 H-4, H-5, H-7,	5719A-1							

See Reverse

Table 4

Types of Kernels appearing on ears of plants that were a[illegible] Y/y in ad[illegible] 6665 + 6666 in which spm was found to be present.

Constitution	Spm Constitution	number of ears	Pale Sh_2 Y	Pale Sh_2 y	Var. Sh_2 Y	Var. Sh_2 y	others		Totals
of ♂ in cross. I 1 ear per plant ... $a_1^{m-1}Sh_2$ / $a_1^{m-1}Sh_2$ = Y/y State 5718 Culture 6638A	in ♀ Y spm/y+	9	640	1118	1033	614			3405
I 2 ears per plant									
6665 G-7 I × 6638A	Y spm/y+	1	70	143	135	88			436
" G-7 tillers × "	"	1	18	49	50	14			131
6665 G-1 I × 6638A	Y spm/y+	1	67	130	141	78			416
6665 G-1 I × 6693A-2 (♂ = a_1^{m-1} (5719A-2) Sh_2 / a_1 Sh_2, Y/y.) pale plant	Y spm/y+	1	61	26	63	11	139 colorless Sh_2		
6665 G-1 I × 6701-2 pale (♂ = $a_1^{m-1}Sh_2$ / $a_1^{m-1}Sh_2$ state 5700A; Y/y	Y spm/y+	1	60	140	120	91			
6666 G-4-I × 6638A	[Y spm/y+]	1	18	27	27	21			
" G-4-II × 6693A-2 (♂ = Y/y)	[Y spm/y+]	1	4	1	6	1			
6665 G-16 × 6638A 2)	Y/y 1 spm, +	1	30	40	47	41	(+ loose linkage to Y)		158
" G-21 × 6638A 1)		1	66	57	79	75			277

1) Confirmed in next generation (6863, 6867)

2) " " " " " loose linkage with Y (6866)

See Reviewer

Table ~~18~~ 28

Spm constitution of plants derived from selected kernels on ears produced by plant 6629A-1, ~~whose~~ the types of kernel ~~types~~ selected are entered in lines 1 and 2 of table ~~5~~ 20.

Kernel type from which plant arose	No. of plants tested	Appearance of plant	No. of plants having Spm	Spm number in plants having it and its location with respect to the Y alleles, ~~in those having~~ in those plants that were Y/y in constitution.
Pale, Sh_2, Y	3	Uniformly pigmented	0	------
Pale, Sh_2, Y	10	"	0	---------
Variegated, Sh_2, Y	17	Variegated	17	16 ~~were~~ Y Spm/y + 1 had 2 Spm, neither linked to Y
Variegated, Sh_2, y	8	Variegated	8	1 Spm in all 8 plants
Variegated, sh_2, Y	1	Variegated	1	Y Spm / y +
Colorless, sh_2, Y	30	Non-pigmented	15	14 ~~were~~ Y Spm / y + 1 ~~were Y/Spm / y + plus one non linked Spm to Y [illegible]~~ "with" 1 Spm not linked with Y.
Coloress, sh_2, y	24	Non-pigmented	6	1 Spm in all 6 plants
total	[illegible]			

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Reorder

Table 19 where ~~in indicated~~ culture numbers are indicated in last column

Constitutions of Tester plants, used to determine Spin constitutions of some plants in Table 18 and the response of different states of a_1^{m-1} to the same Spin element or elements.

State	Chromosome 3	Chr. 5	Chr. 6	Chromosome 9	Spin constitution	1954 culture no.
5718	$a_1^{m1}Sh_2/a_1^{m1}Sh_2$	pr/pr	y/y	ux/ux	0	6638A
5719A-1	" "	" "	Y/y	" "	0	6641A
	" "	" "	y/y	" "	0	6641B
	" "	" "	Y/Y or Y/y	" "	0	6642
5719A-2	" "	" "	Y/Y	" "	0	6643
5700A	" "	Pr/Pr	y/y	sh_1ux/sh_1ux	0	6701-2
Part II	$a^{m-1}sh_2/a_1sh_2$	Pr pr	y y	ux ux	0	6662C
	" "	Pr pr	y y	Wx Wx	0	6675G
5719A-1	" "	Pr pr	y y	Wx Wx	0	6678
	" "	Pr pr	y y	Wx ux	0	6669C
Part III	" "	Pr pr	Y y	Wx Wx	Y Spin/y +	6666E
	" "	Pr pr	Y y	Wx ux	1 Spin	6671E
	" "	Pr pr	Y y	[illegible]	1 Spin	6673F
	" "	Pr pr	y y	Wx ux	3 Spin	6680D
	" "	pr pr	y y	Wx ux	1 Spin	6690

Table 20

Phenotypes of kernels from which plants were grown under cultures indicated in column 1.

1954	Ear from which kernels were selected		Phenotype of kernel from which plant arose						
Culture	♀	♂	Pale Sh2		Var. Sh2		Colorless Sh2		odds
number			Y	y	Y	y	Y	y	
6665	6629A-1	1041-5	5	7	10	3	21	12	
6666	6629A-1	1041-4	5	6	7	5	10	13	1 var Sh2 Y
6670	6629A-4	1041-5	6	7	7	5	6	14	
6673	6629A-6	1040-1	6	6	12	5 1)	17	18	1 2)
6674	6629A-7	1040-1	5	7	7	4	5	6	3 3)
	Totals		28	33	43	22	59	63	

[One plant was variegated for degrees pale [6670A①]]

1. One plant was uniformly pigmented (pale) instead of variegated [6673D②]

2) Kernel was Sh2, y and variegated for pale with few A1 dots within small colorless areas.

3) Kernels were colorless Sh2 y with 1 or 2 small A1 dots

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Table 29

~~Comparison of~~ recombination ~~percentages~~ between Y and Spm ~~derived from ratio of kernel types on ears of Y Spm/y+~~ Y Spm/y+ parents and offspring that were a ch2/a ch2 Y Spm/y+, ~~[illegible]~~

~~[illegible]~~

Phenotype of kernels

		Pale Sh2		Var. Sh2		%			
	No. of ears	Y	y	Y	y	Totals	Recombination		
6629A parent ears of cultures in Table 20	5	155	303	309	180	947	35.3		
Cultures 6665G, 6666G 6670E, 6673G,* 6674F.	26	1653	2922	2838	1530	8943	35.5		

On 7 ears produced by 6 plants in culture 6673G, although linkage of Spm with Y was expressed, exact classification for Y for some kernels could not be made. The kernel types on these ears are excluded from the table. These were a ~~produced~~ a total of 2359 kernels on these 7 ears, 1244 were pale and 1115 were variegated.

A partial inhibitor of Y expression was segregating among the kernels on these ~~plants~~ ears. Therefore

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Table 22

I crosses conducted with plants derived from the cobbler, sh2, Y, Sp cross.
Testers used as of no Spm pollen were plants under of plants

Pedigree	Plant no. of F2 in cross	First ear	other ears		(+)	sh2 - sh2			
A - Plants with Spm			stated						
6665 G - 1		5718	5700A	5719A-2					
" G - 2		5718							
" G - 5		5718							
" G - 6		5718							
" G - 7		5718 (2 ears)							
" G - 12		5718							
" G - 13		5718			✓				
" G - 16		5718							
" G - 21		5718			✓				
6666 G - 2		5718							
" G - 4		5718		5719A-2		✓			
" G - 5		5718							
" G - 6		5718				✓			
" G 9		5718							
" G - 10		5718							
B Plants with no Spm									
6665 G - 3		5718	5700A						
" G - 8		5718							
" G - 9		5718	5700A	5719A-2					
" G - 10		5718	5714F						
" G - 11		5719A-1							
" G - 14		5718	5719A-2						
" G - 15		5719A-1							
" G - 17		5718							
" G - 18		5718							
" G - 19		5718							
" G - 20		5718			✓				
6666 G - 1		5718							
" G - 3		5718							
" G - 7		5719A-1							
" G - 8		5718							
II Crosses conducted with plants derived from cobblers, sh2, Y, Sp cross									
A - plants with Spm									
6665 H - 5		5719A-1 (Y)	5700A						
6666 H - 2		5718							
" H - 6		5718 (2 ears)	5996-4						
" H - 10		5718	5719A-2						
" H - 12		5718							
" H - 13		5718	5719A-2						

9, m-1 state in

1 Tester used as ♂ in cross.

Culture	Plant no. of ♀ in cross		States	other ears.			(+)			
B. no spin in tested plant			FIRST Ear							
6665 H	- 1		5718							
"	- 3		5700A							
"	- 4		5718							
"	- 6		5719A-1 (Yy)							
"	- 7		5719A-1 (Yy)							
"	- 8		5719A-1 (Yy)				✓			
"	- 9		5719A-1 (Yy)							
"	10		5718				✓ (2 ears)			
"	- 11		5719A-1 (Yy)							
"	12		5719A-1 (Yy)							
6666 H	- 1		5718				✓			
" H	- 3		5718							
" H	- 4		5719A-1 (Yy)							
" H	- 5		5719A-1 (Yy)							
" H	- 7		"	"						
" H	- 8		5718				✓			
" H	- 9		5718	5719A-2						
" H	- 11		5718							

Progeny of plant 6629A-① assumed to be YSpm/y+
Testing Y/y plants having Spm.

Ear or Pl	Culture	no of plants tested	no. with YSpm/y+	Y/y 1Spm	Y/y 2Spm				Commits	
6629A-1 I	6665	19	16	2	1				6666C-I	or I.
6629A-1 II	6666	14	14	0	0					
6629A-4 I	6670	10	10							
6629A-6 I	6673	18	13						5 plants,	no test of Y allo-
6629A-7 I	6674	5	1	2					2 "	" " " allo
Totals		66	54	4	1				7	

Progeny from ⊗ of 6629A-4

	YSpm/YSpm	YSpm/ySpm	YSpm/y+	Y+/ySpm	Y/Y 1Spm	Y/y 1Spm	Y/y 2Spm	YSpm/y+ 1Spm	Total
6662 Y kernels	3	1	7	1	3	3	1	1	20
	Spm/Spm	1Spm	2 non-linked Spm						
6662 colorless dry kernels.	2	5	1						

Spm constitution and locations in 3 pm cans plants arrived from 6629A-5 I YSpm/y+ plus 1Spm

Culture 6671 = 14 plants

From Y/y kernels.

YSpm/y+ = 2 plants

Y/y; Wx+/wx Spm = 1 plant

Y/y; WxWx 1Spm = 2 plants

1Spm, no test for linkage = 1 plant

YSpm/y+; W++/wxSpm = 1 plant

Yy; Wxwx; PrPr 2Spm, neither linked to Y or Wx = 1 plant

Yy; W+wx; PrSpm/pr+ = 1 plant.

From y kernels

WxWx Pr+/prSpm = 1
WxWx, PrPr; 1Spm = 1
Wxwx, PrPr; 1Spm = 1
Wxwx, prPr 1Spm = 1
W++/wxSpm, PrPr = 1

From 6629 A-5 I

6672 Y/y hemes 8 plants

6672 F = 8 with Spm
6 no Spm

Y Spm/y+; Wx+/wx Spm; Pr/pr = 1

Y Spm/y+ Wx wx pr pr = 1

Y/y; Wx+/wx Spm; Pr pr = 1

Y/y; Wx Wx; pr pr 1 Spm, not linked to Y = 1

Y y; Wx Wx; pr pr 3 or 4 Spm = 1

Y/y; Wx Wx; Pr pr 1 Spm - Sectional ear [6672-12³] 1

Y/y; Wx Wx, pr pr 1 Spm - linked to Y ? 1

Y/y; Wx/wx Pr pr 2 Spm, neither linked to marks :

6672 y/y hemes 14 plants

Wx/wx Pr+/pr Spm plus 1 Spm = D① = 1

6672 F = 1 no Spm
12 with Spm

Wx/wx Pr/pr 1 Spm D-2, F① [illegible] = 4

Wx/Wx pr pr 1 Spm = F② ③ ④ [illegible] 4

Wx/Wx Pr/pr 1 Spm [illegible] = 4

Wx/wx pr pr 1 Spm F③ = 1

Stall 5719A-2

6693A To a1-b2 Spm or. no Spm

6665G (1)t-2 Y Spm/y+ x 6693A-2

6665G (9)t no Spm x " "

" " (14)t no Spm x " "

6666G (4)t Y Spm/y+ x " "

" H (9)t no Spm x " "

" H (10)t 1 Spm x " "

" H (13)t 1 Spm x " "

Stall [illegible] A

state 5996-4

6704C To a1 sh2 Spm or no Spm

♀ 6666H (6) II ^ 1 Spm × 6704C-(3) ♂

6673G (1)t 1 Spm/y+ × " C-(3)

6683E (10)t Pn++/fr Spm Spm × 6704C (3)

5700 H

6701 to 6703 to a, sh 2 Spm or no Spm

♀ 6665 G ① t Y Spm/y+ × 6701 ② homo ♂

6665 G ③ t no Spm × 6701 ② homo

6665 F ⑨ t no Spm × 6702 ②

6665 H ⑤ t 1 Spm × 6701 ② homo

6665 H ③ no Spm × 6702 ④

6670 F ③ t no Spm × 6701 ② homo

6673 G ⑨ t Y Spm/y+ × 6702 ②

6673 H ② no Spm × 6702 ②

6674 G ⑥ t no Spm × 6702 ②

6707 D ④ t 1 Spm × 6702 ①

6707 D ⑦ t no Spm × 6702 ①

6707 D ⑨ t no Spm × 6702 ①

6707 D ⑩ t no Spm × 6701 ⑥

State 5999. to a, sh 2 Spun or no Spun

6707C to:

♀ 6673 H (4)t no Spun × 6707C-3 ♂

6683 E (3)t no spun × 6707C-3

" E (5)t no spun × " "

6673 H (4)t no spun × " "

State 5714 F

♀ 6668 C (4)t 2 spun × 6646 B (2) ♂

pale ♀ × a₁ ob₂; Spm or no Spm ♂

♀ 6639 (27) × 6683 E (9) Spm ♂

" (28) × " " (2) no Spm

" (13) × " " (3) no Spm

" (24) × " " (10) Pr + 1 pr Spm

6642 A-(2) × " " (2) no Spm

6639 (1) × 6688 C (8) 1 Spm

For I, Table 2.6

		Pale				Var.				Colorless				
f	ST	Sh2		sh2		Sh2		sh2		Sh2	sh2		Totals	
		Y	N	Y	N	Y	N	Y	N					
6665 E-1	6635-1	46	60			62	42				208		418	
" E-2	6632-23	10	15			21	12				66		124	
" E-3 I	6632-2	50	60			56	51				220		437	
" E-3 II	" -23	25	44			39	21				139		268	
" E-4	6635D-1	49	63			70	48		1		201		432	
" E-5	6632-8	36	55			62	36				159		348	
" E-6	6632-11	48	73			51	40				193		405	
" E-7	6637B-5	30	61			65	43				208		407	
" E-8	6632-8	43	56			62	45	1			211		418	
" E-9	6632-2	30	56			48	38				175		347	
6666 C-3 I	" -16	34	62			50	31				211		388	
" " 3 II	" -18	26	66			58	22				187		359	
" C-4	" -11	55	74			66	45				226		466	
" C-5	" -11	23	37		1	40	28				127		256	
" C-6	" -18	29	51		1	68	32			2	214		397	
Totals		534	833		2	818	534	1	1	2	2745		5470	
		1367				1352								

Spin number in Progeny of plants having 1, 2, or 3 Spm elements.
From test crosses. Main ear as indication

		1 Spm	2 Spm	3 or more Spm	Totals		
1 Spm parent, Random selection of kernels.		227	14	3	244		
" " , Recombinants.		58	8	3	69		
	Totals	285	22	6	313		
2 Spm parent Random selection		89	28	11	128		
3 Spm parent Random selection		36	31	26	93		
					534		

Correspondence of Spm number in different parts of same plant

	1 Spm	2 Spm	3 or more Spm			
2 parts of plant						
I and II	6	5				
I and t	45	18	5			
I and pollen	13	3				
3 parts of plant						
I, II and t	3	4	1			
I, t-1 and t-2	9	1	1			
I, II, and pollen	1					
I, t, and pollen	8	1				
4 parts						
I, t-1, t-2, pollen	1					
Totals	86	32	7		9	Total 134

Non correspondent

6629A-7 I=1, t [illegible]
6667C-7 [illegible]
6676B-7 I=2, t=1
6684F-1 I=2, t=1
6875B-7 I=2, t=1
6678B-3 I=2, t=1
6876-8 I=1, t=2
6452-3 I=3, t=2
6453-9 I+t=2, t-2=3

non- Recomb.

Plants =

		Var.	Pale		Tested	From				
6864		14	1		15	6665 E-10 I	x 6632-26			non-selected
6865		15	0		15					" "
6866		11	0		9					"
6867		20	0		17					" "
6868		11	0		9					selected-direct
6869		9	0		9					" "
6870										
6871										
6872		29	1		29	6668 C-3 x 6872			[Recom for W+]	
6873		12	0		9					Recomb.
6874		20	0		20					(non-selected)
6875		20	3 inactive Spur		20	6685 G-2 x 6641 A-5				non-selected
6876		11	0		11	(long pale) ✓✓				(Recomb ?)
6877		9	1 inactive Spur		10	6668 C-6 x 6638 A-4				Recomb.
6878		8	0		8					Recomb
6879		19	1		16	6684 D-1 I x				selected-direct
6880		10	1		11	6641 B-3 x 6684 D-1			[Heterofert. possible]	
6881		10	0		10					selected-direct
6882		9	1		10	6685 F-3 I x 6641 A-4				Recomb
6883		10	0		6					Recomb
6884		19	1		17	6667 F-11 I x 6638 A-3				selected-direct
6885		24	0		22					selected-direct
6894		19	0		15					selected-direct
6895		5	0		5					non-selected
68[illegible]		11 [illegible]			9 [illegible]					non-selected
Excluding 6870 [illegible]		325	6 pale + 4 inactive		302					

1954

non-Recomb. or non-selected From Var. Kernels.

Recomb.

Culture			Pale	Var.		Pale	Var.		
6646	A		0	6					
6647	A + B		0	8					
6649	A + B	1A1	0	9					
6650		1A1	0	4					
6651	B		0	5					
6653		1A1	0	9		0 pale:			
6654		2A1	0	4					
6655	C		0	5					
6656			0	4					
6657			0	8					
6658			0	1					
6662	D		0	10					
6663			0	16					
6664	B		0	10				From 6629A	
6665	E, F		0	13					
6666	C, D, E		0	13					
6667	A to D		0	19					
6668	A		0	10					
6669	B		0	1					
6670	C, D		0	12		1 pale:	182 var.		
6671	C - E		0	19					
6672	C D		0	11					
6673	C D		1	18					
6674	C, D		0	11					
6676	B C		1	19					
6679	C, D		0	9					
6680	C D E		0	19					
6681	B		0	4					
6682	A		0	8					
6683	B		0	9					
6684	D		0	3	Recombination			From 6629B	
6685	D to G		1	8					
6686	C D		1	9					
6687	C		0	6		3 pale:	94 var.		
6688	A		1	9					
6689	B		0	9					
6690			0	1					
6691	B		0	10					
6692	B		0	7					
6693	B		0	6					
6694	A B		0	11					
6695	B, C		0	10					
6696	B		0	9					
6697			0	9					
6698			0	10		0 pale:	124 var		
6703	A to D		0	20					
6704	A + B		0	8					
6705	A B		0	9					
6706	A B	1A1	0	7					
6707	A - B		0	8					

Variegated plants from pale kernels. Summer 1954

Culture		Pale	Var	
6646B		3 ?	0	
6659		19	0	
6660		22	0	From ears of pale plants = 61 plants
6661		20	0	
6662	A to B	10	0	
6664	A	6	0	From 6629 A ears.
6665	A + B D	13	0	
6666	A B	11	0	
6669	C	1	0	
6670	A, B	12	1	
6671	A, B	12	0	1 var: 101 pale
6672	A, B	7	0	
6673	A B	12	0	
6674	A B	12	0	
6676	A	4	0	
6678		1	0	
6679	A B	10	0	
6680	A	10	0	From 6629 B ears
6681	A	5	0	
6683	A	4	1	
6684	A	4	0	
6685	A	8	0	1 var: 72 pale
6686	A B	10	0	
6687	A B	11	0	
6689	A	10	0	
6691	A	10	0	
6692	A	5	0	
6693	A	5	0	0 var: 31 pale
6694	C	3	0	
6695	A	4	0	
6696	A	4	0	
6699		8	0	
6700		5	0	
6701		8	0	31 plants from ears of pale plants
6702		10	0	
6704	C	10	0	
6707	C	10	0	20 pale

Totals = From ears of pale plants = 92 plants, all pale
From ears of variegated plants = 2 variegated : 224 pale

Spm-w

Spm-motivation

6665E-9 × 6632-2 see 6886

6688B-2 × 6634B-10

6688C(8)t × 6702-(2) 2 up

6662 D(7) (x) see 6871

6662 D(10) to 6662B(4)

" " to " B(5)

" D(10) ×

" D(10) to 6632(35)

" E(16) × 6638A-7 - see [illegible] 6870

6671D(2)t × 6634B(2)

6674D(2) × 6641A(5)

6676B(3) × 6632(8) 1 hermit

" B(3)t × 6638A(2) - 2 pattern Spm-s + Spm-w

" C(5) × 6632(34) 2 hermits 6891

" E(4) × 6638A(2)

6680C-[illegible] × 6632(11)

" C-[illegible] × 6631A(2)

" C(5)t × 6632(4)

" E-(6)t × 6675G 6887

6683A(1)t × 6632(25)

6683B(2)t × 6641A(5) 6888

6684C - see ear count

pale plant - 6685F(2) [illegible] × 6641A(5) 2 up

1Spm	no plants	no ear			Pale	Var		Total	no [illegible]
6876-1Spm	6	9	1 spm		1546	1399		2945	
6876-8	I		1Spm		268	172		440	
" -8	I		2Spm		90	217		307	
6876-1			2 linked Spm		79	116		195	
6876-10			2Spm		64	176		240	
" -11			2Spm		121	328		449	
no Spm 6876-6									

Spurig + [illegible] position [illegible]
[illegible]

Spurig + [illegible] pupation
from 6629 A Spurig +

Gauze.

		I	II	I-1	I-2	I-3	potin			
6629 A	1	✓	✓							
6629 A	3	✓								
"	4	✓								
" A	7	✓		✓						
" A	9	✓		✓						
6629 D	1	✓	✓							
" C	8	✓								
" D	10						✓			
" E	3	✓								
" E	4	✓								
" E	9	✓								
" E	19	✓	✓							
6664 C	1	✓								
" C	2	✓								
" C	4	✓								
6665 E	1	✓		✓						
" E	2	✓		✓	✓					
" E	3	✓		✓						
" E	4	✓		✓						
" E	5	✓		✓						
" E	6	✓								
" E	7	✓								
" E	8	✓		✓						
" E	9	✓								
" G	1	✓		✓	✓					
" G	2	✓								
" G	5	✓								
" G	6			✓						
" G	7	✓		✓						
" G	12	✓								
" G	13	✓								
" G	16	✓								
" G	21	✓								
6666 C	1	✓								
" C	2	✓	✓	✓						
" C	3	✓		✓						
" C	4	✓								
" C	5	✓		✓						
" C	6	✓		✓						
6666 C	7	✓		✓						
6666 E							✓			
" G	2	✓								
" G	4	✓								
" G	5	✓								
" G	6	✓								
" G	9	✓								
" G	10	✓								

	I	II	L-1	L-2	L-3	pollen			
6670 C-1	✓								
" C-2	✓								
" C-3	✓								
" C-4	✓								
" C-6	✓		✓						
" C-7	✓		✓						
" E-1	✓								
" E-4	✓								
" E-5	✓								
" E-6	✓								
6673 C-1			✓						
" C-2			✓						
" C-3			✓	✓					
" C-6			✓						
" C-9			✓						
" C-10									
" C-11			✓						
" C-12	✓								
" G-1	✓		✓						
" G-3	✓								
" G-4	✓								
" G-5	✓								
" G-9	✓		✓						
" G-11	✓								
" G-12	✓								
" G-16	✓								
6674 C-1			✓						
" C-5	✓								
" F-2	✓								
" F-3	✓								
" F-5	✓		✓						
6676 B-1	✓	✓							
" B-2	✓								
" B-3	✓		✓						
" B-4	✓								
" B-9	✓								
" B-10	✓								
" C-3	✓								
" C-5	✓								
" C-6	✓								
" C-9	✓	✓							
" D-10	✓								
" E-4	✓		✓						
" E-7	✓								
" E-10	✓								

		I	II	t-1	t-2	t-3	pollen			
(x) ar										
6862 –	2	✓								
" –	9	✓								
" –	10	✓								
6861 –	1	✓	(see 7263 cul two)							
" –	5	✓	" 7262	✓						
6868 –	8	✓								
" –	9	✓								
" –	10	✓								
6869 –	1	✓								
" –	2	✓								
" –	3	✓								
" –	4	✓								
" –	5									
" –	6									
" –	7									
" –	8									
" –	9									
[illegible]										
7262 –	1	✓								
" –	2	✓								
" –	3	✓								
" –	4	✓								
" –	5	✓								
7263 –	1	✓								
" –	2	✓								
" –	3	✓								
" –	4	✓	✓							
" –	5	✓								
" –	6	✓	✓							
" –	7	✓								
" –	8	✓								

(x) ears [illegible] [illegible]
pollen [illegible]

I HHH HHH HHH HHH HHH HHH
HHH HHH HHH HHH HHH || } = 57

I + II HHH = 5

I + I HHH HHH HHH
HHH | = 21

I + P

I + II + I

I + I + I |||| = 4

87

6629A - 7
6662E - 3
6665G - 16
" G - 21
6666C - 1
" C - 2
" C - 7
6674C - 1
" C - 5
6868 - 9

10

(4) = 6662
6862
6869
Pollen = 7262

page from a_1 → B_1

6864 - 4										
[illegible]										
6875 B - 1		[illegible]	[illegible]							
B - 2										
B - 1										
6877 B - 1										
6880 - 7										
6882 B - 2										
6884 - 16										
6886 B - 2										

Spm/Spm

6664

			A1		pale	Nor.				
6662D-2		YY	6632-4		37	232				
" D-2 (1)					3	37				
" D (6) (x)		YY			4	171				
" D 6t		"	6632-23		0	28				
" D 6t		"	" -26		0	70				
" D (9)		YY	" -23		0	30				
" E-11		YY	6638A-3		39	280				
" F-7		YY	" A-2		22	280				
" F-9		YY	" "		24	254				
6664D-3		YY	" " -4		43	435				
6662D-2 (x) : 6900										

Imitations to colorless - state 5715A

6648 (3) x 6669C

" (4) + 6634B (7)

" (5) + 6632 (35) - see (A, mut / a, mu)

State 5720 mutants - + [illegible]

6667G (6) x 6638A (3) Wx + 1 wx Spm + 1 Spm -

6668C (3) x " (4) Wx + 1 wx Spm + Spm - see 6872

6668C (6) + " (4) Pr + 1 pr Spm See 6877

important for relation between high pale ratio + transposition of Spm

Like 6666C (7) ears and pugling 6895

6671F (2) Wx + 1 wx Spm see 6873 (mutant)

6671F (11) Pr Spm / pr +

6671G (1) " "

sectoral ear 6672E (12) I x 6638A (3)

6680F (4) x 6638A (4) - 6874

6683D (2) I x 6641A (5) sectoral ear

6685F (1) I x 6632 (7) - origin of "modified"

6694B (7) - Sectoral tassel, crosses

1955

Homozygous a.m-1

5719A-1 / 5719A-1

6871
6875
6878
6880
6882
6887
6888
6890
6900

5719A-1 / 5718

6866
6867
6869
6870
6872
6874
6877
6895

5999/5718

6883

5996-4/ 5719A-1

6885

Spin/Spin plants in culture 6662

♀	♂		A1	Pale	var.					
6662D-2	6632-4		2	36	232			1+I-2		
6662D-6	⊗			4	231		[illegible]	= 1 spin		
" D 9	6632-23		0	0	30					
" E1	6638A3		0	39	280					
6662D-3	⊗			3	37					

① ③ ② 4 ⑤ 124

Y Spm | Y Spm ; Y Spm | Y+ ; Y Spm | y Spm , Y+ | y Spm . Y Spm | y

What was found was the following:

3 = Y Spm | Y Spm = D ② D ⑥ D ⑨

1 = Y Spm | y Spm = E ⑪

3 = Y Spm | Y + = E ⑤ ⑫ ⑬

7 = Y Spm | y + = E ③ ④ ⑨ ⑭ ⑲ D ① D ⑧

1 = Y | y Spm D ⑩

1 = Y | y ; 2 Spm not linked to Y or y = ⑥

1 = Y Spm | y + plus 1 non-linked Spm = ⑯

1 = Y | y 1 Spm, not linked = D ③

See Results [illegible] for study of Transposition of Spm

Plant	Spm constitution		Culture no. of progeny		Spm constitution in progeny (Plants where progeny, in Table, were grown)		Culture no. of progeny	Table reference
		Table	6665, 6666:					
6629A-1	Y Spm/y+ 35% recombination	20 to 30	6665E-10	manner	Y/y 2 Spm	Table 26	6864	
			" " -10	selfed	Y/y 2 Spm	Table 26	6865	
			66656-16	selfed	Y/y 1 Spm	Table 24	6866	
			66656-21	selfed	—	—	6863	
				selfed	Y/y, 2 Spm	Table 24	6867	
			6666C-1	ear I	Y/y 1 Spm	Table 26	6868	
			6666C-2	ear I	Y Spm/y+ (?)	Table 26	6869	
			6666C-7	ear II	uncertain	Table 26	6895	Table 43
			6895A-1	ear I	Y Spm/y+ 4.5% recomb.	Table 43	7260	Table 43
			6895B-3	ear I	W+ Spm/wx+ recom.	Table 44	7261	Table 44
6629A-8 ear I	Y Spm Spm/y++	see page	6676		see text	Table 31		
6629A-2	Y Spm Spm/y++ plus 2 Spm.	see page	6667:		see text	Table 32		
			6667F-1	ear I	Y Spm Spm/y++	Table 32	6884	Table 33
	main ear	see page	6668		see text			
			6668C-6	ear I	Pr+/pr Spm	Table 34	6877	Table 34
			6668C-3	ear I	Tor+/tr Spm + 1 Spm	Table 35	7285	Table 36-40
			7285 [illegible]	ear I	Tor+ Spm/tr+	Table 37	7330	Table 37-41
			" "	Table	Wx/wx; 1 Spm	" "	7331	Table 42
			7285A-2	table	Tor+ Spm/tr+	" "	7332	Table 39-41
			7285A-7	table	"	"	7333	" "
			7285B-6	ear I	"	"	7334	" "
6704B-3	Y Spm/y+ 18% recombination	see page	6885	Table 45				

							Table	Progeny	
6629A-5 ear I 1Spm | y + plus 1 Spm			6671	(Table 46 and 47) 6671F-2 Wx + | mx Spm			Table 47	6873	Table 47
		tiller ear	6672	(table 46 + 47)					
6629B-2 2Spm		ear I	6680						
[y + | y Spm] see 7262, 7263				6680F-4 Wx + | mx Spm?				6874	
				6680C-2 3 Spm					
					6861				
						7262 7263			
6629B-5 ear I Pr Spm Spm | pr ++			6683						
				6683D-2 tiller		6878			
		ear II	6684						
				6684D-1 tiller		6879			
					pollen	6880 and	6881		
		tiller ear	6685						
				6685F-3 tiller		6882			
				6685F-1 tiller		6889			
				6685G-2		6875			
6703E-10			6876						

Transpositions of Spm - (minus Wx Spm/ wx + from 6872) early transpositions
(" 6877 = intables)

6665 G (13) I (x) = 6862

6665 E (10) I = 6864 — [illegible]

" " " I = 6865

6665 G (16) = 6866 - — weak [illegible]

6666 C (2) I = 6869 YSpm/y + quite stable. [illegible]

" C (1) = 6868 " " " Low transposition rate. [illegible]

6665 G (21) (4) = 6863

" × 6638 A (1) = 6867

6671 F (2) = 6873. Recombinants IVy [illegible]

Wx + [illegible]

6680 F (4) = 6874 (inactivations infer) Recombinants [illegible]

PrSpm/pr+

6685 G (2) = 6875 inactivation High rate [PrSpm/pr+] [illegible]

6703 E (10) = 6876

6668 C (6) = 6877. inactivation - Recombinants

6683 D (2) I = 6878 High rate of transposition Recombinants

6684 D (1) I (x) = 6879 High rate of transposition

6684 D (1) pollen = 6880 Low " " " in selected kernels, non-recombinants

" " = 6881 med " " " " " " non- "

6685 F (3) I = 6882 High rate of transposition Recombinants.

6685 F (1) I = 6889.

103 pa[illegible]

6707 A (5) I = 6883 From 5999

✓ 6667 F (11) = 6884 (reported in tables) non-recombinants

6704 B (4) = 6885 Low rate of transposition non-recombinants
Y Spm/y+
18% recombination

From 6080C-3 [illegible]

6703 E (5) = 6894
3 Spm

✓ 6666C-(7) = 6895 High rate of transposition in 6666C (7) I [illegible]

~~7260~~

✓ 6895 A (2) = 7260 Low rate of transposition in 6895 A (2) I [illegible]
Y Spm/y+ non-recombinants
4.5% "Recomb."

✓ 6895 B (3) = 7261 High rate of transposition
W+ Spm/wy+ non-recombinants.

Discussion - continued order: all from same Spm - in 6629B-1 = 35% recomb

I

✓7260 plants - behavior of Spm - 4% Recomb

✓7261 " - " " Spm

6885 - From Y Spm/ y+ of 6704B-4. 18.90 "recombination"

6864 + 6865 = From 6665E 10 I + I

6866 = From 6665G (16)

6863 = " 6665G (21)

6868 = From 6666C (1) - see Table 26 for changed Recomb rate 45% Recomb.

6869 = " 6666C (2) I " " "

II

6671F (2) - recombinant

III. progeny of 6629B - 5

~~IV. High rates of early transposition - 1954 custom - 6694 - pollentate~~

6629A (2) · main ear = 6668

From main ear. Only progeny from $a_1 sh_2 y$ kernels examined

9 plants = 7 with Spm, 2 with no Spm.

1 Spm = C (1) no linkage with ux ; no test for Pr linkage

C (2) " " " " ; no linkage with pr

discussed, see Table 34 — C (6) = Pr + | pr Spm give data [6877]

2 non-linked Spm = C (9) = Pr + | pr Spm plus 1 Spm not linked to ux

C (3) Wx + | ux Spm + 1 Spm ; no test of Pr linkage [6872]

C (4) no linkage with pr or ux

C (8) " " " " " "

Discussion Finished

6629A (2) Tiller ear = 6667. - Discussed, see Table 32 [illegible]

only plants derived from colorless, sb2 classes examined.

From Y class = 1 plant, Spm present but large sector in white Y chr lost from cells.

10 other plants - all had Spm:

Plants: 6667

1 1 Spm = Y Spm / y+ = F (8)

(54 pale Y : 119 pale y : 127 var Y : 50 var. y)

1 2 non-linked Spm, neither in chr 6 = F (9)

1 2 Spm, Both in Y chromosome = F (11) give data

2 2 Spm, 1 in Y chr, other non-linked = F (1), G (11) = Yy

2 3 Spm, 2 in " " " " " = F (2) F (5)

3 3 or more, at [illegible] positions not steady determined = F (3) (6) (10)

~~but 1 probably in Y chr~~

Data given in Table 32 of Spm paper.

6667 G from y $a_1 sh_2$ kernels = 10 plants

mentioned in text see page 127

2 = no Spm

3 = 1 Spm

2 = 2 non-linked Spm / G ⑥ = 35 pale Wx : 8 pale wx
47 var Wx : 80 var. wx

2 = 2 linked Spm

1 = 3 non-linked Spm (1 linked to wx : 21 pale Wx : 2 pale wx : 97 var Wx : 117 " wx)

In the 3 plants that were Pr pr, no linkage of Spm with Pr.

outline

1. Spm/Spm - 1 pale kernels on ear

2. Progeny of 6629A-8 (YSpmSpm/y++)

19 Y/y plants from variegated kerns - pg 125 Table 31

11 Y/y " from $a_1 sh_2$ Y kernels "

13 y/y " " " " y kernels "

3. Progeny of 6629A-2 (YSpmSpm/y++ plus 2 other Spm) - Tiller ear = 6667

10 Y/y $a_1 sh_2$ plants - pg 127 Table 32 - 1 plant = 6667F-11

8 y/y " " " - pg 127

4. Progeny of 6667F-11 (YSpmSpm/y++) = 6884

20 Y/y variegated kerns - pg 128 Table 33.

5. Progeny of 6629A-2 (YSpmSpm/y++ plus 2 other Spm) main ear = 6668

9 y/y = page 129, Table 34. 6668C-6; 6668C-3

6. Progeny of 6668C-6 (Pr+/pr Spm) = 6877

10 variegated Pr kernels - Table 34

7. Progeny of 6668C-3 (W++/wx Spm plus 1 Spm, non linked) = 6872

30 variegated Pr kernels = page 130 - 131 Table 35. 6872A-12

8. Progeny of 6872A-12 (WxSpm/W++) = 7285

13 variegated Wx kernels = page 132, Table 36, 37, 38; 7285A-1 2nd ear = 7330
" " tiller = 7331
" A-2 2nd " = 7332
" A-7 tiller ear = 7333
" B-6 1st ear = 7334.

7285A-1, 2, 7, B-6 = all Wx+/ux Spm

9. Progeny of 7330, 7332, 7333, 7334 - page 133-134. Table 39, 40, 41

10 Progeny of 7285A-1 letter = 7331. page 135. Table 42
(Wx+/ux; 1Spm, non-linear)

11. Progeny of 6666C-7 = 6895, page 136-139. 6895A-1 = 7260
(1Spm, position not known) 6895B-3 = 7261

(YSm/y+)
12. Progeny of 6895A-1 = 7260. page 139-140 Table 43

Wx+/ux ~~Spm~~
13. Progeny of 6895B-3 = 7261. page 143-145 Table 44.

14. Progeny of 6704B-4 (YSm/y+) = 6888 pg 149 Table 45
(YSm/y+ plus 1Spm, not linear to 1)

15 Progeny of 6629A-5 = 6671, 6672. pg 152, Table 46

6671F-2 = 6873

16. Progeny of 6671F-2 (Wx+/ux Spm) page 153, Table 47

Spin locations in Y chromosome in progeny of plant 6629A-8: culture 6676.

No. of Plants	No. of Ears	Ratio	Phenotypes of 9.7th carrying kernels: Pale Y	Pale y	Variegated Y	Variegated y		Totals		[illegible]
I Y Spm / y +										
14	18	1:1	655	1508	1330	647		4140		[illegible]
			[illegible]		[illegible]					
II Y Spm / Spm / y + +										
3	4	1:2	35	296	411	169		911		[illegible]
			[illegible]		[illegible]					
III Y Spm / Spm / y + +										
13	14	1:2 +	224	475	864	690		2253		[illegible]
			[illegible]		1554					
6667 F-1 (6629A-[illegible])		1:1 +	6	102	121	39		268		[illegible]
			[illegible]		[illegible]					
Progeny from 9.7A, Y kernels 6884:										
I Y Spm / y +										
3	3	1:1	126	420	348	106		1000		[illegible]
			[illegible]		[illegible]					
II Y Spm / Spm / y + +										
12	12	1:2	138	868	1330	616		2952		1468 : 1484
			[illegible]		1946					
III Y Spm / y + plus Spm										
2	2	1:3	55	137	260	230		682		[illegible]
			[illegible]		[illegible]					

new positions + actions of Spm

6629A-1 YSpm | y + 35% recombination

gave YSpm | y + 5% recombination - 6895

PrSpm | pr + 35% " - 6895

PrSpm-w | pr + 6886

WxSpm | wx + 33% " 6895 B (3)

YSpm | y + 45% " 6866

6629A-2

PrSpm | pr + 12% recombination

6629A-4

Pr Spm-w | pr +
Spm-w - linkage not found.

6629B (5) = PrSpm Spm | pr + + gave - 35% PrSpm | pr +
21% PrSpm | pr +

Continue -

1) Plant 6666C-7. 2 ears both pr. Table 26 - Discussion -

1. Ratio of kernel type: 70 pale : 27 var. no obs link with Y or Wx. ☐ ear.

2) Plants grown from them summer 1955 = 6895 A = Y Wx kern; B = y Wx kern.

6895 A-1 Y Spm / y + plus 1 Spm

B-2 Y Spm / y + very close linkage of Spm with Y - culture 7260 stable position

B-1 1 Spm - not linked to Pr or Wx

B-2 Pr Spm / pr + 34% recomb

B-3 Wx Spm / wx + = culture 7261 - unstable position

3) no - 6873 - From 667F(2) Wx+ / sex Spm - Recombinants = none in obs. 9

Plant 6666E(10) I+Z - culture 6864, 6865

Plant 6665G(21) - " 6867 later

4)

6683-6685 Culture

Table 31

Spm locations in Y chromosome in progeny of plant 6629A-8: culture 6676

Spm Constitution of plants	Approximate Ratio Pale : Var.	No. of Plants	No. of Ears	Phenotypes of 9th Carry Kernels: Pale Y	Pale y	Variegated Y	Variegated y	Total	Y : y
in culture 6676									
1 Y Spm / y +	1 : 1	14	18	655	1508	1330	647	4140	1985 : 2155
3 Y Spm Spm / y + +	1 : 2	3	4	35	296	411	169	911	446 : 465
2 Y Spm Spm / y + + dead	1 : 2	13	14	224	475	864	690	2253	1088 : 1165
Parent ear: 6629A-8 main ear Y Spm Spm / y ++	1 : 2	1	1	19	56	66	53	194	[illegible] : 109
4) odd types									
6676B-7 1st ear				46	59	88	71	264	
" 7 2nd "				37	62	49	39	187	
6676C-4				48	147	181	84	460	
5) yy plants 1 Spm		3		–	568	–	552	1120	
yy " 2 Spm		1		–	35		93	128	

Explain [illegible]

✓

1) meaning of reduced ratio – [illegible] Y chromosome [illegible] 6629A-4 ear – [illegible]

2) Y Spm / y + [illegible] y + in other plants [illegible]

3) one Spm close to Y in 3 plants 2 above

4) Both Spm [illegible] from Y in plants in 3.

Revised

5) Lin 1 recombination = 31.4

Part I

Table 2

1. Spm. number and location in plant 6667F-11 derived from tiller ear of plant 6629A-2. Part II. Spm number and location in progeny derived from variegated Y kernels on ear of plant 6667F-11.

Part I

1 Plant in culture 6667 from tiller ear of 6629A-2:										
					Phenotypes of a.m. kernels on Tst-cross ears					
Constitution	Approx. Ratio. pale: variegated	No. Plants	number of ears.	Pale Y	Pale y	Variegated Y	Variegated y	Total	Y : y
Y Spm Spm / y + +									
1) 6667F-11	1:1+	1	1	6	102	121	39	268	127 : 141
Part II Progeny of var. Y kernels in part I. (culture 6884)									
2) Y Spm / y +	1:1	3	3	126	420	348	106	1000	474 : 526
3) Y Spm Spm / y + +	1:2	12	12	138	868	1330	616	2952	1468 : 1484
4) Y Spm / y + plus 1 non-linked Spm	1:3	2	2	55	137	260	230	682	315 : 367

Explain in text

1) 23% recomb based on var cross

See [illegible]