HARVARD UNIVERSITY
Cambridge, Massachusetts

1. Mutation rates in maize-teosinte derivatives.

Certain derivatives of maize-teosinte hybrids which have mutated once continue to mutate at a fantastic rate. For example, a stock in which chromosome 4 from new teosinte had been introduced first mutated to dwarf. This same stock has subsequently mutated to defective seeds (eight times), albinos, virescents, two other types of chlorophyll deficiencies, and a gametophyte factor which affects Mendelian ratios. During the years in which these fourteen mutations occurred, the total number of plants grown did not exceed 195 (based on perfect stands) consequently more than seven percent of the plants grown produced mutations.

A similar situation has occurred in a stock in which chromosome 4 from Florida teosinte was introduced. In a population of not more than 85 plants, there have been four mutations to defective seeds, one to dwarf, one to virescent, one to yellow-green seedlings, and one to a gametophyte factor. A total of 9.4% of the plants have mutated.

2. The nature of the unstable mutants in maize-teosinte derivatives.

Many of the mutations which occur in derivatives of maize-teosinte hybrids are, as has been previously reported (MNL, 1956), unstable and the genetic nature of this instability has now been determined for one of these, a defective seed, and a similar situation is suggested for two others: a dwarf and a gametophyte factor.

The unstable defective seed, $de^{t5}$, is linked with c or r as is indicated by ears grown in 1955 and 1956 which were segregating for both c and r as well as de.

| Year | No. Ears | De color | De not | de color | de not | Total |
|---|---|---|---|---|---|---|
| 1956 | 10 | 1322 | 832 | 265 | 460 | 2879 |
| 1955 | 3 | 265 | 180 | 46 | 60 | 551 |

Similar ears which were also segregating for wx indicate that it is chromosome 9 and therefore the c factor which is involved in the linkage shown above. Following are the data from three ears:

| Row | No. Ears | De Wx | De wx | de Wx | de wx | Total |
|---|---|---|---|---|---|---|
| 56-66ff | 3 | 763 | 198 | 185 | 20 | 1166 |

Three-point backcross tests are now being made to determine the sequence of the factors and the amount of crossing over between them. In the meantime the data already available indicate that the chromosome involved is probably 9.

It now appears probable that $\underline{de}^{t5}$ is not a single gene but a block of genes from teosinte. In the $F_2$ endosperm generation of a cross between a noncolored cc rr stock of $\underline{de}^{t5}$ and a colored normal stock the defective seeds with aleurone color (crossovers) are less defective and consequently weigh more than the colorless defective seeds (a mixture of noncrossovers and undetectable crossovers).

The average weights of the two classes of defectives from 28 segregating ears follows:

| | No. of Kernels | Weight in Grams | |
|---|---|---|---|
| | | Total | Average |
| Noncolored de | 1121 | 31.84 | .028 |
| Colored de | 814 | 35.47 | .044 |

The colored seeds are 57.0% heavier than the noncolored.

The results indicate that the size of the teosinte segment is reduced through crossing over with a corresponding reduction in its deleterious effect upon the development of the endosperm.

This conclusion is supported by differences in the lignification of the glumes of different genotypes. Even small blocks of teosinte genes can affect the nature of the glumes causing them to be stiff and horny. In population of some 200 ears segregating for $\underline{de}^{t5}$ the segregating ears were generally more lignified than the nonsegregating and those segregating an extreme defective had on the average more lignified glumes than those segregating a partial defective.

Since an entire teosinte chromosome can be introduced into the inbred strain A158 without producing defective endosperm, this unstable defective probably represents either a particular block of genes which does not function well in the absence of the remainder of the chromosome or a block of genes which has been transposed from one chromosome to another.

The latter explanation seems the more plausible because these mutations are occurring in strains which have been inbred from five to seven generations and which are presumed to be homozygous for certain teosinte chromosomes and in which crossing over would therefore have no genetic results. The transposition of blocks of genes from one chromosome to another would, of course, be quite a different process and would be expected to produce genetic results.

A similar situation exists with respect to a homozygous genotype of the extreme form of $\underline{de}^{t5}$. If this extreme condition is due to the block of genes from teosinte being present in its entirety, then once the genotype is homozygous for the block of genes crossing over between the homologous chromosomes should have no effect and the mutant might be expected to be, in this state, quite stable. On the contrary it reverts to normal and near-normal at a very substantial rate. These reversions could be accounted for by the transposition of the block of teosinte genes back to its original chromosome.

There is some question whether the unstable defective endosperm described here and similar types which have appeared repeatedly in our maize-teosinte derivatives should actually be called mutants. Perhaps "pseudomutants" would be a better term. The defective endosperm appears actually to be a case of imperfect development resulting from a block of teosinte genes which does not function well in this particular intracellular environment. Bianchi has found that this defective endosperm as well as others of the same general type disappear when outcrossed to certain stocks. In other words, what is being inherited here is not a lesion in the chromosome which produces the defective endosperm whenever it is in the homozygous condition but a certain intracellular environment characteristic of this particular inbred strain. In this particular intracellular environment this particular block of teosinte genes does not function well enough to produce a completely normal endosperm.

### 3. <u>An unstable mutant dwarf in a maize-teosinte derivative</u>.

A number of mutant dwarfs have occurred in various maize-teosinte derivatives involving the inbred A158 in which one or more chromosomes of maize have been replaced by their homologs from varieties of teosinte. Until recently we have not undertaken a special study of these dwarfs. However, in the summer of 1957 a progeny of a teosinte derivative proved to be segregating for a highly variable dwarf. This derivative involved chromosomes (or parts of chromosomes) 1, 7, and 9 of Durango teosinte and had been selfed for five generations when the mutant dwarf first appeared.

The instability of the mutant dwarf is illustrated by comparison of its frequency distribution with respect to height with that of normal plants in the same progeny. The dwarfs vary from 30-149 cms.