## 7. Identification of plasmatypes.

Restored sterile inbreds that are maintained in S or T types of cytoplasm must be correctly identified and used only with the corresponding S or T sterile seed parents. Failure to do this has led to much confusion and unsatisfactory pollen restoration. Many of the sources of pollen restoration carry genes for both S and T restoration. When maintained in one type the restoring genes for the other type are unselected for and tend to be lost although the inbreds themselves may be fully fertile. Fertile inbreds cannot be tested for their plasmatype by crossing on to S or T steriles since they may be carrying restoring genes for both types. If they are segregating for sterile plants these sterile plants can be tested by being pollinated by suitable testers. If not segregating they can be crossed by non-restoring inbreds. The segregating sterile plants in later generations can then be tested.

Donald F. Jones

CORNELL UNIVERSITY
Ithaca, New York
Department of Plant Breeding

## 1. Mutational Behavior of $R^r$ Jana

Previous studies have shown that the action of the standard $\underline{R}^r$: allele (Cornell) is due to two closely linked genes which are separable by crossing over. The $\underline{R}^r$: Cornell allele mutates both to $\underline{R}^g$ and $\underline{r}^r$ but only rarely to $\underline{r}^g$. Earlier, Stadler had observed the same type of mutational sequence in stocks possessing the following $\underline{R}^r$ alleles: $\underline{R}^r$: Boone, Quapaw, Ponca, and Black. Stadler concluded that in the case of these 5 alleles the action of the $\underline{R}$ segment is due to separate genes rather than to the action of a single gene.

Later, Stadler found that this stepwise course of spontaneous mutation is not characteristic of all $\underline{R}^r$ alleles. He reported that two $\underline{R}^r$ alleles with dilute pigmentation mutate directly to $\underline{r}^g$ and not to $\underline{r}^r$. In the case of these two alleles, he proposed that both plant and seed color are dependent upon a single component.

Recently a third type of $\underline{R}^r$ allele has been analyzed which mutates regularly to $\underline{r}^g$ and less frequently to $\underline{r}^r$. In contrast to $\underline{R}^r$: Catspaw and Winnebago, this allele, which is known as $\underline{R}^r$: Jana, is identified by strong plant color both in the seedling and the flowering stages.

The seed mutation data from the cross of ♀♀ $\underline{g}\ \underline{R}^r$: Jana $\underline{K}/\underline{G}\ \underline{R}^r$: Jana $\underline{k}$ × ♂♂ $\underline{g}\ \underline{r}^g\ \underline{k}/\underline{g}\ \underline{r}^g\ \underline{k}$ are summarized in Table 1. The stocks of homozygous $\underline{R}^r$: Jana were marked on either side of the $\underline{R}$ complex with $\underline{g}$ and $\underline{K}$.

Out of a total population of 245,515 female gametes tested, 24 colorless seed mutants were analyzed and of these all but two were $\underline{r}^g$; none of these cases exhibited defective pollen. Of the 22 $\underline{r}^g$ mutants produced, 13 were $\underline{g}\ \underline{r}^g\ \underline{K}$, 7 were $\underline{G}\ \underline{r}^g\ \underline{k}$, and 2 were $\underline{G}\ \underline{r}^g\ \underline{K}$ in constitution. The simplest explanation of the origin of these cases is that the plant and seed color determiners of $\underline{R}^r$: Jana mutated simultaneously to the double recessive or to $\underline{r}^g$. On this assumption the $\underline{g}\ \underline{r}^g\ \underline{K}$ mutants would be attributed to mutations in the $\underline{g}\ \underline{R}^r\ \underline{K}$ chromosome, and the $\underline{G}\ \underline{r}^g\underline{k}$ mutants to mutations in the $\underline{G}\ \underline{R}^r\ \underline{k}$ chromosome. The origin of the two $\underline{G}\ \underline{r}^g\ \underline{K}$ cases in which a crossover occurred may be ascribed to mutations in the $\underline{g}\ \underline{R}^r\ \underline{K}$ chromosome with a coincidental crossover between $\underline{g}$ and $\underline{k}$, for the number of crossovers expected by coincidence is about 3.

Table 1 The frequencies and types of seed color mutants observed in progenies from homozygous $R^r$: Jana. ♀♀ $gR^rK/GR^rk$ x ♂♂$gr^gk/gr^gk$.

| Culture | Number of seeds examined | Number of colorless seeds | Mutant fraction determined | Phenotype of mutant individuals | | | |
|---|---|---|---|---|---|---|---|
| | | | | $gr^rk$ | $gr^gk$ | $Gr^gK$ | $Gr^gk$ |
| 56: 825 | 75, 525 | 6 | 4/6 | 1 | 3 | 0 | 0 |
| 826 | 66, 970 | 9 | 7/9 | 0 | 4 | 0 | 3 |
| 827 | 23, 460 | 5 | 3/5 | 0 | 2 | 1 | 0 |
| 828 | 26, 480 | 1 | 1/1 | 0 | 0 | 0 | 1 |
| 829 | 31, 135 | 6 | 5/6 | 1 | 2 | 1 | 1 |
| 830 | 21, 200 | 3 | 3/3 | 0 | 1 | 0 | 2 |
| 58F 3245 | 745 | 1 | 1/1 | 0 | 1 | 0 | 0 |
| Total | 245, 515* | 31 | 24/31 | 2 | 13 | 2 | 7 |

* Adjusted mutation frequency 24/31 x 245, 515 = 24/190, 076.

It will be seen in Table 1 that homozygous R$^r$:Jana also produced two seed color mutants of type g r$^r$ K. These are mutants that would be expected if the plant and seed color effects of the R$^r$ segment were independent components. On this basis the origin of the two g r$^r$ K mutants would be ascribed to mutations of the seed color determiner R to r in the g R$^r$K chromosome, since the mutant chromosomes are of the same g and K constitution as the g R$^r$ K chromosome.

In general it is evident that R$^r$:Jana mutated more frequently to r$^g$ (rate = $1.16 \times 10^{-4}$) than to r$^r$ (rate = $0.11 \times 10^{-4}$), and that the mutations were chiefly the result of non-crossover alterations. It also appears evident that a large proportion of the seed color mutants from R$^r$:Jana were of the type that would be expected if (P) and (S) were a single entity with two kinds of action. Whether, however, the R segment of R$^r$:Jana actually consists of a single element cannot be definitely concluded on the basis of the present results, since a small proportion of the mutants were of the type expected from the action of two independent genes. For the moment, the significance of this finding still remains unclear. Although it is possible that the seed color factor of R$^r$:Jana mutated independently of the plant color element, it is also conceivable that the origin of the r$^r$ mutants may be attributed to some other mechanism which is not apparent at the present time. It is also puzzling, in view of the high frequency of oblique crossing over in stocks of R$^r$:Cornell, to find so few oblique crossovers in the progeny of R$^r$:Jana. It may be that the structure of R$^r$:Jana is a complex of two spatially segregated parts so oriented as to be nearly incapable of separation by crossing over. One may suggest from these results that the origin of the r$^g$ mutants is due to a suppressive type of mechanism, inhibiting both plant and seed color. However, there is no evidence that indicates such a mutator system present in the stock. The seeds of each of the r$^g$ mutants were closely examined for dominant mutations, but no spots or sectors of colored aleurone were found. A similar examination was made of the plant tissues.

M. H. Emmerling

## 2. New abnormal chromosomes 10.

A number of altered abnormal chromosomes 10 arose as a result of crossing over in abnormal 10/duplicated abnormal 10 heterozygotes. The effect of these altered chromosomes 10 on preferential segregation was studied in backcrossed ears produced by pollinating female plants of R altered K/r k constitution by r k/r k. The results to date are summarized below.

| Culture | Type of chr. 10 | Numbers of Altered K | Numbers of Unchanged k | Percent Altered K |
|---|---|---|---|---|
| 58:243-3 | new knob $^{O}$ (2) * | 1416 | 1365 | 51 |
| -7 | Trisomic-K10, k10, new knob $^{O}$ (3) * | 565 | 536 | 51 |
| -9 | new knob $^{O}$ (4) * | 161 | 133 | 54 |
| -10 | interstitial K10 | 1480 | 1456 | 50 |
| -20 | Trisomic-K10, k10, interstitial K10 | 1177 | 1181 | 48 |
| -23 | Trisomic-K10, k10, interstitial K10 | 1459 | 1282 | 53 |
| -24 | altered abnormal 10 with 2 knobs on 10L | 1231 | 1184 | 50 |
| -27 | Trisomic-ring-10, k10, new knob $^{S}$ (2) ** | 1457 | 1417 | 51 |
| -28 | Trisomic-ring-10, K10, k10 | 834 | 862 | 49 |