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1. Reversions to fertility in S male-sterile cytoplasm in corn.

A number of cases involving changes of the S cytoplasmic sterile condition to the normal or fertile state have been identified. Several strains carrying the S type cytoplasm exhibit surprisingly high frequencies of change from sterile to fertile and to semifertile condition and these represent changes at the cytoplasmic rather than the nuclear level. Singh and Laughnan (Genetics 60:226, 1968) reported the initial studies of this phenomenon as we know it. Exceptional male-fertile offspring appeared among the progeny of an M825S male-sterile plant crossed by inbred line R138TR, carrying no S restorer. While the fertility of the exceptional F_1 individuals was not transmissible through the pollen, it was transmitted efficiently through the egg. The results are consistent with the hypothesis that mutation of the S cytoplasmic element is involved.

Singh and Laughnan investigated the exceptional products of a single event involving somatic change of the S cytoplasmic element. A search has been carried out for additional cases of S element changes in the male-sterile versions of inbred lines R839, R851, R853, R825, M825 and E1. It was soon discovered that the M825 male-sterile line not infrequently produces fertile tassel sectors and occasionally produces plants with entirely fertile tassels. While the M825 line shows the strongest tendency to "go fertile" in this way, similar events have been identified in the other S male-sterile inbred lines.

Upon encountering an exceptional male-fertile plant with an entirely fertile tassel, or with a fertile sector in the tassel, we have introduced and, wherever possible, abided by, a routine crossing procedure:

- (1) The exceptional plant is either self pollinated or, as has more often been the case, is crossed as the pistillate parent by a nonrestoring maintainer plant from a defined inbred line source.
- (2) The exceptional plant is employed as the pollen parent in crosses with S male-sterile plants from the same defined inbred source as indicated in (1) above.

- (3) The exceptional plant is employed as the pollen parent in a cross with a sibling male-sterile plant.
- (4) A male-sterile sibling of the exceptional plant is crossed with a nonrestoring maintainer plant from the same defined source as indicated in (1) and (2) above.

Step (2) above is the most crucial one as it determines whether the male fertility of the exceptional plant is assignable to mutation of the S cytoplasmic factor or to mutation at the nuclear restorer locus. So far all such exceptions, of which hundreds have been analyzed, fail to transmit through the pollen and as such are assignable to changes in the S element at the cytoplasmic level.

The crossing procedure outlined above affords the opportunity to make certain other interesting comparisons, and at least one of these appears to be significant. Both steps (3) and (4) involve sibling male-sterile plants as pistillate parents; in the first case, the pollinator is the exceptional sibling individual while, in the second, the pollinator is an inbred line maintainer source whose male-sterile counterpart has no immediate record of mutation to male-fertility. When we registered the frequencies of offspring, from these crosses, with fertile tassel sectors we found that the pollinator sources differed significantly in regard to their contribution. Among the progeny of sibling male-sterile plants crossed with exceptional plants whose tassels were entirely fertile, 12 per cent had fertile sectors in the tassel while only two per cent of the offspring from crosses of sibling male-sterile plants, in the same families, with maintainer pollen had fertile tassel sectors. Similar results were obtained, 14 per cent and two per cent, respectively, in those cases where the exceptional parents carried fertile tassel sectors. We are inclined, at this point, to regard this contribution from the pollen parent as nuclear, or genotypic, preferring to believe that mutations of the S element are governed by both the plasmon and the nucleus. Nevertheless, we have not excluded the possibility that a cytoplasmic contribution, transmitted through the male gametophyte, is involved in the phenomenon.

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