HOMOZYGOUS diploid lines of maize, the genetic equivalents of advanced generation inbred lines, can be produced directly from monoploid maize plants. The two major problems involved are, first, the production and early recognition of large numbers of the monoploid sporophytes and, second, the derivation of self (and therefore, presumably homozygous) diploid progeny from these aberrant plants. The first problem has been solved in spite of the low rate of natural occurrence of monoploids (about one per thousand diploids on the average) by a combination of genetical, morphological, and cytological sorting methods and by the use of favorable seed and pollen parents. The second problem has been partially solved by dependence on spontaneous doubling of the chromosome complement in occasional cells of the tassel and ear meristems of the monoploid plants. Such doubling leads to the development of diploid sectors in the tassels and ears and greatly increases the chances for successful self-fertilization. About 10% of untreated monoploids yield successful self progeny, largely as a result of this spontaneous somatic diploidization.

At Iowa State College approximately 100 homozygous diploid lines have been developed by the monoploid method during the past 2 years. The following is a discussion of (a) techniques used in isolating monoploid plants in quantity; (b) techniques used in growing these plants and in developing homozygous diploid lines from them; and (c) some ways monoploids and monoploid derivatives may prove useful in a breeding program.

ISOLATION OF MONOPLOIDS

Genetic Methods

Monoploid sporophytes of maize presumably develop by parthenogenesis of otherwise normal eggs, or by apogamy, or, rarely, as a result of androgenesis. Since most monoploids are derived from the seed (female) parent, any such plants occurring in the progeny of a cross between two dissimilar stocks will resemble the seed parent, within the limits of the heterozygosity of that parent, and will be unlike either the pollen (male) parent or the hybrid progeny. On this account the search for monoploids is greatly simplified if one looks for them among individuals of progenies of crosses between markedly dissimilar stocks. Further, in order that the monoploids be recognizable in the seedling stage, it is necessary that the contrast be evident in the seedlings. Therefore, stocks carrying unusual dominant marker genes, or gene systems, which in the hybrid seedlings produce easily recognizable phenotypes, are used as pollen parents. Thus, the ideal marker stocks carry unusual dominant genes which produce an easily recognizable phenotype in the hybrid seedlings, dominant genes which contribute none of its genes to the monoploid.

One additional general requirement for stocks for this work is that they stimulate parthenogenesis. As noted elsewhere (2), certain parents tend to produce significantly higher frequencies of monoploids than other stocks, irrespective of the type of pollination involved. The actual incidence of monoploids in the progeny of any particular cross is influenced by the pollen parent used, and similarly certain seed parents tend to produce high frequencies of monoploids than others. For example, the monoploid stock used as seed parent (2) contributed none of its genes to the monoploid.

Thus, the ideal marker stocks carry unusual marker genes which produce an easily recognizable phenotype in the hybrid seedlings, dominant genes which contribute none of its genes to the monoploid, and the requisite genes for stimulation of parthenogenesis.

Seedling Markers (4)

Purple plant color has, of the types of seedling markers tried so far, proved to be the most satisfactory. Monoploid stocks which in crosses yield a purple (A B Pi R) marker stocks can be used widely without special regard for the genetic nature of the seed parent. In crosses in which the majority of stocks likely to be used are purple (A B Pi R) or brown (a b pi r), if the pollen parent used as seed parent yields a purple colored hybrid progeny. This trait develops first in the older portions of the hybrids. If the germination of the seed is carried out on trays so that the seedlings can be checked readily, the elimination of the plants which do not yield purple color in the roots can be completed in from 6 to 10 days after starting. Pink and red induced colors develop in the roots of the hybrid seedlings.