MONOPOLOIDS IN ZEA MAYS L.
FOLLOWING CROSSES WITH UNTREATED AND
X-RAYED POLLEN*

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Monoploids in Zea mays L. occur spontaneously among individual diploid seedlings. Plants with the gametic chromosome number have also been detected among members of multiple seedlings of maize and numerous other species of angiosperms. Previous reports disclosed that X irradiation of the pollen successfully stimulated reduced parthenogenesis in some other angiosperms, but the results of X-ray treatment were inconclusive in maize. Therefore, a tester stock of maize homozygous for \( lg \) and \( gh \) was crossed with pollen from inbred CT3A, carrying the dominant alleles. The pollen was exposed to 0, 1000, 2000, and 4000\( \text{r} \) units of X rays. Chromosome counts were made from root tips of plants exhibiting both recessive phenotypes to establish the frequencies of monoploids in the control and \( X_1 \) populations.

Monoploids were more abundant among the individual seedlings from crosses with untreated pollen than in the \( X_1 \) populations. X irradiation of the pollen is not a feasible method for the induction of monoploids in maize. The X-ray treatments greatly increased the frequency of multiple seedlings, and deficiencies were numerous among them. The members of a set of multiple seedlings were always genetically identical, and no monoploid members occurred. It is concluded that the induced deficiencies caused atypical development resulting in zygotic or embryonic cleavage.

Introduction

Monoploids and the completely homozygous diploids derived from them by chromosomal doubling are useful in basic and applied studies. Ordinarily monoploids occur infrequently, and their experimental induction is of obvious significance.

The first plant in the angiosperms known to have the gametic number of chromosomes occurred in Datura stramonium following X irradiation of the pollen (Blakeslee et al., 1922). Stadler (1931) reported the first monoploids in maize following X-ray treatment of the pollen but was uncertain if they were induced or spontaneous. However, X irradiation

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of the pollen, in some instances, has undoubtedly induced reduced parthenogenesis in other species of angiosperms (Magoon & Khan, 1963).

Despite the utility of monoploids and the successful induction of reduced parthenogenesis in other species, the evidence is still scanty and inconclusive concerning the effectiveness of X-ray treatment of the pollen of maize. This study, employing comparatively uniform genetic stocks, was undertaken to determine whether or not X irradiation of the pollen is a satisfactory method for the induction of monoploids in maize.

Materials and Methods

A tester stock, homozygous for \( l_g \) in chromosome 2 and \( g_l \) in chromosome 7, obtained from Dr. P. C. Mangelsdorf, was sib-crossed for two generations in order to obtain sufficient kernels to serve as the female parent in marked crosses. The original tester stock appeared quite uniform, and no apparent variability was detected after sib-crossing.

Pollen of inbred CI3A, carrying the dominant alleles of \( l_g \) and \( g_l \), was exposed to 4000, 2000 and 1000r units of X rays. Crosses were also made using untreated pollen of the inbred line. The X-ray treatments, at the rate of 23r per minute, were made with a General Electric Maximar 100 unit, using a target distance of 30 cm. The unit was operated at 5 ma and 100 kvp with added filtration of 3 mm of aluminum.

A total of 1588 kernels without apparent damage from the 4000r treatment was obtained and planted in benches in the greenhouse. Germless kernels and those with severely damaged endosperm, obviously incapable of germination, were not planted. The same selection procedure was followed for the kernels resulting after the 1000 and 2000r treatments, and 1588 kernels were planted for each group. The control consisted of 4800 kernels developed following crosses with untreated pollen, thereby closely approximating the total number of \( X_1 \) kernels.

Both sets of marker genes are readily classified in the seedling stage. The recessive \( l_g \), homozygous or hemizygous, results in absence of the normal ligules and auricles of the leaves. Homozygotes or hemizygotes for \( g_l \) have glossy leaves and, in contrast to normal seedlings, retain droplets of water when lightly sprayed.

Monoploids, derived from the female parent, would exhibit both recessive phenotypes. However, some of the \( X_1 \) seedlings would be hemizygous for \( l_g \) and \( g_l \) due to simultaneous deletion of the dominant alleles and, therefore, have the same phenotype as the monoploids. All plants showing both recessive characters were potted in soil for subsequent determination of mitotic chromosome numbers in order to distinguish