Isolation of New Monosomes

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Tests of haploids of G. barbadense L. as a source of monosomes

Haploids of G. hirsutum rarely if ever, set any seed under any form of pollination. Haploids of G. barbadense on the other hand are partially fertile and will produce a few seeds when pollinated with normal pollen.

The doubled haploid line 57-4, of G. barbadense, produces as high as 61 percent haploids in its progeny. In 1964, 45 seedlings of this line were transplanted to the field. Of the 45 plants, 22 were haploids and 23 were diploids (2n = 4 x = 54). When the haploids commenced flowering, open blossoms were hand-pollinated daily throughout most of the season with pollen from a normal line of G. barbadense, 3-79. Three hundred and twenty-five normal sized seed having dark testa were harvested from the 22 haploid plants.

The 325 seeds were planted singly in peat pots in 1965 and 189 germinated. The 189 seedlings were transplanted to the field where only 160 survived. Table 1 shows the results of analysis of 121 of the 160 plants. Only three simple monosomes were recovered. One plant showed 24 II + chain of III at meiosis. It is believed that the pairing relationships in this plant can be better explained by a chromosome interchange accompanied by a loss equivalent to a whole chromosome, rather than by the duplication and deficiency of whole chromosome. The recovered monosomes in the progeny of 57-4 haploids represents about 2-3% of the analyzed population, which is a rather low frequency.

Other chromosomal structural types recovered from cotton haploid were telosomes, trisomes, and translocations.

Table 1. Cytotypes and their frequency in the progeny of haploids of G. barbadense.

n[1]	26 II	2n-1	24 II + III	25 II + telosome	25 II + III	24 II + IV
21	91	3[2]	1	1	2[3]	2

[1] n = haploid

2 one plant was 24 II + telosome + 1

3 the extra chromosome in one plant was a telosome

Pollen irradiation

Pate and Duncan reported that ganma irradiation of cotton pollen was effective as a means of inducing a rather high frequency of mutations. They used the multiple dominant marker stock, Texas 586, and recorded the frequency of mutations at various levels of gamma radiation at eight loci. The results of their study indicated that many of the mutations may have involved deficiencies for parts of chromosomes or whole chromosomes. On the basis of their study it seemed worthwhile to attempt, by pollen irradiation, to isolate whole chromosome deficiencies for chromosomes carrying marker genes.

The multiple recessive stock, Texas 582, is homozygous for the recessive factors, cup leaf (cu), frego bracteoles (fg), glandless stem and boll (gl_1), cluster fruiting (cl_1), and virescent plant color (v). The normal alleles at the gl_1, cl_1, and v loci generally act as complete dominants to the recessive alleles in the heterozygote, where as, the normal or wild type alleles at the cu and fg loci behave as incomplete dominants in the heterozygotes. Of particular interest here was the induction of whole chromosome deficiencies for the chromosomes carrying the cup and frego loci. It is assumed in these two cases, since incomplete dominance is involved, that the hemizygotes fg/- and cu/- would have essentially the same phenotype as Fgfg and Cucu. Consequently, morphological expression of the bracteole or the leaf in a hemizygous recessive would not aid in identifying a deficiency for the chromosomes carrying the two loci. On the other hand, it is assumed that the hemizygotes of Fg/- and Cu/- would phenotypically be very similar to Fg Fg and Cu Cu, respectively, and therefore, distinguishable from the heterozygotes, Fg fg and Cu cu.

On the basis of the above reasoning, fresh pollen of Texas 582, the multiple recessive, was exposed to approximately 1000r of gamma irradiation. Immediately following exposure, the pollen was dusted on stigmas of emasculated flowers of stocks homozygous for the normal or standard alleles. From these crosses, 422 seeds were harvested and planted singly in peat pots, but only 385 germinated. Three hundred and seventy-five seedlings were transplanted to the field and 374 survived. All plants were scored at least three times during the season for gross changes in overall phenotype of the plant, but particularly for deviations from the expected phenotype for heterozygous cup leaf and frego bract.

Of the 374 plants, 24 were recorded as having leaves with a normal phenotype, 5 were recorded as having bracteoles with a normal phenotype, and one as having both leaves and bracteoles with a normal phenotype. Eighteen of the 31 plants were analyzed cytologically and two were found to be deficiency for whole chromosomes. Both were in the normal leaf class of plants.

One hundred and thirty-nine of the 374 plants were successfully analyzed cytologically. This study suggests that the majority of the mutations involving dominant markers observed by Pate and Duncan were the result of major chromosome deficiencies.

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