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ON THE ORIGIN OF HAPLOID/DIPLOID TWINNING IN COTTON[1]

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ABSTRACT

Twin seedlings were recovered from a cross of the tetraploid cotton species, *Gossypium barbadense* L., (as female) with the wild diploid species, *Gossypium davidsonii* Kell., (as male). One of the embryos was clearly the result of interspecific hybridization. The other showed the characteristics of a polyhaploid and bore the same genetic markers as the female parent. Development of the polyhaploid from an unfertilized nucleus contributed by the mother plant was clearly indicated.

Additional index word: **Triploid.**

EMBRYONIC twinning occurs as a relatively rare event in most of the cultivated tetraploid cottons that have been examined. For example, Blank and Allison (1), working with *Gossypium hirsutum* L., found that about 1 seed in 16,500 contained twin embryos. They found no evidence in their material for a heritable tendency to produce twins. Other workers (see the above authors for a review) found varying rates of twinning in other varieties of G. hirsutum. In all reports the ratio of twins to single embryos was on the order of one in several thousand.

On the other hand twinning can be a relatively frequent event in *Gossypium barbadense* L. Silow and Stephens (7) found individuals of this species which produced twins at the rate of 1 in 300 to 1 in 500. The vast differences in the rates observed in *G. hirsutum* and in selected material of *G. barbadense* suggest that a tendency to produce twins might be heritable.

Occasionally one of a pair of twins will be haploid, or perhaps more properly, polyhaploid, since the species under consideration are tetraploids. For convenience the terms diploid and haploid will be used herein to denote tetraploid and polyhaploid, respectively.

Blank and Allison (1) found a haploid in 4 of the 20 pairs of twins uncovered in their work. Meyer (personal communication) stated that about 30% of the twin pairs examined by him had as one member a haploid seedling. In the past I have saved several pairs of twins and have noted that only occasionally is one of them a haploid. Frequently one of the twins will be much smaller than the other. If one of the pair is haploid, it is usually the smaller of the two.

There have been various explanations for the occurrence of twin embryos in cotton. The cytogenetics of three diploid/diploid twin pairs in *G. hirsutum* was investigated and ably reported by Endrizzi (4), who also supplied a review of the theoretical explanations for twinning. He concluded that diploid /diploid twinning could occur as the result of the cleavage of an embryo, or through simultaneous fertilization of eggs in twin sacs. The haploid/diploid phenomenon is commonly explained as the result of the embry-

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onic development of an accessory haploid cell in the embryo sac after fertilization of the egg, or parthenogenetic development of an unfertilized egg in an accessory embryo sac (5, 9). Quintanilha, Cabral, and Quintanilha (6) found a form of abnormal sporogenesis in cotton that seemingly leads to twin egg nuclei and thus the possibility of twin embryos. In such cases haploid/diploid twinning might be expected, providing that a single pollen tube entered the ovule. Endrizzi (4) recovered a haploid/diploid twin pair from selfing a *G. hirsutum* stock heterozygous for two dominant markers. The diploid member of the pair proved to be homozygous for both markers, and the haploid bore at least one of the dominant alleles. Endrizzi concluded that both embryos were sexually derived, but the results did not exclude the possibility that the haploid might have derived from a sperm nucleus. This posibility seems less remote in view of the fact that Burk (2) recovered androgenically derived haploids in tobacco, as did Campos and Morgan (3) with pepper. Moreover, sectors of tissue in Turcotte and Feaster's (8) semigamous haploids of *G. barbadense* are believed to be of androgenic origin.

Strategic deployment of markers in crosses could give further information about the origin of twins in cotton, and the presence of frequently-twinning strains of *G. barbadense* make such studies feasible. The present report stems from the recovery of a pair of twins after the fortuitous use of marker stocks in an interspecific crossing program.

Results and Discussion

Recently I synthesized a glandless stock of *G. barbadense* that crosses readily, as female, with the New World diploid species *Gossypium davidsonii* Kell. While checking the produce of individual sib plants of this strain for evidence of cross compatibility with the diploid species, a seed containing twin embryos was found. The embryos were approximately equal in size, and had developed in tandem in the seed coat with the radicle of each pointing to the chalazal end. These embryos were germinated in a warm, moist chamber, planted in a greenhouse bed, and allowed to develop to flowering. One twin bore glands and showed other morphological evidences that it was a hybrid between *G. davidsonii* and *G. barbadense*. Since this hybrid plant was sterile, it was presumed to be a triploid. The other plant was glandless and clearly of *G. barbadense* origin. It was also sterile, and showed the spindly stems and small, frequently juvenile-form, leaves typical of haploids of *G. barbadense* (5). This finding shows that the haploid individual in haploid/diploid twin pairs can result from parthenogenetic development of a maternally contributed haploid nucleus.

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