IN THE ideal case of cytoplasmic male sterility, transfer of the genome of one species into the cytoplasm of another should result in 100% male sterility, while the same genome should be 100% fertile in its own cytoplasm. A dominant, non-deleterious gene should be available to restore 100% fertility when it is heterozygous in the genome introduced into the foreign cytoplasm. The ideal situation has not yet developed for cotton.

The interspecific property transfer program for cotton was begun at Stoneville, Mississippi, in 1948. One of its objectives was development of cytoplasmic male sterility. After 14 years and several thousand progeny rows, the first consistent pattern of the interactions governing male sterility in this material began to come into focus. It was evident that male sterility expression was most complex, and that it involved cytoplasm, genotype, and environment. To clarify this situation, a detailed study was made. Utilized as parents were: (1) a single, true-breeding, essentially male sterile plant with cytoplasm from a diploid species, and (2) a fertile Upland doubled haploid. Our report deals with male sterility3 as it occurs within the descendants of these two plants. This is not the only sort of sterility available from the derivatives of the interspecific hybrids developed and studied at Stoneville, Mississippi, nor is it the most complete sterility. However, it is the first cytoplasmically controlled sterility of cotton to be intensively studied and to have its gene-cytoplasm-environment interactions worked out. The general pattern of these interactions holds for a very wide range of progenies from crosses which involved other parents of similar origin, but most of them differ in detail from the single family of plants described in this report.

MATERIALS AND METHODS

The essentially male-sterile parent plant used for this study had cytoplasm from *Gossypium anomalum* Tod., a wild, lintless, diploid species from Africa. A hybrid was produced between *G. anomalum* and *G. thurberi* Wawra & Peyr., a wild, lintless, diploid species from Arizona. The chromosome number of the hybrid was doubled; the resulting amphidiploid was crossed with *G. hirsutum* L., the tetraploid, linted American species usually grown for commercial production of fiber. A doubled haploid of Upland cotton, 'M8,' was used as the *G. hirsutum* parent. A plant breeding true for high sterility resulted from three backcrosses of selected, partially sterile plants to 'M8,' plus selfing. All of the progeny rows reported were descended from 'M8' and 1961:999-8; the latter is designated as 'C9.' Sterile plants and their FI cytoplasm were brought into the greenhouse in the fall of 1962 for producing test-crosses not already available from field plants. Two sets of progenies were selfed, F1, F2, backcross to 'M8,' and backcross to *G. anomalum*, the other *G. hirsutum* cytoplasm.

Flowers were scored by a modification of this system. A score of "0" denotes a flower with 100% fertile anthers, "1" denotes up to 25% fertile anthers, "2" denotes 25% to 50% fertile anthers, "3" denotes 50% to 75% fertile anthers, and "4" denotes 75% to 100% fertile anthers. The number of flowers on each date was recorded on printed tags tied to the plants. The tags were divided into columns for each scored date; a ticket-punch was the most rapid means for recording the number of flowers in each class on each day. Flowers were checked for sterile anthers; on days when a single plant had 10 or more flowers, numbers were written in the appropriate rectangles with laundry-marking pens.

Under most environmental conditions plants had reliable indications of genotype. Plants used were classified for sterility by either or both of these methods. The sterility score determined from all flowers on the plant, sometimes based on over 100 flowers, was used for classification as "sterile," "intermediate," or "fertile" as a measure of the distribution of flower scores among the grandparents. The second method proved as trustworthy as the first in 1962 and 1963, and it had the advantage of being more objective. The plant had finished flowering. A plant was considered sterile if no more than 1 of 10 or more flowers scored over a period of 3 weeks or more was a "3" or "4." Sterile plants either had at least 1 flower in each of the 5 sterility classes, and the number of flowers in each class, and to record the number of flowers in each class, and to record the number of flowers in each class, and to record the number of flowers in each class.

Because variances for flower score data differed from those for reciprocal hybrids, Chi-square techniques were used for the statistical treatments of the data.

RESULTS AND CONCLUSIONS

The studies reported in this paper began to determine whether or not there were differences in sterility between reciprocal crosses of cytoplasm from different species. Frequencies...