A NEW MALE-STERILE MUTANT IN THE TOMATO

Heterosis, expressed in increased yield and earlier fruiting, has been frequently demonstrated in first-generation hybrids between certain horticultural varieties of *Lycopersicon esculentum* Mill.[1] The labor required to emasculate and pollinate flowers for the production of hybrid seed has heretofore prevented the widespread horticultural exploitation of this phenomenon. Barrons and Lucas[1] describe certain simplifications of technique that would reduce the amount of necessary labor. They also make a suggestion: if a male sterile type were used as the female parent in a program of cross-pollination, the need for emasculation would be eliminated. Currence[2] proposes for the same purpose the use of a type which has a stigma exserted beyond the anther tips and which therefore, when artificially pollinated without emasculation, yields a large percentage of hybrid offspring.

An unfruitful plant discovered here by Dr. Paul G. Smith was found to owe its barren condition to male-sterility. This plant and its male-sterile offspring are characterized and readily identified by anthers lighter in color and variously more shrunken than the anthers of male-fertile plants. The sporogenous tissue of male-sterile anthers develops normally until the formation of PMC's. Because further development is halted, as testified by the absence of all meiotic figures save the earliest stages, no pollen is produced. Fertility of the ovules is impaired only slightly if at all by the male-sterile genotype: the mean number of seeds per fruit produced by hand pollinations on five male-sterile plants—86—compares favorably with the mean number—91—observed in similar treatment of eight male-fertile sibs.

TABLE 1

Segregation of Male-Sterility in F_1, F_2 and Backcross Progenies

Progeny No.	Nature of pedigree	Male fertile plants: Obtained	Male fertile plants: Expected	Male-sterile plants: Obtained	Male-sterile plants: Expected
42L1	F_1	25	25	0	0
43L1	F_2	29	26.25	6	8.75
44L12	F_2	14	15	6	5
44L16	F_2	28	27	8	9
44L24	F_2	22	24	10	8
44L11	m.s. $F_2 \times F_1$	7	8.5	10	8.5
44L2	male-sterile $F_2 \times$ male-fertile F_2*	19	18	17	18
44L5		14	13	12	13
44L6		12	12.5	13	12.5
44L8		49	49	0	0
44L18		15	16	17	16
44L20		16	18	20	18
44L21		27	27	0	0

* These are essentially backcrosses planned to determine the genotype of seven random F_2 male-fertile plants.

The transmission of this character to F_1, F_2 and backcross generations, summarized in Table 1, argues recessive monogenic determination and an equal viability of male-sterile and male-fertile phenotypes. This male-sterile type could therefore be readily propagated from seed by backcrossing heterozygotes to male-sterile individuals.

Where hand-emasculated male-fertile plants are used in the large-scale production of hybrid seed, a considerable risk of contamination by self-pollination might be encountered, because any flower accidentally overlooked would produce seed by self-pollination. In contrast, the only source of contamination involved in the use of male-sterile plants is natural crossing. This factor is inconsequential according to Jones,[3] Lesley[4] and Currence and Jenkins[5]; in the present studies not a single fruit was set by open-pollination on six male-sterile plants growing during the summer of 1943 among male-fertile sibs.

The male-sterile tomato reported by Lesley and Lesley[6] differs in two respects from the one reported here: it is determined by two or possibly three factors, and it produces morphologically normal but non-germinable pollen and so is less readily identified. This difference in expression and inheritance points to a different genetic basis of these two mutants.

The writer has observed that mutations to male-sterility occur often enough to warrant search for them in any desired variety. The nearly exclusive propagation by self-pollination in the tomato favors the appearance of viable recessive mutants. Furthermore, when plants are unfruitful by virtue of genetic male-sterility or any of several other cytogenetically conditioned sterilities, their very aggressive vegetative habit renders them conspicuous in fields late in the harvest season. Accordingly, a large number of sterile plants can be readily obtained, and the male-sterile mutants among these can be identified by cytogenetic tests. This method of securing male-sterility in a given variety is believed to be more efficient than the customary procedure of backcrossing a male-sterile mutant to the desired variety. Three varieties of tomato were scanned in this manner for male-sterile types in 1943; and, with comparative ease, morphologically male-sterile types were found in each variety.

Charles M. Rick

College of Agriculture,
University of California,
Davis

1 See review of literature by K. Barrons and H. E. Lucas, *Proc. Amer. Soc. Hort. Sci.*, 40: 395, 1942.

2 T. M. Currence, *Rec. Gen. Soc. Amer.*, 12: 47, 1943.

3 D. F. Jones, Science, 43: 509, 1916.

4 J. W. Lesley, *Jour. Hered.*, 15: 233, 1924.

5 T. M. Currence and J. M. Jenkins, *Proc. Amer. Soc. Hort. Sci.*, 41: 273, 1942.

6 J. W. Lesley and Margaret M. Lesley, *Jour. Agr. Res.*, 58: 621, 1939.