Segregation of glabrous male-sterile in an Autotetraploid Line of Citrullus lanatus

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Love, et al. (4) reported the transfer of a nuclear male-sterile (ms) gene, glabrous male sterile (gms), from a diploid to a tetraploid watermelon line. We noted that this male-sterile tetraploid line could theoretically be maintained by crossing the genotypes gmsgmsgmsgms (female) x +gmsgmsgms (male). Melons harvested from the ms plants would produce seeds that segregate 1:1 for glabrous (male sterile) and hairy (male fertile) plants. The ms tetraploid would serve as the female parent, when planted adjacent to a diploid pollinator, to produce triploid seed for seedless watermelons.

If random chromosome assortment (1,2) is routine in this autotetraploid, the male-fertile simplex genotype +gmsgmsgms, can pollinate the male-sterile nulliplex genotype, gmsgmsgmsgms, to maintain a 1:1 segregation of male-fertile:male-sterile plants (mf:ms). If random chromosome assortment does not occur, segregations may differ widely from this ratio (1,2,3), making it difficult to maintain a ms tetraploid line.

Two plants from an autotetraploid line segregating for gms were selfed and F_1 plants were progeny tested (Table 1). In the first family, the testcross between the nulliplex plant 1 and plant 3 resulted in 5:1 mf:ms progeny, indicating a ++gmsgms genotype form plant 3. Selfing of plant 3 also indicated this genotype. The testcross between plant 2 and plant 4, as well as the selfing of plant 4, indicated a +gmsgmsgms genotype for plant 4. Selfing of plant 4 also indicated this genotype. In field isolation, the ms nulliplex plants and mf simplex plants from the 2 x 4 cross produced seed segregating 1:1 and 3:1, respectively.

In the second family, some segregation ratios did not fit the hypothesis of random chromosome assortment. The 1:1 segregation from the testcross 3 x 6 suggests that the genotype of plant 6 is +gmsgmsgsm. In another testcross, 4 x 6, there were no ms plants among 23 progeny. Ms plants were also absent from the progeny when the plant was selfed. In the next generation, F_2 ms plants pollinated by F_2 mf plants produced progeny segregating closer to 2:1 then1:1 mf:ms. Again, the ms class was low. The isolated, open-pollinated mf F_2 plants produced progeny that poorly fit a 3:1 mf:ms ratio. Seed number in melons from ms plants in both families varied from none to 100; seed number in melons from mf plants varied from 100 to over 200.

In summary, analysis of the segregation of gms in autotetraploid watermelon indicated random chromosome assortment in progeny from one parent. From a sister parent, an F_1 plant was found that produced a reduced number of gmsgms gametes. Investigations are continuing with larger populations.

Literature Cited

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Table 1. Ratios of male-fertile (mf) to male-sterile (ms) plants in families from 2 sister autotetraploid plants of Citrullus lanatus.

	Observed mf:ms	Expected mf:ms	Chi-Square	P	Putative Genotype
Sister 1 selfed	5:2	3:1	0.05	0.50	+gmsgmsgms
ms(1) x mf(3) F_1	25:6	5:1	0.03	0.9-0.8	gmsgmsgmsgms x ++gmsgsm
mf(3) selfed	31:1	35:1	0.18	0.7-0.5	++gmsgms
ms(2) x mf(4) F_1	22:14	1:1	1:36	0.3-0.2	gmsgmsgmsgms x +gmsgmsgms
mf(4) selfed	23:9	3:1	0.04	0.9-0.8	
ms(2) x mf(4) F_2[z]	16:17	1:1	-0-	0.99	
ms(2) x mf(4) F_2[y]	27:9	3:1	0.04	0.9-0.8	
Sister 2 selfed	8:4	3:1	0.11	0.8-0.7	+gmsgmsgms
ms(3) x mf(6) F_1	12:13	1:1	-0-	0.99	gmsgmsgmsgms X +gmsgmsgms
ms(4) x mf(6) F_1	23:0	1:1	21.04	0.001	gmsgmsgmsgms X +gmsgmsgms
mf(6) selfed	28:0	3:1	8.05	0.01-0.001	+gmsgmsgms
ms(3) x mf(6) F_1[z]	21:1	1:1	16.41	0.001	
ms(3) x mf(6) F_2[y]	28:7	3:1	0.24	0.7-0.5	

[z] F_2 from glabrous F_1 plants.

[y] F_2 from hairy F_1 plants.