

Table 4. The frequency of Wx pollen grains in c^{m-2} Sh wx^{m-1} / C sh wx^C Ds, Ac plants.

Plant	Estimated Total Pop.	No. Wx	Wx x 10 ⁻⁵
12501-1	22,000	536	2436
-2	21,000	320	1524
-3	19,000	609	3205
-4	14,000	402	2871
-5	20,000	93	465
-6	25,000	135	540
-7	9,000	151	1678
-9	18,000	191	1061

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4. A test for an unlinked inhibitor of a 5th chromosome gametophyte factor.

Longley (Genetics, 1961) has reported that a 5th chromosome gametophyte factor is one component of a two-component system. The other component is an unlinked inhibitor (In). The Ga gametes have a selective advantage over ga gametes only on the silks of In / - plants (the alleles at the Gametophyte locus in the female plant are immaterial).

Having worked for several years with a 5th chromosome gametophyte factor which is apparently Ga₂, stocks were on hand for a test of whether or not such an inhibitor could be implicated in this particular instance. The stock carrying the Ga factor is an inbred line, 4541, derived from Black Beauty popcorn. This line is A₁, C, R, A₂ Bt Ga Pr. In the F₂ population derived from a cross of 4541 onto Burnham's A₁, C, R, a₂ bt ga pr tester, we have observed a mean bt percentage of 5.1, and an a₂ percentage of 10.4 in a population of 3107 kernels from 7 ears.

The backcross, a₂ bt ga pr / A₂ Bt Ga Pr x a₂ bt ga pr / a₂ bt ga pr and its reciprocal were made in 1960 in order to estimate the recombination between a₂ and bt. Both backcrosses, F₁ x a₂ bt ga pr and a₂ bt ga pr x the F₁, gave proportions of a₂ and bt seeds which were in agreement with the expectation of a 1:1 ratio. The combined estimate (total population = 2457) of a₂ bt recombination was 7.7 percent.

Consider the possible genotypes of the parental strains if a two-component system is applicable. There is a striking deficiency of a₂ and bt kernels in the F₂ progeny. Therefore, 4541 is A₂ Bt Ga Pr and Burnham's tester is a₂ bt ga pr. There is also an In allele contributed by one or both of the parents, but the data from the F₂ progeny are not informative as to this point. However, the backcross a₂ bt ga pr / a₂ bt ga pr x a₂ bt ga pr / A₂ Bt Ga Pr gave .5 bt seeds. Therefore the a₂ bt ga pr / a₂ bt ga pr stock must be in / in since if it were In / in there should be a marked deficiency of a₂ and bt seeds in this backcross progeny. So 4541 must then be A₂ Bt Ga ; In. The backcross onto the tester was a₂ bt ga pr ; in x a₂ bt ga pr / A₂ Bt Ga Pr ; In / in. Since the postulated inhibitor is not linked to the Ga / ga locus,

half the Ga gametes will carry In and the other half in. The same consideration applies to the reciprocal backcross.

From the paired reciprocal BC progenies $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}} \times \frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$ (12722-7 x 12425-6) and $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}} \times \frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$ (12425-6 x 12722-7), seeds which were phenotypically $\frac{A_2 \text{ Bt } Pr}{A_2 \text{ Bt } Pr}$ were selected and planted in 1961. Since the Ga factor with which we have been working seems to be about 10 units distal to Bt, the chances that an $\frac{A_2 \text{ Bt } Pr}{A_2 \text{ Bt } Pr}$ gamete would carry ga are approximately 1/100 (not taking interference into account) and can be disregarded for predictive purposes. Thus in the plants arising from the $\frac{A_2 \text{ Bt } Pr}{A_2 \text{ Bt } Pr}$ seeds from each BC progeny there should be equal numbers of plants which are $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$; In / in (deficiency of a₂, bt, and pr on selfing) and plants which are $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$; in / in (normal ratios of a₂, bt, and pr on selfing).

Thirty plants from $\frac{A_2 \text{ Bt } Pr}{A_2 \text{ Bt } Pr}$ seeds from each backcross progeny were grown. Fifteen selfed ears were obtained from the $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}} \times \frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$ progeny and 12 from the reciprocal. The results of scoring these ears for bt and a₂ kernels are presented in Table 1. For each of the 27 ears the numbers of bt and a₂ kernels are significantly less than the 25 percent expected ($P < .05$ for all and $< .01$ for most) if a gametophyte factor were not operative. To find that all 27 progenies show low percentages of bt where one-half are expected to give 25 percent if an unlinked inhibitor In were necessary to give Ga gametes the competitive advantage over ga gametes, suffices to rule out this hypothesis ($P < .001$).

Table 1. Results of selfing $\frac{a_2 \text{ bt } ga \text{ pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$ / $\frac{A_2 \text{ Bt } Ga \text{ Pr}}{A_2 \text{ Bt } Ga \text{ Pr}}$ plants from paired reciprocal BC progenies.

No.	Tester x F1 (12722-7 x 12425-6)			F ₁ x Tester (12425-6 x 12722-7)		
	Total	% bt	% a ₂	Total	% bt	% a ₂
- 1	412	4.9	10.9	437	6.9	13.5
- 2	408	3.2	11.0	133	6.0	16.5*
- 3	243	3.7	12.8	162	5.6	8.6
- 4	208	9.6	18.3*	241	8.7	16.6
- 5	222	5.0	12.2	172	15.2	17.4*
- 6	377	4.2	11.7	230	4.8	10.4
- 7	334	5.1	11.7	303	4.0	8.9
- 8	312	6.4	13.1	405	3.7	12.3
- 9	357	6.2	14.0	265	9.8	19.6*
-10	342	3.8	12.9	321	5.6	14.6
-11	400	9.3	18.3	344	5.3	12.5
-12	227	7.5	13.2	332	9.0	11.7
-13	232	7.3	13.4			
-14	233	3.9	11.6			
-15	389	4.6	11.6			

* $P < .05$ that these are drawn from a population that is actually 3+ : 1 bt or a₂. $P < .01$ for all other values.

The demonstration that the results are not those expected if a two-factor system were operative for this Ga factor (which is probably Ga₂), is applicable only to this factor. It shows, however, that not all 5th chromosome gametophyte factors require the presence of an inhibitor (In) at another locus in order to exert their effect.

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5. A test for fifth chromosome gametophyte factors in some Mexican races.

The 5th chromosome tester A₁, C, R, a₂ bt pr synthesized by Burnham has been a most useful stock in the investigation of chromosome 5 gametophyte factors because it has not appeared to carry any gametophyte factors itself. For example, in the F₂ of crosses times 4541 (a Black Beauty popcorn inbred which is A₁, C, R, A₂ Bt Ga Pr), we have found 5.1 percent bt kernels and 10.4 percent a₂ kernels. Thus, the gametophyte factor in 4541 is approximately 10 C.O. units distal to bt and is apparently at the locus designated by Brieger as Ga₂. With respect to 4541, the tester appears to be ga₂.

The genotype of various Central American races with respect to the 4th chromosome gametophyte factor, Ga₁, has long been of interest to us. Results of various tests have been reported in previous M.N.L.'s. Last year we decided to test a few Mexican varieties for their allelic constitution at the Ga₂ locus by crossing onto the a₂ bt ga pr tester and selfing. Four Mexican races, Celaya, Conico Norteño, Cuatero de la Virgen, and Vandeño were used. The results are recorded in Table 1.

It is evident that for 3 F₂ progenies (those involving Conico Norteño, Cuatero de la Virgen, and Vandeño) there are significantly more bt kernels than expected. There are several possible explanations.

In the first place it is possible that there is a multiple allelic series at the Ga₂ locus such that gametes with a particular allele have a competitive advantage over those gametes carrying an allele which is lower in the series but are at a competitive disadvantage relative to gametes carrying an allele higher in the series. In this particular case, the allele ga₂^B in the Burnham tester stock would be almost completely eliminated when competing against Ga₂ from 4541. It would, however, be at a competitive advantage against the ga₂ alleles from Conico Norteño, Cuatero de la Virgen, and Vandeño. In the case of Cuatero de la Virgen, for example, if the ga₂ locus is approximately 10 C.O. units from bt as we've calculated, fertilization was effected in 68 percent of the ovules by the ga₂^B allele from the tester stock.

Alternatively, it is possible that the Ga₂ locus is not implicated at all in these cases of preferential fertilization but that another gametophyte locus on chromosome 5 is responsible for the excess of bt kernels. We have detected in other stocks the existence of a second gametophyte factor on Chromosome 5. It is located about 30 C.O. units distal to bt. If the a₂ bt ga pr tester were Ga at this locus while Conico Norteño, Vandeño, and Cuatero de la Virgen were ga and if Ga gametes always effected fertilization, then the observed results would be attained. No decision on which alternative is more likely can be made from these data.