Table 1. The percentage of brittle kernels resulting from self-pollinations and crosses of various bt heterozygotes.

Plant	Genotype	% bt kernels Selfs	Onto Bt/bt-A
16-1	Bt/bt-D	23.2	35.9
16-3	Bt/bt-D	29.8	40.3
15-14	Bt/bt-D	22.2	35.9
6554-6	Bt/bt-C	28.2	44.9
6556-6	Bt/bt-D	25.7	40.2
6556-13	Bt/bt-D	28.9	41.0
6558-5	Bt/bt-E	24.2	46.8
6560-6	Bt/bt-F	22.2	31.8

Clearly, the one locus-two allele system is ruled out. At the next level of complexity are the following two models.

First, there may exist three alleles of this locus; the two alleles carried, for example, by plant 16-1 (Table 1) would lack female action (could not condition the ability to detect, in the incoming male gametes, the heterogeneity conditioned by this locus), but would have male action (Ga*-7001 in the female can differentiate between them). Secondly, there may be two loci involved. In its simplest form, this model would be the following. One gene would act in the male gametes to condition the differences detected and a second, independently acting, gene would condition in the female the ability to detect differences in the male gametes.

To distinguish between these possibilities, the following crosses were analyzed. Plant 8780-11, shown to be Bt ga*-7001/bt-A Ga*-7001 from appropriate crosses and, from pedigree analysis, homozygous for the presumed second gene, was crossed as female by plant 8777 (bt bv/bt bv). The resulting bt kernels were grown, self-pollinated and the resulting Bv progeny were tested for their ability to select Ga*-7001 pollen. Since bt and bv are 5 map units apart, and thus the maximum distance between Ga*-7001 and Bv is 26 units, a minimum of 85% of Bv plants would also carry Ga*-7001. Among 23 plants tested for female action, only 10 could select male gametes that contained Ga*-7001. Again, 20 of the 23 should have shown positive female action if Ga*-7001 alone can select Ga*-7001 pollen. Thus, the first alternative hypothesis appears unlikely. However, a second test, outlined below, suggests that Ga*-7001, or a recessive gene linked to it, is involved in selection. The Bt kernels from the 8780-11 x 8777 cross would lack Ga*-7001. These kernels were grown, self-pollinated, and the Bt progeny were tested for female action. Of 17 plants tested, only one gave rise to excess bt kernels in the cross. This would suggest that Ga*-7001 or a recessive gene linked to it is needed for female action. Future work will be directed at obtaining more definitive data concerning the proper mechanism.

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Attempts to induce cytoplasmic male sterility with chemical agents

During this past summer male sterile material that had been crossed with various inbreds (MNL 49:35) was grown to determine if any of the plants were cytoplasmically male sterile. To date no sterile individuals have been obtained that can be considered to be the result of an induced cytoplasmic mutation.

It was proposed by the author (MNL 47:35-37) that nuclear fertility restorer genes in the material that was treated with the mutagen may disguise an induced cytoplasmic male sterile, i.e., a sterile cytoplasm may be induced with a mutagen but still produce fertile plants due to the presence of nuclear restorer genes. In previously reported research the inbred A632 was used; according to Gracen and Grogan (MNL 48:20-23) and Gracen (personal communication), this inbred has restorer genes for many different sterile cytoplasms. If this inbred carries restorer genes for many of the known sterile cytoplasms, it might also carry restorer genes for sterile cytoplasms that might be induced with chemical agents. To examine this idea, an inbred that does not restore many sterile cytoplasms should be chosen; the inbred W59M was suggested by Gracen.

In an effort to continue this research and examine these theories, during the past summer the inbred W59M was treated with streptomycin and ethidium bromide according to procedures previously published (MNL 47:35-37).

Robert W. Briggs

Use of a genetic marker to make self- and cross-pollinations on the same ear

A procedure which makes it possible to make self- and cross-pollinations on the same ear by using purple aleurone markers was employed to carry out a form of full-sib reciprocal recurrent selection. Full-sib reciprocal recurrent selection is a breeding procedure in which the second ears from individual plants in two populations are self-pollinated, and reciprocal crosses are made on the top ears of the paired plants. At least one member of each crossed pair must be prolific so that crossed seed and selfed seed of both parent plants is obtained. Procedures for sull-sib reciprocal recurrent selection have been described by Hallauer (Crop Sci. 7:192, 1967), Hallauer (Egypt. J. Genet. Cytol. 2:84, 1973) and Lonnquist and Williams (Crop Sci. 7:369, 1967).

Full-sib reciprocal recurrent selection is an excellent breeding procedure but it requires that at least one parent be prolific; and many maize populations are not strongly prolific. A procedure has been developed this past summer which allows this breeding technique to be applied to nonprolific strains of maize. The procedure basically consists of self-pollinating a number of plants in each population, crossing these same shoots with an aleurone marker stock and then reciprocally crossing the plants from the two populations. The first silks available develop from the basal end of the female inflorescence. Thus, the self-pollinated seeds would be at the base of the ear, the purple aleurone kernels in the middle of the ear, and the cross pollinated kernels at the tip of the ear; the purple aleurone kernels would separate the selfed and crossed kernels on each ear. The plant is self-pollinated before it is cross-pollinated since maize is basically protandrous, and in many cases viable pollen would not be present for self-pollinations if the cross-pollinations were made first.

In the field the plants were self-pollinated as soon as silks were present; on the next day the self-pollinated ears were crossed with A C R-nj pollen. Two more days elapsed before plants from the two populations were crossed reciprocally.

Only a small amount of selfed seed is required to recombine selections in order to initiate another cycle of selection. However, relatively large amounts of crossed seed are needed to perform replicated yield trials. The amount of seed needed depends on the number of kernels in one replication and the number of replications tested. The number of crossed seeds and the frequency of ears by number class were: