

CROSS POLLINATION TECHNIQUES WITH COTTON, *Gossypium Hirsutum* L.¹

A. G. Douglas and W. C. Adamson²

HAND pollination techniques currently in use provide some protective covering for the emasculated cotton flower both before and after pollination. The purpose of such covering is primarily to prevent contaminating pollination from unwanted sources.

The use of any common method of protecting emasculated flowers requires considerable time in making a cross. Crossed seed is, therefore, expensive and quantities of such seed for experimental use are sometimes limited. If flowers could be emasculated, left exposed, and pollinated later, the expense of hybrid seed would be greatly reduced. If hybrid seed were being produced for purposes where absolute purity was not necessary, the greater volume and reduced expense would seem desirable.

Cotton pollen is not normally wind-blown. Various types of bees including the honeybee, *Apis mellifera* L., and the bumblebee, *Bombus spp.*, are considered to be the primary pollen vectors for cotton in most areas.

Tu (5) worked with emasculated flowers in an attempt to estimate the percentage of natural crossing. He found that the bolls set on emasculated flowers ranged from 8.4 to 106.7% of the bolls set on unemasculated flowers. More recently, Nersesjan (3) in Armenia reported that of flowers emasculated and left in the presence of bees, 96% set bolls with normal numbers of seed.

Natural crossing on unemasculated flowers in the Athens, Georgia, area was reported as 10.5% in 1948,³ 42% as a 3-year average 1950 through 1952 (4), and 40% as a 3-year average 1957 through 1959 (1).

McLendon (2) reported that red leaf color, caused by an anthocyanin pigment, is simply inherited in a monohybrid ratio. Red color is partially dominant over green so that the heterozygote is distinguishable from either homozygous red (RR) or homozygous green (rr).

Results of two experiments are reported in this paper. The objective of these experiments was to determine the amount of natural cross-pollination which occurred on unprotected emasculated flowers.

On 4 different dates in 1962, 2 treatments were ran-

domly assigned to 2 3-row plots. The plots had previously been planted with an experimental synthetic variety designated A6201. The treatments were as follows:

1. Flowers emasculated and tagged
2. Unemasculated flowers tagged.

Thirty random flowers were used for each treatment on each date: June 19, June 28, July 14, and July 18. The matured bolls were harvested, ginned, and the seed counted in each one.

Seed also were harvested in 1962 from rec. leaf plants (RR) planted in alternate rows with normal green leaf plants (rr) near the test area. Individual bolls were harvested and ginned separately. This seed was germinated in the greenhouse and 1,543 seedlings were classed for leaf color to determine the amount of natural crossing.

One hundred flowers on normal rr plants of the experimental synthetic variety A 6201 were emasculated, tagged, and left unprotected on each of 3 dates in 1964; July 9, July 23, and August 4. Twenty-four hours after emasculation, all stigmas were dusted with pollen from RR plants. On each date of emasculation, 100 fresh flowers were tagged on a row of RR plants with normal rr plants on either side to be used to estimate natural crossing in the area. All RR plants were grown at a sufficient distance from the experimental area so that RR contamination on rr plants would be improbable.

Individual bolls produced by emasculated flowers on rr plants were harvested and ginned separately. Tagged bolls on the RR plants were pooled for dates and each date ginned separately. All seed were germinated in a growth control chamber and seedlings classed for leaf color.

None of the emasculated flowers set bolls in 1962. Of the 120 unemasculated flowers tagged, only 25 set bolls. Of these, 19 were from the first date, 4 from the second and 2 from the third. None of the flowers tagged on the fourth date produced bolls. The number of seed produced per boll ranged from 5 to 46 with a mean of 34.

Of the 1,543 seedlings produced from seed of RR cotton, 19.2% were the result of natural crossing. The percentage of bolls having at least one crossed seed was 93.4% while 47.0% of the bolls had 5 or more crossed seed. The actual percentage crossing should be somewhat higher than observed since any crosses between red plants would not be detectable.

Of the 300 flowers emasculated in 1964, 169 set bolls when pollinated with pollen from RR plants (Table 1). Seed from these bolls produced 3,772 seedlings, 10.4% of which were normal rr and the result of contamination of emasculated flowers.

Seed harvested from tagged, open-pollinated bolls on RR plants produced 4,821 seedlings (Table 2). Of these, 30.9% were classed as Rr and represent the percentage natural crossing which occurred on unemasculated flowers.

The unexpectedly low percentage of bolls set in the 1962 experiment was probably because fruiting was concentrated in the early part of the flowering season. Hot dry weather caused shedding of a great many young bolls later in the season. This hot dry weather probably caused excessive shedding of emasculated flowers which have a tendency to dry out faster than unemasculated ones.

Even though none of the flowers emasculated in 1962 produced mature bolls, they may have been involved in some natural crossing. Cotton bolls usually require that several ovules be fertilized before they will develop normally.

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² Assistant Professor and former graduate student, Department of Agronomy.

³ Hsi, H. C. Some cross-pollination technics in Upland cotton. Unpublished MS Thesis, University of Georgia, 1949.

Table 1. Percentage natural crossing which occurred on emasculated, unprotected rr plants within 24 hours after emasculation in 1964.

	Date of emasculation			Total
	July 9	July 23	Aug. 4	
No. of bolls	68	52	49	169
No. of seed per boll	35	29	31	---
No. of seedlings	1669	1197	906	3772
No. rr seedlings	192	123	78	393
% rr seedlings	15.0	10.3	8.6	10.4

Table 2. Percentage natural crossing which occurred on unemasculated RR plants in 1964.

	Date of flowering			Total
	July 9	July 23	Aug. 4	
No. of bolls	74	61	59	194
No. of seedlings	2005	1522	1294	4821
No. of Rr seedlings	711	489	292	1492
% Rr seedlings	35.5	32.1	22.6	30.9

In 1964, percentage contaminating pollination ranged from 15.0 for the earliest emasculation date to 8.6 for the latest date. Percentage of natural crossing was likewise higher during the earliest part of the season and decreased as the season progressed. This is in agreement with other results.⁴

Pollen vectors were active in the area during the time when stigmas on emasculated plants were receptive because 30.9% natural cross-pollination occurred on unemasculated flowers which bloomed during the same period. On several occasions honeybees were observed visiting freshly emasculated flowers.

Results obtained indicate that cotton flowers could be emasculated and pollinated later, being left unprotected throughout, with contamination of less than 5 seed per boll even when natural cross-pollination of unemasculated flowers averaged 30.9%. Since this amounts to less than 15% of the total seed production, some experiments could utilize seed produced in this manner.

Literature Cited

1. DOUGLAS, A. G., and WEAVER, J. B., JR. Comparison of open-pollinated seed with registered seed of three cotton varieties. *Crop Sci.* 3:515-516. 1963.
2. MCLENDON, C. A. Mendelian inheritance of cotton hybrids. *Georgia Agric. Exp. Sta. Bull.* 99. 1912.
3. NERSESJAN, P. The problem of cross-pollination in cotton. *Hlopkovodstvo* 3:49. 1956. (*Pl. Br. Abs.* 32:891. 1962).
4. SIMPSON, D. M. Natural cross-pollination in cotton. *U.S.D.A. Tech. Bull.* 1094. 1954.
5. TU, C. P. A study on natural crossing in cotton. *J. Agric. Assoc. China* 125:1-18. 1934. (*Pl. Br. Abs.* 8:551. 1938).

⁴Jones, J. E. A study of heterosis and natural crossing in Upland cotton. Unpublished M.S. Thesis, University of Georgia. 1950.