

Self-Incompatibility in Sycamore

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ABSTRACT

Much of the reputed low germination from American sycamore may be due to self-incompatibility or lack of pollen from other trees. Germination tests and X-ray analysis revealed 30-80 percent normal germination from polymix pollinated seed. Only 0-2 percent of the seed resulting from self-pollination germinated normally. No viable seed was obtained from isolated, unpollinated flowers.

Interest is increasing rapidly in improvement and utilization of American sycamore (*Platanus occidentalis* L.). It is valuable for veneer, lumber, and pulp, and susceptible to only a few diseases. Sycamore grows fast throughout its life and attains a larger diameter than any other American hardwood (Betts 1945); within its range, only cottonwood and sometimes a few of the pines produce more volume per acre.

This paper reports the initial results of studies to: (1) determine the feasibility of control-pollinating sycamore, (2) assess the self- and cross-fertility of the species, and (3) determine the receptive period of the flowers.

METHODS

Four sycamore trees in south Mississippi were selected because they were easily accessible and most of them flowered abundantly. Trees 1 and 2 were approximately one-half mile apart. Trees 3 and 4 grew close together.

Female flower heads on each tree were covered with viscose bags as soon as the heads began to break the bud scales. The bagging was done during the third week in March 1966. Male heads were collected from each tree at the time of bagging, and pollen was taken from them with a warm-air extractor, after which it was refrigerated until use a few days later. One hundred normal heads

yielded about 8 cc. of pollen. At anthesis, controlled-pollinations were made as follows: (1) self, (2) each tree by every other tree, and (3) three trees by a polymix of the four trees. Tree 2 bore only enough flowers to allow controlled pollinations by self and each of the other trees, and not enough for polymix pollinations. Several flower heads on each tree were bagged but not pollinated.

On tree 1, polymix pollen was applied by hypodermic syringe as soon as the flowers appeared receptive and 1, 3, 5, 7, 12, 16, and 18 days thereafter. Anthesis occurred 5 days after the flowers appeared receptive.

The bags remained over the flowers for 1 month to assure adequate isolation from contaminating pollen.

The seed was collected in November 1966 and crosses kept separate. Because an unknown number of seed was lost during cleaning with a sieve, no estimate of viable seeds per pollination was attempted.

The U. S. Forest Service's Eastern Tree Seed Laboratory at Macon, Georgia, tested germination. The design was a randomized complete block, with 5 replications and 100 seeds per sample. An arcsin transformation and analysis of variance were conducted on the germination data. Differences between means were evaluated by Duncan's test (1955). Each 100-seed sample was examined by X-ray prior to the germination test as a means of predicting germinability from the internal structure. The seeds were arrayed for all testing on a 10 by 10 grid, making X-ray prediction and data of actual germination for each seed easy to compare.

RESULTS

Sycamore appears to be highly self-incompatible. Average germination from selfing ranged from 0.2 to 1.2 percent (table 1, fig. 1). There were no significant differences (at the 95-percent level of confidence) among selfed individuals; however, the selfs had significantly lower germination than all

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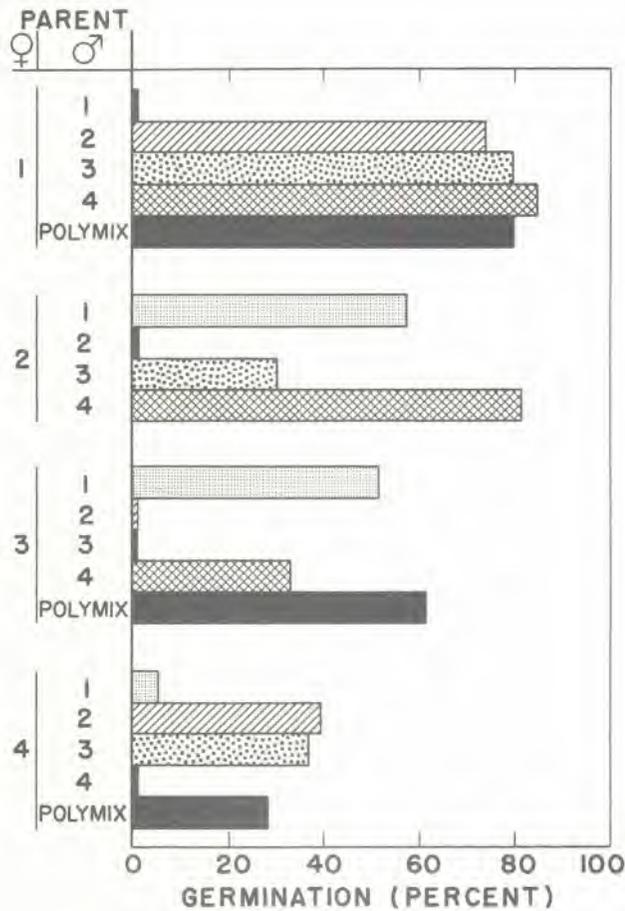


FIGURE 1. Mean germination of control-pollinated sycamore.

other crosses except 3 by 2. The low germinations for 3 by 2 (0.3 percent) and its reciprocal 2 by 3 (15.3 percent) indicate poor crossability between these two trees. Germination was low for 4 by 1 (5.6 percent), probably because of late pollination.

The female flowers were receptive for more than 2 weeks. Pollinations during this period resulted in seed with germinations of better than 50 percent (fig. 2).

No viable seed were obtained from isolated, unpollinated flowers, and X-ray examination revealed no embryos or abortive embryos. Hence apomixis probably does not occur in this species.

Specific combining ability varied widely. Seed from tree 1 gave the best overall germination, and X-ray examination showed it to have more large embryos than seed from trees 2, 3, or 4.

Polymix crosses resulted in germinations rang-

TABLE I.--MEAN GERMINATION OF CONTROL-POLLINATED SYCAMORE SEED. SIGNIFICANT DIFFERENCES AMONG MEANS ARE INDICATED BY DUNCAN'S TEST (1955)

PARENT		MEAN GERMINATION
FEMALE	MALE	
1	4	84.6
2	4	81.2
	POLYMIX	79.9
	3	79.6
	2	73.8
3	POLYMIX	61.8
2	1	57.6
3	1	51.6
	2	39.5
4	3	38.0
3	4	33.0
	POLYMIX	28.1
2	3	15.3
4	1	5.6
2	SELF	1.2
4	SELF	.6
	SELF	.5
3	2	.3
3	SELF	.2

MEANS REPRESENTED BY THE SAME LINE ARE NOT SIGNIFICANTLY DIFFERENT AT THE 95 PERCENT LEVEL OF CONFIDENCE.

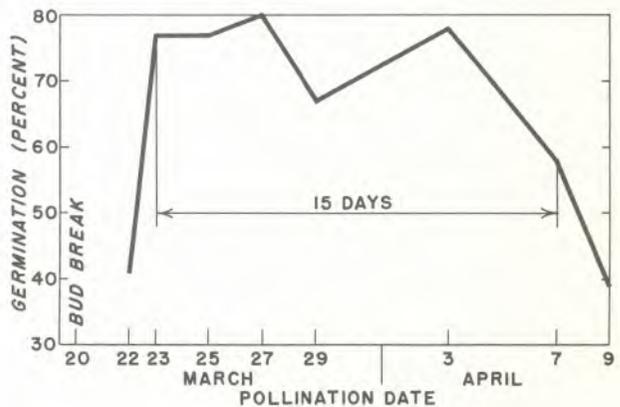


FIGURE 2. Duration of receptivity for sycamore flowers.

ing from 28 to 80 percent (table 1, fig. 1). While there is a greater variation in specific crosses than in polymix crosses, both indicate that sycamore can be efficiently control-pollinated.

Germination predicted from X-ray examination was highly correlated ($r=0.99$) with germination.

DISCUSSION

The U. S. Forest Service's **Woody-Plant Seed Manual** (1948), summarizing results from 15 lots of seed, reported that germinative capacity of sycamore ranges from 5 to 69 percent, with an average of 35 percent. Germination percentages determined at the Eastern Tree Seed Laboratory usually have been below this average, and have given sycamore the reputation of being a poor seed producer. The study reported here indicates that low germination may often result from self-incompatibility. Trees that are growing singly or that occur as scattered individuals in a mixed stand may not receive adequate pollen from other trees. Much selfing

thus occur, and the seed can be expected to have a low germinative capacity. Boyce and Kaeiser (1961) also found selfing prevented good seed germination in yellow-poplar.

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