ARTIFICIAL RIPENING OF SWEETGUM SEEDS

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Untrained collectors of hardwood seeds often start picking the seeds too early in the year. The immature seeds germinate poorly, if at all, and nursery production suffers. In the study reported here, sweetgum *(Liquidambar styraciflua L.)* seeds collected in central Mississippi in mid-August were ripe. Seeds collected as early as July 19 were artificially ripened by storing the seed heads until late September in a cool, moist environment. Ripening treatments improved germination in both 1967 and 1968. The detailed tests of 1968 are described here.

Methods

Four sweetgum trees with moderate to heavy fruit crops were selected near State College, Miss., early in the summer of 1968. Approximately 50 fruit heads were collected from the lower one-third of the crown of each tree on each of six dates

July 19, August 2, August 16, August 30, September 13, September 27.

Ten of the heads from each tree were placed in shallow trays in an air-conditioned laboratory on the day of collection for immediate extraction. After 5 to 7 days of air drying, the seeds were extracted, cleaned, and placed in moist stratification at 37° F. for 14 days. Duplicate 50-seed lots were then germinated to evaluate physiological maturity at the time of collection.

Specific gravity and dry weight were determined on two fruit heads from each tree. Specific gravity was estimated by water displacement. Weights were measured to the nearest 0.1 g.; volume to the nearest 0.5 ml. Dry weights were obtained after drying at 220° F. for 24 hours in a forced-draft oven.

The remaining fruit heads were divided into three lots of 10 to 12 for each tree. One lot was randomly assigned to each of three ripening treatments : Moist cool, moist warm, and dry cool.

In informal tests in 1967, dry-warm treatment proved ineffective. It was not included in the 1968 tests. Cool storage in 1967 was promising enough to justify testing of the treatments described here.

Moist conditions were maintained by mixing the fruit heads with an equal volume of damp peat moss in polyethylene bags. Lots assigned the dry treatment were stored in cotton bags, and no moisture was added.

Lots requiring cool temperatures were placed in a laboratory incubator held at a constant 41 ° F. Warm treatment was imposed on an open shelf in a basement garage, where temperatures ranged from 57° to 84° F., and relative humidity varied from 40 to 100 percent during the treatment period. This location was similar to most partially closed sheds or outbuildings.

All treatment lots remained in storage until apparent maturity was reached on the sample trees. This condition, indicated by fading of the bright green color of the fruit heads, occurred in late September. Hence, the September 27th collection was considered to be physiologically mature. Fruits collected on this date were dried for immediate extraction in the laboratory. At the same time, all stored lots were also dried. After extraction, 50-seed samples of apparently good seeds were stratified for 14 days.

They were then placed on sheets of moist Kimpak and subjected to the recommended *Liquidambar* germination environment of 8 hours light at 86° F., and 16 hours dark at 68° F. per day (2). A positive geotropic response by the emerging radicle was accepted as germination. Counts were made daily for 15 days.

The number of full seeds in each lot was determined by cutting at the end of 15 days. Germinative capacity was expressed as a percentage of the number of full seeds present. Speed of germination was estimated by calculating germination peak value (1).

Results

Among seeds that were not artifically ripened, germination did not occur in the lot collected on July 19th. For untreated seeds collected on August 16th germination averaged 81.3 percent. While this value

1 In charge of the Forest Tree Seed Laboratory, maintained at State College, Miss., by the USDA Forest Serv. South. Forest Exp. Sta., in cooperation with Miss. State Univ.

was not the highest reached, statistical analyses indicated no significant difference in germinative capacity or germination peak value from August 16th until the final collection on September 27th. Apparently, seeds were physiologically mature by August 16th in 1968.

Specific gravity and dry weight of the fruit heads varied little over the collection period

Collection date	*Specific gravity*	*Dry weight*
		Grams
July 19	1.10	2.9
Aug. 2	1.10	3.2
Aug. 16	1.12	2.6
Aug. 30	1.12	3.1
Sept. 13	1.09	3.6
Sept. 27	1.09	3.4

and that for those from the moist-warm treatment

Neither characteristic was a good indicator of seed maturity.

Artificial ripening of early collections improved germination where moisture was added. Fruit heads collected on July 19 and stored either cool or warm with wet peat moss yielded seed that germinated up to 51 percent. Means for all trees were 31.4 percent (moist warm) and 34.3 percent (moist cool), compared with a complete failure for seeds extracted at the collection date (table 1).

The moist ripening treatments were most effective for the August 2 collections. Germination of untreated seeds averaged 19.7 percent. Germination of seeds from the moist-cool treatment averaged 77.1 percent, averaged 77.7 percent. Past August 2d, as physiological maturity was reached in most seeds, the advantages of artificial ripening lessened. Germination peak values followed the same trend as germinative capacity (table 1).

Dry-cool storage had little effect on germination of seeds collected on or before August 16. This treatment appeared to boost germination of seeds collected on or after August 30, however.

Observations indicated that early collection reduced yields of full seeds, even with the ripening treatments. Without ripening, seeds collected July 19th were all bad; with ripening, yields were about 10 percent of normal. Without ripening, the yield of seeds collected August 2d was approximately 50 percent of normal; ripening raised this figure to 80 or 90 percent. From August 16th on, full-seed yield was approximately normal with or without ripening.

For seeds collected before August 16th, moist-cool treatment was best for both germinative capacity and germination peak value, especially the latter. This environment has also proved best for artificial ripening of seeds of several western conifers (3, 4, 5). Unlike results in the conifer studies, however, losses to fungi and molds were not excessive in the present study. A few fruit heads were lost in the moist-warm treatment; losses were insignificant in moist-cool lots.

Artificial ripening success and the relatively constant dry weights of sweetgum fruit heads indicate that all the necessary food reserves were present by early August and needed only to be translocated to

TABLE 1.—*Germinative capacity (percent) and germination peak values of seeds, by ripening treatment and collection date. Values are averages from all trees*

Ripening treatment	July 19	Aug. 2	Aug. 16	Aug. 30	Sept. 13	Sept. 26	All dates
			[GERMINATIVE CAPACITY]				
Moist cool	34.3	77.1	93.9	96.3	89.3	...	83.5
Moist warm	31.4	77.7	74.6	52.8	94.0	...	74.3
Dry cool	0	11.2	80.7	95.1	94.1	...	74.2
None	0	19.7	81.3	74.7	82.4	87.6	70.7
			[GERMINATION PEAK VALUE]				
Moist cool	2.2	8.6	9.6	10.3	10.6	...	8.3
Moist warm	2.2	6.1	5.8	4.6	8.1	...	5.3
Dry cool	0	1.5	8.4	11.4	9.6	...	6.2
None	0	1.5	7.8	7.2	7.6	6.7	5.1

the seeds from the fruit-head tissue.

It is doubtful whether artificial seed ripening to extend the collection season on a production scale is feasible for sweetgum or other species. However, the practice could be used to salvage some seeds when inexperienced collectors deliver immature fruit heads. Artificial ripening on a small scale could also extend the time for collection for research purposes of lots from widely separated locations.

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