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PRODUCTION AND DISTRIBUTION OF SWEETGUM SEED IN 1962 BY FOUR NEW JERSEY STANDS

Although sweetgum (*Liquidambar styraciflua* L.) is one of the most valuable hardwoods in bottomland forests from southern New Jersey and southern Illinois southward, relatively little is known about its production and distribution of seed. Knowledge of both is essential in planning successful measures for reproducing the species. To provide some of the needed information, the Northeastern Forest Experiment Station studied the production and distribution of sweetgum seed in 1962 from four New Jersey stands.

Study Methods

The four stands, in each of which sweetgum was a common or pre-dominant species, were all within a 2-mile radius in Burlington County. They ranged in age from 27 to 42 years, and in average height of dominant trees from 66 to 84 feet. When selected for study in the summer of 1962, all four stands showed promise of a heavy seed crop that fall.

Seed distribution was sampled by paired 1/16-milacre traps spaced along transects extending from within each stand out across an adjoining open field or pasture at a right angle to the stand edge. Each of the open areas was a different cardinal direction (N, E, S, or W) from the stand being sampled. The paired traps inside each stand were placed at 0.1 chain and at 0.25 chain from the edge; those in the open were placed at distances equaling 0.5, 1, 2, and 4 times the height of the dominant trees. All traps were in place before seedfall began.

Fruit Characteristics

Sweetgum seeds are borne in a woody globose head of two-celled beaked capsules (fig. 1). Under favorable conditions two seeds develop in each capsule. However, typical fruits contain many undeveloped seeds that resemble chaff.

The number of developed seeds per fruit appears to vary greatly. The Woody-Plant Seed Manual (U. S. Dept. Agriculture 1948) gives seven or eight as the number of seeds per fruit; and a few observations in southern New Jersey indicate that that number may be about right for very poor crops on isolated trees. However, numbers of seed per fruit may run much higher, especially when seed crops are good. Trenk (1929)

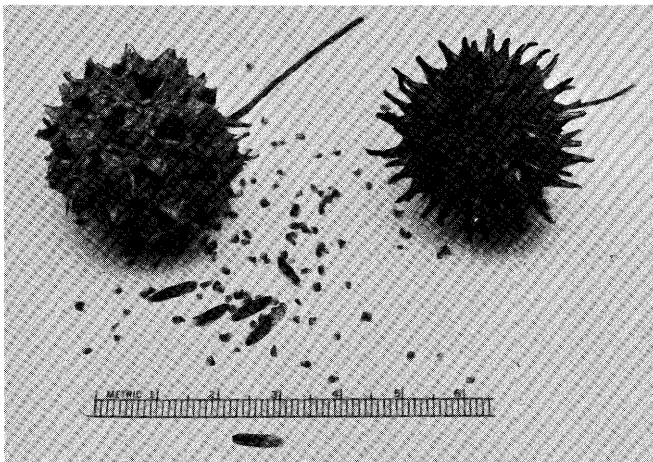


Figure 1.—Open and closed mature fruits of sweetgum. Capsules on the left-hand fruit have opened and released developed seeds and chaff (or abortive seeds). The fruit on the right was wetted, so its capsules are closed.

reported that the fruits usually contain 20 to 50 fertile seeds. In the present study, six fruits collected from the excellent 1962 crop and eight collected from the poor 1963 crop averaged 88 and 61 developed seeds per fruit, respectively. Except for two fruits from one tree in which the seeds were only four percent sound, the developed seed in these two collections averaged 84 percent or more sound.

Amount of Seed Production

In years of good seed crops, dominant trees bear hundreds of fruits, and the best stands must produce several million seeds per acre. Although no measure of total seed production was obtained in this study, the catch under two stands was at the rate of 2.6 to 6.2 million sound seeds per acre (table 1).

Seed production varies greatly among stands. In this study the catch under the most productive stand was 17 times that of the least productive one. These differences seemed to be due mainly to the differences in stand age and composition.

Period of Seedfall

Observed seedfall began on September 20 and was practically completed — about 99 percent — by mid-January. According to seed-trap collections made October 1, semimonthly thereafter until January 18, and a final one in early March, seedfall was mostly light in October and heavy in November; then, except in one stand, it dropped off sharply in December. Only small amounts of seed fell in all stands during January and February (table 2).

Table 1. — *Observed distribution of sound seeds from four sweetgum stands*

Direction of trap line from stand	Seed catch within stand	Proportional catches at distances of — ¹			
		Half stand height	Stand height	Twice stand height	Four times stand height
	<i>Number per acre</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
East	6,184,000	78	43	18	4
South	2,612,000	136	42	12	1
West	624,000	68	35	8	5
North	372,000	15	13	2	0

¹ Mean catch per trap expressed as a percentage of the mean catch per trap under the stand.

Table 2. — *Catch of sound seed, by stands and periods*

Period	Stand I	Stand II	Stand III	Stand IV	All stands
	<i>Percent¹</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent²</i>
Sept. 20 — Oct. 29	4	26	2	2	5
Oct. 29 — Nov. 26	82(86)	56(82)	41(43)	67(69)	75(80)
Nov. 26 — Dec. 27	11(97)	12(94)	55(98)	25(94)	16(96)
Dec. 27 — Jan. 18	2(99)	5(99)	0(98)	5(99)	3(99)
Jan. 18 — March 13	1(100)	1(100)	2(100)	1(100)	1(100)

¹ Of total caught from that stand. Values in parentheses are cumulative.

² Values based on pooled total catches in all four stands.

The rate of seedfall may be very high for short periods. For instance, during one 6-hour period, the catch under one stand was equivalent to 11,900 seeds per acre.

Most of the seeds are apparently released before the fruits fall. In late December about 50 fruits were picked from several trees, and about nine seeds were found in each. Fruits gathered from the ground at the same time contained, on the average, about one seed each. By early March most of the fruits had fallen. Another collection was made from fruits still on the trees at this time, and these fruits contained about one seed each—nearly all of which were sound.

These observations indicate that the absolute end of seedfall may be in April; however, for practical purposes the end can be considered to occur in mid-January.

Effects of Distance and Direction

In the openings near sampled stands, the amount of seed caught per unit area decreased sharply with increased distance from the source. For example, traps at a distance equal to stand height caught less than half as many seeds as traps under the stand. At four times stand height, the proportions fell to 5 percent or less (table 1).

Direction from seed source had surprisingly little effect on seed distribution in comparison with effects observed in previous studies of other species. Among other species, for example, 80 to 85 percent of the seedfall from isolated Atlantic white-cedars in a New Jersey study was on the east side (Little 1950); and in a Maryland study of Virginia pine, four times as many seeds fell on the east side as on the west side of a stand (Sucoff and Church 1960). The usual explanation for these heavier seedfalls on the east side is that the cones are hygroscopic and tend to close during the periods of high humidity or precipitation that commonly are associated with easterly winds, whereas the cones open and shed seed freely during fair weather when the winds generally are westerly.

A similar response to wind and weather conditions was expected from sweetgum, since its fruits also are hygroscopic. However, no such response was discernible in the data from the present study (table 1). The most notable difference related to direction was the smaller catches where the sampling was on the north side. This may be due in this case, at least in part, to the smaller trees and other stand characteristics that account for the comparatively low total seed production by this stand.

If seedfall beyond four times stand height is ignored, 59 to 78 percent of the seeds distributed in the openings fell within stand height. Only 5

to 17 percent landed at distances between two and four times stand height (table 3).

Table 3. — *Apparent distribution of the sweetgum seed that fell in openings outside the stands, by distances from the stands¹*

Direction of opening from stand	Within half stand height	Between 0.5 and 1 times stand height	Between 1 and 2 times stand height	Between 2 and 4 times stand height
	Percent	Percent	Percent	Percent
East	35	24	24	17
South	41	31	19	9
West	41	25	21	13
North	63	15	17	5

¹ Limited to seed falling in openings within a distance equal to four times stand height.

Sweetgum seeds launched from an adequate height in a favorable wind apparently can travel appreciable distances. In Guttenberg's (1952) study of artificially dispersed seeds, although 96 percent fell within 200 feet of the point of origin, a 100-foot fire tower, some seeds were caught at distances between four and six times the height of the source. None were recovered at greater distances. From the seedlings established around some isolated trees in southern New Jersey, it is evident that enough seed for adequate reproduction may be distributed to at least five times the height of the parent tree. Occasional seeds undoubtedly are transported to far greater distances.

In the present study, no relationship was found between seed soundness and distance from source. At all distances the ratio of sound to unsound seed was about 10 to 1.

Application in Silviculture

Though the information from this study can provide only indications, it does suggest the following tentative guides in managing sweetgum.

- In strip or patch clearcuttings, the width should probably not exceed four times the height of dominant stems in the adjoining stand. When crops are poor, such openings may be too wide if a seed-producing stand is present on only one side. But when crops are good, the seed-fall on the outer edge of such openings might be one to four percent

of that under the stand, or at the rate of 26,000 to 240,000 sound seeds per acre (table 1).

- In seed-tree cuttings, two to four trees per acre, if prolific, might be adequate for purposes of regeneration.

Literature Cited

- Guttenberg, Sam.
1952. SWEETGUM SEED IS OVERRATED FLYER. Jour. Forestry 50: 844.
- Little, S.
1950. ECOLOGY AND SILVICULTURE OF WHITECEDAR AND ASSOCIATED HARDWOODS IN SOUTHERN NEW JERSEY. Yale Univ. School Forestry Bul. 56, 103 pp., illus.
- Sucoff, E. I., and T. W. Church.
1960. SEED PRODUCTION AND DISSEMINATION BY VIRGINIA PINE. Jour. Forestry 58: 885-888, illus.
- Trenk, Fred B.
1929. SWEETGUM IN MARYLAND. Univ. Md., Md. Forestry Dept. 75 pp., illus.
- United States Department of Agriculture.
1948. WOODY-PLANT SEED MANUAL. U. S. Dept. Agr. Misc. Pub. 654, 416 pp., illus.

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