

Loblolly Pine Seed Production in the Virginia-North Carolina Coastal Plain

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KNOWLEDGE of seed production in managed forest stands is essential before natural regeneration may be obtained consistently. This report is a summary of the seed-trapping data obtained during the study of natural regeneration of loblolly pine in the Bigwoods and Camp Experimental Forests.¹ Compartment records of seedfall were obtained during a thirteen-year period (1946-1947 through 1958-1959), and continuous records within a compartment extend for up to ten years.

Trapping Techniques

Square, $\frac{1}{4}$ -mileacre seed traps were constructed of wood, with fly screen bottoms and hinged tops of $\frac{3}{4}$ -inch mesh wire or chicken wire. The traps were set about one foot above the ground.

Nine traps, located by a stratified

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¹Located in northeastern North Carolina and southeastern Virginia, respectively. Maintained by the Southeastern Forest Expt. Sta. in cooperation with the Union Bag-Camp Paper Corporation, Franklin, Va.

random design, were used per 35- to 40-acre compartment in the Bigwoods. On each ninth of a compartment a trap was placed in the center of one of nine equal subdivisions, chosen randomly. Traps in the Camp Experimental Forest were placed in 10 separate one-chain-square blocks, chosen randomly.

Traps were checked at monthly intervals, from early November through early April. The seeds were counted, and the number of sound seeds was determined by cutting tests.

Seasonal Distribution

Seed began to fall in October, and 71 percent of the seeds collected in uncut stands had fallen by the end of November. After the November peak the rate of seedfall decreased with time, and some seeds were still falling in March. This time of seedfall agrees with that described by Pomeroy and Korstian (5).

After initial opening, loblolly pine cones tend to close in wet weather, restricting seedfall until they dry out and reopen. The improved air circulation after partial stand removal might be expected to hasten cone drying and seedfall, but an analysis of the data indicates this effect is slight. In open stands of four and eight seed trees per acre, only 3 percent more of the total seedfall was collected by the end of November than in uncut stands.

Annual Variation

Data obtained in this study indicate considerable annual fluctuation in seed crop size. The amount of sound seed produced per acre in three uncut compartments is shown in Figure 1. The annual trend of crop size was similar in compartments located within 30 miles of each other. In a 55- to 60-year-old stand in Sussex County, Virginia, 50,000 or more sound seed per acre fell in four out of

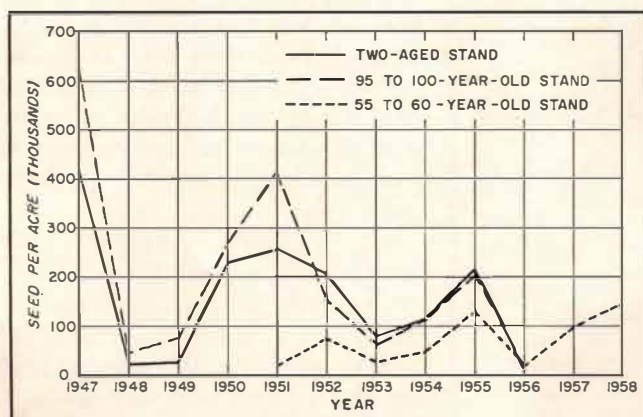


FIG. 1.—Sound seed production in uncut mature loblolly pine stands.

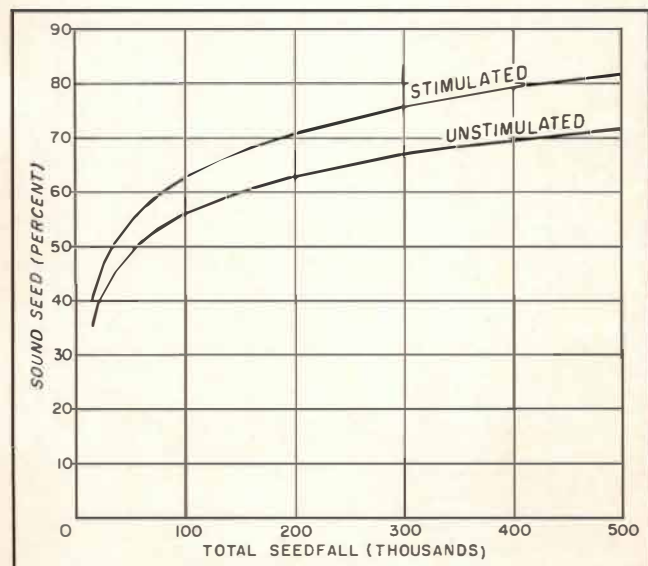


FIG. 2.—Relationship of soundness with seed crop size and effect of stimulation by release.

eight years of trapping. This level of production occurred in eight out of ten years in a 95- to 100-year-old stand of old-field origin, and in seven out of ten years in a two-aged stand composed of 60- to 80- and over 100-year old forest grown trees.

All compartments trapped failed to produce appreciable seed crops in 1956, after severe, regionwide frosts during the last five days of March 1955 had damaged the flowers just before pollen was released.

Other reports of loblolly pine seed production mention considerable annual variation in crop size. Lotti (3) found consistently good crops in a thinned 35- to 45-year-old stand in the South Carolina coastal plain. Annual production was more than 200,000 sound seed per acre in nine out of ten years of measurement. Similar large crops of seed were reported for two nearly 50-year-old stands (4). In other areas, however, smaller crops and less consistent production have been reported. In a 70-

year-old stand in the Duke Forest in the North Carolina piedmont, 50,000 or more seed fell in 8 out of 13 years (5). In the Georgia piedmont Brender (1) recorded seed crops of this size in 7 out of 10 years in an adequately stocked mature stand.

Stimulation by Release

Frequently success of the residual seed source is dependent upon stimulation by preharvest release (6). Removal of adjacent trees before flower buds are initiated increases the number of buds formed and the seeds produced three, four, and five cone crops later. Our results indicate stimulated trees invariably produce larger seed crops. This effect is most important in poor seed years, such as 1948, 1949, and 1953, when unreleased stands did not produce sufficient seed for regeneration on unprepared seedbeds. Even released stands are unsatisfactory seed producers in years such as 1956 after unseasonable weather damaged the developing flowers.

Not only does release increase seed production, but it also improves the proportion of sound seed. An analysis of 96 compartment-sized measurements of the annual seed crop showed a highly significant relationship of percentage of sound seed with both size of crop and the added effect of release (Fig. 2). That soundness is improved by release had not previously been recognized (6). Pomeroy and Korstian demonstrated that the proportion of sound seed increases with the size of the seed crop. Although it has been shown that the relationship between seed crop size and percentage of sound seed is a linear one (6, 7), the inclusion of more data has made its logarithmic nature apparent. It may be expressed as:

$$Y = .10067971 + .24593228x_1 - .01829624x_2$$

where Y represents the proportion of sound seeds expressed as a decimal, x_1 is the logarithm of the total seedfall expressed in thousands, and x_2 is defined as: $+x_1$ when not stimulated by release and $-x_1$ when stimulated.

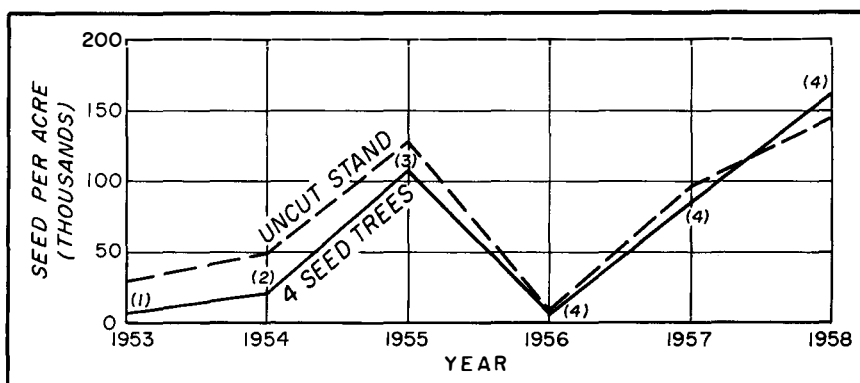


FIG. 3.—Average sound seed production in 55- to 60-year-old stands of 4 stimulated seed trees per acre as compared with uncut stand. Number of compartments sampled is shown for each year.

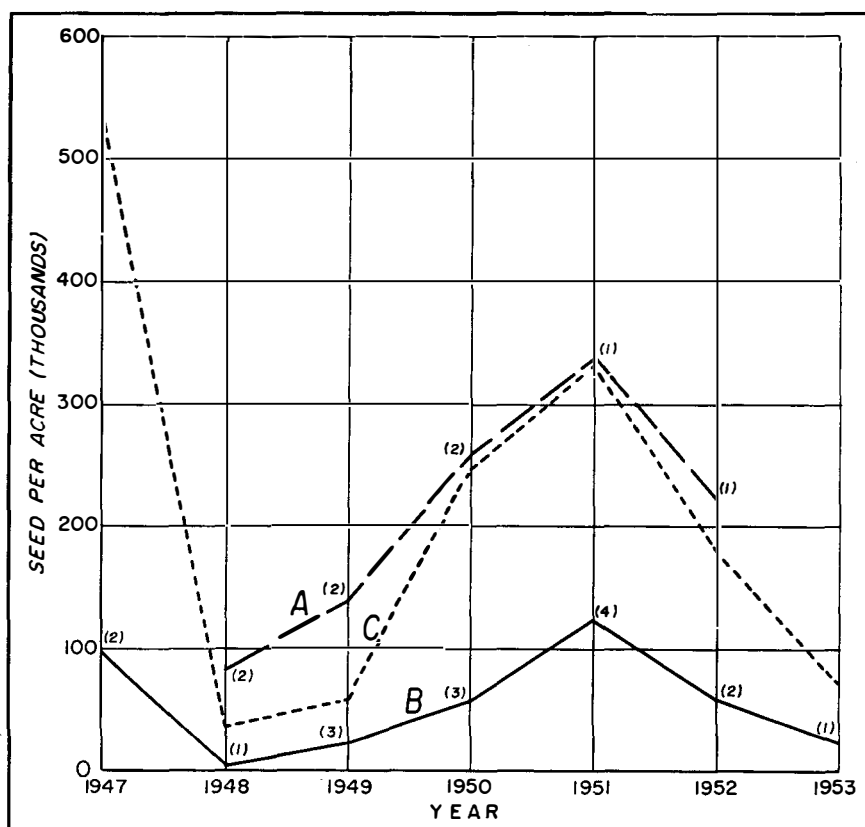


FIG. 4.—Average production of sound seeds in mature stands cut to strips and 8 seed trees (A-stimulated by release; B-unstimulated), compared with uncut stands of the same age (C). Number of compartments sampled is shown for each year.

Production in Managed Stands

Since well-stocked stands in the coastal plain frequently produce ample crops of seed, winter clear-cutting after seedfall, but prior to germination, is practiced by some foresters. Cone crop forecasting permits preliminary planning, but there is no present way to predict unseasonable weather during the critical first year of regeneration. Insurance against unusual seed and seedling mortality is often provided by leaving some part of the stand until regeneration is established.

To evaluate the success of residual seed sources, seeds were trapped in mature stands clearcut to four and eight seed trees per acre and to chainwide strips spaced 4-chains apart. The average production in these stands is shown in Figures 3 and 4. Production after each type of cutting is compared with that in similar uncut stands. The magnitude of seed crops in individual stands varied, particularly in good seed years, but the production in all stands trapped reflected the yearly trends.

Data obtained in the North Carolina coastal plain indicate that roughly 50,000 or 60,000 sound seed per acre are needed the first

seedfall after logging to obtain satisfactory regeneration without seedbed preparation.² Disking prior to logging, or burning after logging, reduced the requirement to about 20,000 to 30,000 sound seed per acre.

The 55- to 60-year-old stands clearcut to four stimulated seed trees per acre (Fig. 3) produced about as many seed as an uncut stand of the same age, but in three out of six years this supply would not have been satisfactory on unprepared sites. These trees received their first release three growing seasons prior to cutting and were apparently re-stimulated by the harvest cut.

No appreciable difference between seed production in stands clearcut to strips and those cut to eight seed trees was observed and they are not separated in Figure 4. The stimulated, residual trees frequently produced as much or more seed than the fully-stocked uncut stands. Over 50,000 sound seeds per acre were produced every year of the trapping. The difference between stimulated and unstimulated stands is quite apparent in Figure 4.

²Unpublished data, Southeastern Forest Expt. Sta.

Seed production was also measured in partially cut stands. Figure 5 shows seed production in two mature stands after two periodic cuts under the selection system. Compartment 8, cut in May 1947 and again in the winter of 1952-1953, had stimulated seed production in 1949-1951 and 1954-1956. Stimulation in compartment 18 was apparent in 1950, following the first cut in the fall of 1947, and continued until 1952. The second cut and period of stimulation were the same as in compartment 8.

Size of seed trees is an important factor affecting seed production and is in turn related to the age and density of the stand. Open-grown trees, even at fairly young ages, produce good seed crops, but in well-stocked unmanaged stands significant cone production does not begin until the trees are from 30 to 50 years old. The older stands in this study generally provided good seed crops which could not be expected in young unmanaged stands. Stimulation by thinning, however, or other preharvest release, considerably increases seed production in young stands. In young loblolly pine plantations in Australia, Florence and McWilliam (2) found increased pollen and cone production at lower stand densities.

Stimulation by thinning was apparent in a 30- to 35-year-old stand (Fig. 6). In this stand there were very few cones prior to thinning in 1950, but these immature trees produced fairly sizable seed crops after stimulation. Even larger crops were reported by Lotti (3) in a

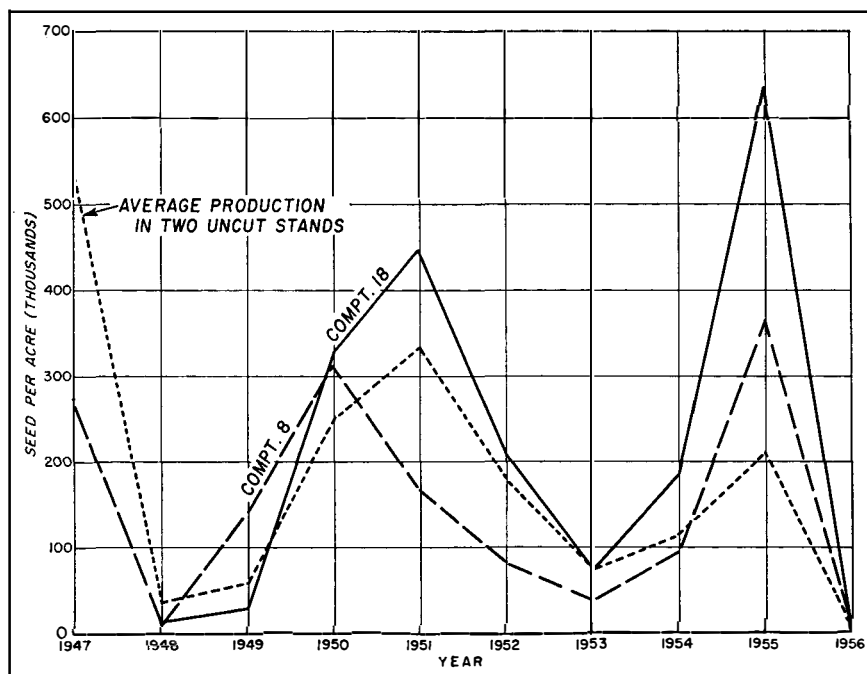


FIG. 5.—Sound seed production in mature selectively cut stands. Compartment 8 was partially cut May 1947 and December 1952; compartment 18 in October 1947 and January 1953.

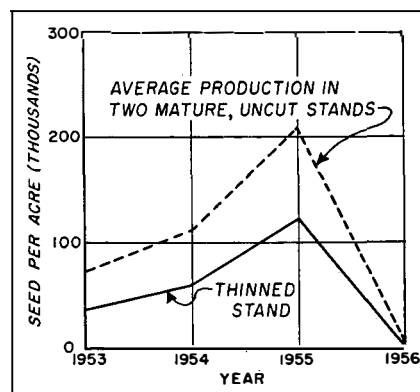


FIG. 6.—Sound seed production in a 30- to 35-year-old thinned stand compared with mature, uncut stands.

young thinned stand in the South Carolina coastal plain.

Summary

Thirteen-year seed-trapping records, obtained during the study of the natural regeneration of loblolly pine, have been used to evaluate seed production under different types of management.

Seed crop size fluctuated considerably from year to year in both uncut and partially cut stands. Almost invariably, stands within 30 miles of each other followed the same annual trend of seed production.

Stimulation by preharvest release of the seed source improved production, particularly in the poor seed years. Stimulated, selectively cut stands of mature trees produced more seed than uncut

stands of a similar age. Stimulated strips and eight seed trees per acre produced quantities similar to uncut stands, and provided an ample seed source. Four mature seed trees per acre, stimulated by preharvest release, produced about as much as an uncut stand of the same age, but in some years this supply was inadequate. In poor years unstimulated seed sources generally did not provide sufficient seed for regeneration on unprepared sites.

Not only does release improve seed production, but it also produces a highly significant increase in the percentage of sound seed.

Stand age and density are important factors affecting seed production. Young forest-grown trees are generally unsatisfactory seed producers, unless stimulated by thinning or other preharvest release.

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