

GROWTH OF SHORTLEAF PINE THINNED BY CROWN AND ROW METHODS

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Row thinning has certain practical advantages over other methods in the management of forest plantations. These include: 1) lower marking and administrative costs; 2) lower felling costs; and 3) easy access for felling, loading, and hauling. There are some doubts, however, if it is as desirable as the crown method when considered from a silvicultural standpoint (Boggess, 1951; and Boggess and McMillan, 1955).

Thinnings are made to improve stand quality and maintain optimum growth rates. This is accomplished in crown thinning by removing immediately competing trees from a selected number of the most desirable trees in the stand. These latter individuals are commonly known as "crop trees". With each succeeding intermediate cut, crop trees are again selected and released as before. Through this process of selection, trees which make up the final harvest should represent the best trees in the stand. Row thinning does not provide this type of selection, nor are individual trees released on all sides as in a crown thinning.

A study was initiated in the winter of 1954-55 to investigate the following, using the crown and row methods in thinning a shortleaf pine plantation: 1) General stand structure and growth under each method of thinning; 2) Diameter growth of selected trees in plots thinned by crown and row methods, and in unthinned

check plots; and 3) Diameter growth of comparable trees from the inside (unreleased) and outside (partially released) rows of row-thinned plots in which every fourth row of trees was removed.

METHODS

Six, one-fifth acre plots were established in an 18-year-old shortleaf pine plantation at the Dixon Springs Experiment Station of the University of Illinois (Pope County). Two plots were thinned by removing every fourth row of trees. Two additional plots were crown-thinned by completely releasing 200 or more crop trees per acre. Plots of both thinning treatments were cut to the same residual basal area. Two plots were established as checks.

Weekly growth measurements were made with a dial-gauge microdendrometer throughout the growing seasons of 1955, 1956, 1957, and 1958. This instrument measures radial changes to the nearest one-thousandth of an inch and is similar to one described and illustrated by Holsøe (1951). It has been used in other studies by Boggess (1957) at the Dixon Springs Station. Microdendrometer growth data are expressed in terms of basal area since all other plot records are kept in this way. Weekly increases (or decreases) were calculated and expressed as the average cumulative growth per tree for a given treatment.

Microdendrometer stations were established on 25 trees on each of the crown-thinned and check plots. Thirty stations were established on each row-thinned plot, 15 of which were in the outside rows and 15 on inside rows. Trees used for microdendrometer measurements were chosen from the crop trees on the crown-thinned plots and from trees of comparable size and vigor on the row-thinned and check plots.

SOIL AND SITE DESCRIPTION

The soil is Grantsburg silt loam, a recently correlated series resembling the Grenada soils which occur from western Kentucky to northeast Mississippi. These are Gray-Brown Podzolic integrated to Red-Yellow Podzolic soils developed under forest vegetation from 80 inches or less of loess deposited over a predominantly sandstone bedrock. Under forest cover (uneroded) the silt loam A_1 horizon, which is two to four inches deep, is underlain by a silt loam A_2 horizon six to eight inches thick and a silty clay loam B horizon. A moderately well-developed silt pan (fragipan) occurs at depths of 30 to 36 inches from the surface. The silt pan is massive in structure, hard, and compact. It affects both the downward movement of water and root penetration.

The site was cultivated and abandoned prior to 1935. It is on a low ridge with a slope of about 4%. Erosion was moderate over the area prior to planting.

RESULTS

The number of trees and basal area per acre, prior to thinning, for each

treatment are shown below.

	<i>No. trees/acre (3.6 in. d.b.h. and over)</i>	<i>Basal area. sq. ft./acre</i>
Row-thinned	742	140.2
Crown-thinned	732	139.8
Unthinned	810	142.0

Basal area of the thinned plots was reduced to approximately 100 square feet per acre. The residual stand was as follows: 1) Row-thinned—568 trees per acre with an average diameter of 5.8 inches (decrease of 0.1 inch following thinning); and 2) Crown-thinned—488 trees per acre with an average diameter of 6.1 inches (increase of 0.2 inch following thinning).

Growth of all trees during the four growing seasons of 1955-58 was as follows:

	<i>Basal area/acre</i>	<i>Av.</i>	
	<i>Per cent</i>	<i>diam.</i>	
	<i>Sq. ft.</i>	<i>increase</i>	
		<i>inc., in.</i>	
Row-thinned	25.0	24	0.7
Crown-thinned	27.0	27	1.0
Unthinned	20.3	14	0.4

Growth of trees selected for microdendrometer measurements is shown in Figs. 1, 2, 3, and 4 for each of the four growing seasons. Data for the outside and inside rows of the row-thinned plots are plotted separately. The combined growth of these two groups lies approximately midway between these two curves. Growth data for unthinned trees is almost identical to that of the unreleased rows on row-thinned plots and, for the sake of clarity, are not shown on the figures.

DISCUSSION

More large trees were removed in the row thinning than in the crown

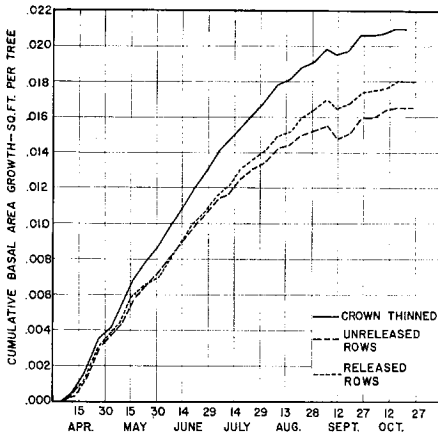


FIG. 1.—Basal area increase during 1955 growing season.

thinning. This may not seem to follow the concept of the latter method where cutting is usually heaviest in the dominant and co-dominant crown classes. By definition, however, the crown method provides for the removal of poor quality trees, or those which may not live until the next thinning, regardless of crown class. In this particular case many trees, damaged by the severe glaze storm of January, 1952 (Bogges and McMillan, 1954), were salvaged in the crown thinning. This could not be done on plots thinned by the row method.

Basal area growth during the four-year period was slightly better on crown-thinned than on row-thinned plots, while growth under both thinning treatments exceeded that of the unthinned check plots. Diameter increases were of the same order.

The growth difference between the two thinning treatments was only two square feet of basal area per acre. This, alone, is not enough to warrant the use of the crown method if possible savings in administration

and operation should favor use of the row method. However, over-all growth does not tell the complete story. The selected trees in the crown thinning grew more than comparable trees in the row thinning (Figs. 1-4). This is directly related to the degree of release, which ranged from all four sides in the crown thinning to release on one side only in the outside rows, and no release for trees in the inside rows of the row thinning.

The released trees in the crown thinning were provided ample growing space and their crowns expanded in all directions, thus developing a much greater leaf surface. In the released rows of the row thinning, space for crown expansion was provided only on one side. Trees in the unreleased rows apparently did not benefit from the thinning as they did not grow any more than those on the unthinned check plots. It is generally believed that diameter growth depends largely on the products of current photosynthesis (Kozlowski, 1958). Thus it is logical that, other things being equal, trees having the

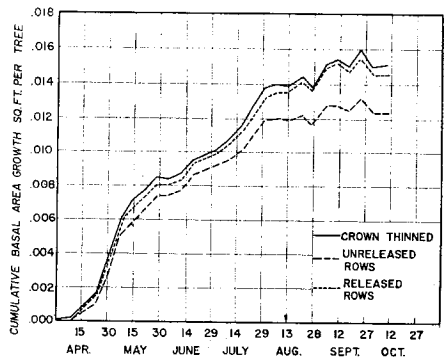


FIG. 2.—Basal area increase during 1956 growing season.

greatest amount of leaf surface would tend to make the greatest diameter growth.

With the foregoing in mind, the growth for 1956 (Fig. 2) should be noted. Two things are apparent when it is compared with the results of the other three years: 1) amount and rate of growth in 1956 were considerably less; and 2) there was very little difference in growth of completely released trees (crown thinning) and partially released trees (row thinning). This is related to the availability of soil moisture, which in turn depends on the amount, intensity, and distribution of rainfall (Bogges, 1957). Precipitation was normal in April, 1956. Deficits of 0.64, 2.47, 1.32, and 1.82 inches occurred in May, June, August, and September, respectively. July had an excess of 2.03 inches, but the amount is deceiving as most of it fell as intense thundershowers

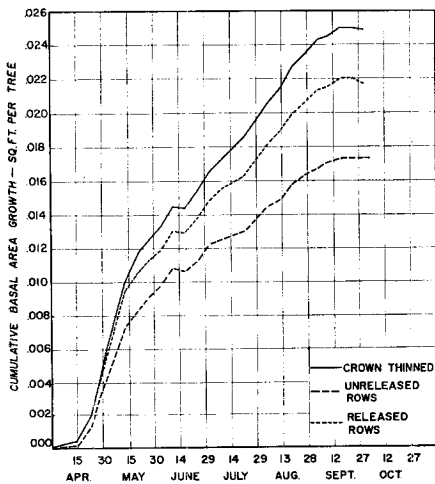


FIG. 3.—Basal area increase during 1957 growing season.

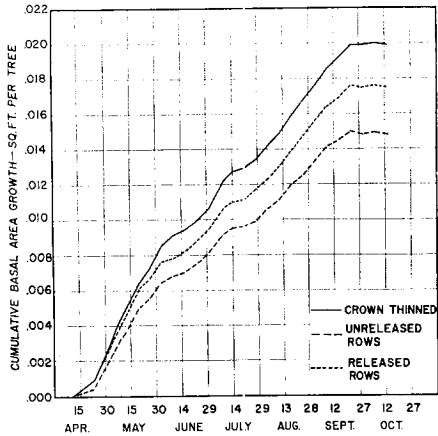


FIG. 4.—Basal area increase during 1958 growing season.

between the 15th and 25th of the month. Soil moisture measurements, taken in a near-by plantation of the same age, indicated that the available moisture was exhausted by the first of August and diameter growth essentially ceased at that time. During the early part of the season, the 1956 growth rate compared favorably with that of the other three years. After June 1 growth slowed, probably as a result of reduced photosynthesis accompanying the rapid depletion of soil moisture (Kozłowski, 1949, 1958). The continuing moisture stress, broken only by the period of high intensity rains in late July, minimized the effect of the increased photosynthetic surface of crown-thinned trees as compared with those in the row thinning. Thus there was little difference in the amount of mid- and late-season growth between the completely released trees in the crown thinning and partially released trees in the row thinning. In other years most

of the growth differences occurred after the middle of May.

In contrast to the above a sharp reduction in diameter growth occurred for a short time in mid-July, 1958, when moisture was excessive. July rainfall was 14.25 inches, with 10.20 inches between July 15 and 22. The rate of photosynthesis was probably reduced during this period. Loustalot (1945) found flooding of pecan trees, growing on a sandy soil, caused photosynthesis to drop to 11% of the normal rate with even greater reductions occurring on heavier soils. While the soil in this instance was not actually flooded in the sense of having standing water on the surface, it was completely waterlogged.

SUMMARY

1. The diameter of selected trees from plots which had been thinned by crown and row methods, as well as those from unthinned check plots, were measured weekly with a dial-gauge microdendrometer during the growing seasons of 1955, 1956, 1957, and 1958. In addition, all trees were measured at the end of each growing season.

2. Diameter growth was related to the degree of release. Trees released on all sides by crown thinning grew more than those released on one side (in the outside rows of the row thinning), while trees in the in-

side rows grew at about the same rate as those on unthinned check plots.

3. Total basal area growth during the four-year period was slightly better on crown-thinned than on row-thinned plots, while growth under both thinning treatments was considerably more than that of unthinned check plots.

4. The relation between diameter growth and soil moisture is discussed.

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