The Relationship Of Native Pecan Tree Spacing To Yield

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Previous research at this station has shown that reducing the stand of native pecan trees will increase production. A simple, rapid method has been needed to determine when and how much to thin these trees to obtain the highest possible yield per acre. Research aimed at finding such a method was started in 1951 by the Oklahoma Agricultural Experiment Station at its Pecan Research Station near Sparks, in central Oklahoma. The study was continued over a seven-year period from 1953 through 1959. This bulletin summarizes the results and describes a recommended spacing based on those results.

PROCEDURE

Trees used in this study were located in a native grove along Quapaw Creek on the Pecan Research Station.

Samples of pecans were obtained in 1951 from each of the bearing trees and analyzed for size, kernel percentage, date of maturity of the pecans, and the amount of yield. These data were used in determining which trees would be removed from the test plots. During the winter of 1951-52, five test plots were established and were thinned as shown in Table 1. The surplus pecan trees were removed by cutting below the ground level with a chain saw.

The research reported herein was done under Oklahoma Station Project 989.

Table 1.—Stands of Native Pecan Trees in Test Plots

Plot	Size of Plot (acres)	Number of Trees		Trees/A. After Thinning
		Before Thinning	After Thinning	
I	12.0	61	50	4.1
II	3.3	38	32	9.4
III	5.1	132	74	14.4
IV	3.6	99	57	17.7
V	1.1	46	46	41.8

Soil Management

The soils in the plots were Port silt loam and Port silty clay loam.

The same system of soil management was used for all plots, and consisted of cultivation and a cover crop. Vetch and rye were seeded early in October at the rate of 20 and 40 pounds per acre, respectively. One hundred pounds of superphosphate per acre, based on soil tests, was applied at this time.

In the spring the cover crop was incorporated into the soil with a heavy stalk cutter. During the summer months the soil was disced several times to control weeds and prepare the land for reseeding the cover crop in the fall.

Records

From 1953 to 1959, the yields of nuts and trunk diameters breast high (DBH) were measured annually for each tree in each plot. Trunk diameters were measured with a steel tree-measuring tape.

RESULTS AND DISCUSSION

During the seven-year period, good crops were produced in 1953, 1955, and 1957. Light crops were produced in 1958 and 1959, and a poor crop in 1956. There was a crop failure in 1954.

Yield per Tree

Table 2 shows the average yield per tree for the various tree stands. The highest seven-year average per tree was obtained from Plot II. The trees in this plot were larger than those in Plot I, which accounted for the higher yields.

Table 2.—Average Yield of Native Pecans per Tree
(Pounds)

Plot	Number of Trees /A.	Average Yield for the Year—							Avg.
		1953	1954	1955	1956	1957	1958	1959	
I	4.1	77.6	0.0	92.5	3.1	90.7	31.3	8.1	43.3
II	9.4	70.3	0.0	123.4	1.0	94.0	3.8	24.5	45.2
III	14.4	51.2	0.0	73.6	2.1	53.3	21.7	16.1	31.1
IV	17.7	43.2	0.0	31.4	10.4	44.4	15.9	3.1	21.2
V	41.8	4.4	0.0	14.7	0.5	10.1	2.1	1.6	4.7

As the number of trees exceeded 14 per acre, the yields declined markedly. The lowest average production per tree was obtained from Plot V which contained 41.8 trees per acre. Examples of an over-crowded stand, and a stand correctly thinned to obtain optimum yield, are illustrated in Figure 1.

Yield per Acre

The average yield per acre is shown in Table 3. The highest production per acre was obtained from Plot III. The yield per tree was less from this plot than from either Plot I or Plot II (see Table 2), but the additional trees per acre in Plot III accounted for the higher production. The fact that Plot V with 41.8 trees per acre produced more pecans than Plot I with 4.1 trees per acre, indicates that there were not enough trees per acre in Plot I.

Table 3.—Average Yield of Native Pecans per Acre
(Pounds)

Plot	Number of Trees /A.	Average Yield for the Year—							Avg.
		1953	1954	1955	1956	1957	1958	1959	
I	4.1	323.2	0.0	385.6	13.0	378.1	130.4	33.7	180.5
II	9.4	660.3	0.0	1159.7	9.1	883.3	35.5	227.6	425.1
III	14.4	716.9	0.0	1030.9	29.2	737.1	299.4	197.7	430.1
IV	17.7	768.6	0.0	497.8	161.9	690.5	247.5	40.8	343.8
V	41.8	190.9	0.0	629.1	22.7	421.8	87.3	65.4	202.4

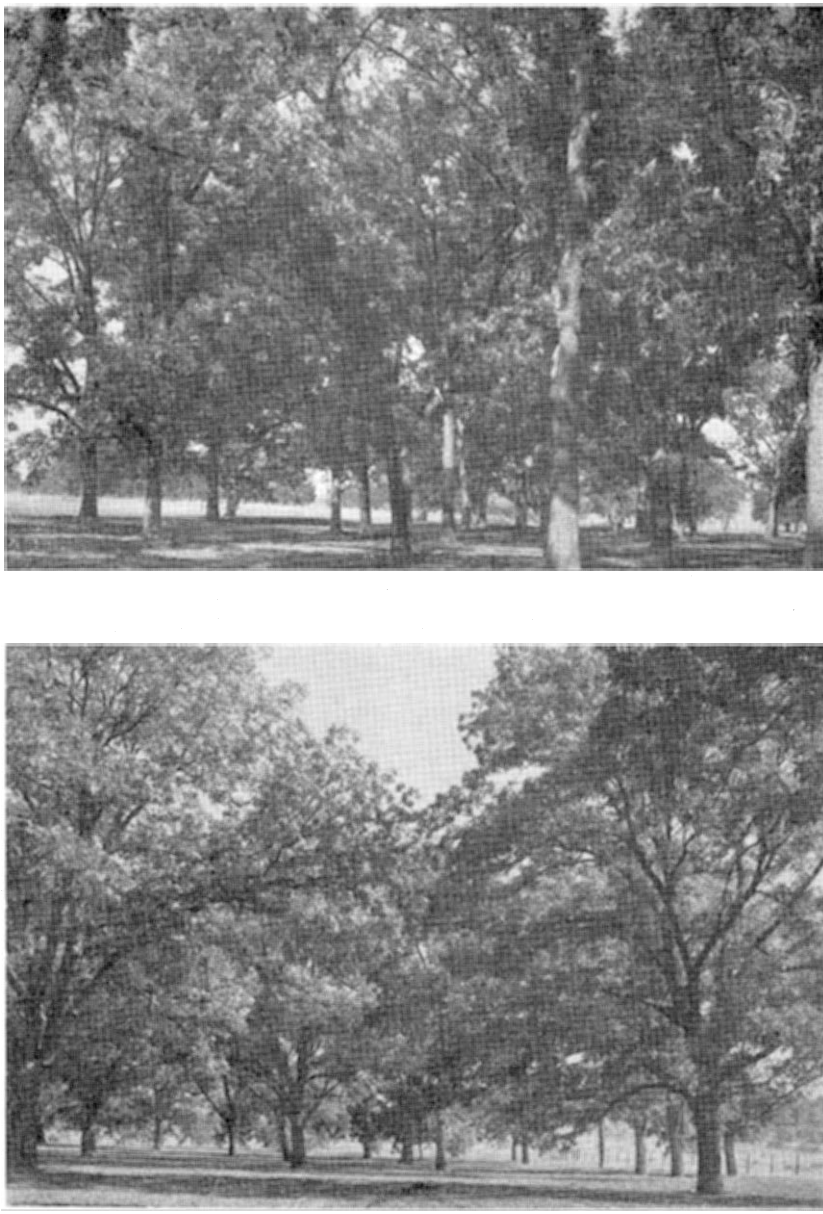

Figure 1.—The upper photograph shows an overcrowded native pecan grove containing 41.8 trees per acre. Below, the grove has been thinned to 14 trees per acre—the maximum number of trees per acre to obtain optimum yield.

Yield in Relation to Trunk Area

Although results obtained from studying the yield per tree and yield per acre gave some information pertinent to optimum spacing, they were not considered sufficiently consistent to establish a satisfactory method for recommending tree-spacing. The possibility of using the number of square feet of cross-sectional trunk area per acre was therefore investigated.

Since the trees used in this study varied in size, the average number of square feet of cross-sectional trunk area per tree was figured (see Table 4). This information was then calculated on a per acre basis (see Table 5).

The yields in pounds per acre were compared to the number of square feet of cross-sectional trunk area per acre. The results (Table 6) indicate that the highest production occurred in Plot I, which contained the least number of trees per acre and the lowest total number of square feet of cross-sectional trunk area per acre. The lowest production was

Table 4.—Average Square Feet of Cross-Sectional Trunk Area per Tree

Plot	Number of Trees /A.	Average Square Feet for the Year—					
		1953	1955	1956	1957	1958	1959
I	4.1	2.32	2.41	2.44	2.49	2.56	2.65
II	9.4	2.69	2.74	2.80	2.88	2.90	3.01
III	14.4	2.32	2.38	2.41	2.48	2.49	2.65
IV	17.7	2.05	2.11	2.16	2.24	2.31	2.42
V	41.8	1.60	1.65	1.72	1.74	1.77	1.80

Table 5.—Average Square Feet of Cross-Sectional Trunk Area per Acre

Plot	Number of Trees /A.	Average Square Feet for the Year—				
		1953	1955	1956	1957	1958
I	4.1	9.64	10.04	10.15	10.36	10.67
II	9.4	25.26	25.73	26.32	27.10	27.36
III	14.4	32.50	33.30	33.37	34.35	34.48
IV	17.7	32.64	33.51	33.63	34.88	35.96
V	41.8	68.50	70.36	71.81	72.92	73.91

Table 6.—Yield of Native Pecans in Pounds per Square Foot of Cross-Sectional Trunk Area per Acre

Plot	Number of Trees /A.	Average Yield for the Year—							Avg.
		1953	1954	1955	1956	1957	1958	1959	
I	4.1	32.41	0.0	38.80	1.27	36.41	12.21	3.05	17.66
II	9.4	26.13	0.0	45.07	0.34	32.61	1.30	8.04	16.21
III	14.4	21.60	0.0	30.95	0.87	21.45	8.68	6.08	12.80
IV	17.7	23.29	0.0	14.90	4.81	19.78	6.88	1.26	10.13
V	41.8	2.79	0.0	8.94	0.32	5.78	1.18	0.86	2.84

from Plot V. From this it is evident that the yields were inversely related to the number of square feet of cross-sectional trunk area per acre. As the total number of square feet increased, the yield per square foot decreased.

Results of these data indicate that the method of using the number of square feet of cross-sectional trunk area is probably the most accurate way to evaluate yields between trees and between plots, when the sizes of each vary.

Tree Spacing in Relation to Trunk Area

To determine the number of square feet of cross-sectional trunk area per acre for maximum production, the yield in pounds per square foot of cross-sectional trunk area per acre (Table 6) was plotted against the average number of square feet of cross-sectional trunk area per acre (Table 5). The results are shown in Figure 2 and give production curves for the years 1953, 1955, 1957, 1958, and for the seven-year average (1953 through 1959).

These results indicate that the maximum production per acre occured at thirty square feet of cross-sectional trunk area per acre. Thus it appears that this is the optimum spacing for pecan trees under the conditions described in this study.

COMPUTING TRUNK AREA PER ACRE

Table 7 illustrates a method of computing the number of square feet of trunk area.

The total number of square feet of cross-sectional trunk area (81.34), divided by the number of acres in Plot V (1.1), gives 73.9 as the total number of square feet per acre. Using the number 30 as the

optimum number of square feet per acre, 43.9 square feet of trunk area should be removed from the acre. The remaining trees should be spaced as uniformly as possible.

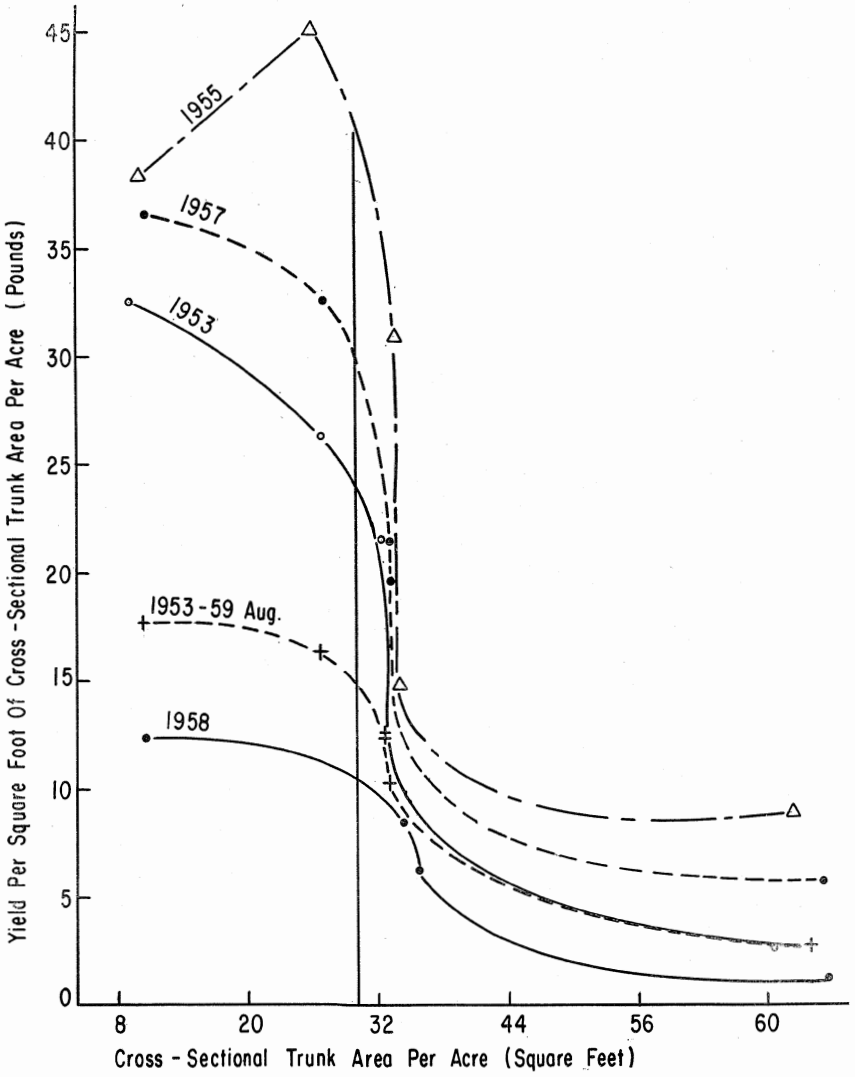

Figure 2.—Yield of pecans in pounds per square foot of cross-sectional trunk area per acre.

Table 7.—Method of Computing Total Square Feet of Trunk Area, Using Data from Plot V as an Example

Size of Tree* (Circumference in inches)	Number of Trees of This Size		Cross-Sectional Trunk Area (Square Feet) (per tree)		Total
44.0	5	×	1.07	equals	5.35
47.1	5	×	1.23	equals	6.15
50.3	5	×	1.40	equals	7.00
53.4	6	×	1.58	equals	9.48
56.5	8	×	1.75	equals	14.00
59.7	8	×	1.97	equals	15.76
62.8	3	×	2.18	equals	6.54
66.0	1	×	2.41	equals	2.41
69.1	3	×	2.64	equals	7.92
75.4	1	×	3.14	equals	3.14
81.7	1	×	3.69	equals	3.69
				Total	81.34

*Data taken from Table 8.

Table 8.—Table Used in Converting Measurement of Tree to Cross-Sectional Trunk Area

Size of Tree*		Cross-Sectional Trunk Area (square feet)
Diameter (inches)	Circumference (inches)	
6	18.8	.20
8	25.1	.35
10	31.4	.55
12	37.7	.79
14	44.0	1.07
15	47.1	1.23
16	50.3	1.40
17	53.4	1.58
18	56.5	1.75
19	59.7	1.97
20	62.8	2.18
21	66.0	2.41
22	69.1	2.64
23	72.3	2.89
24	75.4	3.14
25	78.5	3.41
26	81.7	3.69
27	84.8	3.98
28	88.0	4.28
29	91.1	4.59
30	94.2	4.91

*Either diameter or circumference can be used in figuring cross-sectional trunk area.

SUMMARY

The experiment reported in this bulletin was designed to find a simple, quick method of determining when native pecan trees are crowded and should be thinned. The test was conducted over a seven-year period on five plots of bearing native pecan trees.

Results from the experiment suggest that the number of square feet of cross-sectional trunk area per acre is a reliable method for determining when crowding exists. It was found that the maximum production of pecans per acre occurred at thirty square feet of cross-sectional trunk area per acre. When an acre has more than thirty-four square feet of cross-sectional trunk area, the trees need to be thinned.

A method is given for computing trunk area per acre to determine when crowding exists and how much pecan trees should be thinned.