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PRUNING PIN OAK IN SOUTHEASTERN MISSOURI

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Pin oak (*Quercus palustris* Muenchh.) is an important tree species on bottomlands and poorly drained upland flats in the central United States. It is characterized by rapid height and diameter growth, a straight, strongly excurrent main stem, and many dead branches which persist for many years on the lower bole. These branches cause many small knots and subsequently much loss of value in pin oak lumber (Minckler 1965).

In 1957, a study was installed to determine: the feasibility of pruning pin oak, the degree of epicormic branch sprouting that would occur after pruning, and what factors would affect this sprouting. Early results of this study have been published (Minckler and Krajicek 1964). This report gives the results to 1969--12 and 13 growing seasons after pruning.

METHODS

A complete description of the study area and the experimental methods is given by Minckler and Krajicek (1964). Briefly, the study was designed to test the effect of season of pruning (before, during, or after the growing season) and the effect of exposure of the bole to direct sunlight on the number and spatial distribution of epicormic branches after pruning. Treatments were assigned at random to 150 dominant and codominant trees within a 30-acre portion of a 30- to 35-year-old even-aged, fully stocked pin oak stand in the Mingo National Wildlife Refuge, Stoddard and Wayne Counties, Missouri. In March, 1957, the first 16-foot log was pruned on 40 trees and 10 nonpruned control trees were designated; half of these trees (20 pruned and 5 nonpruned) were exposed to direct sunlight by cutting 1 to 3 trees on the south and southwest sides of the study trees. This entire procedure was repeated in June and again in October, 1957. All pruning was done manually with pruning saws.

The number of live and dead branches on the first log was recorded by tree side (north-northeast and south-southwest) before pruning and 1, 4, and 12 years after treatment. Tree diameter and crown class were also measured. The 12th year measurements were taken on all trees in October, 1969. Since the initial measurements were taken at the time the treatments were applied (March, June, and October, 1957), the data represent 13 growing seasons for the March trees, 12.5 growing seasons for the June trees, and 12 growing seasons for the October trees. Adjustments for these differences in time were made in the analyses where necessary. Of the 150 original study trees, 2 died and 28 had dropped below the codominant crown class by 1969. The results presented here are based on the remaining 120 trees (96 pruned and 24 nonpruned).

RESULTS

Effect of Pruning

Although there was some epicormic branch sprouting after pruning, in 1969 the pruned trees still had less than one-fourth the number of branches on the first 16-foot log as the nonpruned trees--6.1 vs. 25.6 branches (table 1). This difference was statistically significant at the $P = .001$ level. Almost all sprouting on the pruned trees occurred within the first 4 years after pruning; for the remaining 8 years of the study, the mean number of branches per tree remained about constant (fig. 1). The number of branches on the nonpruned trees declined 32 percent over the study period, from 37.7 in 1957 to 25.6 in 1969.

Table 1.--*Mean numbers of branches*[1] *on the first 16-foot log of pruned and nonpruned pin oak trees by month, shading, and tree side*

Month pruned	South half of bole			North half of bole			Sum of north plus south halves[2]		
	Exposed	Shaded	Mean	Exposed	Shaded	Mean	Exposed	Shaded	Mean
March	2.6	4.5	3.4	0.5	2.1	1.2	3.2	6.6	4.7
June	4.4	3.6	4.1	0.5	2.1	1.2	4.9	5.7	5.3
October	9.4	3.8	6.6	2.6	1.2	1.9	12.1	5.0	8.5
Mean of all pruned trees	5.3	4.0	4.7	1.2	1.8	1.5	6.5	5.8	6.1
Mean of all nonpruned trees	17.2	13.2	15.4	11.7	8.5	10.2	28.9	21.7	25.6

[1] Live plus dead branches.
[2] Sum of north plus south half values may not add exactly due to rounding.

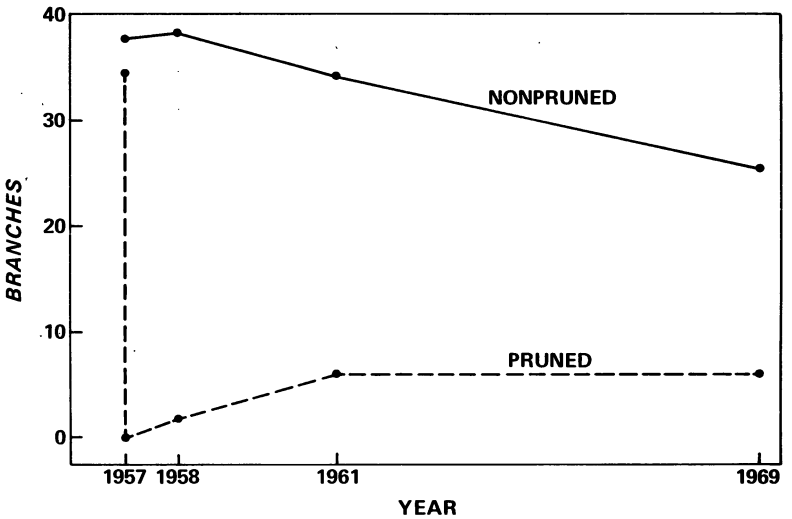

Figure 1.--*Mean number of live plus dead branches (north plus south sides) on the first 16-foot log of the pruned and nonpruned trees from 1957 through 1969.*

Eighty-two percent of the branches on the nonpruned trees and 66 percent on the pruned trees were dead in 1969.

Correlation of Numbers of Branches Before and After Pruning

The number of new branches on the pruned trees was weakly correlated with the number of branches before pruning: (branches in 1969) = .52 + .163 (branches in 1957) Although the R^2 was only .12 (r = +.35), the regression was statistically significant at the P = .01 level. Thus, for every 10 branches on the first log of a tree before pruning, 1½ to 2 new branches can be expected after pruning. The data indicate however, that there will be a great amount of variation around this expected value. This correlation of branch numbers before and after pruning is presumably due to genetic control of branching characteristics within the individual trees.

Effect of Season of Pruning

Because of the correlation between branches before and after pruning, analyses of the 1969 pruned tree data was done by covariance analyses on the regressions:

$$(\text{branches in 1969}) = b_0 + b_1 \text{ (branches in 1957)}.$$

This technique permitted tests to be made on the 1969 pruned tree data after the effect of number of branches in 1957 was removed. Analysis of differences in total branches for the exposed and shaded trees by months of pruning showed season (month) of pruning had no effect on branch sprouting (table 1). All month comparisons were statistically nonsignificant with the exception of the exposed October trees. The mean number of branches for this treatment (12.1) was significantly higher than for the exposed March or June trees (3.2 and 4.9 branches); this greater value was, however, due primarily to 5 trees (out of 16) which inexplicably had from 21 to 37 branches each (the mean number of branches on the other 11 trees in this treatment was 5.8). The mean number of branches for the shaded October trees was 5.0--less than the comparable values for the shaded March and June trees (6.6 and 5.7 branches). Because of the small number of trees which caused this high value and the lack of a similarly high mean for the shaded October trees, the high exposed October value is most likely a chance occurrence, and not due to either month or exposure treatment.

Distribution of Branches on North and South Sides of the Bole

Overall, approximately three-fourths of the new branches on the pruned trees grew on the south-southwest half of the bole (table 1). Differences were analyzed by t-test; adjustment for number of branches before pruning was not made because these north-south comparisons were made on two halves of the same tree. Differences for both pruned and nonpruned trees were significant at the P = .001 level.

The Effect of Direct Sunlight on Branching and Tree Growth

The effect of exposure to direct sunlight was analyzed by the previously described covariance technique to remove the effect of the number of branches before pruning. Exposure of the trees to direct sunlight on the south-southwest side had no effect on the number of new branches on the pruned trees (table 1). Differences in branch numbers between exposed and shaded trees were statistically nonsignificant except in the case of the October trees. As explained before, the differences in these trees were interpreted as being not due to treatment. However, exposure did affect the distribution (by tree side) of the branches; the proportion of branches growing on the south side of the trees was 82 percent for the exposed trees and 69 percent for the shaded trees. This difference was significant at the P = .05 level.

Exposure of the trees by cutting several adjacent trees (in effect, a partial thinning) resulted in a 30 percent increase in diameter growth of the exposed trees compared to the trees which remained completely shaded. Evaluation of the data was by covariance analysis with diameter growth adjusted for initial (1957) diameters. Assuming an initial diameter of 8.0 inches in 1957 and using the average growth period for all treatments (12.5 growing seasons), the exposed trees grew 3.24 inches (.26 inches per year) while the shaded trees grew 2.48 inches (.20 inches per year). This difference was significant at the P = .001 level. This 30 percent increase in diameter growth agrees with results from other studies which have shown that pin oak responds well to thinning or release (Minckler 1953, Minckler 1965, Minckler 1967). Exposure of the trees had no effect on height growth.

Effect of Pruning on Diameter Growth

Although the pruned trees had a 16.5 percent greater diameter growth than the nonpruned trees, this difference was not statistically significant. Because all the bole branches on these trees were small and most (76 percent) were dead at the time of pruning, no significant effect on diameter growth by pruning was expected.

DISCUSSION AND CONCLUSIONS

Mechanical pruning is a feasible method of permanently reducing the number of branches on pole-size pin oak in fully-stocked or partially thinned stands. Regrowth of branches was confined almost

entirely to the first four years after pruning, and presumably (unless perhaps the stand is opened up greatly), the number of branches will remain about the same or decline slowly as the stand gets older. It is interesting to speculate what would have happened if, four years after the pruning, a second pruning had removed the few branches which did sprout. Would more branches have sprouted, or would the trees have remained essentially branch-free after that?

The strong correlation of branching with bole side (aspect) suggests that pin oak branching is strongly affected by light intensity. If this assumption is made, it is then difficult to explain why further exposure to light by cutting adjacent trees did not stimulate even more branching. Although most of the comparisons between exposed and shaded trees in table 1 were not statistically significant, the data (disregarding the October trees) suggest that, if anything, the additional exposure actually reduced the number of branches on both the north and south sides of the trees. For the March and June pruned trees, the south-side mean numbers of branches in 1969 were: exposed = 3.5, shaded = 4.1; the north-side means were: exposed = 0.5, and shaded = 2.1. This last difference was significant at the P = .01 level.

An economic analysis of pin oak pruning is not possible until the trees become larger than their present (1975) estimated mean d.b.h. of about 12 inches. The minimum top diameter (inside bark) for hardwood Grade 1 logs is 13 inches; assuming a form class of .78 (Jensen and Woerheide 1956), these pin oak will need to have a d.b.h. of around 17 inches to be potential Grade 1 logs.

Although a definitive economic analysis cannot be done now, an indication of significant improvement in log quality and value can be inferred from a statement by Boyce and Schroeder (1963) concerning the effect of pruning on hardwood log quality: "... pruning...will result in little or no gain in log quality unless the practice reduces the number of grading defects in the butt log to less than 8." Branches and branch stubs are the main grading defects in pin oak. The mean number of branches on the butt log of pruned trees in 1969 was 6.1; 72 percent of the logs had less than 8 branches, and 49 percent had less than 4 branches. In comparison, the mean number of branches on the nonpruned trees was 25.6, and only 7 percent of these trees had less than 8 branches on the butt log. Final economic analysis will require a lumber grade recovery study on logs from pruned and nonpruned trees to accurately assess the overall effects of pruning and, in particular, to assess the effect of the unequal lateral distribution of sprouts on lumber grade yields.

SUMMARY

Based on this study, the following conclusions and recommendations can be made regarding pin oak pruning:

1. Pruning will significantly and permanently reduce the number of branches on the butt logs of pole-size pin oak.
2. Wherever possible in the selection of trees to be pruned, trees with fewer branches should be chosen over those with more branches; this will result not only in lower pruning costs, but also in fewer epicormic branches after pruning.
3. Pruning can be done at any time of the year without affecting the number of new sprouts after pruning.
4. Pruning can be combined with at least light thinning to increase the diameter growth of the trees without increasing the number of new sprouts after pruning.
5. Consideration should be given to making a second pruning four years after the first pruning to remove the few new branches that will grow on most trees. Assuming that the sprouting after this second pruning would be very light, boles nearly free of branches and clear, knot-free lumber would result.

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