OAK PRUNING IN THE MISSOURI OZARKS

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There is a large price differential between the higher grades of clear oak lumber and the knotty and wormy lower grades. This differential is likely to continue indefinitely. In the past, the FAS grades of hardwood lumber have been obtained from trees well over 100 years old, grown in natural untreated stands. With the advent of forest management, it will be uneconomical to grow trees on a rotation long enough to produce clear lumber from many species under natural pruning. Therefore it seems likely that pruning will be necessary for the production of clear material in many stands managed for the production of sawtimber or veneer.

Black and scarlet oaks are abundant in hardwood stands of the Central States. These species do not prune themselves well naturally, having dead limbs which persist for many years. There is a need for information on the silvicultural and the financial aspects of pruning these species. In order to determine the pathological effect and the economic feasibility of pruning oaks in the Ozarks, a pruned plot with an unpruned control was established in 1937 on the Clark National Forest near Doniphan, Missouri. Fourteen years have elapsed since the trees were pruned, and although the crop trees are not ready for harvest, sufficient information is available to make a reliable prediction of the results.

DESCRIPTION OF PLOTS

The plots, each covering one acre, were laid out side-by-side in a 32-year-old mixed oak stand. The site index was classified as 60, an average site for oak according to yield tables prepared by Schnur (1937). The basal area of all species combined was 63 square feet per acre, corresponding to 73 per cent stocking for this site. The stand was essentially even-aged except for a few large white and post oaks and shortleaf pine, remnants of the former stand which had been logged for sawtimber and ties. Scarlet oak was the most abundant species in the upper crown classes, followed by black oak and pine. A few blackjack oaks and hickories were present.

The pruning was done in June, 1937. All trees over 2 inches d.b.h. were pruned to a height of 17 feet, with the exception that the operation on the smaller trees did not remove more than one-third of the live crown.

Handsaws and polesaws were used, the cuts being made as close to the bole of the tree as practicable. Both live and dead branches were removed.

RESULTS

The plots were examined yearly for the first 4 years after pruning by personnel of the U. S. Forest Service and again at the end of the 1951 growing season by the authors. At the end of the first full growing season approximately 25 per cent of the pruning wounds were healed. By the end of the second year most of the wounds less than an inch in diameter were completely covered. Scarlet and black oaks healed rapidly. As noted by Curtis (1936) in pruning white pine, dead branches which had been pruned by cutting into the live collar at the base of the branch showed accelerated healing. By the end of the third year the wounds under 2 inches in diameter were completely healed on most of the oaks, and approximately 75 per cent of the larger wounds were healed. At the end of the fourth year, all wounds were healed on oaks and pines except wounds over 2 inches in diameter.

In 1951 the trees were divided into 2 crown-class groups, the upper group consisting of dominants and codominants, and the lower consisting of the intermediates and overtopped. On all species of the upper crown-class group, every pruning wound was healed. Healing in the lower crown-class group was nearly complete in the case of scarlet oak, black oak, and white oak, all averaging less than 1 open wound per tree. Post oak, blackjack oak, and hickory showed slower healing, averaging 2 or more open wounds per tree. The experimental findings that healing rate depended largely on tree vigor (expressed here as crown class) agrees with the results presented by Roth (1948) on pruning of oak in Virginia.

Several oaks were dissected (Fig. 1) to determine whether decay was associated with pruning wounds. No decay was observed, probably because most of the original wounds were small, and healing was rapid. Roth (1948) reported that wounds 1.5 inches wide or less were practically free of decay, although decay was prevalent behind wounds 1.6 inches wide or wider.

Numerous grub channels were found in the wood of unpruned oaks and in the central knotty core of pruned oaks; these varied from 1 to 25 inches in length and were about ½-inch wide.

After pruning, epicormic branches or water sprouts appeared on many of the oaks and hickories. Some of these branches persisted and were present 14 years after pruning. Trees in the upper crown class had relatively few water sprouts. Scarlet, white, and post oak in this class averaged 2 per tree, and black oak averaged 7. On intermediate and overtopped trees, however, water sprouts were profuse on the pruned boles. Scarlet oak had an average of 8, white oak 10, post oak 12, black oak 14, and hickory 4.

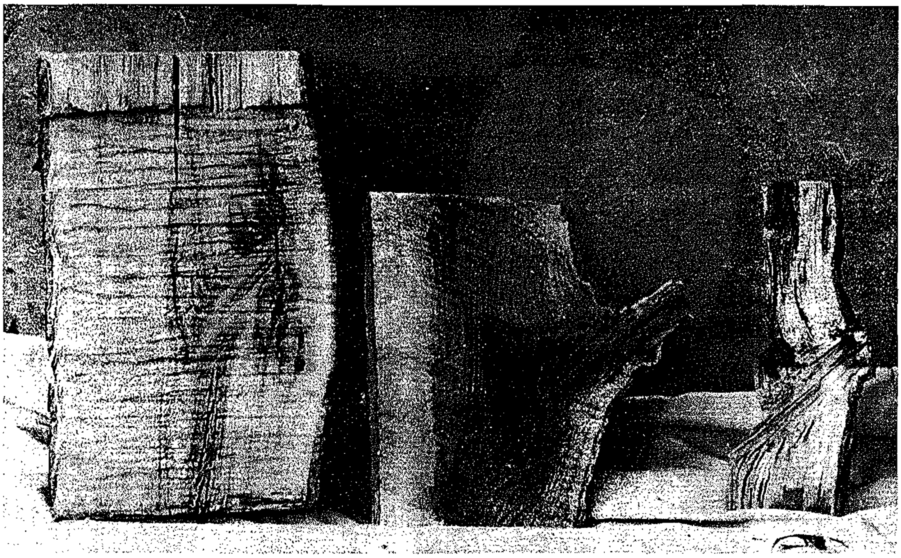

Fig. 1.—Oak stems dissected in 1951, 14 years after pruning. Left, healed-over scarlet oak pruning wound. Center, unpruned scarlet oak showing persistent dead branch stub and grub channels. Right, unpruned black oak showing decay associated with a dead branch stub.

Unpruned trees of both crown classes were limby, as Fig. 2 shows, except for dominant white oak, and pine. In 1951 a tally showed an average of 17 branches or branch stubs in the first 16-foot log of unpruned trees. Lumber produced in the past 14 years and that to be produced in the next 40 to 50 years by these trees will be of low quality. Wood outside the central core of dominant and codominant pruned trees will be nearly free of knots.

FINANCIAL BENEFIT FROM PRUNING

As pointed out by Shaw and Staebler (1950), the profits from pruning are determined by (1) the amount of clear wood produced, (2) the difference in value between clear and knotty wood at the time of harvest, and (3) the cost accumulated at a chosen rate of interest for the required number of years. The profit per pruned tree harvested equals the volume of clear wood produced times the value difference, minus the compounded pruning cost.

An attempt is made to estimate the probable profits from pruning dominant and codominant black and scarlet oak in this stand. The computation is restricted to the upper crown class because the data indicate that pruning of intermediate and overtopped oaks in this stand is not likely to result in the production of much clear lumber. Species other

Fig. 2.—Scarlet and black oak stand in 1951. Left, pruned plot, codominant scarlet oaks in foreground. Right, unpruned plot, showing persistent dead branches on black oak.

than scarlet and black oak were not abundant enough in the stand to furnish conclusive data.

The pruning time is estimated from pruning of a comparable stand at the University Forest of the University of Missouri, as 5 minutes per tree, with 1 minute travel time between trees. This estimate agrees closely with the findings of Moss (1937) in a similar stand in Connecticut that the time for pruning to a height of 15 feet averaged 2¾ minutes, with a travel time from tree to tree of 25 seconds. Using 6 minutes as the total pruning time and with labor at $1 per hour, the total cost per tree equals $0.10.

It is assumed that the trees will be harvested when they have a d.b.h. of 16 inches. The pruning cost of $0.10 must be compounded for the number of years required for the trees to grow from 6.5 inches (their average d.b.h. at the time of pruning) to 16 inches. From increment borings taken in 1951 it was forecast that this would take 38 years, or until 1975. Using 3 per cent as the interest rate, the cost per tree in 1975 equals $0.10 $(1.03)^{38}$, or $0.31.

The amount of clear wood to be produced in the 16-foot butt log may be computed by subtracting the board-foot contents of the knotty core from the log volume as scaled by International ¼-inch Rule. Taper-sawing will be necessary to obtain the maximum yield of clear wood. The butt log of a 16-inch tree with Girard form class 77 (average for the stand) has a scaling diameter of 12.3 inches; this log contains 102 board feet. The knotty core has a diameter of 5.0 inches at the small end. Allowing 1.5 inches for bark thickness, healing, and utilization, this diameter is increased to 6.5 inches. The lumber content of the 6.5 inch core with the utilization assumptions of the International Rule (¼-inch kerf, 1/16-inch shrinkage, and taper of ½ inch for every 4 feet of length) is computed by the formula derived from these assumptions ($.796D^2 + 1.19D + .7$) as 42 board feet. The clear wood produced equals the difference between 102 and 42; that is, 60 board feet.

The price differential between clear lumber and knotty lumber must be forecast for the year of harvest, 1975. A differential of $30 per thousand board feet is predicted, based on past trends and present lumber values. The gross income from pruning is determined by applying this price to the 60 board feet of clear wood produced, giving $1.80. The net profit in 1975 from the pruning investment in 1937 is then the difference between gross income of $1.80 and compounded cost of $0.31, or $1.49 per tree.

The pruning profit may also be computed as a compound rate of interest earned on the investment by solving for the rate p in the equation $\$0.10\,(1 + p)^{38} = \$1.80$. The value of p which satisfies this equation is 7.9 per cent. Obviously, pruning scarlet oak and black oak dominant and codominant trees in this stand is likely to be a profitable investment.

The profit in dollars per acre may be computed by multiplying the profit per tree by the number of pruned trees harvested per acre. In the stand investigated, there were 60 pruned dominant and codominant black and scarlet oaks per acre. The profit in 1975 will then be 60 times $1.49 equals $89.40 per acre.

The forest manager might choose to let the crop trees grow to an average d.b.h. of 18 inches before harvest. In this case, the volume of clear wood produced would be 92 board feet per tree. Applying the price differential of $30 per thousand to this volume gives $2.76 gross income. From this a compounded cost of $0.44 ($1.03^{50} \times \$0.10$, where 50 years is the estimated number of years from pruning to harvest) must be subtracted, showing a profit of $2.32 per tree, or $139.20 per acre. However, the rate of return in this case is 6.9 per cent, slightly less than for the assumption of harvest at 16 inches of d.b.h.

In oak stands similar to this, pruning would be a good long-term investment. On good sites, the profit from pruning should be even higher than on the average site of this study, because of the reduced time it would take to grow the trees to maturity. And if the trees had been pruned earlier, the volume of clear wood produced would be greater, with a corresponding increase in profit.

SUMMARY

A study of the effects of pruning and the financial benefit from pruning was conducted in an oak stand on an average site in the Missouri Ozarks. The trees were examined during the first few years after pruning and again 14 years later.

Pruning wounds healed rapidly, especially on the more vigorous trees. The wounds were practically free of decay. Water sprouts developed profusely on trees in the lower crown classes. Unpruned trees of all crown classes were limby, except for dominant white oak, post oak, and pine.

The profit in the estimated year of harvest from pruning dominant and codominant scarlet and black oaks is estimated at $1.49 per tree, or $89.40 per acre. Expressed in terms of the rate of compound interest that the investment is expected to earn, the return is 7.9 per cent.

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