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Pruning Black Cherry in Understocked Stands

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ABSTRACT

Black cherry trees 4 to 6 inches in diameter at breast height (dbh) with live crown ratios ranging from 73 to 92 percent were pruned to 25, 50, or 75 percent of tree height or were left unpruned. Most trees can be pruned to 50 percent of tree height in one operation. Trees that have large crowns and that are fully exposed on the southwest side should be pruned less severely. Pruning to 75 percent of tree height caused excessive epicormic branching, poor diameter growth, and serious cambium necrosis.

BLACK CHERRY (*Prunus serotina* Ehrh.) is one of our most valuable hardwood tree species, and its usefulness, especially for veneer, depends largely on the amount of clear, knot-free wood that can be produced. Since it is a fairly intolerant species, black cherry prunes itself well in stands that are well stocked with a mixture of species.

But there are thousands of acres of understocked black cherry stands on the high Allegheny Plateau. Most of these stands contain scattered, young, fast-growing, and well-formed trees that are heavily branched because of open growing conditions (Fig. 1). Attempts have been made to regenerate such stands, but regeneration is difficult unless conifers are planted. Pruning provides a means of salvaging these trees and developing stands of higher value. There are likely to be other opportunities for artificial pruning where trees are planted at wide spacings, and where natural regeneration after clearcutting is inadequate, resulting in wide spacing.

Little work has been done on pruning black cherry. Zeedyk and Hough (1958), reporting on a study at the Kane Experimental Forest in northwestern Pennsylvania, concluded that pruning black cherry is a promising silvicultural practice. Pruning was done in a "somewhat open" 13-year-old stand that had been weeded. Trees averaged 2.6 inches in diameter at breast height (dbh), and were pruned to a height of 8

Figure 1.—Black cherry trees in an understocked stand on the Allegheny National Forest. The arrow indicates a study tree that has been pruned.

feet. There is no record of how much crown was removed in pruning. The canopy closed well before the end of the study at age 32. Decay and epicormic branching were not serious. Cambium necrosis did not occur, and all flush-cut black cherry pruning wounds healed in 5 years. Pruned black cherry trees grew an average of 0.338 inches in dbh per year for 19 years, or about 1 inch in 3 years.

A study of pruning in northern hardwoods in Wisconsin included a few black cherry trees, but not enough for separate analysis. However Stoeckeler and Arbogast (1948) reported that pruning cuts on these black cherry trees healed with a minimum of decay.

This study was initiated in 1962 to determine the effects of different intensities of pruning on the growth and quality of open-grown black cherry trees. Three-year results reported by Grisez (1967) have been reaffirmed; they have been supplemented by 10 years of growth records and by examination of dissected stem sections.

METHODS

Scattered black cherry trees in five areas near Marienville, Pa., on the Allegheny National Forest were selected for pruning. The trees were 4 to 6 inches in diameter, reasonably straight, free of forks, and they had live crown ratios ranging from 73 to 92 percent (average of 83). Heights ranged from 23 to 46 feet (average of 35); most trees were 22 to 29 years old.

Open-grown trees provided a severe test of pruning—to prune trees with large crowns and some large live branches. These understocked black cherry stands occupy many of the broad, shallow valleys near the heads of streams. These are areas that never regenerated well—in contrast to the slopes and uplands—after extensive logging and fires that occurred until about 45 years ago. A mixture of grasses, sedges, composites, and other herbs form a generally complete ground cover.

A total of 48 trees were studied—16 trees each in the 4-, 5-, and 6-inch diameter classes. Four trees in each diameter class were randomly assigned to one of four treatments. The treatments and the percentage of live crown removed were:

Treatment	*Percentage of live crown removed*	
	(average)	*(range)*
Not pruned	0	0
Pruned to 25 percent of total height	13	0-19
Pruned to 50 percent of total height	42	37-49
Pruned to 75 percent of total height	71	66-75

The trees were pruned in July and early August, 1962. Trees were diagramed to show: (1) branch locations on each of four faces; (2) whether branches were live or dead at the time of pruning; (3) whether they were removed by pruning or not; and (4) their diameters to the nearest half inch just above the basal swell. The first 17 feet of all trees were diagramed, as were additional heights on trees pruned higher than 17 feet. In all, 988 branches were removed and were observed; 513 unpruned branches also were observed. The 585 live branches that were removed averaged 1.0 inch in diameter; the dead branches removed averaged just over 0.6 inch. An average of 1.5 branches were removed per foot of clear length achieved. No time records were kept.

The diameter at breast height and the total height of each tree were measured at the time of pruning; trees of all treatments averaged 5.1 inches in dbh before pruning. Diameters were remeasured each year for 10 years, ending in 1972, and heights were remeasured after 2 and 4 years. Pruning wounds and diagramed branches were observed each year to determine dates of wound healing and natural pruning.

Epicormic branches on the first 17 feet, or up to the height pruned if higher than 17 feet, were observed each year for 6 years and again in 1972. The number and estimated average length of epicormics were recorded by 4-foot bole sections. All of these records were made about the same time each year—in late July or early August. In November 1974, 11 trees were cut to examine a sample of pruning wounds covering the size range of limbs, both live and dead at the time of pruning.

RESULTS

Pruning methods. Extension ladders of light metal proved to be better than a pole pruner for the higher limbs. We used a 16-foot ladder for trees pruned to 50 percent of their height (Fig. 2), and a 40-foot ladder for those pruned to 75 percent. We had used a pole pruner at first, but it was difficult to apply pressure, to handle the saw in whorls of branches, or to saw close and parallel to the stem. A pruning saw mounted on an ax handle was effective for limbs within reach from the ground.

Smooth young black cherry bark is susceptible to wounding. At first the flat step of the metal ladder caused wounds that resulted in extensive necrosis on trees pruned to 75 percent, but this accidental wounding was prevented by padding the ladder. The cambium was also killed where sawteeth dragged against the bark.

Figure 2.—A black cherry tree that is 6 inches in dbh is pruned to 50 percent of its height from a 16-foot extension ladder.

Diameter growth at breast height. The diameter growth was significantly reduced by the most severe treatment—pruning to 75 percent of total height; there was a slight, but nonsignificant, reduction in the 50-percent pruning treatment. The diameter growth rate of trees in the 50-percent treatment caught up to the unpruned trees and those pruned to 25 percent by the third year after pruning; the growth rate of trees in the 75-percent treatment caught up in about 7 years (Fig. 3).

Differences in *annual* growth rates due to treatments were no longer significant after the fourth year. After 10 years, the differences in *total* diameter growth were still significant at the 5 percent level. These differences were due primarily to the 75-percent treatment.

The recovery of annual diameter growth in the trees pruned to 75 percent was made possible by the epicormic branching which, in some cases, must have matched the amount of crown removed by the middle or latter part of the study.

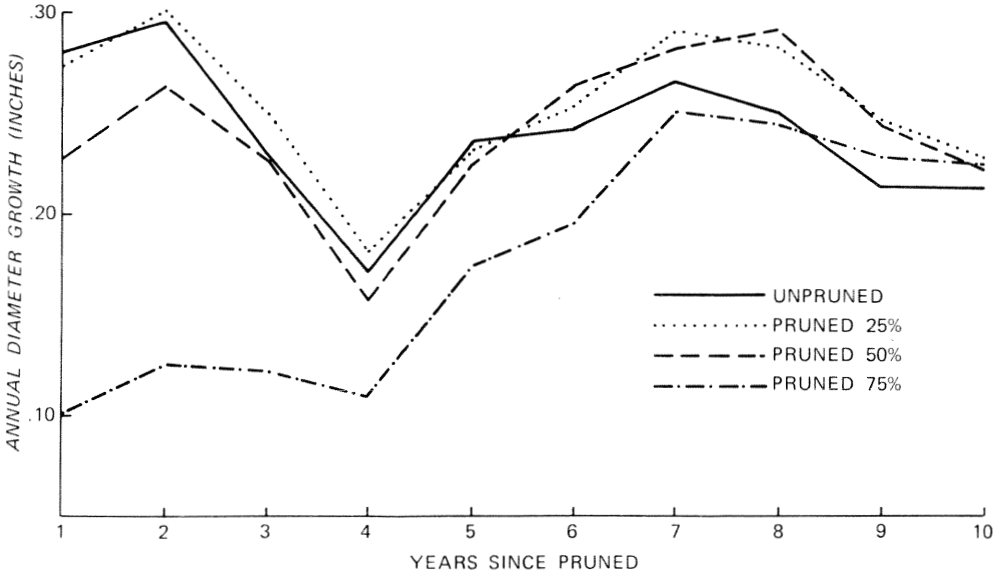
A deficiency in summer rainfall was probably responsible for a 25-percent decrease in diameter growth rate in the 1966 measurements (Fig. 3). Precipitation during May, June, and July, the three months preceding diameter measurement, was 47 percent below normal.

Total 10-year diameter growth, by treatments, was:

Pruning height (percent)	*10-year growth in dbh (inches)*
0	2.39
25	2.54
50	2.40
75	1.77

Height growth. Height growth on the trees in the 50- and 75-percent pruning treatments was slightly better in the 2 years after pruning than it was on the other trees, but the differences were not significant at the 5 percent level; differences were even less after 4 years. Height measurements were not made after 4 years. Height growth by pruning treatment (in feet) for the first 2 and 4 years after pruning were:

Figure 3.—Annual diameter growth by treatment and year.



Years	*Percent of height pruned*			
	0	*25*	*50*	*75*
1962-64	2.0	2.1	2.7	2.7
1962-66	3.8	4.5	4.3	4.8

Epicormic branching. Sprouting on the boles of the most heavily pruned trees was immediate and profuse (Fig. 4). After 1 year, the average tree in the 75-percent treatment had 35 epicormics that averaged nearly 2 feet in length. Sprouting was light on the 50-percent trees, and was negligible on the others (Table 1).

The numbers of epicormics on trees pruned to 75 percent declined steadily during the study

Figure 4.—Thirty-six epicormic branches were alive 4 years after this tree had been pruned to 75 percent of its height.

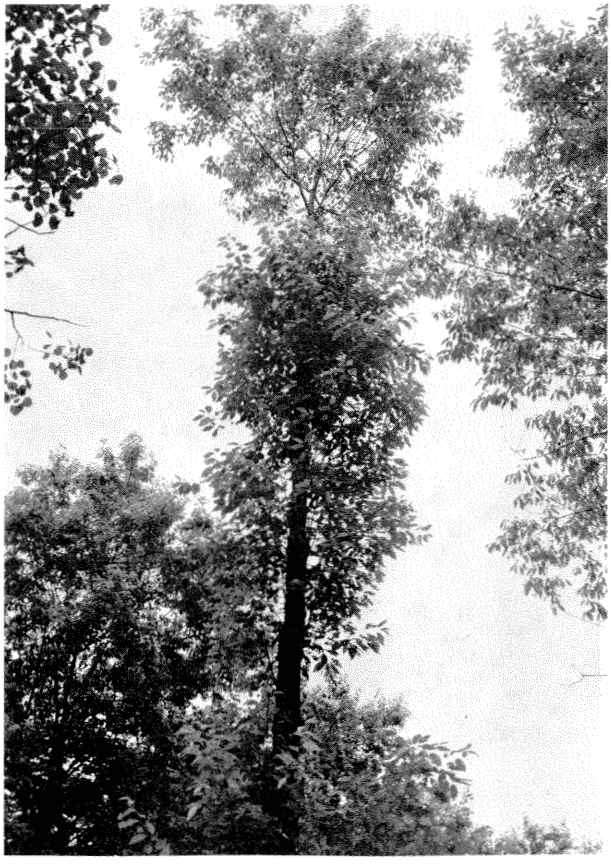


Table 1.—Average number of epicormic branches per tree on the first 17 feet of unpruned trees and the pruned portions of others 1, 5, and 10 years after pruning in 1962

Pruning height	Years since pruning		
	1	5	10
Percent			
0	0.3	0.6	0.4
25	.0	.4	.4
50	1.9	4.7	2.2
75	35.2	25.7	12.6

(Table 1). Epicormics in the 50-percent treatment increased somewhat but then declined, while those on other trees remained at low levels. Even the unpruned trees had some epicormics (Table 1), as did the unpruned portions of the first 17 feet of trees pruned to 25 percent. Surviving epicormics continued to grow in length.

Individual trees varied greatly in the numbers of epicormics that were produced and that survived. Trees in the 75-percent treatment had from 0 to 24 surviving sprouts at the end of the study, and trees in the 50-percent treatment had from 0 to 7 each.

Pruning to 25 or to 50 percent increased the clear length of bole from about 3 to 10 feet (Table 2). The trees pruned to 50 percent had an average of only 2 epicormics on the first 18 feet, while those pruned to 25 percent were very limby (unpruned) above 9 feet. Even if the epicormics on the trees pruned to 50 percent continue to live, the grade of butt logs from these trees will be greatly improved.

Exposure, and possibly heredity, influenced the number of epicormic sprouts. For example, among trees pruned to 50 percent, those with 0 or 1 sprout had point densities around them that averaged 38 square feet per acre at the end of the study—as measured with a 25-factor prism, compared to only 8 square feet of competitors around trees with 2 or more epicormics. Thus the most serious epicormic branching was associated with very low stand densities.

There was no correlation between the number of epicormics and the number or size of the branches removed. Despite an apparent correlation for some trees on which vigorous sprouting occurred where large live limbs had been pruned, other trees did not react this way. One completely open-grown tree that was pruned to 50 percent of its height by removing an above-average number and size of branches remained free of epicormics (Fig. 5). Since this characteristic may be hereditary, the tree was included in the Black Cherry Tree Improvement Program.

There were more epicormics on the sunny southwest faces of the trees than on the other faces at the end of the study. The fewest numbers of epicormics were on the shaded northeast sides. These differences were significant at the 5 percent level. The percentages by face for 16 trees were:

Table 2.—Average clear lengths before pruning, after pruning, and 10 years later (in feet)

Pruning height	Total height in 1962	Clear length in 1962		Clear length in 1972
		Before pruning	After pruning	
Percent				
0	34.3	3.9	3.9	4.0
25	35.0	3.4	9.2	9.4
50	34.0	3.5	18.0	10.4
75	36.4	3.0	27.6	8.2

Figure 5.—This fully exposed tree was pruned to 50 percent of its height 3 years earlier by cutting 18 live limbs up to 2 inches in diameter, and 8 others. The tree remained free of epicormics.

Face	*Percentage of all epicormics*
SW	39
NW	28
SE	23
NE	10

Percentages connected by lines were not significantly different.

Wound healing. Most of the wounds on trees in the 25- and 50-percent treatments healed during the first 4 years after pruning (Table 3). Except for two cases where large necrotic areas developed and prevented healing, all but one scar on the 25- and 50-percent treatments healed by 1971. The two largest wounds—4 x 7- and 3 x 5-inch scars where 2.5-inch limbs were removed—were closed by 1968.

Most of the wounds on the trees pruned to 75 percent also healed during the first 4 years, but 11 of the 539 wounds on these trees were not healed after 10 years; this was caused by the reduced diameter growth rates at points low on the stems.

Pruning wounds healed fastest on the trees pruned to 50 percent; 70 percent of the wounds on these trees were closed after 4 years (Fig. 6).

Figure 6.—Wound healing 4 years after pruning to 50 percent of tree height. The three branches were 5 to 7 feet aboveground. The lower branch was 1 inch in diameter; the others 1.5. The upper branch was live; the others were dead when pruned.

Table 3.—Accumulated proportion of pruning scars healed, by branch size and year, for the 25- and 50-percent treatments combined (in percent)

Branch diameter	Years since pruning									
	1	2	3	4	5	6	7	8	9	10
Inches										
Live branches										
0.5	6	68	88	97	97	100	—	—	—	—
1.0	—	11	47	72	88	94	96	97	100	—
1.5	—	—	8	31	58	90	96	100	—	—
2.0	—	—	—	25	75	100	—	—	—	—
2.5	—	—	—	—	—	100	—	—	—	—
Total	1	18	43	64	81	94	97	98	100	—
Dead branches										
0.5	7	38	59	78	89	96	99	100	—	—
1.0	—	7	33	59	71	83	91	97	98	98
1.5	—	—	50	67	67	83	100	—	—	—
Total	5	28	52	73	83	92	97	99	99.5	99.5
All branches	3	24	48	69	82	93	97	99	99.7	99.7

The corresponding percentages were 65 for the 25 percent treatment, and 50 for the 75-percent treatment.

Apparent differences in healing rates between live- and dead-branch wounds were actually caused by other factors. As a group, dead-branch pruning wounds healed slightly faster than live-branch wounds (Table 3) because the average size of dead branches was smaller. For a given size of branch, live-branch wounds healed faster, but this can be explained by the fact that live branches tend to be located near the tree crown where diameter growth and healing is more rapid, while dead branches are often low on the trunks.

I compared healing rates by 4-foot sections of the stems and found that significantly more wounds healed on upper stem sections by a given date than on the lower sections. There was no statistical difference in healing rates for live- and dead-branch wounds of the same size and position.

Wound healing might have been faster if the trees had been pruned in the dormant season. Marshall (1931), Roth (1943), and Phares and others (1975) recommended pruning in the late dormant season; Neely (1970) found more healing on May wounds than on July wounds. But Woessner (1972) found that more epicormic branches formed on eastern cottonwood trees pruned before or during leafing out than on those pruned after leafing out. If black cherry reacts in the same way, it would be better to prune in the summer.

Cambium necrosis. cambium necrosis was serious only on 2 of the 24 trees pruned to 25 or 50 percent. One 50-percent tree with much poorer vigor than the others had necrosis associated with 5 pruning wounds. All but 1 of these healed with little or no decay. In this case the cambium between 2 pruning wounds on the southwest face died, making 1 large wound. Cambium necrosis was extensive on a second tree that was fully exposed and on which several large limbs had been pruned from the lower southwest side.

Cambium necrosis was more common and more serious on trees pruned to 75 percent of tree height. Eight of the 12 trees in this treatment had noticeable necrosis. While most of the small necrotic areas healed during the study, 4 of the 75-percent trees were ruined by extensive necrosis and resulting decay; this was caused by the close proximity of large live limbs that were removed by pruning, by accidental saw or ladder scrapes, or by sunscald. The worst necrotic areas were on the southwest sides of the trees.

Natural pruning. Pruning is especially useful where natural death and shedding of branches is slow. Records of branches not removed by pruning on the first 17 feet of the control and 25-percent treatments show the slow rate of natural pruning on these open-grown trees (Table 4). Only 7 percent of all live branches at the start of the study in 1962 died, dropped off, and healed by 1972; 56 percent of the dead branches in 1962 did so. The latter percentage is fairly high because many of the branches were in the 0.5-inch class. Only 6 out of 42 (14%) of the larger dead limbs healed.

Decay related to pruning. In November 1974, we split open 46 wounds on 11 trees to check for decay; these covered the range of limb sizes pruned—0.5 to 2.5 inches. They were almost evenly divided between live and dead branches, and included both rapidly healed and slowly healed scars. Six of the 11 trees had been pruned to 50 percent of tree height; these 6 trees contained the largest limbs, and the only unhealed necrotic areas among trees in this treatment.

Frederick H. Berry, pathologist with the Northeastern Forest Experiment Station's Delaware, Ohio, laboratory, made cultures from

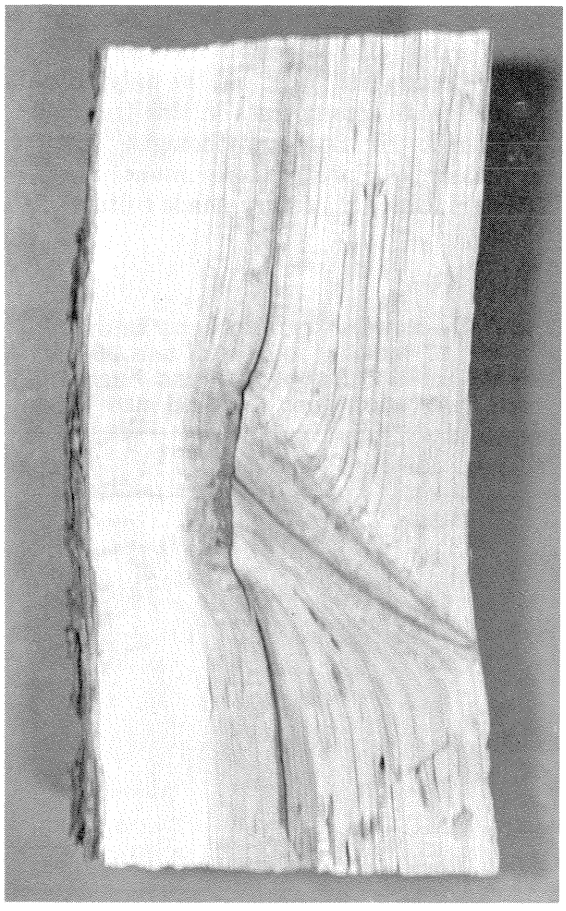
Table 4.—Number of unpruned branches on the first 17 feet of the control and 25-percent treatments that dropped off and healed in 10 years, by branch condition and size.

Branch diameter	Healed	Not healed
Inches		
Live		
0.5	14	62
1.0	4	138
1.5	0	33
2.0	0	5
Total	18	238
Dead		
0.5	114	57
1.0	6	31
1.5	0	5
Total	120	93

14 of the 25 wounds that showed at least a trace of decay. He found active decay in five wounds from three trees; in two of them, the decay was considered serious.

The fungus, *Phlebia chrysocrea* (Berk. & Curt. in Berk.) Burds., was isolated from pruning scars on two vigorous trees. Only one scar seemed to have admitted extensive decay. This was a 4- x 7.5-inch scar that resulted from cutting off a 2.5-inch limb that branched off at an acute angle. Traces of decay in five other wounds where 1.5- to 2.5-inch branches had been removed by pruning were confined in or were next to the enclosed branch stubs, and probably would not have remained active much longer. Decay found in another large pruning scar seemed to have originated at the 4- x 7.5-inch scar.

Figure 7.—Most pruning wounds were sound; this wound, the result of pruning a 1-inch dead branch, healed in 2 years.



In the second tree with advanced decay, *Coriolus versicolor* (L. ex Fr.) Quel. was active in one of six samples from a small, well-exposed tree of very poor vigor. There was extensive decay associated with a large necrotic area on the southwest face that began where two pruned branches had been close together. The active fungus apparently spread from this area rather than originating at the pruning wound where it was found.

Three other pruned trees that were sectioned and sampled had no active decay, and all sectioned wounds on three additional trees were sound (Fig. 7). All sectioned branch stubs on one unpruned tree were sound; those on another were sound or had inactive decay confined to the branch stubs.

Pruning should decrease the risk of decay; though there may be decay at a few of the larger pruned limbs, there is likely to be more of this decay where limbs are not removed but allowed to grow larger and die naturally.

SUMMARY

Only the 75-percent treatment caused a significant reduction in diameter growth at breast height. After this treatment, growth was only 36 percent of that of unpruned trees the first year, but crown recovery gradually reduced the difference so that the 10-year diameter growth on the pruned trees was 74 percent of that of the unpruned trees.

Height growth was slightly, but not significantly greater for the 50- and 75-percent treatments during the first 2 years after pruning.

Trees pruned to 75 percent produced an average of 35 epicormic branches the first year after pruning; an average of 13 per tree were living after the tenth year. Epicormic sprouting was not serious on most of the trees pruned to 50 percent, and sprouting was negligible on the others. The southwest faces of the stems had more epicormics than other faces; the northeast faces had fewer.

Sixty-five and 70 percent of the pruning wounds healed during the first 4 years for the 25- and 50-percent treatments, respectively. There was no difference in healing rates for live- and dead-branch wounds of the same size and position.

On trees pruned to 25 and to 50 percent, cambium necrosis was serious on only one tree of very poor vigor, and on another where several close and large limbs were removed from the southwest side of a fully exposed tree, or where accidental wounds were made. Trees pruned to 75 percent were more sensitive to exposure and accidental wounding.

Natural pruning was very slow on these open-grown trees. Only 7 percent of all live unpruned limbs on the first 17 feet of tree stems died, dropped off, and healed in 10 years. Each of these limbs was 1 inch or less in diameter.

Active decay organisms were found in 3 of the 11 trees sampled, and decay was serious in 2 of them. Decay in one tree originated where a 2.5-inch live limb left a 4- x 7.5-inch pruning scar. The second tree with serious decay was one of very poor vigor.

CONCLUSIONS AND RECOMMENDATIONS

Pruning young black cherry trees in understocked stands can increase the quality and value of the trees.

Pruning open-grown trees to 75 percent of their heights was clearly detrimental, primarily because of the many epicormic branches generated by such severe pruning. Also, diameter growth was reduced, wound healing was somewhat slower, and cambium necrosis was more serious in these trees than in trees that received lighter pruning.

Pruning trees to 50 percent caused few problems; this treatment should be feasible for most black cherry trees. Pruning should be limited to 40 percent of total height on trees that are fully exposed on the south and west sides, if 75 percent or more of their length is in live crowns. Limbs 2 inches or more in diameter are somewhat risky to prune—decay might develop unless the trees are very vigorous.

Pruning in two stages should be practical for gaining more clear length, exposing the southwest face more gradually, if necessary, and removing any epicormics that may have sprouted.

A better job of pruning can be done from a ladder with a hand pruning saw than from the ground with a pole pruner. But care must be taken not to scrape or bruise the thin bark with the ladder or saw. Pruning cuts should be close to the stem and undercuts should be made, if necessary, to prevent bark stripping.

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