EPICORMIC BRANCHES AND LUMBER GRADE OF BOTTOMLAND OAK

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ABSTRACT

Epicormic branches can be a serious problem in management of hardwood forests for high-quality sawtimber production. In one study in central Alabama, defects caused by epicormic branches that developed following a partial cutting resulted in a 13 percent reduction in the value of willow oak lumber. Production of epicormic branches along the boles of hardwood trees is affected by species, stress, and sunlight. Hardwood species vary in their propensity to produce epicormic branches. Categorization of the susceptibility of southern bottomland hardwood species to epicormic branching is presented in tabular form. Various types of stress may reduce vigor in individual trees and lead to the production of epicorrnic branches. Individual-tree vigor, in conjunction with the genetics of the species, controls the propensity of an individual tree to produce epicormic branches. Sunlight and other disturbances serve as triggering mechanisms to stimulate the release of dormant buds that develop into epicormic branches. General guidelines to reduce the risk of epicormic branching in hardwoods are also presented.

INTRODUCTION

Profitable management of hardwood forests for sawtimber production depends on successful development and maintenance of high-quality logs. Management at the individual-tree level is necessary to fully achieve the objective of high-quality hardwood sawtimber production. Bole quality, as manifested by log grade, is a very important determinant of the value of hardwood sawtimber. In fact, Stubbs (1986) estimated that hardwood log Grades 1, 2, and 3 have a value ratio of 13:7:1, with butt logs much more likely to be Grade 1 than upper logs. Consequently, anything that reduces the grade of logs in individual trees will significantly reduce the total value of the stand.

In many hardwood stands, epicormic branches are frequent contributors to log grade reduction. Epicormic branches are adventitious twigs found along **the main bole.** They **develop** from dormant buds that may be released at any time during the life of the tree in response to several types of stimuli (Carpenter et al. 1989). According to USDA Forest Service standard grading rules for hardwood factory logs, epicormic branches greater than 3/8-in. diameter at the bole surface are defects on logs of all sizes, grades, and species. For hard hardwoods, including oaks, smaller epicorrnic branches (3/8-in. diameter or less) are defects in all logs less than 14-in. scaling diameter, but only every other one is considered a defect in logs larger than 14-in. scaling diameter (Rast et al. 1973).

The importance of the defects caused by epicormic branches on individual hardwood logs becomes even more apparent when those logs are sawn into lumber at the mill. Because the grade of hardwood lumber is affected more by the number and distribution of knots rather than by the size of individual knots, the defects caused by epicormic branches can affect the length and number of clear cuttings, as well as the number of clear faces. As a result, the defects-caused by epicormic branches may drastically reduce the grade and subsequent value of the lumber produced from those logs. Consequently, epicormic branching is a serious problem in the management of hardwood stands for the production of high-quality sawtimber.

To illustrate the importance of epicormic branching in hardwood management, this paper first presents a brief summary of the results of a research study to determine the effects of epicormic branches on lumber grade and value in willow oak. It also presents my general observations on the phenomenon of epicormic branching and provides some general guidelines on how to reduce epicormic branching in hardwood stands.

IMPORTANCE OF EPICORMIC BRANCHING

Meadows and Burkhardt (in press) evaluated the effects of epicormic branches on lumber grade and value in a predominantly willow oak stand in central Alabama. A low thinning had been conducted in the stand about 7-10 years prior to final harvest. This partial cutting resulted in a proliferation of epicormic branches along the boles of many of the residual trees. Logs in standing trees were graded twice-with epicormic branches counted as defects (when appropriate, according to USDA Forest Service standard grading rules) and without them counted as defects. By ignoring the presence of existing epicormic branches, we were able to accurately assess the potential grade of each log. In the absence of epicormic branches, 79 percent of all logs were either Grade 1 or 2. However, with epicormic branches counted as defects, only 44 percent of the logs received one of these higher grades and the remainder was classed as low-quality Grade 3 logs. In fact, roughly half (49 percent) of all logs suffered at least a one-grade reduction due to the presence of epicormic branches. In general, as few as five epicormic branches on a 16-foot log were enough to cause a one-grade reduction in log grade (Meadows and Burkhardt, in press).

To assess the effects of epicormic branch defects on lumber grade and value, the stand was harvested and the logs were shipped to a sawmill where they were sawn into lumber and graded. In the absence of epicormic branch defects, 72 percent of the lumber volume was graded as No. 1 Common or better. When epicormic branch defects were counted, only 54 percent of the lumber volume graded out to No. 1 Common or better, with the remaining 46 percent classed as No. 2 Common or below. More importantly, more than 50 percent of the lumber volume that would have been graded as high-value FAS in the absence of epicormic branch defects had to be downgraded to No. 1 Common or below due to the defects caused by epicormic branches (Meadows and Burkhardt, in press).

We conducted a simple economic analysis to determine the loss in lumber value associated with the presence of defects caused by epicormic branches. Using lumber prices prevailing at the time of the. study (for 4/4 red oak lumber in the South), we calculated a reduction in lumber value of $70.78/MBF due to the presence of epicormic branch defects. In this particular 60-acre bottomland tract, assuming an average sawtimber volume of 5,000 board feet per acre, losses in potential lumber value amounted to approximately $21,237 (Meadows and Burkhardt, in press). In other words, for this particular study, defects caused by epicormic branches resulted in a 13 percent reduction in lumber value.

FACTORS AFFECTING EPICORMIC BRANCHING

It is apparent that epicormic branches have a large detrimental effect not only on log grade, but also on lumber grade and, most importantly, on lumber value. But, the production of epicormic branches on the boles of hardwood trees is a poorly understood phenomenon that may be responsible for losses of millions of dollars in potential revenue each year across the South. The following discussion outlines my observations and thoughts about the production and prevention of epicormic branches.

In the past, many foresters believed that epicormic branches developed along the boles of hardwood trees solely as a result of sudden exposure to direct sunlight, especially following some type of partial cutting. However, evidence is mounting that tree vigor plays a major role in determining the propensity of an individual tree to produce epicormic branches (Wahlenberg 1950, Skilling 1957, McKnight 1958, Brown and Kormanik 1970, Erdmann et al. 1985, Meadows 1993). Based on this evidence and on my own general observations, I propose that there are three major factors affecting the production of epicormic branches in hardwoods: (1) species, (2) stress, and (3) sunlight.

Hardwood species vary considerably in their propensity to produce epicormic branches. Based on published information (Putnam et al. 1960, Burns and Honkala 1990) and on my own experience and observations, I classified southern bottomland hardwood species based on their known or suspected susceptibility to epicormic branching (Table 1). This classification is a first attempt at formally recognizing the variability among individual hardwood tree species to produce epicormic branches. Not enough information is known about some species to accurately assess their susceptibility to epicormic branching, so "best guesses" were used to place them in a tentative class (names of these species are followed by question marks in Table 1). Refinements to this classification will be necessary as additional information becomes available.

Table 1. Susceptibility of southern bottomland hardwood tree species to epicormic branches.

High	*Medium*	*Low*
maples ?[1]	hickories ?	pecan ?
American beech	swamp chestnut oak	tupelogum ?
sweetgum	yellow-poplar	sugarberry
blackgum ?	Shumard oak	sycamore
white oak	cherrybark oak	green ash
laurel oak		cottonwood ?
overcup oak		
water oak		
Nuttall oak		
willow oak		
black willow		
elms		

[1]Species names followed by a question mark are tentatively classed due to a lack of information.

Unfortunately, most bottomland oaks, as well as sweetgum, are highly susceptible to epicormic branching (Table 1). Special care must be exercised to minimize epicormic branching when partial cuts are conducted in stands dominated by these species. However, it is important to note that cherrybark, Shumard, and swamp chestnut oaks, all highly valuable commercial timber species, are not quite as susceptible to epicormic branching as are most other bottomland oaks. Green ash, another very valuable commercial hardwood species in southern bottomlands, is not prone to epicormic branching. Consequently, partial cuts can be performed in stands dominated by green ash with minimal risk of epicormic branching on residual trees.

The second major factor that affects the propensity of individual hardwood trees to produce epicormic branches is stress, expressed in terms of individual-tree vigor. There are a number of categories of stress that may be experienced by an individual tree. Any of these stresses may reduce tree vigor and result in the production of epicormic branches:

1. ***climatic events*** — such as prolonged flooding or drought;
2. site — such as unsuitable soil texture, excessive wetness, or low fertility;
3. ***stand*** conditions — such as over-stocking and severe competition leading to stand stagnation;
4. ***suppression*** — epicormic branches produced in response to severe suppression may be some type of survival mechanism for that species;
5. ***stand-level disturbances*** — such as storms or partial cuttings;
6. ***tree-level disturbances*** — such as insects, diseases, or logging damage.

Sunlight is the third major factor affecting epicormic branching in hardwoods. Sudden exposure of the bole to direct sunlight tends to encourage the production of epicormic branches, especially on low-vigor trees of susceptible species. However, high-vigor trees of relatively resistant species generally are not prone to epicormic branching when suddenly exposed to direct sunlight following a partial cutting. Consequently, sunlight acts as a triggering mechanism, rather than as a controlling mechanism, in the production of epicormic branches on hardwoods.

The production of epicormic branches, then, appears to be controlled by the complex inter-relationships among genetics, tree vigor, and exposure to sunlight. Based on these relationships, I propose the following hypothesis to describe the phenomenon of epicormic branching in hardwoods. The genetics of an individual species serves as the template that sets the inherent propensity of a tree to produce epicormic branches. Tree vigor, or health, is the mechanism that controls the production of epicormic branches when the tree is subjected to various stimuli, such as sudden exposure to direct sunlight or other disturbances. These stimuli are the triggering mechanisms that release the dormant buds and lead to the production of epicormic branches along the main bole. In this context, high-vigor trees, especially of relatively resistant species, are much less likely to produce epicormic branches than are low-vigor trees when subjected to any stimulus that tends to trigger the production of epicormic branches. In other words, healthy, vigorous trees may be able to suppress the release of those dormant buds when they are exposed to direct sunlight, whereas trees in poor health may lack that ability.

GUIDELINES TO MINIMIZE EPICORMIC BRANCHING

Epicormic branching along the boles of southern bottomland hardwood trees can never be eliminated, but the occurrence of these defect-causing twigs can be minimized through careful forest management. Some general guidelines to reduce the risk of epicormic branching in southern bottomland hardwood forests include:

Favor resistant species over susceptible species. Where possible and economically desirable, favor the growth and development of low-risk species, such as green ash, over high-risk species, such as willow oak.

Discriminate against off-site species. Trees growing on a site that is unsuited for that species should not be favored in management. For example, cherrybark oak growing on a very wet site subjected to long periods of inundation will likely be an unhealthy, low-vigor tree and, even though a valuable timber species, should not generally be favored during silvicultural operations.

Avoid over-stocking and stand stagnation. Do not allow hardwood stands, especially those with a high component of oak, to become over-stocked, experience severe competition, and stagnate. A severely stagnated stand is composed of unhealthy trees stressed from the rigors of competition. These trees are highly susceptible to epicormic branching, not only as a response to the stress but also if suddenly exposed to direct sunlight following a partial cutting. Land managers should perform silvicultural operations, such as thinning, earlier in the development of the stand before stand stagnation begins.

Maintain healthy stands composed of healthy trees. Healthy stands are not necessarily composed entirely of healthy trees. Conversely, the presence of healthy trees does not necessarily indicate a healthy stand. To provide both, the land manager must manage on both the stand level and the individual-tree level.

Thinnings, and other types of partial cuttings, can be used by the land manager to improve species composition, increase diameter growth of residual trees, and, of equal importance, to maintain healthy stands composed of healthy trees. Johnson (198 1) presented some general guidelines for thinning in southern bottomland hardwood stands: (1) begin thinning early in the life of the stand; (2) favor the largest trees with well-developed crowns; (3) thin from below whenever possible to remove trees with inferior crowns; (4) use frequent, light thinnings instead of infrequent, heavy thinnings; and (5) avoid excessive logging damage to residual trees. In general, marking for any partial cutting should favor the best trees and discriminate against the worst. Adherence to these guidelines will lead to the development of a healthy stand composed predominantly of healthy trees, with low risk of epicormic branching. However, to further reduce the risk of epicormic branching following partial cutting, the land manager, whenever possible, should leave large saplings to provide shade on the lower boles of nearby residual trees.

Epicormic branches can be a serious problem in management of hardwood stands for high-quality sawtimber production. Defects on the lumber caused by the presence of these adventitious twigs lead to losses of millions of dollars in lost potential revenues. The occurrence of epicormic **branches** along the boles of hardwood trees can never be eliminated, but production of new branches can be minimized through careful forest management and adherence to sound general guidelines.

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