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The Sprouting Potential of Dormant Buds on the Bole of Pole-Size Sugar Maple

ABSTRACT. — A study of epicormic sprouting in pole-size sugar maples showed that all visible dormant buds on the bole were capable of producing epicormic shoots. The buds were induced to break dormancy by applying four methods of crown removal known to stimulate sprouting. The amount of crown removed determined the year that the buds broke dormancy; this may be accounted for by the location of growth regulators at the time of treatment. Few buds broke dormancy on untreated trees, indicating that the crown exerts a major influence on the formation of epicormic shoots.

OXFORD: 164.4:181.63:228.11:176.1 *Acer saccharum*

Epicormic shoots tend to occur in varying numbers on the main stem of sugar maple trees. These shoots develop from dormant buds located at the base of branches and at terminal bud scars. The buds become visible on 2-year-old growth and are easily identified by their size and external appearance (Church and Godman 1966). Most dormant buds remain latent and persist without appreciable differentiation, apparently being sustained through a specialized vascular connection with the pith. The more frequent occurrence of epicormic shoots near the base of the live crown, however, raises the question of whether all dormant buds are capable of development, especially those on the lower bole where quality is most important.

THE STUDY

Development of epicormic shoots can be stimulated by a rapid loss of the live crown, which apparently creates the physiological and environmental conditions favorable for dormant bud break. Several intensities of crown removal were tested on 75 sugar maple trees in a 25-year-old stand on the Argonne Experimental Forest in northern Wisconsin to determine the number and location of dormant buds on the main stem capable of shoot development. All study trees were in the codominant crown class, 4 to 6 inches in diameter, and 40 to 50 feet in height. The trees were clear of live branches for approximately half their height, suggesting that stand density was relatively uniform.

Fifteen trees were randomly assigned to each of five crown-removal classes: (1) all leaves removed, (2) leaves and 1-year-old twigs at the end of each branch removed, (3) leaves and the entire branches of the main stem removed, (4) main stem severed at the base of the live crown, and (5) no treatment. To evaluate the possible influence of different moisture conditions within the tree at different times during the day, five trees in each crown-removal class were treated in midmorning, five in midafternoon, and five in the evening.

All treatments were made between June 10 (about three weeks after full leaf development) and June 25. Prior to treatment, 90 percent of the study trees had epicormic shoots along the main stem, and about half of these were current-year shoots. Epicormic shoots present at the time of crown removal were given the same treatment as the main crown.

The number of buds breaking dormancy were counted and their position on the main stem with reference to the original base of the live crown recorded just prior to leaf fall at the end of the first growing season and at the beginning and end of the second growing season.

RESULTS AND DISCUSSION

The existing epicormic shoots that were treated failed to reflush and apparently died before new buds capable of vegetative development had developed at their base. Treatment comparison was therefore limited to the dormancy break of established buds on the main stem. Because the time-of-day treatments had no significant influence on new shoot formation, the 15 trees in each crown-removal class were analyzed as a single treatment.

All trees receiving crown-removal treatments and most untreated trees produced one or more epicormic shoots during the two growing seasons (table 1). Fewer sprouts were produced during the first year, and these came chiefly from dormant buds located in the upper part of the live crown (table 2). First-year sprouting below the live crown increased only slightly following removal of leaves and removal of leaves plus 1-year-old twigs. The severe crown-removal treatments, however, resulted in a significant increase in first-year sprouts.

One explanation for the low incidence of first-year sprouting might be the timing of the movement of growth hormones that regulate bud dormancy. Doorenbos (1953) and Hatcher (1959), working with crabapple trees, have shown that these hormones, which are produced in the growing tips of the branches, move progressively to the lower internodes and basal portion of the stem shortly after physiological activity begins in the spring. Since the crown-removal treatments were not applied in our study until well after growth activity had started, it would seem logical that the dormant bud-inhibiting auxins had already begun to diffuse from the growing terminals. Epicormic sprouting increased below the live crown as additional amounts of the woody portion of the crown were removed, presumably because the amount of regulating hormone was reduced in proportion to the amount of stem and crown that was severed. Because the vegetative buds are the principal source of the hormones, this effect would not be present during the second year.

In all crown removal treatments, all visible dormant buds on the stem produced shoots by the end of the second growing season. Close examination of the stem did not reveal any living buds that remained dormant. It is expected that additional dormant buds will form at the base of the new epicormic shoots, and following the normal pattern of dormant bud development in sugar maple, will become visible on the 2-year-old growth.

The mean number of shoots per tree was not significantly different among crown-removal treatments over the 2-year period (table 2).

Table 1.—Percent of surviving trees developing epicormic shoots in successive growing seasons by position on stem and crown-removal treatment

Crown-removal treatment	First growing season: Surviving trees	Below crown	Live crown	Total stem	Second growing season: Surviving trees	Below crown	Live crown	Total stem
	Number	Percent	Percent	Percent	Number	Percent	Percent	Percent
Untreated	15	0	53	53	15	73	87	87
Leaves	15	13	33	40	15	93	100	100
Twigs	15	13	80	80	13	100	100	100
Branches	15	53	100	100	14	100	100	100
Top	14	93	--	--	11	83	--	--

Table 2.—Average number of new epicormic shoots per surviving tree in successive growing seasons by position on stem and crown-removal treatment

Crown-removal treatment	First growing season			Second growing season			Total epicormic shoots		
	Below crown	Live crown	Total stem	Below crown	Live crown	Total stem	Below crown	Live crown	Total stem
Check	0.0	1.1	1.1	3.1	1.2	4.3	3.1	2.3	5.4
Leaves	.1	1.1	1.3	21.7	14.0	35.7	21.8	15.1	36.9
Twigs	.1	5.1	5.3	18.5	15.4	33.8	18.6	20.5	39.1
Branches	2.3	15.7	18.0	25.5	3.8	29.3	27.8	19.5	47.3
Top	8.9	--	--	10.6	--	--	19.5	--	--

However, the number of shoots was consistently greater on treated trees than on untreated trees. The maximum number of shoots observed within the live crown on any one tree was 30, and on the lower stem the maximum number was 67. The highest incidence of shoots occurred near the base of the live crown.

The decline in number of epicormic shoots within the live crown surviving at the end of the second growing season appeared to be related to a loss in overall vigor and impending mortality of the tree. Although new, vigorous epicormic shoots were abundant on the upper stem at the beginning of the second growing season, this foliage alone was not capable of supporting tree functions; all decapitated and branch-pruned trees, and half of the twig-pruned trees were dead by the beginning of the third growing season.

The pole-size sugar maples studied had one to three dormant buds per foot of stem, both above and below the base of the live crown. Although some dormant buds apparently aborted, especially on the lower bole, no stem sections were consistently free of living buds.

The fact that significantly fewer epicormic shoots formed on the untreated trees indicates that the crown (probably the growing terminals) is a major factor in the control of epicormic shoot development on the bole. This observation agrees with other reports that sugar maple trees with well-developed crowns, particularly the dominant trees in the stand, develop fewer epicormic shoots than trees with poorly developed crowns (Conover and Ralston 1959). Cultural treatments that provide adequate light and growing space to develop and maintain a vigorous crown should thus offer the most promise for preventing epicormic sprouting in this high-value species.

SUMMARY

The study showed that all visible dormant buds on pole-size sugar maple are capable of producing epicormic shoots and can be induced to break dormancy by methods that either defoliate the tree or remove the growing terminals. Four intensities of crown removal (leaves, leaves and first-year twigs, all branches, and entire live crown) were equally effective. However, all the trees that had all branches or the entire crown removed died, whereas most of those that had just leaves and first-year twigs removed survived. The year of shoot development varied with the method of crown removal, probably through the movement of hormones from the growing terminals to the lower portions of the stem.

These results are interpreted silviculturally to mean that the growing terminals of the crown are a major factor influencing epicormic sprout formation. Cultural treatments resulting in vigorous growth of the growing terminals would probably control or limit the formation of new branches, particularly those on the lower bole that can cause a major reduction in log quality.

LITERATURE CITED

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