GROWTH RESPONSE OF ACER SACCHARINUM TO FLURPRIMIDOL INJECTION

by James O. Luken and Roger D. Blanchard

Abstract. Cutless (flurprimidol) was injected in the trunks of nine silver maple trees during fall 1989. Eight trees of similar size and condition were not injected but served as controls. During the 1990 and 1991 growing seasons, significant reductions in leaf mass, current-year stem mass, and current-year stem length in both upper and lower canopy branches occurred with Cutless injection. The longest shoots on injected trees showed 72 - 88% reduction in mean length when compared to control trees. A random sample of shoots (30 per branch) from injected trees also showed 80 - 82% reduction in mean length. Injected trees had variable response and gaunt appearance.

There is currently much research on the efficacy and action of tree growth regulators (4). A comprehensive survey of growth regulator use in the electric utility industry (5) produced information that urban foresters could use when considering a growth regulator program. Still, when electric utilities first consider using tree growth regulators, there is a need for site-, species-, and situation-specific research so that the positive and negative aspects of tree-injected growth regulators can be determined before widespread use.

The results presented here are of a two-year study where recently trimmed adult silver maple (*Acer saccharinum*) trees were injected with Cutless (flurprimidol).

Methods

Cincinnati Gas and Electric Company was primarily interested in testing Cutless on fast-growing silver maple trees under power-lines in urban areas. A site in Hebron, Kentucky was chosen where numerous silver maple trees occurred along a single road. Trees located at the same location that were similar in size and condition were paired. One tree of each pair was designated a control tree; the other was designated for treatment. Eighty percent of the trees were paired giving a final sample size of nine for treated trees and eight for control trees. The diameters of the treated trees ranged from 25.8 - 58.6 cm (mean diameter 43.2, S.D.= 11.0). Diameters of control trees ranged from 39.5 - 62.5 cm (mean diameter 51.9, S.D. = 8.3). There was no significant difference between the mean diameters of treated and control trees.

During September, 1989, trees were injected with manufacturer-recommended volumes (24 ml per port) of Cutless solution (60 g per l). Injection port spacing gave a mean of 4.5 cm of trunk diameter per port (SD = 0.3) and ports were approximately 35 cm from the soil surface. Observations were made on all of the experimental trees at monthly intervals during the 1990 and 1991 growing seasons. In late August of 1990 and 1991, two branches were sampled from each tree: one from the upper part of canopy and one from the lower part of the canopy. Thirty current-year growing points (shoots) were removed from each branch. Lengths of these shoots were determined as were oven-dry masses (70 C) of leaf and stem tissue. Significant differences between treated and control trees were determined with rank sum tests. The 0.05 level of significance was chosen before testing.

Leaf tissue collected during the 1990 growing season was analyzed for flurprimidol concentration using previously published procedures (7). Lack of funds precluded chemical analyses of 1991 tissue.

Results

During the first and second growing seasons after injection there was a reduction in the growth of injected trees when compared to controls. In both upper and lower branches, injected trees had significantly ($P<0.05$) less leaf mass, less current-year stem mass, and shorter shoots (Fig. 1). Considering only the longest shoot on a branch, reduction in mean length ranged from 72 to 88%.

There was little or no evidence of renegade

shoots on injected trees while renegade shoots were common on control trees (Fig. 2). The vast majority of current-year shoots on the treated trees were less then 5 cm long (Fig. 2). Variable responses of different trees to Cutless injection were the result of variable rates of incorporation in canopy tissues. Higher concentrations of flurprimidol in leaf tissue were associated with less leaf and stem growth (Fig. 3).

There was no evidence of leaking, necrosis, or splitting at the injection ports. Foliage on treated trees was a darker green than foliage on control trees. All treated trees produced normal buds in preparation for the subsequent year's growth. Still, complaints from tree-owners occurred during the 1990 and 1991 growing seasons. The major concern was the gaunt appearance of the trees. Some of the tree-owners expressed a desire to have the trees removed during the 1991 growing season.

Discussion

Reductions in growth obtained in this study were somewhat higher than previous research conducted on maples (1,6). The injection system used in this study on silver maple appears well-suited to the species. Contrary to results obtained by others (2), there was no evidence of trunk damage associated with the injection ports.

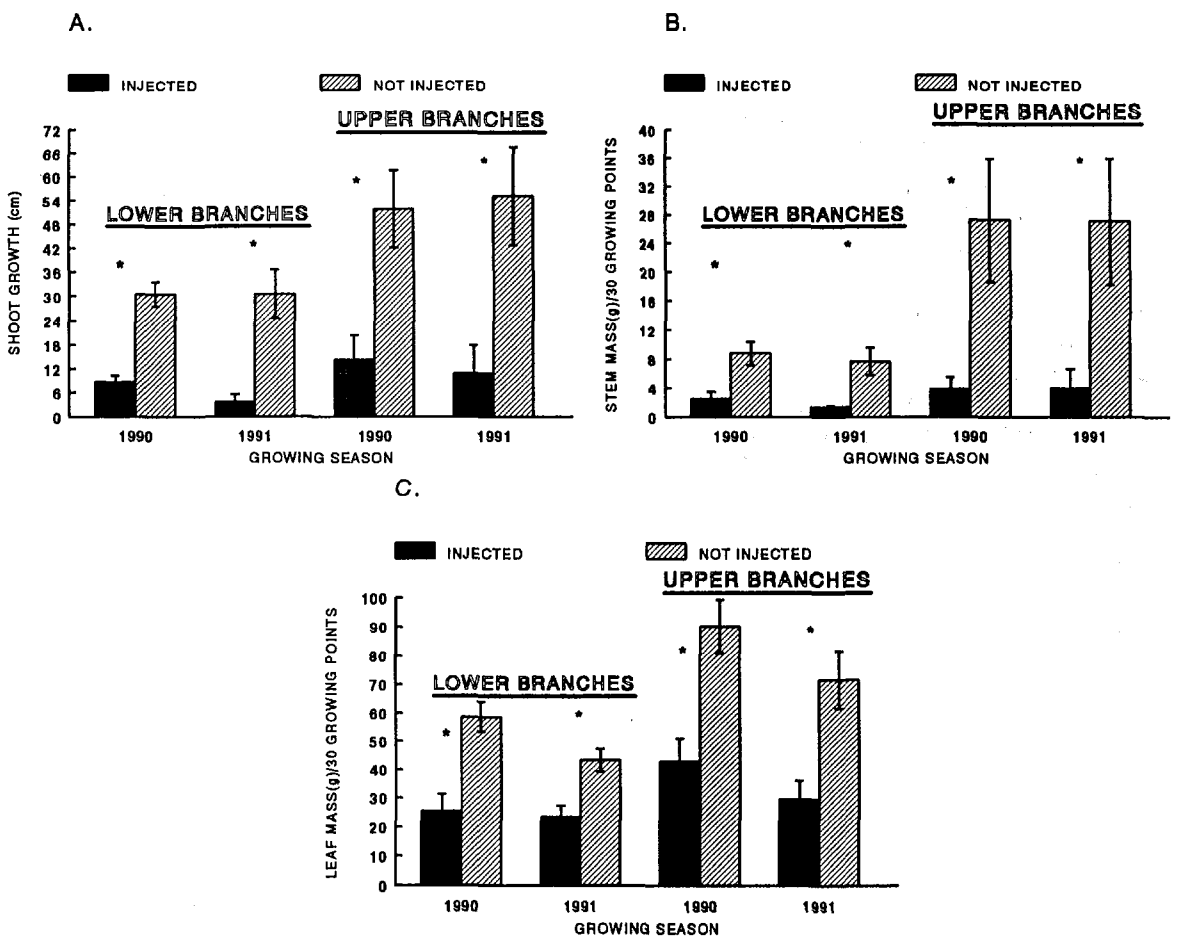

Figure 1. Length of longest shoot (A), stem mass (B), and leaf mass (C) of silver maple branches cut from trees that were injected with flurprimidol and control trees. Means are presented ± standard error. n = 9 for injected trees and n = 8 for control trees. Asterisks indicate a significant ($P < 0.05$) difference between injected trees and controls.

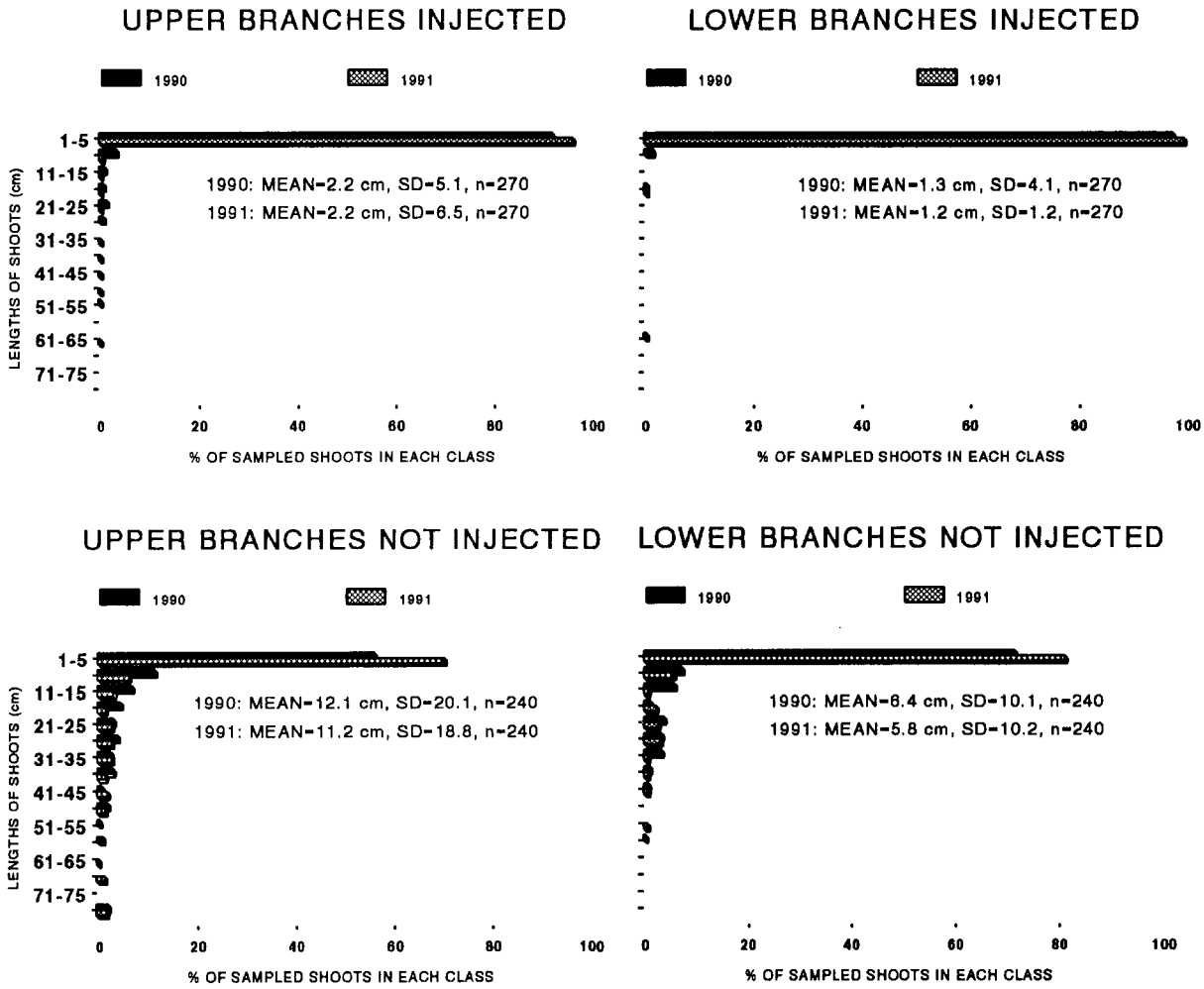

Figure 2. Length class distributions of shoots sampled from silver maple trees injected with flurprimidol and control trees. Thirty shoots from both the lower branch and the upper branch were harvested.

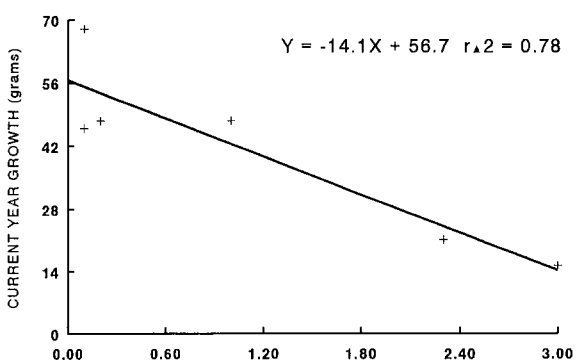

Figure 3. The relationship between flurprimidol concentration in leaf tissue and current year growth (terminal stems plus leaves).

However, there were some negative results associated with Cutless injection, primarily regarding tree appearance and tree-owner dissatisfaction. Because terminal growth of leaf and stem tissue was so severely inhibited, the trees did not appear normal and tree-owners complained of the lack of shade production. Other researchers have noted similar results in terms of tree appearance (1,3) and customer response (5). Also, the degree of growth reduction was quite variable from tree to tree, presumably due to unexplained factors affecting the movement and incorporation of flurprimodol in the stem and branch system.

Several options that might be explored in the

future:

1) Trim trees in the spring and then allow some regrowth to occur during the summer before injection in fall. Unfortunately, this will greatly reduce the extension of trim cycles that could be obtained if trees are injected when trimmed.
2) Reduce injection volumes or solution concentrations to avoid over-inhibition (1). This also will reduce the extension of trim cycles.
3) Limit the use of growth regulators to trees on rights-of-way or other places where shade production and tree appearance are not critical.
4) Reductions in variable response can be anticipated with further developments in techniques for gauging the amount of regulator injected relative to the amount of active tissue in the tree canopy (4). Unfortunately, when trees have been recently trimmed it is difficult to predict how much active canopy tissue will be present when resprouting occurs.

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Literature Cited

1. Arron, G.P. 1986. *Effect of trunk injection of flurprimidol and paclobutrazol on sprout growth in silver maple.* J. Arboric. 12(9): 233-236.
2. Bieller, J.A. 1991. *Injection site wounding when using plant growth regulators.* J. Arboric. 17(3): 78-79.
3. Gilliam, C.H, D.C. Fare, and J.T. Eason. 1988. Control of Acer rubrum with flurprimidol. J. Arboric. 14(4): 99-101.
4. Kimball, S.L. 1990. *The physiology of tree growth regulators.* J. Arboric. 16(2): 39-41.
5. Miller, K.C. and R.E. Abbott. 1991. *Results of TGR survey.* J. Arboric. 17(2): 45-48.
6. Watson, M.R. 1987. *Use of tree growth regulators at Potomac Edison.* J. Arboric. 13(3): 65-69.
7. West, S.D., and Rutherford, B.S. 1986. *Gas chromatographic determination of the plant growth regulator flurprimidol in soil and soil-grass samples.* J. Assoc. Off. Anal. Chem. 69(4): 572-575.

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