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TRUNK INJECTION OF PLANT GROWTH REGULATORS TO CONTROL TREE REGROWTH[1]

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Abstract. In a continuing study of the chemical control of trees under utility rights-of-way, the sprout regrowth of the American sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), red oak (*Quercus rubra*), and shamel ash (*Fraxinus uhdei*) injected with water solutions of 1,2-dihydro-3,6-pyridazinedione (maleic hydrazide, MH) and the sodium salt of 2,3:4, 6-bis-0-(1-methylethylidene)-*α*-L-xylo-2-hexulofuranosonic acid (dikegulac) in the spring of 1977 was recorded again in the fall of 1979 after 3 growing seasons. High concentrations of dikegulac were effective in reducing regrowth on silver maple and red oak after 3 years when compared to untreated controls. Although treatmens made on sycamore and shamel ash showed no significant effect in 1979, visual observations by utility line clearance personnel suggest that chemically treated trees will need no trimming for an additional year or two.

Vegetative management along utility rights-of-way is expensive and can be hazardous (1). The growth of trees along utility lines is normally removed by manual pruning, a process which in certain cases must be repeated annually to avoid contact between tree, limbs and powerlines. A safe and economic alternative to pruning is the application of growth retardants. The foliar application of such chemicals has met with some success but such spraying can result in undesirable ecological side effects (4). Instead, pressure injection of chemicals into trunks of trees offers various ecological as well as economical advantages over foliar spray techniques, i.e. avoidance of drift and contamination of the environment, efficiency, low hazard to the applicator, economy and a lack of the problems associated with foliar absorption (2). The studies reported here were undertaken to determine the effects of 1,2-dihydro-3, 6-pyridazinedione (maleic hydrazide, MH) and the sodium salt of 2,3,4,6-bis-0-(1-methylethylidene)-*α*-L-xylo-2-hexulofuranosonic acid (dikegulac) on sprout regrowth of American sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), red oak (*Quercus rubra*), and shamel ash (*Fraxinus uhdie*) at various geographic locations.

Materials and Methods

In 1977, four sites (Philadelphia, Pennsylvania; Delaware and Lorain, Ohio; and Hayward, California) were selected to conduct injection studies. Table 1 summarized the species, chemical concentrations, and range of dbh (diameter at breast-height) used at these locations. At Philadelphia and Hayward, three concentrations of each chemical were selected, whereas at Delaware and Lorain only two concentrations were utilized to evaluate the effects on sprout growth. Twenty trees per treatment were used at the Delaware and Lorain sites; 10 trees per treatment were used at the Philadelphia and Hayward locations. Aqueous solutions of dikegulac and MH were injected into tree trunks under pressure of 14 kg/cm^2 using the injection equipment described by Brown (3).

The details on statistical design, the volume of chemical used, and treatment method have been described elsewhere (5). Briefly, equidistant holes of 0.54 cm diameter were drilled tangen-

[1]The research reported in this paper was supported by a cooperative agreement between the U.S. Department of Agriculture and the Electric Power Research Institute of Palo Alto, CA 94304. Mention of a growth regulator in this paper does not constitute a recommendation for use by the U.S. Department of Agriculture, nor does it imply registration under FIFRA as amended.

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tially around the tree trunk to intersect outer xylem vessels. The injectors were inserted into these holes and chemicals were injected under pressure. The trees were topped before treatment and 3 limb stubs were selected at random and tagged for determining growth data following treatment. In the fall, after leaf abscission, all sprout regrowth originating within 25cm (ash and sycamore) or 50cm (maple and oak) from the cut ends of preselected limbs was measured. These data were collected every year from 1977 through 1979 to determine the time when repruning might be required. Before the leaves turned color in the fall, foliar index ratings (FI) for each tree were recorded. The data were statistically analyzed to compare growth and FI of untreated controls with that of chemically treated trees.

Results and Discussion

Sprout regrowth data for 1977 have shown that higher concentrations of dikegulac and MH significantly reduced regrowth enough in some species so that mechanical pruning could be delayed for up to 2 years (5). The data collected in the fall of 1979 show that even after three growing seasons, a significant reduction in growth of silver maple was detectable at two concentrations (15.0 and 75.0 g/liters) of dikegulac (Table 2). At the highest concentration, sprout number was also significantly lower than that of the control. In the case of red oak at Lorain, OH, dikegulac was again found to be effective in retarding tree regrowth although sprout number was not affected. The higher concentration (187.5 g/liter) of dikegulac used for red oak was more effective than the lower one (75 g/liter) in reducing regrowth. However, the higher dose caused an unacceptable level of foliar damage on treated trees as indicated by an FI of 2.7.

In the case of treatments with MH, the data indicate that red oak had overcome inhibitory growth effects of extremely high concentrations of chemical (281.25 g/liter) after three seasons. In the case of silver maple, however, MH at 112.5 g/liter significantly retarded tree regrowth although sprout numbers were not affected. This suggests that the concentrations required to control tree regrowth over a long period of time is based upon species sensitivity to the chemical.

The data collected in the fall of 1977 showed that significant growth reduction was obtained with all three concentrations of dikegulac (3.0, 9.0, and 15.0 g/liter) and MH (13.3, 22.5, 67.5 g/liter) injected into sycamore located at Philadelphia, PA (5). In 1979, at the end of the third growing season, no significant growth differences were detectable on trees treated with either chemical (Table 3). Although statistical analysis indicated that sycamore had overcome the inhibitory effects of chemicals, utility personnel visually observing the treated trees indicated that although controls could have been pruned in 1978, the trimming of trees treated with higher concentrations of chemicals may be delayed until 1980 or even 1981. This would suggest that chemical treatment can extend the trimming cycle up to two years, resulting in extensive savings.

Similarly, in the case of shamel ash, the 1979 results showed that there was no significant difference in growth between treated and untreated

Table 1. Species, location, concentration range, and dbh (diameter at breast height) range of trees injected with dikegulac and maleic hydrazide in 1977.

		Concentration range (g/liter)		
Species	*Location*[a]	*Dikegulac*	*MH*	*dbh range (cm)*
American Sycamore	Philadelphia, PA	3.0-15.0	13.3-67.5	24.1-59.7
Silver maple	Delaware, OH	15.0-75.0	67.5-112.5	13.7-26.7
Red Oak	Lorain, OH	75.0-187.5	112.5-281.5	17.0-39.1
Shamel ash	Hayward, CA	9.0-45.0	22.5-112.5	30.5-74.9

[a]Trees in Philadelphia and Hayward were located along the road, while those in Delaware and Lorain were situated in a natural woodstand.

Table 2. Sprout regrowth in 1979 for silver maple and red oak injected with dikegulac and maleic hydrazide in 1977, and located in Delaware and Lorain, OH, respectively.

	Regrowth per limb[a]			
Treatment concn (g/liter)	*No. of sprouts*	*Mean sprout length (cm)*	*Longest sprout (cm)*	*FI[b]*
Silver maple, Delaware, OH				
Control	2.1	296.0	348.2	1.1
Dikegulac —				
15.00	1.7	168.5*	195.8*	1.8
75.00	0.9*	156.9*	167.3*	1.9
Maleic hydrazide				
67.50	2.2	205.8	241.4	1.3
112.50	1.4	151.1*	185.9*	1.5
LSD 5%	0.8	106.2	107.0	
Red oak, Lorain, OH				
Control	5.2	112.3	146.1	1.1
Dikegulac —				
75.00	3.6	55.1*	77.1*	1.6
187.50	5.8	31.2*	49.4*	2.7
Maleic hydrazide				
112.50	4.8	92.7	135.9	1.6
281.25	4.9	77.8	113.4	
LSD 5%	2.3	36.4	45.6	

Table 3. Sprout regrowth in 1979 for American sycamore and shamel ash injected with dikegulac and maleic hydrazide in 1977, and located in Philadelphia, PA and Hayward, CA, respectively.

	Regrowth per limb[a]			
Treatment concn (g/liter)	*No. of sprouts*	*Mean sprout length (cm)*	*Longest sprout (cm)*	*FI[b]*
American sycamore; Philadelphia, PA				
Control	4.6	161.7	215.5	—
Dikegulac —				
3.0	3.3	172.5	204.7	—
9.0	4.4	128.0	166.9	—
15.0	4.0	139.5	178.0	—
Maleic hydrazide				
13.3	3.7	126.3	175.9	—
22.5	4.5	148.0	195.8	—
67.5	4.2	130.2	177.9	—
LSD 5%	1.6	52.2	62.4	—
Shamel ash; Hayward, CA				
Control	1.9	134.5	187.7	0.3
Dikegulac —				
9.0	3.1	151.0	214.3	0.0
15.0	3.0	127.2	169.5	0.2
45.0	2.0	94.3	118.2	0.3
Maleic hydrazide				
22.5	2.2	188.4	246.0	0.0
67.5	0.7*	108.7	113.3	0.2
112.5	2.4	143.0	204.7	0.1
LSD 5%	1.1	81.3	107.8	

[a]Mean no. of sprouts per limb per tree and mean length of the longest sprout per limb.

[b]FI is a subjective foliar index rating (observed prior to fall coloration) on a 0 to 5 scale with 0 designating normal foliage and 5 designating dead foliage on the entire tree.

*Treatment mean significantly different from the control, 5% level.

trees (Table 3), although two years earlier in 1977 dikegulac and MH were found to be effective in reducing growth (5). Still, from an economic point of view, chemical treatment was a success since the mechanical pruning of injected trees had been delayed by at least one year.

These studies show that, depending on species, appropriate concentrations of dikegulac and MH may significantly reduce the regrowth of pruned trees and consequently extend the trimming cycle by at least a year and probably more. This represents extensive potential savings for the utility industry which is confronted with inflated costs at this time.

Literature Cited

1. Abbot, R.E. 1977. *Commercial arboriculture practices in North America.* J. Arboric. 3:141-145.
2. Brown, G.K., W.F. Kwolek, D.E. Wuertz, G.A. Jumper, C.L. Wilson and S.R. Carr. 1977. *Regrowth reduction in American elm and sycamore by growth regulator injection.* J. Am. Soc. Hort. Sci. 102:748-751.
3. Brown, G.K. 1978. *Prototype equipment for commercial pressure-injection of aqueous growth regulators into trees.* J. Arboric. 4:7-13.
4. Kozel, P.C., K.W. Reisch, and G.E. Hull. 1970. *Chemical control of tree regrowth.* Ohio Rpt. 55:104-105.
5. Roberts, B.R., D.E. Wuertz, G.K. Brown, and W.F. Kwolek. 1979. *Controlling sprout growth in shade trees by trunk injection.* J. Am. Soc. Hort. Sci. 104:883-887.

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ABSTRACTS

Wright, R.D. 1980. **How plants respond to freezing.** Am. Nurseryman 151(8): 16, 84-85.

This article covers some of the physiological phenomena that operate in plant tissues, discusses how they help plants develop hardiness, and explains how plants become acclimated to freezing temperatures. Cold acclimation generally follows a two-stage pattern. The first stage is induced by shorter days in late summer and fall and involves two distinct events: growth cessation and the initiation of metabolic changes that affect plant response to low temperatures. The increase in hardiness during the first stage is relatively small; however, it may be significant in some cases, because the development of a few extra degrees of resistance in fall may make the difference between life and death in winter. The second stage of acclimation is apparently induced by low temperatures. Frost appears to be the trigger, but concurrent metabolic or physiological changes involving plant sugars, proteins, tissue hydration, and cell membranes are probably more important. These changes help plants become more resistant to freeze injury.

Gouin, F.R. 1980. **Where are the roots?** Landscape & Turf 25(7): 26.

Landscape contractors who plant B & B plants without first removing the burlap and locating the roots are actually planting a "pig in a poke." You can no longer assume that the top of the root ball is the original planting depth. Years of cultivation have caused topsoil to accumulate around the base of that plant. Your first clue should be stems going straight into the ground like telephone poles. If you are planting several trees coming from the same nursery, that have been machine dug, cut away the lace and burlap from several trees and locate the root system. If the majority of the roots are at the bottom of the root ball and are few in number, you had better decide to either complain to the nursery or prune the top severely.