INJECTING UNDILUTED 2,4-D AMINE TO CONTROL WOODY PLANTS[1/]

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At the 1962 Southern Weed Conference, I summarized results from two studies that indicated the injection of undiluted phenoxy herbicides will kill upland scrub hardwoods more effectively and economically than diluted herbicides.[2/] Substantial savings seemed possible through the use of cheaper chemicals, wider spacing of incisions, elimination of a carrier, and reduction of time spent in filling tools. A later and more comprehensive study, reported herein, substantiates earlier findings and provides additional information to guide landowners in their hardwood control programs.

Study Procedures

The study was installed near Alexandria, Louisiana, in 1962. It consists of five separate but interlocking tests with a total of 57 treatments, each replicated three times. Variables tested included dosage per incision, spacing of incisions, seasons, species, tree size, and herbicides. Because it was impractical to test all combinations of these variables in a complete factorial design, the overall study was skeletonized to reduce the number of treatments.

Each phase of the study included all combinations of 0.5, 1.0, and 2.0 ml. dosages and injector spacings of 1, 3, and 5 inches edge-to-edge around the tree trunks. A 7-inch spacing with each of the three dosages was also tested in May on blackjack oaks 4 to 9 inches in diameter at breast height.

The effectiveness of 2,4-D amine and 2,4,5-T amine was compared on 4- to 9-inch red oaks injected in May. In other phases of the study 2,4-D was applied exclusively. Both herbicides contained 4 pounds acid equivalent per gallon.

To determine if large trees are harder to kill than small ones, red oaks were divided into two size classes--4 to 9 inches d.b.h., and 10 to 15 inches d.b.h.--and treated in May. A comparison of February and May applications was confined to small red oaks.

1/ This paper was read at the Sixteenth Southern Weed Conference, Mobile, Alabama, January 1963.

2/ Peevy, F. A. Injecting undiluted silvicides for control of woody plants. Proc. South. Weed Conf. 15:163-169. 1962.

In the species trial, blackjack oak (Quercus marilandica), red oak (Q. falcata), and sweetgum (Liquidambar styraciflua) were selected to represent species that are easy, moderately difficult, and very difficult to kill. Treatments were applied in May and limited to small trees.

All incisions were made with a commercial tree injector having a 1-3/4-inch cutting edge or bit, and were placed within 2 inches of the groundline. To obtain precise dosages, herbicides were applied with a medical syringe.

The proportion of top-kill in each tree was visually estimated to the nearest 5 percent in September 1962, or 4 to 7 months after treatment. The top-kill shown in table 1 was computed by averaging the proportionate kill on the individual trees. Since sprouting of injected trees was negligible, even with the widest spacing of incisions, no information is included on the number or size of sprouts.

Results

Table 1 summarizes the data from all tests in the study. Each phase is discussed separately below. Some of the data are probably conservative, because measurements were taken in the same year that treatments were applied. Characteristically, mortality has increased substantially in the second year after injection. Whether or not this pattern will be true for small dosages and widely spaced incisions is not known, but experience indicates there will be some increases in top-kill in 1963.

Test of herbicides.--2,4-D and 2,4,5-T amines were almost equally effective on small red oaks injected in May. Previous tests have shown that they are as lethal as diluted or undiluted 2,4,5-T ester. Consequently, 2,4-D amine is the most practical of these herbicides to apply in undiluted form because it costs about $2.75 per gallon as against $7.00-$7.50 for the other chemicals.

Effect of tree size.--With May treatment large red oaks were harder to kill than small ones. Satisfactory kills of trees 4 to 9 inches d.b.h. were obtained with a 0.5-ml. dose at a spacing of 3 inches and with 1 ml. at 5 inches. For 10- to 15-inch trees, a spacing of 1 inch was needed with the 0.5-ml. dosage and 3 inches with the 1-ml. application. When 2 ml. per incision were injected, a 5-inch spacing worked equally well on both size classes. Although it has been recognized before that top-kill varies somewhat by tree size, these data give a better insight into the specific relationship.

Season of application.--Small red oaks were substantially easier to kill in May than in February. Good kills were obtained in both seasons with the more intensive treatments, such as 1-inch spacing of incisions with all dosages, or 1 and 2 ml. of chemcial applied at 3-inch intervals. The difference between seasons became apparent when the amount of herbicide was reduced, either through lower dosages or wider injector spacing. For example, 1 ml. at a 5-inch spacing gave adequate kill in May, while a 3-inch spacing was needed with both 1- and 2-ml. dosages in February.

Table 1.--Top-kill of hardwoods injected with undiluted herbicides (amine formulations with 4 pounds acid equivalent per gallon)

Dosage and spacing of incisions	February application of 2,4-D to red oaks 4 to 9 inches d.b.h.	May applications				
		Red oaks			Blackjack oaks 4 to 9 inches d.b.h., with 2,4-D	Sweetgums 4 to 9 inches d.b.h., with 2,4-D
		4 to 9 inches d.b.h.		10 to 15 inches d.b.h., with 2,4-D		
		2,4-D	2,4,5-T			
	Percent					
0.5 ml.						
1 inch	92	100	100	93	100	80
3 inches	53	97	88	75	100	49
5 inches	25	62	73	63	95	34
7 inches	...	...	...	...	89	...
1.0 ml.						
1 inch	99	100	100	95	100	97
3 inches	96	95	99	90	99	88
5 inches	63	96	91	65	94	79
7 inches	...	...	...	...	99	...
2.0 ml.						
1 inch	100	99	97	100	100	100
3 inches	96	100	100	94	97	92
5 inches	71	98	96	95	100	96
7 inches	...	...	...	...	82	...

Comparison of species.--As anticipated, sweetgum was the most difficult of the three species to kill with May application, and blackjack oak was the easiest. None of the 0.5-ml. treatments were fully effective with sweetgum. A satisfactory kill with this species required either a 1-ml. dosage at 3-inch spacing of injections, or 2 ml. at 5-inch spacing. All treatments tested in May on small red oaks were highly lethal, except 0.5 ml. applied at a 5-inch spacing.

The most interesting feature of the species trial is that high kills of blackjack oak resulted from all dosages applied at a 7-inch spacing of incisions. The 2-ml. dosage was least effective after the first season, but may show up better after the second year. The fact that control of this species was obtained with 0.5 ml. applied at 7-inch intervals indicates that wide lateral movement of a herbicide is possible without massive dosages. With other formulations of phenoxy herbicides it has heretofore been necessary to space injections about 1 inch apart, and with Ammate the maximum distance between chopped cups was 4 inches.

Costs

Relative costs of various treatments are difficult to obtain because average tree size, stand density, topography, condition of the underbrush, labor efficiency, and wages influence the comparisons. The following information has been compiled for a stand of 250 to 300 stems per acre averaging about 5 inches d.b.h.

Table 2.--Injection cost per inch of stem d.b.h.

Volume of 2,4-D per incision (ml.)	Distance between incisions			
	1 inch	3 inches	5 inches	7 inches
	Cent			
0.5	0.24	0.14	0.12	0.10
1.0	.32	.19	.16	.13
2.0	.48	.29	.24	.19

The standard treatment of injecting 5 ml. of 2,4,5-T ester diluted 1:10 in diesel oil at an interval of 1 inch costs about 0.36 cent per inch of trunk diameter. All but one of the treatments in the table--2 ml. at 1-inch spacing--cost substantially less than this. Savings range from about 10 to 70 percent.

Discussion and Conclusions

Injection of phenoxy herbicides is the most widely used method of killing unwanted hardwoods in the South today, and substitution of undiluted 2,4-D amine for diluted 2,4,5-T ester will result in considerable savings. While it is still too early to formulate precise prescriptions, enough information is available for landowners to initiate local trials of dosages and injector spacings. Tools are now available, as at least two manufacturers have placed meter-type injectors on the market in the past few months. Both models are easily adjusted to deliver small amounts of chemical accurately.

Additional economies can be made by better training of crews and scheduling operations for seasons when less costly treatments can be used to obtain high kills. Varying the spacing of incisions by species and tree sizes instead of applying a uniform treatment to all trees can effect savings of 10 percent or more, depending on stand composition. To effect this economy, crew members must have a firm understanding of the different prescriptions, and be constantly alert to their application. Similarly, concentrating operations in the growing season, rather than in the winter, will also cut expenses appreciably.

With the information available so far, the best and safest treatment for all seasons and stands of mixed species is probably 1 ml. in incisions 3 inches apart, edge-to-edge. If stands are primarily blackjack oak, post oak (*Q. stellata*), or other easy-to-kill species, May injection of 0.5 ml. at intervals of 7 inches seems best. For May application to mixed species under 10 inches d.b.h., 1 ml. at 5-inch spacing is most effective and economical.

Additional studies are needed to determine optimum dosages and spacings for other species, especially bottom-land hardwoods. Tests are also needed in late summer and early winter to compare injector spacings up to 7 inches on various species. Finally, more information is needed on height of injection, because root swells close to the groundline necessitate a greater number of jabs than might be required at a height of 12 inches. Some of these studies are already installed; others are planned.