



Figure 1.—Tree injectors similar to the one shown are efficient for applying herbicides for woody-plant control.

Methods Of Applying Herbicides For Controlling Individual Weed Trees

By FRED A. PEEVY*

THE encroachment of weed trees on southern forest land is a major land-management problem; therefore, considerable research has been conducted to find efficient methods of control. Killing defective trees by girdling has been practiced for a number of years, but during the past decade the application of herbicides has proven effective. In recent years, special injectors were developed for applying herbicides to individual tree trunks.

Tree Injectors

The first tools tested for injecting herbicides into woody plants had certain shortcomings. However, in recent years, improved injectors have been developed for applying herbicides into woody plants. These have good cutting points, have a hand lever for controlling dosage, and hold about a gallon of solution. Several types of tree injectors are manu-

factured, but the tree injector shown in Figure 1, and a tool developed earlier, Figure 2, are the only types of injectors that have been used at the Alexandria Research Center for testing this method of application. An ester of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) was applied in a concentration of 32 pounds of acid equivalent per 100 gallons of diesel oil, to blackjack oak with these two types of injectors during February, May and October, 1956, to represent winter, spring, and fall treatments, respectively. Injections were made two inches apart, edge to edge, near ground level into the base of tree trunks for trees that ranged from 2 to 10 inches in trunk diameter. Each incision was filled with the solution. Approximately 8 milliliters (ml.), which is equivalent to about one-half tablespoonful, was applied in each incision. Additional treatments of 2,4,5-T were applied with one of the newer type tree injectors to several hardwood species during 1957. For these injections, an ester

*Range Conservationist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, cooperating with Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture, Alexandria, Louisiana.



Figure 2—This was among the first tools tested for injecting herbicides into woody plants.

Figure 3—Applying fenuron to soil for control of scrub oak.



of 2,4,5-T was applied at a concentration of 12 pounds per hundred gallons of diesel oil into trees ranging from 2 to 12 inches in diameter. Injections were made 2 inches apart, edge to edge, around the base of the tree trunks and each incision was filled with the solution.

Good control was obtained by application of herbicides with tree injectors during 1956 as shown by data presented in Table 1. Only fair kill was obtained during winter with the oldest type injector and the percentage kill was slightly lower at other seasons than that obtained with the newer type injector. The average kill for all seasons was 88 and 77 per cent for the newer and older type of injectors, respectively.

Table 1.—Average mortality in October, 1958, of blackjack oak trees 2 to 10 inches in diameter treated during February, May, and October, 1956, with 2,4,5-T ester in a concentration of 32 pounds per 100 gallons of diesel oil applied with tree injectors at the rate of 8 ml. per inch of trunk diameter.

Type of Injec- tor*	Feb. Kill	Feb. Top Kill	May Kill	May Top Kill	Oct. Kill	Oct. Top Kill	Avg. all Seasons Kill	Avg. all Seasons Top Kill
Older	68	73	80	80	83	89	77	81
Newer	88	88	84	84	91	100	88	91

*—Twenty trees were treated on each of 2 plots selected at random.

In October, 1958, good kills were recorded for several species of upland hardwoods that had been treated 13 months previously by injecting a solution containing 12 pounds of 2,4,5-T per hundred gallons of oil. Data in Table 2 shows that slightly better control was obtained for blackjack and post oaks than for red oak and hickory. The kill of oaks in four stem size classes 13 months after treatment are shown in Table 3. Good control was obtained of trees up to 9 inches in trunk diameter with a solution containing 12 pounds of 2,4,5-T per hundred gallons of oil for injections made 2 inches apart around the tree trunks. A lower percentage of blackjack oak trees having trunk diameters over 9 inches were killed than those under 9 inches. However, observations of exploratory

treatments and commercial applications made during 1956 and 1957 shows that good kills of red, white, blackjack, and post oaks over 9 inches in diameter are obtained within two years after treatment provided injections are made near the ground and spaced one inch apart around the tree trunks. Good kills have been obtained within two years after treatment of blackgum, sweetgum, elm, willow, water oak, and hickory by injections one inch apart on trees under 9 inches in diameter and 1/2 inch apart on trees with trunk diameters larger than 9 inches.

Treatment costs vary from 0.25 to 0.35 cent per inch of trunk diameter; the cost depends on such factors as density of stand, spacing of injections, and concentration of the herbicidal solution. Twelve pounds of 2,4,5-T per 100 gallons of diesel oil can be applied at the rate of 8 ml. per inch of stem diameter for about 0.25 cent per inch of diameter if in-

Table 2.—Percentage kill of trees of several species 2 to 12 inches in diameter treated in September, 1957, with 2,4,5-T ester in diesel oil applied with a newer type tree injector as shown by data recorded 13 months after treatment.*

Species treated	Chemical per 100 gallons	Dose per inch of diameter	Average kill Tree kill	Average kill Top kill
	Pounds	Ml.	Per cent	
Blackjack oak	12	8	93	96
Post oak	12	8	97	97
Red oak	12	8	81	81
Hickory	12	8	83	83

*Forty stems of each species were treated on each of two plots selected at random.

jections are two inches apart, edge to edge, at the base of trunk. The cost will increase slightly for closer spacings of injections or for a stronger concentration of solution. Data obtained from several commercial operations throughout Louisiana show that under average conditions the cost of injecting 2,4,5-T in a concentration of 20 pounds per hundred gallons of diesel oil ranges from \$5 to \$6 per acre. The comparative cost was \$4.25 to \$4.75 per acre when 12 pounds of 2,4,5-T per 100 gallons of diesel oil was applied in girdles made with a mechanically powered tree girdler. However, desired sprout control is not always obtained when the tree girdler is used, and a girdler is not as safe to use as an injector.

Table 3.—Percentage kill of trees in four-stem size classes 13 months after treatment resulting from treatment with 2,4,5-T in a concentration of 12 pounds per 100 gallons of oil and applied with a newer type tree injector at the rate of 8 ml. per inch of trunk diameter for injections spaced 2 inches apart around base of tree trunks.

Species and diameter in inches*	Tree kill	Average kill Tops dead
		Per cent
Blackjack oak:		
1-3	93	99
3-6	100	100
6-9	86	99
Over 9	63	97
Average all sizes	86	97
Post oak:		
1-3	100	100
3-6	100	100
6-9	91	99
Average all sizes	97	99.7

*Ten trees were treated per plot for each size class of each species on two plots located at random.

The use of injectors for applying herbicides for killing woody plants is safe and inexpensive. However, certain precautions should be followed in using these tools. For example, injections should be made into the sap wood near ground level at an angle of 30 to 40 degrees from the vertical. After the injector is thrust into the base of the tree, it should be rocked slightly to form a pocket. The outer edges of these pockets should be about level so the solution will be retained in them. Also, injectors should be emptied each night and flushed out with water or diesel oil, so they will remain in good working condition.

Soil Injector

The application of 3-(p-chlorophenyl)-1,1-dimethylurea (monuron) and 3-phenyl-1, 1-dimethylurea (fenuron) as a soil-injection treatment during late winter and spring killed post and blackjack oaks. These herbicides were effective when applied at rates of 1/2 to 1 gram of active material per inch of trunk diameter. at the base of trees. They were effective when applied around the base of tree trunks either as a finely ground powdered material or mixed in water in concentrations of 8 and 16 pounds per hundred gallons (Figure 3).

Fenuron was more effective than monuron. The cost was approximately $\frac{1}{2}$ cent for chemical and labor for applying $\frac{1}{2}$ gram of fenuron per inch of trunk diameter as a soil-injection treatment. Tests are now underway for determining the effectiveness of pelleted fenuron when applied on the soil surface at the base of trees.

Summary

Results from recent tests show that injection of 2,4,5-T at the base of trees with a tree injector is an efficient method of killing weed trees, since it can be used throughout the year on a variety of woody species. Susceptible species of southern upland hardwoods, under 9 inches in diameter, usually die within a few

months after treatment, and all sizes usually die within two years.

A suitable herbicidal solution can be made by mixing 12 to 20 pounds of 2,4,5-T per 100 gallons of diesel oil. Space injections 2 inches apart, edge to edge, around the base of the trunk near the ground of red, post, blackjack, and white oaks under 9 inches in diameter and 1 inch apart for trees over 9 inches in diameter. For hard-to-kill species such as sweetgum, blackgum, elm, willow, water oak, and hickory, space injections 1 inch apart for stems under 9 inches in diameter and $\frac{1}{2}$ inch apart for those over 9 inches in diameter. Fill incisions with the solution. The cost of treating hardwoods with 2,4,5-T ranged from one-fourth to one-third cent per inch of stem diameter, the cost depending on density of

stand, concentration of herbicidal solution, and the spacing of injections. The application of herbicides with a tree injector was slightly more expensive than application in girdles made with a mechanical tree girdler. However, the injector was safer to use, and better sprout control was obtained from this method of application.

Fenuron was more effective for control of blackjack and post oak than other herbicides as soil applications. Good kill was obtained when this material was applied at rates of $\frac{1}{2}$ to 1 gram per inch of stem diameter during late winter and spring. The cost ranged from one-half to three-fourths cent per inch of trunk diameter.