Fig. 1. — Broadcast foliage spray with spray applied to all plant cover.

Effect of Certain Common Brush Control Techniques and Materials On Game Food and Cover on a Power Line Right-of-way No. 1*

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IN THE SPRING of 1953, a large-scale test of commonly-used spray techniques and chemicals was set up on a 3-mile section of a new power line right-of-way of the Pennsylvania Electric Company. This section of line lies on State Game Lands between Philipsburg and Port Matilda in Centre county, Pennsylvania, and is located on the eastern edge of the Allegheny escarpment at an elevation of 2,000 to 2,100 feet. The forest cover is dominated by mixed oaks, commonly referred to as the oak-hickory forest type in Pennsylvania, which had been cleared in the winter of 1951-52 so that one growing season had elapsed between cutting and initiation of the test.

The major objective of this five-year study is to compare the effects of several common commercial spray techniques and materials on game food and cover produced on the right-of-way. A distinctive feature of this particular study is the use of large replicated treatment areas for the comparison of spray techniques which have been applied under commercial conditions. A second objective of this study is to follow the ecological changes in the plant community present on the right-of-way as a result of spraying, with a view towards comparison of the types of stable covers developed. Other valuable information, such as comparison of effectiveness of sprays on various species of plants, the aesthetic desirability of the cover types developed, and the cost of maintaining the right-of-way in an acceptable vegetative cover by the various techniques and chemicals, will be obtained.

While the results of these tests will apply specifically to the extensive upland oak-hickory forests of central Pennsylvania, there are many similar forest types in the oak-chestnut region of the eastern United States to which the results will apply in a general way. Moreover, as most of the common species present on the test area are found throughout the eastern oak forest, application of species reactions to the sprays may be made to a much wider range than the forest type involved.

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Fig. 2. — Oil-water, semi basal spray with application on lower two-thirds of stem and foliage.

TREATMENTS AND DESIGN OF THE TEST

The six treatments used in the study may be described as follows:

A — No spray. To be compared as a control to sprayed areas and not to be treated in any way until in need of cutting to maintain the right-of-way. Original clearance of the right-of-way was completed in the winter of 1951-52.

B — Broadcast foliage spray (D + T) in water carrier. In this treatment Weedone Industrial Brush Killer, 4 pounds per gallon of the butoxy ethanol esters of 2,4D and 2,4,5T, half and half was mixed at the rate of 1 gallon per 100 gallons of water. The spray was applied at 300 pounds pressure using a number eight nozzle tip. This tip size and the high spraying pressure are necessary to secure thorough coverage of all stems and foliage, especially the dense brush clumps. Spray also was broadcast on all existing ground cover.

C — Summer basal spray (D + T), oil and water carrier. For this treatment formula L-182A of the American Chemical Paint Company was used containing 2 pounds per gallon of the emulsifiable acid of 2,4D and 2,4,5T, half and half. Three gallons of L-128A, 10 gallons of number two household fuel oil, and 87 gallons of water were mixed to obtain 100 gallons of spray material. This spray also was applied at 300 pounds pressure using a number eight nozzle tip for good penetration. The spray was applied at the stumps, bases, and lower two-thirds of stems and foliage of woody brush. Complete encirclement of each stem and run down to the root crown was secured. Only woody brush was sprayed.

D — General summer basal spray (D + T), in oil carrier. For this treatment 6 gallons of L-182A was mixed with number two household fuel oil at the rate of 6 gallons to 94 gallons of oil to obtain 100 gallons of spray material. The application was a combination stump and basal treatment. Number five nozzle tips were used and the spray was applied with approximately 50 pounds of pressure to the basal 12 inches of each stem and to the exposed bark area of each stump. Sufficient material was applied to completely encircle the base of each stem and to run down to the root crown. All the brush species which attain a mature height of over 6 feet were sprayed. The low shrub and herbaceous ground cover was not sprayed.

E — Selective winter basal spray (T) in oil carrier. Application was made in January 1954, and, although the same application techniques and equipment were used as in Treatment D above, it was a very different type of spray. In the first place, Weedone 2,4,5-T (4 pounds acid equivalent per gallon) alone, was used in a concentration of 3 gallons of Weedone in 97 gallons of No. 2 fuel oil. Secondly, it was a more selective spray in that sweetfern was not sprayed at all, while on marginal strips about 18 feet wide neither witch-hazel or bear oak were sprayed. Also, it was not found practical to attempt to spray all seedlings owing to the almost impossible task of finding them in the winter among the low shrubs.

F — Broadcast foliage spray (Ammate) in a water carrier. For this treatment 80 per cent ammonium sulphamate was mixed with water at the rate of ¾ pound per gallon. DuPont sticker spreader was added to this mixture, 4 ounces per 100 gallons. The Ammate spray was applied with 300 pounds pressure using number eight nozzle tips to insure thorough coverage of all stems and foliage of the existing brush.

The treatments just described were applied commercially between June 9 and July 1, 1953, by the Asplundh Tree Expert Company, with the exception of Treatment E which was applied from January 26 to 29, 1954.

Although cost comparisons of spray techniques using materials and labor, only, do not give the entire picture of the cost of a spray operation, they are given here for comparative purposes so that some relative evaluation of the treatments may be made, table 1.

Table 1. — Summary of treatments applied on electric power line right-of-way, June 9 to July 1, 1953.

Treatment	Number Replications	Total Acreage Treated	Average Gallons per Acre	Average Man Hours per Acre	Average Spray Truck Hours per Acre
A — No spray	4	8.60	.....	.....	.....
B — Broadcast foliage spray (D + T), water	4	8.43	460	7.23	2.41
C — Summer basal spray (D + T), oil and water	4	10.08	345	7.11	2.37
D — General summer basal spray (D + T), oil	4	9.82	140	11.61	3.87
E — Selective winter basal spray (T), oil	4	10.05	137	16.90	3.30
F — Broadcast foliage spray, Ammate	4	12.65	415	7.05	2.35

The general design of the tests was kept as simple as possible. Each treatment was repeated in each of four randomized blocks, thus giving four replications per treatment. The blocks were selected so as to include a uniform plant community within each block, while blocks were allowed to vary somewhat from each other in plant community composition. The treatment areas varied from 1.9 acres to 3.9 acres in area, covering from 460 to 940 feet of a 180-foot-wide right-of-way.

Within each treatment area, two types of sample plots were taken for detailed analysis of the vegetation. One type of sample plot consisted of one randomly-located plot per treatment area, each plot being 33 feet wide by 165 feet long extending perpendicular to the right-of-way and subdivided into five, 33-foot-by-33-foot subplots. The entire plot is a transverse belt transect while the subplots were taken in case it becomes desirable later to analyze edges and centers separately. Data were taken on the belt transect using the combined estimate of Braun-Blanquet *(1)* for community analysis. In addition, counts were made of all stumps and stump sprouts on the plots for purpose of determining the effect of sprays on tree and shrub species.

An additional set of 33-foot-by-165-foot belt transects were placed in the forest adjacent to the right-of-way at several points to get information on the species composition of the various layers of the uncut forest in the area.

The second type of plot in each treatment area were five, 100-foot line transects mechanically spaced to divide the treatment area in equal parts, each extending from the edge of the right-of-way past the center. The method of Canfield *(2)* was followed in taking data on the cover value of species by layers on these line transects and consisted essentially of measuring the ground space occupied by each plant on the line.

ANALYSIS OF THE PLANT COMMUNITY ON TREATMENT AREAS BEFORE SPRAYING

The plant community present on the area studied was a typical sample of upland oak-hickory forest common to a large section of the oak-chestnut forest region. It has been separated for analysis into three layers, a tree layer (above 8 feet), a shrub layer (2 to 8 feet), and a ground layer (below 2 feet).

In the forest before the right-of-way was cleared, the tree layer was dominated by white oak, red oak, black oak, and chestnut oak. Red maple and sassafras were abundant. Hickory, black gum, black cherry, Juneberry, flowering dogwood, aspen, and scarlet oak were constantly present but sparse.

The shrub layer was dominated by witch-hazel and sassafras. Bear oak, mountain laurel, maple-leafed viburnum, and chestnut sprouts were characteristically present, along with saplings of the species in the tree layer.

The sparse ground layer was composed of numerous tree seedlings, shrubs, herbs, sedges and grasses. The common shrubs were blueberries, huckleberry, deerberry, and wintergreen. Blackberry, dewberry, and azalea, also were constantly present along with seedlings of species common in the shrub and tree layers. Common herbaceous and grasslike plants present were bracken fern, vernal sedge, wild sarsaparilla, loosestrife and panic grasses.

Fig. 3. —General summer basal, low pressure spray applied directly to lower stems and stumps of all tall-growing woody brush.

The right-of-way, in the second growing season after its original cutting, possessed the same species as the former forest, with a few new additions representing plants that invade forest openings and clearings such as sweetfern and fireweed. The common plants, which dominated the shrubs and ground layers on the right-of-way at the time of spraying, formed a plant community that was highly constant in species composition on all treatment areas.

The shrub layer at the right-of-way was dominated by clumps of tree sprouts that arose following cutting. Five oaks (white, red, black, chestnut and bear oaks) were present in all treatment areas. Also present were red maple, sassafras, witch-hazel and chestnut. Certain other species such as Juneberry, aspen, wild cherry, blackberry, hickory, flowering dogwood, scrub chestnut oak, black gum, scarlet oak, mountain laurel, and chokeberry while not present on all plots were found in at least one replication of each treatment.

The ground layer on the right-of-way was dominated by vernal sedge and bracken fern along with the low shrubs; blueberries, huckleberries, deerberry and wintergreen. This dense layer covered 80 to 100 per cent of the ground area. Panic grasses, loosestrife and wild sarsaparilla were abundant but of small cover value on all treatment areas. Tree seedlings of red maple, sassafras and witch hazel were common, while the various oaks were sparse but constantly present in ground layers on all treatment areas.

EARLY EFFECTS OF SPRAYS ON THE PLANT COVER

Although there was little difference among sprays in respect to their effect on the foliage of sprout clumps, when stem kill was considered a marked difference between sprays showed up. Observations on stem kill were obtained by examining the stem of each species and taking brown discoloration of the inner bark as "kill." In table 2, ¼ stem kill indicates that ¼ of the total stem at the top was killed, full stem means the entire stem was dead. It may be noted that Treatment D, summer basal, and Treatment E, winter basal, caused the most complete stem kill of all species combined. However, an important difference existed between the two basal sprays owing to a high number of seedlings, or seedling sprouts, missed in winter basal (E) as compared to summer basal (D) caused by visual difficulties in locating seedlings in the winter. It is expected that there may be some further stem kill over the next year as a delayed effect of the other sprays.

Table 2. — Early top kill by sprays applied to common trees and arborescent shrubs in June 1953; and data taken September 1953.

Treatment	Foliage Kill per Sprout Clump		Stem Kill per Sprout Clump			
	Average	Range	¼ Stem	½ Stem	¾ Stem	Full Stem
	— *per cent* —		— — — — *per cent* — — —			
A — No spray						
B — Foliage (D+T) water	98	80-100	36	8	11	45
C — Summer basal (D+T) oil and water	98	80-100	14	13	19	54
D — General summer basal (D+T) oil	97	80-100	3	1	5	91
E — Selective basal* (T) oil	99	90-100	1	2	3	94
F — Foliage (Ammate) water	98	80-100	24	31	12	33

* Treatment applied in January 1954; data taken in September.

Fig. 4. — Selective winter basal, low pressure spray applied directly to lower stems and stumps of all trees and tall-growing shrubs except on 18-foot border where bear oak and witch-hazel were not sprayed.

SUMMARY

A replicated series of treatments have been set up on a 3-mile section of a power line right-of-way designed to compare the effects of the spray application on game food and cover of an upland oak-hickory forest cover type. These treatments include a summer foliage spray with 2,4D + 2,4,5T, a foliage spray with Ammate, a summer basal spray with D + T in oil and in oil-water carriers, and a selective winter basal spray with 2,4,5T. A uniform plant community has been described covering the right-of-way at the time of spraying. All sprays caused a foliage kill of from 80 to 100 per cent, but stem kill varied. The highest per cent of stem kill was obtained from the summer and winter basal sprays with the highest number of seedlings and single sprouts being missed in the winter application.

LITERATURE CITED

(1) Braun-Blanquet, J. 1932. Plant sociology. 430 pp. McGraw-Hill.

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