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# Effects of CHEMICAL BRUSH CONTROL Upon Game FOOD and COVER\*

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A 5-YEAR STUDY of the effects of chemical brush control upon game food and cover has been completed on a major electric power transmission right-of-way in central Pennsylvania (1, 2, 3 and 4). The test occupied a 3-mile section that was cleared in the winter of 1951-52 and passes through State game lands that are predominantly covered by a young mixed-oak forest. Questions had been raised by wildlife and sportsmen's groups as to the effect of chemical sprays, both on game populations and on food and cover potentialities of the right-of-way; hence at the beginning of these tests, chemical spraying was not permitted on State game lands. The major objectives of these tests have been, (1) to determine the effects of chemical spraying on game food and cover plants, (2) to study game usage of the various treatment areas, and (3) to study the effectiveness of the sprays in controlling woody brush while producing a low plant cover resistant to invasion by tree species.

## EXPERIMENTAL DESIGN AND METHODS

The experiment was designed so that chemical sprays could be applied with commercial equipment and crews. Each treatment was repeated in 4 randomized blocks on the right-of-way, each test covering an area of from 1.9 to 3.9 acres, table 1. Game usage and general aspects of vegetation were studied on entire treatment areas, while quantitative data were obtained on sample plots laid out within each treatment. These consisted of randomly located strip transects, 33 feet wide, extending across the width of the right-of-way in each treatment

area. A total of four plots per treatment plus three plots in the adjacent uncut forest were used. Data collected from the sample plots were constantly compared with the general treatment areas so that they would be representative. In addition, five 100-foot line transects were spaced mechanically in each treatment area to provide additional quantitative data where needed. Data were collected just prior to treatment in 1953 and in late summer for five years.

The six initial treatments and subsequent follow-up sprays used in the study embraced common commercial techniques used as recommended for maximum effectiveness in woody brush control (1):

- A — Unsprayed, to be handcut as needed.
- B — Broadcast foliage spray of 2,4-D plus 2,4,5-T butoxy ethanol esters, half and half, at a concentration of 4 pounds combined acid equivalent per 100 gallons of water. Applied June 1953.
- C — Oil water, semi-basal spray of emulsifiable acids of 2,4-D plus 2,4,5-T, half and half; 3 gallons of spray material to make a concentration of 6 pounds of combined acid equivalent per 100 gallons spray in an oil-water carrier consisting of 10 gallons of No. 2 fuel oil in 87 gallons of water. Applied June 1953.

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D — *General summer basal spray* of emulsifiable acids of 2,4-D plus 2,4,5-T, half and half, at a concentration of 12 pounds of combined acid equivalent per 100 gallons of spray, No. 2 fuel oil being used as a carrier. Applied June 1953.

E — *Selective winter basal spray* of 2,4,5-T butoxy ethanol esters at a concentration of 12 pounds of acid equivalent per 100 gallons of spray, No. 2 fuel oil being used as a carrier. Applied February 1954.

F — *Broadcast spray of Ammate* at a concentration of  $\frac{1}{4}$  pound per gallon of water; 4 ounces of DuPont sticker-spreader were added per 100 gallons of spray. Applied June 1953.

B-D, C-D, D-D, E-D, F-D — *A follow-up basal spray (D)* applied in July, 1954 (June, 1956 for E-D) to one-half of each replication of treatments B, C, D, E, and F. The follow-up consisted of a summer basal spray in which the ACP formula 1054-E concentrate was used. It contained 2 pounds of 2,4-D and 2 pounds of 2,4,5-T per gallon and was diluted at the rate of 4 gallons in 96 gallons of No. 2 fuel oil.

Vegetation on the right-of-way was separated into two layers for analysis. A shrub layer was recognized that included all woody vegetation over 3 feet in height which makes up the so-called "woody brush" to be eliminated from the right-of-way. A second layer, the ground layer, was recognized that included all vegetation under 3 feet in height. Tree seedlings, sprouts, and suckers that occurred in this layer were not included in the estimates of cover and sociability, table 3, but were tallied separately.

Table 1. — Summary of treatments applied to the electric power transmission right-of-way, June 9 to July 1, 1953. (Feb. 1954 for E).

Treatment	Number Replications	Average 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
Total		59.63			

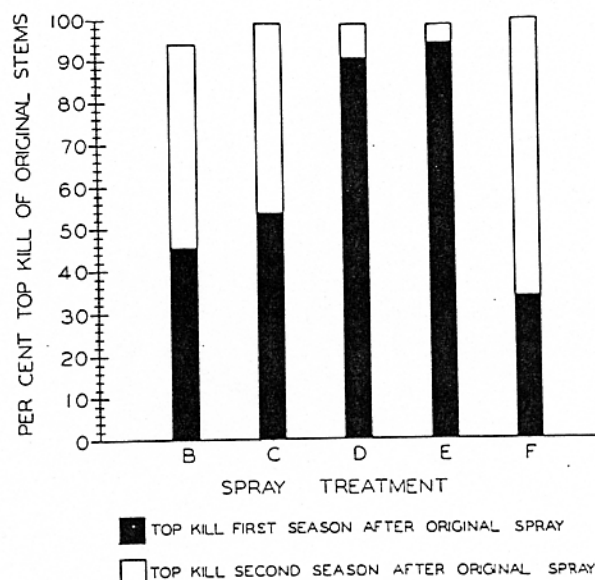


FIG. 1. — Progressive top-kill for all species combined, one and two growing seasons after original spray.

## CONTROL OF WOODY BRUSH

Although the tests were laid out primarily to study the effects of chemical sprays on game food and cover, it was necessary to first obtain control of woody brush. At the time these tests were started typical commercial herbicidal sprays were put on lightly with a resultant resurgence of many woody species and a need for frequent respraying. It should be noted under the description of experimental methods that high volumes, up to 460 gallons per acre, were used in these tests, table 1. This was done to obtain thorough coverage of the woody brush and to permit a broadcast spray over the entire right-of-way where called for by the type of treatment. It is now quite common for commercial sprays to be put on at similar high volumes since it has been shown that this is necessary for effective control such as obtained in these tests.

Data taken for two years following spraying were concerned with top-kill, or death of plants to the ground line. Highly satisfactory results were obtained with all treatments. Top-kills varied from a low of 94.1 per cent for the broadcast foliage spray of 2,4-D plus 2,4,5-T to 99.7 per cent for the Ammate broadcast foliage spray, fig. 1. The species involved included many hard-to-kill plants such as oaks and red maple, table 2.

Resurge, sprouts or suckers from original stems that have been top killed and seedlings or seedling sprouts, was studied for the five years following spraying. The data have been divided into two groups. The first deals with resurge that developed to a height of 3 feet or over and the second with resurge that remained under 3 feet in height during the 5-year period. Since many of these seedlings and sprouts will be destroyed by plant competition, animal activity and extremes of temperature.

Table 2. — Status of woody brush in chemical control test areas on an electric power transmission right-of-way in August 1957, 5 growing seasons after initial spraying in June 1953.

Treatment	Bear Oak	Other Oaks	Red Maple	Miscellaneous Hardwoods	Sassafras	Total	Total Minus Sassafras
Number of Living Plants Per Acre Over 3 Feet in Height							
Single Sprays <sup>1</sup>							
A Unsprayed	126	408	158	288	1,282	2,262	980
B Broadcast (D+T)	24	14	0	2	4	44	40
C Semi-basal	2	2	8	14	2	28	26
D Summer basal	14	4	8	8	124	158	34
E Winter basal <sup>2</sup>	8	28	2	4	1,182	1,224	42
F Broadcast (Ammate)	2	0	10	16	0	28	28
Sprays with Follow-up Basals <sup>3</sup>							
BD Broadcast (D+T)	0	0	0	2	0	2	2
CD Semi-basal	0	0	0	12	0	12	12
DD Summer basal	0	0	0	26	4	30	26
ED Winter basal	0	2	0	4	2	8	6
FD Broadcast (Ammate)	0	0	0	2	2	4	2
Number of Living Plants Per Acre Under 3 Feet in Height							
Single Sprays <sup>1</sup>							
A Unsprayed	112	660	480	614	4,652	6,518	1,866
B Broadcast (D+T)	130	88	36	96	536	886	350
C Semi-basal	94	26	66	134	1,084	1,404	320
D Summer basal	162	128	192	718	7,052	8,252	1,200
E Winter basal <sup>2</sup>	156	458	710	430	15,124	16,878	1,754
F Broadcast (Ammate)	52	56	278	258	1,316	1,960	644
Sprays with Follow-up Basals <sup>3</sup>							
BD Broadcast (D+T)	60	16	16	78	906	1,076	170
CD Semi-basal	38	28	64	88	552	770	218
DD Summer basal	62	78	126	540	1,010	1,816	806
ED Winter basal	48	152	92	72	1,252	1,616	364
FD Broadcast (Ammate)	70	48	88	180	1,132	1,518	386

<sup>1</sup> Applied June 1953

<sup>2</sup> Applied February 1954

<sup>3</sup> Follow-up spray June 1954

it is problematical how many of them will emerge from the ground layer. However, it is important to include such data since this type of resurgence is a potential source of brush on the right-of-way.

A comparison of the status of woody brush on the various treatment areas in August 1957 is given in table 2. It should be noted that it has been necessary to segregate sassafras, which, owing to its root suckering habit, may increase so abundantly on the right-of-way as to obscure the effects of chemicals on other species. When sassafras is segregated in the data, all treatments are shown to have given adequate control with a resurgence of only 26 to 42 plants per acre as compared to 980 for control areas. When sassafras is included, the winter basal spray shows up as an inferior method for control of that species. The broadcast sprays and the semi-basal, on the other hand, when applied in high volumes as used in these tests, gave an adequate control of sassafras.

The picture of brush control becomes less clear when plants under 3 feet are considered because sprouts and seedlings are very abundant in the ground layer, table 2. They form the potential brush to be controlled in the future when some of them emerge into the shrub layer.

## REDEVELOPMENT OF THE GROUND LAYER

There was a distinct difference in the effects of the various sprays upon the ground layer particularly during the first two years following spraying. By the end of five years, however, the ground layer of all treatment areas tended to return to the original community of bracken, sedge, mixed herb, and blueberry, fig. 2. The single outstanding exception was blueberry which did not recover its former abundance in semi-basal and broadcast foliage spray areas, table 3.

Notable differences in the effects of the various sprays upon the ground layer lie mainly between the extreme disturbance caused by the broadcast foliage treatments, with either 2,4-D and 2,4,5-T or Ammate, and the relatively small alterations caused by the basal applications. The semi-basal spray was intermediate in that it caused somewhat less disturbance of the ground layer than the broadcast treatments, table 3. The broadcast Ammate spray produced a low cover which was dominated by fireweed for two growing seasons. This species gradually decreased until it reached a minor proportion in the plant cover by the end of the fifth growing season. The broadcast spray of 2,4-D + 2,4,5-T produced a com-



FIG. 2.—A. Unsprayed area with a dense woody brush cover after 6 growing seasons.

B. Broadcast spray area (Treatment B), 5 growing seasons after spraying, with a low ground cover of Bracken-Sedge-Loosestrife and practical elimination of woody brush over 3 feet tall. A control area is in the background.



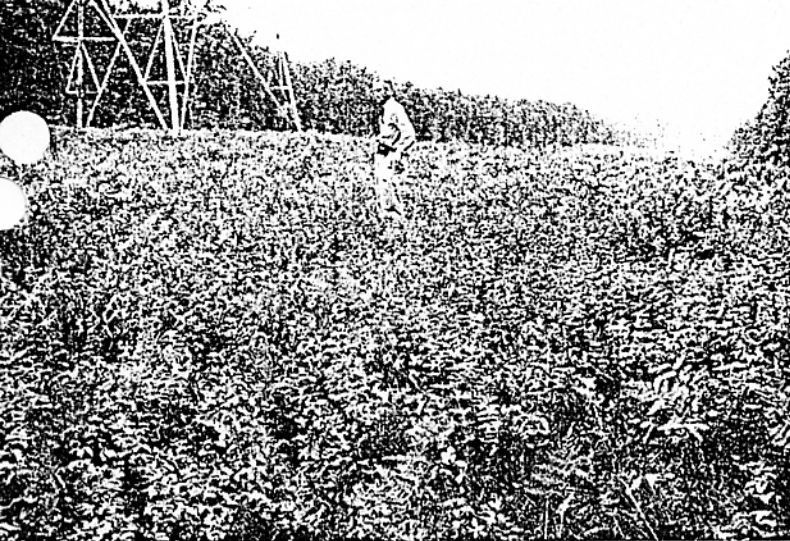
munity dominated by sedges and grasses which persisted for four years. In the case of the semi-basal spray, fireweed was dominant for only one year. Another important effect of the broadcast and semi-basal sprays was the practical elimination of low shrubs, such as blueberry and huckleberry. These recovered so that at the end of five years they were either very sparse or occasional in occurrence. The basal spray areas retained their original plant composition and merely became more dense as bracken and loosestrife increased.

## GAME USAGE

### Direct Observations

One of the methods used for determination of game usage was direct observation. Direct observations in this study included both the animals themselves and definite signs of their having been on the right-of-way as shown by pellets, tracks, and evidences of feeding, fig. 3. In the year following spraying, an intensive study was made of game usage on the various treatments. This has been supplemented over the past five years by observations made while doing other work, such as tallying vegetation changes. During the winter period, special observations were made of signs on the right-of-way after snowfalls.

Certain important trends appear in the number of times wildlife species, or signs of them, were observed



C. Semi-basal spray area (Treatment C), 5 growing seasons after spraying with a low ground cover of Bracken-Sedge-Loosestrife.

D. Selective winter basal spray area (Treatment E), 5 growing seasons after spraying, with a low ground cover of Bracken-Sedge-Loosestrife-Blueberry.

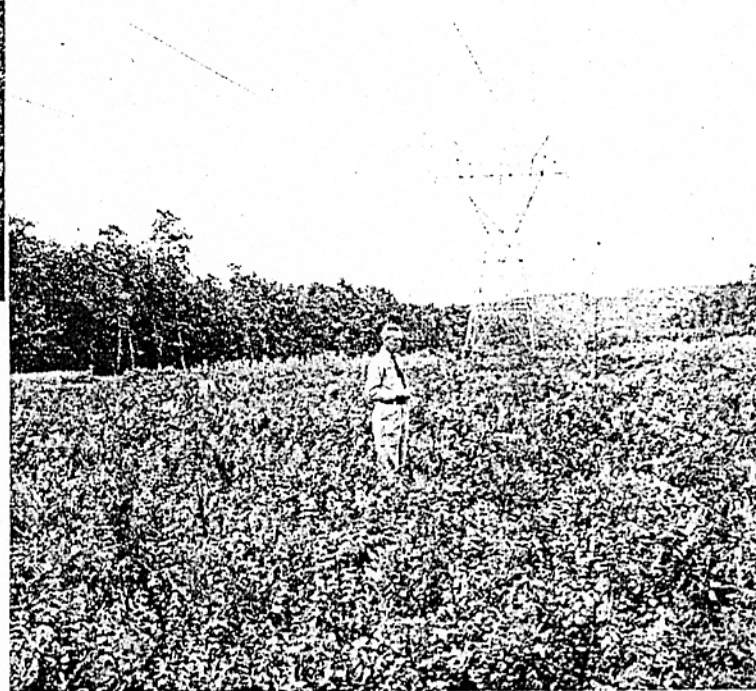


Table 4. — Dominant species of the ground layer in table 3.

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Sedge —
Vernal sedge ( <i>Carex pensylvanica</i> )
Grass —
Broad-leaved Panic-grass ( <i>Panicum latifolium</i> )
Changeable Panic-grass ( <i>Panicum commutatum</i> )
Upland Bent ( <i>Agrostis perennans</i> )
Harsh-leaved Mountain Rice ( <i>Oryzopsis asperifolia</i> )
Meadow fescue ( <i>Festuca elatior</i> )
Bracken —
Bracken fern ( <i>Pteridium aquilinum</i> )
Fireweed ( <i>Erechtites hieracifolia</i> )
Loosestrife ( <i>Lysimachia quadrifolia</i> )
Blueberry —
Low Blueberry ( <i>Vaccinium vacillans</i> )
Low Blueberry ( <i>Vaccinium angustifolium</i> )
Deerberry ( <i>Vaccinium stamineum</i> )
Huckleberry ( <i>Gaylussacia baccata</i> )
Sweetfern ( <i>Comptonia peregrina</i> )

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on treatment areas during the 5 years following spraying, table 5. For example, deer were not only observed on all treatment areas but the total usage of these areas has increased. The control area, Treatment A, was used heavily in winter for bedding down and for feeding on woody browse. During this season the adjacent woods, which are seriously over-browsed, are nearly bare of low cover and food. In the other treatment areas, deer fed heavily in spring and early summer on young shoots of bracken and on the common herb, wild loosestrife.

Also, deer commonly bedded down in the summer in the treatment areas where grass and sedge were common.

Grouse were observed in all treatment areas; and in addition, they were often found on the edges within 150 to 200 feet of the right-of-way. Use of the right-of-way by turkeys was difficult to determine as this bird has a wide daily and annual cruising radius. Most observations were made on treatments B and F, broadcast spray areas, on which a grass-herb cover has become dominant. Flocks of young turkeys use such openings in the summer when they are feeding heavily on various insects.

Use of the right-of-way by squirrels was mostly along the edges where oaks and most other mast-producing trees and shrubs furnished food to these animals. Squirrels were observed to cross the right-of-way from one side to the other during their winter activities and buried acorns which occasionally produced young oak seedlings the following year some distance from the edges.

Rabbits increased on the treatment areas over the observation period. They are not a common game animal in the forests of the plateau but appear to be building up under right-of-way conditions where woodchuck holes are increasing and furnish refuges. Also the abundant low cover and food available on the right-of-way not found in the woods must be attractive to them.

Table 5.—Number of times common wildlife species or signs were observed on treatment areas from October 1, 1953 through October 1957.

Treatment	Deer	Grouse	Rabbit	Squirrel	Turkey
A Unsprayed	83	12	51	6	0
B Broadcast (D+T)	45	8	8	2	31
C Semi-basal	62	7	3	6	1
D Summer basal	53	5	12	8	1
E Winter basal	59	8	25	11	1
F Broadcast (Ammate)	69	8	7	18	15
Total	371	48	106	51	49

### Pellet Counts

In 1954 a special observation technique was used on the right-of-way by which pellet counts were made on 20 line transects, 3 feet wide by 100 feet long, in each of the 6 treatment areas. All pellets were counted on these strips and removed each year during four years following spraying, fig. 3. The number of pellets were taken to be an indication of the degree of usage of the area, although correlations with actual game populations have not been worked out. The data, table 6, are interesting in that they agree in general with the direct observations presented in table 5. The number of deer pellets increased over the 4-year period with the control area, Treatment A, rated highest. Treatment B, the broadcast foliage, had the least number of pellets which was also in agreement with direct observations. Some grouse pellets were found on all treatment areas. They were most abundant on the winter basal (E), the Ammate broadcast spray area (F), and the control area



FIG. 3.—A. Turkey tracks on the right-of-way in March 1956. B. Typical pellets tallied on the right-of-way. Grouse pellets on upper left, rabbit on upper right, and deer on lower right.

(A); A and E also rated number one and two in direct observations. Rabbit pellets showed an increase over the 4-year period with Treatments B, A, and E rated near the top for the number of pellets observed.

Table 6.—Average numbers of animal pellets per treatment obtained from 20, 3-by-100-foot transects, for each treatment.

Treatment		March 1954	April 1955	April 1956	April 1957	Total
Deer						
A	Unsprayed	349	52	1177	1115	2693
B	Broadcast (D+T)	112	113	260	426	911
C	Semi-basal	216	95	316	432	1059
D	Summer basal	391	218	433	632	1674
E	Winter basal	532	277	868	830	2507
F	Broadcast (Ammate)	165	124	610	668	1567
Rabbit						
A	Unsprayed	101	296	482	150	1029
B	Broadcast (D+T)	95	467	248	124	934
C	Semi-basal	3	167	30	35	235
D	Summer basal	132	106	99	28	365
E	Winter basal	102	211	335	116	764
F	Broadcast (Ammate)	2	85	26	30	143
Grouse						
A	Unsprayed	2	0	6	0	8
B	Broadcast (D+T)	0	0	0	¼	¼
C	Semi-basal	0	¼	¼	0	½
D	Summer basal	0	0	¼	0	¼
E	Winter basal	0	0	13	0	13
F	Broadcast (Ammate)	1	0	¼	¼	1½

### SUMMARY

A 5-year study of the development of low plant cover and game usage on a transmission line right-of-way in central Pennsylvania has been made following 5 chemical brush control techniques. The woody brush was first brought under control by use of adequate spray volumes and thorough coverage. A top kill of 94.1 per



cent or higher was obtained. This was followed by a resurge of 26 to 42 woody plants over 3 feet in height per acre 5 years after spraying, sassafras excepted. When sassafras was included, the number of woody plants per acre over 3 feet increased to 1,224 for winter basal and to 158 for summer basal sprays. All techniques gave adequate control except for sassafras in the case of winter basal.

Considerable disturbances of plant cover, both in amount and kind, followed broadcast and semi-basal techniques. Fireweed became prominent for several years after which the plant community developed toward its original composition. Blueberry which was practically eliminated by broadcast sprays remained sparse. The selective basal techniques maintained the original plant community as a low cover.

Common game species used all spray areas the first year following spraying and have either increased their use or maintained it for five years. The development of edges and type interspersation through cutting of the right-of-way and elimination of woody brush on it has favored such species as turkey and rabbits. Deer use the sprayed areas heavily in the spring and summer while grouse appear to prefer the wooded edges.

## Bibliography

- (1) Bramble, W. C. and W. R. Byrnes. 1955. Effect of certain common brush control techniques and materials on game food and cover on a power line right-of-way No. 1. *Pa. Agr. Expt. Sta. Progress Report* 126.
- (2) Bramble, W. C. and W. R. Byrnes. 1955. Effect of certain common brush control techniques and materials on game food and cover on a power line right-of-way No. 2. *Pa. Agr. Expt. Sta. Progress Report* 135.
- (3) Bramble, W. C., W. R. Byrnes, and D. P. Worley. 1956. Effects of certain common brush control techniques and materials on game food and cover on a power line right-of-way No. 3. *Pa. Agr. Expt. Sta. Progress Report* 151.
- (4) Bramble, W. C., W. R. Byrnes, and D. P. Worley. 1957. Effects of certain common brush control techniques and materials on game food and cover on a power line right-of-way No. 4. *Pa. Agr. Expt. Sta. Progress Report* 175.
- (5) Bramble, W. C. and D. P. Worley. 1952. Control of black locust with chemical sprays. *Pa. Agr. Expt. Sta. Progress Report* 72.