

Effects of Certain Common Brush Control Techniques and Materials On Game Food and Cover On a Power Line Right-of-way

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IN THE SPRING OF 1953, a large-scale test of common brush control techniques was installed on a section of a Penelec power line right-of-way in central Pennsylvania (1). This line had been given an initial, capital clearance in the winter of 1951-52 through a typical upland oak forest on State game lands. The principal objectives of the test were, (1) to determine the effects of chemical brush control on game food and cover, (2) to study the game usage of the treatment areas and, (3) to follow the effectiveness of the original treatment with and without subsequent follow-up sprays. Particular attention has been paid to the development of a stable plant cover on the right-of-way.

Six brush control treatments were applied in four replications. Spraying was done by an average crew of local labor supervised by an experienced and competent foreman using commercial equipment commonly used for such work. One year following the initial spray, a follow-up basal spray was applied to half of each treatment area of four original treatments. Treatments and follow-up sprays may be briefly described as follows:

A — Unsprayed

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.

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 Feb. 1954.

F — Broadcast foliage spray of Ammate at a concentration of $\frac{3}{4}$ 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, F-D — A follow-up basal spray (D) applied in June, 1954, to one half of each replication of treatments B, C, D, and F. The follow-up consisted of a summer basal spray using the ACP formula 1054-E and techniques as in D, described above. The 1054-E concentrate 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 fuel oil.

EFFECT OF SPRAYS ON WOODY BRUSH

Top Kill

The comparative effectiveness of the various spray applications in killing woody brush to ground level is given in figure 1. To bring out the progressive top kill of certain of the sprays, notably broadcast foliage (B), oil-water semi-basal (C), and Ammate (F), all of which showed a progressive top kill over two years,

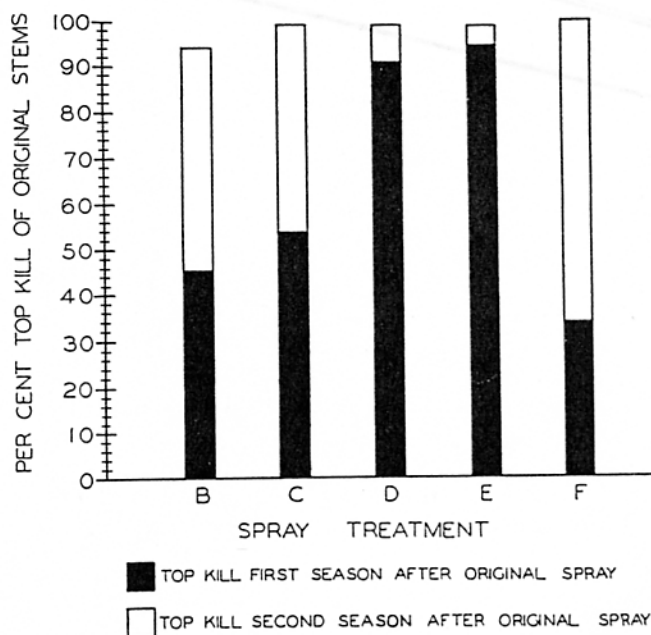


Fig. 1. — Progressive top kill for all species combined, one and two growing seasons after original spray.

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Table 1.—Effects of spray treatments with respect to the number of living plants and stems per acre attaining a height of 3 feet or more, 3 growing seasons after spraying.*

TREATMENT	†PLANTS WITH LIVING STEMS	LIVING STEMS	
		TOTAL	PREDOMINATING SPECIES
			per cent of total
A Unsprayed	712	6,620	
B Foliage	34	228	Scrub Oak 59
C Oil-Water	5	26	Red Maple 69
D Summer Basal	10	66	Scrub Oak 91
E Winter Basal	57	133	Sassafras 81
F Ammate	14	80	Red Maple 92

* Two growing seasons for E.

† Refers to individual sprout clumps or single stems; number of stumps with living sprouts used for A.

data is given for both one and two growing seasons after the original spray. Average top kill after two years ranged from 94.1 per cent for broadcast foliage (B) to 99.7 per cent for broadcast Ammate (F). When analyzed statistically by the analysis of variance, broadcast foliage had produced a significantly lower top kill after two years than the other treatments. There was no significant difference between the rest of the treatments. Practically considered, however, all of the sprays produced highly acceptable top kills owing to the heavy and efficient spray applications used in these tests.

Resurge

Probably the most important feature of the resurge of sprayed brush after three seasons is the relative number of stems that have grown back into the shrub layer, stems that have reached 3 feet and over in height, table 1. It may be noted that the number of stems and number of plants per acre in this category is particularly low for oil-water (C), summer basal (D), and Ammate (F).

It is also of interest to note in connection with the resurge after the various treatments that, in each case, there are particular species which dominate the resurging population. Most striking is the predominance of red maple sprouts resurging after the Ammate spray, of scrub oak sprouts after the summer basal spray and of sassafras sprouts after the winter basal spray. Stems which have grown back over 3 feet in height following broadcast foliage spray are mostly common upland oaks with scrub oak representing 59 per cent, while the sparse resurge after oil-water spraying contains 69 per cent red maple.

The average height of stems in the 3-foot and over class in the sprayed areas was 3½ feet as contrasted to 7 feet in the unsprayed (A) areas. The range in height was 3 to 6 feet in sprayed areas and

3 to 12 feet in unsprayed areas. It now appears that recutting of the unsprayed areas should be done in 1956, after five years of regrowth. These areas have been brushy, beginning in the year after cutting and are becoming increasingly taller and denser each year. The sprayed areas have been clear of impeding brush since spraying in 1953 and will not necessarily need retreatment in 1956. Whether a basal or other selective retreatment may be desirable within the first five years to keep the brush under complete control at a low expenditure of time and spray volume is being tested and appears promising for long range control programs.

Effect of Follow-up Basal Sprays

In the early summer of 1954, one year following the original spray, a summer basal spray (D) was applied as a follow-up spray on one half of the area of each of the replications of treatments B, C, D, and F. This type of follow-up spray aimed at the effect of a "one-two punch" to eliminate resurge of brush quickly and efficiently. The basal follow-up should eliminate the need for creation of new brown strips typical of broadcast respraying after brush has been allowed to re-establish itself following initial foliage spray applications.

The general effect of the basal follow-up sprays, two growing seasons after initial spraying has been to keep the woody brush below a 3-foot height. In the case of basal treatments following the oil-water (C) and Ammate (F) treatments, the height of the resurging woody brush was from 1 to 2 feet. The original 1-spray treatment areas, in contrast, have reached a height of 3 to 6 feet following the original spraying.

A second and even more important effect of follow-up spraying has been to reduce the number of resurging stumps by 74 to 91 per cent as compared to single spray treatments. The number of living stems per acre from those stumps was reduced by follow-up sprays by 86 to 95 per cent of the number of sprouts on the single spray areas, table 2. As may be noted in table 2, the follow-up spray made a difference between 2,926 stems per acre and 142 stems in the case of the broadcast foliage and a difference of 3,562 stems and 352 stems in the case of the Ammate foliage spray. Probably the greatest effect of these follow-up sprays will be seen in the next five years when they should keep the brush under better control than the single sprays and make them easy to hold under control by light spot spraying of resurging brush.

A comparison of labor and materials used in the follow-up basals, as well as in original sprays, is given in table 3. As these sprays were designed to be as thorough as possible in order to get maximum kill of brush, the data are not given as a comparison of minimum costs possible with the respective techniques. They do however, compare thorough application as would be used for maximum control.



Fig. 2. — Unsprayed control area, 4 years after cutting. A dense growth of tree sprouts up to 12 feet in height is suppressing the ground layer.



Fig. 3. — Taking data on a broadcast foliage spray area 3 years after spraying. A dominant Sedge-Grass cover developed after removal of shrubs and herbs.

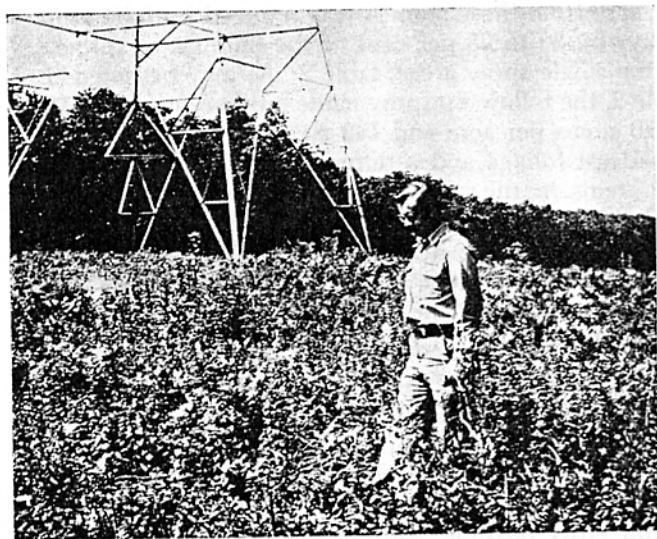


Fig. 4. — Oil-water, semi-basal spray area, 3 years after spraying. A Bracken-Sedge-Herb cover has developed following a fireweed stage.

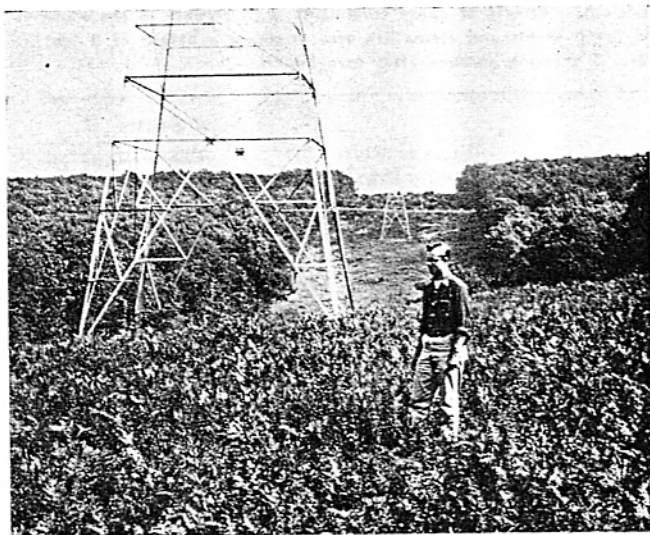


Fig. 5. — Summer basal spray area. The original Bracken-Sedge-Herb-Blueberry cover has been maintained for 3 years.

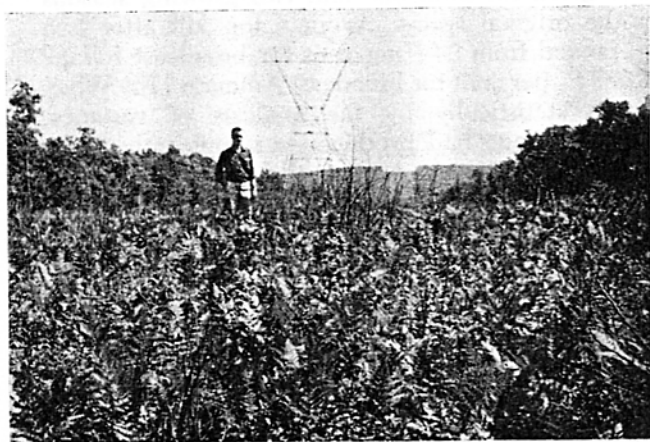


Fig. 6. — Winter basal spray area, 2 years after spraying. A dense Bracken-Sedge-Herb-Blueberry cover has developed.

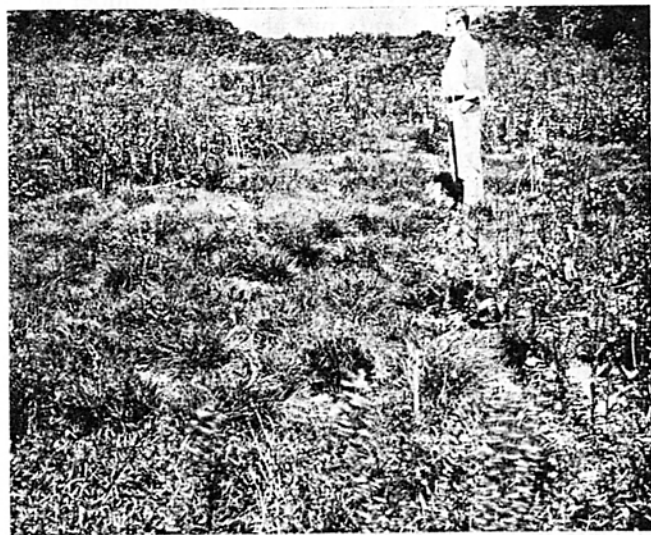


Fig. 7. — Ammate foliage spray area. Fireweed has decreased but a Fireweed-Sedge cover still dominates the area after 3 years.



Fig. 8. — Spotted fawn using the dense ground vegetation on the right-of-way as escape cover.



Fig. 9. — An increase in woodchuck holes on sprayed areas has been accompanied by increased rabbit activity.

Table 2. — Effect of single sprays (B, C, D, and F) on stumps and sprouts with and without follow-up summer basal sprays applied one year after the original sprays (B-D, C-D, D-D, and F-D). Data taken two growing seasons after follow-up spraying.

TREATMENT		STUMPS PER ACRE WITH LIVING SPROUTS	LIVING STUMP SPROUTS PER ACRE
B	Foliage	258	2,926
B-D	Foliage— Summer Basal	24	142
	Difference (per cent)	91	95
C	Oil Water	168	1,570
C-D	Oil Water— Summer Basal	20	74
	Difference (per cent)	88	95
D	Summer Basal	100	970
D-D	Summer Basal— Summer Basal	26	136
	Difference (per cent)	74	86
F	Ammate	250	3,562
F-D	Ammate— Summer Basal	46	352
	Difference (per cent)	82	90
A	Unsprayed	712	7,558

Table 3. — Summary of man hours, truck hours, and spray volume for original treatments applied June 9 to July 1, 1953, and for follow-up sprays applied July 13 to 19, 1954.

Treatment		Replica- tions	Total Acreage Treated	Average Gals. Per Acre	Average Man Hours Per Acre	Average Spray Truck Hours Per Acre
A	Unsprayed	4	8.60
B	Foliage	4	8.43	460	7.23	2.41
B-D	Foliage + Summer Basal	4	3.48	48	5.20	1.30
	Total			508	12.43	3.71
C	Oil Water	4	10.08	345	7.11	2.37
C-D	Oil Water + Summer Basal	4	4.06	20	3.26	.81
	Total			365	10.37	3.18
D	Summer Basal	4	9.82	140	11.61	3.87
D-D	Summer Basal + Summer Basal	4	4.15	21	3.13	.78
	Total			161	14.74	4.65
E	Winter Basal	4	10.05	137	16.90	3.30
F	Ammate	4	12.65	415	7.05	2.35
F-D	Ammate + Summer Basal	4	4.25	40	4.33	1.08
	Total			455	11.38	3.43

LOW PLANT COVER DEVELOPED AFTER SPRAYING

The type of low ground cover which developed three growing seasons following the initial spray treatment, and after the tall woody brush layer as a dominant cover had been eliminated by spraying, is briefly characterized in table 4. The special importance of this vegetation to right-of-way maintenance lies in the fact that the rate of re-invasion by trees will be determined in large part by resistance of this low plant cover to invasion. There is no doubt that a great many trees and shrubs will bombard the right-of-way yearly with seeds. Thus, quick development of stable and dense ground cover should be one of the best insurances of efficient brush control in the long run.

In the case of basal sprays (D and E), the dominant plant cover has remained about the same since spraying, with some slight change toward an increase in Bracken. In the broadcast spray areas (B and F), a drastic change in plant cover was caused by initial killing of a number of the component species of the original ground cover. These broadcast spray areas have been in a state of rapid change, owing to the original kill of ground vegetation, and temporary stages have appeared, dominated by plants such as fireweed which invade bare areas. It is interesting to note that in all of these unstable areas the Vernal Sedge has spread to become very prominent, table 4, particularly in the fall and winter seasons. In the more stable cover developed after the basal sprays, bracken fern, a very resistant species to invasion of foreign plants, shows signs of increasing. Although the trend appears to be towards the same plant community in the case of all sprays, it should be noted that in the broadcast sprays where the huckleberries and blueberries were killed, these areas are still lacking in low shrub cover. Numerous sweetfern seedlings on the Ammate spray areas indicate, however, that certain shrubs at least are invading and will form a part of the cover in the near future.

The ground area covered by low vegetation has increased to 84 and 88 per cent in the broadcast spray areas. This has been most striking by three growing seasons after spraying, table 4. On the other hand, in the unsprayed areas, low ground cover is being

Table 4. — Dominant plant cover developed as a ground layer, three growing seasons after spraying.

TREATMENT	TYPE OF COVER	GROUND AREA COVERED
A — Unsprayed	Bracken-Sedge-Herb-Blueberry	84
B — Foliage	Sedge-Grass	88
C — Oil-Water	Bracken-Sedge-Herb	91
D — Summer Basal	Bracken-Sedge-Herb-Blueberry	96
E — Winter Basal	Bracken-Sedge-Herb-Blueberry	95
F — Ammate	Fireweed-Sedge	84

suppressed by the tall woody sprouts which cover about 50 per cent of the ground area and its per cent coverage is decreasing. Ground cover in the basal areas has been relatively undisturbed and is now about as complete as rocks and other natural debris will permit, 95 to 96 per cent of the ground area being covered.

GAME FOOD AND GAME SPECIES ON THE RIGHT-OF-WAY AFTER SPRAYING

One of the major objectives in this study has been the development of a low plant cover that would be of value to game birds and mammals. The present cover on the right-of-way has been stable only on the basal spray areas where it has remained essentially the same as on the unsprayed control. However, there have been several notable temporary changes on some of the treatments caused by the broadcast spraying that will probably affect the game in the years immediately following the treatment. When the abundance of common plants present on the line is compared with the usage of those species by game, it can be seen that there are certain major defects on the broadcast spray areas, table 5. Perhaps the most important of these differences lie in the shrubs in the ground layer: in the broadcast foliage spray (B) and Ammate (F) spray areas such shrubs as blueberry, huckleberry, and teaberry are sparse or lacking. Taking these shrubs as a group it may be said that they are in high demand by game throughout the year and their absence would be a serious loss to several of the prominent game species in the area (2).

One of the striking changes in the broadcast foliage spray areas (B and F) and semi-basal areas (C) has been the abundance of fireweed which came up following the initial spraying on exposed ground areas. This tall annual weed has persisted for several years, and although it will probably pass out of the picture in the near future, it has dominated the broadcast spray areas. Fireweed has little reported or observed food value for game species.

In the first year after spraying a concentrated observation period was set up to observe the usage of the various treatment areas by common game species (2). During the next two years observations were made in the course of other work on the right-of-way. These are summarized in table 6 where it may be seen that the common game species were observed in all treatments during 1954 and 1955. From these observations it may be concluded that the conditions developed on the right-of-way spraying have been conducive to a varied game usage.

A second type of observation begun in 1954 — namely the counting of deer, rabbit, and grouse pellets on strip transects distributed mechanically through each treatment — was continued in 1955. These were 3-by-100-foot strip transects with 20 strips taken in each treatment. From the results summarized in ta-

Table 5. — Common wildlife food plants, their usage by game species and their relative abundance in the various treatment areas in 1955.

	GAME FOOD ¹				ABUNDANCE AND SOCIABILITY RATING ²					
	Value by Seasons				A	B	C	D	E	F
	Sp	Su	Fa	Wi	Un-sprayed	Foliage	Oil-Water	Summer Basal	Winter Basal	Ammate
					A.S.	A.S.	A.S.	A.S.	A.S.	A.S.
Grasses and Sedges										
Vernal Sedge	H	H	L	H	2.3	2.3	2.4	2.3	2.3	3.4
Panic Grass	L	L	H	L	1.2	1.3	1.3	1.2	1.2	1.3
Other Grasses	H	H	H	H	+2	2.3	1.3	1.2	1.2	+2
Ferns										
Bracken	L	L	H	—	2.2	1.2	3.3	3.4	3.4	1.2
Herbs										
Loosestrife	L	L	—	—	1.1	1.1	1.1	1.2	2.3	1.2
Fireweed	L	—	—	—	+1	2.2	2.3	+1	+2	3.4
Sheep Sorrel	H	H	H	L	+3	1.3	+3	+2	+3	+3
Cinquefoil	H	H	L	L	+1	+2	+3	+1	1.3	+1
Violets	—	H	L	H	+1	+1	+1	+1	+1	+1
Herbaceous Smilax	H	L	L	L	+1	+1	+1	+1	+1	+1
Shrubs										
Blueberry	H	H	H	H	2.2	+2	+2	1.2	2.3	+1
Huckleberry	L	H	H	H	+1	+1	+1	+1	+1	—
Teaberry	L	L	H	L	1.1	+1	+1	1.1	1.1	+1
Sweetfern	L	—	L	H	+1	+1	+1	+1	+1	1.1
Blackberry	H	H	H	H	+1	+1	+1	+1	+1	+1
Witch-hazel	L	L	H	H	1.1	+1	+1	+1	+1	+1

¹ Usage by any of the principal game species (deer, turkey, grouse, rabbit) as reported and observed (2), H = high, L = low.

² A = Abundance and cover expressed in symbols: + = Sparse, cover very small; 1 = Plentiful, but of small cover value; 2 = Covering 1/20 to 1/4 of the area; 3 = Covering 1/4 to 1/2 of the area; 4 = Covering 1/2 to 3/4 of the area; 5 = Covering more than 3/4 of the area.

S = Grouping (sociability) expressed in symbols: 1 = Growing singly; 2 = Grouped or tufted; 3 = Small patches (less than 1 milacre); 4 = Extensive patches or carpets; 5 = Pure population.

For example, 2.3 indicates that a plant covers 1/20 to 1/4 of the ground area and occurs in small patches.

Table 6. — Number of times common wildlife species or signs were observed on treatment areas from January 1954 through September 1955.

Wildlife Observed	A Un-sprayed	B Foliage	C Oil-Water	D Summer Basal	E Winter Basal	F Ammate	Total
Deer	8	8	9	12	7	12	56
Rabbit	4	2	1	3	4	2	16
Grouse	5	1	1	0	0	2	9
Turkey	0	0	0	0	0	5	5
Squirrel	3	1	3	4	2	3	16
Mourning Dove	0	3	0	0	0	0	3
Skunk	0	0	0	2	0	0	2
Fox	0	0	0	0	0	2	2
Totals	20	15	14	21	13	26	109

ble 7, it may be said that deer and rabbits were working in all spray treatments while grouse pellets were sparse. The pellet count has indicated that deer usage of the sprayed right-of-way, in general, decreased in 1954-55 but increased markedly in 1955-56. This increase appears to be caused by a relatively severe winter which made the right-of-way, with its abundant food, an important part of the deer range. During the winter when snow lay on the ground, deer used unsprayed brush areas for bedding down and 2 to 4 times more activity was noted. Usage of the right-of-way by rabbits has increased during the past two years. There has also been a noticeable increase in the number of woodchuck holes which are one of the favorite escape covers of the rabbit. While grouse pellets and direct observations on the right-of-way were very sparse in 1954 and 1955, the bird was abundant in places on the edges and in adjacent woods operations where brush had been piled. As the right-of-way is heavily hunted and is a favorite travel lane for hunters in the area, the game population can be expected to be disturbed and shifted each year, particularly during and following the open hunting season.

Table 7.—Average number of pellets per treatment area; on 3-by-100-foot transects, 20 being taken in each treatment.

TREATMENT	MARCH 1954			APRIL 1955			APRIL 1956		
	Deer	Rabbit	Grouse	Deer	Rabbit	Grouse	Deer	Rabbit	Grouse
A — Unsprayed	349	101	2	52	296	0	1177	482	6
B — Broadcast Foliage	112	95	0	113	467	0	260	248	0
C — Oil-water Semi-basal	216	3	0	95	167	¼	313	30	¼
D — Summer Basal	391	132	0	218	106	0	433	99	¼
E — Winter Basal	532	102	0	277	211	0	868	335	13
F — Ammate	165	2	1	124	85	0	610	26	¼

SUMMARY

After 3 growing seasons, the current tests have shown that a thorough and efficient application of any of the 5 spray techniques used will give an adequate top kill of from 94.1 to 99.7 per cent of the total number of stems. In the resurgence of woody brush that followed top kill, the oil-water, summer basal, and Ammate treatments resulted in the lowest number of stems above 3 feet in height, and in the fewest number of plants per acre.

A follow-up basal spray was applied to one half of each area treated originally by broadcast foliage, oil-water, summer basal, and Ammate spray techniques. This indicated that such treatment will result in vastly improved brush control and in keeping the height of woody stems below 3 feet. The follow-up basal was applied one year after the original treatments.

A marked change in ground cover followed the broadcast applications and the oil-water semi-basal. Temporary plant communities developed during the first three years, with a Grass-Sedge community following the broadcast foliage spray of 2,4-D+2,4,5-T, a Bracken-Sedge-Herb community following the oil-water spray, and a Fireweed-Sedge community following the Ammate spray.

Beginning with almost a complete browning of ground cover following initial broadcast spraying, the percentage of ground area covered increased to between 84 and 88 per cent in the third season. In the case of the basal sprays, a tight ground cover has been maintained since spraying which covers from 95 to 96 per cent of the total ground surface.

Improved game food conditions have resulted from all treatments, owing particularly to creation of a new cover type amidst the unbroken mixed-oak forest of the plateau. Highly valued shrubs such as blueberries and teaberries were present in large numbers only in the basal spray treatments. In the broadcast spray areas a grasslike or herbaceous community dominated, and while these are attractive to certain forms of wildlife, important shrubs were sparse or absent. Common game species of the region continued to use all treatment areas during the third year after spraying, indicating that these areas were making an important contribution towards the maintenance of the game population. Differences in distribution of the various species by treatment seems to be more dependent upon topographic conditions and surrounding vegetation than the composition of the right-of-way at this time.

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