Reprinted from the JOURNAL OF FORESTRY, Vol. 64, No. 10, October 1966

Control of Big Sagebrush Associated with Bitterbrush in Ponderosa Pine[1]

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Abstract. A mixed stand of big sagebrush and bitterbrush growing in the ponderosa pine zone of eastern Oregon was treated with 2 lb/A of 2,4-D at five dates in 1960, 1961, and 1962. Brush mortality was evaluated by individual plant count and bitterbrush crown reduction in each year after treatment. Sprays applied in May, when Sandberg bluegrass heads were in late boot, caused sagebrush mortality of about 95 percent, bitterbrush mortality near 10 percent, and bitterbrush crown reduction of about 25 percent. After the onset of twig elongation on big sagebrush and flower eruption on bitterbrush, significant increase in crown damage and mortality of bitterbrush was realized from applied sprays. All bitterbrush leaves were killed at each spray date. Therefore, bitterbrush recovery was directly related to the earliness of spraying and to the length of growing season remaining after spraying. The results of this study on a typical big sagebrush-bitterbrush site substantiate the results of an earlier study on a marginally-dry site and extend the information to a greater area.

MODERATELY successful selective control of big sagebrush (*Artemisia tridentata* Nutt.) associated with bitterbrush has been obtained with 2,4-D (2,4-dichlorophenoxyacetic acid) applied on a marginally-dry site for bitterbrush.[2] Slightly more selectivity resulted from 2,4-D than from 2,4,5-T (2,4,5-trichlorophenoxyacetic acid). Spraying at any time killed virtually all leaf tissue and current twig growth of bitterbrush. Therefore, spraying before the appearance of bitterbrush flowers, when a near maximum of time remained for bitterbrush resprouting, resulted in minimum bitterbrush damage and good sagebrush control. Because recovery time after spraying was important, the authors concluded that bitterbrush damage should vary among sites and seasons inversely with moisture supply. Seasonal differences were documented in the previous experiment.

This paper presents three years of 2,4-D effect on big sagebrush and bitterbrush on a site believed to be more representative of the sagebrush-bitterbrush association in eastern Oregon. The experimental site lies in a more favorable location with respect to soils, temperatures, and precipitation than the previous experiment.

Experimental Area and Procedure

A stand of big sagebrush-bitterbrush located in the Silvies Valley, 16 miles south of Seneca, Ore., was selected for the study site (Fig. 1). This valley has an elevation of 4,500 to 4,600 feet, dimensions of about 20 miles long by 5 miles wide, and is surrounded by the Malheur National Forest.

Green rabbitbrush (*Chrysothamnus viscidiflorus* [Hook.] Nutt.), grey horsebrush (*Tetradymia canescens* DC.), and wax current (*Ribes cereum* Dougl.) were infrequently present on the plots. The understory vegetation included Sandberg bluegrass (*Poa secunda* Presl.), Idaho fescue (*Festuca idahoensis* Elmer), bottlebrush squirreltail (*Sitanion hystrix* [Nutt.] J. G. Smith), Cusick bluegrass (*Poa cusickii Vasey*), Junegrass (*Koeleria cristata* L.), lupine (*Lupinus laxiflorus* Dougl.), yarrow (*Achillea lanulosa* Nutt.), and phlox (*Phlox diffusa* Benth.).

Cattle grazed the experimental area in the spring prior to May 1 each year. Bitterbrush was seldom grazed by cattle, and winter browsing by deer was light.

The study was conducted as a 5-date × 3-year factorial in four replications. The treatments were applied at approximately two week intervals beginning about May 1 in each of the years 1960, 1961, and 1962. Individual 1/50th acre plots were treated with propylene glycol butyl ether esters of 2,4-D at 2 lb/acre emulsified in water containing 0.5 percent surfactant of the total spray volume of 10 gallons per acre. Equipment and

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[1]A contribution from Squaw Butte Expt. Sta., Burns, Ore. This station is jointly operated and financed by the Crops Research Division, Agricultural Research Service, U. S. Dept. Agric., and the Oregon Agric. Expt. Sta., Oregon State University, Corvallis. Oregon Agric. Expt. Sta. Technical Paper No. 1841.

[2]Hyder, D. N., and Forrest A. Sneva. Selective control of big sagebrush associated with bitterbrush. Jour. Range Mgmt. 15(4):211-215. 1962.

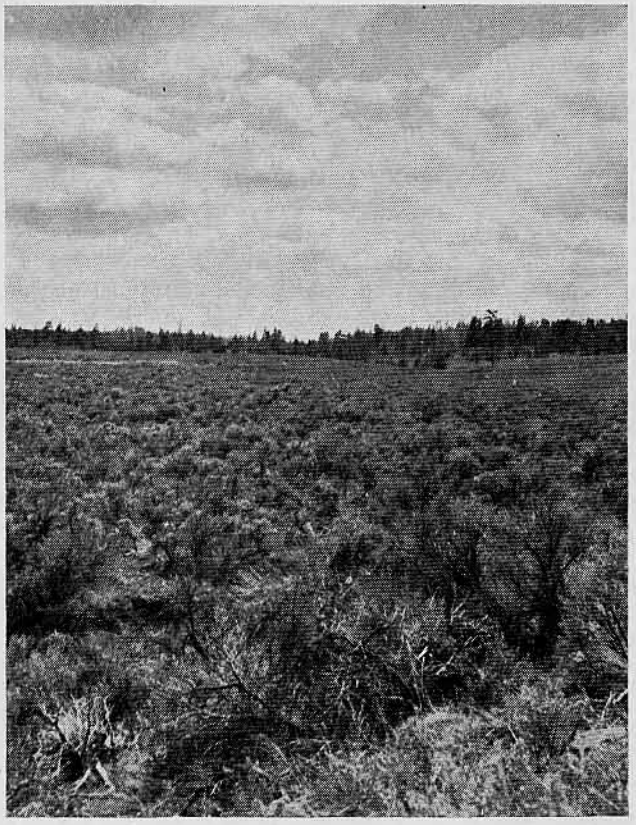

Fig. 1.—View of the bitterbrush-sagebrush study area in the Silvies Valley, Ore.

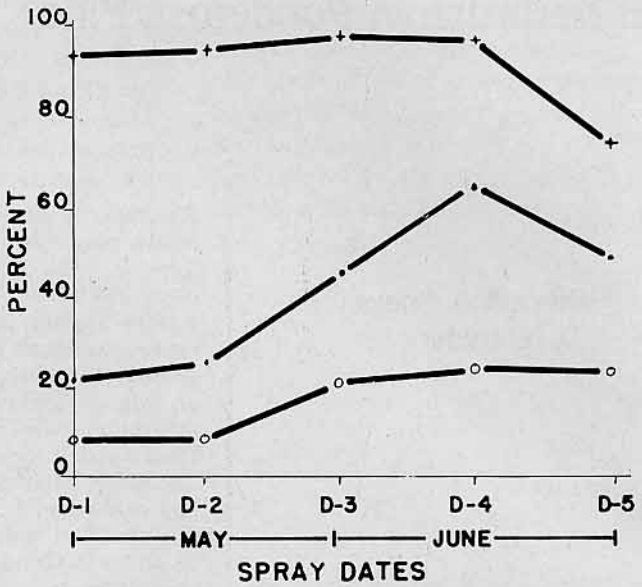

Fig. 2.—Mean mortality by spray date of big sagebrush (X——X), bitterbrush (0——0), and bitterbrush crown reduction (.——.) when sprayed in 1960, 1961, and 1962 with 2 lbs. 2,4-D/A.

spraying procedures were described in the previous paper (*op. cit.*).

Bitterbrush and sagebrush plants were counted before and one year after spraying. Prespray counts of three years averaged 18 bitterbrush and 37 sagebrush plants per plot. Bitterbrush crown reductions were estimated in late summer, 16 months after treatment. Growth development of both brush species and associated species was observed and recorded at each spraying date. Statistical analyses were computed with transformed data (angle transformations) because of uniformly high kills of big sagebrush and uniformly low kills of bitterbrush.

Monthly precipitation amounts and mean monthly temperatures recorded at Seneca during the study years are summarized in Table 1. Crop year precipitation amount for 1959-1960, 1960-1961, and 1961-1962 when compared to the long term amount (11.22 inches), show the years to have been above normal, below normal, and near normal, respectively. Only in September of 1959 was the precipitation amount received during a single month considered extreme. Temperature data suggest that the 1962 season may have been earlier because of higher April temperatures. A shorter growing season for 1961 was suggested by the higher June temperature and lower total precipitation.

Results and Discussion

Big sagebrush mortality.—Years and seasons of spraying caused highly significant differences and interaction in sagebrush mortality (Table 2).

Excellent control of big sagebrush resulted from sprays applied from early May until mid-June (Fig. 2). This period of susceptibility was characterized by Sandberg bluegrass heads in late boot until its herbage was drying (Table 3). A significant decrease in sagebrush mortality occurred between the last two dates of spraying. Big sagebrush susceptibility to 2,4-D decreases when the soil-moisture tension at a depth of 6 inches exceeds 1.7 atmospheres.[3] Low mortality of big sagebrush (58 percent) obtained at the last date of spraying in 1961 suggests soil-moisture depletion at an earlier time in 1961 than in 1960 or 1962. This season by year interaction coincides with precipitation amounts (Table 1).

Bitterbrush mortality. — Treatments applied during the fore part of May and characterized by the boot stage of Sandberg bluegrass development killed less than 10 percent of the bitterbrush plants (Table 2). Sprays applied later caused significantly higher bitterbrush mortalities. The start of this increase in susceptibility of bitterbrush to 2,4-D coincided with the initiation of twig elongation on big sagebrush and flower bud eruption on bitterbrush (Table 3).

Bitterbrush mortalities were significantly higher in 1962 than in the two previous years, but this year difference was unequally distributed among spraying dates. Differences among years were most important for treatment dates 1 and 2. Higher mortalities on these dates in 1962 than in previous years were associated with higher April temperatures.

Bitterbrush crown reduction.— Crown reduction estimates of bitterbrush one year after treatment evaluated spray effect in a manner

[3]Hyder, D. N., Forrest A. Sneva, and Virgil H. Freed. Susceptibility of big sagebrush and green rabbitbrush to 2,4-D as related to certain environmental, phenological, and physiological conditions. Weeds 10(4):288-294. 1962.

similar to mortality counts but with less variability (Fig. 2, Table 2). Reduction less than 27 percent resulted from 2,4-D applied during the fore part of May when bitterbrush mortality averaged 9 percent and big sagebrush mortality averaged 95 percent. Significant seasonal increases in bitterbrush crown reduction began with the initiation of twig elongation on big sagebrush and flower bud eruption on bitterbrush.

Bitterbrush susceptibility to 2,4-D remained low about two weeks later in 1960 than in 1961 or 1962. The growth development of bitterbrush was slightly slower in 1960 than in 1961 and 1962 (Table 3). The delayed bitterbrush development and greater amount of precipitation in 1960 favored bitterbrush recovery after spraying.

As was the case in the previous study, 2,4-D applied at any time killed all exposed leaves of bitterbrush. Therefore, recovery after spraying with 2,4-D depends on the time of spraying in relation to stage of growth development, and the length of the growing season remaining for resprouting from dormant buds. The earlier spray applications giving acceptable levels of sagebrush control provided maximum recovery of bitterbrush; but recovery varied among years in relation to seasonal precipitation amounts and temperatures.

Table 1.—Mean Monthly Temperatures and Precipitation Amounts for Seneca, Ore.

Month	Precipitation			Temperature		
	1959-1960	1960-1961	1961-1962	1959-1960	1960-1961	1961-1962
	Inches			*Degrees Fahrenheit*		
September	3.59	1.20	0.66	47.4	50.4	45.7
October	0.67	0.46	1.16	41.6	41.8	40.1
November	0.35	1.52	1.40	31.4	30.6	28.9
December	1.00	0.51	1.23	23.7	23.0	23.7
January	1.29	0.19	0.81	17.1	26.5	17.1
February	1.17	1.36	1.20	22.4	33.4	26.3
March	1.39	1.44	0.83	33.1	33.3	28.6
April	0.51	0.82	0.96	39.8	38.8	42.6
May	2.41	1.10	2.88	43.9	44.7	43.2
June	0.04	0.25	0.22	54.4	57.7	51.5
July	0.15	0.22	0.13	62.8	57.6	55.8
August	0.32	0.54	T	54.6	63.2	55.8
Total	12.89	9.62	11.48			
Mean				39.4	41.8	38.3

Table 2.—Sagebrush and Bitterbrush Mortality, Bitterbrush Crown Reduction with 2 Lbs. of 2,4-D/A Applied on Five Dates in 1960, 1961, and 1962

Year	Time of spraying[1]					
	Date 1	Date 2	Date 3	Date 4	Date 5	Mean[2]
Big sagebrush mortality			*Percent*			
1960	96	98	99	96	77	93[a]
1961	98	90	95	98	58	88[b]
1962	89	98	100	97	88	94[a]
Mean[2]	94[b]	95[ab]	98[a]	97[a]	74[c]	92
Bitterbrush mortality			*Percent*			
1960	3	8	12	23	21	13[b]
1961	6	0	29	19	18	14[b]
1962	19	18	22	29	31	24[a]
Mean[2]	9[b]	9[b]	21[a]	24[a]	23[a]	17
Bitterbrush crown reduction			*Percent*			
1960	9	10	9	59	38	25[c]
1961	28	20	60	65	48	44[b]
1962	30	48	65	70	60	55[a]
Mean[2]	22[c]	26[c]	45[b]	65[a]	49[b]	41

[1]Calendar dates of spraying are presented in Table 3.
[2]Means with unlike superscripts are significantly different at the 5 percent level.

Table 3.—Development Growth Stages of Bitterbrush, Big Sagebrush, Sandberg Bluegrass, and Other Species

Dates of spraying	Year of spraying		
	1960	1961	1962
D-1	(May 5) Putr leaf buds bursting. Pose heads in boot. Phdi in flower.	(May 8) Putr leaves ⅛ full size. Pose heads in late boot. Phdi in flower.	(May 1) Putr leaves ⅛ full size. Pose heads in boot. Phdi in flower.
D-2	(May 17) Putr leaves ⅛ to ¼ full size. Pose heading. Phdi in flower.	(May 16) Putr leaves ½ full size. Pose heading.	(May 17) Putr leaves 1/3 size. Pose heading. Phdi in flower.
D-3	(May 30) Putr flower buds present and leaves ¾ size. Pose fully headed. New twig growth on Artr ½ inch. Feid in late boot.	(May 31) Putr flower buds present, none open. Pose headed. Artr twig growth to ¾ inch.	(May 28) Putr in late flower bud, leaves ½ size. Pose fully headed. Artr new twig growth present. Sihy, Feid, and Koer heads in boot.
D-4	(June 11) Putr flowering completed, petals have dropped. Pose in anthesis. New Artr twig growth up to 1½ inches. Koer headed, Sihy in late boot.	(June 14) Putr flower petals dropping. Pose anthesis completed. Artr twig growth up to 2 inches. Sihy early head. Koer headed.	(June 11) Putr flowers still present. Pose in anthesis. Koer and Feid headed.
D-5	(June 27) Pose brown, cured, and dry. Koer in anthesis. Putr seed forming.	(June 28) Putr seed juicy. Pose brown and dry. Koer and Sihy in anthesis.	(July 4) Putr seed juicy. Pose brown and dry. Koer and Sihy in late flower to early seed.

Putr—bitterbrush
Artr—big sagebrush
Pose—Sandberg bluegrass
Phdi—phlox
Sihy—bottlebrush squirreltail
Feid—Idaho fescue
Koer—Junegrass

Conclusions

Results of spraying 2,4-D at 2 lb/A during May and June over a 3-year period on a typical sagebrush-bitterbrush site confirm the findings and inferences drawn from a 2-year study conducted on a marginally-dry site.

Excellent control (95 percent) of big sagebrush but less than 27 percent crown reduction of bitterbrush was obtained with sprays applied in the fore part of May. This period was characterized by heads-in-boot and early head emergence of Sandberg bluegrass. Sagebrush control remained high for approximately six weeks, but significant increases in bitterbrush mortality and crown reduction occurred after the onset of twig elongation on big sagebrush and flower eruption on bitterbrush.

Significant year by date interaction suggests that earliness of growth as influenced by temperature and length of growing season remaining after spraying are important factors affecting the selective control of big sagebrush associated with bitterbrush.

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