Chemical Control of Low Sagebrush and Associated Green Rabbitbrush[1]

RICHARD E. ECKERT, JR. AND
RAYMOND A. EVANS

Range Scientists, Crops Research Division, Agricultural Research Service, U. S. D. A., University of Nevada, Reno.

Highlight

Low sagebrush species were effectively controlled with low volatile esters of 2,4-D at 2 lb/acre applied from May 1 to May 15 on sites with early phenology and May 15 to June 1 on sites with late phenology. Sandberg bluegrass phenology ranged from late boot to fully headed but preanthesis. Green rabbitbrush in mixed stands with low sagebrush was effectively controlled with 2,4-D at 3 lb/acre applied near the end of the treatment period for low sagebrush. A combination of picloram plus 2,4-D was also evaluated for green rabbitbrush control.

Low sagebrush (*Artemisia arbuscula* Nutt.) and alkali sagebrush (*A. longiloba* (Osterhout) Beetle) characteristically grow on soils with a fine-textured B horizon. Some of the physical and chemical properties of these soils have been discussed by Eckert (1957), Passey and Hugie (1962), Tueller (1962), and Robertson et al. (1966). In this paper, the term "low sagebrush" refers to both brush species.

In the Intermountain States, a poor to excellent stand of grass may dominate the understory in a low sagebrush type. Perennial species include: bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. & Smith), Idaho fescue (*Festuca idahoensis* Elmer), Sandberg bluegrass (*Poa secunda* Presl.), squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith), and Thurber needlegrass (*Stipa thurberiana* Piper). Annual species include: downy brome (*Bromus tectorum* L.) and 6-weeks fescue (*Festuca octoflora* Walt.). Site potential and range condition determine the dominant species and species composition. Many sites with an understory of desirable perennial grasses have a potential for increased forage production if brush were killed and grass released from competition.

This study has two phases: (1) chemical control of low sagebrush and associated green rabbitbrush (*Chrysothamnus viscidiflorus* (Hook.) Nutt.); and (2) response of understory species. Chemical control is discussed here. Previous research on control of low sagebrush was by Cornelius and Graham (1951, 1958) on forest ranges in northeastern California.

Methods and Materials

Studies were conducted at 9 locations during the period 1963 through 1965. Low sagebrush cover ranged from 6 to 25%; density ranged from 28 to 88 shrubs/400 ft.^{2} Green rabbitbrush was present on 3 sites with a range in cover of from 0.2 to 5%, and a density range of from 8 to 22 shrubs/400 ft.^{2} During the study, precipitation on the most xeric site ranged from 8 to 10 inches, and on the most mesic site from 13 to 21 inches.

In the spring of 1962 and 1963 on 2 sites, we evaluated propylene glycol butyl ether esters of 2,4-dichlorophenoxyacetic acid (2,4-D); of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); and of 2-(2,4,5-trichlorophenoxy) propionic acid (silvex) for control of low sagebrush. All were applied at rates of 1, 2, and 3 lb/acre on four dates: 5/1, 5/15, 6/1, and 6/15. Based upon results from these treatments, 2,4-D at 1 and 2 lb/acre, applied on three dates, were uniform treatments for seven sites in 1963 and 1964. Additional treatments were added in 1964 and 1965 to evaluate a mixture of triisopropanolamine salt of 4-amino-3,5,6-trichloropicolinic acid (picloram[2]) and triisopropanolamine salt of 2,4-D, and 3 and 4 lb/acre of 2,4-D ester for simultaneous

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[2] Picloram is not registered for use on grazing lands.

control of low sagebrush and green rabbitbrush. Two rates of picloram + 2,4-D were used: 0.27 lb/acre picloram plus 1 lb/acre of 2,4-D (low rate) and 0.54 lb/acre picloram plus 2 lb/acre 2,4-D (high rate). Treatment dates for 2,4-D treatments in 1963 and 1964 were 5/1, 5/15, and 6/1 on sites with early phenology, and 5/15, 6/1, and 6/15 on sites with later phenology. Picloram + 2,4-D was applied on 6/1/64 and 5/15, 6/1, and 6/15 in 1965.

Herbicides were applied in water at 10 gpa with a backpack sprayer. All herbicide-water mixtures contained the surfactant X-77 at 0.1% v/v. Treatment plots were 20 × 20 ft with 3 or 4 replications. Phenology and environmental conditions were recorded for each date of application. We evaluated brush control by the density of living shrubs the year after treatment.

Gypsum soil moisture blocks were installed at five locations in the spring of 1964. Block depth varied with location except that all locations had one block at 6 inches. All locations had one block in the B_2 horizon (approximately 12 inches) and one block in the B_3 horizon immediately above the C horizon (17 to 34 inches). Blocks were placed in the check plot and in a treated plot of each replication. Readings were made during the spring and summer of 1964 and 1965.

Results and Discussion

Control of Low Sagebrush

Neither application dates, nor rates of 2,4-D, 2,4,5-T, or silvex, gave significant variation in brush control in the initial trials. Control averaged 94% and ranged from 71% to 100%. However, both date of application and rate of 2,4-D resulted in significant variation in control of low sagebrush in 1963, 1964, and 1965 at other locations (Table 1). Date of application was the more important variable. In 1963, treatments on the middle and late dates of application at three of five locations were 98% effective as compared to 88% on the early date. In 1964, treatments on the early and middle dates at three of seven locations were 96% effective as compared to 85% on the late date. In 1965, treatments on the early and middle dates at one of four locations killed more low sagebrush (91%) than on the late date (80%). Over the 3-year period, average control was 96% on the better date(s) and 84% on the poorer date(s) of application.

We measured significant differences in brush control between 1 and 2 lb/acre of 2,4-D at two of five locations in 1963, at four of six locations in 1964, and at two of three locations in 1965. In all instances control was better with the 2 lb/acre rate. Over the 3-year period, average control with 2 lb/acre was 98% as compared to 90% with 1 lb/acre.

The date × rate interaction was significant in all years on at least one site. In 1963 at one location 1 lb/acre of 2,4-D applied on 5/15 gave 84% control while the other 2,4-D × date combinations gave 99% control. In 1964 at two locations, the 1 lb/acre rate applied on 6/15 resulted in 75% control, compared to 98% with other 2,4-D × date combinations. In 1965 at one location, control with 1 lb/acre applied on 5/15 and 6/1 (last two dates on sites with early phenology) was 86%, and when applied on 5/1 control was 97%. Each instance of poor control with the 1 lb/acre rate was related to extremely early phenology at time of spraying, to rain or hail after spraying, or to vegetation wet from precipitation several hours prior to spraying. The 1 lb/acre rate of 2,4-D is evidently near the minimum herbicide concentration necessary for adequate low sagebrush control when environmental conditions are not optimum. The 2 lb/acre rate resulted in excellent control even under relatively adverse conditions.

Higher rates of 2,4-D ester, and picloram + 2,4-D were used on sites with green rabbitbrush, therefore, we were able to measure the effect of these treatments on both species.

Low sagebrush control with 3 and 4 lb/acre rates of 2,4-D averaged 99% on the dates used, and did not differ significantly from the 2 lb/acre rate.

A comparison of 2,4-D and picloram + 2,4-D for control of low sagebrush indicated: (1) All rates of 2,4-D ester controlled low sagebrush significantly better (99%) on the 5/15 and 6/15 dates than did the low rate of picloram + 2,4-D (71%), however,

Table 1. An evaluation of 1 (D_1) and 2 (D_2) lb/acre of 2,4-D treatments (Tr.) applied on 3 dates, and average percent control (Con.) obtained by the best treatment(s).

Location	1963		1964		1965	
	Tr.	Con.	Tr.	Con.	Tr.	Con.
Date comparisons						
Lower Silver Cr.	NS	100	NS	98	NS	94
Upper Silver Cr.	NS	100	NS	100	5/1 5/15 *	91
Dobe Summit	6/1 6/15 **	99	5/15 6/1 **	98	—	—
Bishop Flat	6/1 6/15 **	98	5/15 6/1 **	98	—	—
Carroll Summit	6/1 6/15 *	96	NS	97	—	—
Lower Duck Cr.	—	—	5/15 6/1 *	93	NS	100
Upper Duck Cr.	—	—	NS	95	NS	100
Rate comparisons						
Lower Silver Cr.	NS	100	D2*	100	D2**	97
Upper Silver Cr.	NS	100	NS	100	D2**	96
Dobe Summit	D2**	100	D2**	98	—	—
Bishop Flat	NS	93	D2**	98	—	—
Carroll Summit	D2*	96	D2*	99	—	—
Lower Duck Cr.	—	—	—	—	—	—
Upper Duck Cr.	—	—	NS	95	NS	100

NS No significant differences between or among treatments.
* Date(s) or rate comparisons listed significantly better (.05) than the unlisted date or rate.
** Date(s) or rate comparisons listed significantly better (.01) than the unlisted date or rate.
— Comparisons not made.

on the 6/1 date the two materials gave similar results; (2) The 2, 3, and 4 lb/acre rates of 2,4-D ester all controlled better (99%) on the 6/15 date than did the high rate of picloram + 2,4-D (67%); (3) In 1965 average control of 99% with 2 lb/acre of 2,4-D was significantly greater than with either the high or low rate of picloram + 2,4-D (86% and 74%); (4) In 1964 the high rate of picloram + 2,4-D controlled better (94%) than did the low rate of this material (83%), however, in 1965 control was similar with both rates; (5) Control with both rates of picloram + 2,4-D was significantly less (55%) on the 6/15 date than on the other two dates in 1965 (93%).

For control of low sagebrush picloram + 2,4-D was less effective than 2,4-D, perhaps because 2,4-D was a salt in the former mixture and an ester in the latter. Tueller and Evans (1965) also indicate that picloram was not as effective as 2,4-D ester for control of big sagebrush (*Artemisia tridentata* Nutt.).

Control of Green Rabbitbrush

Control of green rabbitbrush with 1 and 2 lb/acre of 2,4-D ester averaged 53% and ranged from 8% to 92%. Thc heavier rate of 2,4-D and later dates of application resulted in significantly better control, however, the percent and consistency of control were inadequate.

Treatment with picloram + 2,4-D salt increased rabbitbrush control as compared to 2,4-D ester at 1 and 2 lb/acre. At two locations control with the high rate of picloram + 2,4-D was significantly better (98%) than with 2 lb/acre of 2,4-D ester (68%). At one location, control with the high and low rates of picloram + 2,4-D applied on 6/1 was similar and averaged 94%. Results from another location also suggest that although both rates of picloram + 2,4-D gave similar results when applied on 6/1, the heavier rate was superior on the 5/15 or 6/15 dates. At this location the two rates applied on 6/1 controlled 100%. Control with the lower rate applied on 5/15 and 6/15 averaged 56%, while control with the higher rate applied on the same dates was significantly higher at 98%. Also on the 6/1 date, control with 3 lb/acre of 2,4-D ester was 100%. Rabbitbrush control from the heavier rate of picloram + 2,4-D and the 3 and 4 lb/acre of 2,4-D cster applied on 6/15, averaged 96% compared to 51% with 2 lb/acre of 2,4-D ester applied on the same date.

In 3 year's work at nine locations, control of low sagebrush was best with 2 lb/acre of low volatile ester of 2,4-D plus X-77 at 0.1% v/v applied from May 1 to May 15 on sites with early phenology and May 15 to June 1 on sites with late phenology. During this period low sagebrush had from 1 to 2 inches of new twig growth and Sandberg bluegrass phenology was from late boot to fully headed but pre-anthesis.

In 1964 and 1965, soil moisture tensions during the spray period ranged from 0.3 to 30 bars at the 6-inch depth, from 0.3 to 5.5 bars at the 12-inch depth, and 0.2 to 20 bars at depths of 17 to 34 inches. The high reading of 20 bars was obtained on 6/15/64 at one location. This high tension was related to significantly reduced brush control on this date. Excluding this location, tensions at 17 to 34 inches ranged from 0.2 to 2.0 bars at all other locations.

A low density of rabbitbrush is characteristic of the shrub overstory on the more mesic and higher elevation low sagebrush sites in good condition. Control of sparse rabbitbrush is not an important consideration in a low sagebrush control project. Application of 2 lb/acre of 2,4-D near the end of the effective spraying season for low sagebrush will kill some of the rabbitbrush, and the released understory species will compete vigorously with the surviving rabbitbrush.

On sites in poor condition, control of rabbitbrush is important to prevent domination of the stand by this species within a few years after control of low sagebrush. Under these conditions, 3 lb/acre of 2,4-D applied near the end of the spraying season for low sagebrush, has controlled both species adequately. Hyder et al. (1958) also reported similar methods and results for simultaneous control of green rabbitbrush and big sagebrush in mixed stands.

Areas within the low sagebrush type are used by sage grouse (*Centrocercus urophasianus* (Bonaparte) for strutting grounds, nesting, roosting, resting, and escape cover. In addition, sage grouse are dependent upon sagebrush species and associated forbs for a major portion of their diet. Chemical control of low sagebrush will destroy their habitat. Therefore a large-scale low sagebrush control project should be a joint venture between the action agency and wildlife interests, to select sites in need of treatment but not sage grouse habitat.

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