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# **Progress on an integrated leafy spurge (*Euphorbia esula*) management system combining sheep grazing with fall-applied herbicides**

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## **Introduction**

Leafy spurge (*Euphorbia esula*) is an aggressive, perennial rangeland weed infesting millions of acres in the northern tier of the Great Plains states. It reduces cattle carrying capacity of rangeland and causes extreme economic losses to cattle producers and wild-land areas (2).

Leafy spurge is very difficult to control and a combination of treatments, i.e., integrated weed management, may provide long-term leafy spurge population reductions. University of Wyoming research indicates that sequential applications of glyphosate followed by seeding perennial grasses controlled leafy spurge 83% on the average across all tilled plots three years after treatments were invoked (3).

Sheep will graze leafy spurge. Sheep readily consumed leafy spurge up to 50% of their diet free choice and showed no deleterious signs (1). While sheep grazing may not reduce leafy spurge populations, they may consume enough leafy spurge to release grasses from weed competition thus, allow the area to be grazed by cattle. Additionally, sheep grazing in spring and summer may stress leafy spurge sufficiently to make it more susceptible to fall-applied herbicides.

The objective of our research was to determine if fall-applications of herbicides at reduced rates, preceded by sheep grazing, provided equivalent control to higher rates of those herbicides applied alone in spring or fall.

## Materials and methods

The experiment was initiated in 1991 at Cherry Creek State Park in Aurora, CO. The design was an 8 (herbicides) by 3 (management approaches) factorial arranged in a strip-plot with four replications. The eight herbicide treatments (Table) comprised the main plots and the three management approaches (spring-applied herbicides at flowering, fall-applied herbicides to regrowth, or grazing followed by fall-applied herbicides to regrowth) were subplots. Two sheep grazed their assigned plots (0.33 A) for 75 days per year. All herbicides were applied with a CO<sub>2</sub> backpack sprayer at 24 GPA.

**Table 1. Leafy spurge cover and density in fall, 1992, as impacted by three management approaches.**

Herbicides	Rate (lb ai/A)	Management approaches					
		Spring-applied herbicides		Fall-applied herbicides		Graze + fall-applied herbicides	
		% Cover <sup>1</sup>	Density <sup>2</sup>	% Cover <sup>1</sup>	Density <sup>2</sup>	% Cover <sup>1</sup>	Density <sup>2</sup>
Picloram	0.13	34 a-d	7 b-f	11 cd	6 b-f	10 cd	4 def
	0.25	2 d	1 f	19 bcd	5 b-f	36 abc	9 a-e
	0.5	23 bcd	5 b-f	34 abc	11 a-d	13 cd	3 ef
Picloram + 2,4-D		27 a-d	8 a-e	30 a-d	10 a-e	61 a	16 a
	0.25 + 1.0	8 cd	2 def	52 ab	13 abc	37 abc	11 abc
	0.5 + 1.0	15 cd	4 b-f	23 a-d	7 a-f	4 cd	2 def
Dicamba + 2,4-D	1.0 + 2.0	13 cd	5 c-f	15 cd	3 def	24 bcd	6 b-f
Non-spray control	0	17 bcd	6 b-f	10 cd	4 c-f	23 bcd	12 abc

<sup>1</sup>Means followed by the same letter do not differ, LSD (0.05). Compare cover means for all management approaches.

<sup>2</sup>Means followed by the same letter do not differ, LSD (0.05). Compare density means for all management approaches.

The impact from each management approach was assessed on the entire plant community. Leafy spurge, downy brome (*Bromus tectorum*), smooth brome (*Bromus inermis*), and western wheatgrass (*Agropyron smithii*) cover (Daubenmire) and leafy spurge density were estimated three times per season; before sheep were introduced into the study area in spring, approximately one month after they were removed in summer, and in fall before herbicides were applied. Repeat cover and density determinations were taken from the same locations within plots. Leafy spurge soil seed reserve, plant community biomass (weeds separated from desirable forage), and % control also were taken however, only cover and density from fall 1992 are presented.

## Results

Cover and density data were subjected to analysis of variance as arc sine transformations. Means were separated by LSD (0.05) and are presented in their original scale. No differences occurred among herbicide treatments when averaged over all management approaches and no differences occurred among management approaches when averaged over all herbicide treatments. However, a herbicide by management approach interaction was observed.

Treatments did not differ for downy brome or smooth brome cover. Leafy spurge density and cover differed among treatments. No differences occurred among management approaches with picloram at 0.13 lb/A but there was a trend for decreased leafy spurge density with the graze plus fall-applied herbicide approach (Table). There were fewer leafy spurge shoots with spring-applied picloram at 0.25 lb/A compared to the graze plus fall-applied picloram at this rate. Leafy spurge density was greater with picloram plus 2,4-D at 0.25 + 1.0 lb/A applied alone in fall or preceded by grazing compared to this herbicide treatment spring-applied. No differences occurred among management approaches within the picloram plus 2,4-D treatment at 0.5 + 1.0 lb/A although, there was a trend for decreased leafy spurge density with the graze plus fall-applied herbicide approach. Leafy spurge density did not vary among management approaches within the dicamba plus 2,4-D herbicide treatment. Leafy spurge density did not vary among the non-sprayed control plots but there was a tendency for increased shoots in the grazed plots.

Leafy spurge cover did not differ among management approaches within picloram alone at 0.13 or 0.5 lb/A, although, there was a tendency for reduced cover with the grazing plus fall-applied picloram at these rates. However, picloram at 0.25 lb/A spring-applied reduced leafy spurge cover compared to the other management approaches. No differences among management approaches for leafy spurge cover occurred within picloram plus 2,4-D at 0.13 + 1.0 lb/A and grazing plus this herbicide treatment fall-applied tended to increase leafy spurge cover, which is the opposite trend as that observed for picloram alone at 0.13 lb/A. Leafy spurge cover was greater with picloram plus 2,4-D at 0.25 + 1.0 lb/A applied alone in fall compared to this rate spring-applied. Leafy spurge cover did not differ among management approaches within picloram plus 2,4-D at 0.5 + 1.0 lb/A and there was a trend for reduced leafy spurge cover when this treatment was fall-applied and preceded by grazing. Leafy spurge cover did not differ among the non-sprayed control plots.

Differences for western wheatgrass cover among management approaches occurred however, the stand was not uniform and this may have impacted results. Western wheatgrass cover ranged from 0 to 29%. Western wheatgrass cover was 29% in the fall-applied herbicide management approach and this was different only from those treatments that had less than 1% western wheatgrass cover (data not shown). No western wheatgrass was found in any spring-applied picloram treatment or in any of the 0.5 lb picloram treatments regardless of management approach. However, western wheatgrass cover was 16, 18, and 25% within the picloram plus 2,4-D at 0.5 + 1.0 lb/A in the spring-applied, fall-applied, and graze plus fall-applied management approaches, respectively. Western

wheatgrass is increasing in the study area and with time, differences among management approaches and/or herbicide treatments may become evident.

The management aspects of this experiment will continue through 1994. Plant community measurements will be taken for 2 years following cessation of management input.

## Literature cited

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