Evaluation of Sulfometuron for Leafy Spurge Control and Forage Production

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Leafy spurge is an aggressive and persistent perennial weed that is primarily found in untilled, noncropland habitats such as pastures, rangeland, roadsides, woods, and waste areas (3). Leafy spurge competes with desirable forages and often becomes the dominant species on uncultivated land. Cattle carrying capacity of rangeland can be reduced by 50 to 75 percent from severe infestations (16) due to both decreased forage production and cattle avoiding areas infested 10 percent or more with leafy spurge (4, 7).

Leafy spurge is difficult to eradicate with herbicides. However, a persistent herbicide control program will reduce topgrowth and gradually decrease the root system. Nearly all experimental herbicides have been evaluated for leafy spurge control since the introduction of 2,4-D in the 1940s (1, 8, 9). Most of these herbicides have little or no effect on leafy spurge.

Picloram (Tordon) can provide over 90 percent control of leafy spurge (10). Picloram soil residue reduces the need for immediate retreatment and the number of subsequent retreatments compared to other auxin herbicides that control leafy spurge. When applied annually picloram plus 2,4-D provides greater leafy spurge control than picloram applied alone (11). However, the high cost and long soil persistence of picloram make control of large infestations expensive or environmentally undesirable in some areas (9, 15).

Sulfometuron (Oust) is a sulfonylurea herbicide applied at low rates for control of many annual grasses and broadleaf weeds in noncropland areas (17). Sulfometuron also is used for chemical mowing of roadside rights-of-way and weed control under trees (2, 6). In preliminary research sulfometuron has shown potential for leafy spurge control but had to be applied at 2 ounces active ingredient per acre or less to prevent grass injury (12, 14). Also, leafy spurge control increased when sulfo-meturon was applied with an auxin herbicide compared to sulfometuron applied alone (13).

Sulfometuron may provide more economical and effective control of leafy spurge compared to herbicides presently used or may be useful in areas where auxin herbicides cannot be used. The objectives of this study were to determine the effect of sulfometuron applied alone and with auxin herbicides on leafy spurge control and forage production.

Leafy spurge control

An experiment to evaluate leafy spurge control with sulfometuron and sulfometuron plus auxin herbicides applied annually for three years was established at Chaffee and Dickinson. Both sites had a dense stand (more than 80 percent cover) of leafy spurge and from 10 to 20 percent ground cover of bluegrass (*Poa* spp.) and smooth brome (Bromus inermis Leyss.). The soil characteristics at each location in the study are given in Table 1.

Initial treatments were applied to leafy spurge at the true-flowering growth stage in June 1986 or during fall regrowth in August or September 1986.

Table 1. Soil properties at the various experiment locations in North Dakota.

Location	Soil Series	Organic Matter	Sand	Silt	Clay	pH
		(%)				
Chaffee	Fairdale	3.8	51	39	10	7.8
Dickinson	Vebar-Parshall	4.3	65	25	10	6.3
Fargo	Fargo-Ryan	3.6	5	45	48	7.2
Manning	Moreau	3.6	7	43	45	6.0

Treatments included sulfometuron (Oust) at 1 or 2 ounces per acre alone and sulfometuron at 1 ounce per acre with picloram (Tordon) at 8 ounces per acre, dicamba (Banvel) at 32 ounces per acre or 2,4-D at 16 ounces per acre. Picloram at 32 ounces per acre fall-applied was included as a comparison. All treatments were reapplied in June or September in 1987 and 1988 at both locations.

Herbicides were applied with a tractor-mounted sprayer delivering 8.5 gallons per acre water at 35 pounds per square inch. Evaluation of leafy spurge control was based on visual estimates of the reduction of leafy spurge stems compared to the control. Visual estimates of grass injury were based on grass density and height reduction compared to the control from 0 (no effect) to 100 percent (absence of grass). Plots were 10 by 30 feet and replicated four times in a randomized complete block design.

Forage production

An experiment to evaluate the effect of spring- and fall-applied sulfometuron and sulfometuron plus auxin herbicides on forage production of introduced and native grasses was established on a mixed grass prairie near Manning and on a bluegrass spp. and smooth brome pasture at Fargo. The treatments were similiar to the leafy spurge control experiments except picloram plus 2,4-D at 4 plus 16 ounces per acre was included because this treatment has provided good leafy spurge control and forage production (10). Herbicides were applied at Fargo on June 5 and August 29, 1986 and near Manning on June 22 and September 17, 1986. Plots were 10 by 30 feet arranged in a randomized complete block design with four replications.

Kentucky bluegrass (*Poa pratensis* L.), Canada bluegrass (*Poa compressa* L.), and smooth brome were the only graminoid species present at Fargo, and forbs accounted for less than 2 percent of the vegetation. The predominant graminoid species at Manning were Kentucky bluegrass, western wheatgrass (*Agropyron smithii* Rydb.), prairie junegrass [*Koeleria pyramidata* (Lam.) Beauv.], and green needlegrass (*Stipa viridula* Trin.). Occasionally, needle-and-thread (*Stipa comata* Trin. & Rupr.), slender wheatgrass [*Agropyron trachycaulum* (Link) Malte.], Canada bluegrass, blue grama [*Bouteloua gracilis* (H.B.K.) Griffiths], plains muhly [*Muhlenbergia cuspidata* (Torr.) Rydb.], and various sedges (Carex spp.) were present. Sweetclover (Melilotus spp.) was the most abundant forb at Manning. Soil properties are given in Table 1.

Forage production was determined by hand-clipping three 2-by 2-foot areas from the center of each plot. Samples were separated by graminoids and forbs to determine production. Forage samples were collected from the spring-treated and control plots on August 1 and 22, 1986, at Fargo and Manning, respectively, and all treatments were harvested in July 1987.

Results and Discussion

Leafy spurge control

Leafy spurge control from sulfometuron (Oust) applied with an auxin herbicide was greater than from sulfometuron alone, regardless of the application date (Table 2). Sulfometuron spring-applied at 1 and 2 ounces per acre provided only 5 and 12 percent control, respectively, 12 months after the third annual treatment averaged across both locations. However, sulfometuron at 1 ounce plus 2,4-D at 16 ounces per acre, dicamba (Banvel) at 32 ounces per acre or picloram (Tordon) at 8 ounces per acre provided 28, 54, and 66 percent leafy spurge control, respectively.

Leafy spurge control was greater when sulfometuron plus an auxin herbicide was fall-applied compared to a spring application; however, grass injury also was increased (Table 2). Sulfometuron fall-applied at 1 ounce plus picloram at 8 ounces per acre or dicamba at 32 ounces per acre increased leafy spurge control from 17 percent with sulfometuron alone to an average of 93 and 83 percent, respectively. Sulfometuron plus 2,4-D only increased leafy spurge control slightly compared to sulfometuron alone.

Grass injury was evaluated only at Chaffee because of a drought in 1988 that severly reduced the grass density and production at Dickinson. Grass injury from sulfometuron treatments averaged 64 percent and 93 percent with spring- and fall-applied treatments, respectively, 12 months after the last treatment (Table 2). Grass injury was highest when sulfometuron was applied alone in the spring or following any fall treatment that contained sulfometuron. Grass injury increased dramatically with all treatments following herbicide application in 1988 during severe drought conditions (data not shown).

Sulfometuron inhibited leafy spurge root bud growth regardless of the application date or rate. No herbicide injury symptoms were visible but topgrowth ceased after treatment and root buds did

Table 2. Leafy spurge control with sulfometuron either alone or in combination with various auxin herbicides applied annually for three years in the spring or fall at Chaffee and Dickinson, North Dakota.

Annual application date and treatment	Rate	Control	Grass Injury[a]
	(oz/A)	---------- (%)[b] ----------	
Spring			
Sulfometuron	1	5	99
Sulfometuron	2	12	97
Sulfometuron + picloram	1 + 8	66	44
Sulfometuron + dicamba	1 + 32	54	39
Sulfometuron + 2,4-D	1 + 16	28	40
Fall			
Sulfometuron	1	17	77
Sulfometuron	2	21	98
Sulfometuron + picloram	1 + 8	93	100
Sulfometuron + dicamba	1 + 32	83	98
Sulfometuron + 2,4-D	1 + 16	39	90
Picloram	32	98	21
LSD (0.05)		15	26

[a] Grass injury not evaluated at the Dickinson location due to severe drought conditions.
[b] Mean 12 months after third annual treatment.

not elongate. Plants treated with sulfometuron had short, white, spindly root buds compared to pink, swelled, elongated buds on the roots of untreated plants at the end of the growing season (Figure 1). Sulfometuron is the first herbicide known to directly inhibit leafy spurge root bud growth.

Forage production

Sulfometuron (Oust) alone or applied with an auxin herbicide tended to decrease total forage production. Spring-applied treatments tended to reduce total graminoid yield 3 months after treatment (MAT) at Fargo (Table 3). However, by the following growing season (15 MAT) bluegrass production tended to be equal to or greater than the control for all treatments. Sulfometuron residue had apparently dissipated by the 1987 growing season and did not cause bluegrass injury. Smooth brome yield for all treatments was not different from the untreated check. However, a visual evaluation indicated smooth brome discoloration and stunted growth from sulfometuron applied alone compared to untreated plants.

Picloram (Tordon) or dicamba (Banvel) added to fall-applied sulfometuron at 1 ounce per acre decreased smooth brome yield to 46 and 42 percent of the untreated check, respectively, but did not reduce bluegrass spp. production (Table 3). The herbicide combinations may have had a synergistic effect resulting in increased smooth brome injury compared to sulfometuron at 1 ounce per acre applied alone. Increasing the sulfometuron rate to 2 ounces per acre reduced smooth brome yield to 21 percent of the untreated check.

Spring-applied sulfometuron alone and with an auxin herbicide tended to reduce production of bluegrass spp., green needlegrass, and wheatgrass spp. by an average of 26 percent 3 MAT at Manning (Table 4). Picloram and 2,4-D did not affect total graminoid production compared to the untreated check. Precipitation for April through June 1987 was 66 percent below the seasonal average compared to 19 percent above average for the same period in 1986 at Manning. The dry conditions observed prior to and during the 1987 growing season appeared to have affected graminoid production; production was approximately 25 percent less in the untreated check in 1987 than 1986.

Sulfometuron at 2 ounces per acre fall-applied at Manning tended to reduce cool-season graminoid yield compared to the untreated check (Table 4). The greatest injury was to wheatgrass spp. which produced only 19 percent of the untreated check. Sulfometuron at 1 ounce per acre fall-applied did not reduce total graminoid production, although green needlegrass was injured. Bluegrass spp. and wheatgrass spp. production averaged 143 and 190 percent of the control,

Figure 1. Leafy spurge crown root buds in the fall either treated with sulfometuron in June (A) or untreated (B).

Table 3. The effect of sulfometuron alone and with various auxin herbicides on forage production at Fargo when harvested 3 and 15 months after the spring-applied treatments and 12 months after the fall-applied treatments.

		Harvest date					
		1986 (3 MAT)			1987 (15/12 MAT)		
Application date/treatment	Rate	Bluegrass spp.	Smooth brome	Total	Bluegrass spp.	Smooth brome	Total
	(oz/A)	(% of untreated check[a])					
Spring applied							
Sulfometuron	1	79	94	84	113	73	88
Sulfometuron	2	91	92	92	114	71	98
Sulfometuron + picloram	1 + 8	67	103	80	101	109	104
Sulfometuron + 2,4-D	1 + 16	72	112	86	115	118	116
Sulfometuron + dicamba	1 + 32	69	112	86	120	87	108
Picloram + 2,4-D	4 + 16	116	85	105	106	83	98
LSD (0.05)		NS	NS	NS			
Fall applied							
Sulfometuron	1	—	—	—	87	106	94
Sulfometuron	2	—	—	—	92	21	65
Sulfometuron + picloram	1 + 8	—	—	—	101	46	81
Sulfometuron + 2,4-D	1 + 16	—	—	—	103	62	87
Sulfometuron + dicamba	1 + 32	—	—	—	93	42	74
Picloram + 2,4-D	4 + 16	—	—	—	104	69	94
LSD (0.05)		—	—	—	NS	48	18

[a]Total bluegrass spp. and smooth brome production in the untreated check averaged 1120 and 610 pounds per acre, respectively, in 1986, and 1160 and 690 pounds per acre in 1987, respectively.

Table 4. The effect of sulfometuron alone and with various auxin herbicides on forage production at Manning when harvested 3 and 15 months after the spring-applied treatments and 12 months after the fall-applied treatments.

		Yield/harvest date							
		1986 (3 MAT)				1987 (15/12 MAT)			
Application date/treatment	Rate	Bluegrass spp.	Green needle grass	Wheatgrass spp.	Total grass spp.	Bluegrass spp.	Green needle grass	Wheatgrass spp.	Total grass spp.
	(oz/A)	(% of untreated check)							
Spring applied									
Sulfometuron	1	79	78	97	85	109	87	165	117
Sulfometuron	2	77	60	50	66	146	58	155	125
Sulfometuron + picloram	1 + 8	77	94	76	71	105	107	149	119
Sulfometuron + 2,4-D	1 + 16	82	52	85	78	158	82	178	145
Sulfometuron + dicamba	1 + 32	81	70	50	70	145	37	116	114
Picloram + 2,4-D	4 + 16	95	104	87	94	104	68	177	109
LSD (0.05)		NS	NS	NS	NS				
Fall applied									
Sulfometuron	1	—	—	—	—	143	72	190	130
Sulfometuron	2	—	—	—	—	92	72	19	74
Sulfometuron + picloram	1 + 8	—	—	—	—	109	37	59	79
Sulfometuron + 2,4-D	1 + 16	—	—	—	—	109	111	97	106
Sulfometuron + dicamba	1 + 32	—	—	—	—	96	98	118	99
Picloram + 2,4-D	4 + 16	—	—	—	—	146	60	80	110
LSD (0.05)						NS	NS	79	39

[a]Total bluegrass spp., green needlegrass and wheatgrass spp. production in the untreated check averaged 720, 150 and 460 pounds per acre, respectively, in 1986 and 615, 310 and 205 pounds per acre, respectively, in 1987.

respectively, and compensated for the loss from decreased green needlegrass production. Adding an auxin herbicide to sulfometuron tended to increase injury to the wheatgrass spp., especially when applied with picloram.

Changes in graminoid yield may not be evident for one or two years after sulfometuron treatment. Hirsch (5) reported that warm season graminoid vigor and yield were increased following atrazine applications to mixed prairie range sites. However, prairie junegrass was highly susceptible to atrazine and did not recover even after four years. Sulfometuron applied to pasture and rangeland at rates evaluated in this study should not reduce total graminoid yield but may affect long-term production of some graminoid species, especially if applied annually.

Sulfometuron alone or in combination with dicamba or picloram provided better leafy spurge control than the herbicides applied alone at similar rates (13). Sulfometuron initially may injure some graminoids such as smooth brome and green needlegrass and reduce forage production. Sulfometuron in combination with an auxin herbicide could be used in a leafy spurge management program to provide initial control but probably should not be applied annually because of the potential for grass injury.

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