Leafy Spurge Control Following Nine Years of Herbicide Treatment

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Leafy spurge was first reported in North Dakota in 1909 (2) and since then has spread to all 53 counties. Leafy spurge is estimated to infest over 1.2 million acres in North Dakota and is present on nearly 12 percent of the untilled land in the state (8). Loss of hay and beef cattle production is estimated at $23 million annually due to both reduced forage production from leafy spurge competition and to cattle avoiding grazing in leafy spurge-infested areas (10). This loss results in an estimated $75 million in foregone business activity each year in North Dakota.

Livestock carrying capacity of pasture and rangeland can be reduced 50 to 75 percent by leafy spurge (1, 9). In North Dakota, cattle used 20 and 2 percent of the forage available in zero- and low- (less than 20 percent cover) density leafy spurge infestations by mid-season (4). Moderate- and high-density infestations were avoided until early fall when the milky latex in leafy spurge disappeared. Leafy spurge canopy cover of 10 percent or less and shoot control of 90 percent or more was necessary to achieve 50 percent forage utilization by cattle in Montana (3).

An experiment was begun in 1980 to evaluate various herbicide treatments for long-term leafy spurge control. Initially, experiments were established at seven locations in North Dakota to evaluate both leafy spurge control and forage production. The cost-effectiveness of the various treatments at four locations for the first five years was reported in 1985 (5). Picloram at 0.25 pound per acre or picloram plus 2,4-D at 0.25 plus 1.0 pound per acre were the most cost-effective treatments when considering both leafy spurge control and forage production. Forage harvest was discontinued in 1984, but annual herbicide treatments were continued through 1989 to determine if leafy spurge could be eliminated with annual herbicide treatments.

MATERIALS AND METHODS

An experiment to evaluate long-term leafy spurge management was established at seven sites in North Dakota in 1980. However, by 1989 only one spring and one fall location remained, both near Valley City. All sites were established in early June, except one site which was established in September 1980. The herbicides applied in June 1980 included 2,4-D at 2.0 pounds per acre and picloram (tradename Tordon) at 1.0 and 2.0 pounds per acre.

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The whole plots were 15 by 150 feet and treatments were replicated twice at each site. Each whole plot was divided into five 7.5- by 50-foot subplots for retreatments of 2,4-D at 1.0 pound per acre, picloram at 0.25 pound per acre, picloram plus 2,4-D at 0.25 plus 1.0 pound per acre, and dicamba (tradename Banvel) at 2.0 pounds per acre, or no retreatment. The retreatments were applied in June or August 1981 over the spring and fall treatments, respectively.

The whole plots were retreated in 1982 with the original 1980 treatment, except picloram at 2.0 pounds per acre was reapplied only to the control subplot because this original treatment gave satisfactory leafy spurge control. Subplot retreatments were applied annually thereafter from 1983 through 1988.

Leafy spurge control evaluations were based on percent stand reduction as compared to the control. The average herbicide cost during the experiment was 2,4-D at $2.05 per pound active ingredient (ai), dicamba at $12.45 per pound ai, and picloram at $40 per pound ai with an estimated application cost of $2.05 per acre.

RESULTS AND DISCUSSION

No herbicide treatment eradicated leafy spurge (Table). Although control was 80 percent or better with most treatments every year, a few leafy spurge stems always regrew regardless of treatment. Part of the regrowth could be attributed to invasion from nearby plots that had poor leafy spurge control. However, even when experiments have been conducted on large plots, neither annual retreatments nor periodic treatments using high herbicide rates eradicated leaf spurge (7).

Leafy spurge control in 1984 generally was better from spring-applied than from similar fall-applied treatments; however, by the end of the experiment in 1989, control was similar regardless of application date (Table). Plant growth stage during herbicide application may account for the difference in control from 1984 to 1989.

Other research at North Dakota State University has shown that single spring- or fall-applied treatments gave similar leafy spurge control (6). However, the fall-applied treatments in this study were applied to leafy spurge plants that had been mowed for forage harvest in July of each of the first four years. Thus, the leafy spurge was shorter and in the vegetative growth stage compared to the normal fall growth stage. Mowing reduced the leafy spurge leaf area, which may have resulted in less herbicide uptake and translocation compared to other research. Control was less from

Table. Leafy spurge control from spring- or fall-applied treatments during a nine-year management program in North Dakota.

Treatment		Retreatment		Spring-applied		Fall-applied		Total
1980 and 1982	Rate	1981, 1983-1988	Rate	1984	1989	1984	1989	Cost
	(lb/A)		(lb/A)	(% control)				($/A)
A. 2,4-D	2.0	2,4-D	1.0	19	5	14	28	37
B. Picloram	1.0	...	...	81	6	32	15	42
C. Picloram	1.0	Dicamba	2.0	93	82	55	99	172
D. Picloram	1.0	Picloram	0.25	85	92	64	94	174
E. Picloram	1.0	Picloram + 2,4-D	0.25 + 1.0	91	91	62	96	168
F. Picloram	2.0	...	...	82	8	41	8	82
G. Picloram	2.0[a]	Dicamba	2.0	94	77	73	98	184
H. Picloram	2.0[a]	Picloram	0.25	86	83	65	96	166
I. Picloram	2.0[a]	Picloram + 2,4-D	0.25 + 1.0	86	87	68	97	180
J. ...	...	Dicamba[b]	2.0	62	80	25	94	104
K. ...	...	Picloram[b]	0.25	37	83	46	98	86
L. ...	...	Picloram + 2,4-D[b]	0.25 + 1.0	60	86	43	89	100
LSD (0.05)				23	25	19	28	

[a]Retreatments were applied instead of picloram at 2.0 pounds per acre in 1982.

[b]Treatment applied annually 1981-1988; no treatment in 1980.

fall- compared to spring-applied treatments during the first part of the study.

After forage harvest was discontinued in 1984, plants in areas to be fall treated were tall and in the seed-set growth stage when herbicides were applied rather than the fall regrowth stage. The delay in maturity was due to previous herbicide treatment which resulted in delayed emergence the following growing season.

By 1985, all treatments were delayed at least three weeks so the application was close to the desired growth stage. For example, the spring-applied treatments were delayed from mid-June to early July when leafy spurge in the experiment area was in the true-flower growth stage, and the fall-applied treatments were delayed from mid-August to mid-September when the plants were in the seed-set growth stage. The delay in maturity is typical of a long-term leafy spurge control program and land managers must adjust their application timing accordingly.

All annual retreatments except 2,4-D (Treatment A) maintained satisfactory leafy spurge control (Table). The 2,4-D at 1.0 or 2.0 pounds per acre applied annually from 1984 to 1988 provided only 5 percent (spring) and 28 percent (fall) control in 1989. However, 2,4-D was the least expensive treatment evaluated with a total cumulative cost of $37 per acre. The 2,4-D applied in spring did control leafy spurge top-growth long enough to allow for limited grazing, but regrowth generally occurred by mid-August, and an annual retreatment would be required indefinitely. Fall treatments were applied too late in the growing season to increase grazing.

Landowners with a leafy spurge infestation often begin a management program by applying high rates of a herbicide to get immediate results. While North Dakota State University recommendations include picloram at 1.0 to 2.0 pounds per acre to control small patches and keep the infestation from enlarging, high initial rates are not economical on large infestations (6). Even picloram at 2.0 pounds per acre requires a follow-up treatment 18 to 24 months after the initial treatment to maintain satisfactory control.

An annual treatment of picloram at 0.25 pound per acre or picloram plus 2,4-D at 0.25 plus 1.0 pound per acre is less costly than higher picloram rates and gave leafy spurge control after three to four years that was similar to a high rate applied once (6). For example, picloram at 2.0 pounds per acre spring-applied in 1980 with no retreatment (Treatment F) provided 82 percent leafy spurge control in 1984 but fell to 8 percent by 1989 (Table). When picloram at 2.0 pounds per acre was followed with annual retreatments of dicamba, picloram, or picloram plus 2,4-D (Treatments G, H, and I), an average of 82 percent control was maintained with an average cumulative cost of $177 per acre.

When the low-rate annual retreatments spring applied were not preceded with a high-rate initial treatment (Treatments J, K, and L), control averaged only 53 percent in 1984 but increased to 83 percent in 1989 with an average cost of $97 per acre (Table). These same three treatments when fall-applied averaged 94 percent control.

Several long-term management alternatives provide a choice of herbicides and duration of leafy spurge control. If leafy spurge is in an area that can be treated annually with relatively low application costs, then dicamba at 2.0 pounds per acre, picloram at 0.25 pound per acre, or picloram plus 2,4-D at 0.25 plus 1.0 pound per acre were the most cost effective (Table) (5). If the infestation is located where annual application is expensive, then picloram at 1.0 or 2.0 pounds per acre should provide control for two to three years before a retreatment would be required (Table) (7). Although 2,4-D was the least expensive treatment and should minimize spreading, annual 2,4-D treatments will cause minimal reduction of the original infestation.

The effect of leafy spurge control on future land value is difficult to assess, but leafy spurge-infested land will always have a lower value than uninfested land. Small areas of leafy spurge are more economical to control when they first

appear rather than after they have expanded. Herbicide treatments allow utilization of leafy spurge-infested land, and several treatments do reduce the size of the infestation. However, control efforts must be persistent, because a lapse of one or two years will allow leafy spurge to reinfest to the original or greater acreage.

LITERATURE CITED

1. Alley, H.P., N.E. Humburg, J.K. Fornstrom, and M. Ferrell, 1984. Leafy spurge control with vegetative herbicide treatments. Res. Weed Sci., Wyo. Agric. Exp. Stn. Res. J. 192:90-93.

2. Hanson, H.C., and V.E. Rudd. 1933. Leafy spurge life history and habitats. North Dakota Agric. Exp. Stn. Bull. 266.

3. Hein, D.G. 1988. Single and repetitive picloram treatments on leafy spurge (**Euphorbia esula** L.) and resulting changes in shoot density, canopy cover, forage production and utilization by cattle. Ph.D. Thesis. University of Wyoming. 94 p. Univ. Microfilms. Ann Arbor, MI (Diss. Abstr. AAD88-27917).

4. Lym, R.G., and D.R. Kirby. 1987. Cattle foraging behavior in leafy spurge (**Euphorbia esula**)-infested rangeland. Weed Technol. 1:314-318.

5. Lym, R.G., and C.G. Messersmith. 1985. Cost effectiveness of leafy spurge control during a five-year management program. North Dakota Farm Res. 43(1):7-9, 14.

6. Lym, R.G., and C.G. Messersmith. 1985. Leafy spurge control with herbicides in North Dakota: 20-year summary. J. Range Manage. 38:149-154.

7. Lym, R.G., and C.G. Messersmith. [1990]. Cost-effective long-term leafy spurge control with herbicides. Weed Technol. 4:In review.

8. Personal communication. 1989. N.D. Dep. Agric., Bismarck.

9. Reilly, W., and K.R. Kaufman. 1979. The social and economic impact of leafy spurge in Montana. p. 21-24. **In** Proceedings: Leafy spurge symposium. North Dakota State Univ. Coop. Ext. Serv. Unnumbered publication.

10. Thompson, F. 1990. Economic impact of leafy spurge on North Dakota grazing land. M.S. Thesis, North Dakota State Univ., Fargo. 99 p.