Control of Leafy Spurge with Herbicides

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Leafy spurge is difficult to eradicate, but topgrowth control and a gradual decrease in the underground root system are possible if a persistent management program is followed. Nearly all experimental herbicides have been tried on leafy spurge since the introduction of 2,4-D in the 1940s (1, 4, 6). Most of these herbicides have little or no activity on leafy spurge and there are no promising new herbicides becoming available in the foreseeable future. Herbicides commonly used to control leafy spurge include 2,4-D, dicamba (Banvel), glyphosate (Roundup) and picloram (Tordon) (2). Picloram, dicamba and 2,4-D are selective herbicides that control broadleaf weeds while glyphosate is a nonselective herbicide that controls both grass and broadleaf weeds. This review discusses the most effective use of herbicides for leafy spurge control in several management situations.

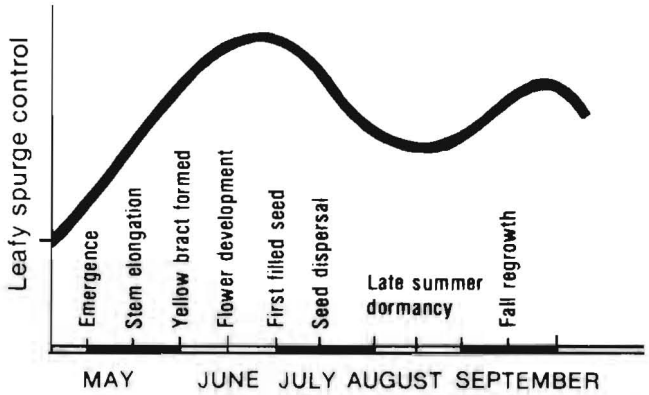

Figure 1. Sensitivity of leafy spurge to 2,4-D, dicamba, or picloram applications made at several times during the growing season.

Timing of Application

The timing of herbicide application to leafy spurge is important for optimum control and is based on the morphological and physiological development of the plant. Leafy spurge control with 2,4-D, dicamba or picloram is best either when flowers and seed are developing during early summer growth or when fall regrowth has developed and before a killing frost (Figure 1). Glyphosate is most effective for leafy spurge control either after seed filling in mid-summer or after fall regrowth has begun until a killing frost. Glyphosate generally provides less long-term control than 2,4-D, dicamba and picloram when applied during spring growth.

The yellow bracts (not true flowers) of leafy spurge usually appear in late May and reach maximum color in early to mid-June, but this is prior to optimum treatment time (Figure 1) and earlier than necessary to prevent seed production. Leafy spurge development in June when control is most effective is characterized by lush green leaves along the entire stem, visible swelling of seed capsules, and vigorous plant growth (Figure 2a). This growth stage for optimum treatment usually begins in mid-June and ends with seed dispersal during hot, dry weather in July. Treatment during the early portion of the optimum period will control established plants and prevent seed production. Herbicide treatment during the latter part of seed set will control established and seedling leafy spurge plants, but viable seed has been produced by this time.

The plant begins a dormant period after seed dispersal and most leaves fall from the stem (Figure 2b). The dormant stage usually coincides with hot dry weather of mid-summer and continues until new fall regrowth is stimulated by cooler weather and rainfall in August or early September. The dormant period generally is not the optimum time to apply herbicides. Fall growth is characterized by a leafless main stem with two or more branches developing below the original flowering branches (Figure 2c). The branches usually are 4 to 6 inches long with small leaves, and the leaves often turn red or yellow as the fall progresses. The plants may appear in poor vigor in late fall, but carbohydrates are being transported to the roots for winter storage and herbicide treatments have been very effective at this time.

Leafy spurge control with herbicides generally follows the morphological and physiological development of the plant as described, but plant response to herbicides can vary almost day-by-day with growing conditions. In particular, control declines with low soil moisture and unseasonably high or low temperatures.

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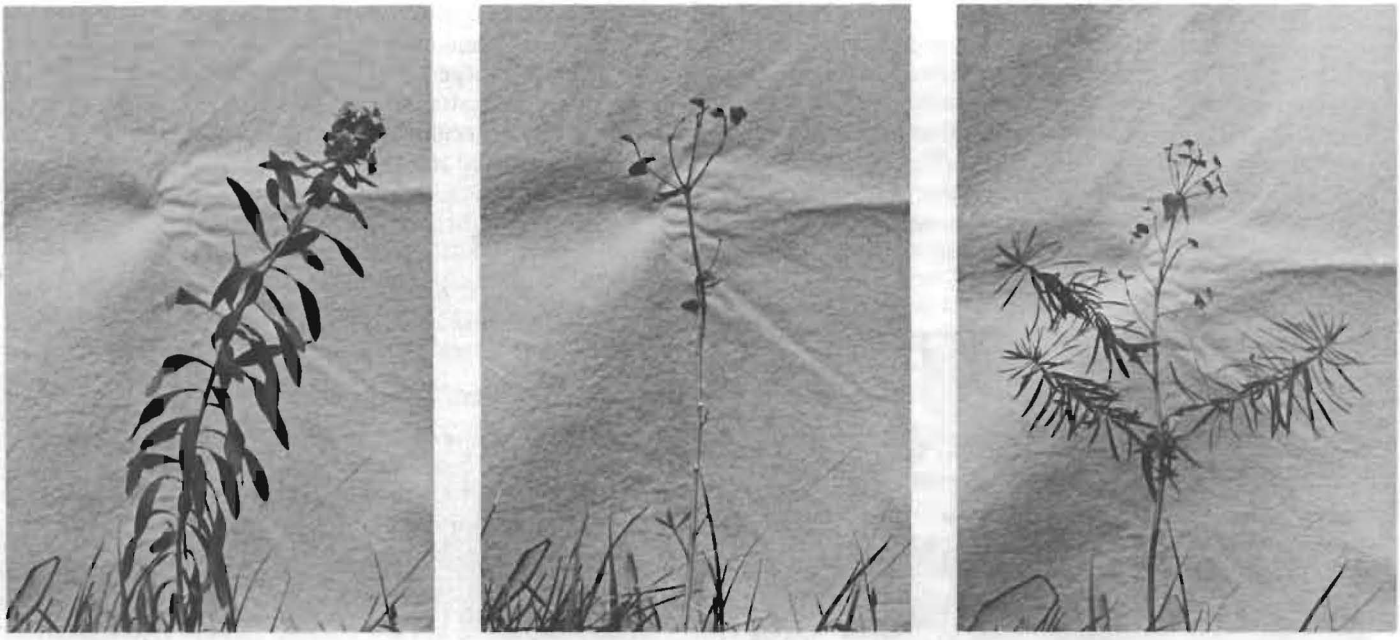

Figure 2. Leafy spurge morphology during the growing season showing: (A) yellow bract formed and flower development, (B) summer dormancy, and (C) fall regrowth.

Control in Pasture and Rangeland

Picloram (Tordon) is the most effective herbicide to control leafy spurge. Picloram granular or liquid formulations at 1 to 2 pounds per acre generally provide similar leafy spurge control. Picloram at 2 pounds per acre applied during seed set in the spring generally gave 90 percent or better leafy spurge control when evaluated one year following treatment, but control decreased gradually in the next two years (Table 1). Forage production in heavily infested pastures nearly doubled in the year following treatment. Forage yields were similar following application of the granular or liquid formulation.

Picloram at 0.25 to 0.5 pound per acre alone or tank mixed with 2,4-D at 1.0 pound per acre applied annually will gradually reduce a leafy spurge stand and is a less expensive treatment than picloram at 1 pound per acre or more. Leafy spurge control was approximately 50 to 60 percent after one year when treated with the picloram plus 2,4-D mixture (Table 1). Additional leafy spurge density reductions should be expected from the annual applications until only small infestations remain after three to five years. This treatment program resulted in a nearly three-fold increase in forage production after the first application. The yield increase was smaller in the following year, but leafy spurge control should increase steadily when picloram at 0.25 pound per acre is applied annually.

Herbicide costs can be reduced by applying picloram with a roller applicator (Figure 3). Picloram roller applied has provided better control than picloram broadcast applied at 1.0 pound per acre (5). Also, the amount of herbicide used in dense infestations has been decreas-

Table 1. Leafy spurge control and forage yield increases from various management programs after three years.

Treatment		Rate		Control			Forage yield	
Year 1	Years 2 & 3	Year 1	Years 2 & 3	Year 1	Year 2	Year 3	Year 2	Year 3
		(lb/A)	(lb/A)		(%)		(% of check)[b]	
Picloram	----------	2.0	—	99	84	63	179	100
Picloram	Picloram + 2,4-D	2.0	0.25 + 1.0	99	86	71	186	143
Roller	----------	1:7[a]	0	84	51	3	198	152
Roller	Picloram	1:7[a]	0.25	84	40	49	222	202
2,4-D	----------	2.0	0	18	9	0	218	100
2,4-D	2,4-D	2.0	1.0	18	13	4	226	129
----------	Picloram + 2,4-D	0	0.25 + 1.0	--	63	32	290	148
----------	Picloram	0	0.25	--	60	70	270	162
Dicamba	----------	8.0	0	40	41	--	--	--
Dicamba	Dicamba	8.0	2.0	40	54	--	--	--
----------	Dicamba	0	2.0	--	46	49	141	176

[a]Picloram (Tordon 22K):water (v:v).
[b]Untreated check = 100%.

ed by 50 to 70 percent compared to picloram broadcast at 2.0 pounds per acre. A greater reduction in picloram applied would occur in less dense stands of leafy spurge. Forage production has consistently been greater following roller than broadcast applications of picloram at 2 pounds per acre (Table 1). The solution concentration applied with the roller should be one part picloram (Tordon 22K) to four to seven parts water (v:v), with the higher herbicide concentration used in denser stands.

Figure 3. A roller applicator showing the carpet covered roller and the herbicide reservoir.

Dicamba (Banvel) is an alternative to picloram for leafy spurge control in pasture and rangeland. Dicamba also is available in a liquid and granular formulation. Dicamba at 6 to 8 pounds per acre will give fair to good leafy spurge control for one year (Table 1), but control usually decreases rapidly during the second year. A retreatment program is necessary to maintain leafy spurge control. Dicamba is less likely to injure grass but has a shorter soil residual than picloram. Roller application of dicamba has been ineffective for leafy spurge control (3).

There are several practical follow-up treatment programs after the initial picloram or dicamba application. The most effective herbicide retreatments both for leafy spurge control and forage production have been picloram at 0.25 pound per acre, picloram at 0.25 pound per acre plus 2,4-D at 1.0 pound per acre, and dicamba at 2.0 pounds per acre (Table 1).

The 2,4-D low volatile ester, oil soluble amine, or water soluble amine at 1 to 2 pounds per acre applied annually gave short term topgrowth control of leafy spurge (Table 1). Spring-applied 2,4-D controlled the topgrowth, but leafy spurge control declined to 50 percent or less by fall and less than 20 percent the following spring. Fall and spring applications of 2,4-D have shown similar leafy spurge control. Applications of 2,4-D both spring and fall have prevented the spread of leafy spurge but generally have provided only small reductions of stand density. Long term control of leafy spurge was not improved when 2,4-D was applied at 10 times the recommended rate (1). However, 2,4-D alone does permit a large increase in forage production compared to no treatment (Table 1). In the short term, 2,4-D is an economical treatment but yearly applications are required indefinitely.

Control in Trees

Leafy spurge is a frequent invader of shelterbelt and other wooded areas. Neither picloram nor dicamba can be used under trees because their long soil residuals are toxic to trees.

The 2,4-D amine or oil soluble amine at 1 to 2 pounds per acre can be used to control leafy spurge topgrowth in trees. The 2,4-D must not contact the tree foliage either by direct spray or drift to prevent tree injury. The 2,4-D ester formulations are volatile, so they are not recommended in trees. Application of 2,4-D must be made annually to prevent the spread of leafy spurge.

Glyphosate (Roundup) at 0.75 pound per acre generally gives 80 to 90 percent control of leafy spurge if applied during fall growth until frost kills the leafy spurge stems. A follow-up treatment of 2,4-D is required for control of seedlings the following spring. A hand held sprayer or garden model controlled droplet applicator (CDA) (Figure 4) are the easiest herbicide application methods in wooded areas. The CDA has the advantages of being very light weight and easy to maneuver in wooded areas. The herbicide:water ratio with the CDA should be 1:4 (v:v) with 2,4-D and 1:3 (v:v) with glyphosate.

Figure 4. A hand-held controlled droplet applicator aplying herbicide to leafy spurge.

Control for Small Infestations

Leafy spurge confined to small well-defined areas should be treated at once to avoid spread of the weed. Picloram at 2 pounds per acre or dicamba at 8 pounds per acre are the most effective treatments, and may eradicate new infestations. The granular formulations of picloram and dicamba are convenient for spot treat-

ments. A 10 by 10 foot square area can be treated with 0.5 cup of Tordon 2K granules (picloram at 2 pounds per acre) or 1 cup of Banvel 5G granules (dicamba at 8 pounds per acre), which generally results in 90 to 99 percent leafy spurge control for two or more years. An extra 10 to 15 feet around leafy spurge patches should be treated to control spreading roots and seedlings around the established stand. A careful follow-up program is necessary for several years to control missed stems and seedlings. Many attempts to control leafy spurge have failed because follow-up treatments were not applied.

Economics of Leafy Spurge Control

An experiment to evaluate 60 long term management alternatives for leafy spurge control and forage production was established at four sites in North Dakota in 1980. Several options for first year treatments were applied in 1980 (Year 1), and retreatment options were applied over the initial treatments in 1981 and 1982 (Years 2 and 3). A few representative treatments were selected to show the trends for leafy spurge control and forage yield increase (Table 1), and a brief economic analysis for several treatments is presented in Table 2. The specific economic values can fluctuate substantially due to year-to-year changes in forage production, cattle prices and herbicide costs, but the economic trends can be a useful management aid.

Picloram at 2 pounds per acre provided the best long term leafy spurge control (Table 1), but was the least economical treatment due to the high cost of picloram (Table 2). The 2,4-D applied once a year at 1 or 2 pounds per acre was the least expensive treatment and provided an economic gain for hay and grazing but the poorest leafy spurge control. Generally, yearly 2,4-D applications would be required indefinitely. Dicamba at 2 pounds per acre provided forage yield increases similar to 2,4-D, but the relatively high dicamba cost resulted in a net loss.

Picloram at 0.25 pound per acre with or without 2,4-D at 1.0 pound per acre applied yearly has provided large forage yield increases, good leafy spurge control, and an economic gain (Tables 1 and 2). The experiments haven't been continued long enough to determine whether leafy spurge can be eradicated with this treatment. Roller applications of picloram have resulted in high forage production, especially when picloram at 0.25 pound per acre is used as are treatment, and the net profit is approaching the break-even point after three years. The fields used in this study had a dense leafy spurge infestation with at least 80 percent coverage, so the roller-applied treatments used approximately 1.0 pound per acre of picloram. Fields with less dense leafy spurge infestations should use less than 1.0 pound per acre of picloram when roller applied and be more profitable.

Conclusion

The extensive underground root system of leafy spurge and the large number of dormant buds makes this plant difficult to control. Picloram at 2.0 pounds per acre is the most effective treatment for leafy spurge control and often is the treatment of choice for small infestations or inaccessible patches since control should last up to three years. Annual applications of picloram at 0.25 pound per acre alone or in combination with 2,4-D at 1.0 pound per acre result in both leafy spurge control and an economic gain to the land user due to increased forage production. Also, annual 2,4-D applications will provide an economic gain through increased forage production, but annual treatments would have to be continued indefinitely. Previously unproductive land can be returned to a productive state if a persistent well planned leafy spurge management program is followed.

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Table 2. Comparison of forage production versus cost of several leafy spurge treatment programs after three years.

Treatment		Rate		Forage		Net return	
Year 1	Years 2 & 3	Year 1	Years 2 & 3	gain[a]	Cost[b]	hayed[c]	grazed[d]
			(lb/A)			($/A)	
Picloram	----------	2.0	0	432	82	-72	-74
Picloram	Picloram + 2,4-D	2.0	0.25 + 1.0	1175	110	-82	-89
Roller	----------	1:7[e]	--	1397	44	-11	-20
Roller	Picloram	1:7[e]	0.25	2281	68	-13	-27
2,4-D	2,4-D	2.0	1.0	1222	15	14	7
----------	Picloram + 2,4-D	--	0.25 + 1.0	1959	28	19	7
----------	Picloram	--	0.25	1963	24	23	11
----------	Dicamba	--	2.0	1374	45	-12	-20

[a]Forage gain = total yield-yield from untreated check for 3 years.
[b]Total cost of herbicide plus application costs for 3 years; estimated application costs for broadcast = $2.05/A and roller = $4.10/A, picloram at $40/lb, 2,4-D at $2.17/lb, and dicamba at $10.30/lb.
[c]Based on hay at $48.00/ton, i.e., [(lb/A forage gain ÷ 2,000 lb/T) × $48/T]-(herbicide cost + application cost) = net return.
[d]Based on cattle price at $0.72/lb, i.e., (lb/A forage gain ÷ 2,000 lb/T) × (50.1 lb(gain)/T) × $0.72/lb-(herbicide cost + application cost) = net return.
[e]Picloram (Tordon 22K):water (v:v).

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