Reprinted with permission from: 1989 Leafy Spurge Symposium. Bozeman, MT. July 12-13, 1989. pp. 36-42.

Sponsored by: Montana Agricultural Experiment Station, Montana State University, Bozeman, MT.

Leafy spurge (*Euphorbia esula* L) control with fluroxypyr

M. A. FERRELL and T. D. WHITSON

Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.

Abstract:

Early reports from Oregon and Wyoming indicated that fluroxypyr (4-amino-3, 5-dichloro-6-fluro-2-pyridyloxyacetic acid) has activity on leafy spurge. Three field studies were conducted near Devil's Tower, in north-eastern Wyoming, to study the activity of fluroxypyr, alone and in combination with other herbicides, for the control of leafy spurge.

A first field study was established to compare the efficacy of initial treatments of fluroxypyr, retreated with dicamba (3,6-dichloro-2-methoxybenzoic acid), 2,4-D LVE ((2,4-dichlorophenoxy) acetic acid), picloram (4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid), and fluroxypyr on the control of leafy spurge. Visual weed control evaluations prior to retreatment applications, showed the leafy spurge to be in a stunted condition with very little flowering. Visual weed control evaluations one year after retreatments showed picloram applied late summer at 0.5 lb ai/a to be the only retreatment that resulted in control, however, this control (approximately 40%) was inadequate.

A second field study involved the use of picloram and fluroxypyr with and without surfactant (X-77) to compare the efficacy of these treatments for the control of leafy spurge. The surfactant, X-77, was not effective in increasing the activity of either picloram or fluroxypyr.

A third field study involved fluroxypyr applied as a tank mix with picloram, dicamba, and 2,4-D LVE for leafy spurge control. No treatments were effective in long-term control of leafy spurge.

Introduction

Leafy spurge is a deep-rooted, herbaceous plant 20 to 100 cm tall. It reproduces by seeds and numerous root and crown buds (Hanson and Rudd 1933). As seed chambers ripen they dehisce explosively, throwing the seed up to 4.5 meters from the parent plant (Bakke 1936). This allows the plant to spread rapidly and form dense infestations of up to 205 shoots per M^2 (Selleck *et al*., 1962). Control is difficult because of an extensive underground root system containing large amounts of carbohydrate reserves (Bakke 1936) and reproductive buds (Coupland and Alex 1955). It also can tolerate various habitats and environmental conditions (Selleck *et al*., 1962).

Leafy spurge has caused scours and weakness in cattle and sheep and may lead to death (Johnston and Peake 1960, Kingsbury 1964, Muenscher 1940). However, sheep have also been reported to graze readily on leafy spurge with no apparent harmful effects (Helgson and Thompson 1938; Landgraf, *et al*., 1984). Cattle grazing capacity may be reduced by as much as 75% due to the competitive effect of leafy spurge (Reilly and Kaufman 1979). Cattle also avoid consumption of leafy spurge and will not eat palatable forages in areas of high leafy spurge density (Lym and Kirby 1987).

Herbicide research to control leafy spurge in Wyoming began in 1952 with 2,4-D. Picloram which became available in 1963 has proven to be the most reliable and effective herbicide for controlling leafy spurge (Vore and Alley 1982). However, long-term herbicide control is either ineffective and/or too expensive (Alley and Messersmith 1985, Messersmith 1979).

Wyoming has over 46,949 acres infested with leafy spurge with infestations present in all 23 counties (Hittle 1983). Although it is primarily a problem on noncultivated land, its presence and control are costly. Wyoming has projected the overall cost of managing 48,619 acres of leafy spurge to be over $10 million (Hittle 1983).

New herbicides must continually be evaluated for activity on leafy spurge in the hope that a more effective and economical means for control might be discovered. Fluroxypyr is a readily translocatable non-phenoxy herbicide showing activity to a large spectrum of broad-leaved plants when applied post-emergence (The Dow Chemical Company). Early reports from Oregon (Whitson 1985) and Wyoming (Whitson and Ferrell 1988) indicated that fluroxypyr has activity on leafy spurge. The purpose of this research was to study the activity of fluroxypyr, alone and in combination with other herbicides, for the control of leafy spurge.

Materials and methods

Three field studies were conducted near Devil's Tower, in northeastern Wyoming, to study the activity of fluroxypyr, alone and in combination with other herbicides, for the long-term control of leafy spurge.

Initial applications of fluroxypyr with retreatments of various herbicides for leafy spurge control**.** A first field study was established to compare the efficacy of initial treat-

ments of fluroxypyr, retreated with dicamba, 2,4-D LVE, picloram, and fluroxypyr on the control of leafy spurge.

Three areas, each 90 ft by 120 ft, were treated with initial applications of fluroxypyr at 3/8, 1/2, and 5/8 lb ai/a. After initial treatments were applied, the areas were divided into plots 9 by 30 ft. with four replications, to which spring and late summer retreatments were applied. The initial treatments were applied broadcast with a $C0_2$ pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi August 12, 1986 (air temp. 96º F, soil temp. 0 inch 115º F, 1 inch 93º F, 2 inch 83º F, 4 inch 78º F, relative humidity 27%, wind south at 5 mph, sky clear). The leafy spurge was 14 inches tall and most of the seed had been shed 4 weeks earlier. The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Spring retreatments were applied May 28, 1987 to a dense stand of leafy spurge 8 to 12 inches tall (air temp. 65º F, soil temp. 0 inch 70º F, 1 inch 60ºC, 2 inch 60º F, 4 inch 55º F, relative humidity 63%, wind calm, sky clear). Late summer treatments were applied August 27, 1987 to high-density leafy spurge 10 to 14 inches tall (air temp. 57º F, soil temp. 0 inch 75º F, 1 inch 70º F, 2 inch 65º F, 4 inch 60º F, relative humidity 77%, wind calm, sky clear).

Picloram and fluroxypyr with and without surfactant for leafy spurge control. A second field study involved the use of picloram and fluroxypyr with and without surfactant (X-77) to compare the efficacy of these treatments for the control of leafy spurge.

Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Treatments were applied broadcast with a $C0_2$ pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi Picloram treatments were applied May 28, 1987 when leafy spurge was in the full bloom stage and 8 to 12 inches high (air temp. 60º F, soil temp 0 inch 60º F, 1 inch 55º F, relative humidity 75%, wind west at 5 mph, sky cloudy). Fluroxypyr treatments were applied July 7, 1987 when leafy spurge plants were setting seed and 10 to 14 inches high (air temp. 80º F, soil temp. 0 inch 95º F, 1 inch 80º F, 2 inch 75º F, 4 inch 70º F, relative humidity 75%, wind south at 5 mph, sky partly cloudy). The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Infestations were heavy throughout the experimental area. Visual weed control evaluations were made June 8, 1988.

Fluroxypyr in combination with various herbicides for leafy spurge control. A third field study involved fluroxypyr applied as a tank mix with picloram, dicamba, and 2,4-D LVE for leafy spurge control.

Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The herbicide treatments were applied broadcast with a $C0_2$ pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi May 28, 1987 (air temp. 60º F, soil temp. 0 inch 60º F, 1 inch 55º F, relative humidity 75%, wind west at 5 mph, sky cloudy). The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was in the full bloom stage and 8 to 12 inches high. Infestations were heavy throughout the experimental area. Visual weed control evaluations were made June 8, 1988.

Results and discussion

Initial applications of fluroxypyr with retreatments of various herbicides for leafy spurge control. Visual weed control evaluations made May 28, 1987, prior to retreatment applications, showed the leafy spurge to be in a stunted condition with very little flowering. Visual weed control evaluations were also made June 8, 1988 to evaluate the retreatments. Picloram applied late summer at 0.5 lb ai/a was the only retreatment that resulted in control, however, this control was inadequate (Table 1).

Table 1. Initial applications of fluroxypyr with retreatments of various herbicides for leafy spurge control. Crook County, 1988.

		Percent shoot control[b]		
		Fluroxypyr initial treatment lb ai/a[c]		
Retreatment[a]	Rate	3/8	1/2	5/8
	(lb ai/a)	(%)		
(Spring)				
dicamba	2.0	0	0	0
2,4-D LVE	2.0	0	0	0
picloram	0.5	0	0	0
fluroxypyr	0.5	0	0	0
check	0.0	0	0	0
(Late summer)				
dicamba	2.0	0	0	0
2,4-D LVE	2.0	0	0	0
picloram	0.5	43	40	40
fluroxypyr	0.5	0	0	0
check	0	0	0	0
LSD (0.05)		2	2	6

[a]Spring retreatments applied May 28, 1987. Late summer retreatments applied August 27, 1987.
[b]Visual evaluations June 8, 1988.
[c]Initial treatments applied August 12, 1986.

Picloram and fluroxypyr with and without surfactant for leafy spurge control. The surfactant, X-77, was not effective in increasing the activity of either picloram or fluroxypyr (Table 2).

Fluroxypyr in combination with various herbicides for leafy spurge control. No treatments were effective in controlling leafy spurge (Table 3).

The results of these three studies indicate that fluroxypyr does not provide long-term control of leafy spurge alone or in combination with other herbicides.

Table 2. Picloram and fluroxypyr with and without surfactant for leafy spurge control. Crook County, 1988.

Treatment[a]	Rate	Control[b]
	(lb ai/a)	(%)
picloram	0.25	3
picloram + X-77	0.25	6
picloram	0.5	10
picloram + X-77	0.5	8
picloram	0.75	30
picloram + X-77	0.75	38
picloram	1.0	43
picloram + X-77	1.0	28
picloram	1.25	38
picloram + X-77	1.25	43
picloram	1.5	50
picloram + X-77	1.5	58
picloram	1.75	58
picloram + X-77	1.75	51
picloram	2.0	61
picloram + X-77	2.0	56
fluroxypyr	0.125	0
fluroxypyr + X-77	0.125	0
fluroxypyr	0.25	0
fluroxypyr + X-77	0.25	0
fluroxypyr	0.5	0
fluroxypyr + X-77	0.5	0
Check	0	0
LDS (0.05)		23

[a]Picloram treatments applied May 28, 1987. Fluroxypyr treatments applied July 7, 1987. X-77 applied at 0.25% v/v.
[b]Visual evaluations June 8, 1988.

Table 3. Fluroxypyr in combination with various herbicides for leafy spurge control. Crook County, 1988.

Treatment[a]	Rate	Control[b]
	(lb ai/a)	(%)
fluroxypyr +	0.5	
picloram	0.25	20
fluroxypyr +	0.5	
picloram	0.5	18
fluroxypyr +	0.5	
dicamba	1.0	0
fluroxypyr +	0.5	
dicamba	2.0	0
fluroxypyr +	0.5	
2,4-D LVE	2.0	0
fluroxypyr +	0.5	
2,4-D LVE	4.0	0
picloram	0.25	0
picloram	0.5	13
dicamba	1.0	0
dicamba	2.0	0
2,4-D LVE	2.0	0
2,4-D LVE	4.0	0
fluroxypyr	0.5	0
Check	0	0
LSD (0.05)		12

[a]Treatments applied May 28, 1987.

[b]Visual evaluations June 8, 1988.

Literature cited

Alley, H. P. and C. G. Messersmith. 1985. Chemical control of leafy spurge. Pages 65-79 *in* A. K. Watson, ed. Leafy spurge. Weed Sci. Soc. Am., Champaign, IL.

Bakke, A. L. 1936. Leafy spurge, *Euphorbia esula* L. Iowa Agric. Exp. Stn. Res. Bull. 198:209-245.

Coupland, R. T. and J. F. Alex. 1955. Distribution of vegetative buds on the underground parts of leafy spurge *(Euphorbia esula* L.). Can. J. Agric. Sci. 35:76-82.

The Dow Chemical Company. Starane Herbicides. Technical information bulletin.

Hanson, H. C. and V. E. Rudd. 1933. Leafy spurge life history and habitats. North Dakota Agric. Exp. Stn. Bull. 266. Fargo. 23 pp.

Helgson, E. A. and E. J. Thompson. 1938. Grazing in relation to the control of leafy spurge. Sci. 88:57.

Hittle, G. F. 1983. Wyoming's leafy spurge program 1978-82 report. Wyo. Dep. of Agric, Cheyenne, WY.

Johnston, A. and R. W. Peake. 1960. Effect of selective grazing by sheep on the control of leafy spurge *(Euphorbia esula* L.). J. Range Mgt.13:192-195.

Kingsbury, J. M. 1964. Poisonous plants of the United States and Canada. Prentice-Hall, Inc., Englewood Cliffs, NJ 626 pp.

Landgraf. B. K., P. K. Fay, and K. M. Havstad. 1984. Utilization of leafy spurge *(Euphorbia esula)* by sheep. Weed Sci. 32:348-352.

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

Messersmith, C. G. 1979. Leafy spurge chemical control workshop. Page 78 *in* Proc. Leafy Spurge Symp. North Dakota Coop. Ext. Serv., Fargo. 84 pp.

Muenscher, W. C. 1940. Poisonous plants of the United States. Macmillan Co., New York. pp. 142-144.

Reilly, W. and K. R. Kaufman. 1979. The social and economic impact of leafy spurge in Montana. Pages 21-24 *in* Proc. Leafy spurge symp. North Dakota Coop. Ext. Ser., Fargo. 84 pp.

Selleck, G. W., R. T. Coupland, and C. Frankton. 1962. Leafy spurge in Saskatchewan. Ecol. Mono. 32:1-29.

Vore, R. E. and H. P. Alley. 1982. Leafy spurge *(Euphorbia esula* L.), Wyoming chemical control research. Univ. Wyo. Agric. Exp. Sta. Bull. MP-46R. 43 pp.

Whitson, T. D. 1985. Comparative treatments of fluroxypyr, dicamba and picloram for leafy spurge control. Pages 46 and 47 *in* Proc. Leafy spurge symp. Bozeman, Montana July 17-18, 1985. 99 pp.

Whitson, T. D. and M. A. Ferrell. 1988. Control of leafy spurge with fluroxypyr. 1988 Western Soc. of Weed Sci. Res. Prog. Rep. pp 57-58.