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FLEA BEETLES FOR LEAFY SPURGE CONTROL
(1998 Field Day Presentation)

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RESEARCH SUMMARY

Flea beetles were released in 1988 and 1989 at two leafy spurge infested sites near Valley City, ND. Above- and below ground characteristics of leafy spurge and the associated plant communities were measured to evaluate the effectiveness of this biocontrol agent for controlling leafy spurge.

Foliar cover, stem density, and biomass of leafy spurge were significantly reduced ($P<0.05$) in flea beetle release sites. Graminoid yields were significantly greater ($P<0.05$) in release compared to control sites. Root weights and bud densities were also reduced ($P<0.05$) in flea beetle release sites indicating root damage by the burrowing larvae. The decrease in leafy spurge dominance and increase in herbaceous yields should result in increased stocking rates and cattle production per unit area from successful flea beetle release sites.

INTRODUCTION

There are over 4,000 exotic plants that have been introduced into North America. Many, such as most small grains, soybeans, smooth bromegrass, crested wheatgrass, alfalfa, etc., are economically important agricultural plant species. However, approximately 10% of the introduced, exotic plant species pose economic problems to land owners and managers. One such plant in North Dakota is leafy spurge (Euphorbia esula).

Leafy spurge is an introduced plant from Eurasia that has been found to be extremely persistent and competitive on pasture and rangeland. It is one of North Dakota's longest listed noxious weeds having been added over 60 years ago (Table 1). In North Dakota, leafy spurge occupies approximately 9%, or 850,000 acres of untilled land (N.D. Dept. of Agri. 1991). Cattle do not graze leafy spurge and even avoid many infested sites resulting in an estimated reduction of direct net annual income of $23 million from livestock sales (Leistritz et al. 1992).

Leafy spurge has been difficult to control. Herbicides have been the most common method to control leafy spurge but successful treatment programs often exceed the total land value (Lym and Moxness 1989, Bangsund et al. 1996). In addition, many areas are not suitable for treatment by herbicide such as riparian zones, wetlands, woodlands, and rough terrain. Sheep and goats readily consume leafy spurge but have received limited acceptance by cattle producers and once grazing is removed, leafy spurge regrows to original densities (Lym et al. 1997). Biological control of leafy spurge using insects has expanded significantly in the 1980's and 1990's, however, limited quantitative information is available regarding these control efforts.

Eight insect species have been released in North Dakota for control of leafy spurge (Lym and Zollinger 1995). Of these, the root-feeding flea beetles (Aphthona spp.) have been the most successful for establishment, reproduction, and redistribution. This study reports on the effects of two flea beetle releases on above- and below ground characteristics of leafy spurge and the associated plant communities.

MATERIALS AND METHODS

Flea beetles were released at two sites in east-central North Dakota. The first release was in 1988 on the Katie Olson Wildlife Management Area approximately 10 miles northwest of Valley City (called the North site). The second site was established in 1989 on private land approximately 10 miles southeast of Valley City (called the South site). Both sites were in the Sheyenne River drainage system which is highly dissected and often steeply sloping (>15%). Soils were a silty clay loam and a silty clay at the North and South sites, respectively. Both sites were typical mixed/tall grass prairie with heavy (>150 stems/yd^2) infestations of leafy spurge. Annual precipitation is 18 inches for this area while approximately 20 inches were received annually over the study period.

Aboveground vegetative sampling was conducted at each site on three randomly selected and permanently located transects in control and insect released areas. Leafy spurge cover and density were estimated from eight 0.1 m^2

(7.9 in x 19.7 in) quadrats positioned randomly along each transect. Leafy spurge and graminoid yields were determined by clipping and drying (60 C) four 0.1 m^2 quadrats along each transect. Vegetative measurements were conducted in late July each year (1993-1995).

Leafy spurge root samples were obtained by coring soil on three random transects in control and insect release sites starting in 1989. Control sites were dropped in 1992 as the insects became established on these sites also. Five random soil cores 6 inches deep and 5 inches in diameter were collected each October from all transects. The leafy spurge roots were extracted from each soil core and washed. Root buds were recorded and the segments later dried at 60 C for dry weight determinations.

The effect of insect biocontrol on leafy spurge infested communities was evaluated as a randomized complete block design with two blocks (location) and two treatments (insect). Blocks were found nonsignificant so a completely randomized design was utilized. Vegetative and root data were analyzed using a one-way ANOVA (SPSS, Inc. 1994) and mean differences were considered significant at the 5% probability level using a Tukey's h test.

RESULTS AND DISCUSSION

Foliar cover of leafy spurge was significantly ($P<0.05$) reduced on flea beetle release sites each year compared to control sites (Table 2). Leafy spurge cover averaged between 44 and 68% annually on control sites compared to pre-study estimates (1988) of 45% (data not shown). A six- to seven-fold reduction in leafy spurge foliar cover occurred between 1988-1989 and 1994 following flea beetle release.

Leafy spurge stem densities were also significantly reduced on flea beetle release sites compared to control sites (Table 2). Pre-study stem densities were estimated at 182 per yd^2. By 1994, flea beetles had reduced leafy spurge stems nearly forty-fold to only 5 per yd^2.

Stem density has been reported to influence cattle grazing behavior in leafy spurge infested pasture. Leafy spurge stem densities exceeding 80 per yd^2 (100 per m^2) decreased cattle use of sites (Lym and Kirby 1987). Additionally, cattle intensify use on non-infested, associated grass dominated areas creating conditions favorable for increased invasion of this noxious weed. Leafy spurge stem densities at flea beetle release sites in this study would not deter cattle from grazing these sites.

Total herbaceous yields were greater ($P<0.05$) on control sites each year of the study (Table 3). However, over half of the yield was contributed by leafy spurge on control sites. Leafy spurge yields were greater ($P<0.05$) on control sites each year, while graminoid yields were greater ($P<0.05$) on flea beetle release sites in 1994 and 1995. Graminoid yields increased approximately 50% between 1993 and 1995 on flea beetle release sites. Since leafy spurge density did not exceed 80 stems/yd^2 on the release sites, cattle would be expected to graze this increased forage supply. This should result in an increased stocking rate and cattle production per unit area from successful flea beetle release sites.

Leafy spurge root weight and root buds were also reduced ($P<0.05$) in flea beetle release sites between 1988 and 1995 (Figure 1). This reduction is caused by flea beetle larvae feeding on leafy spurge roots in fall, winter and spring before emerging as adults in summer. Root dry weight decreased from 5 to 1 ounce per 64 in^3 (4"x4"x4") volume of soil. Root buds decreased from over 80 per 64 in^3 volume of soil to 20 by 1995. This root mass decrease is the main causative agent in the aboveground cover and density reductions in leafy spurge on the study sites.

IMPLICATIONS

The introduction of flea beetles into leafy spurge infested rangeland resulted in decreased cover, density, and biomass of leafy spurge and increased yields of grasses. However, results are not instantaneous. Root biomass was decreased in 2-3 years but beneficial aboveground changes occurred only after 5 years following insect release.

The results of this study should not be interpreted too broadly. Only two of eight flea beetle species were released in this study. Little is known of the habitat requirements of any flea beetle species. Also, soils in this study were clayey/silty and on sideslopes. Flea beetle establishment on sandy soils, overflow or subirrigated sites, and in shrubby or riparian areas have not been successful to date. Finally, successful establishment procedures are not well documented. Questions concerning soils, slope, aspect, leafy spurge density, surface soil litter, over-winter survival, initial release populations, rate of spread, etc. remain to be answered.

Table 1. North Dakota noxious weed list	
Common name	Listed by
Absinth wormwood	1971
Canada thistle	1891
Diffuse knapweed	1996
Field bindweed	1935
Hemp (marijuana)	1971
Hoary cress	1935
Leafy spurge	1935
Musk thistle	1971
Perennial sowthistle	1971
Purple loosestrife	1996
Russian knapweed	1935
Spotted knapweed	1983
N.D. Dept. of Agri.	

Table 2. Foliar cover and density of leafy spurge on insect release sites in east-central North Dakota				
		Year		
Plant characteristic	Treatment	1993	1994	1995
		%		
Foliar cover	Control	68 a[1]	44 a	46 a

	Insect	26 b	7 b	7 b
		#/yd^2		
Density	Control	196 a[1]	193 a	193 a
	Insect	96 b	5 b	4 b

[1]Means within year and plant characteristic followed by a different letter differ (P<0.05).

Table 3. Herbaceous yield on insect release sites in east-central North Dakota

		Year		
Plant category	Treatment	1993	1994	1995
		lbs/ac		
Graminoids	Control	819 a[1]	951 a	889 a
	Insect	928 a	1436 b	1360 b
Leafy spurge	Control	3012 a	1016 a	1112 a
	Insect	661 b	94 b	98 b
Total herbaceous	Control	3831 a	1966 a	2001 a
	Insect	1589 b	1530 b	1458 b

[1]Means within year and plant characteristic followed by a different letter differ (P<0.05).

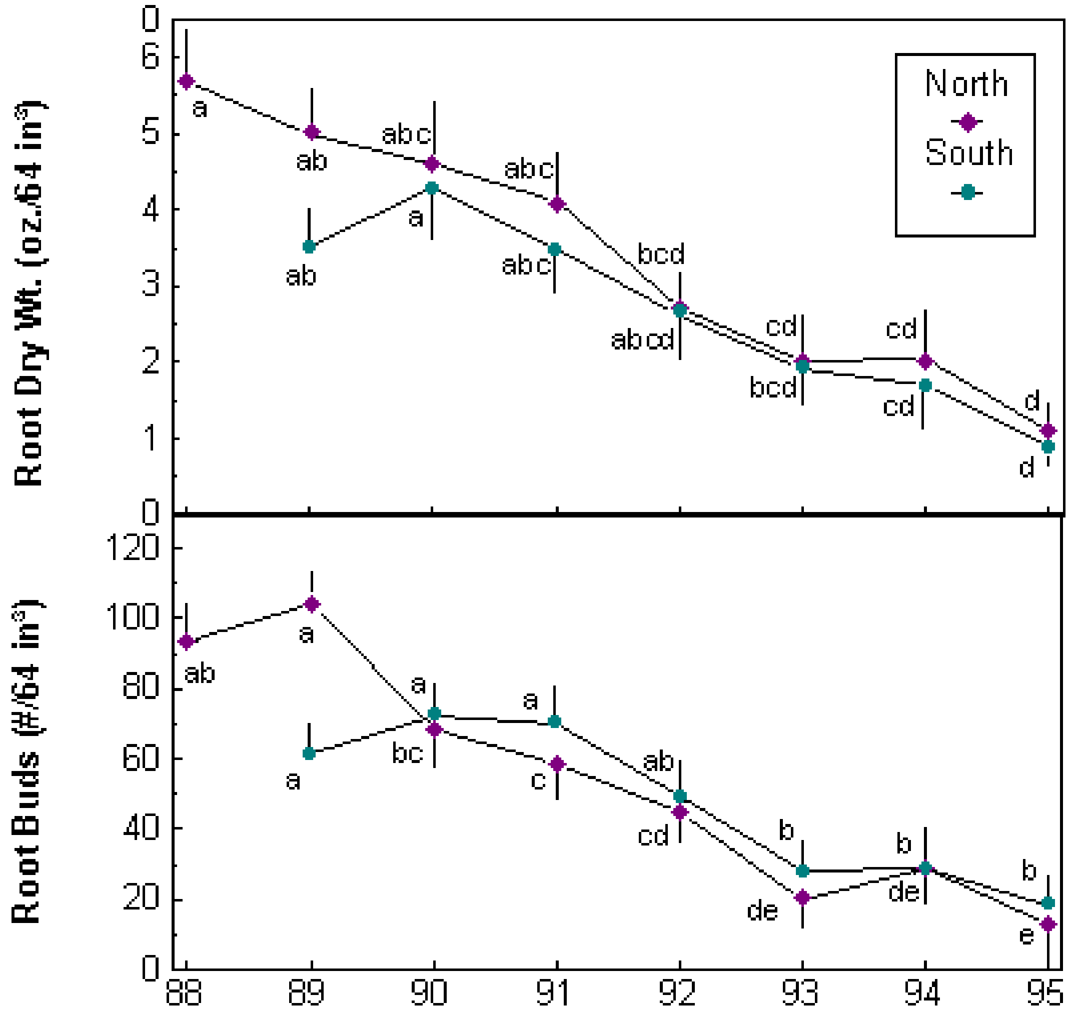

Figure 1. Root dry weight and buds from soil cores following flea beetle release.
Means by location followed by a different letter differ (P<0.05).

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