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Economic feasibility of grazing sheep on leafy spurge-infested rangeland in Montana

KENT E. WILLIAMS, JOHN R. LACEY, AND BRET E. OLSON

Authors are Phillips County extension agent, Malta, Mont. 59538, former extension range management specialist, and associate professor of Range Science, Department of Animal and Range Sciences, Montana State University, Bozeman, Mont. 59717.

Abstract

Leafy spurge (*Euphorbia esula* L.) is a noxious weed on rangelands throughout the Northern Great Plains. Most of these ranges are grazed by cattle which do not use leafy spurge as forage. Although sheep graze leafy spurge, most land managers are reluctant to use sheep to control this noxious weed, which may be related to economic uncertainties regarding their profitability. The purpose of this study was to evaluate the economic feasibility of implementing a sheep enterprise to control leafy spurge on cattle ranches. The physical characteristics of a typical Northern Great Plains ranch, recommended stocking rates for cattle and sheep on native and leafy spurge-infested rangelands, and a sheep enterprise budget were developed using information from the literature. A LOTUS® spreadsheet was developed to calculate returns over total costs of implementing various sheep enterprises. Annual returns from implementing sheep grazing on 520 ha of leafy spurge on a 4,905 ha ranch exceeded total costs by $4,675. Given the ownership costs and returns of our ranch, the breakeven lamb price would be $1.16 kg^{-1}. Returns per head and per unit of land will vary with the distribution and size of a leafy spurge infestation, and sheep production costs and returns. Returns from sheep grazing were higher when leafy spurge was concentrated in fewer rather than in many pastures. Returns were positive when as little as 4% of the ranch was infested with leafy spurge. The availability and utility of our model will allow land managers to assess the feasibility of developing sheep enterprises to control leafy spurge.

Key Words: *Euphorbia esula*, economic analysis, noxious weeds

Leafy spurge (*Euphorbia esula* L.), an aggressive, perennial forb from Eurasia infested over 260 thousand ha of rangeland in Montana in the mid-1980s (Lacey et al. 1985), and has increased at least 25% since that time (H. Stepper, personal communication). Invasion of rangelands by leafy spurge has reduced biodiversity (Belcher and Wilson 1989) and land values for livestock grazing, wildlife habitat, and recreation (Leistritz et al. 1992).

Leafy spurge is difficult to control on range and pastures, though chemical and mechanical control is effective on small infestations (Fay 1992). These strategies may not be economically or environmentally appropriate over large areas. While environmentally appealing, the effectiveness of establishing and using flea beetles (*Apthona* spp.) and other biological control agents to control leafy spurge has not been proven.

Previous research has shown that sheep can be used to control leafy spurge (Johnston and Peake 1960, Bowes and Thomas 1978). Although sheep grazing will reduce density and biomass of leafy spurge, eradication is not likely (Lacey et al. 1985), thus sheep should be considered a long term weed management strategy. This may explain why sheep have not been widely used to control leafy spurge (Alley and Messersmith 1985). Most Montana ranchers raise cattle which do not graze leafy spurge. We believe that sheep are not widely used to control leafy spurge because of economic uncertainties, and possibly managerial constraints associated with using sheep.

Information on costs and returns of using sheep to control leafy spurge on cattle ranches is needed. The objective of this study was to evaluate the economic feasibility of grazing sheep to control leafy spurge on eastern Montana cattle ranches. We developed a model incorporating a LOTUS® spreadsheet to compare different scenarios of sheep grazing leafy spurge.

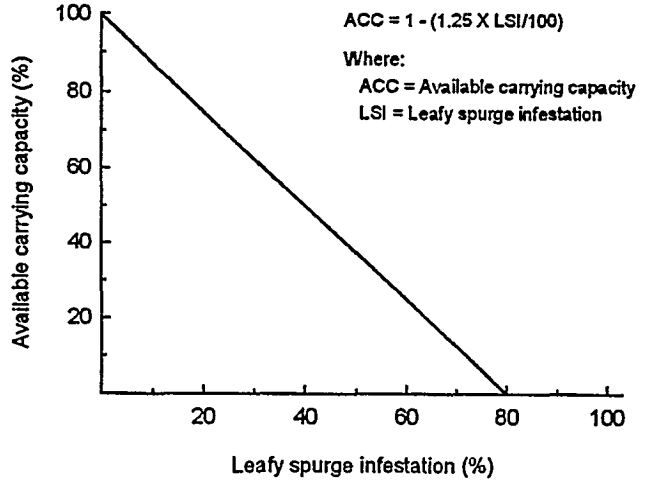

Fig. 1. Influence of leafy spurge infestation on cattle-grazing capacity of rangeland. Adapted from research from North Dakota State University (Leistritz et al. 1992).

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Table 1. Sheep enterprise budget formulated for the Northern Great Plains assuming an average level of management.

Item	
Production characteristics	
Percent lamb crop weaned (%)	140
Market lamb selling weight (kg)	51
Income sources	
Lamb sales @$1.45 kg, 51 kg	$73.95
Cull ewe (16% sold @ $30 hd^{-1})	4.80
Wool sale (4.3 kg @ $2.40 kg^{-1})	10.32
Total income	$89.07
Cash costs per ewe	
grain	$11.02
hay	19.15
mineral and salt	.40
crop residue	.51
supplements	3.00
health	2.00
breeding	4.50
power and fuel	2.00
shearing	2.44
marketing	1.00
machinery	1.50
labor	2.50
miscellaneous	2.00
Total cash costs	$53.02
Return over variable costs	$36.05

Materials and Methods

The typical ranch in southeastern Montana includes 153 ha of cropland, 328 ha of hay, and 4,484 ha of range, a total of 4,965 ha (Johnson et al. 1994). The ranch has 58 km of fence. We assumed the rangeland was fenced into 6 equal sized pastures (747 ha).

The typical ranch carries 471 animal units. Based on an 8-month grazing season, forage from range supplies 3,530 animal unit months (AUMs). For cattle grazing, the average stocking rate of rangeland that is not infested with leafy spurge is 1.27 ha per AUM. Leafy spurge reduces carrying capacity by suppressing forage production, and limits availability because cattle avoid range sites infested with leafy spurge (Lym and Kirby 1987). We used Leistritz et al.'s (1992) model to estimate the influence of leafy spurge infestations on carrying capacities for cattle (Fig. 1). An infestation covering 60% of a pasture reduces carrying capacity for cattle by 75%, or to 25% of its uninfested level. In contrast, sheep readily graze leafy spurge, thus carrying capacities for sheep are unaffected by the level of infestation.

Although leafy spurge density and percent composition varies within plant communities (Selleck et al. 1962), we assumed that leafy spurge composition averaged 50% throughout infested areas. On the basis that leafy spurge makes up to 50% of a sheep's diet (Landgraf et al. 1984), we assumed that sheep would harvest the available forage within areas infested by leafy spurge (Bartz et al. 1985). Forage growing outside of infested areas but within leafy spurge pastures was assumed to be available to cattle. Sheep were substituted for cattle at the ratio of 5:1, and sheep carrying capacity of leafy spurge-infested rangeland was set at 1.27 ha per AUM.

We developed a sheep enterprise budget from Freeman and Jordan (1990) and a Standardized Production Analysis for sheep (SPA; American Sheep Industry 1994). We estimated returns over variable costs of $36.05 per ewe (Table 1).

The opportunity costs of implementing a sheep enterprise on

Table 2. Input variables and output from using LOTUS® spreadsheet to analyze the economics of controlling leafy spurge with sheep.

Pastures with leafy spurge	Ha	Without Spurge ($Ha\ AU^{-1}$)	Without Spurge (AUMs)	Infested (% Ha)	Loss With Spurge (AUM)
Pasture 1	747	1.27	588	50	367
Pasture 2	747	1.27	588	20	147
TOTAL AUMs LOST WITH LEAFY SPURGE					514
Number of months sheep will be grazed					8
Returns over variable cost per sheep ($)Ewe cost ($)					80
Value of a cull ewe ($)					30
Taxes per ewe ($)					2
Years ewe will be in flock					4
Real interest rate (%)					5
Km of fence needed					20
Cost per km of fence ($)					675
Projected life of fence (years)					20
RESULTS:					
Number of sheep that can be run on land infested with leafy spurge					321
Ownership Costs of Sheep:					
Opportunity Cost ($)					2.75
Depreciation ($)					12.50
Taxes ($)					2.00
Total Sheep Ownership Costs $Sheep^{-1}$ ($)					17.25
Total Sheep Ownership Costs ($)					5542.99
Ownership Costs of Fence ($)					675.00
Depreciation ($)					675.00
Total Fence Ownership Costs $Sheep^{-1}$ ($)					4.20
Total Fence Ownership Costs ($)					1350.00
Total Ownership Costs $Sheep^{-1}$ ($					21.45
Total Ownership Costs ($)					6892.99
Returns Over Variable Costs $Sheep^{-1}$ ($)					36.00
Returns Over Variable Costs ($)					11567.97
Returns Over Total Costs $Sheep^{-1}$ ($)					14.55
Returns Over Total Costs ($)					4674.99

Table 3. Influence of the distribution of leafy spurge among pastures, assuming a constant level of infestation (13% of the rangeland on a ranch is infested), on the economic feasibility of implementing a sheep enterprise to control the plant.

	1 Pasture (80%)	2 Pastures (40% each)	3 Pastures (27% each)	4 Pastures (20% each)	5 Pastures (16% each)	6 Pastures (13% each)
Item						
Sheep (number of head)	367	367	367	367	367	367
Km of fence required	11.3	19.4	27.4	33.9	41.9	46.8
Returns ewe^{-1}	16.67	15.18	13.71	12.52	11.05	10.15
Net Returns ($)	6123	5576	5036	4597	4057	3727

Table 4. Relationship between size of leafy spurge infestation within 2 pastures of a 6 pasture ranching operation on the economic returns of implementing a sheep grazing program.

% Infestation	5	10	15	20	30	40	50	60	70	80
Sheep (number of head)	46	9	138	184	275	367	459	551	643	734
Returns ewe^{-1}	-9.72	4.49	9.24	11.62	14.00	15.18	15.90	16.37	16.71	16.97
Net Returns ($)	-449	412	1273	2133	3855	5576	7298	9019	10,740	12,462

the typical ranch were estimated. Although we assumed that woven wire would be placed over existing barbed wire fences (around pastures infested with leafy spurge) to contain sheep, another strand of barbed wire or electric fences could be used to reduce fencing costs in many situations. Fencing costs were depreciated over 20 years which reflects that sheep grazing leafy spurge requires a long term commitment. We assumed that the 6 pastures were rectangular (2 by 3 pastures arranged in a grid pattern). To fence 1 to 6 of these pastures would require 11.3, 19.4, 27.4, 33.9, 41.9, and 46.8 km of materials, respectively. Woven fence was priced at \$65 roll^{-1} (100 m). Ewes were purchased at \$80 head^{-1}. The opportunity cost of implementing the sheep enterprise was calculated using a real interest rate of 5% (Watts and Johnson 1985).

The feasibility of grazing sheep to control leafy spurge was evaluated using a model developed on a LOTUS® spreadsheet. Thirteen input variables were entered: total number of ha in each pasture that contain leafy spurge, ha AUM^{-1} on uninfested range, percent of land within the pasture infested with leafy spurge, the number of months that sheep will be grazed, returns over variable cost per ewe, ewe cost, value of a cull ewe, taxes per ewe, years ewe will be in flock, real interest rate, km of fence needed, cost per km of fence, and projected life of fence.

Model output initially lists the number of AUMs without leafy spurge and the AUM loss resulting from the spurge infestation. Results include number of sheep that can be grazed and ownership costs of sheep and fence. The model is available through the Phillips County Extension Office, Malta, Mont. 59538.

Results and Discussion

Our initial analysis assumed that 2 pastures contained leafy spurge (Table 2). Leafy spurge infested 20% and 50% of the land within the 2 pastures, respectively. The infestations reduced cattle grazing by 514 AUMs. With an 8-month grazing season, 321 sheep could graze those pastures infested with leafy spurge.

Ownership costs were \$5,543 for sheep and \$1,350 for fencing. Returns over variable costs sheep^{-1} were \$36. Returns over total costs sheep^{-1} were \$14.55. Thus, for the 321 sheep returns over total costs were \$4,675. Given these ownership costs and returns, the breakeven lamb price would be \$1.16 kg^{-1}.

The distribution of leafy spurge influences the economic feasibility of using sheep to control the plant (Table 3). If leafy spurge infests 13% of the land base, total returns are \$6,123 if the leafy spurge infests only 1 pasture, but are only \$3,727 if the infestation is spread over 6 pastures. Returns are lower when the infestation is spread over 6 pastures because the costs of implementing sheep grazing are higher with the greater extent of infestation.

The economic feasibility of grazing sheep to control leafy spurge increases as the size of the leafy spurge infestation within a pasture increases (Table 4). Because more sheep are available to pay the opportunity costs of fencing, total returns increase from -\$449 when 5% of the 2 pastures are infested, to \$12,462 when 80% of the 2 pastures are infested. Sheep grazing yielded positive returns when 10% of the 2 pastures were infested. Although returns were negative when only 5% of the pastures were infested, the sheep were being used as a tool for controlling weeds, besides producing wool and lamb. Their costs should be compared with costs of alternative control methods.

Our results provide needed information about the economic feasibility of implementing a sheep enterprise to control leafy spurge on a cattle ranch. Our model could be used to evaluate most conditions in the Northern Great Plains by altering values of input variables. It could then be used to calculate returns over total costs for specific ranch situations.

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