Economic Impact of Leafy Spurge in North Dakota*

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Leafy spurge *(Euphorbia esula)* is a widely established weed in North Dakota, infesting over 1.2 million acres or about 9.2 percent of the state's 13.1 million untilled acres in 1987 (Lym et al. 1988). The North Dakota Department of Agriculture, which conducts an annual survey to estimate the amount of leafy spurge in each county, has found leafy spurge in all 53 counties in North Dakota (Figure 1). The long-lived perennial plant, a native to Europe and Asia, was introduced to North America in 1827 and was first reported in North Dakota in 1909 (Messersmith and Lym 1983). Leafy spurge presents special problems to rangeland and pasture owners because it can reduce livestock carrying capacity by as much as 75 percent (Reilly and Kaufman 1979).

Leafy spurge is a particularly serious problem because of the speed with which it spreads and the difficulty of controlling it given currently available technology (i.e., herbicides). The rapidity with which the weed can spread is demonstrated by the increase in acreages affected. North Dakota had an estimated 200,000 acres with leafy spurge in 1962, but the acreage had more than doubled to 423,425 by 1973, and had doubled again to 861,823 by 1982 (Messersmith and Lym 1983).

The speed with which leafy spurge has been spreading is particularly alarming when the magnitude of present control efforts is considered. During the period 1985-87, North Dakota real property owners were assessed an average of about $770,000 per year for leafy spurge control while the state legislature appropriated about another $181,000 per year. When the landowners' cost share of 20 percent is also considered, the total cost of leafy spurge control appears to have exceeded $1 million per year during this period.

To evaluate the economic feasibility of either presently available chemical controls or the chemical and biocontrol technologies that may be available in the future, a better understanding of the economic effects of leafy spurge infestations is required. Such information also may be useful in making decisions regarding allocation of resources to develop and refine new control technologies.

Examining the economic effects of leafy spurge dispersal requires considering not only the direct effects, such as those experienced by landowners and ranchers, but also the secondary effects on other sectors of the rural economy. A change in an area's resource base or agricultural production practices can have substantial effects on both agribusiness firms and on local trade and service sectors (Leistritz and Ekstrom 1986).

OBJECTIVES

The purpose of the study (Thompson et al. 1990) was to develop a method to estimate the direct and secondary effects of reduced livestock carrying capacity resulting from leafy spurge infestation and to conduct a case study in North Dakota. The specific objectives were:

1. to develop a mathematical function that depicts the growth and spread of leafy spurge over time,
2. to develop a function that relates the increase in leafy spurge infestation to the decrease in livestock carrying capacity for North Dakota pasture and rangeland,
3. to estimate the economic effects of leafy spurge infestation on landowners for both reduced income derived from grazing and reduced land values,
4. to estimate the impacts of leafy spurge infestation on the regional economy, and

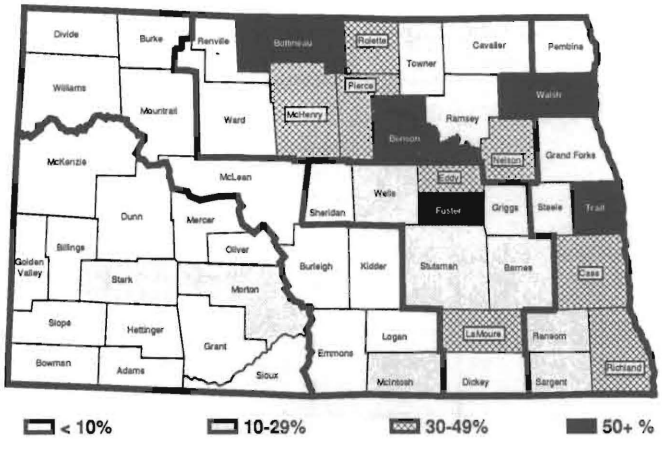

Figure 1. Percentage of pasture and rangeland infested with leafy spurge in North Dakota (U.S. Census and N.D. Dept. of Ag.).

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5. to determine areas where natural resource research could contribute substantially to improving the reliability of economic impact estimates.

PROCEDURES

The leafy spurge growth model and the carrying capacity function were developed through extensive literature reviews and consultations with agronomists and range scientists who have experience in research on leafy spurge (Stroh et al. 1990). Estimating the effect of reduced carrying capacity on landowners' income required establishing a value for units of lost carrying capacity. Two alternative approaches were used to estimate the value of lost carrying capacity (measured in animal unit months or AUMs). These were (1) an analysis of historical rental rates for pasture and (2) a ranch budget analysis. The impact of leafy spurge infestation on the regional economy was estimated using the North Dakota Input-Output Model (Coon et al., 1985). Areas where the state-of-the-science was less than desirable for confidence in the overall model were identified as work progressed through the first four objectives.

CARRYING CAPACITY REDUCTION

A relationship between an increase in leafy spurge infestation and carrying capacity reduction was modeled through review and synthesis of recent literature (Thompson 1990). Carrying capacity is defined as the highest stocking rate that can be achieved without inducing damage to vegetation or related resources (i.e., it is the highest sustainable stocking rate). Leafy spurge infestation reduces livestock carrying capacity in two ways: (1) herbage production is reduced due to competition from leafy spurge and (2) additional useful forage can be lost because cattle totally or partially avoid leafy spurge infested sites, especially early in the grazing season. The relationship between the percentage of a pastureland's area covered by leafy spurge and the reduction in carrying capacity appears to be best approximated by the following linear function:

$$C.C. = 100 - 1.25\ (P.I.)$$

P.I. = percent infestation or the percent of land area covered by spurge

A leafy spurge infestation covering 80 percent of the total land area in a pasture would reduce the carrying capacity to zero from a practical range management standpoint (Figure 2).

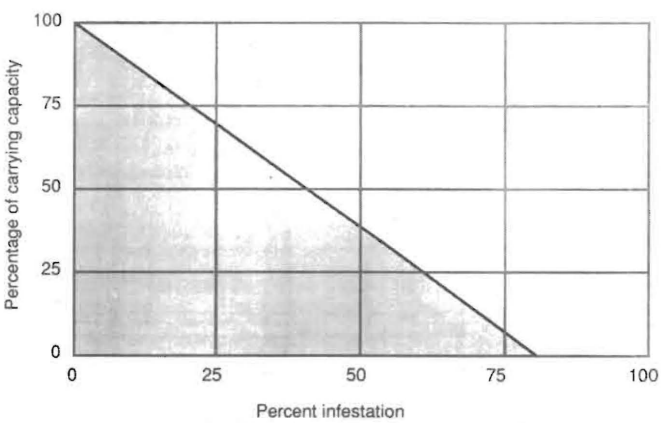

Figure 2. Estimates of reduced carrying capacity caused by various leafy spurge infestation rates (Thompson 1990).

IMPACTS OF FARMERS AND RANCHERS

The impacts of leafy spurge on farmers and ranchers were estimated by computing the value of grazing AUMs for each county and aggregating these values to obtain regional totals for the state. Then the effect of leafy spurge infestation on land values (i.e., potential selling price) was estimated.

The effect of leafy spurge infestation on carrying capacity was estimated for five regions (Figure 3) by dividing the reported acreage of leafy spurge by the total acreage of pasture and rangeland and then applying the carrying capacity model. The reduced AUMs were then valued based on the cash rental rates per AUM. Statewide, the present leafy spurge infestation is estimated to cause a reduction of 577,000 AUMS, valued at $8.6 million (Table 1). The loss in carrying capacity resulting from the present leafy spurge infestation is equivalent to that needed for a herd of about 77,000 cows.

Leafy spurge infestations reduce the productivity of grazing lands and will lead to decreased land values. Over the period 1984-88, grazing land rental rates averaged $8.36 per acre, and the sale prices of such lands averaged $133 per acre. If this value-to-rent ratio of 15.9 is applied to the estimated $8.6 million loss of value of grazing AUMs, then the estimated reduction in grazing land value is $137 million.

Table 1. Effect of Leafy Spurge on Carrying Capacity and Value of Grazing by Region.

Region	Percent Infestation	Reduced AUMs	Value of Reduced AUMs
	------ % ------	- AUMs -	-------- $000 --------
1	4.0	123,600	1,900
2	4.0	56,300	800
3	31.0	196,500	3,000
4	20.8	130,400	1,900
5	29.2	70,200	1,000
State Total	8.6	577,000	8,600

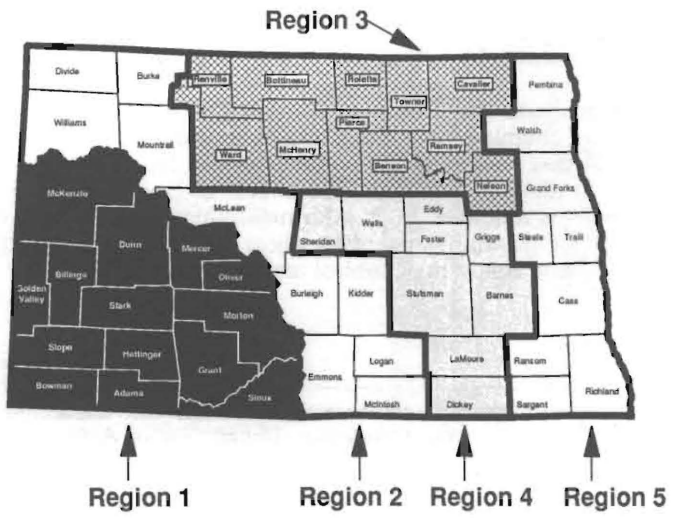

Figure 3. Regions for leafy spurge impact analysis in North Dakota.

IMPACTS ON THE STATE'S ECONOMY

The secondary impacts of leafy spurge infestations on the state's economy arise from two sources: (1) the reduction in income of ranch operators and land owners represented by the loss in grazing value and (2) decreases in production expenditures associated with ranchers' herd reductions. The decreases in production expenditures were estimated using the ranch budget (Hughes et al. 1989). Statewide, the reduction in production expenses associated with decreases in carrying capacity resulting from leafy spurge infestations was estimated to total about $14.4 million. These reductions in expenditures, which are also decreases in revenues for input suppliers, together with the estimated $8.6 million in reduced income to landowners and ranchers constitute the direct impact of present levels of leafy spurge infestation.

The secondary and total impacts of present levels of leafy spurge infestation were estimated using the North Dakota Input-Output Model (Coon et al. 1985). The total impact of the present level of leafy spurge infestation includes a reduction in personal income (i.e., the household sector) of $25 to $26 million, or about $44.20 per lost AUM. Substantial impacts are also shown for the retail trade sector ($19.3 million) and the agriculture—crops sector ($10.7 million). The total reduced business activity for all sectors was almost $75 million. Not included in this business activity reduction is the initial reduction in livestock sales of about $30 million that induced the subsequent economic changes.

CONCLUSIONS AND IMPLICATIONS

Leafy spurge is definitely a problem that warrants attention, both at the farm and regional economy levels. Foregone rancher incomes of $3,600 per 100-cow ranch and land value depreciation of $137 million, coupled with $75 million in foregone business activity, suggest the potential returns to leafy spurge control could be substantial. The high levels of foregone business activity, which also represents foregone tax revenues, further suggest public resources could effectively be used to ameliorate North Dakota's leafy spurge problem; however, attention needs to be paid to the economics of control to ensure the level of control does not exceed that which is economically optimal.

RESEARCH NEEDS

Two areas where additional research is needed to improve the economic impact model are the effect of seed disperal on patch expansion, and the relationship between carrying capacity and infestation by geographic area.

Areas of investigation that would improve empirical estimates of the primary and secondary economic impacts include the site-specific effect of natural or manmade constraints to patch expansion (i.e., roadways, water bodies) and the refinement of the percent distribution and extent of leafy spurge infestation.

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