LEAFY SPURGE — A CHALLENGE IN NATURAL AREAS MANAGEMENT

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Leafy spurge (*Euphorbia esula* L.) is an enterprising weed with a 3 million acre roothold which, according to recent studies, is expanding (Sun, 1981). Many natural area managers are faced with control problems, yet there has been no research designed to determine management for control of leafy spurge on nature preserves and other areas managed for natural integrity. The following review briefly summarizes existing research in leafy spurge control and points out important considerations which can be used to counter its invasion in natural areas.

Leafy spurge has a high degree of resistance to most standard treatments for three main reasons. First, it is very persistent, having a high proportion of its biomass located in relatively inaccessible roots. Bakke (1936) has shown two years of repeated plowing throughout the growing season to be the only means of directly attacking the roots.

Plowing is not a viable option for treating leafy spurge on natural areas, but herbicide application is a frequent choice. The roots seem resistant or only partially susceptible to some major herbicides, probably due to differential absorption and translocation (Bybee, 1979). For example, one of the most widely used herbicides, 2,4,-D, has only moderate impact except at very heavy application rates (Alley, 1979; Vore and Alley, 1980) or with multiple applications per year (Selleck et al., 1962). Some applications of the phenoxy herbicide, Tordon, have been 100% effective (Alley, 1979; Alley and Vore, 1980), but even those well-planned cases of apparent complete effectiveness deserve monitoring for a couple years, and must be weighed in light of other impacts.

A second factor in controlling leafy spurge is its resistance to stress. It is moderately drought resistant, having a thick leaf cutinization, sunken stomates, and a thick cork layer surrounding the roots (Hanson and Rudd, 1933). The viscous white latex throughout the plant has its own distinctive starch grain (Hanson and Rudd, 1933). The extensive root system has enormous starch deposits in both translocation and storage tissue (Bakke, 1936). These carbohydrate reserves are readily built up so that a seedling seven days after germination can grow back when its stem is clipped (Selleck et al., 1962). No studies to date have demonstrated a treatment timing, effective in depleting carbohydrate reserves, except that chemical treatments have had a relatively high success rate when employed at the end of seed production (Messersmith pers. comm.).

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Stress put on leafy spurge in most non-chemical treatment studies is not adequately severe to eradicate the plant. Mowing initially increases stem density (Selleck et al., 1962); results of repeated mowing have not been reported. Sheep have shown a preference for leafy spurge and have reduced it to a non-spreading stubble over four years (Johnston and Peck, 1960). Fire impact seems to have varied with season, though results are inconclusive. Only four studies are known to have recorded leafy spurge fire response. These were conducted at different times in the growing season, and only two were deliberately aimed at controlling leafy spurge. A summary of these studies is presented in Table 1. The remaining non-chemical option, biological control, is in an exploratory phase. Release of the spurge hawkmoth (*Hyles euphorbiae*) has not proven adequate in itself (Forwood and McCarty, 1980; Montana Agricultural Experiment Station, 1979), but some select combination of leafy spurge's 96 European pests might together effect control (Harris, 1979). These methods have not been tried in concert. Only mowing has been tried in conjunction with chemical control to break leafy spurge resistance.

The third reason that leafy spurge is difficult to control is the readiness with which it reproduces. Vegetative reproduction is the primary means of increasing stem density. Seeds are capable of starting new colonies through dissemination by water, animals, and self-propulsion over short distances. They retain their viability in the soil for up to five years (Bakke, 1936). Furthermore, the species is a habitat generalist, occupying a wide range of soil textures, topographic positions, and sunlight exposures (Selleck et al., 1962). Though it is usually most severe on the most highly disturbed mesic sites, it can inhabit a broad range of disturbance conditions. Consequently, it cannot be locally isolated within some single habitat or disturbance condition.

Generally when control is attempted, coordinated management efforts are necessary for optimal effectiveness. Noble and McIntyre (1979) found that range condition is important in affecting both seedling vigor and population density. Other studies have shown that leafy spurge seedlings seem to be sensitive to competition, thereby reducing shoot vigor (Morrow, 1979) and fecundity (Bakke, 1936; Selleck et al., 1962). As a result, early spring grazing may complicate the spurge problem by decreasing the ability of cool season grasses to compete for water. The same affects have not been studied in relation to native grasslands but the vigor of a surrounding native plant community could be a deterrent to leafy spurge population explosions.

In addition, land managers must consider specific local problems. For example, natural area sites must be viewed in light of leafy spurge occurrence on nearby properties. Eliminating leafy spurge infestations is a local all-or-none effort. A perspective on the extent of local management problems should be gained from the local experts.

The urgency of the situation must also be carefully assessed. Factors which would in most cases warrant immediate action are large leafy spurge populations or extensive areas of potential habitat near existing populations. There are potential alternatives to immediate action. Experimental designs might be established using chemical or the under-documented non-chemical controls, either alone or in combination. A land manager might also wait in dealing with the problem until local support is rallied or until more experimental results come in, while continuing to monitor the leafy spurge population.

TABLE 1. Leafy spurge response to fire

AUTHOR	TIME OF BURN	SITE	RESEARCH QUESTION	RESPONSE MEASURE	RESULT
Barker, W. *	Early May, 1979-81	Sheyenne Nat'l Grasslands Eastern, ND	General control by fire	Stem counts	Increase
	Early Oct. 1980	Sheyenne Nat'l Grasslands Eastern, ND	General control by fire	Stem counts	Increase
Bjugstad, A.* and D. Noble	Oct. 20-23, 1980	Western South Dakota	Seed viability control by fire	Seedling counts	Decrease
Dix, R.L.	Sept. 30, 1958	Theodore Roosevelt Nat'l. Mem. Park, West. N D	Vegetation comparison of wildfire burn areas vs. unburned areas	Frequency	Decrease
Olson, W.W.	June, 1973	Tewaukon National Wildlife Refuge Eastern ND	Vegetation comparison of controlled burn areas vs. unburned areas	% Canopy coverage	No change
	August, 1973	"	"	"	"
	June, 1974	"	"	"	Increase
	August, 1974	"	"	"	Increase

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When deciding on a control technique, managers should be wary of species generalizations, because various ecotypes may respond differently to similar control practices (Barreto et al., 1980). There are also no foolproof techniques; the methods of application, phenological timing, and weather conditions, each call for independent considerations.

In summary, there is not a perfect prescription for control of leafy spurge in natural areas. Citations in this review provide an overview of the options and points to consider. County agents, state experimental stations, and the new Leafy Spurge Newsletter serve as clearinghouses for new developments in the field at large. A review of leafy spurge biology is being prepared by Galitz (in press). Finally, we must make the results of leafy spurge control efforts on natural areas available to other land managers and the scientific community.

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