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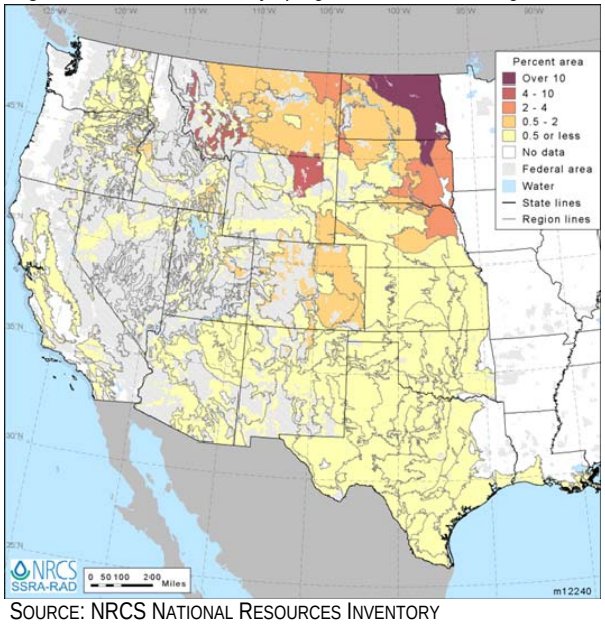
RANGELAND CONSERVATION ANALYSIS #3
CONTROLLING LEAFY SPURGE ON RANGELANDS IN THE NORTHERN PLAINS

The Issue

Leafy spurge (*Euphorbia esula*), a deep-rooted exotic perennial weed, is a serious threat to the health and sustainability of rangeland ecosystems in the Northern Plains. It infests more than 1.4 million acres of U.S. non-Federal rangelands (NRI 2003–06 rangeland field data). Leafy spurge foliar cover is greater than 20 percent on approximately 160,000 acres of non-Federal rangeland, 10 to 20 percent on 239,000 acres, and less than 10 percent on 961,000 acres. Montana, North Dakota, and South Dakota have the heaviest infestations (fig. 1), but the plant is also becoming a problem in Colorado, Nebraska, Wyoming, and Idaho. In North Dakota, leafy spurge acreage has been estimated to double every 10 years (NDSU 2011).

When leafy spurge invades a system, it out-competes and replaces native grasses and legumes, weakening ecosystem stability and diminishing ecosystem services (Steenhagen and Zimdahl 1979). Leafy spurge also produces biochemicals that inhibit the growth of native species (Qin et al 2006). Leafy spurge is toxic to cattle (Halaweish et al. 2002), and the milky latex it produces contains substances that act as irritants and cause blistering and scour when eaten. When leafy spurge reaches 10 percent foliar cover it starts to have significant impacts on forage consumption by cattle. For each 10-percent increase in leafy spurge foliar cover there is a reduction of approximately 20 percent in forage consumption, and as infestations reach 50 percent foliar cover, forage consumption may cease altogether (Hein and Miller 1992; Lacey et al. 1984). This can lead to overgrazing of non-infested areas. In North Dakota alone, leafy spurge causes an estimated $75 million in lost production annually (NDSU 2011). Native ungulates also tend to avoid leafy spurge infested areas. One North Dakota study reports reduction in use by bison, elk, and deer of 79 to 83 percent (Trammell and Butler 1995). No toxicity has been demonstrated for sheep, however. In one study, sheep showed no ill effects from consuming leafy spurge as 40 to 50 percent of their diet (Landgraf et al. 1984).

Figure 1. Distribution of leafy spurge on non-Federal rangelands



SOURCE: NRCS NATIONAL RESOURCES INVENTORY

Control Measures

Due to the plant's extremely deep and hardy root system, and because leafy spurge reproduces by both seed and vegetative means, control of established leafy spurge populations in uncultivated areas is costly and must take place continuously over several years. It is easier to control within the first 2 years after establishment, before the root system has developed a large nutrient reserve that allows the plant to regrow from deep under the surface. After the fourth year the root system becomes so well developed that the plants will not be killed by a single mowing, and herbicides are not translocated to the deepest portions of the roots (NPS 2012). Further, while eradication of local infestations is possible, unless all seed sources are controlled continued treatments will be necessary to prevent re-establishment.

Leafy spurge is difficult and costly to control if infestations are not found and treated early enough. Though it may be

controlled with cultural practices such as disking and/or plowing every few weeks for 2 years, these methods are not practical on range and pasture lands where control costs often exceed the value of the land (Lavigne 1984; Watson 1985) and the disturbance increases soil erosion risk. Research conducted by USDA over the last 4 decades has provided land managers with a series of conservation options to reduce the impact of this invasive plant (ARS 2011).

Prescribed Grazing

Because leafy spurge is not toxic to all animals, prescribed grazing can be used to combat leafy spurge invasions (fig. 2). Temporary fencing and water developments may be needed to concentrate sheep or goats in the affected area (Lacey et al. 1984). To maximize livestock preference for leafy spurge, it is recommended that a closed flock of sheep or goats be used so that all replacements into the flock are reared on spurge-infested pastures (Walker et al. 1992). For leafy spurge, Rinella and Hileman (2009) recommend very light prescribed grazing conducted early in the growing season. Prescribed grazing may take 4 or more years to reduce the impact of leafy spurge infestation (Johnson and Peake 1960, Olsen and Wallander 1998).

Biological Control

Flea beetles can be used on appropriate ecological sites to weaken leafy spurge plants by eating the leaves in the spring (fig. 2). The larvae feed heavily on the roots, causing stunting and may eventually kill the plant. Flea beetles have been established in the United States and Canada (McClay and Harris 1984, Pemberton and Rees 1990) and are having some impact on reducing leafy spurge. Biological control is more effective when combined with other conservation actions, such as prescribed grazing with sheep or goats (Jacobs et al. 2006) and appropriate use of herbicides and reseeding.

Prescribed Burning

Though it will not control leafy spurge by itself, in some cases prescribed fire can be paired effectively with biological control. Prescribed fire can remove leaf litter and increase bare soil resulting in more favorable habitat for the leaf beetle. Use of fire should be delayed until after mid-August to ensure that eggs have been laid. Further, a comprehensive conservation plan should be developed prior to application of disturbances that increase bare ground in arid and semiarid regions due to the potential for increased erosion and loss of ecosystems services associated with soil stability, including loss of soil carbon and valuable soil nutrients.

Herbicides

Chemical herbicides can be used in conjunction with other control measures in some locations. The timing of herbicide applications depends on the specific herbicide, but most indicate that the best timing is when the true flowers and seeds are developing, or after the stems have developed new fall regrowth and plants are moving nutrients downward into the roots (NRCS 2011). As with other treatment options, herbicides need to be used for 3 or 4 consecutive years.

Figure 2. Leafy spurge is a persistent weed common to the U.S. Northern Plains and Canada. Prescribed grazing using sheep can be used in combination with flea beetles to remove leafy spurge

However, leafy spurge spreads along waterways and the use of most chemical herbicides in these areas is prohibited because of possible contamination of water supplies.

Treatment Costs

Conservation practice availability and costs vary by State due to different environmental and legal constraints. This analysis provides a range of options and costs, but exact prescriptions to be used in designing conservation plans depend on site conditions (slope, aspect, soils, density of infestation, density of residual native vegetation, and goal of producer) and prevailing legal and regulatory constraints within the State where practices will be deployed. Treatment costs to eradicate leafy spurge depend on the degree of infestation. Table 1 shows NRCS practice cost data for the primary conservation practices used to treat leafy spurge infested rangeland.

When leafy spurge infestations are first identified, some practices may be applied individually, such as spot treating with herbicides or prescribed grazing. The cost of treating the 961,000 acres with less than 10 percent leafy spurge cover would range from $12 to $20 million per year if prescribed grazing could be implemented singularly.[1] If spot treatment with ground applied herbicides is also needed, costs could rise to $46 to $54 million per year.

Eradicating mature leafy spurge infestations is costlier and typically requires combining conservation practices into a resource management system, and at least 3 years of treatment. For areas where leafy spurge exceeds 10-percent plant cover, a typical conservation system could cost $72 per acre per year if prescribed grazing were used in combination with aerial herbicide application and biological control, or $157 per acre if prescribed grazing were used in combination with ground-applied herbicide application and biological control. Treating with 3-year conservation plans all 399,000 non-Federal rangeland acres that have greater than 10 percent leafy spurge cover would cost $86 to $188 million.

[1] Additional practices such as fencing and water development (pipeline or pond) may be required to fully implement prescribed grazing. These costs are not included in the assessment.

Conclusions

Invasive plant management has traditionally focused on treating established populations of invasive plants. Less emphasis has been placed on preventing invasions by protecting non-infested rangeland (Sheley et al. 2011). A proactive approach focused on systematic prevention and early control provides solid economic returns; on average, every dollar spent on early intervention prevents $17 in later expenses (OTA 1993).

Leafy spurge control must be considered a long-term management program. Landowners and land managers need to concurrently contain present infestations, monitor adjacent acreage to keep the weed from spreading, and design long-term programs to gradually eliminate dense infestations. The major components of invasive plant prevention programs include monitoring to detect early infestations, eradicating satellite patches, and increasing the invasion resistance of desirable plant communities and soil systems (Davies and Sheley 2007). Managing non-infested rangelands to promote maximum potential ecosystem and soil stability by enhancing diversity, promoting conditions that reduce disturbance, and maximizing productivity should minimize invasion and protect non-infested rangeland (Sheley et al. 2011).

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Table 1. Conservation practices and costs that can be combined to reduce impact of leafy spurge in the Northern Plains and restore native rangelands

Conservation Practice	Cost per acre
Prescribed Grazing (528)	$12.75 - $21.35
Integrated Pest Management (315)*	$21.78 - $250
Biological control	$15.40
Herbicide	$35 - $250
Range Planting (550)	$42.40 - $67.12
Prescribed Burning (338)	$12.60
Upland Wildlife Habitat Management (645)	$3.40 - $30

** Depending on the site, Integrated Pest Management may incorporate numerous individual practices to develop an effective conservation plan, such as Forage Harvest Management (511), Prescribed Grazing (528), Forest Stand Improvement (666), Wetland Wildlife Management (644), Upland Wildlife Habitat Management (645), and Herbaceous weed control (315).*

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