



# Integrated Management of Leafy Spurge

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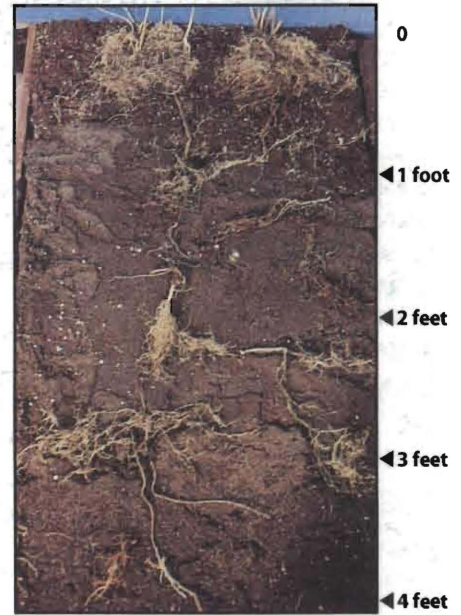
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**L**eafty spurge is the most difficult noxious weed to control in North Dakota and infests all 53 counties in a variety of environments (Figure 1). Leafy spurge is found in pasture, rangeland, cropland, roadsides, shelterbelts, and other non-cultivated areas. Cultivation will control leafy spurge in conventional cropland, but the weed can become the dominant species in reduced-till cropland, pasture, and rangeland if not controlled.

The well developed food storage system in leafy spurge roots enables

the plant to withstand a variety of control methods (Figure 2). Roots are most abundant in the upper foot of soil but can extend to a depth of at least 15 feet. The roots contain many buds that can produce new shoots if the upper portion is destroyed.

Herbicides are the most widely used treatment for leafy spurge control. However, control with herbicides is not always practical due to the high cost of treating large infested areas. Also, the weed frequently occurs in environmentally sensitive areas, such



**Figure 2. Roots of leafy spurge often grow to the water table and contain a large reserve of nutrients allowing the plant to regrow despite repeated control efforts.**



**Figure 1. Leafy spurge plant in flowering growth stage.**

as near water, where herbicide use is restricted. Non-herbicide control options such as biological and cultural methods can provide good but not complete leafy spurge control. An integrated control program combining two or more methods will provide a more successful and cost-effective long-term solution to the leafy spurge problem than a single method used alone.



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## Herbicides

Picloram (Tordon) + 2,4-D at 0.25 to 0.5 pound per acre (1 to 2 pints per acre) + 2,4-D at 1 pound per acre (1 quart of a 4-pound-per-gallon concentrate) is the most widely used treatment for both leafy spurge control and improved forage production in North Dakota. This treatment will provide 90 percent or greater control in three to five years when applied annually. Dicamba (Banvel), glyphosate + 2,4-D (Landmaster BW), dichlobenil (Norosac), fosamine (Krenite), sulfometuron (Oust), and glyphosate (Roundup and Rodeo formulations) are also labeled for leafy spurge control in North Dakota. Several of these herbicides have specific uses, such as near water, on non-cropland, or near trees. Consult Extension Service Circular W-765, **Leafy Spurge Identification and Control**, for a complete discussion on herbicides to control leafy spurge.

## Insects

A major program for leafy spurge bio-control was initiated across the United States in the 1980s. Eight insects for biological control of leafy spurge have been released in North Dakota. The spurge hawkmoth (*Hyles euphorbiae*), a foliar feeder, generally has not survived and when it does, provides control too late in the growing season to be very useful. Five root-feeding flea beetles, *Aphthona cyarissiae*, *A. flava*, *A. czwalinae*, *A. lacertosa*, and *A. nigrescutis*, and a gall midge, *Spurgesa esulae*, have established and reproduced at several sites in the state and region. A stem-boring beetle, *Oberia erythrocephala*, has been released at two locations in North Dakota but has not increased in sufficient numbers to allow redistribution.

The *Aphthona* spp. (Figure 3) are effective for leafy spurge control because the larvae feed on the root system, the populations can increase rapidly after introduction, and the insect is easily captured for transport to additional locations. *A. nigrescutis* has been the most successful flea beetle for leafy spurge control in North Dakota and has been redistributed to all 53 North Dakota counties.

Flea beetles are distributed through the North Dakota Biological Control Program. Contact your county weed officer or a member of your local weed board for information. *A. nigrescutis* should be released on a well-drained south-facing slope, with sandy or sandy loam soil with a moderate density of leafy spurge (60 to 90 plants per square yard) over a 5-acre area, and with minimal grass cover and thatch for best establishment. Consult your local weed officer for the most desirable locations for release of other *Aphthona* spp.

Flea beetle populations take three to five years to become well established and the insects should not be collected or moved during this time. While the insects are establishing do not spray insecticides within a quarter-mile of the site, cultivate or burn the release site. During this time landowners should prevent expansion of the leafy spurge infestation. The prevention program should include monitoring of the insect population to determine the boundaries and treating the perimeters



**Figure 3.** Leafy spurge flea beetle adults feed on the foliage (top), but the real damage to the plants is from larvae feeding on the root system (bottom). Photos courtesy of Dr. Bob Carlson, NDSU.

with herbicides. Herbicides should not be applied directly over the insects in early summer since this would remove the food source for adult beetles. Once established the insects should be redistributed by the land manager, as flea beetle movement to other infested areas is slow.

The leafy spurge gall midge (*Spurgesa esulae*) has established in several areas of North Dakota and has reproduced most successfully when released in wooded areas or near shelterbelts. The gall midge prevents galled stems from flowering, thereby decreasing seed production (Figure 4).

The gall midge generally infests only part of a leafy spurge population so seed production is reduced, but not eliminated. A second control method is needed to reduce the original infestation and prevent spread by roots and seeds of plants not galled. Research at NDSU has shown that the leafy spurge gall midge is compatible with herbicide treatment in an integrated leafy spurge management program. Herbicides such as Tordon or 2,4-D should be applied at the optimum growth stage for leafy spurge control. Some of the area (perhaps 15 to 25 percent) must be left untreated to sustain the insect population.

The integrated program may be most useful near wooded areas or rough terrain. Herbicide treatment would prevent leafy spurge spread outside the tree area or inaccessible site and the gall midge would reduce seed production within the areas where herbicides generally cannot be used.



**Figure 4.** Leafy spurge stem tip galled by *Spurgesa esulae* larvae which prevents seed set.

## Grazing

Sheep and goats provide an alternative to herbicides for controlling leafy spurge topgrowth in pasture and rangeland. Grazing alone will not eradicate leafy spurge but will reduce the infestation, slow the spread of the weed, and allow grasses to be grazed by cattle and horses. Grazing should be started early in the spring when the plant first emerges. On large infestations, pastures should be divided so animals can be regularly rotated and the entire infestation grazed in a timely manner.

Sheep and goats are best suited to control leafy spurge on large infestations, or along waterways and tree areas where chemical control is restricted or cost is prohibitive. NDSU research has shown that grazing leafy spurge with goats followed by a fall applied herbicide treatment provided better leafy spurge control than either method used alone. The goats were allowed to graze until mid-August, then removed to allow 3 to 4 inches of leafy spurge regrowth. Then Tordon plus 2,4-D was applied at 0.5 plus 1 pound per acre (1 quart plus 1 quart of a 4 pound-per-gallon concentrate) in mid-September. Leafy spurge density was reduced over 95 percent when this program was followed for three consecutive years.

Recommended stocking rates vary with terrain, leafy spurge density, and rainfall during the growing season. Sheep should be grazed at approximately three to six head per acre of leafy spurge per month or one to two ewes per acre of leafy spurge for the summer. NDSU research using Angora goats found that 12 to 16 goats per acre of leafy spurge per month or three to four goats per acre of leafy spurge for four months (growing season) controlled leafy spurge with little utilization of the grass species (Figure 5). The stocking rate will decline over time as the leafy spurge infestation is reduced. Prevention of flowering and seed-set by leafy spurge is important. Before moving animals to a leafy spurge free area, they should be contained for three to five days so viable seed can pass through the digestive system.



**Figure 5. Angora goats will graze leafy spurge and shrubs with minimal grazing of grass species if properly stocked.**

Research conducted by USDA-ARS scientists in Idaho suggests goats are better than sheep for controlling leafy spurge. Goats grazed leafy spurge equally regardless of plant density, while consumption by sheep declined as plant density increased. Also, sheep sometimes require a two to three week adjustment period to begin grazing leafy spurge, while goats readily graze the plant immediately. However, goats are more difficult to manage and market than sheep and generally must be kept in a barn during severe winter weather. Which animal to utilize will depend on a land manager's specific conditions (fencing, availability of animals, need to overwinter, etc.) and prevailing markets at the time.

## Cultural

Cultural control of leafy spurge includes properly timed cultivation and/or planting of competitive grass species. Less successful cultural methods also include mowing and fire. All cultural control methods are more successful when combined with herbicide treatments than when used alone.

Few options for control in a growing crop are available because the herbicide rates required for leafy spurge control are greater than rates labeled for use in cropland. A non-chemical control method such as cultivation is desirable to prevent the rapid estab-

lishment of leafy spurge in cropland, especially in limited-tillage areas.

Two types of tillage programs generally are used for leafy spurge control, intensive tillage throughout the growing season and cultivation only in the fall. The intensive cultivation program should begin in the spring, two to four weeks after leafy spurge emerges, using a duckfoot or similar cultivator tilling 4 inches deep. Cultivation should continue every three weeks until the soil freezes in the fall for one to two growing seasons. The tillage schedule should not be interrupted because leafy spurge recovers quickly from the effects of cultivation. Pieces of roots as small as 0.5 inch long and 0.1 inch diameter can produce new shoots. Root pieces also will survive two or three hours of drying in the hot sun.

A second option is to cultivate when the plants are 3 to 6 inches tall post-harvest. Research at NDSU has shown that cultivating leafy spurge twice each fall after harvest for three years provided complete control. The fall cultivation program has an advantage over the season-long program because it allows crops to be grown during the season and limits soil exposure to erosion. Two fall cultivations will reduce leafy spurge infestations faster than one cultivation. However, a single cultivation may be a more practical management option when minimal tillage is desired or soil erosion is a concern.

The amount of time needed for control can be shortened when the cultivation program is combined with a chemical treatment. Apply effective herbicides to leafy spurge at rates labeled for use in the prospective crop at least seven days before the first fall cultivation.

Some perennial grass species can effectively compete with leafy spurge and provide control. The most competitive grasses include wheatgrass, wildrye, and smooth brome. Leafy spurge topgrowth reduction averaged 70 to 80 percent in trials conducted at Fargo and Jamestown (Table 1). The most competitive species can vary by region, so consult with a local agronomist for the species best adapted in your area.

**Table 1. Some grass species competitive with leafy spurge in North Dakota trials<sup>a</sup>.**

Grass species	Control %
'Bozoisky' Russian wildrye <i>Psathyrostachys juncea</i>	40
'Manska' pubescent wheatgrass <i>Agropyron intermedium</i> subsp. <i>barbulatum</i>	70
'Rebound' smooth brome <i>Bromus inermis</i>	80
'Rodan' western wheatgrass <i>Pascopyrum smithii</i>	70
'Arthur' Dahurian wildrye <i>Elymus dahuricas</i>	60

<sup>a</sup>Trials conducted at Fargo and Jamestown, ND in cooperation with Dwight Tober, USDA-SCS, Bismarck.

Control of leafy spurge prior to seeding grasses is important. Glyphosate or glyphosate plus 2,4-D should be applied once or twice during June and July. This treatment will reduce leafy spurge vigor and control other weedy species. The grasses can then be seeded in late summer or early fall. Grasses seeded into tilled land have competed better with leafy spurge than those seeded using no-till. Cultivation probably helped to control leafy spurge while the grasses became established. Annual weeds can be controlled the following spring with herbicides such as 2,4-D, MCPA, and or bromoxynil (Buctril or Bronate).

Mowing and burning have been ineffective for reducing leafy spurge infestations, but may result in uniform regrowth that allows a more timely herbicide treatment. Also, mowing will reduce seed production if repeated every two to four weeks during the growing season. Leafy spurge should be allowed to regrow at least three to five weeks after mowing before a herbicide application or control may be reduced. Herbicides applied with nitrogen fertilizer and/or mowing treat-

ments have not improved leafy spurge control compared to the herbicides applied alone.

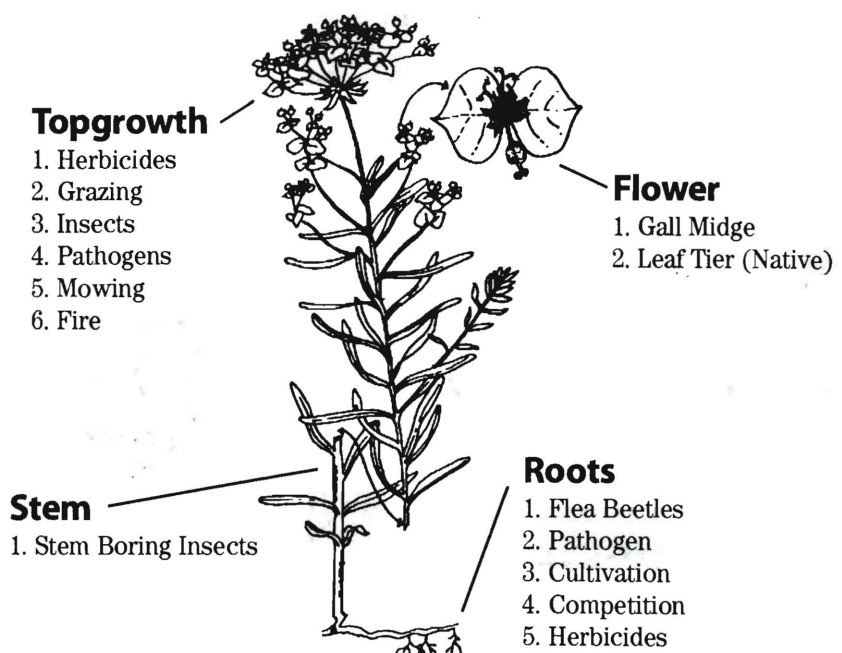
Prescribed burning does not increase long-term control with herbicides but does have some benefits for a complete management program. Prescribed burning can increase visibility of leafy spurge plants and improve detection of small plants and seedlings, especially in wooded areas. Burning also improves spray coverage by eliminating old stems and ground litter. Fire in combination with herbicides may reduce leafy spurge seed viability. Prescribed burning can be hazardous and should only be conducted by professionally trained personnel.

## Mapping A Strategy

Leafy spurge is very persistent and land managers must be more persistent to successfully control this plant. The infested area should be mapped first, before any control is attempted. Con-

trolling leafy spurge is much like fighting a range fire. Small patches should be treated first so the plant does not spread to uninfested acreage. The largest infestations should be surrounded and gradually controlled from the outside in. A rule of thumb is that for every year leafy spurge has been established in a location, two years of treatment will be needed for complete control.

Several options are available for leafy spurge control (Figure 5). Before beginning a leafy spurge control program, consider the best options suited for the situation and utilize more than one. Most successful control programs in North Dakota have used several control methods over several years. Leafy spurge control with pathogens is the only method not currently available to land managers but is being researched. **A successful control program requires a well planned strategy with consistent and timely follow-through.**



**Figure 6. Several methods are currently available for leafy spurge control and should be used together in an integrated long-term management plan.**

All photos except Figure 3 by Rodney G. Lym.

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