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## Leafy spurge: Biology and management

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Leafy spurge (*Euphorbia esula* L.: Euphorbiaceae) is a tenacious, alien, perennial weed that is designated noxious in both the Idaho Noxious Weed Law and the Idaho Seed Law. It was introduced into Massachusetts before 1872 and has since spread westward in the northern United States and Canada. It has caused an estimated \$7 million loss per year in U.S. beef and hay production despite the more than \$10 million per year spent for its control. It is not a weed of economic significance in its native Europe, probably because of native parasites.



**Fig. 1. Infestation of flowering leafy spurge is yellow-green.**

Leafy spurge was first found in Idaho in the early 1900s. Extensive infestations now occur in Camas, Clark, Custer, Elmore, Fremont, Kootenai and Washington counties. It has been reported in all other counties except Ada, Adams, Canyon, Lewis, Payette, Power and Shoshone.

Leafy spurge competes so well in the northwestern United States that it often forms dense stands that nearly exclude all other non-woody vegetation. Leafy spurge thrives in gravelly mountain soils and does well in most other soils of the state. Although it is primarily a problem on land that receives limited cultivation, it also threatens cultivated lands. It grows in environments from semiarid to shallow aquatic.



**Fig. 2. Leafy spurge shoots in preflowering stage have dark-green leaves and light-green stems.**



**Fig. 3. Leafy spurge in flower has short, broad bracts near shoot tips. The inconspicuous flowers lack petals.**



**Fig. 4. Leafy spurge seedpods are 3-part, red-tinged capsules.**

Most spurges contain toxic chemicals. Leafy spurge contains the alkaloid euphorbon, which is toxic to cattle and a known co-carcinogen (increasing the cancer-causing properties of other substances). The plant's white, latex-bearing sap seriously irritates the skin of many people and animals and can cause human blindness upon eye contact. The root sap gives off a substance that inhibits the growth of grasses and other desirable plants in the surrounding soil. Cattle tend to avoid leafy spurge, but sheep and goats learn to favor it and with appropriate attention will thrive on it.

## Identification

The many varieties of leafy spurge in North America are likely the result of natural selection or of crosses among related species. Although differing in important ways, most leafy spurges have reliable identifying features.

Leafy spurge plants can be recognized by their long, narrow leaves that are usually less than 1/4 inch wide and 2 to 3 inches long and by their yellow-green cast from mid-summer until fall. In early spring the plants are dark green. They usually appear in patches but may be scattered throughout cultivated fields. They often grow in clusters from a vertical root.

Mature leafy spurge plants normally attain a height of 1 to 3 feet. The stems are erect and usually single, branching only toward the top. The long, narrow leaves are alternate and crowded. A distinctive milky sap is readily seen by breaking a stem, leaf or root.

From late May to July, inconspicuous flowers without petals develop on the tips of short terminal branches. More noticeable than the flowers are the broad, heartshaped bracts that occur opposite each other near the bases of the flowers. The bracts turn yellow as the plants approach maturity and commonly are mistaken for yellow flowers. The bracts give the infestation a distinctive yellow-green top color from mid-June until the onset of cool nights or frosts. After fall frost, the leaves turn red.

Each flower produces a three-chambered capsule with one seed in each chamber. The seeds are egg-shaped, about  $\frac{1}{10}$  inch long and nearly as wide. They vary in color from

gray to brown or slightly purple but are usually grayish, often flecked with brown or yellow.

Old leafy spurge crowns are semiwoody. The crown bases are typically pinkish due to numerous, ever-present new stem buds. The root system is composed of thick roots that penetrate the soil 8 to 10 feet. Although the stem buds are most conspicuous in the old crown, many appear on the entire root system. Older plants have horizontal roots that enable the colony to enlarge by underground growth.

## **How infestations spread**

Leafy spurge spreads by seeds and roots. As the chambers of the seed capsule ripen, unequal pressures cause the capsule to explode, throwing the seeds as far as 20 feet. The plant's numerous vegetative buds and its ability to throw its seed enable it to spread rapidly. Spread is accelerated when seeds and root sections are moved by tillage equipment, vehicle tires, mammals and birds.

## **Methods of control**

Control of leafy spurge requires a well-planned, integrated program. Combining two or more control methods results in more consistent, stable, long-term control than using any individual method. On ranches, chemical control near uninfested areas combined with carefully managed grazing of leafy spurge where chemical or mechanical control is not practical will likely be the most economical practice.

## **Utilization**

Leafy spurge increases where cattle graze because cattle usually prefer grass and thus remove leafy spurge's competition. Where grazing continues, leafy spurge eventually will dominate, and cattle productivity will decline.

In confinement and with careful herding to concentrate on leafy spurge, sheep and goats at moderate to heavy stocking rates have reduced leafy spurge to a minor component of the vegetation. These grazers thrive on leafy spurge, and often prefer it to grasses once they become accustomed to it. They must be removed as soon as they consume the spurge to avoid overgrazing the grass.

Neither sheep nor goats have significantly suppressed leafy spurge without carefully managed grazing. Because leafy spurge spreads by underground roots, grazing does not control spread unless it is intensive and continues throughout the grazing season. Nevertheless, in small pilot programs and on several spurge-infested commercial ranches, grazing has provided a profitable way to continue agricultural land use. Because of the need for moderate to heavy stocking rates, utilization of small patches of leafy spurge within large pastures or on open rangeland may prove difficult.

When livestock graze leafy spurge after it has begun to flower, the animals will spread the seed to uninfested areas. Consequently, the animals should be kept in a spurge-free holding area for a week to allow seeds to pass through them. Landowners with little experience with sheep or goats should carefully plan for all aspects of such a complex enterprise.

## **Cultivation**

Cultivation will kill a perennial weed such as leafy spurge by starving it to death. Killing leafy spurge by cultivation requires cutting off all top growth every 14 days throughout three to four growing seasons. The cultivator must be sharp and must cut off every shoot about 4 inches below the ground. The final cultivation in fall is important. Failure to cultivate the last growth in fall allows the plant to restore its root reserves, giving it new strength for the following year.

A cultivation program to completely eradicate old plants will take 3 or 4 years. The program prevents crop production during the entire time. Such continuous intensive cultivation is inappropriate for highly erodible land.

Cultivation and other management practices may be integrated for control of leafy spurge in annual cropping. Integration allows use of herbicides, competitive cropping and partial destruction by harvest processes followed by cultivation just after harvest.

## **Selective herbicides**

Leafy spurge is one of the most difficult to control of all perennial weeds. It tolerates all but the most intensive herbicide programs. Successful short-term suppression is possible by cropping with grain or grass and spraying selective herbicide(s). Spray timing is critical. Make the first application of hormone herbicides such as 2,4-D, dicamba and picloram when the plants are beginning to produce flowers or flower buds.

**Control of seedlings** – Kill newly emerged seedlings before they are 4 weeks old. Older seedlings become well established with large root systems that make them more resistant to control efforts.

**Control in well-established forage grasses** – When well-established forage grasses are infested, spraying two or more times per year with maximum labelled doses of a selective herbicide will rapidly reduce the spurge stand and release the grass to thicken and grow more vigorously. Nitrogen applications for the grass will improve its competitive ability and hasten the process.

For best results, spray when leafy spurge is between the beginning bud and first bloom stages and again whenever leafy spurge regrowth is 4 to 6 inches high. The key to success is staying with a consistent system year after year until leafy spurge disappears.

In range or pasture, annual applications of picloram (Tordon, a restricted-use herbicide) will kill leafy spurge plants and allow the grass to grow. Grasses are less sensitive to picloram than is leafy spurge, but their growth is often retarded to some degree after picloram treatment.

Use extreme care while applying picloram to avoid off-target damage to susceptible crops. Livestock must be kept out of fields where picloram-susceptible crops will be grown for at least 72 hours after they graze picloram-treated grass. This delay will allow the animals to excrete picloram residues before moving to these fields. Picloram-sensitive crops include potatoes, beans, sugarbeets, peas and alfalfa.

**Control in riparian areas** – Leafy spurge should be prevented from invading riparian areas (streamsides, lakeshores, etc.). It will grow in shallow water (up to 2 feet deep) where the most effective herbicides are forbidden and animals do not graze. Leafy spurge seeds float and can result in shoreline infestations downstream, where they will provide a seed source for new inland invasions. Some forms of 2,4-D may be used in marshes, lakes, ponds and drainage ditches.

**Control of patches** – Eradication of small patches can prevent a large, uncontrollable infestation in the future. Where a few small patches of leafy spurge are present, apply spot treatments covering the weeds and the area within 20 feet of the patches. A persistent, continuous program of spot treatment is necessary for economic control of leafy spurge when it begins to invade an area and is essential for eradication.

Annual revisions of herbicide recommendations for leafy spurge are published in the Pacific Northwest Weed Control Handbook and other publications. Carefully read the label of any herbicide you intend to purchase for leafy spurge control.

## **Biological Control**

**Competitive vegetation** – Competitive plants growing with leafy spurge will prevent it from reaching its maximum potential growth. However, no forage species has been found that dominates leafy spurge in pastures or rangeland without the aid of herbicides or beneficial parasites.

Grass crops can compete when leafy spurge is treated with effective herbicides. Tall species of well-adapted and densely established grasses will retard a takeover by leafy spurge if they are not grazed heavily. Where annual precipitation is more than 16 inches, creeping grasses are generally more competitive than bunchgrasses, but highly productive grasses are the most competitive, regardless of type. Because alfalfa and leafy spurge emerge in early spring at about the same time, alfalfa has not been a satisfactory smother or competitive crop.

Lawn grasses may yield to leafy spurge to the point where a lawn becomes mostly leafy spurge. Leafy spurge in a lawn will continue to produce seed and to spread by underground roots even when mowed. Adequate soil nutrients will help lawn or pasture grasses compete with leafy spurge.

An extensive stand of large forest trees and shrubs with a high canopy can suppress or even exclude leafy spurge after becoming well established. Unfortunately, trees or shrubs in ornamental plantings usually do not prevent substantial growth of leafy spurge because they do not provide extensive, uninterrupted shade.

**Insect parasites** – Leafy spurges in Europe are assumed to be held in check by native organisms. As a result, substantial research is going toward the discovery, testing and importation of parasites of many types that damage leafy spurge but not other plants.

Biological control methods have not yet been developed to the point of practical or acceptable suppression of leafy spurge. Continued importation of a variety of parasites may eventually contribute to leafy spurge control.

**Introduced insects** – Leafy spurge is attacked by a number of insects in its native habitats in Europe and Asia. These insects live only on leafy spurge and injure the weed by feeding or by causing malformed growth. They stress the weed but do not eradicate it. Several of these insects have been studied to evaluate their potential for controlling the weed in the United States and Canada.

Because many ornamental and native spurges are closely related to leafy spurge, the insects have been tested to determine if they will feed and/or reproduce on these nontarget species. Those insects that feed or breed only on leafy spurge or other weeds become candidates for release in the United States and Canada (Table 1). Some of these insects have been released in Idaho. Others will be released as they become available.

Larvae of the spurge hawkmoth (*Hyles euphorbiae*) defoliate leafy spurge. Larvae of the bud gall midge (*Spurgia esula*, formally known as *Bayeria capitigena*) feed on shoot tips and stimulate the production of galls and malformed shoots. Adults of a long-horned beetle (*Oberea erythrocephala*) girdle stems while its larvae bore into the lower stems and roots. Adults of four *Aphthona* beetle species feed on leaves, and the larvae feed on root hairs and root tissues.

The spurge hawkmoth has been released in Idaho, but it has not survived. No further releases are anticipated because the insect does not appear to be sufficiently effective here. The flea beetles *Aphthona flava* and *Aphthona nigriscutis* also have been released, but it is too soon to tell whether they have become established. Other species are expected to be released in Idaho during the next several years (Table 1). Species that are not mentioned here will probably also be tested.

**Table 1. Insects released or anticipated available for release against leafy spurge in the United States, 1986-1990s.**

Type	Species	Plant part attacked	Damaging stage	Release date	Status <sup>1</sup>
Moth	<i>Hyles euphorbiae</i> *	foliage	larvae	1985, 1986	NE
Fly	<i>Spurgia esula</i>	buds	larvae	1990s	NR
Beetle	<i>Oberea erythrocephala</i>	roots	adults, larvae	1990s	NR
Beetle	<i>Aphthona cyparissiae</i>	roots	larvae	1990s	NR
Beetle	<i>Aphthona czwalinae</i>	roots	larvae	1990s	NR
Beetle	<i>Aphthona flava</i> *	roots	larvae	1986, 1990s	NA
Beetle	<i>Aphthona nigriscutis</i> *	roots	larvae	1989, 1990s	NA

\* = released in Idaho.

<sup>1</sup>NE = not established, NR = not yet released, NA = status unknown.

Until recently, distribution of leafy spurge insects was conducted by University of Idaho personnel in cooperation with scientists from the USDA Agricultural Research Service and from Montana State University. The Plant Pest Quarantine and Protection unit of the USDA Animal Plant Health Inspection Service (APHIS) is now distributing natural enemies to leafy spurge-infested areas of the Pacific Northwest, the northern Great Plains and the Rocky Mountain states. APHIS works in cooperation with the University of Idaho, the Idaho Department of Agriculture, various federal and state land management agencies and county weed control superintendents to release and establish these insects.

Insects will not immediately control leafy spurge when they are released. Newly established natural enemies will require several years to become numerous enough to effectively suppress the weed. Even then, the insects alone may not control leafy spurge.

The goal of biological control is not to eradicate the weed, but to prevent it from dominating so that desirable plant species can recolonize spurge-infested sites. Biological control should be part of a larger vegetation management effort that includes use of herbicides, fertilizers, grass reseeding where needed and sound grazing management techniques. Research is in progress to identify how these control measures can be integrated.

**Native insects** – Occasionally, native insects feed on leafy spurge. Larvae of a leaf-rolling moth (*Sparganothis umbrana*) have been found feeding on spurge near Rathdrum (Kootenai County), Idaho. The caterpillars produce strands of silk with which they tie together the plants' leaves and terminal portions to create a protected area for feeding. The caterpillars can cause considerable damage to the spurge, but the Rathdrum infestation has been localized and sporadic. Moths of this type generally have a broad host plant range. Many are pests of crops and ornamentals, so it is inappropriate to distribute them over a wide area.

Chemicals associated with the spurge latex usually make the plants unacceptable to general plant feeders such as the leafroller species noted above. The localized infestation near Rathdrum may be due to chemical properties of the leafy spurge at that location that attract leafrollers. There is no reason to expect this or any other native insect can control leafy spurge well enough to warrant special efforts to distribute or encourage it.

## **Control on small acreages**

Control of leafy spurge on small acreages, especially homesites, presents special problems. Consistent use of 2,4-D and dicamba can be effective, but frequent use poses a more frequent hazard to nontarget plants such as ornamentals.

Glyphosate can be used where it can be applied without contacting nontarget plants. Glyphosate kills grasses and other plants in addition to leafy spurge, so areas treated with glyphosate should be replanted to an adapted grass. Otherwise, leafy spurge or other weeds will recolonize the treated area.

Dicamba or 2,4-D use in combination with mowing, tilling and pulling can effectively suppress leafy spurge in lawns. This requires application of the herbicide whenever leaves on newly appearing leafy spurge growth are fully expanded. At first this will mean

treatment about every 2 weeks. After 3 to 4 years, the frequency of treatment and the area requiring treatment will decrease.

Small uninfested areas can be protected against leafy spurge invasion from neighboring properties. An infested border around the area may be mowed frequently or treated with herbicides to prevent seed production and to retard root growth into the uninfested area. The border should be at least 30 feet wide to minimize spread of seed across it. As long as leafy spurge continues to live and produce seed in the nearby property, reinfestation will occur.

## **Control on roadsides**

Control of leafy spurge along road right-of-ways is imperative in the effort to stop its spread. Integrated chemical and/or mechanical control and establishment of a competitive grass has been most successful in suppressing spurge along roads.

When moving equipment or animals onto a roadway from an infested area, leave leafy spurge seed or rootstock in the infested area, not on the roadside. This may involve cleaning equipment or animals before moving them. It also may mean confining animals to an area where they do not have access to leafy spurge seed long enough to allow seeds to pass out of their digestive tracts.

Mowing leafy spurge before it sets seed effectively reduces seed spread. Mow several times during the growing season because new plants continue to sprout from root buds. Mowing will not completely prevent seed production because mown plants produce flowers very low to the ground.

Selective, short-lived herbicides such as 2,4-D or dicamba will suppress leafy spurge along roadsides, but several applications are needed. Prevent spray or spray drift from injuring nontarget plants such as nearby crops.

Picloram will suppress established infestations of leafy spurge for 1 or more years depending on soil type. If a new infestation is treated with picloram before it sheds seed, chances are good that the spurge will be eradicated.

Moderate doses of picloram will not kill grasses but should not be used near ornamentals. Picloram and dicamba may not be used in roadside ditches containing water.

Soil sterilants – herbicide treatments that destroy all vegetation – will suppress leafy spurge. As the herbicide decomposes in the soil, however, leafy spurge will likely return because dormant seeds are not susceptible to short-term herbicide treatment.

## **Control in timberlands**

Once spurge becomes established in timberlands, control is time consuming and expensive because treatments must be applied carefully to protect trees. Seed spread from small infestations can be decreased through spot treatment with chemicals such as glyphosate or 2,4-D or by cutting the plants before they flower. When moving animals from infested to uninfested areas, confine them to an area where they do not have access to leafy spurge long enough to allow the seeds to pass out of their digestive tracts.

**Pesticide residues** – Recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed the established tolerances. To avoid excessive residues, follow label directions carefully with respect to rate, number of applications, and minimum interval between application and reentry or harvest.

**Groundwater** – To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

**Trade names** – To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.