FOR MORE INFORMATION

Minnesota Department of Agriculture
www.mda.state.mn.us/weedcontrol/leafyspurge.html
(651) 282-6808

University of Wisconsin Extension
ipcm.wisc.edu/uw_weeds/extension/articles/leafyspurge.htm
(608) 263-7437

Fort McCoy (Wildlife Program)
(608) 388-5766

Wisconsin Department of Natural Resources
www.dnr.state.wi.us/org/land/er/invasive/factsheets/spurge.htm
(608) 267-5066

Michigan Department of Agriculture
(231) 922-5210

Great Lakes Indian Fish & Wildlife Commission
www.glifwc.org/epicenter
(715) 682-6619 x124

The Nature Conservancy
tncweeds.ucdavis.edu/esadocs/euphesul.html

USDA - ARS TEAM Leafy Spurge
www.team.ars.usda.gov/
(406) 433-2020

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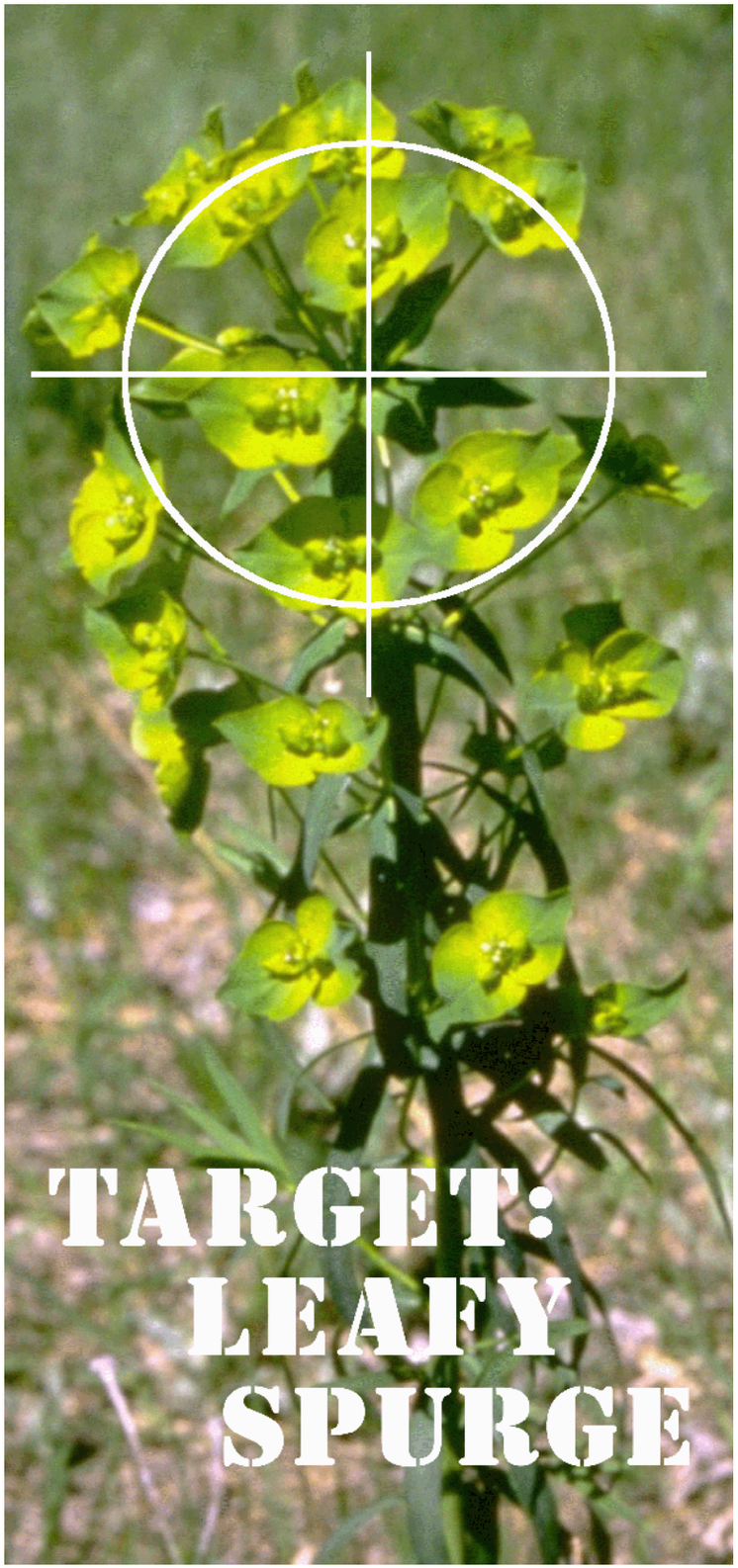


TARGET: LEAFY SPURGE

ORIGIN AND HISTORY

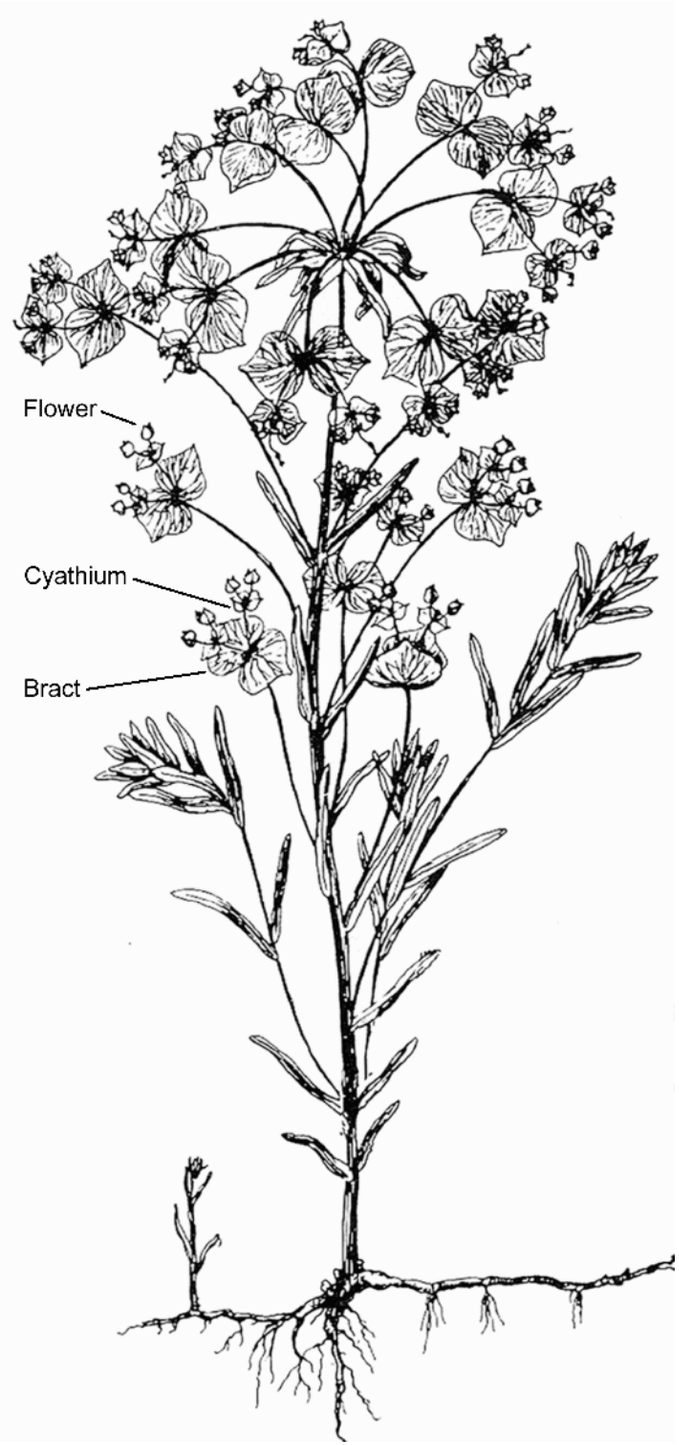
Leafy spurge (*Euphorbia esula*) was first reported from North America in Massachusetts in 1827. A native of Europe and Asia, it was probably introduced a number of times as a contaminant in grain seed. It is now found throughout the northern and western United States and in southern Canada, infesting more than 5 million acres.

THE PROBLEM

Prolific seed production and an extensive root network allow leafy spurge to spread rapidly, displace native vegetation and resist control efforts. Leafy spurge thrives in a wide range of habitats and readily displaces native plants and other desirable vegetation, even in undisturbed habitats. Leafy spurge competes especially well on sunny sites with sandy soils.

The economic and ecological impacts of leafy spurge are substantial. The milky sap, found throughout the plant, is toxic to deer, cattle and other ruminants . While most livestock and wildlife avoid spurge-infested areas, they may ingest dry plants in hay. Avoidance of spurge-infested areas often leads to a vicious cycle: overgrazing and disturbance in spurge-free areas reduces competition from native plants, allowing spurge and other exotics to colonize these areas. This process results in reduced species diversity, degraded wildlife habitat, lost productivity of range and pasture lands, and lower land values. In Wyoming, Montana and the Dakotas, leafy spurge infestations cost an estimated $144 million per year in lost agricultural production and control expenses. Agricultural lands and natural areas in the upper Great Lakes region are also vulnerable.

Researchers recently estimated that leafy spurge is doubling its range in the Great Plains every 5 years. It is also increasing in abundance throughout the upper Great Lakes region. In the upper Great Lakes, leafy spurge is an aggressive invader of roadsides, pastures and old fields, as well as riverbanks, savannas, pine barrens, and prairies. Leafy spurge is classified as a “prohibited noxious weed” in Minnesota, Wisconsin and Michigan.



IDENTIFICATION OF LEAFY SPURGE

General: The entire plant is hairless. Like all spurge species, a milky sap - called latex - is found throughout the plant. The latex is toxic to ruminants and produces dermatitis and blisters in humans.

Flowers: Individual flowers are small, inconspicuous and greenish. The single female flower of each cluster is closely surrounded by several male flowers, each having one stamen.

Cyathium: The cup-shaped structure that surrounds each cluster of flowers. Yellow-green, heart-shaped bracts surround each cyathium, giving the entire structure the appearance of a single greenish-yellow "flower".

Seed Capsule: As the flowers mature, seed capsules are produced in their place. Capsules usually produce 3 seeds each. On a warm sunny day in late summer they burst, propelling the seeds as far as 15 feet. The seeds can remain viable for up to 7 years.

Leaves: The leaves are alternate, long and narrow and pointed at the tip, with smooth edges. They are pale bluish-green, turning orange and then red in the fall.

Stems: Stems appear singly or in clumps of up to 10 or more, from the woody root crown. Plants may reach more than 3 feet tall, but are often shorter.

Roots: Vertical roots have extensive lateral growth and may reach as deep as 20 feet. New shoots, arising from buds on the lateral roots, can emerge through 2 feet of soil. Short roots arising from the long roots take up water and nutrients.

CONTROLLING LEAFY SPURGE

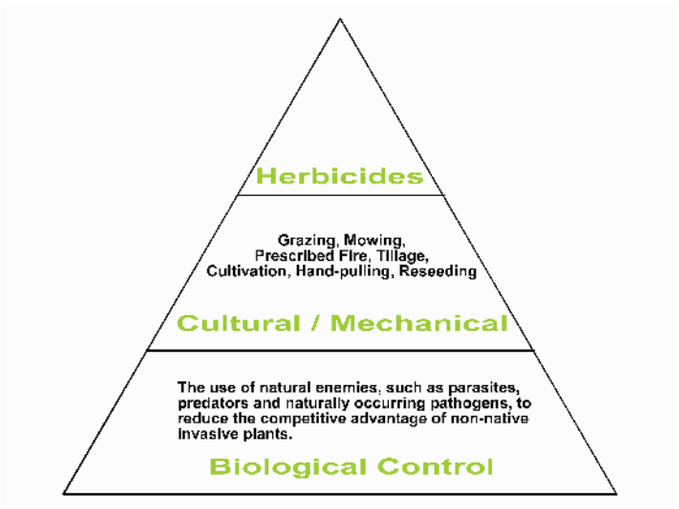
Planning: Prior to initiating control efforts, it will be helpful to conduct a thorough inventory of the area where leafy spurge occurs and develop an overall strategy. Information to note include the location, acreage and relative density of each spurge population. Additional information that may influence the combination of control methods employed include soil type, soil moisture, amount of shade, land use, and environmental regulations governing the use of herbicides and biological controls.

Strategy: Small patches consisting of a few plants should be prioritized for eradication before they have a chance to expand and become significant seed sources. Eradication of small patches is possible if attacked aggressively with herbicide. For large spurge populations, a more realistic goal is to control and limit their spread using an Integrated Pest Management (IPM) approach. A thorough survey of the area will help identify the most appropriate strategy to use at each site.

Go!: Perhaps the most important aspect of leafy spurge control is to get started. Once established, leafy spurge spreads fast. Ecological impacts and economic costs will only increase as control efforts are delayed.

INTEGRATED PEST MANAGEMENT

An integrated pest management approach is the most effective strategy for controlling leafy spurge. This approach combines a foundation of biological control with two or more cultural, mechanical or chemical control methods. IPM provides the flexibility to choose the best combination of control methods for each site while enhancing the effectiveness of any single technique. The stress and damage caused by one control method enhances the effectiveness of other control options.



All of the flea beetle species released so far in North America feed only on the subgenus *Esula* of the genus *Euphorbia*. This subgenus includes cypress spurge (*E. cyparissias*), another non-native invasive plant, but excludes native species such as flowering spurge (*E. corollata*). Although other *Euphorbia* species belonging to the subgenus *Esula* are native to the western US, none of the introduced flea beetles have been found feeding on them to date.

A. nigriscutus and *A. lacertosa* were approved for release in 1989 and 1993, respectively. Both are widely established on the Great Plains. These two flea beetles have exerted significant control on leafy spurge populations.

Biological controls will not completely eradicate leafy spurge. Feeding by adults and larvae stresses the plant and allows naturally occurring plant pathogens to enter the plant and cause additional damage. The stress delays emergence, maturity and flowering and reduces stem density and seed production. Without these advantages, desirable vegetation is able to recolonize the site and compete on an even footing.

CULTURAL AND MECHANICAL CONTROLS

Cultural and mechanical controls include grazing, mowing, hand-pulling, tilling, and prescribed fire. Used alone, these methods are ineffective for long-term control of large leafy spurge infestations. But when used as part of an IPM program, they can significantly improve the effectiveness of biological and chemical controls.

Although leafy spurge is poisonous to most grazing animals, sheep and goats graze it with no ill effects. In fact, it provides them with a nutritious, high protein diet. Goats are more effective than sheep at low spurge densities, because goats prefer spurge to grasses, while sheep prefer grasses to spurge. Grazing is often the best alternative in the wet shaded areas avoided by flea beetles and where chemical control options are more restricted.

SUGGESTED STOCKING RATES *

Months Grazed	Animals Per Acre of Leafy Spurge	
	Sheep	Goats
1	8	16
2	4	8
3	3	6
4	2	4
5	1.75	3.5
6	1.5	3

* Stocking rates can vary with local climate and environmental conditions.

Mowing is useful for preventing seed production and spread. Mowing should be completed in late spring before seeds mature, and again in midsummer to prevent reflowering. Mowing equipment should be thoroughly cleaned prior to leaving infested sites to avoid spreading leafy spurge and other exotics.

Hand-pulling and digging is very labor-intensive and impractical for all but very young plants. Any root fragments left in the soil can resprout. Isolated plants and small stands can be eliminated by digging up the plants with their shallow roots, but only if treatment is repeated several times per year for several years, until the deeper roots starve and the seed bank is completely exhausted.

Prescribed fire can make leafy spurge more vulnerable to herbicides and aid the establishment of biological controls. The tender shoots of new seedlings and regrowth which emerge following a burn are more susceptible to herbicides. In addition, the removal of litter increases the foliar coverage of herbicide applications and will help to discourage ants. Burning is generally conducted in early spring or fall. Avoid burning between mid-May and mid-August if biological control or grazing is being used in combination with prescribed fire.

BIOLOGICAL CONTROL

Biological control offers a simple, environmentally friendly, and cost-effective method for controlling leafy spurge. Easily incorporated with other control methods, the additional stress inflicted by biological controls enhances the effectiveness of other control methods.

In its homeland, leafy spurge is attacked by dozens of insects, fungi and other pests. When leafy spurge was brought to North America, these pests were left behind. Freed of its natural enemies, spurge has a tremendous advantage over native vegetation. Biological control reunites the natural enemies of leafy spurge with their host plant in North America.

Before being imported and released, potential biological control organisms undergo years of testing to make sure that they survive and reproduce only on the target plant and do not attack native plants or valuable crop plants. Most of this testing is done at the International Institute of Biological Control in Europe. Testing in Europe (where most of these biocontrol organisms are native) eliminates the possibility of their accidentally escaping here.

Of the 15 insects that have been tested and approved for release in North America to combat leafy spurge, two species of flea beetle (*Aphthona nigriscutus* and *A. lacertosa*) have emerged as the most effective biological control agents.

Adult flea beetles are small (2-4 mm) and usually hop rather than fly when disturbed. They feed on the foliage of leafy spurge. The larvae are root feeders, feeding on progressively larger spurge roots as they grow.

When possible, flea beetles should be obtained from local sources to insure they are adapted to the local climate and to reduce stress incurred during handling and transportation. State departments of agriculture, natural resources or the state USDA-APHIS office can provide information on local sources.

Adult flea beetles should be collected after the majority of adults have emerged and before they have laid all their eggs. A net with a stiff frame is commonly used to gather adult flea beetles by sweeping the top half of the vegetation. If beetles can be collected at the rate of 100 per minute, the site can be harvested. Collection times vary with local conditions but generally occur between mid-June and mid-July. Frequent site checks will help insure optimal timing. These sun-loving insects are gathered most efficiently on calm, dry, sunny days with warm temperatures. Flea beetles should be kept cool and dry during transportation and released as soon as possible. Containers should be sealed and filled 1/2 to 1/3 full with spurge foliage (avoid roots and seeds). Plastic containers should be avoided to prevent the build up of condensation.

Site selection is the key to successful establishment of flea beetle populations. General habitat requirements for *Aphthona* include well-drained soils with shallow roots for the larvae to feed on and a sunny exposure for the sun-loving adults. However, *A. lacertosa* is slightly more tolerant of shade and moisture. Deep-rooted plants in sandy soils and sites with prolonged periods of standing water should be avoided to insure the survival of larvae. Sites with high ant populations should also be avoided because they can be a significant predator of *Aphthona*. Shady sites and dense patches of spurge also make poor initial release sites. Release beetles at the edge of dense patches where stem densities are sparser. Flea beetles will move into the denser and shadier portions of spurge patches once their population has become well-established.

Flea beetles take several years to become established, so the more beetles initially released, the sooner their impact will become evident. A minimum of 3,000 (about 3/4 full film canister) or more flea beetles should be released at each site to improve the likelihood of successful establishment. Avoid scattering beetles over a large area as this will make it more difficult for males and females to find each other and reduce the chances for successful establishment.

CHEMICAL CONTROL

The information presented here is intended as a guide. Research on chemical control methods for leafy spurge is ongoing. Consult with local weed specialists for the most recent information on chemical control options. Always read and follow the label instructions to insure compliance with registered uses, application rates and safety precautions. The use of trade names in this brochure does not constitute an official endorsement or approval of any product.

Although herbicides are relatively expensive and can have significant environmental impacts, they should be the first choice for eradicating small isolated patches of leafy spurge. While large established patches can be contained and even reduced with herbicides, complete eradication is seldom achieved. Large patches will require a combination of control methods to achieve long-term control. Spring and summer herbicide applications should be avoided if flea beetles are present on the site, because they need the top growth for a food source. After the larvae burrow deeper into the soil to overwinter (mid-August), herbicide can be safely applied.

Persistence is the key when attacking small patches with herbicide alone. Follow-up treatments will be needed for several years, until the seed bank is exhausted. Lapses in treatment will allow leafy spurge to quickly recover.

Several herbicides have been proven effective against leafy spurge, however, they vary in their effectiveness, cost, ecological impact, and timing of application. Imazapic, available commercially as “Plateau”, is a general use herbicide that has been proven effective when applied to fall regrowth. Apply at a rate of 8-12 oz. per acre with a methylated seed oil (MSO) adjuvant at 1 qt. per acre. Application rates over 8 oz. per acre can reduce grass production, but grasses will recover the following year. Plateau is safe to use around most trees, but can be fatal to lilacs.

Applications can be made from late-August to mid-October, as long as sap still flows from cut stems. Mid-September applications of Plateau provided the most effective leafy spurge control in North Dakota. This timing is also compatible with the use of flea beetles and can enhance population establishment by reducing shade.