

Integrated Pest Management (IPM)

# LEAFY SPURGE

## *Prevention and Control*

A comprehensive approach to  
controlling leafy spurge for  
landowners and land managers



## What is integrated pest management?

There is no single method that will always work to control leafy spurge on your property. The most effective control is to combine a variety of techniques — in other words, take an integrated management approach. As a landowner or land manager, you can choose and combine control methods based on your own preferences, size of the problem and accessibility of the leafy spurge patches.

### Why use an IPM approach?

- More effective control of leafy spurge
- Greater cost efficiency
- Lower environmental impact

## Leafy Spurge

Declared a noxious weed in Manitoba, leafy spurge (*Euphorbia esula L.*) is a long-lived and hardy plant introduced to North America from Europe and Asia. Quite distinctive during its blooming period, the vegetative form of leafy spurge is often overlooked, giving it time to establish before landowners notice it.

In early April, leafy spurge arises from a woody crown below the soil surface. The main growth of the plant occurs from April to July. The crown may produce several stems, giving the plant a shrubby appearance. Height of mature stems may vary from 16-32 inches (40-81 cm). The stems are hairless, with numerous linear-shaped, pale blue-green or green leaves. The leaves are  $\frac{3}{4}$  - 3 inches (2-7.5 cm) long, sessile and alternate, except for a whorl of leaves at the base of the inflorescence.

Numerous yellow green bracts forming a flat-

### Leafy spurge's competitive advantage.

Seed production	Vegetative reproduction
Each leafy spurge plant produces approximately 140 seeds per stem. At maturity, given a high temperature and low humidity, the seed capsules will explode, hurtling the seeds up to 15 feet (4.6 m) from the plant. Most leafy spurge seeds will remain viable for up to eight years, although some may survive even longer. During this time, they can be moved to new areas by people, wild or domestic animals, birds, insects and water.	The root system of leafy spurge is extensive, often growing 26 feet (7.9 m) deep and 15 feet (4.6 m) across annually. This system can sustain the plant through extended periods of drought and allows it to recover quickly from grazing stress and herbicide damage. Buds along the root system will create new seedlings, which is the main method through which leafy spurge spreads. A patch of spurge can spread over a metre a year.



The numerous yellow-green bracts, often mistaken for the flowers, start to appear in May.



The milky white latex exuded from damaged plants is an irritant and a useful tool in identifying leafy spurge.

topped cluster start to appear in May, about three weeks after the plant emerges. Often mistaken for the flowers, these bracts form a flat-topped umbel. The small, green and inconspicuous true flowers will emerge two weeks after the bracts. Flowering is usually complete by mid-July, and the seeds have matured and are dispersed by late July to early August. Some plants may produce flowers until frost.



The leafy spurge root system can grow 26 feet deep and 15 feet across annually. The buds along the lateral roots are the main method through which leafy spurge spreads.

Leafy spurge seeds can germinate at any time during the growing season, but the peak season for germination is during late May and early June. Seedlings will not flower in their first year but will bloom and produce seed the next year. New seedlings established through vegetative reproduction can grow throughout the growing season.

All parts of the leafy spurge plant contain milky white latex that is exuded when the plant is damaged. This can be a useful tool in identification, especially when the plant is vegetative. However, be careful not to get the latex on your skin, as it is an irritant.

**Economic impact.**

Area affected	Size of infestation	Total annual impact
Grazing land	225,000 acres	\$16 million
Public land <small>(not all wildlife areas were included in this survey)</small>	107,000 acres	\$2.5 million
Right of Ways	8,200 acres	\$0.4 million
<b>Total</b>	340,000 acres	over \$19 million

\* Leafy Spurge Impact Assessment. Leafy Spurge Stakeholders Group, November 1999. Available at: [www.brandonu.ca/rdi/](http://www.brandonu.ca/rdi/)

**The Problem**

Leafy spurge will readily establish itself in a variety of environments, and it is quick to take advantage of disturbed sites. Leafy spurge can be found in pastures, agricultural lands, roadsides, ditches, and wooded and riparian areas. In Manitoba, it does best in sandy soils of moderate moisture. Leafy spurge is one of the earliest plants to emerge in the spring, and it is able to utilize most of the space, sunlight, nutrients and water unimpeded by other plants.

**The Economic Impact**

Landowners with severe infestations on grazing land may face decreased land values, reduced cattle stocking rates and a reduced income. As a leafy spurge patch expands, normal herbage production in pastures is reduced. Livestock such as cattle and horses will totally or partially avoid grazing in these infested sites, thus increasing the grazing pressure on surrounding vegetation.

- 40% infestation decreases carrying capacity of cattle by 50%
- 80% infestation decreases carrying capacity of cattle by 100%

Leafy spurge’s aggressive growth habits and lack of natural predators in North America allow it to easily displace native vegetation. The result is reduced habitat value as plant and wildlife species density and diversity is reduced. As the native vegetation is crowded out, the carrying capacity of wildlife is also reduced.

It is also believed leafy spurge decreases the ability of the land to hold rainfall and spring runoff, which leads to increased downstream land



**Idle native habitat infested with leafy spurge. Assessed land values are decreasing as a result of leafy spurge infestations.**

erosion and reduced water quality.

Many Weed Control Districts, railways, and the Department of Highways and Transportation have active leafy spurge control programs along the land used by public utilities. However, control costs for leafy spurge are expensive and results are not always immediate.

Often, the care and maintenance along right-of-ways inadvertently does more to increase the spread of leafy spurge than to control it. Gravel may contain seeds that will be spread along gravel roads.

**Prevention the best strategy**

The best defense against leafy spurge is to detect and treat new patches at an early stage,

before it becomes a large problem. Take the time to regularly walk through your property and take note of any new patches of leafy spurge. Start a control program as soon as possible. Care must be taken not to transport leafy spurge to new sites.

- Eliminate leafy spurge along frequently traveled trails or entrances to pastures.
- Avoid driving through or mowing patches of leafy spurge during July-August when the plant has viable seeds on its stems.
- If you cannot avoid driving through leafy spurge, before you leave the site, check your vehicle for any plant fragments or seeds that may be stuck in the undercarriage or wheels.
- Clean all equipment before leaving infested sites. Often pieces of the leafy spurge root or seeds may be caught in equipment. Seeds caught in the equipment or pieces of the leafy spurge roots carried by a cultivator will readily travel and establish in new sites.
- When moving livestock from an infested area, quarantine them for 4-5 days to allow any seeds to move through their system. Research has shown that sheep should be held for 3-4 days; after this time, all viable seeds have passed through their system.
- Avoid transporting hay, topsoil or gravel that has come from an infested area. There may be seeds or pieces of root that will establish in any new areas.
- Avoid cultivation through patches where root fragments and seeds may be dragged across the field. Root fragments as small as 1/2 inch long (1.5 cm) and 1/10 inch diameter (1.5mm) can form new plants.

**Before you start a leafy spurge control program, take a good look at your problem area.**

<b>Size</b>	Small patches of leafy spurge that will be easier to control, versus larger patches.
<b>Location</b>	Is it in a wooded area, or in open pasture? Take a look at the accessibility of the patch.
<b>Associated vegetation</b>	Whether the leafy spurge is in cropland, pastureland or rangeland will also be a factor in determining which control measures you can use.
<b>Costs of each control measure</b>	Each control measure will carry a cost, which can be weighed against the long term and short term economic losses caused by the infestation.

## The Tools of IPM

### Herbicides

For chemical control to be most effective, proper timing is essential. *No single treatment will work to eradicate leafy spurge.*

Spraying with herbicides must be regular and well-timed or the leafy spurge will rapidly re-infest. It is likely not cost-effective to spray after seed set because even if it limits second growth, the seeds have been released and there will be little benefit for next year. It is generally advised to continue treatment until at least 90% of the leafy spurge is eradicated.

The optimal time to apply a herbicide is during the growing season. Spray in the spring between true flowering and seed set, or in the fall during the second period of growth. Spraying at least 15 feet around the visible perimeter of a leafy spurge patch will also help to control any small leafy spurge plants.

Caught quickly enough, herbicides can be used to eliminate or control small patches of leafy spurge. Herbicides are useful in containing or controlling existing patches when used in combination with other management controls.

The rates of herbicides recommended for control may be higher than the rates suggested for use on field crops. Use caution when applying herbicides at these rates, as it may damage crops, pasture vegetation.

**Always check product labels for application details.**

**Amitrol 240®:** Apply in June as the true flowers and seeds are developing, or in early to mid-September after the stems have developed new fall re-growth. Amitrol will give control for only one season. Amitrol® is a non-selective herbicide and applied at the recommended rate, it will kill all vegetation. Unfortunately, removal of the competition may allow leafy spurge to flourish when it comes back the next season. Another option for treatment of leafy spurge with Amitrol® is to apply 0.46 L in 25 L of water to treat a 10m X 10m area. Do not cultivate for 2 weeks after general application or mow treated areas for 3 weeks after application.

**Dicamba (Banvel II®):** Applied once a year, Banvel® will provide moderate top growth control. This can persist through the growing season if conditions are favorable. Unfortunately, the effectiveness decreases rapidly after the first year of use. Applied twice a year, Banvel® can provide excellent control of leafy spurge plants after 3 to 4 years of applications. At this high rate of application, however, other vegetation will also be killed, and new leafy spurge plants may easily germinate from seed.

**2,4-D amine:** Two applications – during active growth in the spring and fall – are required for significant top growth suppression. The ester formulation at \$7.10 to \$7.25/L is also effective, although it is more volatile and expensive than the amine formulations.

**Picloram (Tordon 22K®):** Picloram can remain in the soil suppressing leafy spurge growth for up to 5 years. The degree of control depends on the soil

	Herbicide	Application rates (L/acre)	Cost (per litre)
*Registered	Amitrol 240® Dicamba 2,4-D (amine) 500g/L	15.2 – 18.5 (general application) 0.84 1.82	\$6.20 \$32.99 \$5.50 – \$6.35
Rangelands and pastures	Picloram Dycleer	3.6 0.5	\$39.75 \$33.00
In Crops	MCPA (amine or ester) 500g/L	1.9	Amine: \$6.40 – \$6.65 Ester: \$7.40--\$7.75

\*Herbicides registered in Manitoba for containment and management in rangeland are based on Manitoba Agriculture and Food's **Guide to Crop Protection – 2001**

conditions. The sandier the soil, the shorter the residue will last. During the first year, Picloran will achieve up to 90% control. After the third season of use, only 70% control will be achieved, with its effectiveness rapidly dropping after that. The use of Picloran is restricted in porous soils and irrigated areas due to its persistence and water solubility. Because of this, its use is restricted to licensed chemical spray operators.

**DyCleer:** Will control only top-growth of leafy spurge.

**MCPA (amine or ester) 500g/L:** Provides control of leafy spurge in crops such as wheat (spring and durum), spring and fall rye, winter wheat, flax, peas, under seeded alfalfa (except Flemish varieties), alsike clover, and red clover. Crop injury may result from this high rate of application. MCPA is not registered for use on forage grasses in pastures or rangelands, and as such, any damage is at the risk of the user. Consult specific product labels for more information.

Combining herbicides can help to cut costs as well as increase the efficiency in controlling leafy spurge while decreasing the harmful side effects. There are different opinions on rates of application and mixing rates. Consult your local weed supervisor or agriculture representative to discuss which selection will work best for you.

Although traditionally herbicides have been used as a reliable and integral part of weed control, this has not proven true for dealing with leafy spurge. Continued use of chemicals becomes expensive and generally inefficient. Herbicides seem to become less effective with repeated use.

### **Cultivation**

Using cultivation in cropland will only work if used consistently, as fragments of the root will rapidly form new plants. Cultivation should start in early spring, two to four weeks after the plants emerge and are approximately 3 to 4 inches (8 to 10 cm) tall. For maximum effectiveness, continue cultivation every three weeks until fall. Cultivation should be at least 4 inches deep. If the patch is small, be careful not to spread fragments of leafy

spurge across the field.

If you are growing a crop, an option is to cultivate leafy spurge once or twice in the fall, after harvest when the leafy spurge is 3-6 inches (8 to 15 cm) tall, to help provide control. This must be done every year for three or four years. This method will be more effective combined with a herbicide treatment. If herbicides are applied to the leafy spurge as well, allow at least 7 days after spraying before the first fall cultivation. The use of herbicides will minimize the frequency of cultivation, helping to prevent soil erosion.

Growing crops that are highly competitive with leafy spurge assists in controlling the rate of increase. Perennial forages that are well adapted to your area will compete with leafy spurge. As the grasses develop, they are able to use the available resources, retarding the development of the leafy spurge. Winter crops such as fall rye provide competition for leafy spurge in the fall and spring, while the spurge is actively growing. However, leafy spurge roots exude a toxin that is harmful to other plants.

Hay crops should be harvested before the leafy spurge sets seed to avoid transporting the seed. When grazing animals, limit the amount of grazing so the forages do not become weakened, thereby allowing the leafy spurge to thrive.

Control of leafy spurge prior to seeding grasses is essential; otherwise, the immature grasses will not be able to compete with leafy spurge. Glyphosate or glyphosate plus 2,4-D should be applied once or twice during June and July before seeding the grasses in late summer to early fall. Grasses establish better in a cultivated area.

There is evidence that fertilizing established grasses in the spring or fall may help them to compete with leafy spurge weakened by chemical or bio-control methods. The crop should respond more favorably than the leafy spurge plants, as the much shallower root system of the grasses is able to take up the fertilizer before the leafy spurge.

### **Digging or hand pulling**

Hand pulling is impractical and ineffective unless in a small patch. If you choose to use this method, use gloves to avoid latex sap, try to remove the plant before it reaches 2 inches (5 cm)



The Black flea beetle (*Aphthona lacertosa*) is one of the most successful at combating leafy spurge.



The halo of dead spurge can be used as an indication of beetle populations. This halo effect was created 3 years after a release of *A. lacertosa*.

in height and dig up the entire root. Burn the plants to dispose of them. Continue to monitor the site in subsequent years for any new seedlings or re-growth.

**Mowing**

If timed properly, mowing may be used to prevent leafy spurge from seeding. Repeat mowing should be done every 2 to 4 weeks. Be careful that you mow only during the early flowering stage, before the seeds turn brown. Late mowing will result in seed spread.

**Biological Controls**

Biological control uses the natural enemies of leafy spurge to control and reduce the pest population. The use of beetles and multi-species grazing, using sheep and / or goats, places leafy spurge under stress, resulting in weaker plants, and ultimately in reduced stand density. It may

take several years before you will see promising results. It is important that you do not stop using other control measures while waiting for the bio-control agents to work.

**Flea beetles.** Before any biological controls are authorized for import and released for general use, they undergo rigorous testing to make sure they will not adversely affect anything except the target pest. Thus far the most effective bio-control agents for controlling leafy spurge include the flea beetles from the genus *Aphthona*. The adult beetles feed on the leaves of leafy spurge, but it is the root mining larvae that place the plants under the most stress. The damage caused by the flea beetles will also make the plants more susceptible to other control methods.

The use of insects as bio-control agents may not work for everyone. Often, areas containing leafy

**Flea beetles for bio-control of leafy spurge.**

	<i>Aphthona lacertosa</i> Black flea beetle	<i>Aphthona nigriscutis</i> Black dot flea beetle	<i>Aphthona cyparissae</i> Brown dot flea beetle
Description	Black, 3-4 mm long	Copper, with a black dot behind its head, 2-4 mm long	Copper with a brown dot behind its head, 2-4 mm long
Release conditions	Sun (can tolerate shade and moisture) Heavier, clay-loam soil	Full sun Lighter soils (does well in sandy areas)	Full sun Sandy - sandy loam soil, and will tolerate denser vegetation stands (green needle grass is a good indicator).
Success rate	Excellent	Good	Moderate

## LEAFY SPURGE PREVENTION & CONTROL

spurge simply do not meet site requirements needed by flea beetles, and a population will not survive at the site. In any case, be patient and allow the biological control agents a chance to get established. Try releasing them in several different areas.

A successful release site will show a reduction in leafy spurge from 100% cover to 5% cover. As mentioned previously, this may take several years to accomplish and success will depend mainly on site suitability (soils, slope, aspect) as well as the number of flea beetles released.

All of the flea beetles require well-drained soils. Avoid areas susceptible to spring flooding or sites that collect moisture. Release the beetles in patches of leafy spurge that are at least a half acre or more in size and near the edge of the patch in full sun. A minimum of 1,000 per release is recommended; more if available. Given time, they will make their way into the denser or shadier parts of the infestation.

Do not use insecticides of any kind within a 100-foot (30 m) radius around the colony. If using herbicides, leave at least a 10-foot (3 m) buffer zone around the release site. Spray after August 15 to make sure you do not remove the top growth needed by adult beetles for food. Do not cultivate the insectary or you risk losing your beetle population.

### Collecting and moving the flea beetles.

Although *Apthona* flea beetles are not very mobile, they will move to new spurge patches if they run out of food. After 3 to 5 years, if the existing population has successfully established itself and has thinned out the leafy spurge in the original area, it is advisable to collect and move them. (The halo of dead spurge can be used as an indication of active beetle populations.) As well, the beetles should be visible on the plants. The best time to do this is from mid-June to mid-July. Collect the beetles with a sweep net on hot, sunny days with little to no wind. It is best to harvest early or late in the day and to move the beetles on the same day. As a rule of thumb, you have enough beetles to harvest if you can collect at least 5 per sweep (or 500 in 5 minutes). Place them in a paper bag or cardboard container (plastic is undesirable as it collects condensation). Fill the container  $\frac{1}{3}$  to  $\frac{1}{2}$  full with leafy spurge vegetation, seal tightly with tape and place

the container in a cool dry place. If you cannot release the beetles immediately, place them overnight in a cooler with ice or in the refrigerator (40-45°F / 4-7°C). Make sure the ice does not come into contact with the beetles. If you are moving your insects a short distance, simply keep them in your sweep net and walk to your next patch of spurge to release them.

**Leaf tier moth.** Another species of biological control worth mentioning is the leaf tier moth (*Lobesia euphorbiana*). This moth has spread through much of southwestern Manitoba. The leaf tier larvae roll the terminal leaves of the plant into a tight tube and feed upon developing flowerbuds. This prevents the leafy spurge plant from flowering and setting seed and may weaken the plant enough that it helps other biological control agents thrive. The leaf tier moth goes through several life cycles per year. The leaf tier moth can be collected at the Rural Municipality of Cornwallis office.

**Multi-species grazing.** Multi-species grazing is the practice of using two or more livestock species in the same grazing system. Multi-species grazing works to reduce leafy spurge infestations because different animals use different forage resources in the pasture.

Cattle and horses will not consume leafy spurge and sometimes will avoid leafy spurge patches entirely. Sheep and goats, on the other hand, will



Goats will readily consume leafy spurge.



**Multi-species grazing is an effective, sustainable and flexible tool for controlling leafy spurge. Sheep or goats could be added to an existing system without large reductions in cattle or horse stocking rates.**

eat leafy spurge. Sheep initially exhibit a relative avoidance to leafy spurge, but after they become accustomed to its taste, they will readily graze leafy spurge. Goats exhibit a relative preference for leafy spurge and will readily consume it. Sheep overlap the diet of cattle by 20 to 40% and goats overlap by 5 to 20%. This means that sheep or goats can be added to an existing system without large reductions in cattle or horse stocking rates.

Multi-species stocking rates depend on many factors:

- Length of grazing season
- How much you are willing to reduce your cattle or horse herd
- Amount of bush (sheep and particularly goats will make up a good portion of their diet in woody browse if it is available. This means less percent of the diet will be made up of leafy spurge)
- Amount of leafy spurge in the pasture (it will take a lot more animals to graze 400 stems/m<sup>2</sup> than 30 stems/m<sup>2</sup>)

Studies have shown that continuous grazing will give the quickest reduction in leafy spurge. However, rotational grazing is nearly as good. Use whatever system best suits your farm and management system. The most important thing is to get the control mechanism in your pastures.

It is the repetitive nature of the grazing that eventually kills leafy spurge. In 3 to 5 years, leafy

spurge can be reduced by as much as 90% by using sheep or goats. Putting high numbers of sheep or goats in the pasture for a short period is not as effective as repeat grazing at lower stocking rates. A good place to start would be from 1 to 3 infested acres per sheep or goat. As leafy spurge decreases, the number of sheep or goats will also need to be decreased as they will start to overlap the diet preferred by your cattle or horses.

Sheep can take up to 50% and goats up to 80% leafy spurge as a total of their diet before digestive upsets occur. After that point, symptoms can become performance inhibiting.

Managed grazing with species-specific grazing animals, such as sheep and goats, is also effective against leafy spurge. **Grazing is the only control method that is revenue-neutral or even revenue-generating.** Contact the Sheep and Goat Specialist with Manitoba Agriculture and Food, or your local sheep and goat associations for more details on fencing and predator control.

## Integrated Management Techniques

Combining different tools provides more effective leafy spurge control than any single tool can produce. IPM gives landowners and land managers flexibility to determine the best approach for a specific situation.

### **Burning and Biological Control Agents**

Prescribed burns can be used to enhance flea beetle establishment by reducing spurge densities and removing ground litter than can inhibit establishment. Burns should be performed in the fall, after flea beetles reproduce, or very early in the spring so that leafy spurge top growth is available for emerging insects. Burns should not be conducted from mid-May through mid-August to avoid interference with the adult phase of the flea beetle life cycle.

### **Herbicides and Biological Control Agents**

Research has shown that herbicides and biological control can be complementary if properly used. Timing is the most important factor. Fall applications (after August 15) are compatible with flea beetle survival and can enhance population establishment.

Spring and summer applications, however, will remove top growth needed by adult flea beetles to complete their life cycle and should thus be avoided.

### **Grazing & Herbicides and Grazing & Biological Control Agents**

The integration of multi-species grazing with insect or herbicide controls is extremely effective. Studies using fall applied 2,4-D + Picloram and grazing have shown that it takes less time to reduce leafy spurge densities. Insect controls seem little bothered by the addition of grazing animals. Where possible, it is worthwhile combining more than one control mechanism in the same leafy spurge infestation.

**Remember:** Proper control of leafy spurge is an ongoing long-term battle. No one method is going to eradicate this weed, but successful use of integrated management techniques will reduce and prevent it from spreading. Once you have embarked on a program, DO NOT GIVE UP, even if you do not see immediate results. It may take some time before you achieve a decrease in the infestation. And remember that the problem, left alone or abandoned, will only get worse.

The Leafy Spurge Stakeholders Group (LSSG) is comprised of a diverse base of public, private and nonprofit agencies whose aim is to increase awareness of the problem of leafy spurge through coordinated communications and knowledge transfer. Long term integrated and sustainable strategies to reduce the infestation of leafy spurge need to be developed in the Province of Manitoba. They will emerge through greater public participation and further dialogue and cooperation among local public, private and nonprofit stakeholders in consultation with all levels of government. The LSSG is coordinated by the Rural Development Institute of Brandon University.

## Resources

Your local Ag Rep office

Your local Weed Supervisor

**Leafy Spurge Stakeholders Group:**  
[www.brandonu.ca/rdi/](http://www.brandonu.ca/rdi/)

**Manitoba Agriculture and Food:**  
<http://www.gov.mb.ca/agriculture/crops/cropproduction/gaa01d01.html>

**Manitoba Sheep Association:**  
<http://www.gov.mb.ca/agriculture/livestock/sheep/bsa01s18.html>

**Manitoba Sheep and Goat Specialist (Wray Whitmore):** (204) 945-7676, [wwhitmore@gov.mb.ca](mailto:wwhitmore@gov.mb.ca)  
(<http://www.gov.mb.ca/agriculture/livestock/sheep/bsa01s00.html>)

**Mixed-Grass Prairie Stewardship Program:**  
[www.escape.ca/~mxdgrass](http://www.escape.ca/~mxdgrass)

**Multi-species Grazing and Leafy Spurge Manual:**  
<http://www.team.ars.usda.gov/grazingmanual2.html>

**Team Leafy Spurge:**  
<http://www.team.ars.usda.gov/>

**Weed Bio-control (Agriculture and Agri-Food Canada):**  
<http://res2.agr.ca/lethbridge/weedbio/index.htm>



**Manitoba  
Agriculture  
and Food**



**Acknowledgements:** This manual was compiled by Jennifer Pachkowski of Rural Development Institute, Brandon University, with the technical assistance of Jane Thornton of Manitoba Agriculture and Food. The great photographs have been supplied by Jane, Jennifer, Pauline Morton and TEAM Leafy Spurge from the US. Special thanks to those who provided technical information and support for this project. Funding for the production of this manual was provided by Covering New Ground.

**Integrated Pest Management (IPM)**

Control Method	Growth		Flowering		Seed Dispersal		Growth
	April	May	June	July	August	September	
Herbicide		█					█
Cultivation (every 2 weeks)	█						
Mowing		█	█	█			
Burning	█						
Multi-species grazing	rotational grazing █						
Multi-species grazing	continuous grazing █						
Beetles			█				
Forage competition	█						

**Summary of integrated management techniques**

- Multi-species grazing and flea beetles: Grazing will remove excess trash from the soil surface, providing a more suitable environment for egg deposits and larvae survival. Rotational grazing (during early summer and fall) provides the adult beetles with enough food to complete their life cycle.
- Herbicides and multi-species grazing: Grazing will weaken the leafy spurge plant, leaving it more susceptible to a fall applied herbicide such as 2,4-D + Picloram.
- Herbicides and flea beetles: Herbicides can be used to contain a leafy spurge patch while allowing the flea beetles time to establish. Spray after August 15, and leave a buffer zone of at least 3 metres around the colony to allow the adults enough top-growth to survive.
- Herbicides and cultivation: Using a herbicide at least seven days before a fall cultivation will help to improve control. Using herbicides will also minimize cultivation and help to prevent soil erosion.
- Herbicides and burning, or mowing: Burning and mowing both result in the uniform re-growth of the leafy spurge, which allows a more timely herbicide application. Apply a herbicide after allowing three weeks of growth.
- Burning and flea beetles: Burning a site in the spring before a beetle release will clear the ground of litter and result in the re-growth of tender spurge shoots, which are more palatable to the flea beetles.
- Forage competition, cultivation and herbicides: Using a crop such as fall rye after cultivation and/or herbicide treatment provides competition for leafy spurge in the fall, and again in the spring. Spray the spurge in June during the first growth period. Cultivate in mid-August prior to seeding your forage crop.

