

the plants from going to seed. If another treatment is not used, stand expansion may be inhibited but spurge abundance will likely not be reduced.

Chemical Control

Picloram has been a very effective herbicide for controlling leafy spurge. Usually it is applied in the spring or fall and can provide up to 85-90 percent control in the first year. Unfortunately, in order for this treatment to show long term results, it has to be reapplied every four years, which can get expensive. Picloram plus 2,4-D is a more economical solution and still effective. Annual spring applications for a period of approximately three years can provide good long term control with up to 90-95 percent control after five years.

Picloram is not recommended for use in wooded or riparian areas as it is very slow to absorb and break down into the soil. This allows it to leach into groundwater and contaminate fresh water sources. Because of these environmental concerns, Picloram is only available to licensed applicators.

For control of leafy spurge in wooded or riparian areas glyphosate and 2,4-D is applied in the fall can result in up to 80-90 percent control after the first year, a follow up application of 2,4-D will be required in the spring. The use of 2,4-D reduces top growth, prevents seed production and prevents patch expansion but does not affect the original infestation if used alone. This is why 2,4-D is often used as a follow up maintenance program for long term control.

Leafy spurge can be sensitive to herbicide timing; for best results herbicide should be applied in the spring just prior to flowering, during seed development, and/or in the fall during regrowth (fall applications alone are less effective than spring applications alone). It should also be noted that long term control of leafy spurge with the use of herbicides is only effective if repeated applications are made. Most likely, in order to see results, reapplication will have to take place every one to three years.

USING COMBINATIONS OF MANAGEMENT TECHNIQUES

Biological control and other treatments

Mowing, grazing, burning and herbicides can complement the use of biological control to control leafy spurge infestations. All of these treatments will reduce litter and open the canopy allowing more sunlight to reach the soil, improving flea beetle establishment and development. To avoid damage to the flea beetles, burning should be conducted in fall (October) or early spring (before mid May). Burning in the fall prior to release of flea beetles may improve their establishment. Herbicides should be applied late in the season (after August 15th). Grazing by sheep or goats should not affect establishment.

Chemical Control and Grazing

Grazing sheep and goats can also be used in combination with fall herbicide application to control leafy spurge abundance. For example, grazing combined with a fall application of picloram plus 2,4-D can decrease leafy spurge abundance by 98 percent after the

first three years and maintain control for two seasons after the treatment. Just as with all treatments though, it is very important that this is a continuous process.

Chemical Control and Cultural Control

The root buds of the leafy spurge plants develop early and any damage to the plant such as grazing or burning actually stimulates rapid re-growth. Mowing and burning can complement herbicide use by stimulating leafy spurge re-growth and increasing the effectiveness of the herbicide application for controlling stand expansion.

Monitoring

It is important to monitor the effects of any treatment being used to control leafy spurge. Depending on the response of leafy spurge, the treatment may need to be adapted.

It is helpful to record your management actions (timing, location, intensity, plant stage) as well as weather conditions and changes in the plant community. Installing permanent markers at the edge of the leafy spurge infestation is one way to determine if expansion is being controlled or reduced. Landscape and ground cover photos as well as plant counts may also be useful for monitoring progress.

SUMMARY

Leafy spurge is an extremely persistent species with many competitive advantages that allow it to out compete native species threatening the biodiversity of many native habitats. Management programs for controlling spurge infestations must use an integrated site-specific approach, be regularly monitored and adapted to achieve top growth control and to gradually decrease the underground root system.

FOR FURTHER INFORMATION ON WEEDS AND WEED CONTROL:

1. **Alberta Invasive Plant Council**
(403) 638-3805; www.invasiveplants.ab.ca
2. **Alberta Environmentally Sustainable Agriculture**
(780) 427-3885; www.aesa.ca

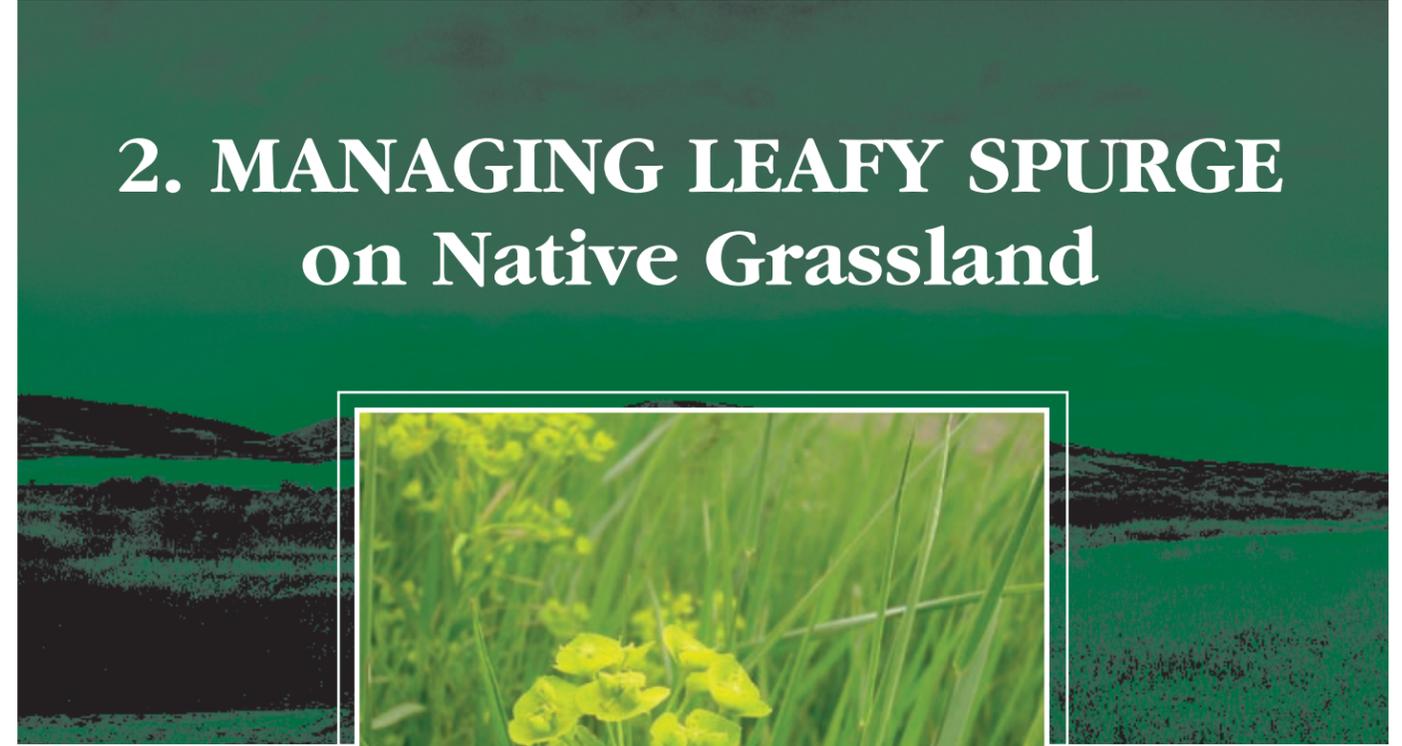
THANK-YOU!

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2. MANAGING LEAFY SPURGE on Native Grassland



INTRODUCTION

Leafy spurge (*Euphorbia esula L.*), a native plant species of Central and Eastern Europe, was first introduced to North America in 1827, most likely as a seed grain contaminant. Leafy spurge has since become a major economic and ecological problem throughout most of North America.

Since its introduction, leafy spurge has rapidly spread to rangelands, pastures, woodlots and prairies across the United States and Canada, infesting over 1,214,000 hectares (3,000,000 acres).

THE PROBLEM

Native prairie is part of our natural history and is important as a grazing resource, wildlife habitat and for soil and water conservation. Without natural enemies or controls in their new habitat, exotic or introduced species have the ability to out compete many of the native plant species and invade native habitats. Threats such as the invasion of exotic species can degrade our prairie by excluding native species, which reduces biodiversity, carrying capacity, habitat and the aesthetics of our prairie ecosystem.

Leafy spurge is an aggressive perennial weed that has many characteristics that allow it to effectively compete with native prairie species:

- **Early spring growth (sometimes as soon as the ground thaws). This allows it to use up available water and nutrients.**
- **An aggressive root system that extends deep into the soil making the plant extremely drought resistant. The vertical roots of the spurge plant can extend to a depth of eight meters (26 feet) and the lateral roots can spread up to five meters (16 feet).**
- **Both of these roots can give rise to shoot buds at almost any point allowing spurge plants to spread at the rate of a few meters per year.**
- **Although the upper portion of the plant can be killed, the living roots below the soil surface or even detached roots will generate new shoots ensuring the plant persists and spreads.**
- **Leafy spurge plants produce allelochemicals or toxins that can inhibit or reduce the germination and/or growth of other surrounding plant species.**
- **The mature spurge plants are relatively tall and can shade surrounding plants, which effectively excludes other species.**
- **Leafy spurge plants produce a milky liquid substance called latex, which is toxic to most animals. Cattle will even avoid forage growing in close proximity to leafy spurge stands.**



Interested landowners are encouraged to contact:
OPERATION GRASSLAND COMMUNITY
 Alberta Fish and Game Association
 6924 – 104 Street NW
 Edmonton, AB T6H 2L7
 Phone: (780) 437-2342 Fax: (780) 438-6872
 On-line at: www.ogcpcsp.com



- **Leafy spurge plants can also reproduce through seed production. The seeds are produced in seed capsules with each capsule containing three seeds that are released explosively up to five meters from the parent plant. Approximately 99 percent of germination occurs within the first two years but seed can remain dormant in the soil for up to eight years.**

Know Your Problem

Before a management regime for controlling leafy spurge can be selected and implemented, the problem needs to be recognized. The first step in this is to take an inventory of the site using field surveys, aerial photos, and GPS (Global Positioning System) (if possible). Some of the important details that should be identified are native species that are present, size of the area infested, density of the infestation, location in relation to the entire pasture, relative biomass of spurge to native species, water sources (above and below ground), range condition, topography, and soil and range types. Maps of the pasture including the area affected can then be created for planning management strategies to control leafy spurge.

CONTROLLING LEAFY SPURGE

The key to control is early detection and treatment of the initial invading plants. When small infestations (patches in diameter of less than eight meters or 26 feet) are detected, management should be aggressive as small infestations spread up to 500 times faster than large infestations. Large-scale infestations are extremely difficult to eradicate and while management should also be aggressive, containing them may be a more achievable management goal.

Leafy spurge cannot be controlled with a single treatment. The best approach is an integrated control program using a combination of biological control, grazing, mowing, and herbicides. The goal is to attack both the above ground growth and underground root system. Management goals for leafy spurge should include: prevention, detecting and eradicating new infestations and containing largescale infestations as well as regular monitoring and reapplication (producers should be prepared to be active in the control of leafy spurge for several years).

MANAGEMENT TECHNIQUES

Control treatments are most effective when invasive species are stressed without injuring desirable native species. This allows for the desirable species to provide competitive stress on the invader.

Biological Control

Several insects native to Eastern Europe have been selected for use in controlling leafy spurge populations in the United States and Canada. The *Aphthona* genus of flea beetles has proven to be the most successful for establishment, redistribution, and control, and several of these beetles have been released in Canada. Generally the *Aphthona* flea beetles prefer well drained sandy loam to loam soils with moderate densities of leafy spurge growth. Each species has slightly different habitat preferences. To increase the likelihood of beetle establishment, different species should be released at the same point. The adult beetles injure leafy spurge by feeding on the foliage but it is the larval stage of the beetle that does

the most damage. The adult female beetle lays her eggs in late June through July near the base of the plant. In eight to ten days the eggs hatch and the larvae burrow through the soil to feed on the roots of the leafy spurge plants. The larvae attack the roots, root buds and shoots. This weakens the plants and depletes plant food reserves thereby making the plants more susceptible to pathogens present in the soil.

Control has been achieved primarily by the black dot spurge flea beetle, the black leafy spurge flea beetle, and the brown legged spurge flea beetle. These three flea beetles have shown the highest success rate. The other beetles are still present in smaller amounts and in the future may play a larger role once the leafy spurge populations begin to decrease and the ratio of leafy spurge stems to biological control agent decreases.

How to use flea beetles to control leafy spurge infestation:

- **Choose beetles whose habitats are suited to the characteristics of the site.**
- **Release a minimum of 1000 beetles between the beginning of June and mid July (3000-5000 is recommended).**
- **Release beetles at a number of points spaced 15-30 meters (50 to 100 feet) apart. The beetles are slow to disperse so using multiple release points will increase beetle effectiveness in larger infestations. Since it may be difficult to obtain such a large quantity of beetles in order to release 1000 at each site, it may be beneficial instead to release at a couple sites (referred to as "supersites") and then to collect from those sites after they have become established (approximately three years) to redistribute to other sites.**
- **Use more than one species of beetle as soil and climate conditions may vary across the site.**
- **Mark the release site (for example, using a fence post or GPS unit) for future monitoring. Record location of the site on a map as well.**

MONITORING

Release sites must be monitored to determine if beetles have successfully established and if there are sufficient numbers of beetles to harvest. Usually it takes 3-4 years for a site to become established and suitable for harvest. Signs or indicators that a site has established beetle activity on it include: stunted leafy spurge plants, reduced or delayed spring emergence, delayed flowering, thinning stands of leafy spurge, feeding damage (pitting of leaves or ragged/shredded leaves), and observable adult beetles on leafy spurge plants and surrounding grass.

After beetle emergence has been determined, the population should be assessed to determine if there are sufficient numbers of beetles to harvest. Assessment should take place between early June and mid July (adult phase of the life cycle), in warm to hot temperatures on calm, sunny days when vegetation is dry. It should be noted that every year before harvesting, beetle populations need to be assessed to ensure adequate numbers.

Steps to Assessing Beetle Populations:

- **Collect beetles using a 15-inch heavyduty sweep net at the original release point and any areas showing signs of activity.**
- **Sweep using firm broad strokes while walking at a comfortable pace. Sweep only the top half of**

the vegetation.

- **Take between 1 and 10 sweeps then calculate the number of beetles.**
- **If you have one to two beetles per sweep or collect more than 500 in 5 minutes you can begin harvesting.**

Harvesting beetles

Harvesting should begin as soon as there are harvestable numbers of beetles present. Do not wait another year for beetle populations to further increase as sometimes beetles can reproduce rapidly and reduce spurge roots so dramatically that beetle populations may crash. Harvesting should be conducted as frequently as possible during early June to mid July, on warm, calm days.

Steps to Harvesting Beetles

- **Use a 15-inch heavy-duty sweep net in the same way as for assessing beetle populations.**
- **Periodically dump beetles collected into a spare net or pillowcase**
- **A sorter can be used to separate beetles from other insects and vegetation. A sorter can easily be made using PVC tubing with the ends capped and several 0.32-0.78 cm (1/8 or 3/16 inch) holes drilled into it. Dump the contents of the net into the tube and place it inside a spare net or pillowcase then place it in the sun. The beetles will climb out of the tube toward the light leaving other insects and vegetation behind.**
- **Count the desired number of beetles using a small graduated bottle (pill bottle). Ten mm is approximately 1000 beetles.**

After the beetles have been collected, they should be released as soon as possible. Store beetles in paper bags or unwaxed paper cups. Plastic containers should not be used as condensation can be a problem.

Fill the container or bag 1/3 full with leafy spurge plants (do not include seed heads) and 500 to 5000 beetles. Staple or tape the bag or container closed without air holes. Store the beetles in a cool dry location out of the sun. Coolers with ice packs work well but beetles must be kept dry.

When releasing beetles, choose days where the weather is similar to that of collection (warm, sunny, calm days). If weather conditions are cool and rainy at the release site, the beetles can be stored for several days at a temperature of 4-7 degrees Celsius.

Keeping record of the species, number of beetles released and location of release is a good idea to determine if the beetles are becoming established and if a particular species of beetle is working well or not.

Grazing

Grazing can be a sustainable option of control with achievable results, especially if grouped with another control measure. Grazing will reduce the leafy spurge canopy (top growth) and increase the competitiveness of native species. Leafy spurge is a very nutritious weed with rather high crude protein levels, and sheep and goats have been used to selectively graze it in native range. Leafy spurge can constitute up to 50 percent of a sheep's diet and 66 percent of a goat's. In fact, once they have been trained to eat it, sheep and goats will actually prefer it over most grasses.

In order for sheep to graze leafy spurge, they have to be trained to do so. If leasing sheep to graze, it is desirable to obtain a flock that has grazed leafy spurge in the past as this eliminates a training period. If a flock of sheep need to be trained to eat leafy spurge, it is best to fence off a highly infested area with temporary fence and then confine the sheep in the area giving them no other option than to graze it. This allows for quick transition and adaptation.

Grazing should begin in the spring when the leafy spurge reaches a height of approximately four to six inches. A stocking rate of one to two sheep per acre of leafy spurge over a four month grazing season should be used in order to achieve adequate control (or four to eight sheep per acre of leafy spurge in a period of one month). The stocking rate should be based on the actual infested acreage rather than the total pasture size. This ensures that the areas infested with leafy spurge are being grazed and that overgrazing will not occur on the remainder of the pasture. As the density of the leafy spurge decreases, the number of sheep needed to graze will also decrease.

A rotational grazing system should be used, especially for large infestations that cover many acres. This increases the utilization of all leafy spurge patches. The pasture should be divided into several smaller pastures. Sheep or goats start to graze in the spring until the leafy spurge plants have been completely defoliated. The sheep are then rotated to the next pasture and this process is repeated. Each pasture should be grazed two or three times over. This is effective in reducing plant vigour by eliminating seed production as well as decreasing carbohydrate reserves.

Although grazing may be an effective and sustainable means of control, other factors must be looked at before starting a control program. Different skills, methods, and facilities/materials are needed to run a sheep operation and many producers do not feel they are fully capable of taking that on. New fence will either have to be put up or existing fence will need to be modified. Sheep require a higher degree of management and care than cattle, as well as a required knowledge of issues such as potential predators. For many producers, the option to lease a flock of sheep is preferred. This eliminates most financial and operational constraints, leaving the lessee only with fencing costs, water and forage supply, and the monthly lease rate.

Grazing, although an effective method does not eliminate leafy spurge. It is a control measure that works best as part of an integrated management system. Grazing will reduce top growth but will not affect the underground root system and therefore will not take part in eradication but instead provide a means of control.

Cultural Control

Mowing reduces seed production and repeated mowing will weaken spurge plants but it is difficult to be selective. Burning alone has little effect on leafy spurge populations.

Selective clipping can be used to control small spurge patches but it is time consuming. The plants must be cut prior to seed set to prevent