WEEDS

DIFFUSE, SPOTTED & RUSSIAN KNAPWEED

(*Centaurea diffusa Lam., Centaura maculosa Lam. & Acroptilon repens L.)*

INTRODUCTION

Knapweed plants are highly competitive herbs of the aster (sunflower) family (*Asteraceae*). There are 13 knapweed species in BC. Three particularly harmful varieties are known to occur in the Okanagan-Similkameen district: diffuse knapweed, spotted knapweed and Russian knapweed. All three species are strong competitors and can form dense colonies in disturbed or overgrazed lands, but diffuse and spotted knapweed will also invade undisturbed natural habitats. Once established, the knapweed plants can dominate an area and significantly reduce desirable vegetation, such as perennial grasses.

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Infestations of diffuse and spotted knapweed are causing severe environmental deterioration in the Southern Interior of BC. Knapweed degrades livestock habitat and reduces forage production, decreases recreational enjoyment and results in undetermined loss of wildlife habitat. These knapweed varieties are generally unpalatable to livestock, and spines on the flower heads of diffuse knapweed may cause injury to the mouth and digestive tract of grazing animals. Diffuse knapweed infestations can greatly reduce dryland forage production with estimated losses of up to 88% in some areas of the United States. Although it is not as common in the Okanagan-Similkameen, Russian knapweed can also threaten the stability of ranching operations by reducing available forage. On agricultural land, the presence of any knapweed varieties can cause serious reductions in yields, crop value, and may even significantly devalue the land itself. Other losses include soil erosion, and reductions in wildlife populations due to the decrease in forage production.

Both diffuse and spotted knapweed are thought to have been introduced from Eurasia in the early 1900's as contaminants of alfalfa seed. Both are presently found throughout BC, primarily in the Southern Interior ranges. They occupy over 40,000 hectares (100,000 acres) in the province, but have the potential to spread to 1 million hectares (2.7 million acres) of grassland range and fringe forest areas. Diffuse knapweed can specifically be found in the Thompson-Nicola, Okanagan and Kettle-Boundary. Spotted knapweed is more common

in wetter areas of the Kootenays, Okanagan, Thompson-Nicola, Kettle River and Fraser Canyon areas, with some small patches in the Cariboo-Central. Both species also occur in coastal and northern areas of the province and in the Yukon.

Native to Mongolia, western Turkestan, Iran, Turkish Armenia, and Asia Minor, Russian knapweed is another highly competitive knapweed variety. Similar to diffuse and spotted knapweed, Russian knapweed was first introduced into Canada around 1900 as a contaminant of alfalfa seed. It is currently found in the largest concentrations in the Keremeos area, and in smaller patches in the east Kootenay region, Okanagan, Merritt, Kamloops and William's Lake areas. Unlike diffuse and spotted knapweed, Russian knapweed spreads through creeping horizontal roots and seed. This provides additional competitive advantages and makes it more difficult to control.

Knapweed plants suppress other vegetation presumably by intense competition for limited soil water. However, associated grasses that remove moisture and nutrients from the rooting zone of knapweed can impede its spread through vegetated areas. Other non-native species, such as crested wheatgrass (*Agropyron cristatum*), have been shown to stress and inhibit diffuse and spotted knapweed invasion by limiting available soil moisture during the critical seedling growth stage.

These knapweed varieties are generally avoided by grazing animals due to their bitter taste. While diffuse and spotted knapweed are non-poisonous, Russian knapweed is toxic to horses and can cause a neurological disorder called “chewing disease”. This disease is limited to horses and does not occur in cattle, sheep or goats.

IDENTIFICATION

Diffuse knapweed plants first form low rosettes (a ring of basal leaves) and may remain in this form for one to several years. After they reach a threshold size, they will bolt, flower, set seed and then die. Thus, they may behave as annuals, biennials or short-lived perennials. Diffuse knapweed grows from a slender, deep taproot. The plants have a single hairy erect stem, which grows from 20-100 cm (8-40 in) in height and has numerous spreading branches which give it a rounded profile. The upper leaves are much reduced in size and less divided than the lower leaves. Flower heads are broadly urn-shaped, 1.5-2.0 cm (0.6-0.8 in) tall, solitary or in clusters of 2-3 at the ends of the branches. The flowers are usually white, sometimes purple, while the spiny bracts surrounding them are yellowish, often with a brownish margin. Spotted knapweed is a biennial or short-lived perennial with a stout taproot. The rosettes are formed from deeply divided, staked basal leaves. It grows several stems 20-120 cm (8-48 in) tall with numerous spreading branches primarily in the upper half of the plant. The divided leaves are longer and narrower than diffuse knapweed. The egg-shaped flower heads are solitary, terminal, 1.5-2.5 cm (0.6-1.0 in) broad and ~1.3 cm (0.5 in) tall. The thistle-like flowers are found at the ends of the branches and are pink-purple, or sometimes white. Bracts surrounding the flower heads have a black triangular spot on the tip, resulting in a spotted appearance.

While diffuse and spotted knapweed are similar looking plants, spotted knapweed can be distinguished by its black fringed bracts, mostly purple flowers, less segmented leaves and longer, white hairs attached to the seeds.

Diffuse knapweed

Spotted knapweed

Russian knapweed is a long-lived perennial which grows in dense patches of single stems. It has deep, creeping roots and stems 30-90 cm (12-36 in) tall. The stem leaves are lobed and toothed along the margin and become smaller up the stem. Young stems are covered with soft, short, gray hairs. The urn-shaped flower heads are solitary, greenish-straw coloured, ~1.3 cm (0.5 in) long and bracts are capped by a papery, finely hairy tip. The flowers are lavender-blue to pink.

BIOLOGY AND ECOLOGY

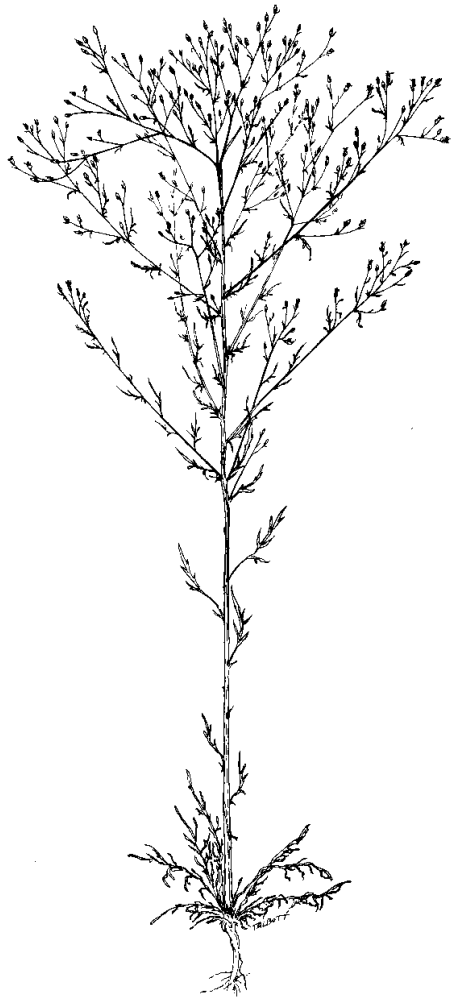
Diffuse knapweed can behave as an annual, biennial or perennial. Plants that complete their juvenile growth by the fall, and overwinter as rosettes, bolt in spring. Plants that have not finished the juvenile stage by the end of fall remain as rosettes through the second year and bolt during the third year. Flower buds are formed in early June and flowering occurs in July and August. Diffuse knapweed is a prolific seed producer, producing 900 seeds per plant, under dry land conditions, and 18,000 under irrigation. Seeds are commonly spread by the wind, as mature plants blow around in a tumbleweed fashion. Vehicles, machinery, wildlife, domestic animals and movement of infested hay and soil assist dispersal.

Spotted knapweed behaves as a biennial or short-lived perennial. Its seeds germinate in the fall and early spring. Seedlings form rosettes which may produce 1-7 flowering stems the following spring. The flowers of this knapweed bloom from July to October. Plants may flower only once, or up to three years in succession, and perennial plants may have up to 20 flowering stems. A single plant is capable of producing over 400 seeds under range conditions and 25,000 under irrigation. Dispersal mechanisms include vehicles, machinery, animals and movement of infested hay and soil.

Russian knapweed shoots emerge early in spring, shortly after soil temperatures remain above freezing. This perennial forms rosettes and bolts in late May to mid-June. Russian knapweed flowers from July to September. While it does not appear to reproduce extensively from seed, one plant may produce 1,200 seeds per year. Seeds are dispersed in contaminated soil, hay and other seed. Animals probably also play an important role in seed dispersal.

Russian knapweed is also able to spread by lateral extensions of its roots, a characteristic lacking in diffuse and spotted knapweed. Buds on the horizontal roots can form adventitious shoots that may grow to be independent plants. The roots of Russian knapweed can extend more than 7 m (23 ft) below the soil surface with 2-2.5 m (6.5-8.2 ft) of growth occurring the first year and 5-7 m (16.4-23 ft) in the second year.

All three varieties of knapweed contain an allelopathic compound which may inhibit



Diffuse knapweed

Spotted knapweed

Russian knapweed

the growth of competing plants. This characteristic may assist the knapweeds in quickly colonizing and dominating new sites.

PREVENTION AND MANAGEMENT

The most effective method of control for the knapweeds is to prevent establishment through proper land management. The healthier the natural plant community, the less susceptible it will be to knapweed invasion. Areas free of knapweed should be monitored annually and all plants found should be destroyed immediately. Here are some recommendations to prevent knapweed invasion on your rangelands/pastures:

- Maintain grasslands in a healthy, vigorous condition to ensure a productive plant community; competitive perennial grasses and forbs utilize water, nutrients and space that would otherwise be readily available to knapweed.

- Regularly patrol your property for knapweed plants and immediately treat new infestations.

- Cooperate with adjacent landowners and encourage them to control knapweed and other weeds.

- Immediately revegetate disturbed, bare soils with a suitable seed mix that provides dense, early colonization to prevent weed invasion.

- Clean your vehicles and machinery of plant material and soil before leaving a knapweed infestation.

- Check seed for contaminants and use only certified seed.

- Learn to identify the different species of knapweed and other noxious weeds.

Once knapweed plants are established, an effective management program needs to first control existing infestations, and then develop a land management plan to deter re-infestation. Since diffuse and spotted knapweed reproduce entirely by seed, the key to controlling existing infestations is to eliminate new seed production and deplete the existing seed bank. Knapweed also tends to grow in dense patches, so it is relatively easy to locate and conduct spot treatments. The keys to controlling Russian knapweed are to: stress the weed and cause it to expend nutrient reserves in its root system; eliminate new seed production; and control its vegetative spread. The management plan for all of the knapweed varieties and any other highly competitive weeds must promote re-population by native plants or other desirable species. Continued monitoring and follow-up treatments should be conducted annually to eliminate any re-infestation of knapweed.

PHYSICAL CONTROL

If adequate labour is available, and the infested area is relatively small, hand pulling before seed set may be an effective method of control. It must be done rigorously, following a strict plan with three separate pullings per year. The first pulling should occur when soil moisture remains high enough to remove the taproot (and the root system in Russian knapweed). The second pulling should take place after the plants have bolted, in late June. The last pulling is to catch any plants that were overlooked during the second pulling, and should occur before seeds

are dispersed. The plants that are removed may still have developing seeds and therefore, after they're removed, the plants must be burned or deeply buried.
Mowing or cutting may also be used for controlling knapweed. Generally for light infestations, hand cutting or mowing should be done in the early flower stage; plants are less likely to re-sprout if allowed to bolt before cutting. Cutting must be repeated over several years to deplete the seed bank.

Fire is not an effective control for knapweed. The seeds are protected by tough, fire-resistant seed head bracts.

In an agricultural setting, cutting, mowing or discing Russian knapweed several times annually will also control the existing top growth. Often, the plants that do re-emerge are smaller in size and lower in vigor. This is a good indication that the plants are under stress and that their nutrient reserves are declining. Aggressive monitoring, followed by a combination of mechanical, chemical, and biological control, is needed to remove an infestation.

BIOLOGICAL CONTROL

Approximately twelve biological control agents that attack diffuse and spotted knapweed have been released in the province, and at least six species are well-established in the Okanagan-Similkameen. Although density reductions are currently occurring at some sites, it appears that none of these agents, alone or in combination, effectively controls diffuse knapweed populations. However, they may prove useful in integrated control programs by weakening the plants and/or reducing seed output enough to make the plants more susceptible to herbicides, prescribed fires or other techniques that stress the plants.

Two seed-reducing flies, *Urophora affinis* and *U. quadrifasciata*, were introduced to BC in 1971 as the first biological control of knapweed. The plant forms gall tissue around the flies, effectively causing the plants to produce flies instead of seeds. They are now spread through most infestations, decreasing seeds and flower heads on plants. A beetle, *Larinus minutus*, also attacks the flower head of knapweed. Another beetle, *Sphenoptera jugolavica*, attacks the knapweed root and causes a progressive decline in knapweed production. Two additional root feeding bioagents are *Agapeta zoegana*, a moth, and *Cyphocleonus achetes*, a beetle.

Only two biological control agents have been approved for release on Russian knapweed: *Subanguina picridis*, a gall-forming nematode, and *Puccinia acroptila*, a stem and leaf rust.

CHEMICAL CONTROL

Tordon 22K (picloram), Transline (clopyralid) 2,4-D and Roundup/Touchdown (glyphosate) are all chemicals that can be used to treat knapweed infestations when plants are young and actively growing. Diffuse or spotted knapweed can be spot-sprayed with Tordon 22K or 2,4-D Amine 500 at a rate of 2.2 L/ha. Transline can also be applied to diffuse or spotted knapweed before the bud stage, at a rate of 0.70 L/ha. If a non-residual herbicide is desired, knapweed can be treated with a wipe-on application of Roundup/Touchdown (33% solution).

For Russian knapweed, Tordon 22K is the most effective herbicide. Rates of 2.2-4.5 L/ha

applied at the rosette or bud stage provides good control for at least 3 years.

For small infestations of all three species, products such as Killex or Tri-Kill should also provide effective control.
Repeat applications will be required for all non-residual herbicides.

Consult your local Ministry of Agriculture and Food office for the most current information on appropriate chemical controls. As with all pesticide treatment, herbicide applicators must handle and apply herbicides in a safe and responsible manner, as dictated by legislation and guidelines under the Pesticide Control Act.

MONITORING PROCEDURES

Monitoring should focus primarily on the most disturbed areas of a site, particularly along roadsides, parking lots, fence lines and river banks.

If an infestation is found, closely search the surrounding area to determine the size and extent of the infestation. Patches of knapweed should be marked, and special attention should be given to these locations during follow-up visits.

POST-TREATMENT GRAZING MANAGEMENT

During early spring, perennial bunchgrasses are growing from root reserves and are more susceptible to competition from invasive weeds. Native grass seedlings are often poor competitors with weeds so it is important to maintain weed control until the grass stand is vigorous and competitive. It is essential that enough leaf area remains after grazing to allow re-growth when soil moisture is available. Failure to alter land management practices to allow the native plant community time to recover and resist competition from weeds will lead to a reduction of forage available for grazing animals.

Management practices that will assist the recovery of the native plant community include:

- delay spring grazing until range readiness has been achieved[1]
- avoid compaction of wet soils
- avoid congregations of livestock whenever possible, to ensure there are no areas of high soil disturbance
- employ appropriate grazing systems that maintain the vigor and health of the range plants

Plant communities that are in good condition may recover without replanting of desirable species. However, replanting competitive native grasses and forbs can help accelerate recovery of the

[1] Range Management Handbook for BC. 1998. Available from the BC Cattlemen's Association (250) 573-3611

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