

Diffuse Knapweed

Centaurea diffusa
Asteraceae

Class B Noxious Weed
Control Required

Legal Status in King County: Diffuse knapweed is a Class B Noxious Weed (non-native species harmful to environmental and economic resources that landowners may be required to control based on distribution in the county and local priorities) according to Washington State Noxious Weed Law, RCW 17.10. In accordance with state law, the King County Noxious Weed Control Board requires property owners to control diffuse knapweed on private and public lands throughout the county (control means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants). In addition, state quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of diffuse knapweed.

BACKGROUND INFORMATION

Impacts and History

- Diffuse knapweed is native to Asia Minor, the Balkans, and the Ukraine and Crimea. Diffuse knapweed was first collected in the U.S. in a Washington State alfalfa field in 1907 and is thought to have been introduced through impure Turkestan alfalfa or possibly hybrid alfalfa seed from Germany.
- Diffuse knapweed is a pioneer species that can quickly invade disturbed and undisturbed grassland, shrubland, and riparian communities. Once established, diffuse knapweed outcompetes and reduces the abundance of desirable native species. This weed rapidly colonizes disturbed areas, but is capable of invading well-managed rangelands and pastures with light soils.
- Diffuse knapweed often attains high densities on sunny wild lands—even when undisturbed by human or livestock activity. Knapweed tends to dominate sites at the expense of community diversity or forage production. It can occupy over 95 percent of the available plant community.
- Knapweed infestations can increase soil surface run-off and sedimentation of streams.



Photo from Weeds of the West 2000

Description

- **Plant:** Diffuse knapweed is a tap-rooted biennial, occasionally annual or short-lived perennial forb that reproduces by seed. Plants overwinter as a rosette that resembles

spotted knapweed. Diffuse knapweed seedlings first form low rosettes and may remain in this form for one to several years depending on environmental conditions. Root growth occurs at this stage and the plant bolts when it reaches a certain size or leaf mass, which will vary with the plant and conditions. Diffuse knapweed plants that complete their juvenile growth by the fall, and overwinter as rosettes, bolt in early May. 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. Plants usually produce a single main stem that divides into numerous branches about halfway up the stem, giving it a ball-shaped, tumbleweed appearance and mobility.

- **Leaves:** The leaves are distinctly pale, grayish-green. The long, deciduous basal leaves, which form the rosette, are stalked and divided into narrow, hairy segments, 1-3 in (3-8 cm) long, and 0.4-1 in (1-3 cm) wide. The stem leaves are alternately arranged, and smaller, less divided, stalkless, and become bract-like near the flower clusters.
- **Stems:** Stems are upright, 4-24 in (10-60 cm) tall, highly branched, angled, with short, stiff hairs on the angles.
- **Flowers:** Flowers are usually white, but can range to light purple. Bloom period is usually from June through September. Bracts on diffuse knapweed have a distinct, rigid terminal spine about one-quarter to one-third of an inch long with four to five pairs of shorter lateral spines. Bracts can have dark-colored tips but lack the dark fringe present on spotted knapweed.
- **Seeds:** Seeds are 0.08-0.1 in (2-3 mm) long, light brown to black, bristles generally absent or a mere fringe less than 0.04 in (1 mm) long.



Habitat

- Diffuse knapweed prefers open sunny habitats and dry conditions and competes well on excessively drained soils.
- In the United States, diffuse knapweed is generally found on light, dry, porous soils. It is usually found on plains, rangelands, and forested benchlands, particularly on rugged or rocky terrain that is not well suited for cultivation. Diffuse knapweed has been observed at elevations up to 7,000 feet.
- Diffuse knapweed spreads along heavily disturbed areas such as road ditches, agricultural field margins, railroad beds, pipelines, and recently installed utility lines. The plant will spread from these sites into rangelands, meadows and other open habitats.
- Knapweed is most common in disturbed habitats and overgrazed or poorly managed pastures.
- Diffuse knapweed is most commonly found in King County on roadsides, railroad tracks and parking areas. The soils in these areas are gravelly or sandy and excessively drained providing the dry conditions that favor diffuse knapweed.

Reproduction and Spread

- Diffuse knapweed reproduces solely by seed. Flower buds are usually formed by early June and flowering occurs from June through September. Flowers open for 2-6 days each. The bracts may reopen after about 20 days and scatter seeds, but seeds often remain in the urn-shaped heads even after they mature and break away from the receptacle. Some of the heads are held horizontally and open and release seeds in the fall as the plant dries out. However, most of the heads remain closed until the plant dries up, breaks off at ground level and effectively becomes a tumble-weed, allowing seeds to be individually dispersed over long distances. Plants average about 1,000 seeds per plant. Seeds are viable for seven years, and germinate throughout the growing season. Seedlings emerging in fall develop into a rosette of leaves that resume growth in spring.
- Mature plants break off at ground level and tumble in the wind or become attached to the undercarriage of vehicles and equipment.
- Motorized vehicles are the greatest contributor to the spread of knapweed, and roadsides, railroads and construction equipment have been a major vector for knapweed spread.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of manual, mechanical, chemical, cultural and biological control methods to match the management requirements of a specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- IPM means using an adaptive approach. Control methods should reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and allow for flexibility of methods used as appropriate to the current situation.

Planning Considerations

- Learn to identify the weed and survey the area for weeds.
- Set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Control practices in critical areas should be selected to minimize soil disturbance or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).
- For larger infestations, the strategy will depend on the land use of the site. Set long term management goals and select the best control methods for the site conditions.

- Persistence is necessary. Plan to revisit the site to control plants that have survived initial control efforts.
- Minimize disturbance to avoid creating more opportunities for germination of weeds.
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Properly dispose of all parts of the plant (see Disposal Methods section below).
- Whenever possible, control should be done before plants are seeding to prevent spread.

Early Detection and Prevention

- Prevention is the key to weed control. Watch for knapweed near known infestations.
- Knapweed is easiest to find once it flowers in **June or July**. Monitor roadsides, waste and disturbed areas, pastures, rangeland, and trails for new infestations.
- Small infestations and individual plants can be effectively hand-pulled or dug up. Uprooting one plant can prevent thousands of new seedlings.
- If there are more plants than you can remove manually, treat them with an appropriate herbicide.
- Prevent plants from spreading away from existing populations by washing tools and boots and clean vehicles and animals that have been in infested areas.
- Clean mowing equipment before moving to un-infested areas.
- If animals are being moved from an infested pasture to an un-infested pasture, if possible, first hold them for at least five days so that the seeds pass out of the animals' digestive system
- Off-road vehicles create disturbances and carry weeds. Clean off-road equipment and avoid driving in infested areas.
- Communicate weed control goals and needs with neighbors and persons working in infested areas. Awareness will increase prevention

Manual

- **If soils are moist, plants can be pulled after they bolt but before they flower.** Typically this is from May to June.
- Plants in flower may form viable seeds even after they are pulled, so carefully bag and dispose of all flowering plants later in the season when seeds are forming.
- In areas where mature plants are pulled, there are usually many small rosettes and seeds left in the soil. Carefully search the area for rosettes and dig them up. Roots break off easily and re-sprout, so use a digging tool. Completely removing plants is easiest when the soil is loose or wet.
- Return to the same location in the following spring and summer to remove plants coming up from seeds already in the soil and continue to monitor the area for several years.

Mechanical

- Rototilling or plowing will eliminate knapweed. Cultivating with a disk will control young plants and seedlings, but established plants can survive if the taproot remains.

- Mowing will **not** control knapweed effectively. Plants are able to re-sprout and flower again in the same season when mowed. Plants that are regularly mowed can persist as short-lived perennials or flower below the level of the mower.
- Mowing may increase the number of stems.

Cultural

- In pastures, good grazing practices and management of grass and forage species will greatly improve control of knapweed. Seeding desirable species in any area will prevent weed infestations.
- Minimize disturbance and re-vegetate disturbed areas to avoid creating opportunities for seed germination. Manage for the species desired on the site.

Chemical

- **Precautions:**
 - o Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - o For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
 - o For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- Herbicides are usually the best method to control large or established infestations in areas that cannot be tilled. For knapweed, it is most effective to apply selective broadleaf herbicides in the spring. Infested areas should not be mowed until after the herbicide has had a chance to work.
- Non-selective herbicides such as glyphosate (Roundup) can be used if damage to grass can be tolerated.
- The timing of an herbicide application is critical to success. Diffuse knapweed should be sprayed in the spring with selective herbicides between the time when the rosettes and seedlings start actively growing until the plant has bolted and before the bud stage. Fall applications after rains have initiated seed germination can also be effective if the plants are green and actively growing.
- Herbicides are most effective on actively growing plants with good soil moisture and warm, dry weather.
- Use a surfactant (spreader-sticker) to enhance herbicide effectiveness.
- Herbicides should be used as one tool in an integrated pest management approach. Cultural techniques such as fertilizing pastures or reseeding and establishing competing vegetation can minimize chemical use. Manual removal of survivors as follow-up can be effective.

Specific Herbicide Information

Selective Broadleaf Herbicides are very effective in controlling knapweed, especially in pastures and grassy area. Grasses are not harmed by these selective herbicides and will compete with knapweed seedlings. Selective herbicides can harm certain grasses, alfalfa, clover and other legumes. Soil type, water table depth and land use should be considered before using any herbicide.

Selective herbicides such as clopyralid (Stinger) and aminopyralid (Milestone) are the most effective herbicides for diffuse knapweed control, having soil residual activity that provides extended control of germination, but must only be used in permanent pastures, rangeland or non-crop areas. Other selective herbicides recommended for diffuse knapweed control are: clopyralid + 2,4-D (Curtail) and clopyralid + triclopyr (Redeem R&P).

Readily available selective herbicides effective in controlling knapweed include 2,4-D (many products), a combination treatment of dicamba and 2,4-D (e.g. Weedmaster or Weed-B-Gon) and a combination treatment of triclopyr and 2,4-D (e.g. Crossbow). If using 2,4-D, or triclopyr (Garlon), re-treatment will be necessary to control late-germinating plants. 2,4-D is most effective when plants are bolting.

NOTE: Certain additional restrictions apply for products containing Triclopyr BEE (e. g. Garlon 4, Crossbow). Refer to the King County Noxious Weed Regulatory Guidelines for more details.

Glyphosate (Roundup) will effectively kill individual knapweed plants or plants where damage to grass can be tolerated. Roundup treatments should be made before bud stage. Treatment with glyphosate should be combined with effective re-vegetation of the site to prevent seedlings from re-infesting the area.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species, reducing the population and reproductive ability of the weed. Biological control is generally most effective when used on large infestations or in areas where it is difficult to use other control techniques. Because knapweed has severely infested large areas of rangeland in western United States, there has been considerable effort to find biological control agents. Since the 1960's, 14 agents have been released, 13 insect species and 1 fungus, and this combination of biocontrol agents is beginning to have some success. In King County, the knapweed infestations are relatively small and biological control agents are not well-suited to prevent small, pioneering infestations.

- Biological control can take many years to have a significant impact on an infestation. Population density and the number of flowering plants can be greatly reduced but eradication is not possible with biocontrol.
- Any biological control plan needs to incorporate another non-chemical control method if the goal is to prevent all seed production.
- The seed-feeding weevils, *Larinus minutus*, (most often used for diffuse) and *L. obtusus* (most often used for spotted) and the root-mining weevil *Cyphocleonus achates* are the primary biocontrol agents used. Studies demonstrate that the combination of these species can be very effective in reducing knapweed populations in Montana. In eastern Washington, *L. minutus* has been effective in reducing weed infestations when adults build to outbreak populations and feed heavily on above-ground foliage and larvae attack flowering plants and reduce seed production. The combination of biocontrol and droughts in eastern Washington was likely important to the observed knapweed reductions.
- *Bangasternus fausti*, a seed-feeding weevil, is smaller, has a blunt snout and emerges earlier in the season than the *Larinus* beetles. It appears to co-exist with *Larinus* and may attack the earlier flowering plants that are missed by *Larinus* beetles.
- *Chaetorellia acrolophi* and *Terellia virens* are two relatively new seed-feeding flies. Because of the effectiveness and easy establishment of the *Larinus* beetles, the flies are not commonly used. However, at cool wet sites, where *Larinus* beetles do not readily establish, they are an important alternative option.
- The root-mining beetle, *Sphenoptera jugoslavica*, is fairly widespread in eastern Washington but its effectiveness has not been fully assessed.
- The seed-feeding moth, *Metzeneria paucipunctella*, is rarely redistributed in Washington because it attacks other biocontrol agents within the seed head and are subject to mortality from mice and parasitoids.
- The seed-feeding flies *Urophora affinis* and *U. quadrifasciata* are no longer distributed as biocontrol agents. They are found at almost every site and are considered ineffective.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Prevent plants from forming seed.
- Pull plants by hand if soil is wet; the plants may need to be dug up if large or in dry compacted soil.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- Apply appropriate herbicide to actively growing plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.
- Monitor site throughout growing season and remove any new plants.

Large Infestations / Monocultures in Grassy Areas

- Mowing will not control knapweed. Mowing can be used if the infestation is found later in the year to keep the plants from flowering until an approved control method can be used. Do not mow plants that have gone to seed.
- Large infestations can be controlled with selective herbicides. (See the Chemical section of this BMP). Suppression of large infestations of knapweed with a selective herbicide will greatly increase grass production, which in turn increases the suppression of the knapweed.
- Promote healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to weeds. Fertilize according to the soil needs.
- Pastures should be managed to promote grass and clover vigor. Avoid overgrazing and move animals when grass is still about 3 inches tall. Cross fencing allows regrowth of grasses, decreasing weeds and increasing forage. Avoid grazing when soil is very wet because holes can be opened up to new weed infestations. For more information on pasture management, contact the King Conservation District (<http://www.kingcd.org>).
- Monitor for knapweed on edges of pastures and in disturbed areas along roads, fences and watering and feeding areas. Remove isolated plants before they flower.
- Severely infested pastures should be reseeded.

Control in Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See the Noxious Weed Regulatory Guidelines for more information or contact your local jurisdiction.
- In some cases, the cleared area will need to be replanted with native or non-invasive vegetation and stabilized against erosion. See the King County Surface Water Design Manual for further information about sediment and erosion control practices (<http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual> or call 206-296-6519).
- Focus on manual removal for small infestations if possible.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants.
- Mowing can serve in the interim until more effective control measures can be utilized.
- Aminopyralid and amine formulations of 2,4-D and triclopyr can be used to the edge of water (see product label for more information).
- If a non-selective herbicide is used, the area should be re-seeded to prevent reinvasion by weeds.
- Infested areas will need to incorporate a management plan lasting for several years to control plants germinating from the seed bank.

Control on Road Rights-of-Way

- Pull small infestations if possible, and prevent seed production.

- In most areas, spray with a selective broadleaf herbicide. Be sure to look for small rosettes and seedlings near the larger plants.
- Aminopyralid and amine formulations of 2,4-D and triclopyr can be used to the edge of water.
- Spot spray with glyphosate if weeds are in areas with no desirable grasses.
- Re-vegetate with desired species if necessary.
- If plants are about to flower, they can be mowed until a more effective control strategy can be used.

Disposal Methods

- Bag all flowering stems. If the plants are in seed, carefully cut off the seed heads and place in a bag without dispersing the seeds.
- Dispose of flowering stems with garbage or take to a transfer station for disposal. Do not compost or put in yard waste.
- Non-flowering plants may be left on site if there is no likelihood of dispersal from that location.
- If disposing of plants on site, leave plants roots up and chop up with a shovel to reduce risk of plant re-rooting. Plants should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dump yard waste in parks or natural areas, as weeds may spread from yard waste piles.

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