



King County

Department of
Natural Resources and Parks
Water and Land Resources Division

Noxious Weed Control Program

BEST MANAGEMENT PRACTICES

Invasive Knotweeds

**Bohemian Knotweed, Japanese Knotweed,
Giant Knotweed, Himalayan Knotweed**

*Polygonum bohemicum, P. cuspidatum,
P. sachalinense, P. polystachyum*
Polygonaceae

Class B Noxious Weed; Not Designated for Control

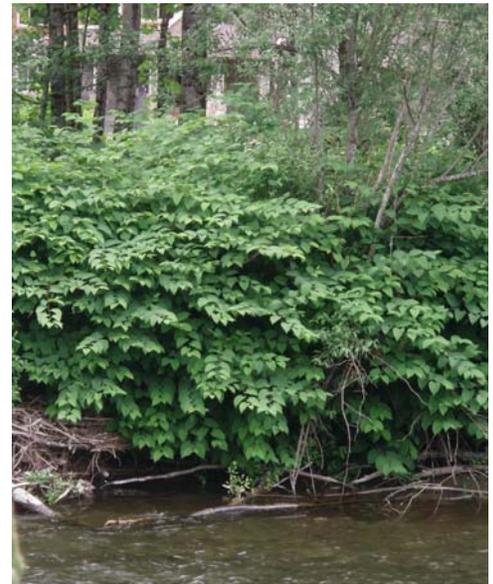
Legal Status in King County: Class B non-designated noxious weed (non-native species listed on the Washington State Weed List, but already widespread in this area). The King County Noxious Weed Control Board recommends, but does not require, property owners to control and prevent the spread of invasive knotweeds on public and private lands throughout the county. State quarantine laws prohibit transporting, buying, selling or offering invasive knotweed for sale or distributing plants, plant parts or seeds.



BACKGROUND INFORMATION

Impacts and History

- Displaces native vegetation due to its aggressive growth.
- Creates bank erosion problems and is considered a potential flood hazard. Despite knotweed's large rhizome mass, it provides poor erosion control.
- Lowers quality of riparian habitat for fish and wildlife.
- Thickets can completely clog small waterways.
- Forms dense stands that crowd out all other vegetation, degrading native plant and animal habitat.
- Difficult to control because of extremely vigorous rhizomes that form a deep, dense mat.
- Plants can resprout from stem or root fragments; plant parts that fall into the water can create new infestations downstream.
- Japanese and giant knotweeds are native to northeastern Asia. Giant and Japanese knotweeds hybridize to produce Bohemian knotweed. Himalayan knotweed is native to south and central Asia, including the Himalayas.
- Introduced in the U.S. in the late 1800s as ornamental plants and for erosion control.



Bohemian knotweed on the Cedar River

Description

- Large, clump-forming, herbaceous perennial with 4 to 12 feet tall, round canes with thin, papery sheaths and creeping roots. The hollow stems are jointed and swollen at the nodes, giving a bamboo-like appearance.
- Japanese, giant, Bohemian and Himalayan knotweed are members of the buckwheat family (Polygonaceae).
- Rhizomes can spread at least 23 feet (7 meters) from the parent plant and can penetrate more than 7 feet (2 meters) into the soil.
- Forms large, dense clones of either male or female plants.
- Stems are thick and hollow, resembling bamboo, green to reddish in color, often red-speckled. Young shoots look similar to red asparagus.
- Leaves are alternate, bright green with smooth edges. Leaf shape ranges from an elongate triangle (Himalayan knotweed), through rounded with a flat base (Japanese knotweed), somewhat heart-shaped (Bohemian knotweed) to huge, “elephant ear” type leaves (giant knotweed). Hybrids blur these distinctions. Leaf size may vary, however they are generally 4 to 6 inches long by 3 to 4 inches wide on Japanese knotweed and 7 to 9 inches long on hybrid Bohemian knotweed. Giant knotweed leaves often exceed 12 inches across, twice the size of Japanese knotweed leaves.
- Flowers are small, white/green on Japanese, Bohemian and giant knotweed and light pinkish-white on Himalayan knotweed and grow in showy plume-like branched clusters. Flowers form in July and August and grow in dense clusters from the leaf joints. Flowers are either all female (form seeds) or all male (don't form seeds) on each plant.
- Flowers in late July, typically start to form seeds by mid-August.

Habitat

- Can grow in partial shade or full sun.
- Knotweed thrives in any moist soil or river cobble, but can also grow in dry areas
- Most commonly found in the flood zone along rivers and creeks, it also grows in roadside ditches, railroad rights-of-way, unmanaged lands, wetlands, neglected gardens, and other moist areas.

Reproduction and Spread

- Knotweed typically starts growth in April, but can begin as late as June in higher elevations.
- Reproduces by seed and vegetatively from rhizomes and roots. Knotweed can spread rapidly due to its ability to reproduce vegetatively.
- Invasive knotweeds spread mainly by rhizomes. Rhizome and root fragments are dispersed by natural causes (flood, erosion) or man-made dispersal (roadside clearing, fill dirt).
- Root fragments, as small as ½ in (1 cm) can form new plant colonies and can also be spread in contaminated fill material.
- Cut or broken stems will sprout if left on moist soil or put directly into water, or if moved by beavers or earth-moving equipment. Each node on the plant stock is able to produce roots and new plants.

- Seeds can be viable for as long as 15 years. Seeds in the upper 1 inch (2 cm) of soil generally are viable for 4 to 5 years. Below 1 inch (2 cm), the seeds remain dormant longer. However, knotweed seedlings are not often found in the wild and most dispersal is by root and stem fragments.
- Knotweed canes die back with the first hard frost (Pridham and Bing 1975) and go dormant during the winter. The dead, brown stems may remain standing through the winter with new canes developing in the spring from the same rootstock.

Local Distribution

Found throughout King County. The heaviest concentrations of invasive knotweeds are found along riparian corridors and road rights-of-way. Infestations can also be found in residential gardens, wetlands, and upland areas.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that 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 should allow for flexibility in method as appropriate.

Planning Considerations

- Survey 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**).
- Specific suggestions are given in the Best Management section.
- It is possible, but not easy, to control knotweed, especially on a landscape scale.
- Because of knotweed's incredibly extensive root system and sprouting ability, landscape level control requires long-term planning and follow-up.
- Because the plant spreads easily downstream by water, it is necessary to begin control from the furthest upstream infestation, including all tributaries and other upstream sources of possible re-infestation.
- Even on a patch-by-patch basis, successful eradication is likely to take several years and multiple treatments.
- Although there are potentially successful mechanical or manual control options for small patches, landscape level projects and large sites will likely require integrating herbicide into the control strategy.

- Outreach to all public and private landowners and the broader community, as well as volunteer recruitment and coordination, will improve the success of large landscape scale projects.
- Work with volunteers and other organizations in the community to expand the ability to physically get the work done.
- Landscape level projects may have a greater chance of success under a coordinated effort such as a Cooperative Weed Management Area (CWMA).
- Grants are available for invasive vegetation removal, such as knotweed, that benefits public resources, especially for work done through non-profit organizations or government agencies.

Early Detection and Prevention

- Monitor for new populations in May and June.
- Dig up isolated or small populations (50 stems or less). If there are more stems than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the late summer/early fall.
- Prevent plants from spreading away from existing populations by washing vehicles, machinery, and equipment that have been in infested areas.
- Prevent knotweed from entering waterways.
- Do not discard stems or root fragments in waterways or on moist soil.

Manual or Mechanical Control

- **When to use manual methods:** If there is easy access to the site and patches are reasonably small (50 stems or less), commit to following an intensive control regimen.
- **Variations:** Cutting, mowing, pulling, digging, covering.
- Cutting, mowing and pulling stimulates shoot growth and depletes the roots. The more shoots there are per linear foot of root, the more likely it will be to physically pull out the roots, exhaust them by depriving them of energy (i.e. by cutting the shoot off) or eradicating them with an herbicide treatment.
- When controlling knotweed manually, be sure to practice the four T's: timely, tenacious, tough and thorough (Soll 2004).
- Hand pulling and the use of hand mechanical tools to control noxious weeds are generally allowable in critical areas in unincorporated King County (refer to the **King County Noxious Weed Regulatory Guidelines** for details).
- Be aware that repeated cutting tends to produce numerous small stems that may make future treatment with stem injection more difficult.
- **CUT** stems close to the ground **TWICE A MONTH OR MORE** between April and August, and then once a month or more until the first frost, over 3 to 5 consecutive years (Soll 2004).
 - Try to keep plants from growing taller than 6 inches.
 - Using a machete, loppers or pruning shears, cut the stems to the ground surface. Using a mower/weed-eater, cut as low as possible and as often as possible. Be sure not to scatter stems or root fragments.
 - Rake and pile up the cut stems where they will dry out because stems or stem fragments can sprout, and the area (or adjacent areas) may become re-infested.

- Goats are reported to eat knotweed and in some circumstances, controlled goat grazing may be an option similar to intensive mowing. Be aware that goats will eat desirable vegetation as well as knotweed.
 - Do not allow cut, mowed or pulled vegetation to enter waterways.
- **DIG** up as much root as possible in August over at least three consecutive years; reported to work for small, isolated patches.
 - Each time you see new sprouts (start looking a week after you pull), uproot them as well, trying to pull out as much of the root as you can each time.
 - Be sure to carefully dry or dispose of the roots. Do not put them in a compost pile.
 - Be sure to search at least 20 feet (7 meters) away from the original patch center.
- **COVER** with heavy duty geo-textile fabric or black plastic.
 - Works better with isolated and smaller patches on open terrain.
 - Plan to leave the covering material in place throughout three to five growing seasons.
 - First, cut stems down to ground surface. Next, cover the area with geo-textile fabric or heavy duty black plastic extending beyond the plant base and stems at least 7 feet beyond the outside stems. Leave covering material loose and clean of debris, weighted down with heavy rocks or cement blocks. Watch for holes in the fabric and at the perimeters for any new growth. Every two to four weeks during the growing season, stomp down re-growth under covering material and clean debris.
 - Try this method at the beginning of the year or after cutting the plant down several times during the growing season which will reduce some of the rapid plant growth.

Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- For your personal safety, at a minimum, wear gloves, long sleeves and pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- 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.
- **Variations:** foliar spray, wick wipe, cut and pour, or stem injection.
- Herbicides with the active ingredient glyphosate (Rodeo, Aquamaster, AquaNeat, among others), dicamba (Banvel, Clarity, among others), and imazapyr (Habitat, Arsenal) have shown to be variably effective in controlling knotweed either separately or in combination. Each offers benefits and potential risks.
- **Non-selective herbicide, injection method (glyphosate):** can effectively control knotweed. Currently only glyphosate products are labeled for the injection method. Aquamaster/Rodeo/AquaNeat, (aquatic formulations of glyphosate) can be used on or near aquatic sites while Roundup Pro, a non-aquatic formulation, can be used on terrestrial sites.
- **Non-selective herbicides, foliar applications (such as glyphosate, imazapyr)** are most effective when used in combination at a 2% - 1% ratio (2% glyphosate, 1% imazapyr). Glyphosate translocates to roots and rhizomes of perennial weeds and has no apparent soil

activity, while imazapyr is readily absorbed through foliage and roots and can be applied pre-emergent or post-emergent.

- **Selective Broadleaf Herbicides (such as dicamba)** may be more appropriate for knotweed patches adjacent to grass fields or in lawns. Dicamba is a growth regulating broadleaf herbicide, dicamba is readily absorbed and translocated from either roots or foliage. Do not apply to areas where roots of desirable species are growing.

Description of Chemical Control Methods

Foliar Application

- Backpack sprayer or large volume sprayer.
- Easiest and fastest method, risk of drift onto desirable vegetation and into water and soil.
- Use a systemic herbicide which translocates from leaves to the roots.
- Non-selective herbicides, such as glyphosate (Roundup) will harm all actively growing plants if leaves are sprayed. Selective broadleaf herbicides will not harm grasses.

Timing

The right time to apply herbicides is greatly affected by herbicide choice. According to Oregon Department of Agriculture literature, the ideal time to spray most deep-rooted perennials is when they are in bud to early flowering stage. However, because knotweed may be 15 feet tall when it begins to flower (July or August in the Pacific Northwest (PNW)), this is not always practical. Also, spraying taller plants means creating more risk of pesticide drift and older plants may not be as efficient in chemical translocation.

The best time, from a practical standpoint, is when the patches are 3 to 6 feet (1-2 m) tall. Although shorter plants may not have adequate leaf surface to absorb, and translocate, enough chemical to be effective, young, rapidly growing plants do have a more efficient biological process to translocate chemicals. A spring herbicide application or cutting will set back the plant so that it can be sprayed at an effective height and growth stage later in the year. Plants controlled later in the season can be cut to 5 ft in height immediately before spraying, although control effectiveness is somewhat reduced. TNC field data analysis suggest treatment done in April or May is not as effective as those done in June or July.

Regardless of herbicide choice, rate or spray timing, large, established patches (hundreds or thousands of stems) will almost certainly require foliar treatments over two or more years. Similar to treating patches mechanically, be sure to search for new shoots up to 20 feet or more away from the central patch after herbicide treatment begins (Soll 2004).

Specific Herbicide Information

Glyphosate: 2% to 5 % solution.

- Apply as coarse spray with complete, uniform coverage.
- Apply when knotweed is actively growing and most have reached the bud to early flowering stage until the first hard frost.
- Aquamaster/Rodeo plus surfactant (LI-700, Competitor, Agridex) are approved for aquatic sites.

- Roundup Pro (has surfactant mixed in) can be used on terrestrial sites.

Imazapyr : slow-acting and expensive but effective. Can be used alone or in combination with glyphosate.

- 1% solution with 0.25% surfactant or 0.5 to 1 lb per acre.
- Apply from midsummer after seed set until first killing frost.
- Habitat – approved for aquatic sites.
- Arsenal – approved for non-aquatic sites (see label for crop rotation and other restrictions).

Dicamba: 0.25 lb active ingredient with 1 gal water per 400 sq ft.

- Cut plants in June and then apply dicamba to regrowth in late August.
- Apply as basal spray to stems at ground level.
- For upland applications only.

Wick Wipe

- Use an applicator wand with a sponge on the end of a reservoir for the herbicide. Wipe the sponge soaked with herbicide on the leaves and stem of the plants.
- Use glyphosate at 33 to 75 % concentration.
- Greatly reduces drift.
- Hard to get chemical on leaf surface and seems to increase personal contact with herbicide.

Cut and Pour

- Good for small patches and greatly reduces drift.
- Cut stems between lowest 2 nodes.
- Put 3 ml undiluted (concentrated) glyphosate into stem cavity (can use a large needle with measured reservoir to be precise).
- Be very careful not to splash herbicide onto the ground.
- Follow label directions on amount applied per acre (i.e. for the 7.5 quart per acre label rate, can only treat 2375 stems per acre at 3 ml per stem).
- Timing best in late summer or early fall.
- Need to remove cut stems away from water where they can dry out and not spread off site.

Stem-Injection

- Use stem injection gun or similar tool.
- Follow directions carefully especially on calibrating and cleaning the equipment.
- Highly effective; 90% or more controlled in first year.
- Greatly reduces drift and is highly selective.
- No cut stems to deal with.
- Need to inject every cane in the stand; very time and labor intensive compared with foliar spraying.
- Can only inject stems over ½ inch in diameter so there will always be small stems that can't be injected in a population, especially in the second year of treatment.

- Inject 3 ml into each stem between first and second nodes from the ground, or between second and third node if cane is too woody lower down.
- Glyphosate is the only product labeled for injection method, and at 3 ml per cane, can only inject approximately 2375 canes per acre (label maximum is 7.5 quarts per acre).
- Timing best from early July to end of September.

Combination of Methods

- Using a combination of methods can increase efficacy.
- **Cut/Spray:** Cutting stems, followed by foliar spray 3 to 4 weeks later, instead of spraying twice, will reduce overall herbicide input into the watershed and is probably more labor efficient (can use volunteers or unlicensed crews to cut the infestation).
- **Bend/Spray:** This method is highly effective. Bend stems and then approximately 3 to 4 weeks later, spray site. Can use volunteers or unlicensed crews to bend the stems prior to foliar application.
- **Cut/Cover:** This method is moderately effective. Needs constant monitoring and controlling of plants around perimeter and scattered plants that grow through sheet mulch through holes/overlap areas. Every two to four weeks need to stomp down re-growth under covering material and clean off debris.
- **Spray/Spray:** Spring or summer spray followed by fall foliar spray; sets plants back so they can be sprayed at the appropriate growth stage and at the best (easiest) height. This method increases the amount of overall herbicide input into the watershed but takes the least time of all the methods other than spraying once.

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. Biological control is generally most effective when used in conjunction with other control techniques.
- Research is underway for possible biological control agents that have been identified in the knotweed's native range. However, there are currently no biological control agents available for managing invasive knotweed.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Dig up plants by hand if soil is wet.
- Apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants. Remember to search at least 25 feet from the original infestation.

- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass or use a wick wiper or stem injector.

Large Infestations/Monocultures

- Mowing is not effective for controlling invasive knotweed infestations.
- Large infestations can be controlled with herbicides. (See the Chemical section of this BMP).
- Eradication of knotweed with a single herbicide application is difficult. Typically it takes several treatments, over 4 to 5 years to get an infestation under control.
- Be sure to monitor for invasive knotweeds on edges of sheet-mulched sites, at overlapped areas in the sheet-mulch, where sheet-mulch has been staked, and around edges of chemically treated areas.

Control in Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See Noxious Weed Regulatory Guidelines for more information ([http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious Weeds Regulatory Guidelines.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious_Weeds_Regulatory_Guidelines.pdf)).
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Water Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://dnr.metrokc.gov/wlr/Dss/Manual.htm> for information).
- Survey area and document extent of infestation from the headwaters of waterways down.
- Focus on manual removal for small (less than 50 stems) infestations if possible.
- Target the knotweed, retain all native and beneficial plants.
- Inject plants directly adjacent to waterways with glyphosate.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- Use aquatic formulations if there is any risk of herbicide entering the water.
- Infested areas will need to incorporate a management plan lasting at least several years to control plants re-sprouting from the rhizome mass, skipped plants and any regrowth.
- Mowing will not control invasive knotweed species, but it can serve as the first step in a combination approach to control.

Control on Road Rights-of-Way

- Dig up small infestations if possible.
- Spot spray with appropriate herbicides.
- Mowing is not an effective means of control and can spread knotweed infestations along road rights-of-way, but it can serve as the first step in a combination approach to control.

Knotweed Disposal Methods

- Knotweed crowns and rhizomes should be collected and discarded with the trash or taken to a transfer station for disposal. Composting crowns and rhizomes is not recommended.
- Knotweed stems can be composted, but they will root on moist soil so they need to be completely dried out before composting.

- Stems can be left on site to dry out and decompose if they are in a dry area where they will not move into waterways or onto moist soil. The area should be monitored for re-growth and stems should not be moved to an un-infested area.
- Dried out stems may be broken up or chipped into pieces less than an inch long and then composted on site, disposed of in a city-provided yard waste container or in the green recycling at a transfer station.
- Stems of knotweed with seeds should be collected and put in the trash or taken to a transfer station. If removal is not feasible, these stems can be left on site. However, there is a risk of spread from the seeds, so the area should be monitored for several years for seedlings. Stems should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dispose of knotweed plants or plant parts into waterways, wetlands, or other wet sites where they might take root.

References:

Child, L.E. and P.M. Wade. 2000. The Japanese Knotweed Manual: The Management and Control of an Invasive Alien Weed. Packard Publishing Limited, West Sussex, UK.

Peachey, E., D. Ball, R. Parker, J.P. Yenish, T.W. Miller, D.W. Morishita, P.J.S. Hutchinson, eds. 2007. 2007 Pacific Northwest Weed Management Handbook. Oregon State University.

Soll, Jonathan. 'Controlling Knotweed (*Polygonum cuspidatum*, *P. sachalinense*, *P. polystachyum* and hybrids) in the Pacific Northwest". 2004. The Nature Conservancy.

Online:<<http://tncweeds.ucdavis.edu/moredocs/polssp01.pdf>>. Accessed 12/19/2007.

Washington State Noxious Weed Control Board. 2006. Written Findings. Accessed 12/20/2007.

http://www.nwcb.wa.gov/weed_info/Written_findings/Polygonum_cuspidatum.html

http://www.nwcb.wa.gov/weed_info/Written_findings/Polygonum_bohemicum.doc

http://www.nwcb.wa.gov/weed_info/Written_findings/Polygonum_sachalinense%20.html

http://www.nwcb.wa.gov/weed_info/Written_findings/Polygonum_polystachyum.doc