

2010 Knotweed Control in BC



1. Treatment

Landscape Level

- When considering an invasive species landscape-level control project, planning for a long and sustained effort is critical to its success.
- For riparian system management, control should be planned with water movement as a primary factor in deciding where to start working. Control should be undertaken at a watershed scale, with control beginning at the headwaters and moving downstream.
- Outreach is essential in order to educate private landowners about the negative impacts of knotweed and then gain their participation and commitment.
- Other factors that will influence management options include funding, workforce, land ownership, site accessibility, infestation size, herbicide restrictions and potential non-target impacts.

Stand Level

- Look to exploit any vulnerabilities knotweed has e.g. intolerance to full shade or salt water. By re-establishing competitive native vegetation that suppresses light available to knotweed, there is a slowing of the growth of rhizome (root) development.
- Managing the stems i.e. disposal can represent a significant, often unforeseen financial cost relating to the overall knotweed control effort.
- There is no single “best” control strategy for knotweed – a combination of two or more approaches below, over a multi-year horizon, will be required to realize success as **knotweed is no ordinary plant.**
- Control must be accomplished within financial, ecological, practical and legal considerations.

A. Small Patches e.g. 300 stems or less

(i) Cutting (disposal required – see page 4)

1. Use a machete, loppers or pruning shears to cut stems as close to the ground as possible **twice per month or more between April and August**; then reduce the frequency to once a month in September, October and November until the first frost. Never let plants grow beyond 15 cm (6”) in height.
2. Repeat 1 until knotweed stops re-sprouting , usually after three to five years (or more).
3. During monitoring, search up to 20 meters away from parent plant for new sprouts.

** Cutting stimulates shoot production, depriving the roots of energy, offsetting rhizome production. **If you are going to kill knotweed, you must kill the roots****

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(ii) Digging (disposal required – see page 4)

1. Using a sharp mattock or shovel, dig up as much of the main root mass and lateral rhizomes as possible when soil is soft.
2. Monitor throughout growing season and pull out as many new sprouts as possible, searching up to 20 meters away from parent plant for new sprouts.
3. Repeat 2. until knotweed stops re-sprouting, usually after three to five years (or more).

(iii) Smothering (disposal required – see page 4)

1. Use machete or loppers to cut stems to as close to the ground as possible. Stomp down and flatten the area as much as possible by foot.
2. Cover the area where cutting occurred with either old carpeting (contiguous and not torn or ripped) or thick cardboard (e.g. used to package refrigerators) or a new tarp, sealing any rips or overlap with multiple sheets, using duct tape.
3. Install contiguous, plastic wedge/barrier into the ground to a depth of 75 cm and up to 8 cm above the surface several meters beyond the outer most perimeter of the infestation. If lateral shoots emerge over time from under the barrier, then pull them out immediately, as well as fix the barrier.
4. On top of the carpeting or cardboard, add two layers of black plastic (or a single layer of the heavy-duty variety e.g. 5 mm) or geo-textile fabric. Extend plastic or fabric at least 6 m beyond the actual perimeter of the cut stems. Avoid creating holes in covering material or overlaps where “escapes” could occur.
5. Use logs, rocks, or stakes to anchor the covering material in 4. Add layer of 10-15 cm of sawdust, bark or wood mulch over the entire treatment area. Be mindful that birds may mistaken black plastic for a garage bag and puncture holes in it.
6. Continuously monitor edges and remove emerging stems if/when they occur around edges for several years. Repair material tears/breaks that may occur. Stomp on any plants that attempt to “stand up” and push through and puncture a seam.
7. Incorporate signage to educate people about the control project and why knotweed is a serious threat to the environment and to people.
8. Leave area for 5 years before attempting to re-introduce ecologically suitable, competitive native plants into the covered area e.g. salmonberry (*Rubus spectabilis*) and thimbleberry (*Rubus parviflorus*). Fast growing competitive trees include Sitka alder (*Alnus viridis*), Sitka willow (*Salix sitchensis*), Scouler’s willow (*Salix scouleriana*) and Hooker’s willow (*Salix hookeriana*).

(iv) Stem injection (no disposal required)

Most Applicable Situations

- infestations overhanging water
- infestations found near sensitive or highly desirable vegetation
- infestations encountered too late in the season for multiple summer cuttings
- small patches (<300 stems) with a high percentage of injectable stems (2 cm +)

Note: root-to-root contact may transmit glyphosate to desirable native plants.

1. Purchase stem injector kit (injector, canister, needles, marking system) from JK International <http://www.jkinjectiontools.com/> (see Appendix D, pages 7-8).

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2. Use measuring vial and calibrate the injector using undiluted glyphosate and not pure water (contrary to manufacturer's directions) so that 3-5 ml of herbicide is ejected per squeeze. See Appendix A on page 5.
3. Select appropriate type of needle. See Appendix A, Stem Injector Procedures on page 5.
4. In late summer or early autumn horizontally insert needle so that the needle hole is oriented downward. Poke needle all the way through both sides of stem, between the 1st and 2nd nodes or just below the 3rd node if the stem is too woody further down.
5. Inject 3-5 ml of undiluted glyphosate into each cane over 2 cm in diameter (as each cane has its own rhizome system). Stems smaller than 2 cm in diameter do not have sufficient cavity size to accommodate injection. These stems will be injected during a follow-up treatment.
6. Mark each injected stem.
7. Return to site three to four weeks later to complete a follow-up injection on stems too small to inject initially. Inject these stems if of sufficient diameter (2 cm).
8. Return following year to repeat treatments on any re-sprouts or use a backpack sprayer in fall to treat re-growth. See Appendix B, Backpack Foliar Spray Section on page 5 for specific advice.
9. Use clean water to thoroughly clean and soak stem injector after daily usage, especially if it will not be used again for a few days, as crystallization will occur, negatively affecting the injector.

B. Large Patches e.g. 300 stems or more

(i) Excavator / Backpack Foliar Spray (no disposal required)

1. Use excavator to dig out the existing plant adding at least 2 m beyond the outmost perimeter of the plant and down to a depth of 2-3 meters, if possible.
2. Deposit the plant (and all of its parts) upside down into the very bottom of the hole, compacting it and ensuring all plant parts, especially root material is deposited here.
3. Place old carpeting (with no rips or holes), tarp, geo-textile material or thick (5 mm) plastic poly over the inverted plant.
4. Entirely fill the remainder of the hole with rock and soil, replacing productive upper horizons back on top.
5. Promptly re-vegetate disturbed area with ecologically-suited native grass seed if in a high value conservation area or an agronomic sod-forming grass seed mixture using a grade of Common No. 1 Forage Mixture or better in all other areas.
6. Monitor site for several years, using a backpack foliar spot application of diluted systemic herbicide (i.e. goes from leaves to roots) if re-sprouting occurs. See Appendix B.

(ii) Machete / Backpack Foliar Spray (disposal required)

1. Use machete to cut down knotweed patch once in June or July, then in late August or early September, spray re-growth when stems reach 1-2 m tall, after flower buds form. See Appendix B for specific advice.
2. Repeat for two to three years ensuring regular monitoring and that searches for re-sprouting extend at least 7 m away from treatment site.

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(iii) “Cut & Fill” / Backpack Foliar Spray (disposal required)

1. In July, use loppers to cut all stems just below the 3rd node above the ground and place all plant parts on new tarps or in heavy plastic bags for subsequent disposal at local landfill.
2. Using a stem injector (or a laboratory squirt bottle) deposit 3-5 ml of either:
 - Vantage Plus Max II (48% glyphosate) http://pr-rp.pmra-arla.gc.ca/PR_SOL/pr_web.ve1?p_ukid=13681 or
 - Roundup Super Concentrate (36% glyphosate) http://pr-rp.pmra-arla.gc.ca/PR_SOL/pr_web.ve1?p_ukid=9639using a 50:50 herbicide / water ratio into the “well” created by cutting the internode in half. Herbicide must be deposited immediately after cutting as the plant cells will “seal” quickly, preventing the translocation of the herbicide. Take no longer than 30 minutes to complete this. Lay the needle horizontally across each cut stem with the hole pointing downwards and squeeze trigger.
3. In early September (or before first frost), use a backpack sprayer and apply 8-10% solution of either aforementioned glyphosate formulations, also adding ~ 1% surfactant e.g. :
 - Sylgard 309 http://pr-rp.pmra-arla.gc.ca/PR_SOL/pr_web.ve1?p_ukid=8402 or
 - LI 700 http://pr-rp.pmra-arla.gc.ca/PR_SOL/pr_web.ve1?p_ukid=10076 ,applied to the leaves of the re-growth.

Note: LI700 has been recognized in the US by the National Oceanic & Atmospheric Administration as “salmon-friendly”, therefore it is preferable within proximity to watercourses. Surfactant improves wetting and penetration. Apply herbicide so that every leaf is covered with a mist, but not to the point of run-off. Ensure knotweed plants have reached at least 1 m in height before re-treating. Treat only target species as herbicide is non-selective. Spray should be applied while backing away from the treated area (to avoid walking through the sprayed sites.) It may take several weeks for herbicide to show impact.

2. Disposal

- Careful disposal of all cut plant material is critical for effective control.
- Cut material needs to be elevated, dried and eventually incinerated.
- If cut stems cannot be burnt, then seal in heavy-duty plastic bags and send to the landfill for deep burying.
- Keep stem material away from waterways or freshly exposed soil as **knotweed can re-root at the nodes**.
- Composting on tarps or newly paved road surfaces (i.e. with no cracks) also can be effective.

3. Remediation

- it is important to rapidly establish, vigorous growing native plants after knotweed has been successfully removed
- any disturbed soil that occurred as a result of the knotweed removal should be promptly grass seeded using a native or an ecologically-suited agronomic sodgrass formulation that is a grade of Common No. 1 Forage Mixture or better (to minimize the potential introduction of weed seed). Native seed should be used in high value conservation areas.

** There is no “silver bullet” or single best control strategy for knotweed – each site is different **

*** It will likely take 3-5 years to be successful using integrated approaches – DON’T give up! ***

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Appendix A – Stem Injection Procedures

1. Select appropriate needle type:
 - Standard or Hardened – summer treatment of Bohemian, Giant, Japanese knotweed, Giant hogweed (These are the same needles except hardened last twice as long).
 - Cavity - summer treatment of Himalayan knotweed or Himalayan blackberry
 - Short - autumn treatment of Bohemian, Giant, Japanese knotweed and Giant hogweed
2. Carefully pour undiluted glyphosate into the injector canister, noting in field book how many mL or L of product that you use, each time you fill the canister.
3. Calibrate the injector using the Allen key and measuring vial. Adjust the screw under the trigger using the Allen key so that 3-5 ml of herbicide is ejected per squeeze into the vial. Use undiluted glyphosate and *not* pure water - this is contrary to manufacturer's directions.
4. Add marking apparatus to the injector.
5. Poke needle horizontally all the way through both sides of stem between the 1st and 2nd nodes (or just below the 3rd node if stem is too woody further down) ensuring that the needle hole is pointing downward. Ensure marker leaves a mark on each injected stem.
6. Pull trigger to inject 3-5 ml of undiluted glyphosate into each stem over 2 cm in diameter (as each cane has its own rhizome system). Stems smaller than 2 cm in diameter do not have sufficient cavity size to accommodate injection. These stems will be injected during a follow-up treatment.
7. When completed, document in field book how much product in mL or L was used.
8. Fill in **Invasive Plant Chemical & Mechanical Treatment Record**. Forms are available on-line: http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1265.pdf
9. Return to treated sites three to four weeks later to complete follow-up injections on stems too small to inject initially. Inject these stems if of sufficient diameter (2 cm).
10. Return following year to repeat stem injections on any sufficient diameter re-sprouts or use a backpack sprayer in fall to treat re-growth.
11. Thoroughly clean stem injector after each use.
12. Follow storage and disposal instructions found on label based on herbicide container.

Appendix B – Backpack Sprayer Procedures

Calibration

1. Measure a square 5 x 5 metres in a flat area on pavement, gravel or bare soil.
 - Check the “squareness” by measuring diagonally from corner to corner – it should be about 7.1 metres.
 - Use sidewalk chalk or a stick to mark the lines that define the square.
 - The area of this square = $25 \text{ m}^2 / 10,000 \text{ m}^2$ (in one hectare or ha) = 0.0025 ha or 1/400th ha.
2. Outside of the square, fill the sprayer tank with water. Some sprayers have pressure gauges, some do not. If there is a pressure gauge, pressurize to 40 psi (or 3 bar). If there is no pressure gauge, pump the lever up and down until a moderate amount of resistance is felt (to fully pressurize the tank).
 - Test spray outside the square to ensure the nozzle is spraying correctly.

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- The height from the nozzle to the ground determines coverage therefore hold the nozzle at a height that gives you maximum consistent coverage from the width of nozzle spray.
 - Adjust the tank pressure to produce a spray that is neither too coarse or too fine. Low pressure produces large droplets and a coarse spray which tend to run. High pressure produces small droplets and a fine spray which will drift.
3. Step into one corner of the square and have a partner ready with a stopwatch to time your application.
 - At the command of sprayer, commence spraying and time counting moving the wand slowly from side to side.
 - Slowly pump the lever to keep tank pressured to a consistent pressure and nozzle stream.
 - Record the time that it takes to wet the entire square.
 4. Re-pressurize the tank to the same pressure used in 3. and then spray the wand into a measuring beaker for the exact same amount of time that was used to wet the entire square.
 - Record the volume of water sprayed into the beaker and then multiply by 400 to obtain your application rate i.e. litres per hectare.
 - Example:
 - Sprayed square in 65 seconds
 - Sprayed into beaker for 65 seconds = 1.1 litres of spray
 - Application Rate = 1.1 litres spray volume x 400 = 440 litres/hectare.
 5. To lower your application rate, increase your walking speed or change to a nozzle that produces a finer spray. To increase your application rate, decrease walking speed or change to a nozzle which produces a courser spray.

Tank Mixing

The best time to spray is when the patches of re-growth reach about 1meter tall. While shorter plants may not have the surface area to absorb and translocate enough herbicide to be effective, relative to large plants, they have more efficient biological processes to translocate chemicals. Spraying taller plants requires more herbicide to enter the environment (potentially affecting non-target plants) and older plants may not be as efficient in chemical translocation.

Calculating a 10% Active Ingredient Tank Mixture

A 10% active ingredient (a.i.) herbicide solution = 100 g or ml of active ingredient in 1000 ml of solution (mostly water).

- Obtain the a.i. from the herbicide label e.g. Vantage Plus Max II (VPM) is 480 g/1000 mL or 48% a.i.
- We want to dilute to 10% a.i. or 100 g a.i./ 1000 mL
- Cross multiply as follows:

$$\frac{480 \text{ g a.i.}}{1000 \text{ mL}} = \frac{100 \text{ g a.i.}}{? \text{ mL}}$$

$$\frac{1000 \text{ mL} \times 100 \text{ g a.i.}}{480 \text{ g a.i.}} = 208 \text{ mL of VPM / each litre of solution gives you a 10% solution}$$

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- **To completely fill a 15 L backpack sprayer at 10% a.i.**, multiply 208 mL or 0.2 L of VPM x 15 L = **3.0 L of VPM**, and the rest is water, dye, and surfactant (15 L – 3.2 L = 11.8 L).
- **To half fill a 15 L backpack sprayer at 10% a.i.**, multiply 0.2 L of VPM x 7.5 L = **1.5 L of VPM**, and the rest is water, dye, and surfactant (7.5 L – 1.5 L = 6.0 L).
- **To quarter fill a 15 L backpack sprayer at 10% a.i.**, multiply 0.2 L of VPM x 3.8 L = **0.8 L of VPM**, and the rest is water, dye, and surfactant (3.8 L – 0.8 L = 3.0 L).

Calculating a 8% Active Ingredient Tank Mixture

A 8% active ingredient (a.i.) herbicide solution = 80 g or ml of active ingredient in 1000 ml of solution (mostly water).

- Obtain the a.i. from the herbicide label e.g. Vantage Plus Max II (VPM) is 480 g/1000 mL or 48% a.i.
- We want to dilute to 8% a.i. or 80 g a.i./ 1000mL
- Cross multiply as follows:

$$\frac{480 \text{ g a.i.}}{1000 \text{ mL}} = \frac{80 \text{ g a.i.}}{? \text{ mL}}$$

$$\frac{1000 \text{ mL} \times 80 \text{ g a.i.}}{480 \text{ g a.i.}} = 167 \text{ mL of VPM / each litre of solution gives you a 8\% solution}$$

- **To completely fill a 15 L backpack sprayer at 8% a.i.**, multiply 167 mL or 0.2 L of VPM x 15 L = **3 L of VPM**, and the rest is water, dye, and surfactant (15 L – 3 L = 12 L).
- **To half fill a 15 L backpack sprayer at 8% a.i.**, multiply 0.2 L of VPM x 7.5 L = **1.5 L of VPM**, and the rest is water, dye, and surfactant (7.5 L – 1.5 L = 6.0 L).
- **To quarter fill a 15 L backpack sprayer at 8% a.i.**, then multiply 0.2 L of VPM x 3.8 L = **0.8 L of VPM**, and the rest is water, dye, and surfactant (3.8 L – 0.8 L = 3.0 L).

Note – **Amount of herbicide used is virtually the same for 8 to 10% a.i. applications** (due to decimal rounding)

Note - Useless otherwise specified on the label, normally only ~ 1 teaspoon (15 mL) of surfactant and ~ 1 teaspoon of blue dye are added to a full tank mix. Add these after the herbicide has been poured into the tank, but before the water is added in order to achieve excellent mixing before spraying.

Appendix C – Applying Herbicide Safely

1. Read and understand the herbicide label before mixing or applying product. They can be obtained by going to the Pest Management Regulatory Agency's Database at: http://pr-rp.pmra-arla.gc.ca/portal/page?_pageid=34,17551&_dad=portal&_schema=PORTAL

Each herbicide label is a guide, but the intent of the label must be followed.

Three points to remember:

- Use only on the appropriate site (industrial vegetation and non-crop sites);
- Comply with the timing of the recommended application;
- Do not exceed the maximum label rate is not exceeded.

* *The intent is to use the lowest efficacious application rate possible on the appropriate site **

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2. Pre-treatment:
 - Wear long sleeved shirt and long pants
 - Put on clean clothes every morning
 - Wash clothes separately if potentially exposed to herbicide
 - Wear chemical resistant natural rubber gloves (not leather or cloth)
 - Wear rubber or vinyl boots with socks and protective eyewear
 - Determine wind direction and speed to avoid drift or exposure
 - Calibrate equipment and check for loose connections or cracked hoses
3. Application:
 - Never spray overhead
 - Treat just target plants – invasive alien plants
 - Spray just enough solution to wet the leaves and stems while avoiding dripping
 - Try and spray the top surface of every leaf on the plant and the stems
 - It may take several weeks to show significant adverse effects (sometimes up to 30-45 days)
4. Post-application
 - Thoroughly clean spray equipment after using, before storing and when changing herbicide types.
 - Follow storage and disposal instructions found on label based on herbicide container

Appendix D – Stem Injector Assembly (2010 US Pricing)

- JK1000 (stem injector) - \$189.97 (includes injector, measuring vial, canister, Allen key)
- Refillable Canister - \$26.95
 - each canister holds up to 16 oz., enough to deliver ~ 100 injections at 5 ml/injection
 - purchase 2 per worker
- Holster Package - \$76.95 for holster, web belt, canister pouch
- JK Holster Insert - \$5.95 to provide drip protection
- Standard Needles - \$8.97 for one or \$144.50 for 25 (bulk purchase)
 - summer use
 - hollow-stemmed species: Bohemian, Giant, Japanese knotweed, Giant hogweed
 - each lasts 1000-1200 injections
- Hardened Needles - \$12.97 for one or \$275.61 for 25 (bulk purchase)
 - for summer use
 - hollow-stemmed species: Bohemian, Giant, Japanese knotweed, Giant hogweed
 - each lasts 2000-3000 injections
- Short Needles - \$12.97 for one or \$275.61 for 25 (bulk purchase)
 - for autumn use
 - for fall hollow-stemmed species: Bohemian, Giant, Japanese knotweed and Giant hogweed) when canes are dry
 - each lasts 3000 injections
- Cavity Needles - \$23.95 for one
 - for summer use
 - for solid/porous stemmed species: Himalayan knotweed or Himalayan blackberry

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- each lasts 3000 injections
- Marking System - \$38.90 for two Stem Marker Mounting Brackets & Pen (or simply cut and affix a small section of sponge that can be firmly wedged onto the injector nozzle end so that it can both easily absorb dye and subsequently mark injected stems)

Appendix E – Application Standards Near Water

British Columbia's Integrated Pest Management Regulation (IPMR) contains standards that relate to maintaining pesticide-free zones, no-treatment zones, selective application of herbicides; and, protecting biological control agents.



Pesticide Free Zone (PFZ)

- an area that must not be treated with pesticides, and must be protected from pesticides moving into it, measured by the horizontal distance from the high water mark (HWM)
- must be identified prior to any herbicide application (e.g. marked or flagged)
- the required minimum PFZ width for all active ingredients is 10 meters, except for glyphosate
- for glyphosate applications, the 10 meter PFZ may be reduced down to within **1 meter of the HWM** of a water body or classified wetland (whether it is fish bearing or not) as long as a selective technique is used e.g. stem injection, cut & paint

No Treatment Zone (NTZ) or Buffer Zone

- an area of sufficient width around the PFZ in order to ensure no pesticide gets into the PFZ
- must be identified prior to any herbicide application (e.g. marked or flagged)
- the width of the NTZ depends on the herbicide application equipment and technique as follows:

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Equipment/Application Technique	<i>Suggested Minimum NTZ Width</i> (meters in horizontal distance)
Stem injection, Cut & Paint, Squirt bottles	0
Foliar backpack, Basal bark	5
ATV/Quad	5

Source: "Handbook for Pesticide Applicators and Dispensers" (MoE, 2005)

In addition to the PFZ and NTZ requirements, a person must:

- Not apply the herbicide more than 1.5 meters from a targeted weed or plant; and,
- Make reasonable efforts to identify sites where biological weed control organisms have been released, and prevent harm to those organisms.

Appendix F – Rating Post-Treatment Efficacy & Non-Target Damage

<u>Invasive Plant Control</u>		<u>Non-Target Damage</u>
9 complete		9 no damage
8 excellent – none to a few reproducing plants with rational for misses such as under non target vegetation, distant singular plants far from the centre of the site, etc.	Unless contractually or otherwise specified for higher or lower levels, can be acceptable level of control	8 possible effect
7 good – some reproduction but considered acceptable or movement off site can or will be prevented		7 slight effect
6 fair – significant misses, more than a few plants, and reproduction occurring.	Usually considered unacceptable level of control	6 definite effect
5 poor		5 severe effect
4 moderate		4 severe effect
3 definite effect		3 severe effect
2 slight effect		2 severe effect
1 possible effect		1 severe effect
0 no effect		0 complete kill