

A LANDOWNERS GUIDE TO INVASIVE KNOTWEED CONTROL



Adirondack Park Invasive Plant Program

8 Nature Way
Keene Valley, NY 12943

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INTRODUCTION

Thank you for participating in APIPP's Invasive Knotweed Control Program. Your efforts will help protect the Adirondacks from the negative impacts of invasive species. This document will serve as a reference to guide the effective and environmentally conscious control of invasive knotweed species on your own property. Within this guide you will find information on the biology of knotweed, its impacts, and detailed instructions on how to implement best management practices.

Included within this knotweed injection toolbox you will find:

- Injector tool
- Paint pens
- Measuring cup
- Funnel
- Pair of chemical resistant gloves
- Treatment data sheet

The knotweed injection toolbox does *not* include herbicide. Please refer to Appendix A for more information about purchasing herbicide.

Before starting your knotweed control project, please take the time to review this manual. If you have questions regarding its content, please contact APIPP's Terrestrial Invasive Species Project Coordinator (contact information provided below).

This kit is provided free of charge, but we kindly request that you complete the attached data sheet to document your management activities. Reporting this information will help increase our understanding of the distribution of knotweed across the landscape and provide valuable information to inform adaptive management efforts. Failure to report management activities may bar future participation in the program.

Before treating your knotweed stand, please record its location using a GPS, the iMapInvasives app, or APIPP's online reporting tool at www.adkinvasives.com.

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KNOTWEED BIOLOGY AND IDENTIFICATION

What is invasive knotweed?

Knotweed is an annual, herbaceous perennial shrub native to Japan, China and Korea. There are four knotweed species present in the region, including Japanese, giant, Bohemian, and Himalayan. All are fast growing and can easily exceed 12 feet in height. The most commonly recognized variety is Japanese knotweed (*Reynoutria japonica*), described below:



Leaves:

Leaves are simple, alternate, and heart shaped with a blunt base and finely pointed tip. The upper surface is dark green, with a lighter green underside. They can vary significantly in size depending on the height of the plant, often exceeding 12 inches in length.

Canes/Stem:

Stems are upright, rigid, hollow, and round. They are divided by concentric rings (nodes) where branches meet the main stem. The cane is light green and is often mottled with reddish-purple blotches. Some canes are covered with a fine white coating that is easily rubbed off. Canes brown and remain standing when dead.



Flowers:

Flowers are small, numerous, and creamy white. They are arranged in clusters at the terminal ends of branches. In New York, blooms typically occur in late-August through September.

Branches:

The secondary branches of Japanese knotweed have a distinct zig-zag pattern when viewed from above or below.



Roots/Rhizomes:

Roots are extensive and develop quickly, accounting for up to 2/3 of total plant biomass. Rhizomes may extend 40+ feet laterally from visible stems. They are brown with a bright orange interior. Segments as small as 1cm are capable for forming new infestations.

OTHER KNOTWEED SPECIES

Giant knotweed (*Reynoutria sachalinensis*)

Some key identification characteristics of this species include:

- Average maximum growth height of 19 feet
- Thicker, less mottled stems than Japanese or Bohemian knotweed
- Mid-stem leaves are often greater than 12 inches long and 2/3 as wide
- Leaf base is deeply heart-shaped
- Leaf tip is blunt or acute point



Bohemian knotweed (*Reynoutria x bohemicum*)

This species is a hybrid between giant and Japanese knotweed. It shares many characteristics of both parent species. Some key identification characteristics include:

- Average maximum growth height of 16 feet
- The leaf base is typically more heart shaped than Japanese knotweed
- Hairs on the leaf undersides are short and broad, compared with long and wavy on giant knotweed.
- Leaves are 2-12 inches long and $\frac{2}{3}$ as wide
- Leaf tip intermittent between Japanese and giant knotweed



Himalayan knotweed (*Polygonum polystachyum*)

Some key identification characteristics of this species include:

- Average maximum growth height around 6-9 feet
- Leaves are oblong or lance shaped, 4-8 inches long and half as wide



POTENTIAL THREATS AND IMPACTS

The threats and impacts associated with knotweed invasions can be significant. The type and degree of impact is influenced by a variety of factors such as habitat type, infestation size and density, and site conditions. Cumulative impacts are likely to be greater for large, well established stands.

Quickly identifying and treating new knotweed infestations is critical to prevent negative impacts and increase opportunities for management success.

ECOLOGICAL IMPACTS:

Knotweed species can invade a variety of habitat types including forest edges, roadsides, yards, and riparian corridors. When established in riparian areas, knotweed can be easily dispersed via fragmentation of its roots and aboveground plant material. Large monotypic infestations of knotweed can decrease biodiversity of native plants, decrease the value of habitat for wildlife, and increase streamside soil erosion due to the absence of a groundcover vegetation.



SOCIETAL IMPACTS:

When growing along riparian corridors, dense stands of knotweed can impede recreational access for boaters and anglers.

In developed areas, knotweed growing along roadways can block signage or impede line-of-sight at intersections – creating a safety hazard for motorists.

ECONOMIC IMPACTS:

Knotweed's aggressive rhizome system can directly damage infrastructure such as roads, sidewalks, and building foundations. Roots can grow through concrete or asphalt over three inches thick – necessitating to costly repairs.

The direct costs associated with controlling well established stands of knotweed can be high. Most infestations will require at least five years of treatment.



STRATEGIES FOR KNOTWEED REMOVAL

GENERAL MANAGEMENT GUIDELINES

- Do not mow knotweed. It can easily spread by stem plant fragments.
- Follow principles of Integrated Plant Management (IPM); evaluate all available control strategies.
- Document and record treatment information; adapt management techniques, if necessary
- Treatment is never a “one and done.” Always plan for a multi-year control effort
- Never compost knotweed material (see solarization section below).

Mechanical Control

Very-small to small sized infestations can be managed by digging or pulling. This management technique is limited to true early-detection sized infestations that contain only a handful of stems.

1. Using a digging tool, carefully remove the entire plant and its root system.
2. Small plants may be hand pulled depending on soil conditions and the stage of root development.
3. Remove excess soil from the root ball, taking care to not break apart the rhizome system.
4. Inspect the area where the knotweed was removed for any residual rhizome or root material; remove if detected.
5. Place all plant material in a black plastic bag and solarize for at least two weeks before disposal in a landfill.



SOLARIZE, DON'T COMPOST

Knotweed plant material that is cut or excavated during management must be properly contained and disposed of to prevent unintentional spread to new locations.

1. Place all plant material in a 3mm+ black garbage bag
2. Place closed bags in full sun and allow them to decompose for *at least* two weeks
3. Check the plant material inside. If it's liquified and decomposed, it can be disposed of in the waste stream.

Chemical Control

Moderate to large infestations of knotweed are most effectively controlled using systemic herbicides. Herbicide selection, timing, and application technique are all important variables that will determine the efficacy of treatments. Before initiating chemical control, please review the following background information.

HERBICIDE SELECTION

A variety of herbicide products are available and labeled for control of knotweed species. The best product for your treatment will vary based on site conditions and your management objectives. APIPP recommends two potential herbicide active ingredients for knotweed control:

Glyphosate

- Applied as a foliar spray or stem injection
- Breaks down quickly in the environment, with little to no residual effect
- Readily available for purchase by non-certified applicators
- Common trade names include: RoundUp, Accord XRT-II

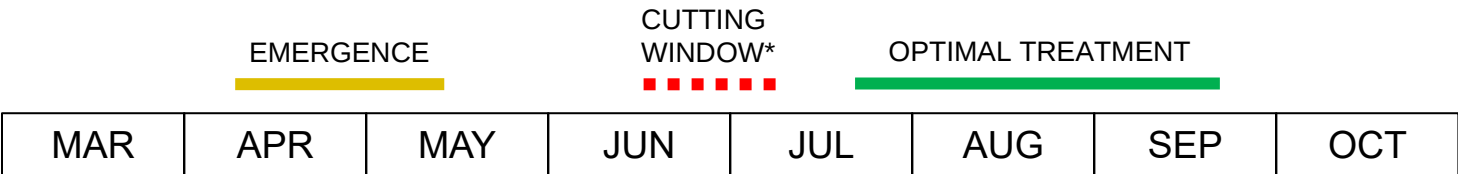
Imazapyr

- Applied as a foliar spray
- Has a long residual effect in the soil, providing extended control
- Relatively few products are available for non-certified applicators
- Common trade names include: Arsenal, Arsenal Powerline

See Appendix A for a list of herbicides that are effective against knotweed. When purchasing herbicide, consider the total quantity of knotweed to be treated. If your infestation is small, purchase the smallest quantity of herbicide possible.

HERBICIDE TIMING

The herbicides used to control knotweed are systemic, meaning they are absorbed by the plant and transported throughout its circulatory system. Ideally, herbicide applications should be performed late in the growing season while plants are flowering. At this time, knotweed is actively moving nutrients into its root system to prepare for winter dormancy. Systemic products will also be carried into the root system, providing effective control. All treatments should be completed two-weeks before the first anticipated frost. The figure below provides an overview of knotweeds life cycle and indicates the optimal times for management.



* Cutting for follow up foliar spray during optimal treatment window

HERBICIDE APPLICATION TECHNIQUES

Stem Injection

The stem injection technique utilizes a specialized tool to deliver a small dose of concentrated herbicide (100%) directly inside the hollow knotweed stem. It is very effective and significantly decreases the potential for off-target impacts but is time and resource intensive. It is most effective on larger stems and is the best option for chemical control at sensitive sites. A draw-off style injection tool is included with this kit.



Foliar Spray

The foliar spray technique utilizes a hand-held or backpack sprayer to deliver a diluted solution of herbicide to knotweed's foliage. It is useful for covering large and dense infestations, or for plants too small to inject. While it is quick and efficient, this method presents a higher potential for off-target impacts via herbicide spray drift. Foliar spray treatments should be performed under favorable environmental conditions (i.e. low wind).



REGULATIONS AND PERMITTING REQUIREMENTS

Before beginning herbicide treatment, consider the following regulations and permitting requirements to ensure your management efforts are not in violation of local, state or federal laws/regulations. **Please note:** this is not an exhaustive list. It is the sole responsibility of the landowner to ensure compliance with all applicable laws regulations.

1) THE LABEL IS THE LAW!

All herbicide applications must be performed in strict accordance with the herbicide manufacturers product label. This includes wearing appropriate personal protective equipment, using approved dosage rates, and only applying to locations listed on the label. Using an herbicide in any manner inconsistent with its label is a violation of federal law.

2) DO NOT USE HERBICIDES NEAR WATER

Non-certified applicators (i.e. landowners) are not permitted to apply herbicide within 100-feet of surface water or wetlands. Aquatic applications require special herbicides and state permitting. If you think your treatment site is located near a wetland, please contact APIPP for guidance.

3) KNOW YOUR BOUNDARIES

Non-certified applicators may apply general use herbicides on their *own* properties. Treatments performed on land not owned by the applicator are considered commercial and require certification – even if no compensation is provided for the treatment. In other words, you cannot treat your neighbors land, the Forest Preserve, right-of-way areas, etc.

ENVIRONMENTAL CONSIDERATIONS

When applied in accordance with label recommendations, herbicides present little risk for environmental impact. The guidance below will help ensure your treatment does not impact non-target organisms or resources:

BEES AND POLLINATORS - Time applications when pollinators are least active. Evening applications are better than early morning, and both are better than midday.

WIND- Avoid foliar spray treatments during periods of moderate or high wind to minimize off-target drift.

RAIN - Do not treat plants when rain is in the near-term forecast.

SUN AND HEAT - Avoid foliar spray treatments when temperatures exceed 80°F. Herbicides will evaporate faster than they can be absorbed by the plant.

DEW - Do not treat plants when dew is present. The herbicide will become diluted or runoff.

WATER SOURCES - Do not use herbicide near surface water, wetlands, or drinking water wells.

CONTAMINATION - To prevent environmental contamination, never use more product than what is recommended by the label. Always dispose of excess product properly.

BE PATIENT!



Systematic herbicides require time to take effect. Plants may not show visible signs of decline for 2-3 weeks after treatment. Do not cut, remove, or disturb plants until they are brown and dry. Additional applications will not increase effectiveness and may lead to environmental contamination.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) must always be worn when handling or applying herbicide. Consult the herbicide product label for a list of required PPE. At a minimum, most manufactures recommend long-pants, long-sleeves, shoes with socks, and chemical resistant gloves. Protective eyewear is always a good precaution. Be sure all PPE is clean and in good working order.

Personal Protective Equipment (PPE)

Some of the materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves made of any waterproof material such as natural rubber
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exists, use detergent and hot water. Keep and wash PPE separately from other laundry.

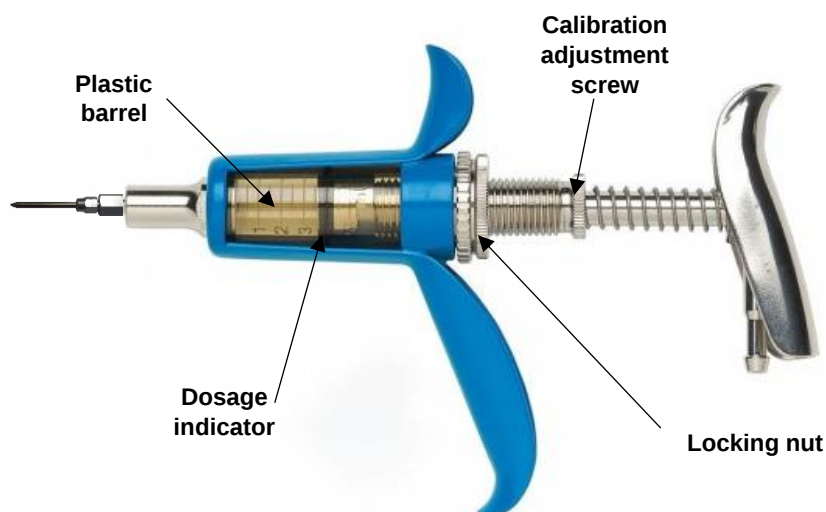
HERBICIDE APPLICATION INSTRUCTIONS

The following section provides step by step instructions to guide your chemical control work. While these general best management practices are known to be effective on knotweed, always consult the herbicide label to ensure the rates and techniques described below are permitted.

Stem Injection

INJECTOR CALIBRATION

Before beginning application, it's important to calibrate the injection tool to ensure it is delivering an optimal dose of herbicide within the herbicide manufactures recommendations. Always wear personal protective equipment when handling herbicide application equipment. Follow the steps below to calibrate the injection tool:



The injection tool can be easily calibrated without tools. First, check the current dosage setting by viewing the plastic barrel. The black ring within the plastic barrel indicates the dosage. The barrel is marked with ml increments. The tool is provided pre-calibrated to a 3ml dosage. It is recommended that you do not change this setting. However, if you need to increase or decrease the dosage:

1. Loosen the locking nut
- 2a. To *increase* dosage, loosen the adjustment screw. The black dosage indicator will move to the *rear* of the unit.
- 2b. To *decrease* dosage, tighten the adjustment screw. The black dosage indication will move to the *front* of the unit.
3. Once the dosage indicator is in the appropriate position, hand tighten the locking nut.

INJECTION INSTRUCTIONS

For maximum treatment efficacy, all knotweed stems large enough to receive the injection needle should be treated. Smaller stems should be treated with a foliar spray of herbicide (see page 11). Generally, stems must be approximately the diameter of a penny to be injected. If a stem is too small, it will break and leak herbicide product. Follow the steps below to complete your injection treatment;

1. Assess your knotweed stand and determine the best starting point. Using a systematic approach, such as working front-to-back or left-to-right can help ensure all stems are treated. Injecting and marking each stem on the same side will make it easier to track your progress.
2. Assemble the tool by attaching the hose to the injector plunger (see schematic – page 17).
3. Fill the herbicide reservoir with the appropriate product (glyphosate), making sure not to exceed the max fill line. Most stem injections require undiluted product, but always consult your herbicide product label before treatment. Fill the injection tool reservoir over a catch basin or impermeable surface to ensure spills can easily be contained. Have paper towels and/or an absorbent material ready as a precaution. Securely fasten the reservoir to the hose.
Note: Remember to track the total quantity of herbicide used for reporting and to ensure you do not exceed label recommendations.



4. Holding the injection tool with the reservoir upright, align the needle between the second and third node (or another location specified by the product label). See Photo 1 – nodes are identified in red.
5. Holding the injection tool with your hand off the plunger, carefully insert the needle into the stem. You may need to support the stem with another hand to prevent it from bending or breaking. Slowly and fully



squeeze the plunger one-time to dispense herbicide into the stem (Photo 2). The plunger should feel firm while being depressed, indicating liquid is moving through the system. Use the clear window to verify herbicide is leaving the tool.

Photo 2



6. Once the injection is complete, remove the tool from the stem and mark the cane using the provided paint marker (Photo 3). Be sure to mark *above* the injection site to prevent contaminating the marker with herbicide residue. Remember, marking all stems on the same side will make it easier to track your progress.
7. Repeat steps 4-6 for all stems in the infestation that are large enough to accept the injection needle. Be sure to track the total quantity of herbicide solution used.
8. Once injections are complete, carefully return unused herbicide from the injection tool to the original manufacturers container. A funnel is provided in the toolbox to minimize the potential for spills. Pour over a catch basin or impermeable surface to ensure spills can easily be contained. If your treatment is complete, proceed to the cleanup instructions on page 15. If you plan to perform a follow-up foliar spray for smaller plants, proceed to the section below. To aid the cleanup process, the injection tool can be triple-rinsed into your spray apparatus by following the protocol described on page 15, step 2.

Photo 3



PREPARING A FOLIAR SPRAY SOLUTION

Consult your herbicide label to determine the appropriate dilution rate for a spray-to-wet treatment of knotweed. The labeled rate is usually in a range from 2-5%. When preparing a solution for foliar spray, mix the lowest volume of solution possible. Avoid storing excess product in a diluted state. It is better to mix a small batch and need to refill, than mix a large batch and have an abundance of leftover spray mix.

1. Determine the total quantity of solution to be mixed and the appropriate amount of herbicide needed.
2. Fill your sprayer to $\frac{1}{2}$ of the desired volume with water (Photo 4).
3. Carefully measure herbicide using the measuring cup provided. If your herbicide container is squeeze and fill design, you do not need to use the measuring cup. Pour to measured herbicide into the backpack (Photo 5).
4. Using caution not to splatter, carefully rinse the measuring container, dumping the rinse water into your sprayer. Repeat for a total of three-rinses (Photo 6).
5. If you are using a marker dye, add the appropriate amount to your spray solution. If needed, triple rinse the measuring vessel as described above.
6. Continue filling the sprayer with water until it reaches the desired volume.
7. Secure the sprayer lid and gently agitate your solution. You are now ready to begin application.

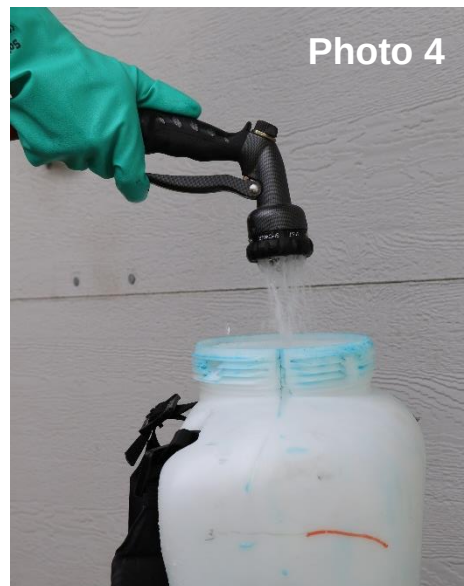


Photo 4



Photo 5



Photo 6

FOLIAR SPRAY INSTRUCTIONS

If you have already performed a stem injection treatment on your knotweed stand, foliar spray should only be used as a “clean-up” to treat any stems that were too small to inject.

The foliar spray technique can also be used as a standalone management strategy for large/dense stands. When foliar spray is used as the primary management action, it can be helpful to cut down your knotweed during mid-summer (see treatment timing page 5) and allow the canes to regrow for 4-6 weeks before treatment. This will minimize the need to spray overhead and allow for a more selective treatment.

1. Assess your knotweed stand and determine the most appropriate starting point. Using a systematic approach, such as working front-to-back or left-to-right, can help ensure all stems are treated. Treat your stand as if you were painting a floor; avoid walking through areas that have already been sprayed to limit your exposure to herbicide.
2. Pressurize your backpack or handheld sprayer by repeatedly depressing its priming lever until the stroke is firm.
3. Aim your sprayer wand or nozzle at the knotweed to be treated and briefly depress the level to test the spray pattern (Photo 7). A very fine spray pattern will limit the amount of herbicide being applied but will increase the potential for herbicide drift. Large droplets will deliver a large quantity of herbicide and can lead to over application. A middle-balance is ideal.
4. If needed, adjust your sprayer wand or nozzle to achieve the desired spray pattern. Tightening the nozzle will produce a finer droplet, while loosening the nozzle will produce larger droplets (Photo 8).
5. Spray the foliage of all untreated knotweed plants. At least 70% of the leaf surface area should be treated. Spray plants until wet, but not until the point of runoff (Photo 9).
6. If possible, use all the solution in your sprayer without over applying. If you have finished treating your knotweed but have a small amount of solution remaining, it can be used to treat other undesirable

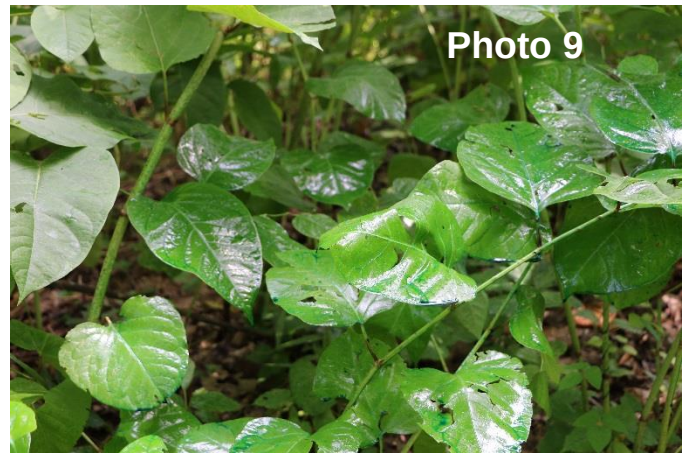


Photo 7



Photo 8

plants around your property. Be sure you do not treat near water or treat a species not included on the products label.



7. Once you have completed treating your knotweed, proceed to page 15 for cleanup instructions.



CLEANUP

To avoid drying and hardening of pesticide residues - and potential corrosion and damage to equipment - clean all application equipment immediately following the treatment. Be sure to clean the entire injection system, not just the herbicide reservoir. Follow the steps below:

Injector Tool Cleanup

1. Be sure all herbicide product has been removed from the injector tool's reservoir. Insert the needle of the injection tool into the herbicide container and depress the plunger multiple times to remove any residual product from the internal components of the system (Photo 10).
2. Working over a catch basin or impermeable surface to contain spills, carefully fill the herbicide reservoir 1/3 full of clean water (Photo 11).

Replace the lid. Aim the injection tool into a rinsate collection container or herbicide sprayer and depress the trigger until the reservoir has been emptied.

Note: If you are performing a foliar spray following injection, water from the rinsate collection container can be used as part of your solution. Otherwise, dispose of rinse water in accordance with the herbicide manufacturers recommendations.

3. Repeat steps 2-3 for a total of three rinses. Wipe the tool dry with a paper-towel or disposable cloth. It can now be placed back in the toolbox.
4. Remove the needle and place it in the storage tube to prevent physical injury.
5. Rinse or soak the herbicide reservoir cap with water to clean out its check valve.



Photo 10



Photo 11

Sprayer Cleanup

1. Spray out all herbicide solution from your tank. Ideally, all solution should be used to treat knotweed, but excess product may also be used to manage nuisance vegetation around your property. Do not treat near water or spray a species not listed on the product label.
2. Fill the backpack sprayer approximately $\frac{1}{2}$ full of water. Secure the sprayers lid and agitate.
3. Spray out the rinse water on an impermeable surface (level, not near water sources) where it can evaporate or another place without plant life, since the water will have chemical residue.
4. Repeat steps 2-3 for a total of three rinses.
5. Wipe down your sprayer with dry with a paper-towel or disposable cloth. It can now be stored for later use.

SHARE YOUR SUCCESS!



Before



After

Persistent management efforts can yield impressive results. Please share your experience and success stories with APIPP's Terrestrial Project Coordinator.

APPENDIX A: HERBICIDE SELECTION

Several factors should be considered when selecting an herbicide for knotweed control such as the size of the infestation, proximity to sensitive features (desirable plants, eater, etc.) and the ultimate management objective. Avoid purchasing excess herbicide to reduce the need for long-term storage. However, recognize that chemical control is never a “one-and-done” project. Multiple treatments will be required over consecutive years, so a small amount of excess herbicide is appropriate.

Use the table below to select an herbicide for your control project. Glyphosate based products should include at least 40% active ingredient to be effective against knotweed. Check the product label to ensure knotweed is a listed target species and that injection is an approved application method.

The inclusion of herbicide products and retailers in this list does not constitute endorsement but is simply provided as a reference to aid landowners in selecting an effective product. For more information, contact APiPPs Terrestrial Project Coordinator.

	Product Trade Name
Glyphosate Based	Accord XRT-II
	Pronto Big N' Tuf
	RoundUp ProMax
	Compare N Save Grass and Weed Killer
	RoundUp Weed and Grass Killer Super Concentrate
	GroundWork Super Weed & Grass Killer
	FarmWorks 41%Glyphosate Plus
	RoundUp PowerMax
Imazapyr Based	Arsenal
	Arsenal Powerline

Online Herbicide Retailers:

- www.forestrysuppliers.com
- www.gemplers.com
- www.arborchem.com

APPENDIX B: INJECTION TOOL SCHEMATIC

