

Eradication of Japanese Knotweed

Introduction

Japanese knotweed is a highly invasive, non-native species that is spreading rapidly throughout Vermont, damaging ecosystems and properties. Native to East Asia, it arrived in North America in the mid-1800s. It was originally used for ornamental and privacy purposes in domestic gardens. Invasion from one site to another now occurs primarily by distribution of rhizomes along rivers particularly during floods, or soil that is moved during construction projects. It is now considered one of the most invasive plants in the world and is found on every continent except Antarctica. The knotweed problem is so widespread that a Statewide funded program would be extremely complex and expensive, and unlikely to have an immediate impact. An alternative approach is to empower each community to address the problem in its own town. A successful program will almost certainly involve private landowners and the broader community such as volunteers and other local organizations.

But what will it take to eradicate Japanese knotweed and what are the legal requirements and limitations? Here we provide a series of documents that attempt to present everything you need to know to get involved in a successful eradication program. It is hoped that these documents will encourage efforts Statewide. While recognizing that knotweed is not the only invasive problem in Vermont, it is the major problem, so these documents focus primarily on this species.

Document #1 presents multiple strategies and makes the case that, particularly when invasion is large, a successful eradication program will need to include herbicide treatment as a major part of an integrated pest management. The most effective herbicide is glyphosate that has been erroneously maligned because of perceived human health and environmental concerns. This misinformation is discussed in document #2. Documents #3-4 focus on additional issues related to herbicide use, while #5 discusses the experience of volunteer groups, and their importance in an eradication program.

This series contains the following:

- #1. Suggested operating procedures
- #2. Glyphosate safety issues
- #3. Glyphosate buyers guide
- #4. Pesticide regulations, certification and permits
- #5. Enhancing community involvement

These documents were generated by a town-based volunteer working group with several years of experience testing various approaches and eventually focusing on herbicide treatments as the most effective approach for control. The information discussed includes the experience from several other towns in Vermont and from across the nation. One member of this working group obtained applicator certification, which provided additional knowledge of the legal aspects that are discussed in these documents.

There is an urgency to resolve these concerns as Japanese knotweed is spreading rapidly throughout the State of Vermont and beyond.

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Eradication of Japanese Knotweed

Summary

Japanese knotweed is a highly invasive, bamboo-like plant that has invaded much of the USA and is causing tremendous damage to properties and the environment. It destabilizes riverbanks and washes downstream during floods invading additional sites. It is also spread when dirt is moved such as in road or building construction projects.

Eradication is difficult because the plant has deep rhizomes that cannot be effectively removed by digging. Digging, cutting or mowing will slowly deplete the plants energy and reduce growth over many years but may not eradicate it. Smothering the plant for an extensive period of time (5 years) may be more effective, but all these approaches are only practical on relatively small patches and are not applicable to rocky riverbanks.

The most effective approach to eradication is the use of herbicide, and this is the only method applicable to large patches which represent the bulk of the invasion in Vermont

The most effective herbicide is glyphosate which has little detriment to human or animal health and does not cause cancer despite extensive misinformation on the internet. Furthermore, Japanese knotweed is far more detrimental to the environment than glyphosate.

Spraying must be done with a glyphosate concentration (5-8%) and in late summer when the plant is sending energy back down to its rhizomes. Cutting in June/July is also recommended as the plant regrows to a more manageable size and will not be in flower when sprayed in the fall. Some regrowth will occur the following year but can be treated with a spot spray. Monitoring and treatment as necessary should continue for several years thereafter.

Property owners can purchase glyphosate and spray their own property, or they can hire a certified applicator.

The extent of invasion is so extensive throughout Vermont that a statewide program would be too expensive to envision. Community involvement will be essential with volunteer groups representing each town or river basin. Such teams may need to engage a certified applicator to spray land they do not own, though it can be cheaper if one of their own team becomes certified, particularly if the volunteers cover the cost.

Invasion has occurred along state and town roads as a result of construction, and the state needs to develop an eradication program rather than mowing annually as the latter does more to spread the invasion than control it.

The use of pesticides is regulated by Federal and State laws. The label on the herbicide is the law, as is the Vermont Rule for Use of Pesticides, both of which need to be understood and followed.

This series of documents has been developed to explain the established and recommended methods of control, the relative safety of glyphosate, which products to purchase, how to read the label, and the legal aspects that are involved.

Eradication of Japanese Knotweed: #1. Suggested Operating Procedures

Japanese knotweed is a rapidly growing, non-native plant that has invaded many riverbanks, roadsides, and other locations throughout Vermont. It is quick to shade out native species and garden cultivars. It takes over roadsides, residences, and community areas, threatens our riverbanks, fish and wildlife habitats, and increases fire danger. It will target weak spots in buildings, crack masonry, split pipes and ravage foundations. It will infiltrate even the smallest and thinnest of cracks and wind its way through drains and septic systems, blocking and eventually breaking pipes. The damage can be extremely costly to a property owner, and its presence will lower property values, and even prevent a potential sale.

How it spreads: While the 6-10 feet tall stems look menacing, the real issue is the underground rhizomes that can grow lightning fast and invade new areas. Up to 2/3 of the mature plant's biomass is stored underground in its system of rhizomes. Cutting or mowing knotweed only removes the above ground portion and only serves to stimulate the rhizome to send up additional shoots. The rhizomes can go down 8 feet, so digging is unlikely to remove them, and every small piece of rhizome can produce another plant. In addition, the cut stems can generate new plants. Moving contaminated soil is the major route for transmission to another location, whether it be a result of road or building construction, or the result of hurricane Irene or other flash floods. New plants spread by the 2023 and 2024 floods sprouted within a couple of months.

How to control Japanese knotweed: For small patches of knotweed, approaches for control include smothering for 5 years, direct injection of herbicide into stems, or foliar spray with herbicide. For large patches, which is the vast majority of the problem throughout the State, the only effective control is foliar spraying. This requires cutting stems in early July when they can already be >6 feet high, and then spraying the regrowing stems 6-8 weeks later when the rhizomes are further depleted of energy. Success with this approach is considered better than 90% control, not 100%, so needs to be repeated for several years. More detail of these control strategies is provided below.



Spring



Summer



Leaves and flowers

General Considerations for Controlling Japanese Knotweed

***Be pro-active now; next year the problem will be much bigger
Ignoring it is not an acceptable strategy***

Stay alert: early detection is critical, particularly after the recent floods. The sooner it is recognized, the more likely it can be controlled. If left untreated, it can rapidly grow into a much larger, uncontrollable problem. Unfortunately, most of the knotweed patches throughout the State are already too large for easy management.

There is no single recommended method to eradicate Japanese knotweed, but all guidelines emphasize that it requires repeated effort over several, if not many years. The preferred method depends on your site conditions, the extent of invasion, the amount of effort you are willing to invest, and cost.

Every landowner can control their own patch of knotweed. The most effective and easiest method requires herbicide spraying. The most effective herbicide is glyphosate because, unlike most other herbicides, it translocates from the leaves down into the underground rhizomes. Unfortunately, the internet contains extensive misinformation regarding its potential to cause cancer and toxicity. Glyphosate is one of the most benign pesticides available as discussed in document #2 in this series. People should not be scared of using glyphosate when applied according to instructions on the label (document #3 discusses what to read on the label). It should also be realized that Japanese knotweed is far more damaging to the environment than the glyphosate that can be used to control it.

If you have a few small shoots, the easiest approach is to spot spray with glyphosate in late summer

Small patches: the plants can be smothered, injected, or sprayed with glyphosate.

Large patches: herbicide spraying is the most rapid and effective method, is cheaper and less labor intensive than most other methods. The best approach is the cut-and-spray method as detailed below. Cutting is important as effective spraying of 10-foot-high canes is not feasible. Furthermore, much less herbicide is required when the canes are much shorter, and potential for drift is reduced as the spray head can pass easily just above the growth. An alternative approach suggests an additional spraying in spring making the cutting unnecessary, but this added herbicide load will exceed the maximum amount of glyphosate permitted per annum.

The Vermont Rule for Control of Pesticides is a document that details the regulations that must be adhered to when using pesticides in Vermont. Aspects in the Rule related to eradicating knotweed are discussed in this series of documents. For example, some commercial herbicide formulations cannot be used close to water. These formulations require a Vermont-certified applicator who is licensed to purchase and use them.

Mowing is an alternative approach if the site is flat, so this is not amenable to rocky land or steep riverbanks. This requires regular mowing for many years. If you cut or mow, ensure no canes go into the river as this will result in further invasion downstream.

Effective removal by digging requires 10-foot deep holes, and killing of every piece of root removed. This can be very expensive. Limited digging of only the crowns will reduce the density of the knotweed patch so would need to be repeated for many years.

An excellent recent review on the topic (from England)

<https://www.theguardian.com/environment/2023/may/16/the-war-on-japanese-knotweed>

Control of Japanese knotweed by herbicide treatment

This is one of the most effective methods for controlling knotweed and is applicable to most situations. It can be performed by individual landowners on their own property, or they can hire a certified applicator. A State-certified applicator is required for spraying on another person's land, and with the owner's permission. Spraying close to water requires different formulations some of which require a certified applicator to purchase and use. The exception to this limitation is detailed in document #3 in this series.

While very effective, do not expect 100% kill in the first year. Anticipate up to 90% success, but plan for further treatments over the following couple of years. Finally, stay alert for any regeneration in subsequent years, and treat them immediately.

Suggested procedure:

1. Cut canes close to the ground in early July if they are >3 ft tall. A brush cutter works well (weed whacker with a blade) as the canes are hollow. New or regrowth areas may only have small plants and will not require cutting.
2. Canes can be left to desiccate where they are cut. Do not pile them up as that will retain moisture and facilitate new growth from the canes.
3. The plants will rapidly regrow, so spray all the foliage with glyphosate in late August/September.
4. Repeat as necessary in years 2 and 3 (cutting in early July may only be required for canes that grow more than 3 feet as those would be likely to flower at the time of spraying).

Comments:

Glyphosate is an EPA-approved, non-selective herbicide, that kills any plant it touches. It is available from many companies under various trade names though Roundup for home and garden use no longer contains glyphosate. You will need to use glyphosate at 5-8% to adequately control knotweed. Glyphosate is generally available in concentrations of 41% or 53.8%. Check closely as many herbicide products do not contain glyphosate. Use a small hand sprayer or a backpack sprayer depending on size of patch.

Most formulations also contain a surfactant that is essential for wetting the leaves but can be toxic to amphibians and fish which precludes its use near water. To spray near water, alternative forms of glyphosate and surfactant are available (see document #3).

During spring, the energy in the rhizomes goes into new growth – an upward movement of energy. In late summer to fall, the plants send energy back to the rhizomes to over winter and provide energy for next year's growth and further invasion. Herbicide treatment should be done in late summer/fall, but while daytime temperatures still reach 60°F, so that it goes down to the rhizomes along with the energy.

Plants must not be sprayed with herbicide when in flower as this is detrimental to pollinators such as bees. If cut in July, the knotweed is unlikely to flower by the time it is sprayed.



Control of Japanese knotweed by herbicide injection

This approach can be very effective for treating small stands, or new invasions. It also has the advantage that you do not have to cut the large plants in July, although it can help to remove the dead canes just after the snow melts as this facilitates access later in the year. The disadvantage is that it requires special equipment (the injector) that can be expensive. Several injection systems are available, but one frequently recommended is the JK1000 system (~\$280; picture below).

(<https://www.jkinjectiontools.com/shop/injection-systems-and-canisters/jk1000-injection-system/>)

Wait until late summer or early fall, when the Japanese knotweed canes are a half inch or more in diameter. Toward the end of knotweed's growing season, nutrients are transferred from the leaves down through the canes and on down to the rhizomes. Glyphosate injected during this time will follow the same path down to the rhizomes. And it is the rhizomes which must ultimately be destroyed if you are to be successful at knotweed removal.

Suggested procedure:

1. Early spring: while the ground is still frozen, rake out dead canes from the previous years. Just hit them with a rake and they will break off. While this step is optional, it will make future injections easier as you will need to crawl under the plants
2. Spring/summer: let the canes grow
3. Late August: At or soon after flowering, inject undiluted (41%) herbicide just below the second node up from the ground of the knotweed cane. The canes should be at least $\frac{1}{2}$ inch thick. Smaller canes cannot be injected, but if you kill the major canes many of the smaller ones may also die.
4. September/October (before frost): Inject herbicide into any canes that still have green leaves. This will significantly improve the response rate.
5. Year 2: This approach has been reported to be 95-100% successful within one year but repeat injections or spot spraying will be required in subsequent years if stems recur.

Comments:

The dead canes raked out in spring can be piled or burned. Continuously monitor piles to ensure no growth. If growth reappears, best to quickly spot spray with herbicide (see previous herbicide section).

The maximum number of canes that can be injected is around 1400 as more would exceed the permissible glyphosate/per acre (and be labor intensive). The advantage of herbicide injection over a foliar spray is that it is more selective as to what it kills. It is particularly useful where knotweed is growing intimately with desirable plants or near water. However, small canes, particularly around the periphery are often too small to inject and may require a spot spray directed only at the leaves (see foliar spray method).

Each canister of the JK100 system holds 16 oz (473 cc), so can do <100 stems per refill. Use undiluted glyphosate concentrations (41%) and this will facilitate injection of about 950 stems per gallon. Minimum personal protection includes impermeable gloves, and eye protection.



JK 1000 injection system

An alternative approach to stem injection is to cut the canes in late summer, and then add the herbicide directly into the hollow cane. This may be more labor intensive as each cane would need to be individually cut just below a node to accommodate up to 5 ml of herbicide, less for smaller canes. A 20% solution of glyphosate may suffice which would allow addition to around 3,000 canes before exceeding the permissible glyphosate/acre. In addition, there may still be some small shoots that do not have a hollow core and may be best controlled by a spot spray.

Control of Japanese knotweed by smothering

If you wish to avoid the use of herbicide, you can smother the knotweed. This approach is not feasible directly on riverbanks or rough ground. This is generally appropriate for small areas (~200 sq. ft), although we have smothered about 1,000 sq. ft. near a well as spraying within 50 feet of the well is not allowed.

Cut canes have sharp stems that will pierce the plastic sheet, so it is best to dig out the crowns. Smothering knotweed that is intermingled with brush is difficult unless the brush is also removed. The presence of trees could prevent the efficacy of this approach. As the plastic can be degraded by sun, it is best to provide some type of mulching, for example wood chip. The cut canes can also be used as mulch.

Suggested procedure:

1. Cut the knotweed near ground level. This can be done at any time of year although early summer will deplete the rhizomes as a good start at killing the plants.
2. Pile canes on an impervious surface such as a tarp until they desiccate; the plastic tarp that you will install is the most practical place.
3. Dig up the crowns as they have sharp edges that will puncture the plastic tarp. They break off fairly easily. They can be placed on the tarp after installation and left to dry and die.
4. Cover the entire area with the heavy-duty black plastic tarp (6 mil, available at Home Depot or equivalent). If overlapping sheets, ensure 2 ft overlapping plastic, and extend 5-10 feet beyond the known knotweed patch
5. Weight edges down with rocks or logs
6. Cover with canes, woodchip or other mulch to protect plastic from photodegradation by the sun
7. Leave in place for 5 years minimum, then the area can be replanted.

Comments:

In one site, the landowner provided 4 mil plastic so it was used as a double layer. The approach was complicated by mixed brush which also had to be removed as wrapping plastic around the brush would have allowed holes through which the knotweed could grow. A further problem occurs if the patch goes down a slope (left picture below) and while this was covered with plastic, it would not support additional mulch on top, but being in the shade it will probably be protected from photo-degradation.

In another area, 6 mil plastic was used as a single layer, but this was against a wall so the tarp was affixed with wood strips 3 feet up the wall. Some knotweed still found its way out but was rapidly trimmed back.

Keep an eye on the patch and ensure no knotweed escapes around the edges of the tarp. The plant grows in all directions under the tarp to try to find light and is often successful, though these shoots can be easily removed. Raising the edge of the tarp and trimming them back works well, but if they have rooted beyond the tarp, digging may suffice if the roots are still shallow. Alternately, a spot spray with herbicide may be a better alternative than trying to extend the tarp.



Control of Japanese knotweed by cutting or mowing

There are different opinions regarding the efficacy of mowing probably related to the frequency of mowing, and its ability to spread the problem further. Cutting once or twice each year as common for road crews along the right-of-way is much more likely to enhance growth and spread, and will definitely not kill the plant. In contrast, much more frequent cutting will certainly limit growth and may eventually kill the knotweed.

Mowing Japanese knotweed on relatively flat terrain such as a field or lawn can control and starve out the plant. It is important to mow it frequently (weekly or biweekly) and as low as you can set the mower. The rationale is that by mowing it regularly and not allowing it to establish a canopy of leaves it will be forced to use the stored energy in the root system to grow new shoots. Every time you mow, you are forcing it to use more of that stored energy. Also, by not letting it establish leaves it cannot feed the underground rhizome system.

A more effective strategy may be to cut the knotweed only 3 or 4 times during the year. The idea is that it should be encouraged to grow to use up more of its stored energy, but once it gets to 18-24 inches, cut it back before it can send more energy to its rhizomes. This method probably encourages more rapid depletion of the energy stored in the rhizomes than mowing.

Both methods take time and diligence, and will take several years, but by being consistent, the colony of knotweed will weaken and eventually it may starve itself out and die, though long term efficacy of this approach remains to be established.

Additional Comments:

Limitations: for mowing, the ground needs to be level. Riverbanks, rocky or other uneven ground would not be amenable to this method.

In a well-developed patch, the knotweed crowns make mowing extremely difficult initially. It may be best to dig these out first. See following discussion of digging.

Simply mowing on the periphery of a knotweed patch will not work as it will keep invading from the main plant. This approach needs to be applied to an entire knotweed patch. Also mowing should always be from the outside of the patch inward to avoid spreading fragments beyond the existing patch.

The frequency of cutting and the best height to cut is still under investigation, but its application to rough ground or riverbanks suggests it will have greater applicability than mowing.

An alternative to mowing or cutting that has been used in one or two sites in Vermont is to use goats that can consume a lot of knotweed, although as with the other approaches discussed here, it will reduce knotweed growth but is unlikely to eradicate it.

Control of Japanese knotweed by digging

An established knotweed plant will have a crown at ground level and rhizomes below, often with a main tap root that appears orange when broken. New growth each year starts from the crown, and 10 or more new stems can appear depending on the age of the crown. The crown is fairly easy to dig up, breaking the tap root below. This means that new growth will occur from lower or side rhizomes and it will take several years before a large crown develops again. Hence, digging has the advantage of thinning out the plants but will not eradicate them. As shoots begin to reappear, they can be pulled out though this will be a continuing task for many years as the patch is slowly decreased in size. Digging will also make it easier to smother without the fear that the old stems will puncture the plastic cover.

Once dug out, the crowns must be thoroughly desiccated before discarding. They can be spread on a tarp or in a drying rack. They may sprout again but as long as they cannot root, they will eventually die, though this can take many months. Alternatively, place them in black plastic bags and leave in sun over the summer. Eventually it may be best to burn the crowns to ensure they are truly dead.

Limit: this approach is labor intensive, requiring more volunteers than other methods, repeated effort, and is limited by the size of the patch. However, it may help to control knotweed near a potable water source such as a well where spraying is restricted. This could also be a precursor to smothering, particularly around a well.



Digging can be performed on a more industrial scale with an excavator going down at least 10-feet to ensure all rhizomes are removed, then you have to be sure they are fully dead in all the removed dirt before disposal. To put this approach in perspective, there were 10 acres of Japanese knotweed at the 2012 Olympic site in East London. It took 4 years and £70 million (\$85 million) to clear it. Most of the cost was due to extensive excavation though some herbicide was also used, specifically glyphosate, chosen because it was deemed a "milder chemical" than other possible agents.

Eradication of Japanese Knotweed:

#2. Glyphosate safety and ongoing litigation explained

Summary

Japanese knotweed is far more damaging to the environment than glyphosate. Public concern for the toxicity and carcinogenicity of glyphosate is based on misleading and erroneous information. This document attempts to allay these concerns and thereby make glyphosate more acceptable for the control of Japanese knotweed. The following is the conclusion from the University of Maryland Extension service (ref. 1).

There are no risks to human health from current uses of glyphosate

There is no indication that children are more sensitive to glyphosate

There is no evidence that glyphosate causes cancer in humans

There is no indication that glyphosate is an endocrine disrupter

Trace amounts of glyphosate on food are not of concern for the consumer

The State of Vermont has generated a similar document with explanations for most of these conclusions (appended). Here, we provide further explanation and additional discussion points relating to the safety of glyphosate, as well as recent information on the ongoing litigation. Understanding this information will be particularly useful for authorities and volunteers when discussing people's concern for spraying on or near their land.

Explanations

The most effective and widely applicable method of control of Japanese knotweed is "cut-and-spray," particularly for large patches or along riverbanks where alternative methods such as mowing, digging or smothering are not feasible (discussed in document #2, and refs. 2, 3). The most effective and probably the safest herbicide to use is glyphosate (ref. 4). The EPA has determined that glyphosate is safe to use when following the label instructions, which include personal protective equipment (long pants, long sleeve shirt, shoes with socks) and avoiding contact with skin and eyes. Impermeable gloves (nitrile) are also an excellent addition although not listed on the label.

Unfortunately, glyphosate has been erroneously maligned for its toxicity and for inducing cancer. It is far less toxic than many common household products, and its cancer-causing effect is highly questionable. Only one source (IARC, an agency within the World Health Organization) considers it to be "probably" associated with cancer, and non-Hodgkin lymphoma (NHL) is usually cited as the most likely cancer. This conclusion contradicts three other WHO agencies. Regulatory agencies in the USA and many other countries have also concluded that the standard use of glyphosate causes no health concerns (see below). IARC's conclusion was based on an assessment of hazard: could glyphosate cause cancer at some dose and schedule, but according to IARC, almost everything causes cancer. They did not consider risk

which also assesses likely exposure. For example, cancer studies fed rats glyphosate daily for up to 2 years. This is a life-time exposure for rats and far beyond that for a person using glyphosate for a couple of days around the garden or to kill Japanese knotweed, and hopefully consuming none. A fact often ignored when raising this concern is that even the IARC report suggests glyphosate poses only a very low risk of inducing cancer; they classified it as a Class 2A carcinogen along with red meat, hot beverages and many common medicines, and less hazardous than bacon, salted fish, oral contraceptives and wine, among many examples (ref. 1).

With respect to toxicity, glyphosate is about 30-fold less toxic than caffeine and 560-fold less toxic than nicotine. It is even less toxic than salt. The best way to understand risk is to compare it to other common products we are exposed to, and thereby realize the risk associated with glyphosate is extremely low and that no one is likely to be exposed to a high dose that might be detrimental to human health.

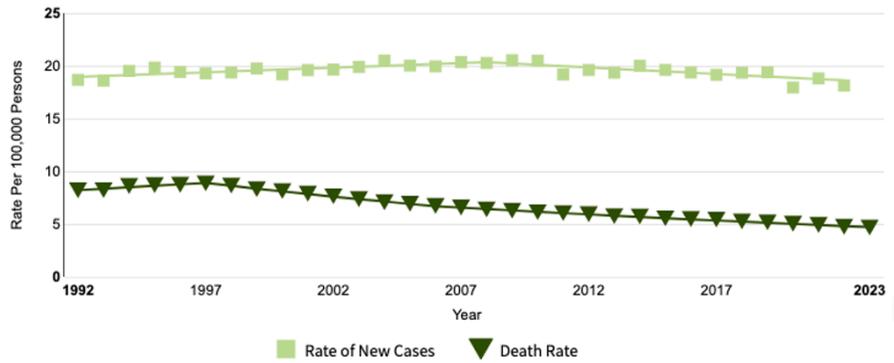
Unfortunately, the IARC report has resulted in many legal suites and payouts by Monsanto and Bayer, who now own the Roundup brand. However, the majority if suites have failed which is not commonly realized, and Bayer is still appealing other suites (see more details below). The EPA made a different conclusion than IARC in that they find no evidence that glyphosate causes NHL. But it is not just the EPA. In November 2023, the EU Commission re-approved glyphosate for 10 years, following favorable scientific assessments by its health and safety agencies, including the European Chemicals Agency (ECHA) and European Food Safety Authority (EFSA), which *“did not identify any critical areas of concern.”* Regulatory authorities in Japan, Australia, Korea, Canada, New Zealand and elsewhere have also recently reaffirmed that glyphosate-based products can be used safely as directed.

The State of Vermont has also written a very informative document that explains this misinformation and concludes that it is neither a carcinogen nor toxic (appended). Similar documents have been published by other independent groups (for example, U. Maryland Extension service whose conclusions are detailed above; ref. 1). The reported toxicity to wildlife, particularly fish and amphibians, has been attributed to other ingredients in the formulation, particularly surfactants as discussed more in document #3 of this series. While people may have legitimate concerns about pesticides in general, it needs to be recognized that every pesticide poses a different level of hazard and risk. Glyphosate formulations are federally classified as general use, not restricted use. Furthermore, the pesticide product label must contain one of 4 signal words that describes the potential toxicity: Danger-poison, Danger, Warning, and Caution. All glyphosate labels have only a “Caution” descriptor.

Because the cost of litigation is high, Bayer withdrew glyphosate from domestic products (lawn and garden), but not because of any safety concerns. It is still available for professional use (agricultural and forestry), and it can still be bought from other companies. Bayer continues to assert that it is safe if used according to the label. It is also important to note that the suites relate to people who administer glyphosate and not to those who might be exposed by any other means (e.g., children playing at the park after spraying, particularly as it dries and is absorbed rapidly by the plants and is rapidly inactivated once it hits the ground). Furthermore, it is very interesting that the suites have been filed primarily by homeowners who used relatively low amounts of glyphosate (Roundup) around their property, and not by farmers who have used millions of gallons on their farms over the past 40 years. This suggests the suites are not founded on evidence rather they are driven more by litigators than by plaintiffs. The lawyers are the people who make the most money out of litigation. They have spent more than \$100 million

on advertising and marketing their services, because the successful suites can earn them billions; lawyers make on average about 47 cents on each dollar awarded.

The IARC conclusion was also based on a survey of a limited number of research studies. There is a detailed document written by EPA scientists that analyzed numerous peer-reviewed epidemiology studies, and which concluded that “high quality” epidemiology studies show no evidence of NHL (ref. 5). It also concludes that a number of studies used in the IARC epidemiology analysis were of low quality. Similar conclusions have been drawn from an independent study in the European Union (ref. 6). Some of the issues in low quality studies are a failure to consider confounding factors including age, use of other pesticides, obesity, and a compromised immune system (e.g., HIV), an established risk for NHL. Importantly, the rate of NHL increased slightly around 1980 concurrent with the onset of HIV, and then plateaued around 1995 when highly active antiretroviral therapy began (ref. 7). There has been no increase in NHL that can be attributed to the time frame of the introduction and widespread use of glyphosate. Specifically, between 1995 and 2015, there was an 8-fold increase in the amount of glyphosate used in the USA, with no increase in the incidence of NHL. Furthermore, the American Cancer Society reports a 0.1% decrease in the incidence of NHL each year since 2015 (ref. 8). Furthermore, the death rate from NHL has decreased by almost 50% over this time frame. If glyphosate caused NHL, there would have been a dramatic increase in the disease over this time frame. Hence, there is no evidence of increased cancer after exposure to glyphosate.



Incidence rates for non-Hodgkin lymphoma 1992-2023 (source American Cancer Society)

Other agencies have performed independent studies. The National Toxicology Program, USA investigated the impact of glyphosate in a series of standard assays to evaluate whether glyphosate causes genotoxicity, or damage to DNA, using the bacterial reverse gene mutation assay (a.k.a. Ames assay), an in vitro micronucleus assay to detect chromosomal damage, and a multiplexed DNA damage assay that distinguishes whether chromosomal damage is due to chromosome breaks or changes in chromosome number (ref. 9). They concluded that glyphosate and a microbial metabolite of glyphosate found in soil, did not cause permanent changes to DNA, such as gene mutations or chromosomal damage. These kinds of changes to DNA are commonly associated with increased risk for cancer. The highest concentration of glyphosate used in these experiments was comparable to an adult person drinking about 16 ounces of a glyphosate-based formulation that contained 41% glyphosate. These findings were similar to their prior results in which rodents exposed to high levels of glyphosate in feed showed little evidence of toxicity, and there was no evidence of glyphosate causing chromosomal damage to DNA.

There are numerous other studies that have failed to find an association between glyphosate and NHL or other cancers. For example, a dose relationship study concluded that “*glyphosate systemic doses from agricultural applications are many orders of magnitude less than daily lifetime doses considered by regulatory agencies to impart no excess risk of deleterious health effects, even for sensitive subpopulations*” (ref. 10). Also, an expert review panel did not find support in the epidemiology literature for a causal association between glyphosate and NHL or Multiple Myeloma (ref. 11).

One of the other compelling arguments is the problem of coincidence events. NHL is a relatively common cancer with a lifetime risk of 1/50, and commonly with increasing age (ref. 8), so most NHL could occur after someone had used glyphosate; but this does not make it causative. If 0.1% of the adult population in the USA were to use glyphosate, that would mean about 300,000 users, and if 2% of these (i.e., 1/50) got NHL, there would be 6,000 cases solely on the basis of coincidence and not because of causation. Of course, we don’t know how many people have actually used glyphosate, but it has been very widely used suggesting most, and probably all NHL cases purported to be caused by glyphosate are in fact due simply to coincidence.

To put this another way, the annual incidence of NHL in the USA is about 20/100,000 which will result in an estimated 80,350 new cases of NHL in 2025. As mentioned above, the incidence rate has not changed significantly for 30 years. Considering that there is an estimate of cumulative suits against Bayer (settled and pending) of 170,000, there would have been a dramatic increase in the incident of NHL if every plaintiff’s disease was caused by glyphosate. The fact that a plaintiff has been diagnosed with NHL is unfortunate but cannot be discriminated from the high incidence rate for this disease caused by other factors.

In most comparative studies, glyphosate is considered one of the safest pesticides available, and is still deemed the only truly effective agent to kill Japanese knotweed. Importantly for knotweed control, it is translocated to the underground rhizomes, whereas most other pesticides are not. Alternatives are generally more toxic and far less effective at controlling Japanese knotweed. Additionally, unlike alternative herbicides, glyphosate is rapidly deactivated upon contact with soil due to its strong binding ability to soil particles, which essentially prevents it from moving further and terminates its herbicidal activity once it touches the ground; it is unlikely to enter waters through surface or subsurface runoff except when the soil itself is washed away by runoff, and even then, it remains bound to soil particles and unavailable to plants.

So why does litigation continue? The primary issue in most cases is that the label on the product failed to warn the user of the potential risks of using Roundup. The legal reasoning goes as follows: the plaintiff has NHL, the plaintiff used glyphosate, the Roundup label did not say that glyphosate might cause cancer, hence the company is at fault for not including a warning. Omitted from this reasoning is the question of whether glyphosate actually caused the plaintiff’s cancer, and considering how frequently NHL occurs and the discussion above, this is extremely unlikely. Since the EPA had determined glyphosate is safe as used, then Bayer has claimed that States cannot add an alternate warning, particularly one that would not be supported by the evidence. This position is consistent with the Federal Insecticide, Fungicide and Rodenticide Act which dictates that only EPA-approved labels are legal. In other words, federal law preempts state failure-to-warn claims. Indeed, a recent legal decision in the USA (Schaffner vs. Monsanto; August 15, 2024) stated that “*state-based failure-to-warn claims central to this case and others are expressly preempted by the federal law overseeing pesticide labeling.*” Hence, most suits against Bayer have no legal basis. Due to differences between decisions in several federal courts, the final outcome will require consideration by the US Supreme court to whom the case was submitted in April, 2025. On January 16, 2026, the Supreme court agreed to review the

case which should be decided this spring. The question of the potential toxicity or carcinogenesis in these cases seems to be of minor consideration to the litigators.

An interesting exception is a case in Australia in July 2024, where a Federal Court with the aid of a neutral, court-appointed scientific expert and following a scientific conclave process, found in a detailed 322-page opinion that the weight of scientific evidence does not support a link between glyphosate and NHL, and dismissed the case (*McNickle v Huntsman Chemical Company Australia Pty Ltd*). Consequently, in December 2024, the Australian Federal court closed all remaining injury litigation related to glyphosate.

Bayer has won 17 of the most recent 25 cases and will continue to appeal those on which it has lost, particularly on the basis of the recent outcome of *Schaffner vs. Monsanto*. The weight of evidence is beginning to override the misinformation and legal morass that has been created. Hopefully, glyphosate will recover its broad acceptance as the safest and most effective means to control Japanese knotweed.

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What is glyphosate?

Glyphosate is a type of pesticide, known as an herbicide. Herbicides damage or kill plants. Glyphosate is a broad-spectrum herbicide, meaning it affects both grasses and broadleaf plants. It was first registered for use in the US in 1974 and is currently the most widely used pesticide in the world.

How is glyphosate used in Vermont?

Glyphosate-containing products, such as Roundup®, are used to control many different types of weeds in many different settings in Vermont, such as:

- * Agricultural practices, such as terminating cover crops for water quality practices
- * Weed control in ornamental plantings, lawn, turf, invasive plant control, and right-of-way maintenance
- * Weed control in genetically engineered (GE) crop production, such as corn and soybeans

In Vermont, glyphosate-containing products can be used by homeowners, farmers, and commercial applicators, making it difficult to estimate statewide usage. However, it is one of the most commonly used herbicides in Vermont and usage could go up as water quality conservation practices increase statewide.

How does glyphosate work?

Glyphosate works by blocking a plant's ability to make certain proteins. When this happens, the plant cannot grow, and it dies. For glyphosate to work, it must be applied to actively growing plants.

How is glyphosate evaluated for safety?

In the US, the Environmental Protection Agency (EPA) evaluates and registers pesticides for use. During registration, the EPA uses a scientific process to evaluate risks to human health and the environment. One part of the process is toxicity testing. Toxicity, or how poisonous a chemical is, is measured by the median lethal dose, the "LD50."

The LD50 is the amount of a substance needed to kill 50% of a test population of animals. The substance can be given to the test population in a variety of ways, such as by feeding (oral), by placing on the skin (dermal), or by air (inhalation).

Generally, an LD50 is expressed as milligrams of the substance per kilogram of animal body weight. The lower the LD50, the more toxic the substance.

The EPA also looks at risks in the short-term (acute), long-term (chronic), and even those in between (sub-chronic) in this process. The potential carcinogenicity (ability to cause cancer) is another risk evaluated. After all the tests are done, the EPA determines if, and how, it can manage risks to humans and the environment from the pesticide, while balancing the economic and social benefits. A product's label will reflect the entire assessment through the directions for use and ways to reduce exposure, such as personal protective equipment (PPE), limitations, and restrictions on sales and use.

What happens to glyphosate in the environment?

Glyphosate sticks tightly to soil and has a relatively short half-life, making it unlikely to be found in ground and surface water. It can remain in soil for up to 6 months, depending on the climate and soil type. Glyphosate breaks down into its primary metabolite, aminomethylphosphonic acid (AMPA) by bacteria in the soil.

Glyphosate has been shown to have low toxicity on birds, mammals, fish, and invertebrates. However, some products that contain glyphosate may be more toxic to these because of other ingredients.

The Vermont Agency of Agriculture, Food & Markets has been testing for glyphosate and AMPA in Vermont to better understand its impact on our environment. To date, the Agency has test results for over 290 ground and surface water samples for glyphosate and AMPA. Neither have been found in any sample (Table 1).

Table 1. Ground and surface water samples tested for glyphosate and AMPA by county in Vermont, 2006-2018 (as of 12/1/2018)

County	Number of samples
Addison	26
Caledonia	56
Chittenden	14
Essex	2
Franklin	91
Grand Isle	8
Orange	12
Orleans	29
Rutland	7
Washington	40
Windsor	5
TOTAL	290

Is glyphosate safe?

Glyphosate can be used safely if used according to the label. Glyphosate is relatively non-toxic to hu-

mans. Many household products are more toxic than glyphosate; for example, caffeine, table salt, and nicotine are all more toxic than glyphosate (Table 2).

Glyphosate is used on crops, are they safe to eat?

Glyphosate is used on a variety of fruit, grain, and vegetable crops, including certain genetically engineered crops and other non-genetically engineered crops. The use of glyphosate on these crops is also evaluated for risks to human health when they are added to the pesticide label. The EPA determined that if the products are used according to the label, these foods are safe to eat.

What about recent reports that glyphosate was found in food/drink?

As it is widely used, trace amounts of glyphosate may be found in various food and beverage products. This type of potential exposure is

Table 2. ACUTE TOXICITY: Life-threatening one-time doses

Substance	Found In	Lethal Dose (LD50)	Toxicity
Water	Water	90,000	Practically non-toxic (>5,000 mg/kg)
Sucrose	Table sugar	29,700	
Ethanol	Beer, wine, spirits	7,060	
Calcium carbonate	Antacids	6,450	
Glyphosate	Herbicide (Roundup®)	4,900	Slightly (500 - 5,000 mg/kg)
Sodium chloride	Table salt	3,000	
Acetaminophen	Tylenol	1,944	
2,4-D	Herbicide	666	
Codeine	Pain killer, cough suppressant	427	Moderately (50 - 500 mg/kg)
Copper sulfate	Organic fungicide	300	
Caffeine	Coffee, tea, soda	192	
Rotenone	Organic insecticide	60	
Vitamin D3	Supplements	42	Highly (1 - 50 mg/kg)
Nicotine	Cigarettes	9	
Hydrogen cyanide	Fruit pits	4	
Botulinum toxin	Botox	<0.001	

*University of Florida Pesticide Information Office, <http://fafdl.org/gmobb/6-of-17-is-glyphosate-an-especially-dangerous-pesticide/> and the NIH TOXNET Database, <https://toxnet.nlm.nih.gov/> compares the toxicity of herbicides and household items. The lower the LD50 value (the dose at which half of lab animals [rats, oral] die), the more toxic the substance.

considered in the EPA's assessment. The conclusion is that these do not pose a risk to human health. The World Health Organization (WHO) agrees with this conclusion. The EPA has determined the acceptable limit for glyphosate on food to be 1 milligram per kilogram of body weight per day. The trace amounts recently found in foods (~0.02 milligrams per serving) are well below the EPA's acceptable limit. For an average person weighing 65 kilograms, you would have to eat 430 pounds of oats *a day*. Keep in mind that other ingredients in foods may be more toxic, like caffeine and table salt.

Does glyphosate cause cancer?

In 2015, the International Agency for Research on Cancer (IARC), a division of the WHO, classified glyphosate as "probably carcinogenic to humans (Group 2A)." After this news, the EPA conducted a re-evaluation of all the available data and stated that glyphosate is "not likely to be carcinogenic to humans at doses relevant for human health risk assessment."

Furthermore, in 2016 the EPA consulted with an independent Scientific Advisory Panel for a review of both its conclusion and the process they used to reach the conclusion. The review by independent scientists and academics supported the EPA's process and conclusion.

Why the difference between IARC and EPA? How are there different answers?

EPA's cancer classification for glyphosate is based on a weight of evidence assessment. The data used by the EPA included studies submitted for registration of glyphosate, as well as those in the open scientific literature. IARC only uses data that have been published, or accepted for publication, in open scientific literature. As a result, the IARC only used a subset of the cancer studies.

It is not unusual in this field of science to use different methodologies and occasionally reach different conclusions. The EPA's assessment is consistent with many other countries and regulatory authorities' current and recent assessments, including Canada, Australia, the European Food Safety Authority, Germany, the Joint FAO/WHO Meeting on Pesticide Residues, European Chemicals Agency, Japan, and New Zealand.

Is there a link between glyphosate and Parkinson's disease or non-Hodgkin's lymphoma?

The EPA's review of the scientific data, including glyphosate data from the Agricultural Health Study, does not support a cause and effect relationship between exposure to glyphosate and Parkinson's disease or non-Hodgkin's lymphoma.

What if the data changes?

Every 15 years the EPA re-evaluates pesticide risks using updated scientific research data. Currently glyphosate is in this process.

In Vermont, the Agency of Agriculture regulates pesticide use, and it does so on the best available scientific data. In its regulation, it considers the risks to Vermonters and our environment. If scientific data indicate an increased risk to either, the Agency will work with its state and federal partners to lessen the risk.

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National Pesticide Information Center: <http://npic.orst.edu/ingred/glyphosate.html>

The European Food Safety Authority: www.efsa.europa.eu/en/topics/topic/glyphosate

Eradication of Japanese Knotweed:

#3 Glyphosate Buyers Guide

You as an individual or group have decided to use glyphosate to eradicate Japanese knotweed. You have decided to use the cut-and-spray method or injection as discussed in document #1. Here we discuss what you need to know when choosing which glyphosate product to purchase. All the necessary information is on the label, and it is the law to follow the label though, as discussed, the facts are not always obvious. The major questions are:

- The concentration of glyphosate
- Does it include a surfactant
- Is it approved for use near water (only important if you plan to spray near water)
- Are the directions for use on the label appropriate for use against Japanese knotweed

The **glyphosate concentration** is listed in the ingredients, most commonly at 41-53.8% so will need dilution in water before spraying. The concentration recommended for successful treatment of Japanese knotweed is 4-8%; we usually use 5% in our work and will focus on that in this discussion. Beware of lower concentration products, and that many Roundup products no longer contain glyphosate. There may still be some lower concentration products available, but most are of little use considering the high concentrations required. Also avoid products in which glyphosate is combined with other herbicides such as diquat; you do not want the quick burn this will provide, nor does it translocate to the roots.

Water for dilution. Glyphosate reacts with calcium and magnesium in hard water. If you have hard water (>120 ppm), you can add ammonium sulfate (spray grade) as it will chelate the calcium and solve this problem. If you only need a couple of gallons of spray, the alternative is to use distilled water.

A **surfactant** is required to reduce the surface tension of the water-based herbicide solution, allowing the droplets to spread out and cover a larger area of the leaf surface, ensuring more uniform coverage and increased potential for the herbicide to be absorbed. Without a surfactant, the herbicide droplets will bead up and roll off. The presence of surfactant may not be listed on the label, and certainly its chemical nature is not listed in the ingredients. Many formulations already contain a surfactant and nothing more maybe said about it on the label. Formulations that require addition of a surfactant will say this elsewhere on the label. These products are discussed below.

The law requires that the **site of application** must be on the product label. All formulations are approved for terrestrial use but whether this includes use "**near water**" requires more explanation. Several formulations are approved for terrestrial and aquatic use, and the latter is discussed in detail on the label, but this is specifically for plants growing in water; hence areas near water are considered a terrestrial site. Usually, the terrestrial formulations do not mention river banks specifically, although contrary to what the law of the label apparently requires, there is no information describing buffer zones or setback distances (except where there might be a potable water inlet). This could suggest there is no limitation. However, those approved for aquatic sites do mention either riverbanks or ditch banks as permissible sites, which implies only these are approved for use near water (with one exception discussed below).

Whether a formulation can be **used near water** (for example, riverbanks) depends on the specific surfactant in the formulation. Unfortunately, its chemical form is not detailed in the “other ingredients” as this is deemed a trade secret. Some surfactants are more toxic to aquatic species so are not approved for use near an aqueous environment. If the formulation already includes a surfactant, it will likely be of the more toxic form and therefore should not be used near water. If you plan on spraying near water, you must purchase a formulation that does not contain a surfactant, and then add an appropriate surfactant that is bought separately. There is no universal definition of “near” in this context; the best definition seems to be “any distance that allows the spray to enter the water is too near.” As glyphosate has no soil runoff, this relates primarily to the possibility of drift so probably 10-20 feet would be a reasonable distance as long as the wind is not blowing. As mentioned above, the product labels do not detail a buffer or setback distance so are not informative in this regard. If spraying on a riverbank, it is always best to walk in the river and spray away from the river.

The product label will often state a distance that must be maintained from a potable water intake from a river or lake, but none appear to address the distance from a well. The Vermont Rule for Pesticides requires a 50-foot margin must be maintained around a private water source such as a spring or well, but 100 or 200 feet from any public water source (Section 5.02(n) and (o)).

It appears that **all formulations can be used for treating Japanese knotweed at 5%** but details are not usually specific to this invasive species. Many labels describe how to dilute glyphosate up to 8 or 10% showing that such concentrations are legal to use, though it is not always clear under what circumstances this would be appropriate. Instead, some labels simply describe use against hard to kill perennials or hardy brush which, though unstated, would include Japanese knotweed. To achieve the suggested 5% for treatment of Japanese knotweed without exceeding the maximum permitted per acre, a low volume directed spray application should be used. This means that spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted (not to run off). Coverage of the top one half of the plant is important for best results. A low volume spray can use 15-25 gallons of diluted spray per acre.

The Vermont Pesticide Rule provides additional guidance for when the label is not specific to a particular circumstance. Section 5.02(j) includes statements that you can spray any target pest not specified on the label, or use any reasonable method as long as neither the pest nor method is not prohibited by the labeling. This Rule means that even though Japanese knotweed or low-volume spray may not be specifically listed on the label, using the product in this manner to spray knotweed is still legal.

Labels often describe knotweed as an annual, but this refers to a different species and not the perennial invasive Japanese knotweeds.

Pesticides in Vermont are classified as class A, B or C. Most glyphosate products approved for use near water are the aquatic formulations and deemed class A; they can only be purchased by a certified applicator (though at least one exception exists). Other glyphosate formulations are classified as class B and anyone can buy them. Unfortunately, Home Depot and Lowes in Vermont no longer sell herbicides that contain glyphosate but other stores still do. A list of dealers is available at <https://www.kellysolutions.com/vt/index.htm>. This list is best sorted by dealers as they are grouped as approved for class A or B (and C). Details of each individual pesticide can also be searched at this website.

The following is a discussion around several glyphosate-containing products to highlight these issues and provide information that may facilitate the choice of an appropriate product for treatment of Japanese knotweed. This is not intended to be a complete list, nor is it intended to recommend specific products.

Formulations that contain surfactant

Many commercial products already contain a surfactant. The labels do not list river or ditch banks as a permissible site so are not approved for use near water presumably because the surfactant (not the glyphosate) is deemed toxic to amphibians and fish. As mentioned above, few of their labels describe conditions specific for treatment of Japanese knotweed though they often describe appropriate conditions in other parts of the label, most likely when discussing treatment of perennials or woody brush.

Farmworks 41% (Ragan and Massey) contains 41% glyphosate with surfactant and is not approved for areas where surface water is present.

The label includes a dilution guide for solutions up to 10% for hand-held sprayers and mentions a limit of 8 quarts/acre/year.

Guidelines are provided for a variety of species, but Japanese knotweed is not specifically described except for stem injections (5 ml/stem). In several places, the label discusses use at 5 to 10 percent solution when using low-volume directed sprays for spot treatment of woody brush or trees.

The label also states “For hard-to-control weeds, use a 5 to 10 percent spray solution. Use the higher specified rates of this product within the specified range for control or partial control of woody brush, trees and hard-to-control perennial herbaceous weeds.”

Finally, section 15.3 of the label says: “When using application methods that result in less than complete coverage, use a 5 percent solution for annual and perennial weeds and a 5 to 10 percent solution for woody brush and trees.” This latter sentence appears to be referring to low-volume spraying as discussed above.

This product is classified as a Class B pesticide in Vermont. It is manufactured by Ragan and Massey and is exclusively available at Tractor Supply Company.

Compare-N-Save 41% is identical to Farmworks 41%, and has the same manufacturer.

This product is classified as a Class B pesticide in Vermont and is exclusively available at Tractor Supply Company. It may have an advantage for people attacking small patches as it is available in a smaller, quart-size volume, providing 2 gallons of 5% spray.

Roundup Pro Concentrate contains 50.2% glyphosate with surfactant and is not approved for areas where surface water is present.

The label provides a dilution guide for solutions up to 8%. It suggests “For control of Japanese knotweed (*Polygonum cuspidatum*), this product may be applied as a 2.0% v/v spray-to-wet solution. Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment.” However, the more effective method for eradicating knotweed is described in Section 7.3: “For low volume directed spray applications, use a 4 to 8 percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody brush and trees.”

This product is classified as a Class B pesticide so should be available, though whether it can be purchased in Vermont is unknown. In 2025, it was available at Lowes in New Hampshire.

Martins Eraser contains 41% glyphosate with surfactant and is not approved for use in aquatic environments. The label provides no discussion of the higher concentrations or use on hard-to-kill perennials or woody brush.

The maximum permitted rate is 2.5 gallons/acre/year which is slightly higher than the 2 gallons (8 qt) described for Farmworks 41%.

This product is classified as a Class B pesticide in Vermont though which stores in Vermont sell it is unknown. It was found in an Agway store in New Hampshire. Do not confuse with Eraser Max that also contains imazapyr.

Roundup Super Concentrate contains 50.2% glyphosate. The label on the bottle is very brief and provides no information pertaining to high concentration or low volume spraying.

This product is classified as a Class B pesticide in Vermont but was discontinued when Monsanto/Bayer stopped selling glyphosate for home and garden use. Some old stock may still exist.

Formulations without surfactant

Roundup Custom (also known as Aquamaster) is listed for aquatic and terrestrial use. It contains 53.8% glyphosate and 46.2% other ingredients, though what these other ingredients are is unknown, but it does not include surfactant as the label says this product requires the addition of a nonionic surfactant. Which surfactant to use will be discussed below.

The label provides information for dilution up to 8%, and there are several references as to when this is appropriate to use (recall we are trying to spray 5% on Japanese knotweed). Specifically, Section 8.0 states: “For control of Japanese knotweed (*Polygonum cuspidatum*), this product may be applied as a 2.0% v/v spray-to-wet solution with 0.5 to 2.0% v/v of a nonionic surfactant containing at least 70 percent active ingredient. Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment.” However, sections 7.3, 12.2 and 12.3 state “When using hand-held equipment for low-volume directed spot treatments, apply a 4- to 8-percent solution of this product.”

Elsewhere the label says: “For low-volume directed spray applications, use a 4- to 8-percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody

brush and trees. Spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted. Or 15-25 gallons/acre.”

The maximum permissible is 8 quarts/acre per year.

Section 8.1 provides additional details on its use in **or around** “all bodies of fresh and brackish water which may be flowing, non-flowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.” This will require an appropriate surfactant approved for an aqueous environment as discussed below.

This product is classified as a Class A pesticide in Vermont because of its approval for use in aquatic environments, so is only available to certified pesticide applicators. Complicating this issue is the fact that most retailers and distributors will not ship or sell this product to Vermont residents even if they are certified. Agricultural stores in Vermont may sell this product to a certified applicator. It can be purchased at Nutrien in Lyndonville and presumably Nutrien in Addison. Presumably, there are other stores across Vermont that do sell this product to certified applicators (see the website described above).

Rodeo also contains 53.8% glyphosate with no surfactant and is approved for use around aquatic sites. An aquatic approved surfactant is required. The instructions for dilution include concentrations up to 10%, and it may be used at 5-10% with a low-volume spray. Also detailed is 5-8% on woody brush but there is no specific mention of Japanese knotweed on the label.

This product is also classified as a Class A pesticide in Vermont so is only available to certified pesticide applicators. As with Roundup Custom, most retailers and distributors will not ship or sell this product to Vermont residents even if they are certified. This may be available at Agricultural stores such as Nutrien.

Farmworks 53.8% also contains 53.8% glyphosate and requires addition of surfactant. While this product appears identical to the two above, it is not approved for aquatic sites. However, ditch banks are listed as a permissible site, and there is no described limitation for use near water. There is a comment that “any single broadcast application made over water must not exceed 7.5 pints per acre.” This would suggest it can be used in an aquatic environment, though as that site is not specifically listed on the label, this should be avoided.

To clarify this issue, the product support department at Ragan and Massey confirmed that “Our 53.8 % Glyphosate products are labeled as a terrestrial application. It can be applied to riverbanks and shorelines not submerged/covered by water.” This is also listed as an allowed site for spraying on the Vermont Agriculture, Farms and Market website: go to <https://www.kellysolutions.com/vt/index.htm>, select Pesticide Registration Search, then Search by Product Name, enter name, then go to Sites to which this Product may be Applied.

The label discusses dilutions up to 8% for handheld sprayers, but these higher concentrations are not described in any labelled rates for specific species. There is also no discussion of application to hard-to-control perennial herbaceous weeds or use with low-volume sprays. However, there is a statement as follows: “For broadcast ground applications, unless otherwise specified use this product at the rate of 3 to 7.5 pints per acre for perennial weeds. Use the

labeled rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified.” Hence, if 7.5 pints is added to 10 gallons, this would give about 5% that could be used on each patch under an acre. Recall also that Section 5.02(j) of the Rule means that using the product to treat Japanese knotweed or using low-volume spray is still legal as nothing on the label precludes it.

This product is classified as a Class B pesticide in Vermont and is exclusively available at Tractor Supply Company. As discussed above, as this can be used along riverbanks, it is possibly the only product for this purpose that can be purchased by someone who is not a certified applicator. It is possible that similar glyphosate formulations exist that can be used along riverbanks but do not require applicator certification to purchase.

Surfactant

As noted above, many formulations already include a surfactant, but none of these are approved for use near water. Certain surfactants have been shown to be far less toxic to aquatic species as well as birds and mammals, but these do not appear to be included in the premixed formulations. Unfortunately, specification of the surfactants in each formulation remains a trade secret.

Surfactants that are not approved for use near water, include Farmworks 80/20 which is available for purchase at Tractor Supply Co. Generally, 0.5 fluid ounce per gallon is sufficient to wet knotweed or any other weeds. Hence, someone could buy both herbicide (Farmworks 53.8%) and surfactant from Tractor Supply and use the mix as long as it is not near water (although Farmworks 41% would fit this situation anyway because it already contains a surfactant). An alternative surfactant is SA50 Southern Ag available online and approved for use with herbicides but not for use near water.

A search for surfactants approved for spraying near water lists Brewer 90-10, Cide-Kick, Alligare 90, Activator 90, and AquaSurf. However, some online retailers say these products cannot be shipped to Vermont. The stated reason for this restriction is that Vermont has implemented strict regulations to protect its environment, particularly its bee and pollinator populations. This rationale is misleading as, like the use of glyphosate, it is already illegal to spray when plants are in flower but can be used at other times. Furthermore, the State of Vermont does not regulate surfactants. If not available online, an appropriate surfactant can be purchased at agriculture stores such as Nutrien.

Eradication of Japanese Knotweed:

#4. Pesticide Regulation, Applicator Certification and Permitting

The goal of these documents is to facilitate widespread involvement in a program to eradicate Japanese knotweed in Vermont. The most effective approach will almost certainly require integrating herbicide use into a control strategy. It is important that communities recognize the legal ramifications as to what they and their concerned residents can legally do with respect to herbicide use. This document explains these issues.

Regulation of Pesticides

- Pesticides are federally classified as either restricted use or general use. Glyphosate-containing products are listed as general use and can be bought and used by the general public. When used according to the label, they are not considered to cause "unreasonable adverse effects" on people or the environment.
- Pesticides in Vermont are classified as either Class A: restricted use; Class B: a general use pesticide that the Secretary classifies as a controlled sale product; Class C a general use pesticide that the Secretary classifies as a homeowner or specialty product.
- In Vermont, glyphosate is classified differently than federal rules; it is listed as either a Class A, B or C pesticide depending on its formulation. The glyphosate formulations that can be used near water (Aquamaster, Roundup Custom and Rodeo) are listed as Class A (restricted use) so can only be purchased by a certified pesticide applicator in Vermont. These formulations do not contain a surfactant and this needs to be added by the applicator. An exception appears to be Farmworks 53.8% which is classified as a Class B pesticide so can be bought by anyone and used near water (see document #3).
- Glyphosate formulations that contain a surfactant, and can be purchased by anyone, cannot be used near water (see document #3).
- Glyphosate is water soluble, commercially purchased in a solution and, those formulations that already contain a surfactant, require only dilution in water before foliar spraying.
- The label on the product is the law and must be followed by the property owner or other applicator at all times. See document #3 for an explanation of what relevant information is on the label.
- A property owner can legally purchase and use glyphosate of Class B or C on land they own without being certified. The limitation requiring that they can only spray their own property is included in the Vermont Rule.
- The "Vermont Rule for Control of Pesticides (the Rule)" is the law as applied in the State of Vermont, in addition to the label.

Certification of Pesticide Applicators

- The Vermont Rule for use of Pesticides states that only a certified pesticide applicator can apply glyphosate on land they do not own (Rule 3.04). Permission of the landowner is also required (Rule 6.08). In other words, a property owner can hire a certified applicator (for remuneration or gratis) to spray their land. A sample permission form is appended to this document.
- Federal rules do not require that applicators be certified to spray general-use pesticides, but certification is required when using restricted-use pesticides.
- In Vermont, the requirement for certifying a pesticide applicator has been expanded to include those who use any pesticide on land they do not own; this includes Class B and C pesticides in addition to restricted-use or Class A pesticides.
- To become a certified applicator in Vermont, an individual must pass a Core test, and a specific category test. Currently, it is recommended to take the Forest pests category as a category specific for terrestrial invasive species has been proposed but no training manual or test has yet been established.
- Details of the different applicator types and resources, including links to purchase training manuals can be found on the Agency of Agriculture Food and Markets website (<https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/pesticide-programs/applicator-types>)
- The written exam can be taken at one of 4 locations in the State.
- The Core training manual to become certified in Vermont focuses predominantly on restricted-use pesticides (Class A) and Hazard classes I or II described as Dangerous – poison, Dangerous, or Warning. Glyphosate and other herbicides effective for the treatment of invasive plants are listed as Hazard Class III which requires only a Caution label.
- Both the Core training manual and the Forest pest category manual provide extensive detail on multiple pests, restricted use pesticides, pesticide formulations and industrial/agricultural scale administration methods that are not relevant for control of terrestrial invasive species.
- Every certified applicator must work for a company whether for remuneration or gratis. Alternately, an independent company can be established by the applicator with him/her as the sole employee for a cost of \$75/annum.

Permit Requirements

- A property owner does not need a permit to spray their own land whether they use a certified applicator or do the work themselves.
- Spraying of town land by a certified applicator also does not need a permit as it is deemed the town is spraying its own land.

- An entity that has a right-of-way over a public or private property would need to obtain a permit to spray if it is necessary to maintain the right-of-way (Rule 6.01). If the spraying is unnecessary for maintenance of the right-of-way then a permit under Rule 6.08 may be required.
- A landowner can always spray their own land or contract a certified applicator even if there is an easement / right-of-way across it, and as such a permit would not be required although the owner of the easement should probably be informed.
- Right-of-way means an interest in real property, above, on, or below the ground, that entitles the holder of the interest to pass over the land for the purpose of carrying, transmitting, or transporting liquids, gases, electricity, communications, vehicles, or people. For the purpose of this rule, it is immaterial whether the right-of-way is owned, leased, or an easement (from the “Vermont Rule”).
- Volunteer groups may need a permit to spray, particularly when combining multiple properties within a project area. This may involve a permit consistent with Rule 6.08. For clarification, it is recommended to contact David Huber at the Vermont Agency of Agriculture, Foods and Markets (David.Huber@Vermont.gov).

PERMISSION TO TREAT INVASIVE SPECIES ON MY PROPERTY IN VERMONT

I, _____, hereby agree to allow the Invasive Species Working Group
[modify group name as appropriate] based in *[add name of town]*, Vermont, to enter my property located at:

for the purpose of controlling non-native invasive plants by methods discussed below. I also support treatment on neighboring properties, if those plants may threaten to invade my property. The primary goal of this Working Group is to control, and hopefully eradicate Japanese knotweed, and any other non-native invasive species (e.g., Asian honeysuckle, barberry) in our town, and encourage similar treatments throughout Vermont. The invasive species to be treated are defined as noxious weeds by the State of Vermont and have serious impact on public and private spaces and structures, our economy, our environment, and our health. They cannot be transported or dumped and must be treated at each individual location.

Japanese Knotweed is extremely difficult to control because 2/3 of its biomass resides underground in the form of rhizomes that can descend 6-8 feet and result in new growth and spread every spring. The most effective strategy for controlling Japanese knotweed is to cut the bamboo-like canes in June/July when they are often more than 6 feet tall. This results in new growth that is then more vulnerable to the application of herbicide in late summer or fall, and the smaller plants will require the administration of less herbicide. Cutting canes will be accomplished by a team of volunteers, while administration of herbicides will use recommended labeled rates and in accordance with all label instructions under the direction of a Vermont-certified commercial applicator. The specific herbicide to be used is glyphosate; if necessary, a formulation will be used that is specifically approved for use near water. Glyphosate is highly effective and one of the least toxic herbicides available; we can provide documentation on its safety upon request. Control will require a similar follow up in year 2 and further monitoring and treatment of any recurrent plants in subsequent years.

I agree to hold harmless from any liability, the Working Group *[modify group name as appropriate]*, its volunteers and certified applicator while they are applying strategies to eradicate these invasive species on my property. I understand that the intention for this weed control is for the benefit of myself and my property, as well as for the entire town and State.

Signed _____ Date _____
Landowner or his/her representative

For further information and questions contact the Invasive Species Working Group at
[add contact information]

Eradication of Japanese knotweed

#5 Community involvement

The enormity of the Japanese knotweed problem in Vermont has not been widely realized; it is rapidly destroying the environment as well as public and private properties. Major invasion has occurred along riverbanks and in some places, it is the sole plant growing along the bank for miles. A couple of examples are the upper Winooski River in Marshfield, and Thatcher Brook through Waterbury. Further down the Winooski River, many small patches of knotweed can be seen, and if untreated, they will rapidly expand to be large patches, and soon the entire riverbank will have a monoculture of knotweed. The Waits River upstream from Bradford is also seriously invaded, but the same thing is happening along many other rivers in Vermont.

Japanese knotweed is also spread during construction projects as evidence along many roadsides. Movement of just one small piece of rhizome in contaminated soil can result in acres of invasion within a few years.

Why haven't efforts been made to eradicate it? A state-sponsored program would be extremely expensive, which leaves every community to solve its own local invasion. A few towns have invested in a community effort, each using a different approach based on their own research and testing. This series of documents was written with the intent of facilitating a major attack on knotweed by using well-established approaches. Individuals and towns no longer need to experiment on how to control knotweed but can act based on what are now proven strategies (document #1).

Ignoring the problem is not an acceptable strategy. If nothing is done, it will keep expanding until there is little native vegetation left, and wildlife habitat and property will have been destroyed. It will take many years to control, but if every town starts now, it could have a major impact in the long term. Vermont could set the standard for what other States may then follow.

The need for community involvement

The first thing to consider is the diversity of land ownership over which knotweed has spread. Property in Vermont is owned by either the state, town, businesses or private individuals, the latter of whom represent the majority of properties in Vermont. A program to eradicate Japanese knotweed would need to involve all of these stake holders either individually, or better by working together. In this regard, volunteer groups can play a major role.

Let's begin with **private landowners**. As mentioned elsewhere in these documents, every landowner can take care of the knotweed on their own property. They could choose a mechanical approach albeit smothering is probably the only mechanical strategy that will eventually eradicate knotweed. If they choose to spray herbicide, they do not need a certified applicator. However, most landowners do not have the knowledge or technology required. Even if these documents were circulated to everyone, many landowners do not have the physical or technical ability to do the work, particularly if the patch is large. How many have a brush whacker, a backpack or handheld sprayer? How much will it cost them to buy the tools and the herbicide? This is a place where volunteer groups could have the greatest impact.

There is an interesting issue along several of the rural rivers in Vermont. There are many large stretches of riverbank that are owned by out of town and out of state individuals. These owners

may not realize how badly their property has been invaded. Other properties may have no resident owner having been abandoned (perhaps in a flood zone), in probate or repossessed by a bank. Volunteers will likely be required to map the invasion on all these properties. Subsequent communication with the landowners will probably be best by the town who has their contact information for the purposes of sending tax bills. As non-residents, will these landowners be willing to attack the knotweed on their property, or can they be encouraged to contribute to the cost of a certified applicator? Alternately, will they give permission for volunteers to work on their property?

What can volunteers do? Volunteers can survey the landscape to determine where the invasions are, they can educate landowners, advise them on the various approaches, help with the work, or even do the work if the owner cannot. They could provide equipment and labor, help dig or smother where planned. If they can raise funds, they could pay a certified applicator. If it is difficult to engage a certified applicator or raise funds, then one volunteer could become certified, and the team could donate the funds, as the only additional cost is buying herbicide which is relatively cheap. A certified applicator can also supervise others to spray, so each volunteer group would only need one individual to be certified.

Our experience as volunteers in Groton has been very informative. We chose to attack 17 contiguous properties (public and private) on the bank of the Wells River that runs through downtown. This site was also selected for the greatest visibility to other town residents. Step 1 was to get permission. This involved meeting with individuals, explaining the problems knotweed was causing, and how we planned to attack it, and then get their signed permission. A couple of individuals were concerned about the use of herbicide but the explanations presented in document #2 were found to be persuasive. Step 2 was submission of a Watershed grant to the State which fortunately was funded. Step 3, volunteers cut the knotweed in late June, and a certified applicator was hired to spray in late August. The following year, there were at least 90% fewer canes, and in some places no canes regrew; canes that did grow, were spot sprayed in the fall. We continue to monitor these areas and our certified volunteer will spot spray if necessary.

An important impact of this project was much greater awareness in Groton of the problem and the solutions. Several other landowners have asked for help, and we have been glad to contribute labor and spraying. This effort was possible because of our state-certified volunteer. We continue to recruit landowners up and down the river. Importantly, all of this has been done at no cost to the landowners. It is not very expensive once you have the necessary equipment. Volunteers are primarily required for cutting, which is only a week or two in summer, depending on the size of the project. Spraying takes very little time with a battery-powered backpack sprayer. This also highlights the importance of having a volunteer who can spray because many patches may be too small to interest a paid applicator. If a volunteer is not certified, then the volunteer group could recruit multiple landowners to increase the interest of a paid applicator.

Another issue for the volunteers was to convince town administrators of the importance of this program. Groton now funds an eradication program on town land along the Wells River, albeit the cutting is still being done by volunteers, but the spraying is paid for.

Volunteers need to be cognizant of the concerns for using glyphosate. It is worth reiterating the issue of obtaining permission from landowners to spray on their property. Some landowners will be reticent about the use of glyphosate because of the misinformation that is widely available. Hence, it is critical that volunteers who meet with landowners are well aware of these concerns and possible explanations. Several of the issues were discussed in document

#2, particularly the concern for cancer, but there are many other concerns that have been heard. We provide an addendum to this document that attempts to provide answers to some of these concerns. However, it is also important to recognize that many people's opinion is deeply ingrained and there will be no benefit in attempting to change their mind. For now, the best resolution is simply to move on to the next landowner. There is still plenty of knotweed out there to be eradicated, so there is little to be gained by trying to convince these reticent folks. Maybe their concerns will soften when they see the success of the eradication program on their neighbor's property or throughout their town, or when the invasion on their property becomes too much to control.

How does a program get started? Does it start with the town or concerned residents? To date, efforts in Groton, Hyde Park and the Mad River Valley have begun with concerned residents, but a statewide program could help establish volunteer teams in every town. The state could circulate information to towns far more easily than to every landowner. The first thing every town will need to do is identify a conscientious individual or group who can lead its program (e.g., town employee or volunteer). Town Conservation Commissions would be an excellent start for those towns that have one, and some are already very active. Alternately, town planning committees could certainly be involved.

Once a town has a dedicated individual or group, then word of mouth can be the most effective communication. Identifying invaded properties and inviting owners to join an eradication program, and then taking care of their property can be seen positively, and others may either volunteer or ask for help. A broader communication in each town could involve local presentations, inclusion in an annual town report, and local newspapers, though the broadest communication throughout the town could be information distributed with annual tax bills.

How many volunteers do you need? This depends very much on which approach to control is selected. Mechanical approaches require large teams of volunteers. The Waitsfield/Warren Conservation Commission has recruited UVM interns as well as weekly community workdays to dig and pull-out knotweed. Hyde Park has used a mechanical approach using a small team of volunteers and high school students. These groups report working on 90 -180 small sites, and both report that mechanical approaches work. The Craftsbury Conservation Commission reports "82 volunteers put in 606 hours digging knotweed in 2024." However, each town emphasizes the need for long term efforts as the patches only slowly decrease in size over multiple years when using mechanical methods.

To quote from Hyde Park's annual report for 2024: "But supply of labor is not endless and there are sites that are not conducive to mechanical control -- either because of their sheer size or their location/circumstance. In those situations, the choice is either to do nothing or to do something else; hence our interest in working with glyphosate which is the herbicide known to be effective against knotweed." They reported very positive results with glyphosate with at least one site apparently clear after one year's spray. Curt Lindberg (Waitsfield) has also been quoted as saying that "mechanical removal is not adequate for larger scale knotweed removal." The VTinvasives.org website also states that "mechanical methods alone will not eradicate established Japanese knotweed patches, and may worsen the infestation."

All the knotweed patches treated in Groton were considered large, with many on the riverbank, obviating the use of mechanical techniques. The cut-and-spray herbicide approach also requires fewer volunteers because it is more effective, obviating the need for repeated cutting after the first year. In 2024, Groton had 3 volunteers who cut a total of 3 acres of knotweed in June /July with a combined effort of 80 work hours. Part of this effort was expended in raking

canes up the riverbank to avoid any washing further downstream. In 2025, one volunteer cut almost 3 acres in about 40 hours; this effort was easier because raking was not required. In both years, a certified applicator then sprayed in early September.

Can you obtain funding? Funding continues to be a problem as there are few grants available for this type of work in Vermont. Hyde Park and Groton both obtained a watershed grant for work in their towns (maximum \$10,000). The Waitsfield/Warren team were successful in obtaining a grant in 2024 from the Lake Champlain Basin for \$100,000. Perhaps the most expensive part of their grant is for restoration of the riparian buffer as this requires purchase and planting of appropriate species. Unfortunately grants of this size are not available for most of the Vermont towns.

The lack of available funding reiterates the need for effective volunteer groups, and the cheapest possible approach to eradicating knotweed. This returns to the focus on herbicide spraying which can be done for little, if anything, by landowners and volunteers, particularly if a volunteer becomes a certified applicator. However, volunteers may still have to bear these minimal costs.

Businesses are another stake holder and here is a case where they might be encouraged to volunteer or even sponsor the work, particularly if it is on or near their property. One of the properties in Groton was a restaurant, and after volunteering to cut and spray his property, the owner gratefully joined our volunteer group that year. Participation in the eradication program could be seen as good community involvement and even publicity for the company. One example could be Ben and Jerry's in Waterbury as their visitor center is across the road from Thatcher Brook that has extensive invasion by Japanese knotweed. A further benefit of engagement by any business would be setting a public example that could encourage further participation by other businesses. Unfortunately, businesses may avoid getting involved because of public fear of pesticides based on misinformation discussed in document #2 and the addendum to this document.

State highways. Volunteers could also help the State take care of its highways. But this should be an alternate strategy only if the State fails to take care of knotweed growing along the highways. Unfortunately, the current strategy of mowing once or twice a year only exacerbates the problem rather than solving it. Digging or smothering are unlikely to be practical along most rights-of-way given the size of patches and the many years of work needed, so herbicide spraying will be the most likely method. The State usually mows the roadsides around midsummer which would be appropriate for the first step in a cut-and-spray strategy and therefore incur no additional cost to the State. It should be left for a couple of months to regrow, and then sprayed with herbicide around the end of August. The State already sprays in some places to maintain the right-of-way, but not to eradicate invasive species so presumably already contract the work to a certified applicator. This should be a standard part of maintaining the right-of-way. As a last resort, it may require volunteers to take on this work by obtaining permission from the owner over whose land the easement occurs as discussed in document #3.

Towns also need to address the problem of knotweed along their highways and back roads. They may need to contract the work to a certified applicator: the current charge is about \$1,000/acre for foliar spraying. In the case of town rights-of-way, the involvement of volunteers may be more appropriate and could make this far cheaper or free if volunteers are willing to bear the costs as discussed above.

The State and towns also need to eradicate knotweed in their forests and parks, but similar approaches would apply as discussed above.

How else can the State help?

Before a broad communication program is initiated, specific details need to be publicly available so towns and individuals have access to comprehensive information on the problem and solutions. A statewide program will not work if every town or individual needs to do their own research as to how to eradicate knotweed, particularly as there is far too much misinformation on the internet. The current series of documents present important details that could catalyze rapid activation of a program in every town. The best place for publication would be a state-sponsored website (e.g. "Vermont Invasives"), or a link from that website, which would give credit to the importance of this effort.

The bigger problem is communicating with other towns across the State who have not yet initiated a program of eradication. Are towns aware of the problem? If it is not on town land, it is easier for towns to ignore it. It may be growing along the rights-of-way on town roads, so the town needs to recognize it and know how to control it. If it is along a river in their town, even on private land, they should be taking notice. Statewide communications could be enhanced by stories in newspapers or on TV (e.g. Charlie Nardoizzi – the garden guy).

Tactical Basin Plans are revised every 5 years and are concerned with water quality across rivers and lakes in 15 different river basins in Vermont. These plans have ignored invasive species in the past, but it is evident that Japanese knotweed is having a huge impact on the rivers through its invasion of the riverbanks. These basin plans need to address the knotweed invasion. It is interesting that the application information for Watershed grants says "Vermont's Tactical Basin Planning can help identify project areas or types that are more likely to be funded." Fortunately, the Watershed grant review committee was more accepting of the fact that knotweed was not addressed in the Tactical Basin Plans.

Towns plans are required to be revised every 5 years. There should be a state mandate that these plans address the extent of invasion within each town, and discuss any ongoing approaches to control it. This would be an excellent means to ensure each town is fully aware of the problem it faces.

Addendum to document #5: Other frequently heard concerns for glyphosate

Volunteers seeking permission to use glyphosate on another person's land will need to understand the potential concerns that may be raised so that they can discuss it with any reticent landowner. If it is obvious the landowner is uninterested in such a discussion, then it is best to move on; arguments have no value. The following are some concerns that have been raised, together with the misinformation regarding cancer causation discussed in document #2.

Glyphosate is a non-specific weed killer

This is correct. However, in most cases, particularly large patches, the knotweed has become a monoculture, shading out and killing every other plant. Hence, there is nothing but knotweed to kill. Once the knotweed has been treated, there is no residual activity in the soil so native species can quickly repopulate the site.

Glyphosate is found in food

The presence in food results from spraying a food crop but only a low level has been found in food or human urine, and this is far below the levels shown in experiments to have any adverse health risks. Hence, scientists have concluded that, even when sprayed on crops, the residue is at too low a concentration to have any health risk. Admittedly, many people believe that any residue in food is too much and some recent studies have identified concerns at such low levels. Importantly, knotweed is not a food crop and spraying it will have no impact on food. Nor is the spraying on knotweed repeated annually for many years as it is in an agricultural setting.

Glyphosate is toxic to animals, pets

Pesticides by definition are poisons, but that is a misleading description as every poison has a different potency, usually described by the dose that can kill 50% of a population (LD50; based on tests in experimental animals). Pesticides are according to federal rules divided into various categories, each with a descriptive term: Danger (oral LD50 less than 50 mg/kg), Warning (oral LD50 50-500 mg/kg) or Caution (oral LD50 500-5000 mg/kg). Dermal exposure is generally 4-fold higher. Keep in mind that the lower number means the pesticide is more toxic as less is needed to be toxic.

To put these values in perspective, it is best to compare to other common products that we are exposed to. The LD50 for nicotine is 10 mg/kg, caffeine is 190 mg/kg, salt is 3,000 mg/kg, while glyphosate is 5,600 mg/kg, which puts it in the category of practically non-toxic. Many medicines you may take are far more toxic than the chemicals described here. In other words, a 90 kg human (200 pounds) would have to drink more than a gallon of 41% glyphosate to reach the LD50 level.

These values are for acute toxicity (one time exposure). While the accumulative effect of long-term chronic exposure is more toxic, it is interesting that carcinogenesis studies fed glyphosate to rats daily for up to 2 years, a lifetime exposure for rats. There was no difference in survival between the treated and untreated control rats. This demonstrates no lethality due to glyphosate after very long exposure. Importantly, the administration of glyphosate to knotweed is only a single treatment in year 1, that may be repeated in year 2, but it is not a chronic treatment.

With this information in hand, it is not surprising that there is no evidence glyphosate is toxic to animals.

Glyphosate is toxic to fish and amphibians

Glyphosate is not toxic to fish or amphibians. This concern relates to formulations that contain a surfactant that elicits the toxicity but are not approved for use near water. Importantly alternate formulations have been developed containing much safer surfactants and are approved for use near or even on water because no toxicity has been observed.

Concern for runoff into rivers and lakes

Glyphosate binds rapidly to soil particles and can only run off if there is erosion, and even then, it is in an inactive form. It only persists in soil in this particulate form for a few months while being degraded by soil microbes.

Glyphosate destroys the soil microbiome

Millions of gallons of glyphosate have been applied to millions of acres for over 40 years in agriculture with no known problems. In agriculture, much of the spray is to open ground to prevent small weeds before they grow. In contrast, using glyphosate against knotweed is, for the most part, just a one-time spray in the first year with a spot spray in subsequent years, and even then, most spray stays on the leaves when doing a low-volume spray, and not much enters the soil. There is no evidence that this is detrimental to the soil microbiome.

Glyphosate is toxic to pollinators

In recent years, there has been increasing concern for the potential of toxicity to insect pollinators. While glyphosate is not an insecticide, it may still have detrimental impact. What is rarely considered is that Japanese knotweed itself is a significant threat to pollinators. Japanese knotweed outcompetes and displaces native plants as it spreads and produces large monocultures. This results in depletion of the insects preferred food sources. Furthermore, knotweed only flowers for a couple of weeks in late summer, whereas pollinators require sustenance throughout spring, summer and fall. Following eradication of knotweed, native plant species will regrow or can be planted and thereby provide for pollinators in the very place knotweed once stood.

With respect to spraying, the most effective time to spray is when the plant would be in flower, but this is circumvented in the cut and spray method as the plants are unlikely to be flowering at the time of spraying. In addition, it is illegal to spray any plants that are in flower. Also, using injection methods means that no insects are exposed to glyphosate. In summary, appropriate use of glyphosate is not detrimental to pollinators, while Japanese knotweed is.

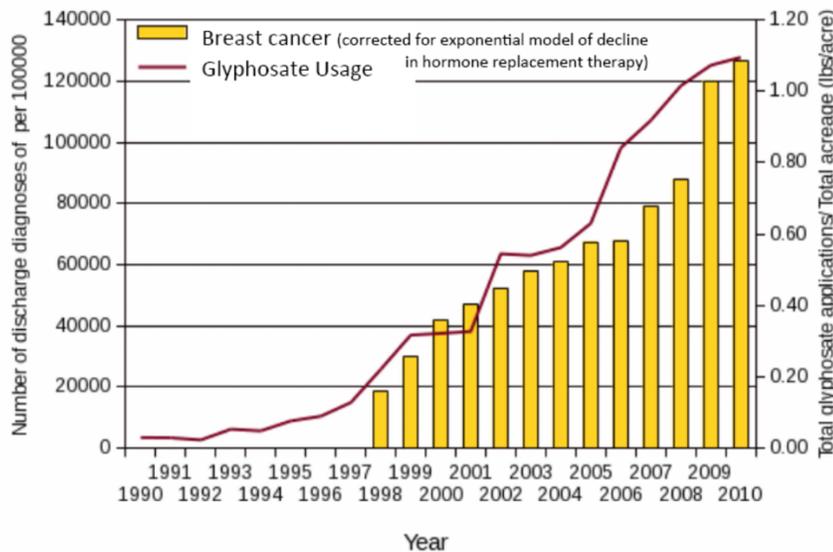
The case for “Toxic Legacy” by Stephanie Seneff”

Toxic Legacy is a book published by Stephanie Seneff based on a series of papers she has published highlighting the impact of glyphosate on human health. A review of this book states: “Agrochemical companies claim that glyphosate is safe for humans, animals, and the environment. But emerging scientific research on glyphosate’s deadly disruption of the gut microbiome, its crippling effect on protein synthesis, and its impact on the body’s ability to use and transport sulfur—not to mention several landmark legal cases—tells a very different story.” In Toxic Legacy, senior research scientist Stephanie Seneff, PhD, delivers compelling evidence based on countless published, peer-reviewed studies—all in frank, illuminating, and always accessible language.”

Unfortunately, the book is full of numerous claims that ignore the experimental data. These have been explained in a rebuttal by Mesnage and Antoniou who concluded “We found that these authors inappropriately employ a deductive reasoning approach based on syllogism. We found

that their conclusions are not supported by the available scientific evidence. Their commentaries are at best unsubstantiated theories, speculations, or simply incorrect.” Syllogism is a form of reasoning where two premises lead to a conclusion, but can easily lead to faulty conclusions. Mesnage offers the following example. A logical syllogism is: “man is mortal, Socrates is mortal, hence Socrates is a man.” However, a faulty syllogism easily arises from this logical approach because “a cat is mortal, Socrates is mortal, hence Socrates is a cat.”

One example of a fallacy in Seneff’s work is the correlation between breast cancer increase and glyphosate use. Breast cancer increased from 1997 to 2010; glyphosate use increased from 1997 to 2010. But the conclusion that glyphosate causes breast cancer does not follow from these two premises because cancer is well known to require a lag time between exposure and disease, 20 years in the case of smoking and lung cancer. Hence, concurrent lines as shown in the figure are actually evidence that some other exposure some years before any exposure to glyphosate might be involved, though what that exposure might be is not known.



From Samsel A and Seneff S. Glyphosate, pathways to modern diseases IV: cancer and related pathologies. *Journal of Biological Physics and Chemistry* 15; 121-159, 2015

Unfortunately, Seneff’s book also does not deal with risk, which considers dose and extent of exposure. How much do you have to consume before it impacts your gut microbiome, impacts protein synthesis or sulfur transport? These are important questions that are ignored. As is the question as to why cancer incidence has not increased (see document #2). Also, focusing on one litigation case omits the fact that most litigation cases against Bayer have failed because they could not establish a causal relationship between Roundup and the disease in the plaintiff (see Document #2).

Mesnage R, and Antoniou MN. Facts and Fallacies in the Debate on Glyphosate Toxicity. *Frontiers in Public Health* 5:316, 2017