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INVASIVE SPECIES TECHNICAL NOTE

ECOLOGY AND MANAGEMENT OF INVASIVE KNOTWEEDS (*POLYGONUM* SPP.)

Hilary Parkinson, Research Associate, Montana State University, Bozeman, Montana
Monica Pokorny, Plant Materials Specialist, NRCS, Bozeman, Montana
Jane Mangold, Extension Invasive Plant Specialist, Montana State University, Bozeman, Montana
Joseph Scianna, Manager, NRCS Bridger Plant Materials Center, Bridger, Montana

The invasive knotweeds (*Polygonum* spp.) are perennial, rhizomatous plants in the buckwheat family, Polygonaceae. They resemble bamboo with their hollow stems and rapid, aggressive growth habits. There are four species known to occur in Montana: Japanese knotweed (*Polygonum cuspidatum*[1]), giant knotweed (*P. sachalinense*), Bohemian knotweed (*P.* × *bohemicum*) which is a hybrid between giant and Japanese knotweeds, and Himalayan knotweed (*P. polystachyum*). They were introduced to the United States in the late 1800s from Asia, predominantly as ornamentals and for erosion control. The knotweeds have escaped cultivation and are found spreading in Montana as single plants or small populations. Members of the knotweed complex can outcompete existing vegetation to form dense monotypic stands, and they are extremely difficult to control (Figure 1). The most common method of spread is rhizome fragments dispersed along waterways or in transported soil. Control options include repeated cutting or hand pulling and foliar applications or stem injections of herbicides.

Figure 1. Knotweed infestations form dense stands that can reach five to nineteen feet in height.
(Photo by: Tom Heutte, USDA Forest Service, Bugwood.org, used under CC BY-NC 3.0 US)

Montana designated the knotweed complex as priority 1B noxious weeds. Such weeds have limited presence in Montana and management criteria focus on education, eradication, or containment. Of the species in the complex, Japanese and giant knotweed are the most widely

[1] Nomenclature follows USDA PLANTS Database, accessed March 2017. Synonym scientific names are *Fallopia japonica* (Japanese knotweed), *Fallopia sachalinensis* (giant knotweed), and *Fallopia* ×*bohemica* (Bohemian knotweed).

reported in western North America, although their distribution in Montana is still limited. Bohemian knotweed has been reported three times in Montana. However, recent genetic research indicates Bohemian knotweed may be more widespread in Montana than previously thought, and may be misidentified as Japanese knotweed. In addition, Himalayan knotweed, which is not included in the knotweed complex on the Montana noxious weed list, was reported in Sanders County, Montana, in 1985.

IDENTIFICATION AND ECOLOGY

The knotweed complex consists of herbaceous perennial plants with an upright, shrub-like habit. Plants in the knotweed complex have two characteristics to distinguish them from most other related native or non-native plants in Montana: (1) alternate leaves arising from hollow, bamboo-like stems that grow in clumps; and (2) the obvious nodes (which are not hollow) have a papery or membranous sheath (Figure 2). Specific physical differences among the four species are summarized in Table 1. If you need help identifying a plant that you believe is in the knotweed complex, contact your local Natural Resources Conservation Service (NRCS) office, Extension agent, or weed coordinator, or send a sample to Montana State University, Schutter Diagnostic Laboratory, 121 Plant BioScience Building, Bozeman, MT 59717-3150.

Figure 2. The knotweeds have hollow stems that resemble bamboo.
(Photo by Robert Vidéki, Doronicum Kft., Bugwood.org, used under CC BY-NC 3.0 US)

Roots

The knotweed complex are perennial plants with a rhizomatous root system; plants can also spread by stolons, which are above ground runners (Figure 3). All four knotweed species found in Montana reproduce primarily by rhizome fragments.

Figure 3. Knotweeds spread through rhizomes, root fragments, stolons, and stem fragments that can root and form new plants. (Photo by Ohio State Weed Lab, The Ohio State University, Bugwood.org, used under CC BY-NC 3.0)

Stems and Leaves

Knotweeds vary in height from about five feet (1.5 meters) to more than 19 feet (5.8 meters). Giant knotweed is the largest and can grow up to 20 feet (6 meters) tall. Japanese knotweed tends to be the shortest ranging from five to eight feet (1.5 to 2.5 meters), but it can overlap in height with Himalayan knotweed and Bohemian knotweed on moist sites. More typically, Japanese knotweed attains a mature stature of three to six feet (1 to 3 meters) in Montana.

A distinguishing feature is the membranous sheath surrounding the joint at the base of each stem node. The hollow stems are smooth, stout, and swollen where each leaf is attached. Stems have a characteristic reddish-brown color that is obvious after leaf drop in the fall. Leaves are arranged alternately on the stem and are attached to the stem by a long petiole (Figure 4).

Figure 4. Leaves are arranged alternatively and have a long petiole attaching them to the stem. (Photo by Jack Ranney, University of Tennessee, Bugwood.org, used under CC BY-NC 3.0 US)

Leaf shape and the surface of veins on the underside of the leaves are vegetative characteristics that can be used to distinguish among knotweed species. The Himalayan knotweed leaf is narrow; its width is less than half of its length. Japanese leaf shape is ovate to somewhat triangular with a pointed tip. Japanese and Bohemian knotweed have leaf widths more than two-thirds of their length. The leaf base of giant knotweed is deeply heart shaped, compared to the base of Japanese knotweed which is flat (forms a right angle with the leaf stem) (Figure 5).

Figure 5. Giant (left), Bohemian (center) and Japanese (right) knotweed leaves.
(Photo by Barbara Tokarska-Guzik, University of Silesia, Bugwood.org, used under CC BY 3.0 US)

The leaf shape of Bohemian knotweed is variable and may resemble either parent (giant and Japanese knotweed). Bohemian knotweed has small stout hairs on the main leaf vein on the underside of the leaf in contrast to the multi-cellular hairs found on giant knotweed veins and the rough ridges (but absence of hairs) on Japanese knotweed veins. Use a magnifying glass to see these differences. Bohemian knotweed is frequently misidentified as Japanese knotweed.

Flowers

Flowers appear in late summer. Flowers are greenish-white to creamy-white, except for Himalayan knotweed which has pinkish-white to pink flowers. Flowers emerge from where leaves meet the stem and have five petals (technically tepals), rarely four, all of which are upright (Figure 6).

Figure 6. Flowers of Japanese (left) and giant knotweeds (right). Notice the large leaf size in giant knotweed. (Photo on left by Milan Zubrik, Forest Research Institute - Slovakia, Bugwood.org, used under CC BY-NC 3.0 US. Photo on right by Jan Samanek, Phytosanitary Administration, Bugwood.org, used under CC BY 3.0 US)

Himalayan, giant, and Bohemian knotweeds bear perfect flowers (with male and female parts in the same flower). Japanese and Bohemian are gynodioecious, meaning some individuals bear only female flowers while other have perfect flowers.

Seeds

Fruit set has not been observed on plants at some Montana sites, presumably because typically only one sex is present, or because conditions are unfavorable for fruit set and/or maturation. Fruits, when present, are $^1/_8$ inch, brown, shiny, triangular achenes.

Himalayan, Bohemian, and giant knotweed plants may occasionally produce seed, while seed production in Japanese knotweed is rare. This is due to differences in flower types (perfect, female only, etc.). In Japanese knotweed's escaped range, only the female form is typically present, meaning no seeds are produced due to lack of pollen. Occasionally a mixed-sex population of Japanese knotweed occurs which may produce seed. Bohemian knotweed tends to have a larger quantity of perfect flowers than female flowers, and recent genetic research confirmed its spread by seed is common. If a giant knotweed plant occurs in the vicinity of a female Japanese or Bohemian knotweed patch, it can provide pollen, allowing seed production. Additionally, fertile pollen from a perfect Bohemian knotweed flower may backcross to fertilize a female Japanese knotweed flower.

Table 1. Characteristics of species in the knotweed complex in Montana. (Adapted from Wilson 2007).

Characteristics	Japanese Knotweed	Giant Knotweed	Bohemian Knotweed	Himalayan Knotweed
Stems	5 to 8 ft (1.5-2.5m) multiple branches	10 to 20 ft (3-6m) few or no branches	6 to 17 ft (2-5m) few to several branches	6 to 10 ft (2-3m) upper half branched
Leaf Size	1 to 4 in long (3-10cm) ⅔ as wide	8 to 16 in long (20- 40cm) ⅔ as wide	2 to 12 in long (5-30cm) ⅔ as wide	up to 8 in long (20cm), < ½ as wide
Leaf Shape	Ovate, base straight, not curved, tip abruptly pointed, thick and leathery	Ovate, deeply indented at the base, tip pointed, thin and flexible	Ovate, base varies in shape from straight to curved, tip gradually to sharply tapered	Broadly lance
Leaf Hairs	No stiff hairs on leaf margin, veins on leaf underside have rough, ridged appearance	Tiny, stiff hairs on leaf margin; long hairs on veins on leaf underside	Few or no hairs on leaf margins, short, stout hairs on veins on leaf underside	Many stiff hairs on the leaf margin and on veins on leaf underside
Sex and Seed	Female or perfect (rare), rarely produces seed	Perfect and fertile, usually produces seed	Either female or perfect, produces seed	Perfect and fertile, usually produces seed
Flower Color & Arrangement	Greenish-white to creamy-white in a loose, drooping arrangement	Greenish-white to creamy-white in a compact, drooping arrangement	Greenish-white to creamy-white in an erect or loose, drooping arrangement	Pinkish-white to pink in a loose, spreading arrangement

Life History / Reproduction

Knotweed plants are herbaceous perennials that produce new shoots from rhizomes and crowns. New shoots emerge from mid-spring to late summer. Sprouts are fleshy, pointed at the tip, and slender, resembling asparagus shoots. New shoots may not be hollow until they mature.

Following emergence, growth is rapid: Japanese knotweed can grow two to four inches (5 to 10.2 centimeters) per day in the spring. Flowering occurs in late summer, from August to September, with fruit set beginning in September. Knotweed stems and leaves are not frost tolerant, and at the onset of cold temperatures, above ground growth dies; although, dead canes often remain upright and fruits sometimes remain on the stem throughout winter.

When seed is produced, it typically forms two to three weeks after flowering. Seed germination increases the longer the seed is on the stem. A study in Pennsylvania found Japanese knotweed seed collected in early September had germination rates below ten percent, while seed collected four weeks later had germination rates as high as 90 percent.

Spread

Knotweed is propagated by seeds and vegetative plant parts (rhizomes, rootstocks, runners, and stems). Based on the relatively slow spread of this species in Montana, dispersion by seeds from ornamental plantings appears limited. Research on knotweed genetic variation confirmed giant and Japanese knotweeds spreads through vegetative reproduction while Bohemian knotweed spreads vegetatively and by seed.

The invasiveness of knotweed is primarily due to vigorous rhizomes. Rhizome fragments are spread when soil from a knotweed patch is excavated and moved off site, or when rhizomes from plants growing along a riverbank break off and float downstream (Figure 7). Rhizome fragments as small as 0.02 pounds (7 grams) can regenerate, provided a node is present. They can also regenerate when buried up to depths of three feet (0.9 meters), and they have been observed to emerge through two inches (5 centimeters) of concrete. The hybrid Bohemian knotweed has been reported to have better regeneration ability than both parents. Stem fragments can also serve as a mode of spread. If a cut stem lands on moist soil or grass, root and shoots may emerge and develop into a new plant.

Figure 7. After escaping cultivation, knotweed infestations commonly spread along roads and waterways. (Photo on left by Randy Westbrooks, Invasive Plant Control, Inc., Bugwood.org. Photo on right by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org. Used under CC BY 3.0 US)

Once a propagule has landed in a suitable habitat, whether as a rhizome fragment, stem section, or seed (least common), it can grow rapidly. Underground rhizomes can grow 50 to 65 feet (15.2 to 19.8 meters) laterally and produce new shoots, thus plants can establish firmly and expand locally (Figure 8).

Figure 8. Knotweeds were introduced as ornamental plants and have escaped cultivation.
(Photo by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org, used under CC BY 3.0 US)

Habitat

Japanese knotweed is native to Japan, China, Korea, and Taiwan. It is considered an early successional species and is commonly the first plant to colonize volcanic slopes. Giant knotweed is native to northern Japan. It is similar to Japanese knotweed in its ability to colonize disturbed areas. Himalayan knotweed is native to the Himalayan region of southern Asia. In its native range, it proliferates with disturbance, spreading in avalanche prone areas, along tree lines, and on eroded slopes. Bohemian knotweed was first described in eastern Europe. It is not clear whether Bohemian knotweed in the Americas came vegetatively from European sources or developed from crosses between giant and Japanese knotweeds on American soils.

In Europe and the United States, plants in the knotweed complex are often found in yards and managed landscapes where they were intentionally planted. Escaped plants are most commonly found in moist areas such as along riverbanks, canals, wetlands, and lakeshores. However, they can tolerate a range of moisture conditions and occur frequently in disturbed areas like utility pathways, waste places, mining areas, and along roadways.

Japanese knotweed and giant knotweed are unlikely to invade forests or areas with a closed canopy because they are considered shade intolerant. However, Japanese knotweed has been documented growing in open forest canopies of black poplar (*Populus nigra*), red alder (*Alnus rubra*), and Douglas fir (*Pseudotsuga menziesii*). Open forest canopies in Montana may be vulnerable to invasion. Himalayan and Bohemian knotweed tolerance to shading is unknown but it is likely similar to that of Japanese and giant knotweeds. Knotweeds are rarely limited by soil types or nutrient levels; research on Japanese knotweed found nutrient-poor sites do not prevent its establishment or survival, but only reduce its growth rate compared to nutrient-rich sites. Japanese knotweed can grow in soils with pH ranging from 4.5 to 7.4. Information is limited on the pH ranges for the other species.

ECONOMIC IMPACTS

Knotweed can form extensive, monotypic stands, especially in moist areas. The dense stands can exclude native vegetation. It can line the banks of creeks and rivers, forming nearly impenetrable walls. These dense stands are associated with changes in water quality and food chains, and they may impact fisheries and wildlife habitat. It can survive prolonged flooding and can rapidly colonize scoured sites along riparian areas. After crowding out native vegetation, knotweed leaves banks vulnerable to erosion when it dies back in winter.

Damages to infrastructure by knotweed rhizomes and stems are well documented. Plants can push through concrete, displacing foundations, walls, pavements, and drainage works. Growth of Japanese knotweed along roadways reduces sight distances, blocks road signs, and damages pavement.

Differences among species in the knotweed complex regarding their ability to impact ecosystems and infrastructure are not well documented. Most of the research recording the impacts of plants in the knotweed complex has focused on Japanese knotweed, though many were likely Bohemian knotweed misidentified as Japanese knotweed. Reports suggest Bohemian knotweed may be more competitive than Japanese or giant knotweed and may spread at a faster rate.

MANAGEMENT ALTERNATIVES

Knotweed control efforts will typically require a combination of treatments over multiple years. Most research on control methods has focused on Japanese knotweed. Until more research is completed, management alternatives for the other three species are based on ecommendations for Japanese knotweed control, except where noted. The area within a 60 foot (18 meters) radius of the original patch should be monitored regularly for several years following treatment, even after the patch appears to be eradicated.

Herbicide Control[2]

Chemical control is by application of herbicide to cut stems or foliage and by stem injection. Treated plants may require multiple applications over time. The cut stem treatment is particularly useful when knotweed is growing among desirable, non-target species. Foliar application to plants is through broadcast spraying. Stem injection is one of the more commonly recommended methods of herbicide application for knotweeds, and like cut stem treatment, is more selective than foliar applications. This involves using a hand-operated injection device designed to deliver repeated, pre-measured doses. Prior to injection, make a hole using an awl or other pointed tool. Check www.greenbook.net for updates to herbicides labels.

Glyphosate, imazapyr, and aminopyralid + triclopyr are the active ingredients of herbicides labeled for control of knotweeds (Table 2). For individual plants or large solid stands of knotweed, broadcast apply glyphosate (Roundup®, Accord®, AquaMaster®, Rodeo®, AquaPro®, AquaNeat®) at a 4 to 8 percent solution until the foliage is thoroughly wet but not dripping (Table 2). Broadcast apply aminopyralid + triclopyr (Capstone®) at 8 to 9 pints per acre (9 to 10.5 liters per hectare) or imazapyr (Arsenal®, Habitat®) at 3 to 4 pints per acre (3.5 to 4.5 liters per hectare) to actively growing foliage. Follow herbicide labels for surfactant and adjuvant

[2] Any mention of products in this publication does not constitute a recommendation by the NRCS. It is a violation of Federal law to use herbicides in a manner inconsistent with their labeling.

recommendations. In some cases, it may be necessary to precede foliar sprays with cut stem applications for effective control. In all cases, monitor infestation sites for several years and control sprouts and volunteers as necessary.

For cut stem application method, remove stems approximately 2 to 4 inches (5 to 10 centimeters) above ground. Within five minutes spray or paint newly cut surfaces with a 50 to 100 percent glyphosate solution, undiluted aminopyralid + triclopyr, a 2:1 imazapyr:water concentrate solution, or a dilute imazapyr solution (8 to 12 ounces of Arsenal® or Habitat® per gallon water (60 to 90 grams herbicide per liter water; Table 2). Use an approved formulation of glyphosate (e.g. Rodeo®, Aquaneat®, Aquamaster®) and imazapyr (e.g. Habitat®) in riparian and wetland areas. Always follow label instructions.

When using the stem injection method, all stems within a stand must be treated. Inject 0.03 ounces (1 milliliter) of either undiluted aminopyralid + triclopyr, dilute imazapyr (8 to 12 ounces per gallon water; 60 to 90 grams herbicide per liter water), or imazapyr concentrate (2:1 herbicide:water). Knotweeds are small diameter shrubs and should only need one injection of imazapyr or aminopyralid + triclopyr per stem. If a stem is over three inches in diameter, then make two injections opposite each other on the stem. When using glyphosate, inject 0.17 ounce (5 milliliter) undiluted product per stem into the hollow portion of the stem between the second and third internode or approximately six inches (15.2 centimeters) above the ground (Table 2).

While many herbicide labels do not recommend a specific application time, reports suggest glyphosate products are most effective from July to September or prior to leaves discoloring and falling off. Aminopyralid + triclopyr (Capstone®) has had optimum results when application are made to 3 to 4 feet (1 to 1.5 meters) tall plants in the early summer. Fall application may be most effective because plants will translocate more herbicides to rhizomes rather than above-ground growth.

Table 2. Examples of herbicides for management of the knotweed complex. Consult herbicide labels for rate, application, restriction, and safety information as well as recommendations for adjuvants or surfactants.

INGREDIENT **TRADE NAME(S)**	**MODE OF ACTION**	**DIRECTIONS**	**KNOTWEEDS LISTED ON THE LABEL**
Glyphosate[1] Roundup	Inhibition of EPSP synthase	Broadcast at a 4 – 8 percent solution; Apply 50 to 100 percent solution to cut stems; Inject 0.17 oz (5 mL) undiluted into the hollow stem between the second and third node	Japanese, Bohemian, Giant, and Himalayan
Glyphosate Accord, AquaMaster			Japanese, Bohemian, and Giant
Glyphosate Rodeo, AquaPro			Japanese and Giant
Glyphosate AquaNeat			Japanese and Himalayan
Aminopyralid + *triclopyr* Capstone	Auxiliary growth regulator	Broadcast 8 – 9 pints/acre (9 -10.5 l/ha); Apply undiluted to cut stems; Inject 0.03 ounces (1 mL) undiluted	Japanese, Bohemian, Giant, and Himalayan
Imazapyr Arsenal, Habitat	Inhibition of acetolactate synthase	Broadcast 3-4 pints/acre (3.5 – 4.5 l/ha) to actively growing foliage; Apply dilute (8 – 12 oz/gal) or concentrate (2:1 Arsenal:water) solutions to cut stems; Inject 0.03 ounces (1 mL) diluted or concentrate	Japanese

[1]There are many trade names for glyphosate. Make sure the trade name is labeled for the knotweed species, adjust rates as specified, and always follow label instructions.

Tillage

Tilling alone is not recommended as it can increase new sprouts by breaking up rhizomes into fragments. However, it may be used in combination with other treatments, like mowing re-sprouts or to promote leaf production prior to herbicide application.

Hand Pulling, Digging, Mowing, Cutting, and Covering

Hand pulling or digging is effective if done consistently on new, small patches and when plants are young and the soil is moist. Knotweed that is cut, pulled, or mowed can easily regenerate. Treat the patch twice monthly to remove new sprouts as they emerge. When digging plants, remove, bag, and properly dispose of all vegetative parts including trimmed stems. Alternatively, place stems and all excavated material on a dry surface such as a tarp or concrete until dried out and the risk of regeneration is gone, or burn the material.

Stem cutting is effective if cutting is done three times per year for many years to significantly reduce rhizome reserves. There is some risk that cutting will exacerbate lateral rhizome expansion. For greatest effect, the last cutting should occur before plants begin to lose their leaves with the onset of winter. Where possible, mowing is also effective if repeated for several years. Mower height should be as close to the ground as possible, and mowing should be repeated when plants reach a height of six inches (15 centimeters). Mowing should continue throughout the growing season until a killing frost occurs.

Covering knotweed plants with heavy black plastic or cardboard for more than one year may suppress the plant. This is recommended for very small infestations. Rhizomes may remain dormant for up to 20 years, so the lack of regrowth in years following removal of the covering does not mean the plant is dead, and regular monitoring is required.

Biological Control and Grazing

Grazing has been observed to reduce the establishment and growth of Japanese knotweed where grazing pressure is high. Young shoots are palatable to sheep, goats, cattle, and horses. Grazing will not kill the plants, but repeated grazing can weaken them.

Currently, no insect biological control is approved but there are some promising candidates. These include a leaf chewing beetle (*Gallerucida bifasciata*), a rust pathogen (*Puccinia polygoni-amphibii* var. *tovariae*), a plant-feeding insect (*Aphalara itador*) and a leaf-spot fungus (*Mycosphaerella* species). More research on host range and specificity is needed before any can be approved for release.

Revegetation

Revegetation alone is unlikely to be an effective control method. Other measures should be taken to first control knotweed (e.g. combination of digging/grubbing, mowing, and herbicides). Once a patch appears to be eradicated, revegetation is strongly recommended to suppress reinvasion. In natural areas, the following native species are recommended for revegetation: shrubs such as willow (*Salix* sp.), American elderberry (*Sambucus canadensis*, *S. cerulean*, *S. racemosa*), or alder (*Alnus serrulata* and *A. incana* ssp. *rugosa*); grasses such as streambank or thickspike wheatgrass (*Elymus lanceolatus*) or Great Basin wildrye (*Leymus cinereus*). Select

species based on site conditions. Use competitive, fast-establishing species adapted to the environmental conditions characteristic of the site and appropriate for the desired land use.

Integrated Pest Management

Prevention of knotweed establishment is the priority for management, because once established, eradication is extremely difficult. Plants in the knotweed complex currently occur in scattered isolated areas across Montana, where in other states they line rivers and roadways. Prevent spread by identifying and suppressing existing patches. Do not spread soil from an area with knotweed to other areas, because this soil will contain root fragments that can easily regenerate into new plants. If knotweed plants are discovered growing outside of cultivation, notify the landowner and report the exact location of the infestation to your local county weed district or Extension office.

For existing patches, an integrated management strategy is recommended. Cutting the stems one to three times during the growing season prior to mid-summer and then applying herbicide in late summer or early fall is effective. This can increase herbicide efficiency by stimulating new growth which may be more susceptible to herbicide activity.

Additionally, clipping will reduce the amount and height of foliage to be sprayed, making the patch more accessible. Other mechanical treatments like grazing or mowing may be substituted for clipping (up to mid- summer) in combination with a fall herbicide application.

Patches should be monitored for many years after re-growth appears to have ceased. Herbicide applications and other mechanical treatments will leave the area exposed to other invasive weeds. After patches appear to be successfully controlled, revegetate the site with appropriate species if desirable vegetation is not returning naturally.

Landscaping with Alternative Species

Unfortunately, many of invasive knotweed species are still commercially available in nurseries or mail order catalogs. Before purchasing a plant, inquire about the plant's invasiveness. Several desirable woody plants can be used for landscaping in lieu of knotweeds. In many cases, a native plant can fulfill the landscape characteristic desired. For example, elderberry is a mid-sized shrub with clusters of creamy white flowers similar to Japanese knotweed and will thrive in moist conditions. Depending on soil and climatic conditions, use non-invasive species such as cotoneaster (*Cotoneaster* species), skunkbush sumac (*Rhus trilob*ata), common lilac (*Syringa vulgaris*), western snowberry (*Symphoricarpos occidentalis*), red-osier dogwood (*Cornus sericea* ssp. *sericea*), serviceberry (*Amelanchier alnifolia*), western sandcherry (*Prunus pumila* var. *besseyi*), rose (*Rosa* species), chokecherry (*Prunus virginiana*), silverberry (*Elaeagnus commutata*), and other hedge forming species. Landscaping with native plants will reduce the risk of invasion, reduce fertilizer and water use, and often provide better habitat for wildlife such as songbirds.

REFERENCES

Bram, M.R. and J.N. McNair. 2004. Seed germinability and its seasonal onset of Japanese knotweed (*Polygonum cuspidatum*). Weed Science 52(5):759-767.

Dassonville N., S. Vanderhoeven, W. Gruber, and P. Meerts. 2007. Invasion by *Fallopia japonica* increases topsoil mineral nutrient concentrations. Ecoscience, 14(2):230-240.

Francis, R.A., K.A. Riley, and S.P.G. Hoggart. 2008. Vegetative regeneration of *Fallopia japonica* (Houtt.) Ronse Decraene (Japanese knotweed) at varying burial depths. Weed Biology and Management, 8(1):69-72.

Gaskin, J.F., M. Schwarzlander, F.S. Grevstad, M.A. Haverhals, R.S. Bourchier, and T.W. Miller. 2014. Extreme differences in population structure and genetic diversity for three invasive congeners: knotweeds in western North America. Biological Invasions 16:2127-2136.

Hirose, T., and M. Tateno. 1984. Soil nitrogen patterns induced by colonization of *Polygonum cuspidatum* on Mt. Fuji. Oecologia, 61:218-223.

Hitchcock, L., A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle.

Kurose, D., N. Furuya, M. Matsumoto, D.H. Djeddour, H.C. Evans, and K. Tsuchiya. 2009. Evaluation of a Puccinia Rust as a Potential Biological control agent of *Fallopia japonica*. Journal of the Faculty of Agriculture Kyushu University, 54(1):59-64.

Lacerf, L., D. Patfield, A. Boiche, M. Riipinen, E. Chauvet, and M. Dobson. 2007. Stream ecosystems respond to riparian invasion by Japanese knotweed (*Fallopia japonica*). Canadian Journal of Fisheries and Aquatic Sciences, 64(9):1273-1283.

Lesica, P. 2012. Manual of Montana Vascular Plants. BRIT Press. Forth Worth, TX.

Maerz, J.C., B. Blossey, and V. Nuzzo. 2005. Green frogs show reduced foraging success in habitats invaded by Japanese knotweed. Biodiversity and Conservation, 14(12):2901-2911.

Rice, P.M. 2017. INVADERS Database System. Division of Biological Sciences, University of Montana, Missoula, Mont. 59812-4824.

Scott, R., and R.H. Mars. 1984. Impact of Japanese knotweed and methods of control. Aspects of applied biology, Weed control and vegetation management in forestry and amenity areas. pp. 291-296.

Seiger, L.A. 1991. Elemental stewardship abstract for *Polygonum cuspidatum* Japanese knotweed, Mexican bamboo. The Nature Conservancy. Arlington, Virginia.

Seiger, L.A. and H.C. Merchant. 1997. Mechanical control of Japanese knotweed (*Fallopia japonica* [Houtt.] Ronse Decraene): Effects of cutting regime on rhizomatous reserves. Natural Areas Journal, 17(4):341-345.

United States Department of Agriculture Natural Resource Conservation Service PLANTS Database. http://plants.usda.gov/. Accessed March 2017.

Urgenson, L.S., S.H. Reichard, and C.B. Halpern. 2009. Community and ecosystem consequences of giant knotweed (*Polygonum sachalinense*) invasion into riparian forests of western Washington, USA. Biological conservation, 142(7): 1536-1541.

Wang, Y., J.Q. Ding, and G. Zhang. 2008. *Gallerucida bifasciata* (Coleoptera: Chrysomelidae), a potential biological control agent for Japanese knotweed (*Fallopia japonica*). Biocontrol Science and Technology, 18(1):59-74.

Wilson, L.M. 2007. Key to identification of invasive knotweeds in British Columbia. B.C. Ministry of Forest and Range, Forest Practices Branch, Kamloops, B.C.

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