



Giant Hogweed Control Methods



Are you worried about giant hogweed hurting you or someone else? Is giant hogweed causing ecological damage to your environment through replacement of native plants or erosion of soil? Are giant hogweed plants limiting your access to areas where you wish to recreate (e.g. back yard, stream bank) or work in (e.g. overrunning your garden, field or orchards)? If you answered yes to any of these questions, you may be interested in learning about methods for controlling this non-native invasive plant.

A variety of control methods are available including manual and mechanical methods, as well as the use of herbicides. Some control methods are best used on small sites and others for large sites. You will have to choose the method that works best for the habitat, stage of plant growth and size of the site. In some cases a giant hogweed infestation will be best controlled using several different methods. For instance, after using methods for large scale control (e.g. herbicide) for a number of years, when only a few plants remain, it may be cheaper and easier to switch to a small scale control method (e.g. cut the taproots). The final part to any control method is to plant grasses or other plants to provide competition for giant hogweed and to decrease soil erosion. Please read through all the available methods and information provided, particularly the safety instructions, before choosing and implementing the control strategy that will work best for your giant hogweed site.

In order for your control effort to be successful, you will have to ensure that no additional seeds are being introduced to the area. If your site is along a stream, you will want to coordinate with other properties upstream from your site to limit the source of seeds flowing downstream that could re-infest your site. It is very important to ensure that the giant hogweed plants are controlled before they produce seeds and that all existing flower heads are removed, degraded and disposed of safely. With no influx of seed and a few years of persistent control efforts giant hogweed plants can be eradicated.

For more giant hogweed information, to learn more about how to identify this plant or if you have other giant hogweed related questions, please refer to the DEC giant hogweed web page: <http://www.dec.ny.gov/animals/39809.html> or call the giant hogweed hotline at 845-256-3111.

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1. Giant Hogweed Growth & Development (Information pertaining to control)

Giant hogweed plants are long lived perennial plants. Once seedlings emerge from seed they persist, and will overwinter, as rosettes until the plant is triggered to bolt a flower stalk. Often, the tall majestic plants seen in brochures and in the media are more than 5 years old and can be as old as 25 years. Most plants will die after producing a flower stalk, however, giant hogweed is perennial in nature and if the root has developed side shoots, they could grow new plants the following year.

Giant hogweed plants are most commonly recognized when they are mature and flowering. Since giant hogweed plants typically take three to four years before flowering, one must also look for the more numerous younger vegetative plants with large basal leaf rosettes when identifying plants to control. In its first few years of growth, leaves and stem of non-flowering plants will die back over the winter. After the mature plant flowers and sets seed, the whole plant including the root will die. If the flowering plants are damaged or cut above the root before the flowers open, the plant may survive a couple more years. As a rough guide, giant hogweed plants start growing in early spring, flower in June-July and set seed in August. Giant hogweed plants have a long branching taproot up to 2 feet long (60 cm) and 6 inches (15 cm) in diameter at the crown. Their large taproots store substantial below-ground resources which can give some defense against physical and chemical control practices.



The plants reproduce by seed, an average plant produces 20,000 seeds but some plants have been reported to produce over 100,000 seeds. However since most seeds fall within a few meters of the parent plant, seedlings develop under very crowded conditions and thus seedling mortality is high. The majority of the seeds (95%) are found within the top 2 inches (5 cm) of the soil layer. The seeds are dispersed short distances by wind and can travel longer distances by water (can float up to three days). Most seeds are found within 30 feet (10 meters) of the giant hogweed colony with a few plants traveling more than 150 feet (50 meters) away. The seeds can travel farther when assisted by people- improper disposal of flower heads, purposeful sharing of seeds/seedlings with other gardeners, transporting seed-laden soil during construction, mowing along roadsides, and wind currents generated along highways and railroads from fast moving vehicles may cause seeds to travel farther. Seeds may remain viable in the seed bank for more than 5 years. Since the dispersal of giant hogweed is almost entirely by seeds it is very important to prevent the plant from flowering and setting seed.

Giant hogweed plants grow best in open sites with abundant light, but can grow successfully in woodland, forest edge and partially shaded habitats too. The plants grow well in undisturbed or unmanaged sites and are less frequently found in tilled or grazed areas. Plants are resistant to frost and can withstand flooding, though they cannot grow on permanently submerged ground. With their tremendous growth, large leaf area and prolific seed production, giant hogweed plants are able to outcompete and replace native vegetation. Giant hogweed plants shade out

surrounding vegetation with their giant leaves and tight growth pattern. Bare soil is created below the plants, which leads to soil erosion in winter. Bare soil, in conjunction with the loss of plants with finely branched roots able to hold the soil, is of special concern along slopes and stream banks.

Studies have found that giant hogweed invasion patterns often begin with cultivation as a garden ornamental. The spread begins slowly from these cultivated areas. Over time the giant hogweed typically spreads first along rivers or stream corridors. Once the plants become more prevalent they are able to spread throughout a variety of habitats.



2. Public Health Hazards & Safety Instructions

When the clear watery giant hogweed sap, which contains several photosensitizing furanocoumarins, contacts the human skin in conjunction with sunlight (specifically ultraviolet radiation), it can cause phytophotodermatitis. This is a serious skin inflammation that may lead to painful blisters that form within 48 hours and become dark pigmentation or scars that can last up to 6 years, though typically only last a few months. Long-term sensitivity to sunlight often occurs. Blindness may occur if the sap gets into the eye.

The skin reaction will depend on the sensitivity of the individual. Heat and moisture (sweat or dew) can enhance the skin reaction. The phototoxic reaction can be activated by ultraviolet radiation 15 minutes after contact, with a sensitivity peak between 30 minutes and two hours. The toxic furanocoumarins are present in all parts of the plant: the lower parts of the hollow stems and petioles may be partly filled with fluid; the hollow hairs on the plant also contain the sap.



Example of a skin reaction to giant hogweed sap over a 5 month period

Photo credit: Bob Kleinberg

Safety precautions to follow when controlling giant hogweed plants:

- Do not touch the plant with bare skin- toxicity can result from any action that involves bruising, cutting or touching the foliage, stem, flower or fruit.
- Prevent ultraviolet light from reaching the skin.
- Apply sun block before beginning to work near giant hogweed plants.
- Keep water, soap and eye-wash near work area in case of exposure to sap.

- Wear long waterproof gloves, long sleeves, pants, boots and eye protection if you plan to handle or cut down plants. Synthetic water-resistant materials are best, since cotton and linen fibers can soak up the plant sap and be penetrated by plant hairs (e.g. dishwashing gloves, rain suit or tyvek suit, and rubber boots).
- Do not touch your exposed skin with the sap covered gloves! Wearing a face shield will help to keep you from touching your face with sap covered gloves.
- If controlling plants with multiple people, keep a good distance from one another as the sap can splash three to four feet while doing control.
- Wash equipment with water immediately after use.
- Change out of work clothes and wash yourself with soap and water after doing control.
- Limit exposure to sunlight after control.
- Launder clothing (separately) that may have contacted plants.
- At small sites, some people have chosen to work around giant hogweed plants after sunset to limit their exposure to sunlight.
- DO NOT use a “weed-whacker” or brush cutter – sap may splatter on you as stems are cut.



What should you do if you are exposed to giant hogweed sap?

If accidental exposure to the plant sap occurs, wash the affected area thoroughly with soap and water as soon as possible. Keep the exposed area away from sunlight for at least 48 hours. If a reaction occurs, topical steroids applied early can reduce the severity of the reaction and ease discomfort. If sap goes in the eyes, rinse them with water, wear sunglasses and seek immediate medical care. As the area may be sensitive to sunlight for a few years, you may want to apply sunblock and/or keep the affected area covered from the sun for that length of time. Please see a physician if you have a reaction or have any questions.

3. Manual & Mechanical Control

Manual and mechanical control methods include root cutting, cutting the plant, covering the soil, mowing, plowing and removing the umbels (flower heads). Except for root cutting, manual control will not cause immediate death of the plant. All other methods will need two to three treatments per year for several years to deplete the root reserves and kill the plants. All methods will need to occur for multiple years until no new plants grow from the seed bank. Monitor the site for at least three more years to make sure no new seedlings appear.

a. Cut or dig up roots

This is a labor intensive but very effective method which will typically kill the individual plant after one treatment. It is ideal for a single plant or small infestations. We have found 400 plants to be a manageable amount for two people to control manually. This method can also be used for larger infestations if you have more time and/or people. If no seeds are produced in 2-3 years, it is possible to clean an area in 3-5 years by root-cutting every year until no more plants are found.

Cut the taproot approximately 6 inches (15 cm) below ground level using a spade with a sharp blade. Some people have reported success with cutting the plants only 1.5 inches (2-3 cm) below the soil surface. In areas with erosion or on steep inclines, where additional soil may be covering the plant base, plant taproots may need to be cut up to 10 inches (25 cm) below the soil surface. When cutting the root you need to separate the thick stem base bearing old leaf scars, from the root below. The stem base can be covered with up to 2 inches (5 cm) of soil. It is easiest to cut in early spring before the leaves are very large. If the plant does not die, cut again when they regrow. The cut part of the plants should be removed from the soil and left out to dry or bagged and disposed of. Instead of cutting through the root some people prefer to carefully dig up the entire root and allow them to thoroughly dry before disposal. This method works as well but involves undue effort.



To make this control method even more effective, return to the site 1-2 weeks (later in the season is fine too) after the initial root-cutting. Cut or dig up the roots of any giant hogweed plants that were missed the first time (or spray plants with herbicide), and remove any giant hogweed seedlings that have started to grow. When using the root-cutting method, another option is to apply herbicide to the cut root remaining in the soil, to help ensure no part of the root grows back the following year.

b. Hand pull

Young plants can be easily hand pulled (April-May). This is easiest to do when the soil is loose and moist. As the stems are not woody, they will break easily so it is best to pull them gently to ensure full root removal. Using a trowel or other small hand tool may help to ease them out of the soil. Pulling will not work for mature plants as the tap root is too large. Since you may actually be touching the plant, you must be very careful to wear waterproof gloves and clothing and not get the sap on yourself if you use this method.

c. Hogweed flower/seed head removal & safe disposal

Removal of the flower head can be as effective as cutting the whole mature plant. The plant is going to die after flowering but cutting off the flower/seed head is **VERY** important to keep it from spreading the seed. If this is your only control method for that plant then timing of the cutting is crucial; if cut too early the plant can regenerate and produce new flowers with more numerous viable seeds. You should cut off the flower heads after the seeds have formed but before they mature to prevent the plant from shedding the seeds and from



forming new flowers on lower branches (if cut while flowering new umbels may form). If you do cut the plant in the flowering stage make sure to check the plant again in a few weeks to cut off any new flower heads that may form. As the seeds mature they shed more easily. When cutting the flower head try to avoid scattering seeds on the ground; if seeds are shedding, contain them within as small an area as possible.

A cut and hold long reach pruner is the ideal tool for flower head removal, but any sharp cutting tool which is long enough so that you won't touch the plant can be used. Use the pruner/lopper/knife to carefully cut off all flower heads and place them in sturdy (or doubled/tripled) trash bags. Since the seeds may mature on the severed flower head, they must be carefully disposed of. Clear or dark trash bags will work for solarization (a method of using the heat from the sun to destroy the seed viability). Seal trash bags tightly. If sap has gotten on the outside of the bag, put it inside another trash bag so the outside is safe to handle. If possible place in a secure location where they will be exposed to direct sunlight to give flowers and seeds a heat treatment (solarization) for 1 week or more to destroy seed viability. Then dispose of trash bags in the garbage.



d. Plowing

Plowing is often one of the single best methods of mechanical control for giant hogweed, though it will have to be done for multiple years as large roots are capable of regrowth. This method eradicates the plant from infested fields and if done in the fall, frost and freezing temperatures will help degrade the root stock. Large roots should be hand removed from the plow zone to ensure no regrowth occurs. Deep plowing of the soil will significantly reduce the germination of hogweed seeds due to the upper soil layer being buried (most seeds are within the top 2 inches of the soil). The best results are obtained if the plants are controlled mechanically or chemically before plowing. Make sure to clean the plowing equipment before using in another area to avoid spreading giant hogweed seeds to new locations.

e. Cutting & Mowing

Cutting plants above ground is not recommended as an eradication method. If you choose to use this method, the plants must be cut at least two to three times per growing season for several years until the taproot energy reserves are depleted. In the beginning of this process the plants will typically grow back within a couple of weeks after being cut. Start when plants are small and continue mowing throughout the season, DO NOT mow if the plants are larger than your mower and NEVER mow if there is a flower or seed head. Repeated mowing is often used for large infested areas and if done consistently and on a regular basis can destroy most of the plants, scything can be done in areas unsuitable for mechanical mowing, such as along riverbanks or on slopes but will not be effective in killing the plants. Be careful not to spread the seeds; all flower heads should be removed and carefully disposed of (read part 3.c.) before mowing. If possible remove the plants; if they are placed in piles they will shade out the vegetation below and create favorable habitat for hogweed plants. Mowing equipment should be cleaned on site before using in another area to avoid spreading giant hogweed seeds to new locations.

f. Cut and cover

This is an effective method when done correctly. It is recommended for use in small areas. It will keep plants from regrowing and prevent the seedlings from emerging. Cut the plants down to ground level and cover the soil with black plastic. Check the following year to make sure seedlings don't poke through the black plastic. After a few years the can be removed and the area revegetated with native or non-invasive plants.

g. Bury plants & seeds using a skid loader

This is a very effective method. Use a skid loader to invert the flower bed or infested area upside down and you will have composted and smothered most of the plants. Since the majority of the seeds (95%) are found within the top 2 inches (5 cm) of the soil layer, the emergence of new plants is prevented by burying the topsoil to a minimum depth of 20 inches (50 cm) and covering it with clean soil. It is important to clean the equipment used on site before using in another area to avoid spreading giant hogweed seeds to new locations.

4. Herbicide Control

Giant hogweed is susceptible to systemic herbicides, such as glyphosate and triclopyr, and the application of these herbicides is considered effective and cost efficient. Herbicide application can be used for controlling a single plant or large stands of giant hogweed. These systemic herbicides will be absorbed by the leaves and will move into the root to prevent regrowth. Triclopyr is a selective herbicide that acts only on broadleaf plants and will not harm grasses in the area. Glyphosate is non-persistent in the soil but is also a non-selective herbicide and will kill any surrounding vegetation it comes into contact with. Some triclopyr and glyphosate products (e.g. Rodeo) are labeled for use in riparian areas and near water. Areas sprayed with triclopyr can recolonize with grasses and other herbaceous species within the same growing season which helps to suppress giant hogweed seedling growth and decrease soil erosion. Recolonization at sites using glyphosate will probably be slower than sites using triclopyr unless reseeded.



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Spray giant hogweed leaves with an herbicide containing triclopyr or glyphosate as the active ingredient. Use the recommended manufacturer's dose and follow label instructions- there is no advantage to using a higher dose. Apply the herbicide between late April and early June when hogweed leaves are green and actively growing. A follow-up treatment, in July or August, may be needed for the plants that did not die from the first herbicide application (e.g. seedlings, now leaf rosettes, which were once covered by leaves of the plants originally sprayed). During this follow-up treatment it is strongly recommended to remove any flower heads present to decrease next year's seed source (Read part 3.c.). Giant hogweed plants can be sprayed through mid-October as long as they are still green and not dying back. It is easiest to spray before the plants grow overly tall. Options for dealing with tall plants are: spray them as they are, cut them down to ground level and spray the re-growth, or carefully cut the plants above waist height and spray remaining leaves. To be successful in eradicating giant hogweed, herbicide treatments (or another control method) will have to be repeated for multiple years, in order to kill the plants missed the prior year as well as the plants emerging from the seedbank.

Spray during dry and calm weather. Cover leaf surfaces thoroughly with spray droplets, but do not spray to the point that liquid is dripping off the leaves. Adding a dye to the herbicide will help you see where you have already sprayed. Do not apply herbicide to non-target organisms as you want the other plants to live and revegetate the area. Be patient, it may take treated plants one to two weeks for control symptoms to appear. Do not cut or dig up the plant until the top growth has died back. If the leaves remain green several weeks or a month after the initial treatment, spray them with herbicide again.

For licensed pesticide applicators, there are seven herbicides that are legal for specific use on giant hogweed due to FIFRA 2(ee) Recommendations:

Accord XRT II, EPA Reg. No. 62719-556

Garlon 4 Ultra, EPA Reg. No. 62719-527

Rodeo, EPA Reg. No. 62719-324 (can be applied in and around aquatic sites)

Roundup ProMax Herbicide, EPA Reg. No. 524-579

Roundup Pro Concentrate Herbicide, EPA Reg. No. 524-529

Vegetation Manager Triclopyr 3 SL, EPA Reg. No. 72167-49-74477

Vista, EPA Reg. No. 62719-308

Some of these herbicides are classified as restricted and can only be applied by, or under the supervision of, a certified commercial pesticide applicator. A copy of the FIFRA 2(ee) Recommendation letter as well as a copy of the herbicide label needs to be carried by the applicator when applying herbicides. The 2(ee) recommendations can be downloaded at the NYS Pesticide Product, Ingredient and Manufacturer System (PIMS) database web site:

http://pmep.cce.cornell.edu/regulation/2ee/unlabeled_pest/index.html

5. Animal Control (Grazing)

Grazing by cattle, sheep, pigs or goats is very efficient for control of large stands of hogweed. The livestock prefer young plants so it is best to begin the grazing early in the season when the plants are small. In areas with dense stands of hogweed, a single cut is recommended to allow establishment of other plant species so that the livestock can have a mixed diet. The grazing pressure can be adjusted for the stand density and growing season. It is recommended to use more animals in the spring (20-30 sheep per hectare) and reduce grazing pressure at the end of June (5-10 sheep per hectare). GH contains chemicals that can cause inflammation of the skin and any mucus-secreting membrane that is exposed to light (lips, nostrils, eye area). Densely pigmented skin and hairy surfaces are more resistant to the negative effects of these chemicals. Choose livestock that are hairy and have dark pigmentation where there is bare skin. Animals that are affected (showing skin inflammation or blistering) must be removed from the field temporarily. The livestock will require monitoring by a veterinarian. If possible the fenced area should include the giant hogweed colony as well as the surrounding area where seed dispersal may have taken place. Grazing will need to continue for a number of years until the taproot energy reserves and seedbank are depleted.

6. Monitor



It may be possible for hogweed seeds to remain viable in the soil for 15 years. For this reason long-term monitoring is important. Check the site and surrounding areas for the next several years for the emergence of any hogweed seedlings or regrowth from previous year's plants. Seed bank longevity is dependent on soil conditions and the number of year's viable seed was produced.

7. Revegetation

This step is very important. After removing giant hogweed plants you may be left with an area of bare soil vulnerable to soil erosion, giant hogweed seedlings, and introduction of other invasive weeds. Re-establishment of native or non-invasive vegetation (e.g. through sowing of grass mixtures) at treated sites may be necessary to help achieve your desired control outcome. This will help to reduce soil erosion and provide competition for giant hogweed seedlings.

8. Overall Giant Hogweed Control Strategies

- Prevent introduction into new areas.
- Since the dispersal of giant hogweed is almost entirely by seeds it is very important to prevent the plant from setting seed.
- Do not move soil contaminated with seed. If removal of contaminated soil is necessary, seedling emergence can be prevented by burying the soil to a minimum depth of 20 inches (50 cm) and covering it with clean soil.
- Control new, smaller infestations first before the seed bank has a chance to establish.
- As a federal noxious weed, sowing and planting of giant hogweed should be prohibited.
- Locate and map distribution of all populations.
- Focus on populations on the margin of range expansion as a way to slow or prevent further invasion.
- Target populations along rivers and streams and urban stormwater systems. Coordinate throughout the entire drainage system. Sites upstream should be controlled first, since seeds will be dispersed downstream.
- Stands along transportation corridors (railroads, highways) should be managed to prevent dispersal of seeds. Seeds get blown by air currents from fast moving vehicles or trains and can also be spread by maintenance practices.
- Educate the public to help locate giant hogweed populations, prevent spread, and control plants on their property.

9. Literature

- Andersen, U.V. (1994) Sheep grazing as a method of controlling *Heracleum mantegazzianum*. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 77-91. Wiley, Chichester.
- Bravo, M.A. and J.C. Fuller (2006). Giant hogweed eradication in Pennsylvania and neighboring states. NEWSS Proceedings,
- Bravo, M.A., Diesing, J., Grieneisen R. & Polach M. (2007). Pennsylvania giant hogweed eradication program update. NEWSS Proceedings,
- Bravo, M.A. (2007) Giant hogweed eradication in Pennsylvania and surrounding States. WSSA Proceedings,
- Bravo, M.A. (2008) Data management challenges in regulatory weed programs. A look back at the Pennsylvania giant hogweed eradication program. WSSA Proceedings.
- Brendley, B.W. & Kalac, C.R. (1999) An eradication program for giant hogweed. Gannon University, Erie PA. WSSA Proceedings
- Caffrey, J.M. (1994) Spread and management of *Heracleum mantegazzianum* (Giant Hogweed) along Irish river corridors. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 67-76. Wiley, Chichester.
- Caffrey, J.M. (1999) Phenology and long-term control of *Heracleum mantegazzianum*. *Hydrobiologia*, **415**, 223-228
- Dawson, F.H. & Holland D. (1999) The distribution in bankside habitats of three alien invasive plants in the U.K. in relation to the development of control strategies. *Hydrobiologia*, **415**, 193-201.
- Dodd, F.S., De Waal, L.C., Wade, P.M. & Tiley, G.E.D. Control and management of

- Heracleum mantegazzianum* (Giant Hogweed). *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 111-126. Wiley, Chichester.
- Fuller, J., Campbell, J.M. & Zeller, M. (2000) Controlling the spread of giant hogweed (*Heracleum mantegazzianum*) in Pennsylvania. *Journal of the Pennsylvania Academy of Science*. **73**, 118.
- King County Noxious Weed Control Program (2007) Best management practices. Giant hogweed- *Heracleum mantegazzianum*. www.kingcounty.gov/weeds.
- Lundstrom H. & Darby E. (1994) The *Heracleum mantegazzianum* (Giant Hogweed) problem in Sweden: Suggestions for its management and control. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 93-100. Wiley, Chichester.
- Moravcova, L., Pysek, P., Krinke, L., Pergl, J., Perglova, I., & Thompson, K. (2007) Seed germination, dispersal and seed bank in *Heracleum mantegazzianum*. *Ecology & Management of Giant Hogweed (Heracleum mantegazzianum)* (eds P. Pysek, M.J. W. Cock, W. Nentwig and H.P. Ravn), pp.74-91. CABI, Oxfordshire.
- Nielsen, C., Ravn, H.P., Nentwig, W. & Wade, M. (eds.) (2005) *The giant hogweed best practices manual: guidelines for the management and control of an invasive weed in Europe*. Forest and Landscape. Denmark, Horsholm, 44. <http://www.giant-alien.dk/>
- Nielsen, C., Vanaga, I., Treikale, O. & Priekule, I. (2007) Mechanical and chemical control of *Heracleum mantegazzianum* and *H. sosnowskyi*. *Ecology & Management of Giant Hogweed (Heracleum mantegazzianum)* (eds P. Pysek, M.J. W. Cock, W. Nentwig and H.P. Ravn), pp.226-239. CABI, Oxfordshire.
- Page, N.A, Wall, R.E., Darbyshire, J.D. & Mulligan G.A. (2006) The biology of invasive alien plants in Canada. 4. *Heracleum mantegazzianum* Sommier & Levier. *Canadian Journal of Plant Science*, **86**, 569-589.
- Pysek, P. (1994) Ecological aspects of invasion by *Heracleum mantegazzianum* in the Czech Republic. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 45-54. Wiley, Chichester.
- Sampson C. (1994) Cost and impact of current control methods used against *Heracleum mantegazzianum* (Giant Hogweed) and the case for instigating a biological control programme. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 55-65. Wiley, Chichester.
- Tiley, G.E.D. & Philp B. (1994) *Heracleum mantegazzianum* (Giant Hogweed) and its control in Scotland. *Ecology and Management of Invasive Riverside Plants* (eds L.C. de Waal, L.E. Child, P.M. Wade & J.H. Brock), pp 101-109. Wiley, Chichester.
- Tiley, G.E.D., Dodd, F.S., & Wade, P.M. (1996) *Heracleum mantegazzianum* Sommier & Levier. *Journal of Ecology*, **84**, 297-319.
- Wright, M. (1984) Giant hogweed: time for action is now. *New Science* **101** (1404), 44.