Japanese Hop

Humulus japonicus Sieb. & Zucc.
Hemp family (Cannabaceae)

NATIVE RANGE

Temperate Asia (China, Japan, Korea, Taiwan and the Russian Federation) and tropical Asia (Vietnam)

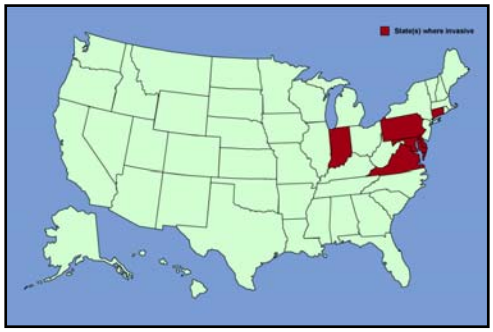
DESCRIPTION

Japanese hop, or hops, is an herbaceous, usually annual vine that lacks tendrils and climbs by twining. It is shallow-rooted but can climb to heights of ten feet or more with the help of rough-textured stems that are covered with short, sharp, downward pointing prickles. These prickles can be very irritating to the skin. The leaves are rough textured, paired, and palmate with 5 to 7 (sometimes 9) lobes. The margins of the leaves are toothed. The leaf stems (petioles) tend to be as long as or longer than the leaves and have a pair of small bracts at the base. Male and female flowers are borne on separate plants. The male flowers are very small, greenish yellow and occur in branched panicles. The female flowers are in pale green, plump, drooping, cone-like structures with overlapping scales called hops. The hop scales and the seeds are covered with yellow glands. The seeds are about 1/8 in. in diameter, roundish with a blunt tip, and light brown with darker specks.

Look-alikes: Common hop (*Humulus lupulus*) has five varieties, three of which are native to the U.S. (vars. *lupuloides*, *neomexicanus*, and *pubescens*), one (var. *lupulus*) that is native to Europe and western Asia, and another (var. *cordifolius*) that is native to eastern Asia. Common hop leaves are 3-lobed or non-lobed. Native bur cucumber (*Sicyos angulatus*) lacks prickles, has tendrils, and the leaves have much less pronounced lobes. Virginia creeper (*Parthenocissus quinquefolia*) and several cinquefoil (*Potentilla*) species have leaves that are deeply divided into five leaflets and the plants lack prickles.

ECOLOGICAL THREAT

Japanese hop can spread to cover large areas of open ground or low vegetation including understory shrubs and small trees. The vines grow rapidly during the summer, climbing up and over everything in their path and can form dense mats several feet deep, blocking light to plants underneath. Hop vines also twine around shrubs and trees causing them to break or fall over. Japanese hop is invasive in riparian and floodplain habitats where it displaces native vegetation, prevents the emergence of new plants, and kills newly planted trees installed for streamside habitat restoration. Hop can quickly cover small trees, hiding them from view and preventing mowing or application of non-selective herbicide.



DISTRIBUTION IN THE UNITED STATES

Japanese hop occurs in scattered locations from Nebraska to Maine to Georgia and is most common in the Northeastern U.S. and eastern Canada. It has been reported to be invasive in natural areas in Connecticut, Delaware, Indiana, Maryland, Pennsylvania, Virginia, and the District of Columbia.

HABITAT IN THE UNITED STATES

Japanese hop prefers plentiful sunlight and moisture, rich exposed soil, and is most commonly found along stream banks and floodplains. Growth is less vigorous in shade and on drier soils, but it can grow in disturbed areas with fairly moist soils, including roadsides, old fields, and forest edges. In milder climates, it can survive the winter.

Plant Conservation Alliance's Alien Plant Working Group
Weeds Gone Wild: Alien Plant Invaders of Natural Areas
http://www.nps.gov/plants/alien/

BACKGROUND
Japanese hop was originally imported to America in the late 1800s for use as a tonic in Asian medicine and as an ornamental vine. It is still sold for these purposes today. The common hop (*Humulus lupulus*) contains bitter acids and essential oils used as preservative and flavoring in beer, but the chemistry of Japanese hop is less desirable for that purpose.

BIOLOGY & SPREAD

Hop spreads by seed which begin to germinate in early spring, but new plants may continue to emerge as the season progresses if sunlight and moisture are available. Newly germinated seedlings may spend several weeks in the tiny 2-leaf cotyledon stage, but once hot weather arrives, they grow very rapidly. Many thousands of hop plants per acre may be produced, eventually blanketing the land and vegetation. In the mid-Atlantic region, flowering occurs in July and August with seeds maturing through September. After that, growth slows and the plants begin to decline. The first hard frost of autumn kills the vines and they quickly disintegrate. By this time the Japanese hop will already have produced a crop of seeds to continue and spread the infestation the next year. Seeds may be dispersed by animals (including people), machinery and floodwaters.

MANAGEMENT OPTIONS

Biological
No biological control agents are currently available for release to control Japanese hop. However, the U.S. Forest Service has been investigating natural enemies of plants of Asian origin that are invasive in the U.S. They have identified two moths (*Epirrhoe sepergressa* and *Chytonix segregata*) and one fungus (*Pseudocercospora humuli*), as potential natural enemies of Japanese hops and will continue research on those species. The Japanese beetle (*Popillia japonica*) has been observed to feed on hop but did not cause extensive damage.

Cultural
Japanese hop prefers direct sunlight and does not tolerate heavy shade. As soon as the tree canopy closes, the hop will cease to be a problem. Practices that favor fast tree growth, early crown closure, and heavy shade will help the new stand survive and outgrow the hop. These include planting fast-growing tree species that are adapted to the site and that will create dense shade in spring and summer, spacing the plants close together, and using effective weed control measures. Hop will climb up and over shrubs and small trees, but it needs a ladder of tall weeds, shrubs, or low tree branches to cling to as it climbs. To minimize the availability of low-growing vegetation for hop to climb, it is important to reduce the proportion of shrubs and smaller trees in favor of tall-growing trees. As trees grow taller, prune the lower limbs and basal sprouts to reduce the ladder effect.

Use of tree shelters can assist hop control by marking the location of the seedling, protecting it from herbicide spray, reducing low branching and making a less structured ladder. However, if the shelter surface is smooth, hop can still climb via the stake or adjacent vegetation. As much as possible, prevent hop vines from growing inside or overtop the shelters and depositing seed inside the shelter. Practices such as adequate site preparation, pre-emergent herbicide application or hand weeding inside the shelter, and herbicide application around the shelter can be used. If shelters are not used it is especially important to prevent and control hop from establishing or to detect and act on infestations early, before the vines can begin to climb onto the tree plantings.

Hop does not readily germinate in grassy areas, particularly in tall, sod-forming perennial grasses such as tall fescue (*Schedonorus phoenix*, previously *Festuca arundinacea*) or reed canary grass (*Phalaris arundinacea*). It should be noted that these two sod-forming cool-season grasses are among the worst weeds from the standpoint of tree growth and they have been reported to be invasive in natural areas, presenting a challenge that land managers will need to address on a case-by-case basis. They should not be planted. Hop is much more likely to germinate and grow in an area where the soil is exposed or dominated by sparse broadleaf weed cover. However, once germinated it will overtop and kill grass, leaving a bare area for the next year's hop seedlings to grow. Consideration should be given to avoiding practices such as non-selective herbicide use that would reduce or remove the grass cover. Establishing or encouraging other groundcover vegetation that is thick and growing in early spring could possibly reduce hop germination and seedling survival. Fall plantings of hairy vetch (*Vicia villosa*), wheat, barley or cereal rye might serve this purpose.

Manual and Mechanical

Manual control is the most targeted method, with the least likelihood of damage to other plants. However, it is slow and labor-intensive and best suited for fairly small, readily accessible infested areas. Japanese hop does not develop an extensive or deep root system and as a result is fairly easy to pull or dig early in the season, especially when the soil is moist. This is an effective method but care must be taken to remove the root and not just break the stem off at ground level. Hand weeding needs to be started early in the growing season (April – May) while the roots are small and before the vines become tangled with other vegetation. Monthly pulling and monitoring will be needed until the infestation is eradicated. Due to the irritating prickles on the stems and leaves, it is important to wear gloves, long pants and long sleeves to avoid skin contact with the plant. Started early enough, and using proper precautions, this is a good method for homeowners or for volunteers working in public areas.

Cutting or mowing the hop vines as close to the ground as possible is an acceptable control method as long as the cutting is started early (late spring), the entire site is thoroughly cut, and the practice is repeated frequently until the plants die back in fall. There are problems with this method. Attempts to mow or drive a vehicle through tree planting sites with tangles of hop vines covering the trees can result in the vines pulling out trees and breaking tree shelters. Vines quickly re-grow from the cut stems and from uncut vines around the trees. If successful, mowing tends to retain and promote the development of perennial grasses.

Chemical

Pre-Emergent Herbicide. The use of pre-emergent herbicides, which typically kill weed seeds as they germinate, is potentially valuable in controlling hop. Because hop seeds are large (about 1/8th in. or 3 mm), it is harder to prevent their successful germination than it is for smaller seeds. The advantages are that, depending on product, rate and timing, pre-emergents may be used safely over and around young trees, generally causing minimal or no damage to other perennial vegetation, and they prevent the weed problem from occurring. This eliminates the need to rescue the trees from an established hop infestation later. When combined with post-emergent herbicides applied later in the season pre-emergent herbicides may provide a longer period of control by preventing production of seeds before frost.

If hop was present the previous year it is likely to return. Pre-emergent applications should be made in mid-March, although products that possess both pre- and early post-emergent properties may be used through mid-April. Alternatively, if the window of opportunity for pre-emergent application is missed, a combination of a pre-emergent herbicide plus a fairly low rate of a post-emergent herbicide, thoroughly applied to reach the tiny hop plants and seedlings through other vegetation or debris, may be very effective in controlling new growth. Calibration of spray equipment and uniform application of the targeted rate (amount per acre) is crucial when using pre-emergent herbicides. Sulfometuron methyl (Oust® XP at a rate of 1 oz./acre) was found in trials to have the most long-lasting control (through July), with the added benefit of relatively low cost. Metsulfuron methyl, simazine, pendimethalin, and imazapic also provided good pre-emergent control but did not control seeds germinating after June.

Post-Emergent Herbicide. Post-emergent herbicides are products that kill emerged, growing plants in seedling to adult stages. It is the most common approach for weed control and is also effective for management of hop. Ideally, the first application would be made after most seeds have germinated (mid-April to mid-May) and before hop vines are covering the trees (early June to late July, depending on tree size) or before seed formation starts (August). Treatments in August or later can lessen the damage from hop vines and reduce seed production. Applications timed closer to the initiation of seed formation are more likely to prevent seed production before frost. In study plots in the Mid-Atlantic where post-emergent treatments were applied in June, no newly germinated hop seedlings were observed for the remainder of the growing season. However, at least some seeds were produced in all plots, even ones where the treatments were most effective. These seeds were formed on hop vines that were not badly damaged by the treatment or that died back and re-grew from the roots later in the summer. Of the products tested in the mid-Atlantic, metsulfuron methyl (Escort XP® at 1 oz./ac.) and glyphosate (Accord Concentrate® at 1 qt./ac.) provided the greatest control.

Two treatments are recommended in order to protect trees from damage by the hop vines and to prevent or reduce seed production. Effective combinations include a pre-emergent herbicide in early March, or slightly later if using a product with post-emergent properties, followed by post-emergent application in mid-summer, or two post-emergent treatments (mid and late summer) to prevent the fall seed set. The herbicide options can also be combined with efforts to pull vines or regularly mowing. According to The Nature Conservancy, hop seeds in the soil are unlikely to last more than three years. Repeat treatments for two to three years should be expected especially in areas subject to flooding that may receive influx of seed from upstream infestations.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

For more information on Japanese hop management, please contact:

- Philip D. Pannill, U.S. Fish and Wildlife Service, National Conservation Training Center, Shepherdstown, WV, phil_pannill@fws.gov
- Aaron Cook, Western Maryland RC&D, Clear Spring, MD, acook@dnr.state.md.us

SUGGESTED ALTERNATIVE PLANTS

The following native plants grow well in the in sunny sites preferred by Japanese hop:

- Virginia creeper (*Parthenocissus quinquefolia*), an adaptable vine that scrambles along the ground or climbs and adheres with the help of tendrils with sticky disks; has purple to crimson autumn foliage and bluish-black berries on bright red stalks; fruits are favored by birds and other wildlife.
- Coral or trumpet honeysuckle (*Lonicera sempervirens*), a vigorous, sun-loving vine with striking red or yellow flowers and a long flowering period (intermittently April-October).
- Purple passionflower (*Passiflora incarnata*), a hardy, fast-growing annual vine with stunning ornate purple and white flowers, three-lobed leaves, and pale green inflated pulpy fruits called 'maypops.' Blooms from June to September.
- Trumpet creeper (*Campsis radicans*), a hardy, sun-loving, vigorous perennial vine with medium-large orange-red, broad tubular flowers favored by hummingbirds; leaves are opposite and compound; adapted to many soil types.
- Crossvine (*Bignonia capreolata*), perennial vine with showy orange-red flowers in early summer and paired, glossy, semi-evergreen leaves turning reddish-purple in winter; favors moist, well-drained soils.

You can find information about these and other plants by looking them up on the USDA PLANTS Database (http://plants.usda.gov) or on the Native Plant Information Network (http://www.wildflower.org/explore/).

OTHER LINKS

- Invasive.org photos. http://www.invasive.org/species/subject.cfm?sub=10091
- Invasive Plant Atlas of New England. http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=55
- John Hilty's Wildflowers of Illinois. http://www.illinoiswildflowers.info/weeds/plants/jp_hop.htm
- NatureServe Explorer. http://www.natureserve.org/explorer/
- University of Missouri Extension's Vine weeds of Missouri. http://extension.missouri.edu/explore/agguides/pests/ipm1021japanesehop.htm
- Wisconsin Dept. of Natural Resources – Japanese Hop. http://dnr.wi.gov/invasives/fact/japanhop.htm

AUTHORS

Philip D. Pannill, U.S. Fish and Wildlife Service, National Conservation Training Center, Shepherdstown, WV
Aaron Cook, Western Maryland RC&D, Clear Spring, MD
Anne Hairston-Strang, Maryland Department of Natural Resources Forest Service, Annapolis, MD
Jil M. Swearingen, National Park Service, Center for Urban Ecology, Washington, DC

REVIEWER
Sue Salmons, National Park Service, Center for Urban Ecology, Washington, DC

PHOTOGRAPHS
Chris Evans, River to River CWMA, invasive.org
Philip D. Pannill & Aaron Cook
Leslie J. Mehrhoff, University of Connecticut, invasive.org
Philip D. Pannill & Aaron Cook

REFERENCES
Flora: Quality Health from God's Pharmacy.
http://www.florahealth.com/flora/home/Canada/HealthInformation/Encyclopedias/HopsandLupulin.htm#ScientificNames

Indiana Invasive Plant Species Assessment Working Group, 2007. http://www.in.gov/dnr/files/Japanese_Hop.pdf

Kaufmann, S.R. and W. Kaufmann. 2007. Invasive Plants: Guide to Identification and the Impacts and Control of Common North American Species. Stackpole Books. 458 pp.

Pannill, P. and A. Cook. 2008. Management of Japanese Hops on Forest Regeneration Sites. Maryland Department of Natural Resources Forest Service. http://www.dnr.state.md.us/forests/pdfs/jhopreport.pdf

Meyers-Rice, B. 1999. Weed Notes: *Humulus japonicus* Siebold & Zucc. The Nature Conservancy, Wildland Weeds Management and Research. http://www.invasive.org/gist/moredocs/humjap01.pdf

Swearingen, J. 2009. WeedUS Database of Plants Invading Natural Areas in the United States: Japanese Hop (*Humulus japonicus*). http://www.invasive.org/weedus/subject.html?sub=10091

Undersander, D.J., N.J. Ehlke, A.R. Kaminski, J.D. Doll, K.A. Kelling. Hairy Vetch. Alternative Field Crops Manual. University of Wisconsin Cooperative Extension Service, the University of Minnesota Extension Service and the Center for Alternative Plant and Animal Products. http://www.hort.purdue.edu/newcrop/AFCM/vetch.html

U.S. Department of Agriculture. 2005. Weed of the Week. U.S. Forest Service. http://www.invasive.org/weedcd/pdfs/wow/japanese-hop.pdf

USDA, NRCS. 2009. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Zheng, H., Y. Wu, J. Ding, D. Binion, W. Fu and R. Reardon. 2004. Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies, Volume 1. FHTET 2004-5, pp 85-87.