

Taxon: <i>Humulus lupulus L.</i>	Family: Cannabaceae
Common Name(s): common hop European hop hop	Synonym(s):

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 23 Apr 2018
WRA Score: 8.5	Designation: H(HPWRA)	Rating: High Risk

Keywords: Perennial Vine, Temperate, Weedy, Dioecious, Wind-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	n
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y

Qsn #	Question	Answer Option	Answer
303	Agricultural/forestry/horticultural weed		
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
304	Environmental weed		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
402	Allelopathic		
403	Parasitic	y=1, n=0	n
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	y
405	Toxic to animals	y=1, n=0	y
406	Host for recognized pests and pathogens		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	y
412	Forms dense thickets	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m ²)	y=1, n=-1	n

Qsn #	Question	Answer Option	Answer
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Both Cannabis and Humulus are among the oldest cultivated plants." ... "Humulus lupulus (hop) reportedly has been used for brewery of beer in the 8 th century in Europe; since the 1300's it has been in cultivation. In the 1600's it was introduced into N America, and today it is cultivated in many parts of the temperate zones of the northern and the southern hemisphere. Triploids are grown in New Zealand."
	Small, E. (1984). Hybridization in the domesticated-weed-wild complex. Pp. 195-210 in Grant, W. F. (ed.). Plant Biosystematics. Academic Press, Don Mills, Ontario	"Wild and domesticated hops (a separate weedy phase is not recognizable) are quite similar, and it is not surprising that germplasm transfer has taken place readily."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Low
	Source(s)	Notes

Qsn #	Question	Answer
	<p>USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2018]</p>	<p>"Native Africa Northern Africa: Morocco Asia-Temperate Caucasus: Armenia ; Azerbaijan ; Georgia ; Russian Federation Dagestan; Russian Federation-Ciscaucasia Ciscaucasia China: China Gansu, Sichuan, Xinjiang Eastern Asia: Japan Hokkaido, Honshu Middle Asia: Kyrgyzstan Siberia: Russian Federation Buryatia, Gorno-Altay, Altay, Krasnoyarsk, Chita, Irkutsk, Kemerovo, Kurgan, Novosibirsk, Omsk, Tomsk, Tyumen Western Asia: Israel ; Lebanon ; Syria ; Turkey Europe Eastern Europe: Belarus ; Russian Federation-European part European part; Ukraine Middle Europe: Austria ; Belgium ; Czech Republic ; Hungary ; Netherlands ; Poland ; Slovakia ; Switzerland Northern Europe: Denmark ; Finland ; Norway ; Sweden ; United Kingdom Southeastern Europe: Albania ; Bosnia and Herzegovina ; Bulgaria ; Croatia ; Greece ; Italy ; Macedonia ; Montenegro ; Romania ; Serbia ; Slovenia Southwestern Europe: France ; Portugal ; Spain Northern America Eastern Canada: Canada New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec North-Central U.S.A.: United States Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin Northeastern U.S.A.: United States Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia Northern Mexico: Mexico Chihuahua Northwestern U.S.A.: United States Colorado, Montana South-Central U.S.A.: United States New Mexico Southeastern U.S.A.: United States Arkansas, Delaware, Kentucky, Maryland, North Carolina, Virginia Southwestern U.S.A.: United States Arizona, California, Nevada Western Canada: Canada Alberta, Manitoba, Saskatchewan"</p>

202	Quality of climate match data	High
	Source(s)	Notes
	<p>USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2018]</p>	

203	Broad climate suitability (environmental versatility)	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - <i>Humulus lupulus</i> . https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	"Ranging from Boreal Wet through Subtropical Dry Forest Life Zones, hops is reported to tolerate annual precipitation of 3.1 to 13.7 dm (mean of 34 cases = 7.4), annual temperature of 5.6 to 21.3°C (mean of 34 cases = 10.0), and pH of 4.5 to 8.2 (mean of 26 cases = 6.5) (Duke, 1978,1979). Suitable for temperate climates between latitudes 35–51°N and 34–43°S, with mean summer temperatures of 16–18°C. Hops are quite hardy if other growing conditions are good. When dormant, they withstand freezing; however, a severe frost will kill young, tender vines in spring. Annual rainfall requirement is about 30 cm, distributed between March and August. Dry weather in September is best for the harvest. "

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	Notes
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Two spp., native to parts of the northern temperate zone but now widely cultivated, escaped, or naturalised throughout temperate areas of both hemispheres."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Two spp., native to parts of the northern temperate zone but now widely cultivated, escaped, or naturalised throughout temperate areas of both hemispheres."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Bojňanský, V. & Fargašová, A. 2007. Atlas of Seeds and Fruits of Central and East-European Flora: The Carpathian Mountains Region. Springer, Dordrecht, The Netherlands	"A plant, cultivated since ancient times, with obscure origin, probably Europe. The infructescence of a female plant is used in brewing beer, often an escape from hopfields; in the whole Carpathians."
	Missouri Botanical Garden. 2018. <i>Humulus lupulus</i> 'Aureus'. http://www.missouribotanicalgarden.org . [Accessed 23 Apr 2018]	"Hops grown commercially in the U.S. are the European variety which has now escaped cultivation and naturalized in many areas."
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Two spp., native to parts of the northern temperate zone but now widely cultivated, escaped, or naturalized throughout temperate areas of both hemispheres."

Qsn #	Question	Answer
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Waste places, riverbanks, deserted gardens, often scrambling over scrub or trees at forest margins." ... "Humulus has been revised recently by Small, E., Syst. Bot. 3: 37-76 (1978). He recognised 5 vars for <i>H. lupulus</i> ; both cultivated and wild plants in N.Z. fall within <i>H. lupulus</i> var. <i>lupulus</i> . This var. is cultivated for the glandular infructescence which is used in brewing; plants escaped from cultivation are now well-established, persistent weeds in some areas. "
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2018. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/ . [Accessed]	No evidence to date

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"plants escaped from cultivation are now well-established, persistent weeds in some areas. "
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations"
	McAvoy, W.A. (2001). Invasive Plant Species in Delaware. Delaware Natural Heritage Program. http://www.dnrec.state.de.us/fw/invasive.htm . [Accessed 20 Apr 2018]	[<i>Humulus lupulus</i> regarded as a weed. Species highlighted in bold are considered to be the most damaging to natural areas in the state. No significant impacts specified] "This list contains 64 species and varieties of alien vascular plants considered to be invasive in the state of Delaware. These species are, or have extreme potential to be detrimental to natural systems, i.e., displace native vegetation and disrupt ecological processes. This list is based on personal knowledge, consultation with knowledgeable individuals, and the literature. Species highlighted in bold are considered to be the most damaging to natural areas in the state. These species are usually shade tolerant, many have a perennial habit, many reproduce and spread primarily by seed and/or spread rapidly through vegetative means, many occur in a variety of habitat types, and many are currently widespread and abundant in the state or have high potential to become widespread." [<i>Humulus lupulus</i> - common hop perennial herb Disturbed areas, edges, old fields, roadsides, ditches]
	Dave's Garden. (2018). Hops - <i>Humulus lupulus</i> . https://davesgarden.com/guides/pf/go/1115/ . [Accessed 18 Apr 2018]	[Yard & landscaping weed] "On May 15, 2011, micheflowers from Peoria, IL (Zone 5b) wrote: This plant has been very invasive in my yard. It has crawled all over the ground and up and over the fence to cover the mock orange. I thought I had removed most of it last year but it's up stronger than ever this year. It is a beautiful vine but I would only recommend it if you have a farm or acreage. I was unaware that it can cause skin irritants and after trying to remove it last year I had a swollen arm that broke out and was full of itchy scratchy lesions for almost 6 weeks! I also have a client that has the hops vine planted on a very large fence and it is completely out of control and growing all over her beds. Her landscaper has repeatedly tried to dig it out but cannot get all of it. Her vine is in 100 percent sun and mine is in the shade and it has thrived equally well in both settings."

Qsn #	Question	Answer
303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations" [Possibly. Impacts unverified with supporting literature]
	Jensen, P.K., et al. (2011). Survey of Weeds in Maize Crops in Europe. DJF Report Agricultural Science No. 149. Aarhus University, Denmark	"Weed species reported in maize" [Less common/rare - includes <i>Humulus lupulus</i> . Does not indicate negative impacts are occurring]

304	Environmental weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations" [Also included in citations of environmental weeds, but evidence of impacts unable to be verified in supporting literature]
	McAvoy, W.A. (2001). Invasive Plant Species in Delaware. Delaware Natural Heritage Program. http://www.dnrec.state.de.us/fw/invasive.htm . [Accessed 20 Apr 2018]	[<i>Humulus lupulus</i> regarded as a weed. No significant impacts specified] "This list contains 64 species and varieties of alien vascular plants considered to be invasive in the state of Delaware. These species are, or have extreme potential to be detrimental to natural systems, i.e., displace native vegetation and disrupt ecological processes. This list is based on personal knowledge, consultation with knowledgeable individuals, and the literature. Species highlighted in bold are considered to be the most damaging to natural areas in the state. These species are usually shade tolerant, many have a perennial habit, many reproduce and spread primarily by seed and/or spread rapidly through vegetative means, many occur in a variety of habitat types, and many are currently widespread and abundant in the state or have high potential to become widespread." [<i>Humulus lupulus</i> - common hop perennial herb Disturbed areas, edges, old fields, roadsides, ditches]

305	Congeneric weed	y
	Source(s)	Notes
	Balogh, L., & Dancza, I. (2008). <i>Humulus japonicus</i> , an emerging invader in Hungary. Plant invasions: human perceptions, ecological impacts and management. Backhuys Publishers, Leiden, 73-91.	"Although <i>H. japonicus</i> has occurred as a casual alien species in Europe since the late 19th century, it has become naturalized in only a few places, and has not proved to be invasive outside Hungary. However, it has become invasive in the eastern part of the temperate zone of Northern America. The causes of variation in invasion success of <i>H. japonicus</i> in different regions need further studies. According to Hungarian experience, the inundation areas are most exposed to invasion where even a single plant of <i>H. japonicus</i> can spread over a large area. However, future spread of this species can be expected also in the vicinity of historical and botanical gardens. The early detection, monitoring and control of <i>H. japonicus</i> will allow us to prevent the species from becoming a widespread, dangerous invasive plant. Its populations can be suppressed mainly mechanically along living waters, while in other areas chemical methods can also be applied. This study wishes to encourage further investigations into the invasion ecology of <i>H. japonicus</i> by summarizing the knowledge on the species."

Qsn #	Question	Answer
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	" <i>Humulus japonicus</i> ... Weed of: Forestry, Orchards & Plantations, Pastures"
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Two spp., native to parts of the northern temperate zone but now widely cultivated, escaped, or naturalized throughout temperate areas of both hemispheres."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Plants perennial. Petiole usually shorter than leaf blade; leaf blade 35(7)-lobed, sometimes simple, 411 × 48 cm, abaxially glabrous or with scattered soft pubescence but without rigid spinulose hairs on veins, adaxially with few or no cystolith hairs marginally when young, base cordate, margin coarsely serrate, apex acute."

402	Allelopathic	n
	Source(s)	Notes
	Zhang, X. H., Zhang, E. H., & Lang, D. Y. (2011). Autotoxic compounds from rhizosphere soil of <i>Humulus lupulus L.</i> extracts: identification and biological activity. <i>Agronomy Journal</i> , 103(3), 695-701	[Potentially allelopathic against other hops plants] "Hop (<i>Humulus lupulus L.</i>) is a perennial herb that has been widely used in brewing around the world. Autotoxicity has been reported as one of the major problems hindering continuous hop cultivation. In this study, the autotoxic compounds from rhizosphere soil of hop fields at different time periods of hop cultivation were separated and identified by gas chromatography–mass spectrometry (GC– MS)." ... "These results suggest that 2,4-bis(1,1-dimethylethyl)-phenol is involved in hops autotoxicity and that autotoxicity is the main deterrent to the success of hops replanting." ... "Autotoxicity is an intraspecific allelopathy that occurs when a plant species releases chemicals that inhibit or delay germination and growth of the same plant species."

403	Parasitic	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Herbs, perennial or annual, twining, dioecious." [Cannabaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Small, E. (1980). The relationships of hop cultivars and wild variants of <i>Humulus lupulus</i> . <i>Canadian Journal of Botany</i> , 58(6), 676-686	"Although used for such varied purposes as ornament, bread making, stuffing of pillows, salad greens, textile fibers, fodder, and pharmaceuticals, for centuries hop plants have been employed primarily as an ingredient in brewing fermented liquors ..."

Qsn #	Question	Answer
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 23 Apr 2018]	"Conventionally, the spent hops are often used as fodder or manure."
	Siuda, A., Żurowski, W., & Siuda, H. (1969). The food of the roe deer. Acta Theriologica, 14(18), 247-262	"Table 2. Particulars of rumen contents of roe-deer at different seasons of the year." [Includes Humulus lupulus]

405	Toxic to animals	y
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 23 Apr 2018]	"Conventionally, the spent hops are often used as fodder or manure." [No evidence]
	Wag! 2018. Hops Poisoning in Dogs. https://wagwalking.com/condition/hops-poisoning . [Accessed 23 Apr 2018]	"Hops flowers are used to flavor beer during the brewing process. They can be extremely toxic to dogs and large amounts can quickly cause death. This is called hops toxicity. It has become more common with the increased popularity of home brewing."
	Fuller, T.C. & McClintock, E.M. 1986. Poisonous plants of California: Issue 53 of California natural history guides. University of California Press, Berkeley and Los Angeles, CA	"Humulus lupulus ... Hop pickers may develop vesicular dermatitis on the hands, face, and genitals. The rough hairs on the leaves may cause mechanical abrasion." [No evidence of toxicity to animals]

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 23 Apr 2018]	"Many fungi cause diseases in hop plants: Armillaria mellea, Ascochyta humuli, Cercospora cannabis, C. humuli, Erysiphe cichoracearum, Fumago vagans, Fusarium oxysporum, F. sambucinum, F. solani, Gibberella pulicaria, Glomerella cingulata, Leptosphaeria doliolu, Mycosphaerella erysiphina, Oidium erysiphoides, Peronoplasmopara humuli, Phyllosticta decidua, Ph. humuli, Cylindrosporium humuli, Phytophthora cactorum, Podosphaera humuli, Pseudoperonospora humuli (Downy mildew), Rhizoctonia solani, Sclerotinia libertiana, S. sclerotiorum, Septoria humuli, S. lupulina, Sphaerotheca humuli, S. macularis, Typhula humulina, Ureolella tami var. humuli, Verticillium albo-atrum, V. dahliae, V. tricorpus, Botrytis cinerea (Gray mold). Following bacteria also attack hops: Agrobacterium tumefaciens, Corynebacterium humuli and Pseudomonas cannabina. Cuscuta europaea also parasitizes the plant. Viruses known to attack hops include: Chlorotic disease, Chlorotic mosaic, Fluffy tip, Mosaic, Nettlehead Humulus virus 2, and Split-leaf blotch. Nematodes isolated from hops include: Ditylenchus destructor, Heterodera humuli, Meloidogyne hapla, M. incognita, and M. javanica, (Golden, p.c. 1984). Injury by aphids and spider mites (Tetranychus) may be serious."
	Missouri Botanical Garden. 2018. Humulus lupulus 'Aureus'. http://www.missouribotanicalgarden.org . [Accessed]	"No serious insect or disease problems."

407	Causes allergies or is otherwise toxic to humans	

Qsn #	Question	Answer
	Source(s)	Notes
	Fuller, T.C. & McClintock, E.M. 1986. Poisonous plants of California: Issue 53 of California natural history guides. University of California Press, Berkeley and Los Angeles, CA	"Humulus lupulus ... Hop pickers may develop vesicular dermatitis on the hands, face, and genitals. The rough hairs on the leaves may cause mechanical abrasion."
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	[Can cause dermatitis in susceptible individuals] "Hops dermatitis has long been recognized. Not only hands and face, but legs have suffered purpuric eruptions due to hop picking. Although only 1 in 3,000 workers is estimated to be treated, one in 30 are believed to suffer dermatitis (Mitchell and Rook, 1979)."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Potentially yes to susceptible individuals] "Hop pickers can develop allergic responses and dermatitis from working with common hop plants. The hairs on the leaves may cause mechanical abrasion of the skin."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 23 Apr 2018]	[Does not occur in fire prone areas] "Ranging from Boreal Wet through Subtropical Dry Forest Life Zones, hops is reported to tolerate annual precipitation of 3.1 to 13.7 dm (mean of 34 cases = 7.4), annual temperature of 5.6 to 21.3°C (mean of 34 cases = 10.0), and pH of 4.5 to 8.2 (mean of 26 cases = 6.5) (Duke, 1978,1979). Suitable for temperate climates between latitudes 35–51°N and 34–43°S, with mean summer temperatures of 16–18 C. Hops are quite hardy if other growing conditions are good."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Plants for a Future. (2018). Humulus lupulus. https://www.pfaf.org/user/Plant.aspx?LatinName=Humulus+lupulus . [Accessed 23 Apr 2018]	"It can grow in semi-shade (light woodland) or no shade."
	Missouri Botanical Garden. 2018. Humulus lupulus 'Aureus'. http://www.missouribotanicalgarden.org . [Accessed 23 Apr 2018]	"Sun: Full sun to part shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	"Hops do well over a wide range of soils provided they are fertile and moisture-holding. Light to heavy loams are best. Soil depth of 45 dm is required for the Goldings varieties."
	Plants for a Future. (2018). Humulus lupulus. https://www.pfaf.org/user/Plant.aspx?LatinName=Humulus+lupulus . [Accessed 20 Apr 2018]	"Suitable for: light (sandy), medium (loamy) and heavy (clay) soils. Suitable pH: acid, neutral and basic (alkaline) soils."

411	Climbing or smothering growth habit	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Climbing shrub, female flowers in cone-like catkins"
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Herbs, perennial or annual, twining, dioecious."

412	Forms dense thickets	n
	Source(s)	Notes
	Duke, J.A. 1983. Handbook of Energy Crops - <i>Humulus lupulus</i> . https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 23 Apr 2018]	[No evidence. Vine] "Perennial herbaceous vine, living 10–20 years, with horizontal and vertical roots, the horizontal roots spreading out at depth of 20–30 cm and giving rise to fibrous roots in upper layers of soil, the vertical roots developing downward to depth of 152 cm with spread of 183–244 cm with no fibrous roots"

501	Aquatic	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial] "Plants perennial. Petiole usually shorter than leaf blade" ... "This species is cultivated throughout China, especially in E Shandong (Qingdao) and Xinjiang. The flowers and infructescences are important ingredients for beer making. The female flowers and bracts are used medicinally."

502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Apr 2018]	"Family: Cannabaceae"

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Apr 2018]	"Family: Cannabaceae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes

Qsn #	Question	Answer
	Robbins, W. R. (1917). The Botany of Crop Plants: A Text and Reference Book. P. Blakiston's Son & Company, Philadelphia, PA	"The root system of the common hop plant is large as compared with above ground parts. This holds true in both young and old plants. The roots extend to considerable depths in the soil and also spread horizontally in the surface layers. They give rise to a fine network of small rootlets. Older roots become covered with a reddish-brown bark."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Apr 2018]	No evidence. Widespread native & cultivated ranges

602	Produces viable seed	y
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Achenes flat, included in bracts."
	Small, E. (1984). Hybridization in the domesticated-weed-wild complex. Pp. 195-210 in Grant, W. F. (ed.). Plant Biosystematics. Academic Press, Don Mills, Ontario	"Hops are dioecious, and the staminate plants are removed as soon as they can be recognized in hop yards, since they contribute no fruits, and indeed seedless hops are often desired. But in fact even in "seedless" hop yards, one frequently encounters seeds and seedlings, male plants managing to make an appearance in or near to the yards."
	Duke, J.A. 1983. Handbook of Energy Crops - <i>Humulus lupulus</i> . https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	"Plants propagated from seed which require dormancy period for germination. More frequently propagation from layering or cuttings from established stocks each place."
	Plants for a Future. (2018). <i>Humulus lupulus</i> . https://www.pfaf.org/user/Plant.aspx?LatinName=Humulus+lupulus . [Accessed 18 Apr 2018]	"Propagation - Seed - sow spring in a cold frame[37]. Germination is fairly quick. Prick out the seedlings into individual pots as soon as they are large enough to handle and plant out in the summer or following spring."

603	Hybridizes naturally	
	Source(s)	Notes
	Small, E. (1984). Hybridization in the domesticated-weed-wild complex. Pp. 195-210 in Grant, W. F. (ed.). Plant Biosystematics. Academic Press, Don Mills, Ontario	[Natural hybridization may occur between wild and cultivated plants. Unknown if natural congeneric hybridization occurs] "Much of the genetic "contamination" by wild plants seems to have been due to unscrupulous suppliers of the rhizome cuttings used by hop planters in the past, the indistinguishable and more easily obtained wild plants often being sold (Davis, 1957). The "contaminated" product obviously has proven acceptable in North America and Japan. One wonders whether other food plants and other cultures have acquired distinctive regional tastes as a result of local hybridization."

Qsn #	Question	Answer
604	Self-compatible or apomictic	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Herbs, perennial or annual, twining, dioecious."
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	"plants dioecious with unisexual flowers on separate plants, but occasionally monoecious plants occur, in which case male or female flowers are often infertile"

605	Requires specialist pollinators	n
	Source(s)	Notes
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Cannabaceae" ... "POLLINATION. The members of the family are wind-pollinated. The stigmata are reported to be exerted from the bracts and receptive 4-5 days. The staminate flowers are generally pendent at anthesis, but rather than expelling their pollen at once, the pollen sacs gradually dehisce basipetally by a longitudinal slit. Initially, pollen sifts through an apical oval opening having the appearance of a pore."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Male inflorescences laxly paniculate. Male flowers: filaments straight in bud; female inflorescences a cone-like spicate cyme; bracts imbricate, persistent and enlarged in fruit, margin entire. Female flowers: calyx thinly membranous, appressed to ovary, margin entire; ovary ± surrounded by appressed calyx; styles 2-branched; branches caducous."
	Robbins, W. R. (1917). The Botany of Crop Plants: A Text and Reference Book. P. Blakiston's Son & Company, Philadelphia, PA	"The long, brush-like stigmas adapt the plant to wind pollination. When the pistillate inflorescences are young, the stigmas protrude from between the small "bracts" and become very conspicuous. Only the basal bracts of the inflorescence are to be seen. As soon as fertilization has taken place the stigmas ("brush") drop off and the "bracts" rapidly increase in size."
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 20 Apr 2018]	"wind-pollinated; female inflorescence cone-like, 2.5–5 cm long; male flowers in long racemes."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Sullivan, J. J., Williams, P. A., Timmins, S. M., & Smale, M. C. (2009). Distribution and spread of environmental weeds along New Zealand roadsides. <i>New Zealand Journal of Ecology</i> , 33(2): 190-204	"Road users and maintenance practices, particularly the use of roadside slashers, are important dispersers of roadside weeds and numerous websites are devoted to codes of best practice to minimise this (e.g. Tyers et al. 2004). Species reliant on vegetative spread benefit particularly from this practice, e.g. domestic hops (<i>Humulus lupulus</i>) in the Buller catchment, Nelson (PAW, pers. obs.)."

607	Minimum generative time (years)	3
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Qsn #	Question	Answer
	Source(s)	Notes
	Ladenburger, K. 2014. Getting Hoppy. MaximumYield. https://www.maximumyield.com/getting-hoppy/2/1171 . [Accessed 23 Apr 2018]	"In the first year, plants grown from a new rhizome will not deliver sprawling monster vines and tons of hops. The plants may not even flower in that first year. But as the years go by, the yields get bigger. The hops plant reaches maturity at around its third year. From then on it is possible to grow giant plants with massive yields."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Sullivan, J. J., Williams, P. A., Timmins, S. M., & Smale, M. C. (2009). Distribution and spread of environmental weeds along New Zealand roadsides. <i>New Zealand Journal of Ecology</i> , 33(2): 190-204	"Road users and maintenance practices, particularly the use of roadside slashers, are important dispersers of roadside weeds and numerous websites are devoted to codes of best practice to minimise this (e.g. Tyers et al. 2004). Species reliant on vegetative spread benefit particularly from this practice, e.g. domestic hops (<i>Humulus lupulus</i>) in the Buller catchment, Nelson (PAW, pers. obs.)."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.). 1993. The Families and Genera of Vascular Plants: Volume II. Flowering Plants. Dicotyledons: Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin, Heidelberg, New York	"Two spp., native to parts of the northern temperate zone but now widely cultivated, escaped, or naturalised throughout temperate areas of both hemispheres."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2003. <i>Flora of China</i> . Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Achenes flat, included in bracts."
	Butaye, J., Jacquemyn, H., & Hermy, M. (2001). Differential colonization causing non-random forest plant community structure in a fragmented agricultural landscape. <i>Ecography</i> , 24(4), 369-380	"Table 4. ... <i>Humulus lupulus</i> ... Dispersal mechanism - Ane: anemochorous"

Qsn #	Question	Answer
705	Propagules water dispersed	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"

706	Propagules bird dispersed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"
	Robbins, W. R. (1917). The Botany of Crop Plants: A Text and Reference Book. P. Blakiston's Son & Company, Philadelphia, PA	[No adaptations for bird dispersal] "The Mature Fruit.—The fruit ... is a small achene surrounded by the persistent cup-shaped perianth. The single seed within has a curved embryo about which is a small amount of endosperm."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Robbins, W. R. (1917). The Botany of Crop Plants: A Text and Reference Book. P. Blakiston's Son & Company, Philadelphia, PA	[No means of external attachment] "The Mature Fruit.—The fruit (Fig. 105) is a small achene surrounded by the persistent cup-shaped perianth. The single seed within has a curved embryo about which is a small amount of endosperm."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Unknown if seeds can be dispersed externally in wool of sheep or fur of other animals] "Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"

708	Propagules survive passage through the gut	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee" [Unknown if seeds survive gut passage if incidentally consumed by cattle, sheep or other livestock]

Qsn #	Question	Answer
801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Small, E. (1984). Hybridization in the domesticated-weed-wild complex. Pp. 195-210 in Grant, W. F. (ed.). Plant Biosystematics. Academic Press, Don Mills, Ontario	"Hops are dioecious, and the staminate plants are removed as soon as they can be recognized in hop yards, since they contribute no fruits, and indeed seedless hops are often desired. But in fact even in "seedless" hop yards, one frequently encounters seeds and seedlings, male plants managing to make an appearance in or near to the yards."
	Robbins, W. R. (1917). The Botany of Crop Plants: A Text and Reference Book. P. Blakiston's Son & Company, Philadelphia, PA	"Salmon and Amos have shown that, in England at least, seeded hops bearing an average of 9.5 seeds per hop"
	Duke, J.A. 1983. Handbook of Energy Crops - Humulus lupulus. https://www.hort.purdue.edu/newcrop/duke_energy/Humulus_lupulus.html . [Accessed 30 Apr 2018]	"Some triploid varieties grown in Europe are seedless."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Seed Longevity: Long Term"
	Royal Botanic Gardens Kew. (2018) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 23 Apr 2018]	"Storage Behaviour: Orthodox Storage Conditions: Seeds stored dry at room temperature (Williams & Weston, 1958); viability maintained after 8 years hermetic storage at -18°C (Montezuma-De-Carvalho et al., 1984)"
	Balogh, L., & Dancza, I. (2008). Humulus japonicus, an emerging invader in Hungary. Plant invasions: human perceptions, ecological impacts and management. Backhuys Publishers, Leiden, 73-91.	[Related species has seeds which persist for 3 years] "Fruits ripen from the middle of August and do not remain viable for long; they disappear from the soil seed bank within three years (Krauss 1931)."

803	Well controlled by herbicides	
	Source(s)	Notes
	Balogh, L., & Dancza, I. (2008). Humulus japonicus, an emerging invader in Hungary. Plant invasions: human perceptions, ecological impacts and management. Backhuys Publishers, Leiden, 73-91.	[Herbicides may be effective on related taxon] "Meyers-Rice (1999) proposes spot-application of the systemic glyphosate herbicide, before flowering; optimum shoot-length for control is 15-20 cm in spring. However, as in Hungary H. japonicus infests primarily (semi)natural riparian habitats, chemical weed control is not an option in order to protect the non-target species and the integrity of habitats."
	Steffen, B. & Edgin, B. 2007. Vegetation Management Guideline Japanese Hops (Humulus japonicus Sieb. & Zucc.). Illinois Department of Natural Resources, Goreville, IL & Illinois Nature Preserves Commission, Newton, IL	[Related taxon may be controlled by herbicides] "Triclopyr (Garlon 3A, Tahoe 3A) are broadleaf specific herbicides that can control Japanese hops. For Garlon 3A and Tahoe 3A, a 2 % solution (2 ½ ounces of herbicide per gallon of solution) is recommended. Garlon 3A and Tahoe 3A are rainfast in 3 hours, Curtail in six hours. Apply the herbicides to thoroughly cover the plants."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Missouri Botanical Garden. 2018. <i>Humulus lupulus</i> 'Aureus'. http://www.missouribotanicalgarden.org . [Accessed 23 Apr 2018]	"Plants die to the ground each winter, but perennial roots survive to send up new growth each spring. Stems may be pruned to the ground in autumn after a hard frost. Propagate by cuttings of runners emanating from the crown."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability
- Widely cultivated & naturalized in temperate areas (but no evidence in Hawaiian Islands to date)
- A yard, garden & general weed of cultivated lands
- Potential agricultural & environmental weed (impacts unverified)
- *Humulus japonicus* is invasive
- Toxic to dogs
- May cause dermatitis to susceptible individuals
- Tolerates many soil types
- Climbing & potential smother habit
- Reproduces by seeds & vegetative fragments
- Seeds dispersed by wind, water, animals & intentionally by people
- Vegetative fragments dispersed by machinery
- Seeds persist for >1 year (possibly 3 years)
- Tolerates cutting & freezing (regrows from roots)

Low Risk Traits

- Primarily grows in temperate climates (may limit ability to persist & spread to higher elevation areas of tropical islands)
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock (palatable to some grazing animals despite toxicity to dogs)
- Integral ingredient in beer brewing
- Dioecious (female flowers used in brewing; eliminates seed production if no male plants are present)
- Herbicides may provide effective control