Taxon: Zanthoxylum piperitum (L.) DC. **Family:** Rutaceae

Common Name(s): Japanese pepper
Japanese prickly ash

Synonym(s): Fagara piperita L.
Zanthoxylum ovalifoliolatum Nakai

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 4 May 2023

WRA Score: **-2.0** **Designation:** L **Rating:** Low Risk

Keywords: Temperate Tree, Spiny, Shade Tolerant, Dioecious, Bird-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
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
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	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	?
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	n
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	y
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	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	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
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	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	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
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
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	n
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
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
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**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Hills and mountains; Hokkaido, Honshu, Shikoku, Kyushu; rather common and frequently cultivated. Korea, Manchuria, and China." [No evidence]

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2023). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2023). 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**
	Staples, G. & Kristiansen, M.S. (1999). Ethnic culinary herbs: a guide to identification and cultivation in Hawaii. University of Hawaii Press, Honolulu, HI	" ... Zanthoxylum piperitum (Linnaeus) de Candolle, a temperate zone specie that does not thrive in our climate except at higher elevations."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 2 May 2023]	"Asia-Temperate CHINA: China EASTERN ASIA: Korea, Japan [Hokkaidô, Honshu, Kyushu, Shikoku]"

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 2 May 2023]	

203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 2 May 2023]	"Asia-Temperate CHINA: China EASTERN ASIA: Korea, Japan [Hokkaidô, Honshu, Kyushu, Shikoku]"

Qsn #	Question	Answer
	Staples, G. & Kristiansen, M.S. (1999). Ethnic culinary herbs: a guide to identification and cultivation in Hawaii. University of Hawaii Press, Honolulu, HI	"This Okinawan species is used in Hawai'i in the same way as true Japanese sansho, derived from Zanthoxylum piperitum (Linnaeus) de Candolle, a temperate zone specie that does not thrive in our climate except at higher elevations."
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"USDA hardiness: 5-9"

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 2 May 2023]	"Native Asia-Temperate CHINA: China EASTERN ASIA: Korea, Japan [Hokkaidô, Honshu, Kyushu, Shikoku]"
	KewScience. (2023). Plants of the World Online - Zanthoxylum piperitum. http://powo.science.kew.org. [Accessed 3 May 2023]	"The native range of this species is China to S. Korea, Japan. It is a shrub or tree and grows primarily in the temperate biome."
	Staples, G. & Kristiansen, M.S. (1999). Ethnic culinary herbs: a guide to identification and cultivation in Hawaii. University of Hawaii Press, Honolulu, HI	"This Okinawan species is used in Hawai'i in the same way as true Japanese sansho, derived from Zanthoxylum piperitum (Linnaeus) de Candolle, a temperate zone specie that does not thrive in our climate except at higher elevations."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 2 May 2023]	No evidence

205	Does the species have a history of repeated introductions outside its natural range?	?
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Crop, Herbal, Ornamental Dispersed by: Humans"
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"rather common and frequently cultivated." [Whether cultivated within or outside native range not specified.]
	Staples, G. & Kristiansen, M.S. (1999). Ethnic culinary herbs: a guide to identification and cultivation in Hawaii. University of Hawaii Press, Honolulu, HI	"Zanthoxylum piperitum (Linnaeus) de Candolle, a temperate zone specie that does not thrive in our climate except at higher elevations."

301	Naturalized beyond native range	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 2 May 2023]	No evidence

Qsn #	Question	Answer
	GBIF Secretariat (2023). Zanthoxylum piperitum (L.) DC. GBIF Backbone Taxonomy. Checklist dataset. https://www.gbif.org/species/7269282. [Accessed 2 May 2023]	No evidence

302	Garden/amenity/disturbance weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	GBIF Secretariat (2023). Zanthoxylum piperitum (L.) DC. GBIF Backbone Taxonomy. Checklist dataset. https://www.gbif.org/species/7269282. [Accessed 2 May 2023]	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi. [Accessed 2 May 2023]	No evidence

304	Environmental weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi. [Accessed 2 May 2023]	No evidence

305	Congeneric weed	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Chiara, M., Gentili, R., Citterio, S., & Galasso, G. (2016). Zanthoxylum armatum (Rutaceae) a new invasive species in Italy 111° Congresso della Società Botanica Italiana. III International Plant Science Conference. At: Università di Roma Tor Vergata, Orto Botanico	[Potentially] "Z. armatum DC. is a deciduous shrub native to South and East Asia (fig. 1-4). It is an important plant in traditional herbal medicine (e.g. China, India) and it is cultivated in different part of the globe (1, 2) for ornamental and alimentary purposes. Due to its qualities, Z. armatum was introduced to Italy at Hanbury Botanical Gardens (Ventimiglia, IM) in 1868 (3), and then cultivated in other Italian botanical institutions. First official evidences of naturalization in Italy dated back to 2012: a naturalized population of Z. armatum was found in the mesophilous mixed woods of Blevio (CO) (4). Progressively other records of naturalization have been collected in Italy. Episodes of naturalization and spread are known also in Argentina (Cordoba province), where the species is cultivated and classified as naturalized neophyte (1)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	A number of species are classified as naturalized or weeds of some type. Unable to verify or corroborate negative impacts.
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi. [Accessed 2 May 2023]	No evidence

401	Produces spines, thorns or burrs	y
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Dioecious shrub; prickles on branches at base of leaves 2, 5-8 mm. long; leaves puberulous while young, 5-15 cm. long, short-petiolate, the leaflets 11-19, sessile, broadly lanceolate to ovate, 1-3.5 cm. long, 6--12 mm. wide, emarginate, cuneate to obtuse at base, obtusely toothed with pellucid glands in the sinus; inflorescence terminal on short branches, pedunculate, many-flowered; flowers greenish yellow, small."

402	Allelopathic	
	Source(s)	**Notes**
	Patiño, L. O. J., Prieto, R. J. A., & Cuca, S. L. E. (2011). Zanthoxylum genus as potential source of bioactive compounds. Bioactive Compounds in Phytomedicine, 10, 184-218. InTech, Rijeka, Croatia	[Unknown] "There are few reports on allelopathic activity of Zanthoxylum species. One report shows a bioguided fractionation of the ethyl acetate extract of the Z. limonella fruits led to the isolation of xanthoxyline, a substance with allelopathic effects of on Chinese amaranth (Amaranthus tricolor L.) and Barnyardgrass (Echinochloa crus-galli (L.) Beauv.). At a concentration of 2500µM, xanthoxyline completely inhibited seed germination and growth of Chinese amaranth, and showed a significantly inhibitory effect on seed germination of Barnyardgrass by 43.59% (Charoenying et al., 2010)."

403	Parasitic	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Deciduous shrub with prickles thickened at base; petioles wingless; leaflets 11-19, I-3.5 cm. long." [Rutaceae. No evidence]

404	Unpalatable to grazing animals	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Tsuji, Y., & Jacobs, D. S. (2011). Sleeping-site preferences of wild Japanese macaques (Macaca fuscata): the importance of nonpredatory factors. Journal of Mammalogy, 92(6), 1261–1269	[Macaques feed on bark] "Macaques spend much time feeding on the leaves and flowers of B. thunbergii in spring (18-29% of their total feeding time), on the fruits of berries of V. dilatatum and R. multijlora in fall (14-36%), and on the thorny bark of Z. piperitum in winter and spring (4-15%), respectively (Tsuji and Takatsuki 2004; Tsuji et al. 2006). The densities of these plant species therefore seemed to affect the foraging locations of the macaques before sleep."
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	[Possibly. Used for human consumption] "Seed - cooked. It is ground into a powder and used as a condiment, a pepper substitute[1, 2, 11, 34, 183]. The fruit can also be used[116]. It is often heated in order to bring out its full flavour and can be mixed with salt for use as a table condiment[183]. The ground and dry-roasted fruit is an ingredient of the Chinese 'five spice powder'[238]. The bark and leaves are used as a spice[2, 105, 238]. Young leaves - raw or cooked. They are used in soups or as a flavouring in salads[177, 179, 183]."
	Feldhamer, G. A. (1980). Cervus nippon. Mammalian Species, 128, 1–7	[Reported to be unpalatable to Sika deer. Thorns may deter browsing] "Sika deer in the Tanzawa Mountains, Japan, utilized 72 species of trees and shrubs, and 34 species of forbs and grasses (Furubayashi and Maruyama, 1977). Twenty-three species of generally unpalatable plants were recorded on Kinkazan Island, Japan (Ito, 1967, 1975), and included thorn-shrubs (Zanthoxylum piperitum and Z. schinifolium), Japanese barberry (Berberis thunbergi), fetter-hush (Leucothoe grayana) and sunflower (Senecio cannabifolius)."
	Ito, T. (1975). Ecological Studies on the Japanese Deer, Cervus nippon nippon Temminck on Kinkazan Island V. Development And Distribution of the Unpalatable Plant Societies for Deer. Bulletin of The Marine Biological Station of Asamushi 15(3): 115-129	[Young growth browsed] "The newly grown sprouts of Zanthoxylum piperitum are occasionally nibbled from spring to early summer. At the north end of the Shikayama grassland the cone-shaped browsed forms of this species with finely branching twigs and small leaves are scattered between 180 to 220 meters in altitude."

405	Toxic to animals	n
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"Known Hazards None known"

Qsn #	Question	Answer
	Hieu, T. T., Kim, S. I., & Ahn, Y. J. (2014). Toxicity of Zanthoxylum piperitum and Zanthoxylum armatum oil constituents and related compounds to Stomoxys calcitrans (Diptera: Muscidae). Journal of Medical Entomology, 49(5), 1084-1091	[Distillate may be toxic to insects] "Zanthoxylum plants (Rutaceae) have drawn attention because they contain insecticidal principles against insects. An assessment was made of the insecticidal and acetylcholinesterase (AChE) inhibitory activities of Zanthoxylum piperitum steam distillate and Zanthoxylum armatum seed oil, their 28 constituents, and eight structurally related compounds against female stable fly, Stomoxys calcitrans (L.). Results were compared with those of two organophosphorus insecticides chlorpyrifos and dichlorvos. Potent fumigant toxicity was observed with cuminaldehyde, thymol, (1S)-(-)-verbenone, (-)-myrtenal, carvacrol, (S)-(Z)-verbenol, Zanthoxylum piperitum steam distillate, cuminyl alcohol, Zanthoxylum armatum seed oil, piperitone, (-)-(Z)-myrtanol, and citronellal (LC50, 0.075–0.456 μg/cm3). However, they were five orders of magnitude less toxic than either chlorpyrifos or dichlorvos. An in vitro bioassay using female fly heads indicates that strong AChE inhibition was produced by citronellyl acetate, α-pinene, thymol, carvacrol, and α-terpineol (1.20–2.73 mM), but no direct correlation between fly toxicity and AChE inhibition by the test compounds was observed. Structure–activity relationships indicate that structural characteristics, such as carbon skeleton, degrees of saturation and types of functional groups, and vapor pressure parameter, appear to play a role in determining toxicities of the test monoterpenoids to stable flies. Global efforts to reduce the level of highly toxic synthetic insecticides in the agricultural environment justify further studies on Z. piperitum and Z. armatum oil-derived materials as potential insecticides for the control of stable fly populations."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"One of mine was attacked by spider mites and I sprayed it with a pesticide to kill them."
	Deka, B., Babu, A., & Sarkar, S. (2020). Scirtothrips dorsalis, Hood (Thysanoptera: Thripidae): A major pest of tea plantations in North East India. Journal of Entomology and Zoology Studies, 8, 1222-1228	[Broad host range includes Zanthoxylum piperitum] "Scirtothrips dorsalis Hood, is a polyphagous insect found colonizing on several crops including cotton, chilli, mango, pepper, citrus, grapes, strawberry, and peanuts including tea. Tea thrips feed the host plant tissues using the piercing and sucking mouth parts and consume the plant sap resulting curling and silvering of the tea leaves, which causes considerable yield loss in India, during the last few decades, the infestation of thrips has been increasing and it get recognized as a foremost sucking pests in the tea cultivated regions in India. Besides deforestation, climate change, continuous application of synthetic pesticides the biological characteristics like high reproductive rate, short generation time, has led to resistance to synthetic insecticides along with their manipulation in periodical outbreaks. In this review, all accessible information on S. dorsalis damaging the tea plants have been summarized in framework of its management strategies."

Qsn #	Question	Answer
407	**Causes allergies or is otherwise toxic to humans**	**n**
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"Known Hazards None known"
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	**Creates a fire hazard in natural ecosystems**	**n**
	Source(s)	**Notes**
	Staples, G. & Kristiansen, M.S. (1999). Ethnic culinary herbs: a guide to identification and cultivation in Hawaii. University of Hawaii Press, Honolulu, HI	"Zanthoxylum piperitum (Linnaeus) de Candolle, a temperate zone specie that does not thrive in our climate except at higher elevations" [A temperate tree. No evidence of increased fire risk in native range]

409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"Easily grown in loamy soils in most positions, but prefers a good deep well-drained moisture retentive soil in full sun or semi-shade[1, 11, 200]." ... " Some reports suggest it can grow in deep shade."
	BALKEP. (2023). Japanese Pepper Tree - Zanthoxylum piperitum. https://www.balkep.org/zanthoxylum-piperitum.html. [Accessed 2 May 2023]	"It can grow in the deep shade of a forest making this an ideal candidate for the forest garden."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 2 May 2023]	"A deciduous shrub growing to about 15 feet, preferring a loamy soil but not really fussy as to soil or location."
	BALKEP. (2023). Japanese Pepper Tree - Zanthoxylum piperitum. https://www.balkep.org/zanthoxylum-piperitum.html. [Accessed 2 May 2023]	"It's easily grown in a variety of soil types and can tolerate quite cold temperatures, some wind and drought." ... "Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well drained soil. Suitable pH: acid, neutral and basic (alkaline) soils"

411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Zanthoxylum piperitum (L.) DC. Fagara piperita L.--SANSHO. Dioecious shrub; prickles on branches at base of leaves 2, 5-8 mm. long; leaves puberulous while young, 5-15 cm. long, short-petiolate, the leaflets 11-19, sessile, broadly lanceolate to ovate, 1-3.5 cm. long, 6--12 mm. wide, emarginate, cuneate to obtuse at base, obtusely toothed with pellucid glands in the sinus; inflorescence terminal on short branches, pedunculate, many-flowered; flowers greenish yellow, small."

412	Forms dense thickets	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Hills and mountains; Hokkaido, Honshu, Shikoku, Kyushu; rather common and frequently cultivated. --Korea, Manchuria, and China."
	WRA Specialist. (2023). Personal Communication	No evidence found

501	Aquatic	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	[Terrestrial] "Dioecious shrub; prickles on branches at base of leaves 2, 5-8 mm. long; leaves puberulous while young, 5-15 cm. long, short-petiolate, the leaflets 11-19, sessile, broadly lanceolate to ovate, 1-3.5 cm. long, 6--12 mm. wide, emarginate, cuneate to obtuse at base, obtusely toothed with pellucid glands in the sinus; inflorescence terminal on short branches, pedunculate, many-flowered; flowers greenish yellow, small.--Apr.-May. Hills and mountains; Hokkaido, Honshu, Shikoku, Kyushu; rather common and frequently cultivated."

502	Grass	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 1 May 2023]	"Family: Rutaceae Subfamily: Toddalioideae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 1 May 2023]	"Family: Rutaceae Subfamily: Toddalioideae"

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

Qsn #	Question	Answer
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Dioecious shrub; prickles on branches at base of leaves 2, 5-8 mm. long; leaves puberulous while young, 5-15 cm. long, short-petiolate, the leaflets 11-19, sessile, broadly lanceolate to ovate, 1-3.5 cm. long, 6--12 mm. wide, emarginate, cuneate to obtuse at base, obtusely toothed with pellucid glands in the sinus"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	KewScience. (2023). Plants of the World Online - Zanthoxylum piperitum. http://powo.science.kew.org. [Accessed 3 May 2023]	"Conservation LC - least concern"

602	Produces viable seed	y
	Source(s)	**Notes**
	BALKEP. (2023). Japanese Pepper Tree - Zanthoxylum piperitum. https://www.balkep.org/zanthoxylum-piperitum.html. [Accessed 3 May 2023]	"It is in flower in June, and the seeds ripen in October"
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 3 May 2023]	"Propagation: Seed - best sown in a greenhouse as soon as it is ripe in the autumn. Stored seed may requires up to 3 months cold stratification, though scarification may also help[113]. Sow stored seed in a cold frame as early in the year as possible. Germination should take place in late spring, though it might take another 12 months. Prick out the seedlings into individual pots when they are large enough to handle and grow them on in a cold frame for their first winter. Plant them out in early summer."

603	Hybridizes naturally	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Reichelt, N., Wen, J., Pätzold, C., & Appelhans, M. S. (2021). Target enrichment improves phylogenetic resolution in the genus Zanthoxylum (Rutaceae) and indicates both incomplete lineage sorting and hybridization events. Annals of Botany, 128(4), 497-510	[Unknown. Hybridization suspected in genus] "In summary, we have identified a number of nodes that are putatively associated with past hybridization or ILS events. Among these, the putative hybridization events prior to the colonization of the Hawaiian Islands and the colonization of temperate Asia by a North American ancestor are particularly interesting. The Hawaiian Islands are among the areas with the highest percentage of polyploid plants in the world and most of the polyploidization events are inferred to have taken place prior to the immigration (Paetzold et al., 2018). The success of (allo)polyploids as colonizers of oceanic islands and as long-distance dispersers in general has often been associated with the smaller effect of inbreeding depression of allopolyploids (Lindner & Barker, 2014; Pannell, 2015). Hawaiian Zanthoxylum are a good example of this. Some, but not all, of the temperate Asian Zanthoxylum species are octaploids (e.g. Z. armatum and Z. simulans; Desai, 1960; Guerra, 1984), so that the putative hybridization at the base of this lineage probably did not result in a polyploidization event. Instead, at least two polyploidization events occurred within the temperate Asian Zanthoxylum lineage. As far as we know, all of the temperate Asian species are apomicts (Liu et al., 1986; Naumova, 1993). The formation of apomicts is often strongly correlated to hybridization (Hojsgaard and Hörandl, 2019). Apomictic species often have a wider distribution compared with their sexual relatives and often occur in more extreme habitats ('geographical parthenogenesis'; Cosendai et al., 2013; Kirchheimer et al., 2018). Apomixis in Zanthoxylum might thus represent a case of geographical parthenogenesis, where the evolution of apomictic reproduction facilitated the colonization of temperate areas of Eastern Asia."

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Dioecious shrub; prickles on branches at base of leaves 2, 5-8 mm. long"

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"Inflorescence terminal on short branches, pedunculate, many-flowered; flowers greenish yellow, small"
	Kubitzki, K. (ed.). (2011). The Families and Genera of Vascular Plants. Vol. X. Flowering Plants. Eudicots: Sapindales, Cucurbitales, Myrtaceae. Springer, New York	[Family description] "POLLINATION AND REPRODUCTIVE SYSTEMS. Basically, Rutaceae appear entomogamous (Engler 1931; Kuhlmann and K€uhn 1947; Armstrong 1979), with smaller Hymenoptera and Diptera as predominating pollinators in the humid forest biome."
	Zomlefer, W.B. (1994). Guide to Flowering Plant Families. The University of North Carolina Press, Chapel Hill & London	[Family description] "With strong scent, abundant nectar (from the discs), and often showy corollas, rutaceous flowers generally attract flies and bees as principal pollinators. Many in the family are characterized by imperfect flowers, such as Zanthoxylum clava-herculis (Pig, 64: 1c,g), which is dioecious."

606	Reproduction by vegetative fragmentation	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 3 May 2023]	[May be able to spread by suckers] "Stored seed may requires up to 3 months cold stratification, though scarification may also help[113]. Sow stored seed in a cold frame as early in the year as possible. Germination should take place in late spring, though it might take another 12 months. Prick out the seedlings into individual pots when they are large enough to handle and grow them on in a cold frame for their first winter. Plant them out in early summer. Cuttings of half-ripe wood, July/August in a frame. Root cuttings, 3cm long, planted horizontally in pots in a greenhouse. Good percentage[78]. Suckers, removed in late winter and planted into their permanent positions[113]."

607	Minimum generative time (years)	>3
	Source(s)	**Notes**
	BALKEP. (2023). Japanese Pepper Tree - Zanthoxylum piperitum. https://www.balkep.org/zanthoxylum-piperitum.html. [Accessed 3 May 2023]	"years to bearing yield: 3rd or 4th year from seed"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy" [Fruit and seeds lack means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Crop, Herbal, Ornamental"
	Ito, T. (1975). Ecological Studies on the Japanese Deer, Cervus nippon nippon Temminck on Kinkazan Island V. Development And Distribution of the Unpalatable Plant Societies for Deer. Bulletin of The Marine Biological Station of Asamushi 15(3): 115-129	"rather common and frequently cultivated"

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy" [No evidence]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Crop, Herbal, Ornamental"

704	Propagules adapted to wind dispersal	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Ito, T. (1975). Ecological Studies on the Japanese Deer, Cervus nippon nippon Temminck on Kinkazan Island V. Development And Distribution of the Unpalatable Plant Societies for Deer. Bulletin of The Marine Biological Station of Asamushi 15(3): 115-129	"fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy."

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Ito, T. (1975). Ecological Studies on the Japanese Deer, Cervus nippon nippon Temminck on Kinkazan Island V. Development And Distribution of the Unpalatable Plant Societies for Deer. Bulletin of The Marine Biological Station of Asamushi 15(3): 115-129	"Hills and mountains" [Fleshy-fruited. Adapted for zoochory]

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Kim, E. M., Kang, C. W., Lee, S. Y., Song, K. M., & Won, H. K (2016). The Status of Birds Consuming Fruits and Seeds of the Tree and Related Tree Species on Jeju Island, the Republic of Korea. Journal of Environmental Science International, 25(5), 635-644	"Table 2. List of fruits and seeds consumed by birds, the number of birds with confirmed fruit and seed consumption, and the relative consumption rate (CR) of their fruits from 2013 to 2015 on jeju Island, the Republic of Korea" [Includes Zanthoxylum piperitum]
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	[Family Description] "fruit a berry, drupe, or capsule; seeds sometimes with endosperm, the embryo straight or curved" ... [Genus Description] "fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Ohwi, J. (1965). Flora of Japan. Smithsonian Institution, Washington, D.C.	"fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy." [No means of external attachment]

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Kim, E. M., Kang, C. W., Lee, S. Y., Song, K. M., & Won, H. K (2016). The Status of Birds Consuming Fruits and Seeds of the Tree and Related Tree Species on Jeju Island, the Republic of Korea. Journal of Environmental Science International, 25(5), 635-644	"Table 2. List of fruits and seeds consumed by birds, the number of birds with confirmed fruit and seed consumption, and the relative consumption rate (CR) of their fruits from 2013 to 2015 on jeju Island, the Republic of Korea" [Includes Zanthoxylum piperitum]
	Tsuji, Y., Sato, K., & Sato, Y. (2011). The role of Japanese macaques (Macaca fuscata) as endozoochorous seed dispersers on Kinkazan Island, northern Japan. Mammalian Biology, 76, 525-533	"Table 2. Seeds found within fecal samples of Japanese macaques on Kinkazan, northern Japan (1999-2009)." [Presumably yes. Includes Zanthoxylum piperitum]

801	Prolific seed production (>1000/m2)	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Ito, T. (1975). Ecological Studies on the Japanese Deer, Cervus nippon nippon Temminck on Kinkazan Island V. Development And Distribution of the Unpalatable Plant Societies for Deer. Bulletin of The Marine Biological Station of Asamushi 15(3): 115-129	"fruitlets 1-5, dehiscent, 1-seeded; seeds ellipsoidal, black, lustrous, the endosperm fleshy." [Unlikely. 1-seeded fruitlets]

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Plants for a Future. (2023). Zanthoxylum piperitum. https://pfaf.org. [Accessed 3 May 2023]	"Stored seed may requires up to 3 months cold stratification, though scarification may also help[113]. Sow stored seed in a cold frame as early in the year as possible. Germination should take place in late spring, though it might take another 12 months. Prick out the seedlings into individual pots when they are large enough to handle and grow them on in a cold frame for their first winter."
	Nakagoshi, N. (1984). Buried viable seed populations in forest communities on the Hiba Mountains, southwestern Japan. Journal of science of the Hiroshima University. Series B. Division 2. Botany. Hiroshima, 19(1), 1-56	[Possibly Yes] "Table 21. Ecological characteristics of seeds of the 209 species of the Hiba mountains. Seed bank types, Type A: no reserve of seeds in the growing season; Type B: reduced seed bank in the growing season; Type C: permanent seed bank through the year" [Zanthoxylum piperitum - Type C: permanent seed bank through the year]

803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	WRA Specialist. (2023). Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	
	Source(s)	**Notes**
	Maeda, T., Yonemoto, Y., Higuchi, H., & Kitabayashi, T. (2010). Effects of cutting back pruning on sprouting and fruit set in Japanese pepper (Zanthoxylum piperitum (L.) DC. f. inerme Makino) trees. Horticultural Research (Japan), 9(4), 485-488	[Possibly. Tolerates pruning and used as a bonsai tree] "Abstract : Pruning of Budousanshou (Zanthoxylum piperitum (L.) DC. f. inerme Makino) trees was investigated to determine whether the pruning degree influences sprouting and fruit set. First, the mother branches were divided into three groups by length, and then the four degrees of pruning were set up, i.e. no pruning, cutting back 1/3, cutting back 1/2, and cutting back 2/3 for each mother branch group. The sprouting rate, spike-bearing shoot rate, flower number and berry number in the fruit cluster were compared next spring. As a result, there was a greater tendency toward higher many flower numbers, berry numbers in the fruit cluster and berry numbers per mother branch after cutting back 1/3. These numbers tended to be higher than those in the other pruning groups for the medium mother branch length. The sprouting rate increased when trees were pruned by cutting back 2/3 and the spike-bearing shoot rate tended to become higher after cutting back 1/2 or 2/3. "

Qsn #	Question	Answer
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. (2023). Personal Communication	Unknown

Summary of Risk Traits:

Zanthoxylum piperitum, commonly known as Japanese pepper, Sansho pepper, or prickly ash, is a small deciduous tree or shrub that can grow up to 5 meters in height. It is native to Japan, Korea, China, and Taiwan, and is commonly cultivated in other parts of Asia as well as in North America and Europe. Its leaves are green, glossy, and have a citrusy aroma. The fruit of the plant is a small, reddish-brown berry-like drupe that has a sharp, pungent, and citrusy flavor. The seeds inside the fruit are also used as a spice. It is a temperate species that is unlikely to become naturalized or invasive in the Hawaiian Islands but may be able to spread by its bird-dispersed seeds if grown in cooler, higher elevation habitats. Its spines may also deter browsing by feral ungulates, giving it a competitive advantage over other unarmed, or palatable vegetation.

High Risk / Undesirable Traits
• Prickles or spines on branches at base of leaves
• Reported to be unpalatable to deer in native range (although deer may browse on young growth)
• Reported to be tolerant of deep shade (and could potentially invade intact forest understory)
• Tolerates many soil types.
• Reproduces by seeds and potentially by suckering.
• Seeds dispersed by birds, other frugivorous animals, and through intentional cultivation.
• Seeds may form a persistent seed bank.
• Tolerates pruning and may resprout after cutting if mechanical control is attempted.

Low Risk Traits
• No reports of naturalization or invasiveness where introduced.
• A temperate species that may only pose a risk of naturalization or invasion in cooler, higher elevations of tropical islands.
• Non-toxic
• Dioecious
• Reaches maturity in 3+ years.