Taxon: Piper nigrum L. **Family:** Piperaceae

Common Name(s): black pepper
white pepper

Synonym(s):

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 10 May 2017

WRA Score: 6.0 **Designation:** EVALUATE **Rating:** Evaluate

Keywords: Domesticated Climber, Shade-Tolerant, Self-Compatible, Spreads Vegetatively, Animal-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	y
102	Has the species become naturalized where grown?	y=1, n=-1	y
103	Does the species have weedy races?	y=1, n=-1	n
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)	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
204	Native or naturalized in regions with tropical or subtropical climates	y=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
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	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
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	y
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	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)		
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)	y=1, n=-1	n
803	Well controlled by herbicides		
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)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**y**
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Domestication of pepper appears to be a much later event. There is, only speculative evidence as to when pepper was introduced to other countries as a domesticated crop. Colonists from India are believed to have introduced pepper cultivation to Indonesia about 100 B.C. (Rosengarten 1973). Many such introductions surely might have taken place subsequently also." ... "The cultivars of black pepper might have originated from the wild ones through domestication and selection. Over hundred cultivars are known, but many of them are getting extinct due to various reasons like devastation of pepper cultivation by diseases such as, foot rot and slow decline; replacement of the traditional cultivars by a few high yielding varieties etc. Cultivar diversity is richest in the state of Kerala followed by the state of Karnataka. Most of the cultivars are bisexual forms, unlike their wild counterparts."

102	**Has the species become naturalized where grown?**	**y**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Piper nigrum L. Piperaceae Total N° of Refs: 12 Toxic - Habit: Vine Preferred Climate/s: Mediterranean, Subtropical, Tropical Origin: C Asia, E Asia Major Pathway/s: Crop, Herbal, Ornamental Dispersed by: Humans References: Guyana-W-32, Federated States of Micronesia-N-230, Belize-N-850, Africa-N-990, Laos-N-1102, Global-Q- 1205, French Polynesia-N-1514, Brazil-N- 1597, Eastern Caribbean-N-1742, Sao Tome and Principe-N-1805, Afghanistan- W-1977, Lao People's Democratic Republic-W-1977."

103	**Does the species have weedy races?**	**n**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence [Citations as a weed inconclusive]

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 May 2017]	Native: Asia-Tropical Indian Subcontinent: India

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 May 2017]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	**Notes**
	Heim, E. 2015. Flora and Vegetation of Bali Indonesia: An Illustrated Field Guide. BoD – Books on Demand, Norderstedt	"Ecology: Grows best at elevations up to 500 m, but can grow up to 2000 m." [Can grow over an elevation range in excess of 2000 m, demonstrating some environmental versatility]

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"The species is a native of the dense evergreen forests of the Western Ghats in South West India, now widely cultivated pantropically." ... "Black pepper is a tropical vine and needs artificial support (wooden, timber, cement) or trunk of live tree as support."
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 May 2017]	Native: Asia-Tropical Indian Subcontinent: India

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Although pepper is not cultivated commercially to a significant degree in Hawaii, the plants are easily grown here and they flower and fruit well."
	Imada, C.T., Staples, G.W. & Herbst, D.R. 2005. Annotated Checklist of Cultivated Plants of Hawai'i. http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/. [Accessed 8 May 2017]	"Locations: Foster Botanical Garden (Confirmed) Harold L. Lyon Arboretum Wahiawa Botanical Garden Waimea Arboretum & Botanical Garden"
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"The species is a native of the dense evergreen forests of the Western Ghats in South West India, now widely cultivated pantropically. The major producing countries are India, Indonesia, Sarawak, Malaysia and Brazil. It is also cultivated also in Sri Lanka, Myanmar, Thailand, Cambodia, Laos, Vietnam, New Guinea, on many Pacific islands, the Antilles, Madagascar, Zanzibar and in West Africa (Ghana to Angola)."

301	Naturalized beyond native range	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Reported to be naturalized in a number of locations] "References: Guyana-W-32, Federated States of Micronesia-N-230, Belize-N-850, Africa-N-990, Laos-N-1102, Global-Q- 1205, French Polynesia-N-1514, Brazil-N- 1597, Eastern Caribbean-N-1742, Sao Tome and Principe-N-1805, Afghanistan- W-1977, Lao People's Democratic Republic-W-1977."
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2017. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/. [Accessed 8 May 2017]	No evidence to date

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	Cited as a weed, but conclusive evidence lacking

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

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

305	Congeneric weed	y
	Source(s)	**Notes**
	Rogers, H. M., & Hartemink, A. E. (2000). Soil seed bank and growth rates of an invasive species, Piper aduncum, in the lowlands of Papua New Guinea. Journal of Tropical Ecology, 16(02), 243-251	"In the lowlands of Papua New Guinea the exotic tall shrub Piper aduncum L., that originates from South America now dominates much of the secondary fallow vegetation. In many parts of the lowlands Piper aduncum invaded similarly to C. odorata in Asia and Africa and M. calvescens in Polynesia. P. aduncum is indigenous to tropical America where it is found from Mexico to Bolivia. Its habitat in Central America is restricted to evergreen vegetation and near watercourses in seasonally deciduous forests, from sea level to c. 1500 m asl. P. aduncum was introduced in Indonesia in 1860, and is now commonly found in Irian Jaya and Malaysia. In the Paci®c it occurs in Fiji but is not found in Hawaii or Northern Australia (Hartemink 1999)."

Qsn #	Question	Answer
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[P. aduncum & P. auritum are invasive weeds] "Piper aduncum ... "P. aduncum is a shade-tolerant shrub and tree native to the West Indies and tropical America. It was both intentionally (as an ornamental species) and accidentally (on packing material) introduced into a number of countries outside of its native range where it has naturalized and become invasive. P. aduncum is a pioneer species colonising areas of bare ground, with high levels of sunlight. For example, disturbed areas such as roadsides, forest margins and clearings of often colonised. In comparison to other pioneer species, P. aduncum produces a large number of seeds and has rapid growth rates. This gives it a competitive advantage leading to the formation of dense thickets which outcompete native species and decrease biodiversity. P. aduncum also has an impact on the cultivation of P. methysticum (kava) by acting as a host for pests and pathogens and lowering the quality of the crop. Control of this species is difficult and care must be taken to ensure all parts of the root are removed to prevent regrowth." ... "Piper auritum ... P. auritum is an invasive and noxious weed which competes with other plants and threatens native forests where it is introduced. It grows very fast and vigorously, quickly forming large thickets and a dense canopy, and is hard to kill as new shoots grow from rhizomes, cut stems and cuttings left on the soil surface. The dense growth and spreading root suckers of P. auritum displace other plants. It is extremely difficult to control as root fragments, rhizomes and stems re-grow when cut. The plant grows more than twice as fast as true kava (P. methysticum Frost) and can out-compete older P. methysticum individuals within a year of its own establishment (Denslow and Nelson, 2000; Hawaii Invasive Species, 2013)."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	[No evidence] "Perennial woody climber up to 4 m high. The pepper plant is normally grown with support, either on a living tree or a post (which can be made of cement or wood) or trellis. Robust glabrous, woody stem with distinct enlarged nodes and rooting at the nodes. It has a shallow root system. Two types of branches are produced, vegetative (climbing) and reproductive (fruiting). Leaves alternate, simple, entire, ovate to ovate-oblong, 10–15 × 5–9 cm, thick, more or less leathery, glabrous, base rounded, usually slightly oblique, apex acute; veins 5–7(–9), reticulate veins prominent (Plates 1 and 2). Petiole 1–2 cm"

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Yan, G., Zhu, C., Luo, Y., Yang, Y., & Wei, J. (2006). Potentia allelopathic effects of Piper nigrum, Mangifera indica and Clausena lansium. Ying yong sheng tai xue bao= The journal of applied ecology/Zhongguo sheng tai xue xue hui, Zhongguo ke xue yuan Shenyang ying yong sheng tai yan jiu suo zhu ban, 1 (9), 1633-1636	[Potentially Yes. Demonstrated in laboratory setting] "With Piper nigrum, Mangifera indica and Clausena lansium as the donators, this paper studied their potential allelopathic effects on the germination and growth of Zea mays, Glycine max, Cucurbita moschata, Arachis hypogaea, Raphanus sativus, Echinochloa crusgalli, Digitaria sanguinalis and Stylosanthes guianensis. The results showed that the aqueous extracts of these donators could inhibit the germination and growth of Z. mays, G. max, C. moschata, E. crus-galli and D. sanguinalis at high concentration, but stimulate them at low concentration. In rhizosphere soil of P. nigrum and M. indica, the germination and growth of Z. mays L was stimulated, while A. hypogaea was inhibited. The aqueous extracts of the donators were extracted by ethyl acetate and n-butanol, respectively, and the inhibitory activity of both aqueous and n-butanol fractions from P. nigrum and M. indica on Z. mays, R. sativus and S. guianensis was stronger than that of ethyl acetate fraction, indicating that P. nigrum and M. indica contained the allelochemicals with high polarity. "

403	Parasitic	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Perennial woody climber up to 4 m high." [Piperaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	Unknown. No information on palatability of foliage to animals

405	Toxic to animals	n
	Source(s)	**Notes**
	KewScience. 2017. Plants of the World Online - Piper nigrum. http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:682369-1. [Accessed 8 May 2017]	"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

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	KewScience. 2017. Plants of the World Online - Piper nigrum. http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:682369-1. [Accessed 8 May 2017]	"Plants are not unduly affected by pests or diseases (even aphids dislike the taste of the leaves)."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The vines are susceptible to several fungal pathogens and insect pests."

Qsn #	Question	Answer
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Three major diseases of black pepper namely foot rot disease, yellows disease and stunted growth disease are continuously causing severe problems to Indonesian farmers. Foot rot disease, caused by Phytophthora capsici, appears to be the most destructive, as it occurs in almost all parts of pepper plantations throughout the country. Yellows disease is caused by a complex of biotic and abiotic factors, such as parasitic nematodes (Radopholus similis and Meloidogyne incognita), parasitic fungus (Fusarium solani), nutrient deficiency and water stress. The stunted growth disease is suspected to be caused by a virus or a mycoplasma—like organism (MLO). These two diseases, in certain areas have also become serious problems. In some pepper gardens, the loss due to the major diseases may be as high as 55 per cent, depending on various factors affecting the whole system of pepper cultivation (Wahid and Sitepu 1992)." ... "Infestation by insect pests is one of the main factors responsible for the low productivity of pepper in major pepper growing countries. Pepper is infested by 56 genera/species of insects in India damaging various parts of the vine such as roots, stems, shoots, leaves, spikes and berries. However, when the nature and extent of damage is taken into consideration, pollu beetle (Longitarsus nigripennis Mots.), top shoot borer (Cydia hemidoxa Meyr.), leaf gall thrips (Liothrips karnyi Bagn.) and scale insects (Lepidosaphes piperis Green and Aspidiotus destructor Sign.) could be considered as major pests. The other genera/species belonging to diverse groups are minor pests though some of them can cause severe damage to the crop sporadically in certain locations. Information on insect pests of pepper in India are available mainly from Devasahayam et al. (1988) and Premkumar et al. (1994). The major insects pests of pepper in Indonesia and Malaysia are pepper weevil/stem borer (Lophobaris piperis Marshl.), pepper bug (Dasynus piperis China) and tingid bug/blossom bug (Diconocoris hewetti Dist.). Information on various aspects of these pests are mainly available from Kueh (1979) and Deciyanto and Suprapto (1991). The information available on distribution, nature and extent of damage, life history, seasonal population, resistance, natural enemies, alternate hosts and management of these insect pests in India, Indonesia and Malaysia is reviewed here."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	KewScience. 2017. Plants of the World Online - Piper nigrum. http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:682369-1. [Accessed 8 May 2017]	"Hazards - None known."
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"There are no data available on the acute or chronic toxicologic aspects of pepper and/ or its constituents. Pepper constituents are not used therapeutically in the allopathic system. Pepper has been in use since very early times as a spice and food additive. No health hazard or untoward action may arise in the concentrations used."

Qsn #	Question	Answer
	Cohle, S. D., Trestrail, J. D., Oxley, D. W., Walp, B., & Jachimczyk, J. (1988). Fatal pepper aspiration. American Journal of Diseases of Children, 142(6), 633-636	[Aspiration of processed pepper can be fatal] "Eight patients (five previously undescribed) died due to aspiration of pepper. Seven deaths involved homicides, and one death was accidental in a child with documented pica. The pepper was administered by the mothers in three children and by a foster mother, the mother's boyfriend, an adult male friend, and the child's godfather in one case each. Homicidal pepper aspiration shares many of the features of more conventional child abuse: in each instance, the child was being punished, four of the seven assailants initially gave incorrect histories, and four children were chronically abused. The facts that each death occurred in a different state and that five of the seven homicides occurred within the two years preceding the preparation of this report suggest that this form of child abuse is not confined to any single part of the country and may be increasing in frequency."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Used medicinally] "Used in Ayurveda, Unani and Sidha. Roots and fruits of Deeringia amaranthoides pounded with roots of Piper nigrum and given in stomach pain. Seed powder mixed with water given orally to cure malaria and fevers. Dried unripe fruit rubefacient, carminative, diaphoretic, stimulant, postpartum remedy, stomachic, treat diarrhea, rheumatic pains, digestion, asthma, chronic bronchitis, scabies, sores, and poisons, especially food poisoning from meat; fruits crushed and taken for relief from cold, cough and fever; Mimosa pudica roots, Musa sapientum peel, Drymaria cordata leafy twigs and Piper nigrum seeds ground together and made into pills given orally to pregnant women to cause abortion; decoction of whole plant of Cyperus scariosus with Piper nigrum given to cure influenza, cough, cold, fevers. Fruits pesticide, insecticide, for fungal infection. Veterinary medicine, a mixture of leaves of Pergularia extensa, Piper nigrum seeds and Allium sativum juice put into eyes for any kind of disease in cattle. Ceremonial, ritual, ingredient of Patra pooja in different religious pooja ceremonies."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	[No evidence. Does not occur in fire prone habitats] "Pepper is distributed extensively in the moist evergreen forests and to a lesser extent in semi-evergreen and moist-deciduous forests of Western Ghats of South India, growing from almost sea level to an elevation of around 1500 m."

Qsn #	Question	Answer
409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Sivaraman, K., Kandiannan, K., Peter, K. V., & Thankamani, C. K. (1999). Agronomy of black pepper (Piper nigrum L.)-a review. Journal of Spices and Aromatic Crops, 8(1): 1-18	"Black pepper vines kept' under shade (7% incident light) remained green and healthy whereas those exposed to sunlight turned yellow and developed necrotic patches during summer (Vijayakumar & Mammen 1990). Fifty per cent shade boosted the growth of black pepper cuttings in the nursery (Senanayake & Kirthisinghe 1983)."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"It grows in full sun or partial shade on well-composted, moist, well-drained, fertile soils rich in organic matter."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Sivaraman, K., Kandiannan, K., Peter, K. V., & Thankamani, C. K. (1999). Agronomy of black pepper (Piper nigrum L.)-a review. Journal of Spices and Aromatic Crops, 8(1): 1-18	"Black pepper grows well on soils ranging from heavy clay to light sandy days rich in humus with friable nature, well drained, but still with ample water holding capacity. Soils with near neutral pH, high organic matter and high base. saturation with Ca and Mg enhanced the productivity (Mathew et al. 1995)"
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Pepper plantations are established on a wide variety of soils, their texture varying from sandy loam to clayey loam. In Malaysia, most of the plantations are in soils which have been developed on slate, sandstone and on areas of alluvial origin having poor nutrient status (DeWaard 1969). The clay is of kaolinite type and of poor buffering capacity. The soil pH ranges between 4.5 to 5.5. In Indonesia, pepper plantations are raised in all types of soils, ranging from rich loose volcanic to clayey loam. In Sri Lanka, red clay loam and sandy loam are favoured by planters. In India, pepper is grown on a wide range of soils under the following situations:"

411	**Climbing or smothering growth habit**	**y**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Perennial woody climber up to 4 m high."

412	**Forms dense thickets**	**n**
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	[Climber] "The common black pepper, found extensively in the evergreen forests of Western Ghats, and in the adjoining areas, almost from sea level up to an elevation of 1300 m. Perennial climber, climbing by means of ivy-like roots which adheres to the support tree."

501	**Aquatic**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	[Terrestrial] "The species is a native of the dense evergreen forests of the Western Ghats in South West India, now widely cultivated pantropically." ... "Perennial woody climber up to 4 m high. The pepper plant is normally grown with support, either on a living tree or a post (which can be made of cement or wood) or trellis."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 May 2017]	Piperaceae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 May 2017]	Piperaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Perennial woody climber up to 4 m high. The pepper plant is normally grown with support, either on a living tree or a post (which can be made of cement or wood) or trellis. Robust glabrous, woody stem with distinct enlarged nodes and rooting at the nodes. It has a shallow root system."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	[No evidence] {The species is a native of the dense evergreen forests of the Western Ghats in South West India, now widely cultivated pantropically. The major producing countries are India, Indonesia, Sarawak, Malaysia and Brazil. It is also cultivated also in Sri Lanka, Myanmar, Thailand, Cambodia, Laos, Vietnam, New Guinea, on many Paci fi c islands, the Antilles, Madagascar, Zanzibar and in West Africa (Ghana to Angola)."

602	Produces viable seed	y
	Source(s)	**Notes**
	Sivaraman, K., Kandiannan, K., Peter, K. V., & Thankamani, C. K. (1999). Agronomy of black pepper (Piper nigrum L.)-a review. Journal of Spices and Aromatic Crops, 8(1): 1-18	"Black pepper is propagated vegetatively as well as through seed. As the crop is heterozygous in nature, seedlings raised from seeds will not breed true to type."

Qsn #	Question	Answer
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Pepper seed is recalcitrant and viability is retained only for about a week. Storing at 5°C after removing the seed coat prolongs viability. If sown within a few days after harvesting, ripe seeds germinate easily in 20–25 days. Ghawas and Maaraf (1983) showed that seeds stored in poly bags, at 4°C and 42 per cent RH retained viability for 40 days. Removal of pericarp enhanced germination. Keeping seeds in shade for three days after harvest was reported to be beneficial (Ibrahim et al. 1993)."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	[Possibly Yes] "Recent surveys by scientists of IISR in some areas of Western Ghats in Idukki district led to the discovery of intermediate populations, apparently composed of hybrids between P. nigrum, P. sugandhi, P. trichostachyon and P. galeatum and their segregating progenies."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Semple, K. (1974). Pollination in Piperaceae. Annals of the Missouri Botanical Garden, 61(3), 868-871	"Piper nigrum has been found to be partially self-fertile." ... "In Piper nigrum self-fertilization yields good fruit and presumably self-fertilization may occur in other Pipers as well."
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"The cultivated P. nigrum is monoecious having hermaphrodite flowers, while the wild ones are mostly dioecious. Human selection might have played a major role in the directional evolution of hermaphroditism in the cultivated pepper. Pepper is predominantly self pollinated, and the pollen dispersal is aided by rain or dew drops, and also by the gravitational descending of pollen (geitonogamy). The flowers are protogynous, but in the absence of an active pollen transfer mechanism, protogyny becomes ineffective in ensuring outbreeding."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"The cultivated P. nigrum is monoecious having hermaphrodite flowers, while the wild ones are mostly dioecious. Human selection might have played a major role in the directional evolution of hermaphroditism in the cultivated pepper. Pepper is predominantly self pollinated, and the pollen dispersal is aided by rain or dew drops, and also by the gravitational descending of pollen (geitonogamy). The flowers are protogynous, but in the absence of an active pollen transfer mechanism, protogyny becomes ineffective in ensuring outbreeding."

606	Reproduction by vegetative fragmentation	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Heim, E. 2015. Flora and Vegetation of Bali Indonesia: An Illustrated Field Guide. BoD – Books on Demand, Norderstedt	"Description: Climbers woody. Nodes clearly enlarged and rooting, glabrous" [Roots at nodes]
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Pepper, blessed with the twin advantages of vegetative propagation and viable sexual reproduction, offers much scope for exploitation of hybrid vigour as well as selection breeding."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Robust glabrous, woody stem with distinct enlarged nodes and rooting at the nodes. It has a shallow root system."

607	Minimum generative time (years)	
	Source(s)	**Notes**
	Orbán, S. 2012. Exotic Spices and Herbs. Eszterházy Károly Főiskola, Eger	"The plants will bring their first fruits at the age of 3, and they can be kept in culture for more than 15-20 years."
	PlantUse contributors. 2017. Piper nigrum (PROSEA). PlantUse, http://uses.plantnet-project.org/e/index.php?title=Piper_nigrum_(PROSEA)&oldid=222042. [Accessed]	"Though easier to root, stolons or runners are less suitable as planting material than terminal orthotropic shoots because they bear fruit late, about 3 years from planting."
	WRA Specialist. 2017. Personal Communication	Reaches maturity from vegetative propagules within 3 years. Time to maturity from seed unknown.

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Drupe green borne in cluster (spike) 20–30 cm long (Plates 1 , 2 and 3), becoming red when ripe, drying black when unripe (Plate 6), globose, 3–4 mm in diam., sessile containing a single seed." [No evidence. Seeds small, but otherwise lack means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"The species is a native of the dense evergreen forests of the Western Ghats in South West India, now widely cultivated pantropically. The major producing countries are India, Indonesia, Sarawak, Malaysia and Brazil. It is also cultivated also in Sri Lanka, Myanmar, Thailand, Cambodia, Laos, Vietnam, New Guinea, on many Paci fi c islands, the Antilles, Madagascar, Zanzibar and in West Africa (Ghana to Angola)."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Pepper seed is recalcitrant and viability is retained only for about a week." [No evidence. Unlikely, as seeds lose viability quickly]

704	Propagules adapted to wind dispersal	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Drupe green borne in cluster (spike) 20–30 cm long (Plates 1 , 2 and 3), becoming red when ripe, drying black when unripe (Plate 6), globose, 3–4 mm in diam., sessile containing a single seed."

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"The common black pepper, found extensively in the evergreen forests of Western Ghats, and in the adjoining areas, almost from sea level up to an elevation of 1300 m. Perennial climber, climbing by means of ivy-like roots which adheres to the support tree. Vigorous vine, old stem thick and rough, branches numerous, runner shoots arise from the base." ... "Fruit a drupe, green when young changes to red on ripening, seed mostly spherical, pungent." [Possible, but unlikely unless growing in close proximity to streams or other water courses]

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Drupe green borne in cluster (spike) 20–30 cm long (Plates 1 , 2 and 3), becoming red when ripe, drying black when unripe (Plate 6), globose, 3–4 mm in diam., sessile containing a single seed."
	Muthuramkumar, S., & Parthasarathy, N. (2000). Alpha diversity of lianas in a tropical evergreen forest in the Anamalais, Western Ghats, India. Diversity and Distributions, 6(1), 1-14	"Table 2 Alpha diversity of lianas ³ 1 cm d.b.h. in the 30-ha plot of tropical evergreen forest at Varagalaiar, Western Ghats, India, with details on family, density and the number of hectares of occurrence and mode of dispersal (DM)" [Piper nigrum - Dispersal mode: A = animals]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	"Drupe green borne in cluster (spike) 20–30 cm long (Plates 1 , 2 and 3), becoming red when ripe, drying black when unripe (Plate 6), globose, 3–4 mm in diam., sessile containing a single seed." [No evidence. Seeds small, but otherwise lack means of external attachment]

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Muthuramkumar, S., & Parthasarathy, N. (2000). Alpha diversity of lianas in a tropical evergreen forest in the Anamalais, Western Ghats, India. Diversity and Distributions, 6(1), 1-14	[Presumably Yes. Animal-dispersed] "Table 2 Alpha diversity of lianas ³ 1 cm d.b.h. in the 30-ha plot of tropical evergreen forest at Varagalaiar, Western Ghats, India, with details on family, density and the number of hectares of occurrence and mode of dispersal (DM)" [Piper nigrum - Dispersal mode: A = animals]

801	Prolific seed production (>1000/m2)	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 4, Fruits. Springer, New York	[Single-seeded, but large spikes. Unlikely to reach such high densities, unless cultivated for this purpose] "Drupe green borne in cluster (spike) 20–30 cm long (Plates 1 , 2 and 3), becoming red when ripe, drying black when unripe (Plate 6), globose, 3–4 mm in diam., sessile containing a single seed."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	**Notes**
	Ravindran, P. N., ed. (2000). Black Pepper: Piper nigrum. Overseas Publishers Association, Amsterdam	"Pepper seed is recalcitrant and viability is retained only for about a week. Storing at 5°C after removing the seed coat prolongs viability. If sown within a few days after harvesting, ripe seeds germinate easily in 20–25 days. Ghawas and Maaraf (1983) showed that seeds stored in poly bags, at 4°C and 42 per cent RH retained viability for 40 days. Removal of pericarp enhanced germination. Keeping seeds in shade for three days after harvest was reported to be beneficial (Ibrahim et al. 1993)."

803	Well controlled by herbicides	
	Source(s)	**Notes**
	WRA Specialist. 2017. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**
	PlantUse contributors. 2017. Piper nigrum (PROSEA). PlantUse, http://uses.plantnet-project.org/e/index.php?title=Piper_nigrum_(PROSEA)&oldid=222042. [Accessed 10 May 2017]	[Tolerates repeated pruning] "In unshaded intensive cropping of pepper, husbandry mainly includes weeding, mounding, topping of stem shoots, pruning for regular shape, manuring and disease and pest control." ... "Pruning aims to maximize the number of fruiting branches. Usually three stems are allowed to climb up the post. When 60-90 cm long, each is pruned back, usually to just below the lowest stem node without lateral branch, leaving 3-4 nodes, each with a fruiting branch. This process is repeated regularly, stimulating secondary and higher□order branching. After 30 months, plants are 2.5 m tall, have a bushy appearance with the maximum number of main branches and a close canopy. The plants may now be considered as full□grown and start flowering fully with the onset of the rains."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Unknown, but possibly no] "Although pepper is not cultivated commercially to a significant degree in Hawaii, the plants are easily grown here and they flower and fruit well."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Elevation range exceeds 1000 m, demonstrating environmental versatility
• Grows well in tropical climates
• Naturalized outside native range
• Other Piper species have become invasive
• Shade tolerant
• Tolerates many soil types
• Climbing habit
• Reproduces by seeds and vegetatively (rooting at nodes)
• Cultivated forms monoecious and self-compatible
• Reproductively mature within 3 years from vegetative propagation
• Seeds adapted for bird and animal dispersal
• Tolerates & resprouts from regular pruning

Low Risk Traits
• Domesticated crop with long history of cultivation
• No reports of invasiveness or negative impacts in introduced range
• Unarmed (no spines, thorns, or burrs)
• Non-toxic
• Ornamental
• Recalcitrant seeds lose viability quickly (within one week)

Second Screening Results for Vines & Lianas

(A) Reported as a weed of cultivated lands?> No.
(B) Unpalatable to grazers Or known to form dense stands?> Palatability of foliage unknown
(C) Shade tolerant or known to form dense stands?> Shade tolerant
(D) Bird- Or clearly wind- dispersed?> Adapted for bird and animal dispersal
(E) Life cycle <4 years? Mature within 3 years from vegetative propagules.
Outcome = Evaluate