

Taxon: *Syzygium aromaticum* (L.) Merr. & L. M. Perry

Family: Myrtaceae

Common Name(s): clove
clove tree
cloves
Zanzibar redheads

Synonym(s): *Caryophyllus aromaticus* L.
Caryophyllus hortensis Noronha
Caryophyllus silvestris Teijsm. ex
Eugenia aromatica (L.) Baill. nom.
Eugenia caryophyllata Thunb.
Eugenia caryophyllus (Spreng.)
Jambosa caryophyllus (Thunb.) Nied.
Myrtus caryophyllus Spreng.

Assessor: Chuck Chimera

Status: Assessor Approved

End Date: 4 Apr 2023

WRA Score: 1.0

Designation: EVALUATE

Rating: Evaluate

Keywords: Tropical Tree, Naturalized, Spice Plant, Self-Fertile, Animal-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)	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	n
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		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		
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	y=1, n=-1	n

Qsn #	Question	Answer Option	Answer
405	Toxic to animals		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
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
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
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	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
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/m ²)	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		
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
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	[Long cultivated, but not domesticated] "The clove tree was first cultivated on some islands of the Moluccas, where it occurs wild, as well as in New Guinea. It is found in abundance as a second-storey forest tree on the lower mountain slopes. The crop and its trade has a long and fascinating history going back to the Han Dynasty in the 3rd Century BC. The story of the clove trade and the spread of the crop is full of intrigue and brutality. Apart from pepper (<i>Piper nigrum</i> L.), no other crop may have played a comparable role in world history. Early in the 17th Century, when the Dutch ousted the Portuguese from the Moluccas, clove cultivation had spread to many islands. Under Dutch rule, the crop was forcibly eradicated everywhere and concentrated on Ambon (a southern island of the group) and 3 nearby small islands. This is the wettest part of the Moluccas. From the Moluccas the clove tree was taken to other parts of Asia: early in the 19th Century the British took plants to Pinang (Malaysia), Sumatra (Indonesia), India and Sri Lanka. In the 20th Century, much material spread throughout Indonesia. During expeditions in 1753, 1770 and 1772, the French appropriated some offspring from trees that must have escaped the Dutch axe, and took them from the North Moluccas to Mauritius. These plants gave rise to the clove populations outside Asia, in Zanzibar, Madagascar and recently also in Bahia in Brazil. "

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"	High
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Cloves are native to Indonesia and occur especially in the north and central Maluka (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."

202	Quality of climate match data	High
-----	-------------------------------	------

Qsn #	Question	Answer
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Cloves are native to Indonesia and occur especially in the north and central Maluka (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Being strictly a tropical species, clove requires a warm humid tropical climate with an annual rainfall from 1,500 to 2,500 mm. It grows well from mean sea level up to an elevation of 1,000 m."
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Notions about the ecological requirements of the clove vary, perhaps because of an underlying dilemma: a climate with a marked dry season promotes flowering, but the tree does not cope at all well with stress. There are two ways out of this dilemma. The first is to choose a climate with a pronounced dry season (Zanzibar, East Java), but to limit stress by going for deep fertile soils, providing water and shade during the early years. The other way is to choose a wet climate with a short dry season (Madagascar, Sumatra, Pinang). The choice is linked with the use of the produce. Cloves from wet areas are less suitable for making cigarettes, since the smoke becomes pungent and there is no crackling ("kretek") sound during the smoking. In Indonesia, cloves for "kretek" cigarettes are said to require 3 months in which the monthly rainfall is less than 60 mm, whereas for cloves to be used as spice, rainfall should not drop below 80 mm in any month. Annual rainfall should exceed 1500 mm; wet clove areas usually receive 3000-4000 mm. With mean temperatures of 21°C in July and August, Madagascar is the coolest clove country, reaching to the Tropic of Capricorn. Cloves are almost exclusively grown on islands, but proximity of the sea may not be as necessary as it was once thought to be, nor is the crop restricted to the lowlands. In parts of Sumatra and Java, and in the Nilgiri Hills in south India, cloves are grown successfully far from the sea and at altitudes of 600-900 m. Sheltered sites are preferred, because wind causes additional stress, and strong winds are not tolerated. Shade is necessary for young trees until they are firmly established. Growth can be sustained on poor and acid soils, but waterlogging is very harmful. Adequate depth of soil is essential and water-holding capacity should be in keeping with the severity of the dry season; if not, irrigation is needed. "

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Cloves are native to Indonesia and occur especially in the north and central Maluka (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."

Qsn #	Question	Answer
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Preferred Climate/s: Mediterranean, Tropical Origin: E Asia, SE Asia Major Pathway/s: Crop, Herbal, Ornamental Dispersed by: Humans References: Africa-W-760, Mozambique-nC-943, Laos-N-1102, western Indian Ocean-I-1146, La Reunion-U-1321, Eastern Caribbean-N-1742, Borneo-N-1796, Sao Tome and Principe-N-1805, Seychelles-N-1925, -I-, Comoros-W-1977, Lao People's Democratic Republic-W-1977, Seychelles-W-1977."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."
	van Wyk, B.-E. & Wink, M. (2017). Medicinal Plants of the World. Second edition. CABI, Wallingford	"Origin. Southeast Asia (Moluccas Islands); traditionally cultivated in Tanzania (Zanzibar), Madagascar and other East African islands, but is nowadays found as a crop in almost all tropical parts of the world."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Vos, P. (2004). Case Studies on the Status of invasive Woody Plant Species in the Western Indian Ocean: 2. The Comoros Archipelago (Union of the Comoros and Mayotte). FAO, Rome, Italy	[Listed among 16 species that are highly invasive. No impacts have been specifically attributed to <i>Syzygium aromaticum</i>] "There are only a few isolated studies for the Comoros archipelago on this subject. According to these studies and from discussions with local environmental specialists, 16 woody species are estimated to be highly invasive in the Comoros archipelago: <i>Acacia auriculiformis</i> , <i>Acacia mangium</i> , <i>Albizia lebbek</i> , <i>Cinnamomum verum</i> , <i>Clidemia hirta</i> , <i>Gliricidia sepium</i> , <i>Jatropha curcas</i> , <i>Lantana camara</i> , <i>Leucaena leucocephala</i> , <i>Litsea glutinosa</i> , <i>Psidium guajava</i> , <i>Psidium cattleianum</i> , <i>Senna</i> sp., <i>Spathodea campanulata</i> , <i>Syzygium aromaticum</i> and <i>Syzygium jambos</i> . • The introduction dates of these species are unknown and could date back many centuries, as the archipelago has been inhabited on a permanent basis since the ninth century. However, many introductions seem to date from the nineteenth century and the massive settlement by colonists associated with the sugar cane industry followed by the increase in production of spices and essential oils. These species naturalized and spread on deforested land."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[<i>Syzygium aromaticum</i> reported to be naturalized in a number of locations] "References: Africa-W-760, Mozambique-nC-943, Laos-N-1102, western Indian Ocean-I-1146, La Reunion-U-1321, Eastern Caribbean-N-1742, Borneo-N-1796, Sao Tome and Principe-N-1805, Seychelles-N-1925, -I-, Comoros-W-1977, Lao People's Democratic Republic-W-1977, Seychelles-W-1977."

302	Garden/amenity/disturbance weed	
-----	---------------------------------	--

Qsn #	Question	Answer
	Source(s)	Notes
	Vos, P. (2004). Case Studies on the Status of invasive Woody Plant Species in the Western Indian Ocean: 2. The Comoros Archipelago (Union of the Comoros and Mayotte). FAO, Rome, Italy	[Listed among 16 species that are highly invasive. No impacts have been specifically attributed to <i>Syzygium aromaticum</i>] "There are only a few isolated studies for the Comoros archipelago on this subject. According to these studies and from discussions with local environmental specialists, 16 woody species are estimated to be highly invasive in the Comoros archipelago: <i>Acacia auriculiformis</i> , <i>Acacia mangium</i> , <i>Albizia lebbek</i> , <i>Cinnamomum verum</i> , <i>Clidemia hirta</i> , <i>Gliricidia sepium</i> , <i>Jatropha curcas</i> , <i>Lantana camara</i> , <i>Leucaena leucocephala</i> , <i>Litsea glutinosa</i> , <i>Psidium guajava</i> , <i>Psidium cattleianum</i> , <i>Senna</i> sp., <i>Spathodea campanulata</i> , <i>Syzygium aromaticum</i> and <i>Syzygium jambos</i> . • The introduction dates of these species are unknown and could date back many centuries, as the archipelago has been inhabited on a permanent basis since the ninth century. However, many introductions seem to date from the nineteenth century and the massive settlement by colonists associated with the sugar cane industry followed by the increase in production of spices and essential oils. These species naturalized and spread on deforested land."

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	
	Source(s)	Notes
	Vos, P. (2004). Case Studies on the Status of invasive Woody Plant Species in the Western Indian Ocean: 2. The Comoros Archipelago (Union of the Comoros and Mayotte). FAO, Rome, Italy	[Listed among 16 species that are highly invasive. No impacts have been specifically attributed to <i>Syzygium aromaticum</i>] "There are only a few isolated studies for the Comoros archipelago on this subject. According to these studies and from discussions with local environmental specialists, 16 woody species are estimated to be highly invasive in the Comoros archipelago: <i>Acacia auriculiformis</i> , <i>Acacia mangium</i> , <i>Albizia lebbek</i> , <i>Cinnamomum verum</i> , <i>Clidemia hirta</i> , <i>Gliricidia sepium</i> , <i>Jatropha curcas</i> , <i>Lantana camara</i> , <i>Leucaena leucocephala</i> , <i>Litsea glutinosa</i> , <i>Psidium guajava</i> , <i>Psidium cattleianum</i> , <i>Senna</i> sp., <i>Spathodea campanulata</i> , <i>Syzygium aromaticum</i> and <i>Syzygium jambos</i> . • The introduction dates of these species are unknown and could date back many centuries, as the archipelago has been inhabited on a permanent basis since the ninth century. However, many introductions seem to date from the nineteenth century and the massive settlement by colonists associated with the sugar cane industry followed by the increase in production of spices and essential oils. These species naturalized and spread on deforested land."

305	Congeneric weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[<i>Syzygium cumini</i>] " <i>Syzygium cumini</i> has become invasive in many tropical regions and islands. It spreads rapidly and forms dense canopies shading out native plant species and preventing any regeneration of trees and shrubs. In Florida the tree invades a number of habitats of high conservation value, e.g. hammocks, wet pinelands and sawgrass marshes (Langeland and Craddock Burks, 1998)." [<i>Syzygium jambos</i>] "Rose apple is a medium-sized tree that is able to invade undisturbed rainforest, although it grows best in disturbed forests and in forest edges. The tree has become invasive on a number of islands, where it forms dense thickets shading out other plant species. In Fiji it occurs from sea level to 850 m altitude. On the island of La Réunion the tree extensively spreads in semi-dry riparian forests, where it displaces native vegetation (Csurhes and Edwards, 1998; Varnham, 2006; ISSG, 2014)."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Slender, evergreen tree, up to 20 m tall, conical when young, later becoming cylindrical, in cultivation usually smaller and branched from the base. Roots form an extensive dense mat close to the surface with some major laterals, from which occasional "sinker" roots descend. Shoot growth determinate, appearing in flushes, forming a dense canopy of fine twigs. Leaves opposite, simple, glabrous; petiole 1-3 cm long, reddish, somewhat thickened at base; blade obovate-oblong to elliptical, 6-13 cm × 3-6 cm, base very acute, apex acuminate, coriaceous, shining, gland-dotted. Inflorescence terminal, paniculate, about 5 cm long, with 3-20(-40) bisexual flowers, usually borne in cymose groups of 3. Flower buds 1-2 cm long, constituting the cloves just before opening; calyx tubular, tube subterete to subquadrangular, 1-1.5 cm long, yellowish-green with a red flush, slightly protruding beyond the ovary (hypanthium), with 4, ovate-triangular, fleshy lobes 2-4 mm long; petals 4, coherent, tinged red, rounded, 6 mm in diameter, shed as an hemispherical calyptra as the flower opens; stamens numerous, up to 7 mm long; pistil with 2-celled ovary, style 3-4 mm long, stigma 2-lobed. Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long."

402	Allelopathic	
	Source(s)	Notes

Qsn #	Question	Answer
	Jose, A. M., & Surendran, D. (2020). Comparative Allelopathic Effect of <i>Syzygium aromaticum</i> And <i>Myristica fragrans</i> On Seed Germination of <i>Amaranthus cruentus</i> . <i>Journal of Advanced Scientific Research</i> , 11(04), 347-349	[Potentially. Extracts demonstrate allelopathic effects] "The present study aimed to compare the allelopathic effect of aqueous leaf extract of <i>Syzygium aromaticum</i> and <i>Myristica fragrans</i> on seed germination of <i>Amaranthus cruentus</i> . The study was conducted by petridish method using four different concentrations of aqueous leaf extracts of both plants for seven days. The control group was also maintained. The number of germinated seeds on each days of experiment were recorded and the germination percentage were calculated using the data obtained on the seventh day. The percentages of seed germination were found decreased according to the increasing concentration of leaf extracts of both plants. The aqueous leaf extract of <i>Syzygium aromaticum</i> showed more inhibitory effect on seed germination of <i>Amaranthus cruentus</i> than that of <i>Myristica fragrans</i> ."

403	Parasitic	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Slender, evergreen tree, up to 20 m tall, conical when young, later becoming cylindrical, in cultivation usually smaller and branched from the base." [Myrtaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Yusri, S., Salim, M. A., & Ryadin, A. R. (2017). Effect of nutmeg (<i>Myristica fragrans</i> Houtt) leaves and clove (<i>Syzygium aromaticum</i> L.) leaves treatment to physical and chemical characteristics of Kacang goat (<i>Capra hircus</i>). <i>Russian Journal of Agricultural and Socio-Economic Sciences</i> , 70(10), 226-231	[Leaves fed and presumably palatable to goats] "Nutmeg (<i>Myristica fragrans</i> Houtt) and clove (<i>Syzygium aromaticum</i> L) is an herb plants that contain essential oils. The research objective was to determine the physical quality (pH, shrinkage cooking, and water holding capacity) and chemical quality (moisture content, protein content and fat content) of Kacang goat (<i>Capra hircus</i>) by rationing of nutmeg and clove leaves treatment. There are four treatments that consisted of the percentage of R0 = ration basal (without the addition of nutmeg and clove leaves), R1 = basal diet + 5% of nutmeg leaves, R2 = basal diet + 5% of clove leaves, R3 = basal diet + 5% of nutmeg leaves + 5 % of clove leaves, while each treatment was replicated four times. The results showed that the use of nutmeg and cloves leaves in a ration of 5% does not affect the physical and chemical quality of the Kacang goat in terms of pH, cooking shrinkage, water holding capacity, moisture content, protein content and fat content."

Qsn #	Question	Answer
405	Toxic to animals	
	Source(s)	Notes
	Wag! (2023). What is Clove Poisoning in Cats? https://wagwalking.com/cat/condition/clove-poisoning-in-cats . [Accessed 3 Apr 2023]	[Possibly harmful to cats] "Clove aromas may interest your cat, and they may want to taste some. However, ingesting clove in any form can be dangerous for cats. Cloves contain eugenol, a substance that's toxic to felines, especially in large amounts. Even simply inhaling eugenol can cause respiratory and other serious problems."
	WRA Specialist. (2023). Personal Communication	Unknown if leaves or other unprocessed plants parts could be toxic of harmful to animals

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"In both Zanzibar and Indonesia, the clove is threatened by diseases that kill the tree. Identification of the causal agents has been difficult amidst tree decline through non-parasitic forms of stress. "Sumatra disease" is the main problem in Indonesia, killing up to 10% of the mature trees each year in parts of Sumatra and West Java, with an estimated annual crop loss of US\$ 25 million. A tenacious research effort identified <i>Pseudomonas syzygii</i> as the cause. The bacteria live in the xylem vessels and apparently spread upwards from the roots. The symptoms are dieback, starting in the crown, vascular discoloration and root decay. Injections of oxytetracycline, the most effective antibiotic treatment, delay the decline but cannot cure the tree. Since then, it has been found that <i>Hindola striata</i> and possibly <i>H. fulva</i> act as vectors. Nearby forest is an important source of these tiny insects (tube-building cercopids of the family Machaerotidae), but they can complete their life cycle on the clove tree. This opens up prospects for the control of the disease: in the 1990s researchers identified egg parasites of <i>Hindola</i> and tested insecticides for specific action on <i>Hindola</i> ; plants infected with non-virulent strains of the bacterium have been found to be immune to the virulent strain. Resistant clove cultivars have not been found, but grafts on resistant related species are being tested. Leaf blister blight, named "cacar daun" in Indonesia, is second only to Sumatra disease in the loss of crop and trees it causes. The causal fungi are <i>Phyllosticta syzygium</i> and <i>Guigordia hevea</i> . Fungicides can be effective, but research into the biology of the fungi, occurrence of resistance, etc. is needed to control the disease efficiently. A number of fungi and parasitic algae cause leaf spots; other fungi are involved in root decay. Insect pests recorded on clove include stem, branch and twig borers, root feeders, a few sucking insects and caterpillars. However, crop losses are largely incidental, recurrent damage being caused mainly by borers. Termites may cause havoc in a young plantation and the fiery red tree ants make life difficult for the clove pickers."

Qsn #	Question	Answer
	<p>CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK</p>	<p>"Pests recorded Insects: Anomala cupripes (large green chafer beetle) Aspidiotus destructor (coconut scale) Bactrocera dorsalis (Oriental fruit fly) Bactrocera kandiensis Ceroplastes floridensis (soft scale) Eumeta variegata Glyptotermes dilatatus (live-wood tea termite (Sri Lanka)) Spodoptera litura (taro caterpillar) Nematodes: Criconemella (ring nematode) Helicotylenchus dihystra (common spiral nematode) Rotylenchulus reniformis (reniform nematode) Fungus diseases: Calonectria quinqueseptata (leaf spot: Hevea spp.) Cephaleuros virescens (algal spot of coffee) Cryphonectria cubensis (Eucalyptus canker) Cylindrocladium camelliae (root rot: tea) Fusarium oxysporum Ganoderma philippii (tea root rot) Pythium debaryanum (damping-off)"</p>
	<p>Ridley, G.S., Bain, J., Bulman, L.S., Dick, M.A. & Kay, M.K. (2000). Threats to New Zealand's indigenous forests from exotic pathogens and pests. Science for Conservation 142. Department of Conservation, Wellington, New Zealand</p>	<p>"Stem canker of Myrtaceae: Cryphonectria cubensis Cryphonectria cubensis has become a significant pathogen of Eucalyptus spp. in tropical areas of Brazil, Central America, Florida, Hawaii and Western Samoa (Hodges et al. 1979; Hodges 1980), Cameroon (Gibson 1981), India (Sharma et al. 1985) and South Africa (Wingfield et al. 1989; Conradie et al. 1990). It is only recently that C. cubensis has been found in native stands of Eucalyptus (E. marginata) in temperate Western Australia (Davison & Coates 1991; Davison & Tay 1995). The only other known host is Syzygium aromaticum (Hodges et al. 1986), the clove, which has been dispersed throughout the tropics from its native range in the Molucca Islands of Indonesia. It is believed that the fungus has been inadvertently carried to most tropical areas on S. aromaticum plants destined for either clove production or as tropical ornamentals (Hodges et al. 1986). If that is indeed the case then the fungus was already well established as a minor pathogen before the arrival in most cases of Eucalyptus spp. for use in plantation forestry. However there is still an anomaly in the presence of C. cubensis in Western Australia which has yet to be explained but suggests that non-tropical Myrtaceae could be at risk in the future. The original host of C. cubensis was Syzygium aromaticum a member of the subfamily Myrtoideae whereas Eucalyptus is a Leptospermoideae. This represents a jump of both genus and subfamily. Hodges et al. (1986) inoculated stem segments of a number of Myrtaceae but only obtained fungal growth on four of the thirteen species trialed (Eucalyptus saligna, Syzygium aromaticum, Syncarpia glomulifera and Eugenia megacarpa). Similar inoculation trials were conducted by Swart et al. (1991) who showed that Eucalyptus grandis, Psidium guajava and Syzygium cordatum were also susceptible."</p>

407	Causes allergies or is otherwise toxic to humans	
-----	--	--

Qsn #	Question	Answer
	Source(s)	Notes
	van Wyk, B.-E. & Wink, M. (2017). Medicinal Plants of the World. Second edition. CABI, Wallingford	"Warning The oil can cause allergies."
	WebMD. (2023). Clove - Uses, Side Effects, and More. https://www.webmd.com/vitamins/ai/ingredientmono-251/clove . [Accessed 3 Apr 2023]	<p>[Clove oil with both medicinal uses, and potential risks. Unknown if leaves or other unprocessed plant parts are allergenic or toxic]</p> <p>"When taken by mouth: Clove is commonly consumed in foods. There isn't enough reliable information to know if taking clove in larger amounts is safe or what the side effects might be.</p> <p>When applied to the skin: Clove oil or cream containing clove flower is possibly safe. But applying clove oil in the mouth or on the gums can sometimes cause irritation and gum damage. Applying clove oil or cream to the skin can sometimes cause burning and skin irritation.</p> <p>When inhaled: Smoke from clove cigarettes is likely unsafe and can cause side effects such as breathing problems and lung disease.</p> <p>Pregnancy and breast-feeding: Clove is commonly consumed in foods. There isn't enough reliable information to know if clove is safe to use in larger amounts when pregnant or breast-feeding. Stay on the safe side and stick to food amounts.</p> <p>Children: Clove oil is likely unsafe to take by mouth. Even small amounts of clove oil can cause severe side effects such as seizures, liver damage, and fluid imbalances.</p> <p>Bleeding disorders: Clove oil contains a chemical called eugenol that seems to slow blood clotting. Taking clove oil might cause bleeding in people with bleeding disorders.</p> <p>Surgery: Cloves contain chemicals that might affect blood sugar levels and slow blood clotting. It might interfere with blood sugar control or cause bleeding during or after surgery. Stop using clove at least 2 weeks before a scheduled surgery."</p>

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	[No evidence from cultivation, and unlikely given habitat and growing conditions] "Being strictly a tropical species, clove requires a warm humid tropical climate with an annual rainfall from 1,500 to 2,500 mm. It grows well from mean sea level up to an elevation of 1,000 m. In its native habitat it is commonly found in woodlands and rainforests."
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	[No evidence] "Cloves are almost exclusively grown on islands, but proximity of the sea may not be as necessary as it was once thought to be, nor is the crop restricted to the lowlands. In parts of Sumatra and Java, and in the Nilgiri Hills in south India, cloves are grown successfully far from the sea and at altitudes of 600-900 m. Sheltered sites are preferred, because wind causes additional stress, and strong winds are not tolerated. Shade is necessary for young trees until they are firmly established. "

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes

Qsn #	Question	Answer
	NC State Extension. (2023). <i>Syzygium aromaticum</i> . https://plants.ces.ncsu.edu/plants/syzygium-aromaticum/ . [Accessed 4 Apr 2023]	"Light: Full sun (6 or more hours of direct sunlight a day) Partial Shade (Direct sunlight only part of the day, 2-6 hours)"
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Shade is necessary for young trees until they are firmly established."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Growth can be sustained on poor and acid soils, but waterlogging is very harmful. Adequate depth of soil is essential and water-holding capacity should be in keeping with the severity of the dry season; if not, irrigation is needed."
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"It prefers well-drained, deep loamy soils with high humus content and black loams of semi-forest regions and will also grow on loose well-drained lateritic soils."
	NC State Extension. (2023). <i>Syzygium aromaticum</i> . https://plants.ces.ncsu.edu/plants/syzygium-aromaticum/ . [Accessed 4 Apr 2023]	"Soil Texture: Loam (Silt) Sand Soil pH: Acid (<6.0) Soil Drainage: Good Drainage Moist"

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"A medium-sized, branched, glabrescent, evergreen tree growing to 6–15 m tall with a conical or pyramidal canopy (Plate 1) and a greyish bark."

412	Forms dense thickets	n
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	[No evidence] "Cloves are native to Indonesia and occur especially in the north and central Maluka (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania. Agroecology Being strictly a tropical species, clove requires a warm humid tropical climate with an annual rainfall from 1,500 to 2,500 mm. It grows well from mean sea level up to an elevation of 1,000 m. In its native habitat it is commonly found in woodlands and rainforests. It prefers well-drained, deep loamy soils with high humus content and black loams of semi-forest regions and will also grow on loose well-drained lateritic soils."

Qsn #	Question	Answer
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	[No evidence] "The clove tree was first cultivated on some islands of the Moluccas, where it occurs wild, as well as in New Guinea. It is found in abundance as a second-storey forest tree on the lower mountain slopes."

501	Aquatic	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	[Terrestrial] "Cloves are almost exclusively grown on islands, but proximity of the sea may not be as necessary as it was once thought to be, nor is the crop restricted to the lowlands. In parts of Sumatra and Java, and in the Nilgiri Hills in south India, cloves are grown successfully far from the sea and at altitudes of 600-900 m. Sheltered sites are preferred, because wind causes additional stress, and strong winds are not tolerated. Shade is necessary for young trees until they are firmly established. "

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 29 Mar 2023]	"Family: Myrtaceae Subfamily: Myrtoideae Tribe: Syzygieae"

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 29 Mar 2023]	"Family: Myrtaceae Subfamily: Myrtoideae Tribe: Syzygieae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Slender, evergreen tree, up to 20 m tall, conical when young, later becoming cylindrical, in cultivation usually smaller and branched from the base. Roots form an extensive dense mat close to the surface with some major laterals, from which occasional "sinker" roots descend. "

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes

Qsn #	Question	Answer
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Cloves are native to Indonesia and occur especially in the north and central Maluka (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."
	Sujanapal, P., & Kunhikannan, C. (2017). The Genus <i>Syzygium</i> in Western Ghats. In <i>The Genus Syzygium</i> (pp. 15-56). CRC Press, Boca Raton, FL	"Distribution: Native of Molucanna Islands (Indonesia), now widely cultivated in many tropical regions, including India, mainly in the states of Kerala, Tamil Nadu, Karnataka, Goa, and Maharashtra for the clove of commerce. Fl. & fr.: December–July. Threat status: No threat."

602	Produces viable seed	y
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Cloves are propagated by seed. Seed from selected mother trees is extracted from the fresh fruit and germination follows in 2-6 weeks. Seedlings are raised in shaded nursery beds and respond to care: controlled watering, excellent drainage, adequate spacing for sturdy growth, and timely hardening-off by reduced shading and watering. Plants should reach a height of more than 50 cm within one year and should be moved to the field before they get much older. During transplanting, speed, protection of the root system and trimming of the shoots greatly increase the chance of survival. "
	Lim, T.K. (2014). <i>Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers</i> . Springer, Dordrecht	"Cloves are usually propagated by seeds or by cuttings. They can also be propagated by approach grafting or cleft grafting."

603	Hybridizes naturally	
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	[Itra-specific hybrids documented] "Hybrids of wild and cultivated cloves are similar to the wild parent. Hence the only direct way to widen the genetic basis is to trace clove populations descended from trees that escaped the eradication campaign (e.g. in New Guinea). Presumably the Zanzibar type is such a population. Hybrids between trees from Zanzibar and Indonesia are superior to both parents in both vigour and yield in the early years."
	Brink, M., 2008. <i>Syzygium cordatum</i> Hochst. ex C.Krauss. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). <i>Protia 7(1): Timbers/Bois d'œuvre 1</i> . [CD-Rom]. PROTA, Wageningen, Netherlands	[Unknown. Hybridization documented in genus] " <i>Syzygium cordatum</i> hybridizes with <i>Syzygium guineense</i> (Willd.) DC., and the 2 species are connected by a complete range of intermediates."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Naturally set seed results mostly from cross-pollination, but the floral biology of the clove also favours self-pollination and fairly uniform populations developed in the areas where only a few trees were introduced initially."

Qsn #	Question	Answer
	Rema, J., Krishnamoorthy, B., & Mathew, P. A. (1997). Vegetative propagation of major tree spices. <i>Journal of Spices and Aromatic Crops</i> , 6(2), 57-405	"Self pollination is reported to be the more probable mechanism for pollination in clove as maximum pollen viability and stigma receptivity are attained simultaneously (Nair et al. 1974; Sritharan & Bavappa 1981; Pool & Bermavie 1986). However, the flowers are frequently visited by thrips, ants, and bees suggesting the possibility of transfer of pollen from anther to stigma of the same flower (Pool & Bermavie 1986) or cross pollination (Tidbury 1949). Though clove is a predominantly self pollinated crop, morphological variants like king clove, dwarf and bushy clove and small leaved clove are known to exist (Pool et al. 1986; Kuriachan et al. 1992; Krishnamoorthy & Rema 1994b)."
	Orwa C, et al. (2009). Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 4 Apr 2023]	"The clove tree is monoecious, flowers are hermaphrodite and self-pollinating."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Roubik, D. W. (ed.). (2018). <i>The pollination of cultivated plants: A compendium for practitioners: Volume 1</i> . FAO, Rome	"Clove (<i>Syzygium aromaticum</i>), guava (<i>Psidium guajava</i>) and allspice (<i>Pimenta dioica</i>) are shrubs or trees with yellow to white flowers. Bees and other insects visit clove and guava flowers, which are slightly smaller and lack the red colour of Acca (formerly Feijoa, see below). This implies that bees and other insect visitors are probably more effective pollinators for clove and guava than for feijoas and the large gum flowers." ... "Bee pollination of cloves (<i>Syzygium aromaticum</i>) requires outcrossing, although the clove of commerce is a flower bud. Bees probably play an important role in pollination, though other insects are involved and may be more significant in some areas."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Cloves are propagated by seed. Seed from selected mother trees is extracted from the fresh fruit and germination follows in 2-6 weeks. Seedlings are raised in shaded nursery beds and respond to care: controlled watering, excellent drainage, adequate spacing for sturdy growth, and timely hardening-off by reduced shading and watering. Plants should reach a height of more than 50 cm within one year and should be moved to the field before they get much older. During transplanting, speed, protection of the root system and trimming of the shoots greatly increase the chance of survival. "
	Rema, J., Krishnamoorthy, B., & Mathew, P. A. (1997). Vegetative propagation of major tree spices. <i>Journal of Spices and Aromatic Crops</i> , 6(2), 57-405	"Reports indicate that clove can be successfully propagated through cuttings, layering and approach grafting."

Qsn #	Question	Answer
607	Minimum generative time (years)	>3
	Source(s)	Notes
	Orwa C, et al. (2009). Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 4 Apr 2023]	"Generally, it takes 20-30 years for clove to attain full bearing. First bearing is 8-10 years after planting, in Zanzibar (Tanzania) 4-6 years and in Indonesia 6-8 years."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long." [No means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Lim, T.K. (2014). Edible Medicinal And Non-Medicinal Plants. Volume 8, Flowers. Springer, Dordrecht	"Cloves are native to Indonesia and occur especially in the north and central Maluku (Moluccas) and Papua Barat (Irian Jaya). It has been introduced and now widely cultivated in Brazil, Haiti, India, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Seychelles, Sri Lanka and Tanzania."
	van Wyk, B.-E. & Wink, M. (2017). Medicinal Plants of the World. Second edition. CABI, Wallingford	"Origin. Southeast Asia (Moluccas Islands); traditionally cultivated in Tanzania (Zanzibar), Madagascar and other East African islands, but is nowadays found as a crop in almost all tropical parts of the world."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans" [No evidence]

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	[Fleshy-fruited] "Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long."

705	Propagules water dispersed	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). Plant Resources of South-East Asia. A Selection. Pudoc/Prosea, Wageningen, Netherlands	"It is found in abundance as a second-storey forest tree on the lower mountain slopes." ... "Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long." [A fleshy-fruited species that is not restricted to riparian areas, or proximity to water. Water dispersal unlikely to play an important role in the dispersal of this species]

Qsn #	Question	Answer
	Alvarenga, J. M., Araújo-Santos, I., & Benchimol, M. (2020). Influencia da Cobertura florestal na chegada de sementes em agroflorestas de cacau. <i>Agrotrópica</i> 32(3): 207 - 216	[Listed as animal dispersed] "Tabela 1. Lista e classificação das espécies (em relação ao modo de dispersão e estágio sucessional) das sementes identificadas em coletores de sementes estabelecidos em 15 agroflorestas de cacau na região sul da Bahia ao longo de 12 meses" [Syzygium aromaticum - Dispersão = Zoocórica]

706	Propagules bird dispersed	y
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long." [Fleshy-fruited. Presumably possible.]
	Alvarenga, J. M., Araújo-Santos, I., & Benchimol, M. (2020). Influencia da Cobertura florestal na chegada de sementes em agroflorestas de cacau. <i>Agrotrópica</i> 32(3): 207 - 216	[Listed as animal dispersed] "Tabela 1. Lista e classificação das espécies (em relação ao modo de dispersão e estágio sucessional) das sementes identificadas em coletores de sementes estabelecidos em 15 agroflorestas de cacau na região sul da Bahia ao longo de 12 meses" [Syzygium aromaticum - Dispersão = Zoocórica]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long." [No means of external attachment]

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	Farida, W. R. (2020). Forest plants selection as feed sources and nesting tree of obi cuscus (<i>Phalanger rothschildi thomas</i> , 1898) in Obi islands, North Maluku. <i>IOP Conference Series: Earth and Environmental Science</i> 486(1): 012104	"Obi cuscus (<i>Phalanger rothschildi</i>) is an arboreal marsupial and is an endemic animal from Obi Island, Bisa Island, and Obilatu Island part of the Obi Islands, North Maluku province." ... "Obi cuscus plays an important role in seed dispersal, including food selection and nutritional needs." [Syzygium aromaticum reported to eat fruit and presumably disperse seeds]
	Alvarenga, J. M., Araújo-Santos, I., & Benchimol, M. (2020). Influencia da Cobertura florestal na chegada de sementes em agroflorestas de cacau. <i>Agrotrópica</i> 32(3): 207 - 216	[Presumably yes. Listed as animal dispersed] "Tabela 1. Lista e classificação das espécies (em relação ao modo de dispersão e estágio sucessional) das sementes identificadas em coletores de sementes estabelecidos em 15 agroflorestas de cacau na região sul da Bahia ao longo de 12 meses" [Syzygium aromaticum - Dispersão = Zoocórica]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Westphal, E., & Jansen, P. C. M. (Eds.). (1989). <i>Plant Resources of South-East Asia. A Selection</i> . Pudoc/Prosea, Wageningen, Netherlands	"Fruit (called mother of cloves) an ellipsoidal-obovoid berry, 2-2.5 cm long, dark red, usually containing only 1 oblongoid seed 1.5 cm long." [No evidence. One-seeded fruit]

802	Evidence that a persistent propagule bank is formed (>1 yr)	n

Qsn #	Question	Answer
	Source(s)	Notes
	Anilkumar, C., Krishnan, P. N., & Nabeesa, S. (2000). Seed viability of <i>Syzygium aromaticum</i> (L.) Merrill & Perry during storage. In <i>Spices and aromatic plants: challenges and opportunities in the new century. Contributory papers. Centennial conference on spices and aromatic plants, Calicut, Kerala, India, 20-23 September, 2000</i> (pp. 55-59). Indian Society for Spices	"Abstract : <i>S. aromaticum</i> is an important spice crop for its dried unopened flower buds, the clove of commerce. Normal propagation of this species is through seeds which have short viability period. In the present study, correlation that exist between moisture content and storage temperature with respect to viability of <i>S. aromaticum</i> seeds were analysed for standardizing suitable germplasm storage conditions. Depulped seeds kept at 28±3°C and 70% RH lost their viability due to 10% decrease in initial moisture content in 4 days. Seeds stored in polyethylene bags at freezing temperature (0°C) was found to be fatal while at chilling temperature (10°C) they remained viable for a month. Depulped seeds stored in polyethylene bags kept at 20 and 30°C retained their viability until 6 and 9 months, respectively, though sprouted under storage. Seeds stored in closed polyethylene bags at 30°C was found to be a suitable germplasm repository."

803	Well controlled by herbicides	
	Source(s)	Notes
	Motooka, P., Castro, L., Nelson, D., Nagai, G. & Ching, L. (2003). <i>Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide</i> . CTAHR, UH Manoa, Honolulu, HI	"Sensitive to picloram applied cut surface and to glyphosate applied to drilled holes. Good control with triclopyr applied basal bark and cut-surface(30)." [Herbicides effective on related invasive species <i>S. jambos</i> , so may also be effective on <i>Syzygium aromaticum</i>]

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Orwa C, et al. (2009). <i>Agroforestry Database: a tree reference and selection guide version 4.0</i> . http://www.worldagroforestry.org . [Accessed 4 Apr 2023]	[Unknown. Generally not severely pruned or cut back. Maintained for bud production] "Thinning is recommended to reduce branch overcrowding in trees. Dead and diseased shoots should be removed once or twice a year."

Qsn #	Question	Answer
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Carnegie, A. J., & Lidbetter, J. R. (2012). Rapidly expanding host range for <i>Puccinia psidii</i> sensu lato in Australia. <i>Australasian Plant Pathology</i> , 41(1), 13-29	[Pathogen present in Hawaiian Islands. Impacts <i>Syzygium</i> and <i>Eugenia</i> species. Effects on <i>Syzygium aromaticum</i> unknown] "A rust affecting Myrtaceae was recently detected in New South Wales, Australia."... "In Australia, <i>P. psidii</i> s.l. has currently been found on 107 host species in 30 genera during surveys, including species in <i>Angophora</i> , <i>Asteromyrtus</i> , <i>Austromyrtus</i> , <i>Backhousia</i> , <i>Callistemon</i> , <i>Chamelaucium</i> , <i>Choricarpia</i> , <i>Decaspermum</i> , <i>Eucalyptus</i> , <i>Eugenia</i> , <i>Gossia</i> , <i>Lenwebbia</i> , <i>Leptospermum</i> , <i>Lophomyrtus</i> , <i>Melaleuca</i> , <i>Metrosideros</i> , <i>Myrtus</i> , <i>Pilidiostigma</i> , <i>Rhodamnia</i> , <i>Rhodomyrtus</i> , <i>Ristantia</i> , <i>Stockwellia</i> , <i>Syncarpia</i> , <i>Syzygium</i> , <i>Tristania</i> , <i>Tristaniopsis</i> , <i>Ugni</i> , <i>Uromyrtus</i> and <i>Xanthostemon</i> . Species under cultivation (in nurseries and gardens) that are severely affected include <i>Gossia inophloia</i> , <i>Agonis flexuosa</i> , <i>Syzygium jambos</i> and <i>S. anisatum</i> while species that are severely damaged in native bushland include <i>Rhodamnia rubescens</i> , <i>Rhodomyrtus psidioides</i> , <i>Choricarpia leptopetala</i> and <i>Melaleuca quinquenervia</i> ."

Summary of Risk Traits:

Syzygium aromaticum, commonly known as clove, is an evergreen tree native to Indonesia that grows to a height of 10-20 meters. The tree produces aromatic flower buds, which are harvested and dried to make the popular spice known as cloves. In addition to their culinary uses, cloves have also been used in traditional medicine to treat various ailments. The tree has been widely cultivated and is naturalized in some locations. It is listed among 16 species that are reported to be highly invasive in the Comoros archipelago, although specific impacts have not been described. In the Hawaiian Islands, it could spread if birds or other animals disperse its seeds. Contact with the leaves may also cause dermatitis in susceptible individuals.

High Risk / Undesirable Traits

- Thrives and spreads in regions with tropical climates
- Introduced and naturalized in a number of tropical locations, but no evidence in the Hawaiian Islands to date.
- Reported to be invasive in Intermediate-altitude humid forest of the Comoros archipelago, presumably with negative environmental effects, but specific impacts have not been documented
- Other *Syzygium* species are invasive weeds
- Potentially allelopathic (extracts demonstrate inhibitory effects)
- Potentially toxic or allergenic to animals and susceptible people
- Potential host of tree pests and pathogens.
- Shade tolerant when young.
- Reproduces by seeds.
- Capable of self-pollination.
- Fleshy-fruited seeds dispersed by fruit eating animals, probably birds, and through intentional cultivation by people.

Low Risk Traits

- Valued and cultivated as a spice plant, with almost no reports of negative impacts within its introduced range.
- Unarmed (no spines, thorns, or burrs)
- Foliage palatable to goats.
- Generally reaches maturity in 8-10 years.
- Relatively large seeds unlikely to be accidentally dispersed.
- Seeds have short viability, and are unlikely to form a seed bank.

Second Screening Results for Trees/tree-like shrubs

- (A) Shade tolerant or known to form dense stands? Yes. Young trees require shade.
(B) Bird- Or clearly wind- dispersed?> Probably Yes. Fleshy-fruited and presumably bird-dispersed.
(C) Life cycle <4 years? No. Reaches maturity in 8-10 years (4-6 years in Zanzibar)
Outcome = Evaluate

TAXON: *Syzygium aromaticum* (L.)
Merr. & L. M. Perry

SCORE: 1.0

RATING: Evaluate