

<b>Taxon:</b> <i>Acorus calamus L.</i>	<b>Family:</b> Acoraceae
<b>Common Name(s):</b> calamus flagroot myrtle flag sweet calamus sweet flag sweetroot	<b>Synonym(s):</b> <i>Acorus calamus L. var. calamus</i> <i>Calamus aromaticus Garsault</i> " "

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 2 Mar 2020
<b>WRA Score:</b> 8.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Widely Naturalized, Aquatic Weed, Monoculture-Forming, Spreads Vegetatively, Water 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	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)	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
305	Congeneric weed		
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		

Qsn #	Question	Answer Option	Answer
406	Host for recognized pests and pathogens	y=1, n=0	n
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	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	y
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		
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators		
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
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	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m <sup>2</sup> )	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	y=-1, n=1	y
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
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Acorus calamus is diploid, triploid, and tetraploid. Diploids are known to grow naturally in E Asia (Mongolia and C Siberia, at least) and North America; tetraploids are known only from Asia (India, E Siberia, and Japan); and triploids are typical for the plants in Europe, SW Asia, India (Himalayan region), and E North America. The triploid cytotype probably originated in the Himalayan region, as a hybrid between the diploid and tetraploid cytotypes. It then probably dispersed naturally or with humans to Sakhalin and with humans to Turkey, then to Europe, and finally to E North America as a medicinal plant (Evstatieva et al., Fitologiya 48: 19–22. 1996; Löve & Löve, Proc. Genet. Soc. Canada 2: 14–17. 1957)."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	NA

Qsn #	Question	Answer
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, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 2 Mar 2020]	"Native Asia-Temperate WESTERN ASIA: Afghanistan, Iran, Turkey CAUCASUS: Armenia, Azerbaijan, Georgia SIBERIA: Russian Federation [Buryatia, Gorno-Altay, Tuva, Yakutia-Sakha, Krasnoyarsk, Chita, Irkutsk] MONGOLIA: Mongolia RUSSIAN FAR EAST: Russian Federation [Khabarovsk, Primorye, Amur] CHINA: China EASTERN ASIA: Japan, Korea, South Asia-Tropical INDIAN SUBCONTINENT: Bangladesh, Bhutan, India (n.), Nepal, Pakistan, Sri Lanka INDO-CHINA: Thailand, Vietnam MALESIA: Indonesia [Sulawesi, Jawa]"
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Throughout China [Afghanistan, Bangladesh, Bhutan, India, Indonesia, Japan, Korea, Malaysia (Sarawak), Mongolia, Nepal, Pakistan, Russia (Far East, Siberia), Sri Lanka, Thailand, Vietnam; SW Asia, Europe (except S), North America]." [Tropical forms would presumably be cultivated in Hawaii]

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 2 Mar 2020]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Missouri Botanical Gardens. (2020). <i>Acorus calamus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 2 Mar 2020]	"Zone: 4 to 10"
	Mayo, S.J., Bogner, J. & Boyce, P.C. (1997). The Genera of Araceae. Royal Botanic Gardens, Kew, London, UK	[Broad climate suitability (environmental versatility)? Yes] "temperate to tropical wetlands, up to 1100m alt. in central Europe and up to 2600m alt. in China; helophyte, marshes, streams, ponds, swampy sites, pastures, meadows." [Broad distribution and elevational range]

204	Native or naturalized in regions with tropical or subtropical climates	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Throughout China [Afghanistan, Bangladesh, Bhutan, India, Indonesia, Japan, Korea, Malaysia (Sarawak), Mongolia, Nepal, Pakistan, Russia (Far East, Siberia), Sri Lanka, Thailand, Vietnam; SW Asia, Europe (except S), North America]." [Tropical forms would presumably be cultivated in Hawaii]
	Imada, C. (2019). Hawaiian Naturalized Vascular Plants Checklist (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No evidence to date

205	<b>Does the species have a history of repeated introductions outside its natural range?</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"One genus and two species: temperate and subtropical Asia and North America, tropical Asia; introduced and naturalized in Europe, New Guinea (at least partly), and North America (partly); both species in China."

301	<b>Naturalized beyond native range</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"...A. calamus is especially prone to naturalise and under favourable conditions become quite weedy."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"One genus and two species: temperate and subtropical Asia and North America, tropical Asia; introduced and naturalized in Europe, New Guinea (at least partly), and North America (partly); both species in China."
	Imada, C. (2019). Hawaiian Naturalized Vascular Plants Checklist (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No evidence in the Hawaiian Islands to date

302	<b>Garden/amenity/disturbance weed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"...A. calamus is especially prone to naturalise and under favourable conditions become quite weedy." [Potential environmental weed]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations" [Numerous references as a weed, but little documentation of serious environmental impacts]

Qsn #	Question	Answer
303	<b>Agricultural/forestry/horticultural weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations"
	Duke, J.A. (1982). Handbook of Edible Weeds. CRC Press, Boca Raton, FL	[Potentially] "Could be a weed with aquatic crops"

304	<b>Environmental weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations"
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. <i>Biological Invasions</i> , 1(2-3): 281-300	[Not in this study] "Acorus calamus is not often perceived as weedy, but it competes with more productive waterfowl food plants (Martin and Uhler 1939). A better assessment of its distribution and invasiveness awaits more sophisticated means of species identification."

305	<b>Congeneric weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	<i>Acorus gramineus</i> naturalized, and cited as a potential weed in a number of locations

401	<b>Produces spines, thorns or burrs</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). <i>Flora of China</i> . Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Rhizome stout, 4–10(–20) × (0.8–)1–1.5(–3) cm, aromatic; roots at lower side of rhizome. Leaves several, mid-green, often reddish at base, ensiform, (60–)70–100(–150) × (0.7–)1– 2(–2.5) cm (mostly 1–1.5 cm wide), apex acuminate; midrib conspicuous on both sides. Peduncle compressed triangular, (15–)40–50 cm. Spathe mid-green, leaflike, 30–50 cm, acute. Spadix straight or slightly curved, erect, oblique, narrowly conic to subcylindric (tapering toward apex), 4.5–6.5(–8) × 0.6–1.2(–1.5) cm, densely flowered."

402	<b>Allelopathic</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Fujii, Y., Parvez, S. S., Parvez, M., Ohmae, Y., & Iida, O. 2003. Screening of 239 medicinal plant species for allelopathic activity using the sandwich method. <i>Weed Biology and Management</i> , 3(4): 233-241	Not significant in this study

403	<b>Parasitic</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Acorus has been considered for a long time to be a member of the Araceae and only recently has it been removed from the family,..."

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Heinrich, H. H., & Predl, S. (1995). Can We Landscape to Accommodate Deer? Proc. Fast. Wildl. Damage Control Conf. 6: 102-112	[Possibly Yes] "Appendix 1 Species Reported to be Most Deer Resistant" [Includes <i>Acorus calamus</i> ]

405	Toxic to animals	
	Source(s)	Notes
	Plants for a Future. (2020). <i>Acorus calamus</i> . <a href="https://pfaf.org">https://pfaf.org</a> . [Accessed 2 Mar 2020]	"The fresh root can be poisonous[7]. When using the plant medicinally, the isolated essential oil should not be used[165]. The essential oil in the roots of some populations of this plant contains the compound asarone. This has tranquillising and antibiotic activity, but is also potentially toxic and carcinogenic[218, 238]. It seems that these compounds are found in the triploid form of the species (found in Asia) whilst the diploid form (found in N. America and Siberia) is free of the compounds[218, 238]."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	Unknown. Some toxic properties identified

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	Missouri Botanical Gardens. (2020). <i>Acorus calamus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 2 Mar 2020]	"No serious insect or disease problems. Scorch will occur if soils are not kept consistently moist to wet."
	Balakumbahan, R., Rajamani, K., & Kumanan, K. (2010). <i>Acorus calamus</i> : An overview. Journal of Medicinal Plants Research, 4(25), 2740-2745	[Common pests] "Mealy bugs and caterpillar are the pests occurring on this crop. Spraying the shoots and drenching the roots of plants with 10 ml methyl parathion or 20 ml Quinolphos in 10 L of water can be effective in controlling the shoot and root mealy bugs. Major disease is leaf spot and a spray of Captan 10 g with Chloropyriphos 20 ml/10 L controls leaf spot as well as mealy bugs and caterpillar."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes

Qsn #	Question	Answer
	Small, E. & Catling, P.M. 1999. Canadian Medicinal Crops. NRC Research Press, Ottawa, Canada	[Possibly Yes] "There has been concern over the safety of sweet flag, which is currently banned in food products in North America. The prohibition was based on cancerous tumors developed in laboratory animals treat with sweet flag high in content of carcinogenic $\beta$ -asarone. Carcinogenic $\beta$ -asarone is present in large amounts in Asian plants, and in limited amounts in European plants. The apparent absences of this and other toxic phenylpropane derivatives in the plants of North America may represent a means of using sweet flag relatively safely. However, it is important to realize that even if North American sweet flag lacks the carcinogenic substances fund in the plants of the Old World, under certain conditions it is still reputed to be poisonous, producing disturbed digestion, gastroenteritis, constipation, and bloody diarrhea. The volatile oil causes dermatitis on contact with the skin in some individuals. It should be emphasized in view of the toxic potential of the plant, that any kind of personal use without the supervision of an informed physician is hazardous.'
	Plants for a Future. (2020). <i>Acorus calamus</i> . <a href="https://pfaf.org">https://pfaf.org</a> . [Accessed 2 Mar 2020]	[Possibly] "The fresh root can be poisonous[7]. When using the plant medicinally, the isolated essential oil should not be used[165]. The essential oil in the roots of some populations of this plant contains the compound asarone. This has tranquillising and antibiotic activity, but is also potentially toxic and carcinogenic[218, 238]. It seems that these compounds are found in the triploid form of the species (found in Asia) whilst the diploid form (found in N. America and Siberia) is free of the compounds[218, 238]."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Possibly] "The rhizomes are used for treatment of neurasthenia, chronic bronchitis, diarrhea, abdominal distention, chills, colds, externally for abscesses, liver disturbance, and stomach and gut disease. Mainly the rhizome of <i>Acorus calamus</i> is used because the content of the essential oil is highest in the rhizome; the leaves are also used, although the roots and leaves have poor oil content and are therefore of no wide or practical use. Other uses are reported as aromatizer for wine and tobacco, as perfume and insecticide, and as medicine for ulcers, kidney disease, and other diseases, though betaasarone is said to be carcinogenic (Keller & Stahl, <i>Planta Medica</i> 47: 71–74. 1983)."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Swamps, pond sides, standing water" [Unlikely given habitat]

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Balakumbahan, R., Rajamani, K., & Kumanan, K. (2010). <i>Acorus calamus</i> : An overview. <i>Journal of Medicinal Plants Research</i> , 4(25), 2740-2745	"Plenty of sunshine should be available to the plant during its growth and after harvesting for drying the rhizomes."



Qsn #	Question	Answer
	Missouri Botanical Gardens. (2020). <i>Acorus calamus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 2 Mar 2020]	["Tolerates: Wet Soil, Dense Shade"]

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	de Padua, L.S., Bunyaphrathatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Sweet flag can be planted on clayey loams and light alluvial soils."
	Lokesh, G.B. (2004). Sweet flag ( <i>Acorus calamus</i> ) Cultivation and Economics aspects. <i>Natural Product Radiance</i> 3(1): 19-21	"Sweet flag comes up in almost all types of soil with sufficient moisture or irrigation. This can also be grown in waterlogged or marshy soils. Tropical to subtropical climate is suitable for this crop."
	Balakumbahan, R., Rajamani, K., & Kumanan, K. (2010). <i>Acorus calamus</i> : An overview. <i>Journal of Medicinal Plants Research</i> , 4(25), 2740-2745	"This species comes up well in clayey loams, sandy loams and light alluvial soils of river banks."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). <i>Flora of China</i> . Vol. 23 ( <i>Acoraceae</i> through <i>Cyperaceae</i> ). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Perennial herbs, glabrous, aromatic, growing in marshes or as emergent aquatics"

412	Forms dense thickets	y
	Source(s)	Notes
	Jeon, S. H., Kim, H., Nam, J. M., & Kim, J. G. (2013). Habitat characteristics of sweet flag ( <i>Acorus calamus</i> ) and their relationships with sweet flag biomass. <i>Landscape and ecological engineering</i> , 9(1), 67-75	" <i>Acorus calamus</i> , one of the few extratropical members of the <i>Araceae</i> , is a tall perennial wetland monocot with scented leaves and rhizomes. This species forms a shallow and compact network of rhizomes that prevents the coexistence of most other species (Henjy ´ and Husa´k 1978; Dykyjova´ 1980)."
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: <i>Alismatanae</i> and <i>Commelinanae</i> (except <i>Gramineae</i> ). Springer-Verlag, Berlin, Heidelberg, New York	" <i>Acorus</i> is a herbaceous helophyte which forms large dense stands due to its extensively branched rhizomatous stems."

Qsn #	Question	Answer
501	<b>Aquatic</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Swamps, pond sides, standing water, also cultivated; below 2800 m."
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Sweet flag is a component of semi-aquatic habitats, usually in eutrophic locations. It can be a vigorous invader of new sites. In Malesia, it is found along ditches, pools, fish-ponds and marshes, and is sometimes cultivated."
502	<b>Grass</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	Acoraceae
503	<b>Nitrogen fixing woody plant</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Perennial herbs, glabrous, aromatic, growing in marshes or as emergent aquatics" [Acoraceae]
504	<b>Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Rhizome stout, 4–10(–20) × (0.8–)1–1.5(–3) cm, aromatic; roots at lower side of rhizome."
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"This question is specifically to deal with plants that have specialized organs and should not include plants merely with rhizomes/ stolons"
601	<b>Evidence of substantial reproductive failure in native habitat</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"The species are apparently not threatened. Both are easy to grow, and <i>A. calamus</i> is especially prone to naturalise and under favourable conditions become quite weedy."

Qsn #	Question	Answer
	de Padua, L.S., Bunyaphratsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	[Globally secure. Regionally endangered] "Sweet flag has a very large area of distribution and is common in many parts of the world in habitats which are not at risk of destruction. However, locally (e.g. in certain parts of India) it is endangered or even on the verge of extinction. The great genetic variability which is correlated with differences in chemical composition should be taken into account when making germplasm collections and when breeding for special purposes."

602	Produces viable seed	
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Seed oblong- ellipsoid to ovoid, 2.5–3(–4) × 1–1.2(–1.8) mm, without bristles; testa light brown, subsmooth and slightly foveolate."
	Small, E. & Catling, P.M. 1999. Canadian Medicinal Crops. NRC Research Press, Ottawa, Canada	[Possibly Yes] "Sweet flag is found in temperate to subtemperate regions of Eurasia and the America. The diploid (with 24 chromosomes) <i>A. calamus</i> var. <i>americanus</i> (Raf.) Wulf [sometimes treated as a species, <i>A. americanus</i> (Raf.) Raf.] occurs from North America to Siberia; the tetraploid (with 48 chromosomes) <i>A. c.</i> var. <i>angustatus</i> Bess. Occupies eastern and tropical southern Asia; and a sterile triploid (with 36 chromosomes), <i>A. c.</i> var. <i>calamus</i> , is in Europe, temperate India, the Himalayan regions, and eastern North America." [Assessment is treating the fertile diploid and tetraploid forms]
	Buell, M. F. (1935). Seed and seedling of <i>Acorus calamus</i> . Botanical Gazette, 96(4), 758-765	[Produces viable seed? Possibly Yes] " <i>Acorus calamus</i> L. grows in eastern and tropical Asia, in Europe, and in eastern North America. In Europe, where it has been introduced and naturalized within historic times, it appears to be uniformly sterile. This is also true of much of the material growing in the older-settled parts of the United States, material which was probably introduced from Europe. In the northern interior, however, where it has every appearance of being native, it fruits abundantly."
	Jeon, S. H., Kim, H., Nam, J. M., & Kim, J. G. (2013). Habitat characteristics of sweet flag ( <i>Acorus calamus</i> ) and their relationships with sweet flag biomass. Landscape and ecological engineering, 9(1), 67-75	[Yes in Korea] " <i>A. calamus</i> has small seeds with an average length of 3–4 mm (Buell 1935), and its seedlings are small and fragile. Germination requires that the seeds be submerged in water at low temperatures (Jervis and Buell 1964). This may reduce the probability of successful establishment during unfavorable hydrological conditions in the germination season, which occurs in early March (Jervis and Buell 1964)."

603	Hybridizes naturally	
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Unknown] "The triploid cytotype probably originated in the Himalayan region, as a hybrid between the diploid and tetraploid cytotypes." [No evidence of modern natural hybridization]

604	Self-compatible or apomictic	

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Unknown] "Flowers yellowish green, 1.8–2 mm in diam. seen from above; tepals oblong, 2.5–3 × 1– 1.2(–1.4) mm, keeled, membranous, apex triangular hooded; filaments oblong, flat, 2–2.5 × 0.3–0.5 mm, anthers creamcolored, 0.4–0.5 mm in diam.; pollen grains ca. 20 µm, exine shallowly and remotely foveolate; gynoeceium obconic-cylindric, 2.5–3.5(–4) × (0.8–)1–2.3 mm, with conic, spongy apex and stigma very small."
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	Unknown

605	Requires specialist pollinators	
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Unknown] "The pollination of the <i>Acorus</i> species is not known, but entomophily is likely because the pollen is sticky."
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	[Unknown] "The pollinators or pollinating agency of <i>Acorus</i> is unknown; both entomophily and anemophily have been suggested, but entomophily appears more likely."

606	Reproduction by vegetative fragmentation	y
	<b>Source(s)</b>	<b>Notes</b>
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means."
	de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Eds.). 1999. Plant Resources of South-East Asia. No 12(1). Medicinal and Poisonous Plants 1. Backhuys Publishers, Leiden, The Netherlands	"Sweet flag can be propagated easily from pieces of rhizome. The field is ploughed and watered prior to planting, and sometimes green manure is incorporated. The rhizome pieces to be planted are generally 6 cm long and have growing tops. They are planted at 20 cm × 20 cm. Roots start to develop 10-15 days after planting, and are soon followed by leaves. "
	Plants for a Future. (2020). <i>Acorus calamus</i> . <a href="https://pfaf.org">https://pfaf.org</a> . [Accessed 2 Mar 2020]	"The plant seldom flowers or sets seed in Britain and never does so unless it is growing in water[4]. It can spread quite freely at the roots however and soon becomes established."

607	Minimum generative time (years)	2
	<b>Source(s)</b>	<b>Notes</b>
	Shiple, B., & Parent, M. (1991). Germination responses of 64 wetland species in relation to seed size, minimum time to reproduction and seedling relative growth rate. Functional Ecology, 5(1): 111-118	[2+] "Appendix 1 Lag time (L, days) is the number of days from the beginning of the experiment until the first seed germinates" ... "OP indicates obligate perennials (perennials requiring at least two growing seasons to reproduce)," [ <i>Acorus calamus</i> = OP]

Qsn #	Question	Answer
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Small, E. & Catling, P.M. 1999. Canadian Medicinal Crops. NRC Research Press, Ottawa, Canada	"Sweet flag has commercial promise as a natural pesticide, antifungal and antibacterial agent, flavoring ingredient, perfume component, and medicine. It has been successfully cultivated for its products in various parts of Europe and Asia, and is currently cultivated as an ornamental. "

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins."

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins.}

705	Propagules water dispersed	y
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means."

706	Propagules bird dispersed	n
	Source(s)	Notes

Qsn #	Question	Answer
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"The pollination of the <i>Acorus</i> species is not known, but entomophily is likely because the pollen is sticky. Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins." ... "Berry oblong-obovoid, 1- to few seeded, (3.5–)4–4.5 × 2–3(–3.5) mm. Seed oblong- ellipsoid to ovoid, 2.5–3(–4) × 1–1.2(–1.8) mm, without bristles; testa light brown, subsmooth and slightly foveolate." [Fleshy-fruits adapted for water dispersal]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No apparent means of external attachment] "Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins."
	WRA Specialist. (2020). Personal Communication	No evidence that rhizomes or seeds, if produced, are consumed or internally dispersed

801	Prolific seed production (>1000/m <sup>2</sup> )	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means. The seeds also are dispersed by water along streams or river margins." [Seeds may be produced by some forms, but none are reported to seed prolifically]

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2020) Seed Information Database (SID). Version 7.1. Available from: <a href="http://data.kew.org/sid/">http://data.kew.org/sid/</a> . [Accessed 2 Mar 2020]	"The species has been shown to form a transient soil seed bank, with seeds persisting in the soil for <1 year (Thompson et al., 1997). Although this may suggest that seeds of the species are short-lived under ambient conditions, and perhaps recalcitrant or intermediate, a number of factors may have resulted in the inclusion of orthodox seeds within this category (see Thompson et al., 1997 for further detail). Further research is necessary before the storage behaviour of the taxon can be reliably classified."

Qsn #	Question	Answer
	Leck, M. A., & Simpson, R. L. (1995). Ten-year seed bank and vegetation dynamics of a tidal freshwater marsh. <i>American Journal of Botany</i> , 82(12), 1547-1557	[Not in this study due to lack of seed production] "When there is lack of similarity between floristic composition of the vegetation and the seed bank, it may be due to a variety of factors, including dominant species that produce few or no viable seeds (e.g., <i>Acorus calamus</i> ; Leck and Simpson, 1987..."
	Hopfensperger, K. N., Engelhardt, K. A. M., & Lookingbill, T. R. (2009). Vegetation and seed bank dynamics in a tidal freshwater marsh. <i>Journal of Vegetation Science</i> , 20(4), 767-778	[Possibly No] "Species found in the vegetation and not in the seed bank included <i>Onoclea sensibilis</i> L., <i>Acorus calamus</i> L., and <i>Zizania aquatica</i> L." [May be due to lack of seed production]

803	Well controlled by herbicides	y
	Source(s)	Notes
	Klingman, D.L., Bovey, R.W., Knake, E.L., Lange, A.H., Meade, J.A., Skroach, W.A., Stewart, R.E. & Wyse, D.L. 1983. <i>USDA Weed Control Compendium</i> . AD-BU-2281. Extension Service, U.S. Department of Agriculture, Washington, DC	"Table 1 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides" [E (Excellent) Over 95 percent of the weed population is killed by a single treatment. - This rating was given to the use of Glyphosate on <i>Acorus calamus</i> ]

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). <i>Flora of China</i> . Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Probably Yes] "Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid <i>Acorus calamus</i> has been dispersed by this means." [Fragments will spread]

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	Unknown

**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Grows in tropical climates
- Broad climate suitability
- Widely naturalized
- Regarded as a weed in many locations
- May be toxic if ingested
- Tolerates many soil types
- Can form dense monocultures that exclude other vegetation
- Spreads vegetatively by rhizome fragments and possibly seeds
- Can reach maturity in 2 growing seasons
- Rhizome fragments and seeds dispersed along waterways

## Low Risk Traits

- Sterile forms may limit dispersal
- Medicinal and edible uses
- Herbicides may provide effective control