

<b>Taxon:</b> <i>Thalia geniculata</i> L.	<b>Family:</b> Marantaceae
<b>Common Name(s):</b> arrowroot bent alligator-flag fire-flag	<b>Synonym(s):</b> <i>Thalia welwitschii</i> Ridl.

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Approved	<b>End Date:</b> 14 May 2024
<b>WRA Score:</b> 8.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Rhizomatous Herb, Weedy, Semi-Aquatic, Selfing, 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	y = 1*multiplier (see Appendix 2), n = 0	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	y = 1, n = -1	n
405	Toxic to animals	y = 1, n = 0	n
406	Host for recognized pests and pathogens	y = 1, n = 0	n
407	Causes allergies or is otherwise toxic to humans	y = 1, n = 0	n
408	Creates a fire hazard in natural ecosystems	y = 1, n = 0	n
409	Is a shade tolerant plant at some stage of its life cycle		

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y = 1, n = 0	n
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	n
502	Grass	y = 1, n = 0	n
503	Nitrogen fixing woody plant	y = 1, n = 0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y = 1, n = 0	n
601	Evidence of substantial reproductive failure in native habitat	y = 1, n = 0	n
602	Produces viable seed	y = 1, n = -1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y = 1, n = -1	y
605	Requires specialist pollinators	y = -1, n = 0	n
606	Reproduction by vegetative fragmentation	y = 1, n = -1	y
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y = 1, n = -1	y
702	Propagules dispersed intentionally by people	y = 1, n = -1	y
703	Propagules likely to disperse as a produce contaminant	y = 1, n = -1	n
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> )		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y = 1, n = -1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	[Not domesticated] "This species has the widest distribution known for any of the Marantaceae, occurring in both Africa and the Americas. Because of the marked lack of variation among the African populations, it is believed that its occurrence in west Africa was a historically recent, probably accidental, introduction (L. Andersson 1981b). The variation in pubescence and bract size within the American continent has been used as the basis for describing additional species or varieties (L. Andersson 1981b). Populations of <i>Thalia geniculata</i> with a striking red-purple coloration on the petiole, sheath, and pulvinus were described as <i>T. geniculata</i> f. <i>rheumoides</i> Shuey (A. G. Shuey 1975) . Such homogeneous populations are to be expected in a mainly selfing species."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2024). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2024). 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
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	"Lowlands in ponds, wet roadside ditches, swamps, marshes, cypress sloughs, margin of streams or lakes, full sun, often in regions with pronounced dry season; Fla., La.; Mexico; West Indies; Central America; South America (to Argentina and Paraguay); w Africa."

202	Quality of climate match data	High
	Source(s)	Notes
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	"Lowlands in ponds, wet roadside ditches, swamps, marshes, cypress sloughs, margin of streams or lakes, full sun, often in regions with pronounced dry season; Fla., La.; Mexico; West Indies; Central America; South America (to Argentina and Paraguay); w Africa."

Qsn #	Question	Answer
203	<b>Broad climate suitability (environmental versatility)</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	"Lowlands in ponds, wet roadside ditches, swamps, marshes, cypress sloughs, margin of streams or lakes, full sun, often in regions with pronounced dry season; Fla., La.; Mexico; West Indies; Central America; South America (to Argentina and Paraguay); w Africa. This species has the widest distribution known for any of the Marantaceae, occurring in both Africa and the Americas."
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Thalia geniculata! occurs in swamps, near pools and in other wet locations in forest, savanna and fallow land, from sea-level up to 1100 m altitude."

204	<b>Native or naturalized in regions with tropical or subtropical climates</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Thalia geniculata originates from America, where it occurs in the south-eastern United States, Mexico, Central America, the Caribbean and South America. Because of the lack of variation among the African populations, it is believed to have been introduced into tropical Africa, where it has widely naturalized and it is now distributed from Senegal eastward to Sudan and Ethiopia and southward to Angola and Zambia. Thalia geniculata has the widest distribution of all Marantaceae."
	Faccenda, K. (2024). Report of 24 new naturalized weeds across the islands of Hawai'i. Bishop Museum Occasional Papers 156: 71-110	[Oahu] "While identifying iNaturalist observations from O'ahu in 2021, an observation of Thalia geniculata posted by Adam Almeida was noted as unusual, as it appeared naturalized. The locality reported in the observation was subsequently visited in 2022 and voucher specimens were made. A small population of likely 5-20 plants was seen growing in a ditch under Keolu Dr. near Akamu St. in Kailua (Figure 12). It was difficult to estimate the population size as the clumps were rather large and some were merged together."

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>
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Because of the lack of variation among the African populations, it is believed to have been introduced into tropical Africa, where it has widely naturalized and it is now distributed from Senegal eastward to Sudan and Ethiopia and southward to Angola and Zambia."
	Queensland Government. (2024). Weeds of Australia - Thalia geniculata. <a href="https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm</a> . [Accessed 9 May 2024]	"Thalia (Thalia geniculata) is commonly grown in private and public gardens as an ornamental, particularly in ponds and water features. A form with red leaf stalks is also popular in cultivation. This plant is known as red-stemmed thalia (Thalia geniculata 'Ruminoides' or Thalia geniculata forma ruminoides)."
	Faccenda, K. (2024). Report of 24 new naturalized weeds across the islands of Hawai'i. Bishop Museum Occasional Papers 156: 71-110	[Oahu] "A small population of likely 5-20 plants was seen growing in a ditch under Keolu Dr. near Akamu St. in Kailua"

301	<b>Naturalized beyond native range</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Queensland Government. (2024). Weeds of Australia - Thalia geniculata. <a href="https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm</a> . [Accessed 9 May 2024]	"Locally naturalised in south-eastern Queensland. This species was first recorded as naturalised in Toowong in Brisbane in January 2006. It has since been recorded from waterways in other parts of Brisbane including along Ithaca and Ekibin Creeks."

Qsn #	Question	Answer
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16.</i> PROTA, Wageningen, Netherlands	" <i>Thalia geniculata</i> originates from America, where it occurs in the south-eastern United States, Mexico, Central America, the Caribbean and South America. Because of the lack of variation among the African populations, it is believed to have been introduced into tropical Africa, where it has widely naturalized and it is now distributed from Senegal eastward to Sudan and Ethiopia and southward to Angola and Zambia. <i>Thalia geniculata</i> has the widest distribution of all Marantaceae."
	Faccenda, K. (2024). Report of 24 new naturalized weeds across the islands of Hawai'i. <i>Bishop Museum Occasional Papers</i> 156: 71-110	[Oahu] "While identifying iNaturalist observations from O'ahu in 2021, an observation of <i>Thalia geniculata</i> posted by Adam Almeida was noted as unusual, as it appeared naturalized. The locality reported in the observation was subsequently visited in 2022 and voucher specimens were made. A small population of likely 5-20 plants was seen growing in a ditch under Keolu Dr. near Akamu St. in Kailua (Figure 12). It was difficult to estimate the population size as the clumps were rather large and some were merged together."

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Brisbane City Council. (2024). Weed identification Tool - Fire flag - <i>Thalia geniculata</i> . <a href="https://weeds.brisbane.qld.gov.au/weeds/fire-flag">https://weeds.brisbane.qld.gov.au/weeds/fire-flag</a> . [Accessed 14 May 2024]	" <i>Thalia</i> ( <i>Thalia geniculata</i> ) is an emerging environmental weed in south-eastern Queensland. It is a potentially serious weed of waterways and other wetter habitats in the warmer coastal districts of Australia."
	Faccenda, K. (2024). Report of 24 new naturalized weeds across the islands of Hawai'i. <i>Bishop Museum Occasional Papers</i> 156: 71-110	[Incipient naturalization on Oahu. No impacts to date] "A small population of likely 5-20 plants was seen growing in a ditch under Keolu Dr. near Akamu St. in Kailua (Figure 12). It was difficult to estimate the population size as the clumps were rather large and some were merged together."
	Save Our Waterways Now. (2024). <i>Thalia geniculata</i> (MARANTACEAE) Fireflag, Arrowroot, Bent Alligatorflag. <a href="https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/">https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/</a> . [Accessed 14 May 2024]	[Potential environmental weed recommended for control] " <i>Thalia</i> is an aquatic, upright, emergent perennial with 1 m long arrow-shaped leaves on thin stems. It forms dense clumps to 3 m tall and has the potential to become another environmental weed which will choke waterways and exclude habitat for native fauna."
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/html/thalia_geniculata.htm</a> . [Accessed 13 May 2024]	[Potential environmental weed] " <i>Thalia</i> ( <i>Thalia geniculata</i> ) is an emerging environmental weed in south-eastern Queensland. It is a potentially serious weed of waterways and other wetter habitats in the warmer coastal districts of Australia."

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes

Qsn #	Question	Answer
	Rivero, L. E., Antigua, G., Colón, C., Almarales, P., Hernández, A., & García de la Osa, J. (2005). Determination of several biological characteristics of weed species in irrigated rice in Cuba. <i>Revista Comalfi</i> 27(1-2):4-8	[Potential weed or rice] "The present work was conducted under greenhouse conditions, using weed seeds collected in rice fields, seeded in pots and grown during two years, in dry and rainy seasons, at the Rice Research Institute. Weeds studied were <i>Echinochloa crusgalli</i> (L) Beauv., <i>Echinochloa colona</i> (L) Link, <i>Ischaemum rugosum</i> Salisb., <i>Paspalum distichum</i> L and <i>Thalia geniculata</i> L, compared with rice variety J-104. <i>E. crusgalli</i> grew more than <i>E. colona</i> in all stages, during dry and rainy seasons, but was higher than the rice variety only in reproductive stage during rainy season. Both weeds can grow initially faster than rice variety in both seasons. The rice variety was taller than <i>P. distichum</i> , which is a good index of competitive advantage. <i>Ischaemum rugosum</i> has a marked trend to flower in the same season of the year, regardless of germination timing, which expresses a typical behavior of a photoperiodical species. During the initial growth stage, rice surpassed weed growth, which favors the crop in its competition for light. <i>Thalia geniculata</i> was taller than the rice variety in all growth stages. The number of seeds per plant was greater in the species of <i>Echinochloa</i> genus and they showed less dormancy than the rest of the studied species. The highest viability of seeds, buried at 10 cm depth, was shown by <i>Ischaemum rugosum</i> . At 18 months it reached 78 % germination and at two years, under normal air temperature and at 9 °c, germination was 7.3 and 7.4 %, respectively. Evaluations conducted on seeds buried at different depths showed that at 8 cm, a significant number of <i>E. crusgalli</i> and <i>I. rugosum</i> seeds were able to germinate. The species with greater coleoptile length was <i>I. rugosum</i> , which expresses its ability to reach the soil surface and establish as a weed."

304	Environmental weed	
	Source(s)	Notes
	Brisbane City Council. (2024). Weed identification Tool - Fire flag - <i>Thalia geniculata</i> . <a href="https://weeds.brisbane.qld.gov.au/weeds/fire-flag">https://weeds.brisbane.qld.gov.au/weeds/fire-flag</a> . [Accessed 14 May 2024]	" <i>Thalia</i> ( <i>Thalia geniculata</i> ) is an emerging environmental weed in south-eastern Queensland. It is a potentially serious weed of waterways and other wetter habitats in the warmer coastal districts of Australia."
	Save Our Waterways Now. (2024). <i>Thalia geniculata</i> (MARANTACEAE) Fireflag, Arrowroot, Bent Alligatorflag. <a href="https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/">https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/</a> . [Accessed 14 May 2024]	[Potential environmental weed recommended for control] " <i>Thalia</i> is an aquatic, upright, emergent perennial with 1 m long arrow-shaped leaves on thin stems. It forms dense clumps to 3 m tall and has the potential to become another environmental weed which will choke waterways and exclude habitat for native fauna."
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/Html/thalia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/Html/thalia_geniculata.htm</a> . [Accessed 9 May 2024]	[Potentially] " <i>Thalia</i> ( <i>Thalia geniculata</i> ) is an emerging environmental weed in south-eastern Queensland. It is a potentially serious weed of waterways and other wetter habitats in the warmer coastal districts of Australia."

305	Congeneric weed	
	Source(s)	Notes

Qsn #	Question	Answer
	Si, C. & Jian-Qing, D. I. N. G. (2011). Risk Assessment and Spread Potential of Alien Wetland Plant Species <i>Thalia dealbata</i> in China. <i>Plant Science Journal</i> , 29(6), 675-682	[Potentially invasive in China] "This study examined the spread potential of alien wetland plant species <i>Thalia dealbata</i> in China using an adapted Australia Weed Risk Assessment System, climate match model(MaxEnt) and frozen experiment in winter. <i>Thalia dealbata</i> achieved a score of 18 by the adapted Australian Weed Risk Assessment System, far beyond the cutoff value given by the system (6).According to the results given by MaxEnt, <i>Thalia dealbata</i> was able to grow on the east side of the line formed by Beijing, Zhengzhou, Xi ' an, Chengdu and Lijiang. Jiangsu Province, Zhejiang Province and Southeastern part of Anhui Province were especially suitable for the growth of <i>Thalia dealbata</i> . According to the results of the frozen experiment, the plants that stayed in cold storage of 0 for two months were still able to accomplish their life cycle, although their biomass and flower number were significantly lower than those that stayed in cold storage for a shorter period of time. In conclusion, our results suggest that <i>Thalia dealbata</i> had invasive potential and was able to grow in most areas in China. "

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Flora of North America Editorial Committee. (1993). <i>Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae</i> . Oxford University Press, Oxford, UK	[No evidence] "Plants 1--3.5 m. Leaves: basal 2--6, cauline 0--1(--2); sheath green or occasionally red-purple, glabrous; petiole green or occasionally red-purple, glabrous; pulvinus caramel-colored, olive-green, or red-purple, 0.3--2.5 cm, glabrous; blade ovate to narrowly ovate, 19--60 ´ 4--26 cm, firm, stiff-papery, base rounded to subtruncate, apex acute to acuminate, occasionally obtuse with acuminate tip, abaxial surface green, faintly pruinose, glabrous, adaxial surface glabrous. Inflorescences lax, broadly spreading to pendent, paniclelike array, up to ca. 0.6 m; scapes 0.8--2.5 m; rachis not pruinose; internodes 5--20 mm; bracts not pruinose, green or streaked or tinged with purple, narrowly ovate, 1.3--2.8 cm, herbaceous, sparsely to densely villous. Flowers: sepals 0.5--2 mm; outer staminode faint lavender to purple, 15--20 ´ 5--10 mm; callose staminode base yellow, apex purple, apical rim, reflexed, petal-like. Fruits ellipsoid, 9--12 ´ 6--7 mm. Seeds smooth dark brown to black, ellipsoid, 7--10 ´ 5--6 mm."

402	Allelopathic	n
	Source(s)	Notes
	WRA Specialist. (2024). Personal Communication	Unknown. No evidence found

403	Parasitic	n
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA</i> , Wageningen, Netherlands	"Perennial, straggling herb up to 3.5 m tall, with short rhizome, tufts of leaves, and stems bearing an inflorescence and a single subtending leaf or sheath." [Marantaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA</i> , Wageningen, Netherlands	"The leaves are sometimes eaten in Burkina Faso. In Ghana <i>Thalia geniculata</i> is given as fodder to small ruminants. Ash from the burnt stem has been used for making salt."

Qsn #	Question	Answer
	Tomas, W. M., & Salis, S. M. (2000). Diet of the marsh deer ( <i>Blastocerus dichotomus</i> ) in the Pantanal wetland, Brazil. <i>Studies on Neotropical Fauna and Environment</i> , 35(3), 165-172	"The marsh deer fed mainly on the new growth of shrubs (e.g. <i>Ludwigia nervosa</i> , <i>Mimosa pellita</i> and <i>Couepia uiti</i> ) and earlier growth stages of aquatic plants and grasses (e.g., <i>Thalia geniculata</i> , <i>Eleocharis acutangula</i> , and <i>Luziola spruceana</i> ). Also, flowers of several plants were frequently consumed, such as those of <i>Pontederia cordata</i> , <i>Thalia geniculata</i> , <i>Eichhornia azurea</i> , and <i>Andropogon hypogynus</i> ."

405	Toxic to animals	n
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"The leaves are sometimes eaten in Burkina Faso. In Ghana <i>Thalia geniculata</i> is given as fodder to small ruminants. Ash from the burnt stem has been used for making salt." [No evidence]
	Quattrocchi, U. (2012). <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL</i>	No evidence

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	Gardenia. (2024). <i>Thalia geniculata</i> 'Ruminoides' (Red Stemmed Alligator-Flag). <a href="https://www.gardenia.net/plant/thalia-geniculata-ruminoides">https://www.gardenia.net/plant/thalia-geniculata-ruminoides</a> . [Accessed 13 May 2024]	"No serious pest or disease issues."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Quattrocchi, U. (2012). <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL</i>	[No evidence] "Leaves astringent, febrifuge, for diarrhea and fevers. Magic, ritual, stem as divining rod."
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	[No evidence] "The leaves are sometimes eaten in Burkina Faso. In Ghana <i>Thalia geniculata</i> is given as fodder to small ruminants. Ash from the burnt stem has been used for making salt."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	[No evidence. Unlikely given habitat] " <i>Thalia geniculata</i> occurs in swamps, near pools and in other wet locations in forest, savanna and fallow land, from sea-level up to 1100 m altitude."



Qsn #	Question	Answer
409	Is a shade tolerant plant at some stage of its life cycle	
	<b>Source(s)</b>	<b>Notes</b>
	Florida Native Plant Society. (2024). <i>Thalia geniculata</i> . <a href="https://www.fnps.org/plant/thalia-geniculata">https://www.fnps.org/plant/thalia-geniculata</a> . [Accessed 13 May 2024]	"Light: Full Sun, Part Shade"
	Gardenia. (2024). <i>Thalia geniculata</i> 'Ruminoides' (Red Stemmed Alligator-Flag). <a href="https://www.gardenia.net/plant/thalia-geniculata-ruminoides">https://www.gardenia.net/plant/thalia-geniculata-ruminoides</a> . [Accessed 13 May 2024]	"Performs best in full sun to part shade in moist to wet loamy soils."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	<b>Source(s)</b>	<b>Notes</b>
	Lady Bird Johnson Wildflower Center. (2019). <i>Thalia geniculata</i> . <a href="https://www.wildflower.org/plants/result.php?id_plant=THGE2">https://www.wildflower.org/plants/result.php?id_plant=THGE2</a> . [Accessed 13 May 2024]	"Soil Description: Shallow water or poorly drained, wet soils. "
	Gardenia. (2024). <i>Thalia geniculata</i> 'Ruminoides' (Red Stemmed Alligator-Flag). <a href="https://www.gardenia.net/plant/thalia-geniculata-ruminoides">https://www.gardenia.net/plant/thalia-geniculata-ruminoides</a> . [Accessed 13 May 2024]	"Soil Type Loam Soil pH Acid, Alkaline, Neutral Soil Drainage Poorly Drained"
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	" <i>Thalia, geniculata</i> can be grown in moist soil or water up to 25 cm deep."

411	Climbing or smothering growth habit	n
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"Perennial, straggling herb up to 3.5 m tall, with short rhizome, tufts of leaves, and stems bearing an inflorescence and a single subtending leaf or sheath."

412	Forms dense thickets	y
	<b>Source(s)</b>	<b>Notes</b>
	Hammer, R. L. (2014). <i>Everglades Wildflowers: A Field Guide to Wildflowers of the Historic Everglades, including Big Cypress, Corkscrew, and Fakahatchee Swamps</i> . Rowman & Littlefield, Lanham, MD	"It is very common in the Everglades region, often forming dense thickets."
	Damasceno-Junior, G.A. et al. (2021). <i>Monodominant stands in the Pantanal</i> . In <i>Flora and Vegetation of the Pantanal Wetland</i> (pp. 393-442). Springer International Publishing, Cham	"[Grows with other species in a monodominant stand] "The fireflag is widespread in Africa and the Americas (GBIF 2019b; Brasil 2020). In the Pantanal, it forms the Caetezal, an emergent aquatic monodominant stand, present throughout the Pantanal. Together with <i>Cyperus giganteus</i> stands, Caetezal covers 1.2% of all Pantanal vegetation (Silva et al. 2000), occurring in depressions with water during almost the whole year and that during the flooding period are inundated up to 1.5 m for 3-5 months (Schessl 1999). Caetezais are indicative of those environments (see the chapter on "Macrohabitats" Chap. 7). Plant size (1-4 m) and leaf blade width vary according to flood level and soil fertility (A. Pott pers. obs.). Stands are not monospecific, as many associated aquatic plants grow interspersed."

501	Aquatic	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	" Lowlands in ponds, wet roadside ditches, swamps, marshes, cypress sloughs, margin of streams or lakes, full sun, often in regions with pronounced dry season" [Semi-aquatic. Applies to obligate aquatic taxa. Wetland taxa and those that grow on stream banks do not qualify.]
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Thalia geniculata occurs in swamps, near pools and in other wet locations in forest, savanna and fallow land, from sea-level up to 1100 m altitude. It occurs as a weed, particularly in rice cultivation. It does not tolerate frost or salt water." [Not an obligate aquatic species]
502	<b>Grass</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	Marantaceae
503	<b>Nitrogen fixing woody plant</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	Marantaceae
504	<b>Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Perennial, straggling herb up to 3.5 m tall, with short rhizome, tufts of leaves, and stems bearing an inflorescence and a single subtending leaf or sheath."
601	<b>Evidence of substantial reproductive failure in native habitat</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"In view of its extremely wide distribution Thalia geniculata is not threatened with genetic erosion."
602	<b>Produces viable seed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Natural reproduction is by seed and via rhizomes. The seeds and rhizome pieces are dispersed by water. A gas-filled space between the seed and the fruit wall makes the fruit buoyant."

Qsn #	Question	Answer
603	Hybridizes naturally	
	Source(s)	Notes
	WRA Specialist. (2024). Personal Communication	Unknown. No evidence found
604	Self-compatible or apomictic	y
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Pollination is triggered by bees and hummingbirds, but self-pollination is also possible."
	Flora of North America Editorial Committee. (1993). Flora of North America: Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae(in Part), and Zingiberidae. Oxford University Press, Oxford, UK	"Populations of <i>Thalia geniculata</i> with a striking red-purple coloration on the petiole, sheath, and pulvinus were described as <i>T. geniculata</i> f. <i>rheumoides</i> Shuey (A. G. Shuey 1975) . Such homogeneous populations are to be expected in a mainly selfing species."
605	Requires specialist pollinators	n
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Pollination is triggered by bees and hummingbirds, but self-pollination is also possible."
606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	"Natural reproduction is by seed and via rhizomes. The seeds and rhizome pieces are dispersed by water. A gas-filled space between the seed and the fruit wall makes the fruit buoyant."
607	Minimum generative time (years)	
	Source(s)	Notes
	Brink, M. & Achigan-Dako, E.G. (2012). Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands	[Unknown] "Natural reproduction is by seed and via rhizomes."
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/Html/thalia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/Html/thalia_geniculata.htm</a> . [Accessed 8 May 2024]	[Dumped garden waste] "The seeds can be dispersed downstream during floods, as can pieces of rhizome that are dislodged from larger plants. Both, but particularly the rhizomes, can also be spread into waterways in dumped garden waste."
702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Crop, Herbal, Ornamental"
703	Propagules likely to disperse as a produce contaminant	n

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm</a> . [Accessed 13 May 2024]	"The seeds can be dispersed downstream during floods, as can pieces of rhizome that are dislodged from larger plants. Both, but particularly the rhizomes, can also be spread into waterways in dumped garden waste."
704	<b>Propagules adapted to wind dispersal</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"The seeds and rhizome pieces are dispersed by water. A gasfilled space between the seed and the fruit wall makes the fruit buoyant."
705	<b>Propagules water dispersed</b>	y
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"Natural reproduction is by seed and via rhizomes. The seeds and rhizome pieces are dispersed by water. A gas-filled space between the seed and the fruit wall makes the fruit buoyant."
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm</a> . [Accessed 8 May 2024]	"The seeds can be dispersed downstream during floods, as can pieces of rhizome that are dislodged from larger plants. Both, but particularly the rhizomes, can also be spread into waterways in dumped garden waste."
706	<b>Propagules bird dispersed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"The seeds and rhizome pieces are dispersed by water. A gasfilled space between the seed and the fruit wall makes the fruit buoyant."
707	<b>Propagules dispersed by other animals (externally)</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Queensland Government. (2024). Weeds of Australia - <i>Thalia geniculata</i> . <a href="https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm">https://keyserver.lucidcentral.org/weeds/data/media/Html/halia_geniculata.htm</a> . [Accessed 13 May 2024]	"The seeds can be dispersed downstream during floods, as can pieces of rhizome that are dislodged from larger plants. Both, but particularly the rhizomes, can also be spread into waterways in dumped garden waste."
708	<b>Propagules survive passage through the gut</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	"The seeds and rhizome pieces are dispersed by water. A gasfilled space between the seed and the fruit wall makes the fruit buoyant."
801	<b>Prolific seed production (&gt;1000/m2)</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA, Wageningen, Netherlands</i>	[Unknown] " <i>Thalia geniculata</i> can be propagated by rhizome division or with seed. The 1000-seed weight is 50-80 g."

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	
	<b>Source(s)</b>	<b>Notes</b>
	SER, INSR, RBGK, (2023). Seed Information Database (SID). <a href="https://ser-sid.org/">https://ser-sid.org/</a> . [Accessed 14 May 2024]	Unknown. No storage or seed longevity data reported
803	Well controlled by herbicides	
	<b>Source(s)</b>	<b>Notes</b>
	Brisbane City Council. (2024). Weed identification Tool - Fire flag - <i>Thalia geniculata</i> . <a href="https://weeds.brisbane.qld.gov.au/weeds/fire-flag">https://weeds.brisbane.qld.gov.au/weeds/fire-flag</a> . [Accessed 14 May 2024]	"Control Methods - Foliar spray" [No specifics on herbicides or efficacy provided]
	Save Our Waterways Now. (2024). <i>Thalia geniculata</i> (MARANTACEAE) Fireflag, Arrowroot, Bent Alligatorflag. <a href="https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/">https://sown.com.au/thalia-geniculata-marantaceae-fireflag-arrowroot-bent-alligatorflag/</a> . [Accessed 13 May 2024]	"If you find <i>Thalia</i> in your waterway, report it to local council. It can be treated effectively by cutting and painting with biactive Glyphosate which is registered for use in a waterway." [No information on application rate or concentration provided]
	Hutchinson, J. T., & Langeland, K. A. (2008). Response of selected nontarget native Florida wetland plant species to metsulfuron methyl. <i>Journal of Aquatic Plant Management</i> , 46, 72-76	[Effectively controlled with metsulfuron] "We tested five rates (10.5, 21, 42, 84, and 168 g a.i./ha) of metsulfuron methyl on selected nontarget native wetland plants. Metsulfuron methyl applied at rates up to 168 g a.i./ ha had minimal effects on sand cord grass ( <i>Spartina bakeri</i> ) and soft rush ( <i>Juncus effusus</i> ), but severely affected lizard's tail ( <i>Saururus cernuus</i> ), golden canna ( <i>Canna flaccida</i> ), fireflag ( <i>Thalia geniculata</i> ), swamp fern ( <i>Blechnum serrulatum</i> ) and cinnamon fern ( <i>Osmunda cinnamomea</i> ). Soft rush and sand cord grass exhibited <20% necrosis 12 weeks post-treatment. Survival rates of these two plants were >87% at all application rates of metsulfuron methyl. Buttonbush ( <i>Cephalanthus occidentalis</i> ) exhibited >80% survival at all application rates, but regrowth was coppice sprouting. Swamp lily ( <i>Crinum americanum</i> ) survival rates were variable (19 to 88%) but indicated this species is tolerant of metsulfuron methyl up to rates 168 g a.i./ha. Necrosis was 100% for lizard's tail, fireflag, and golden canna at four to five weeks post-treatment, and survival was 0% for these plants. Swamp fern was very susceptible to metsulfuron methyl but had limited survival at low rates. Cinnamon fern mortality was 100% for all rates of metsulfuron methyl. The results of this study indicated that aerial application of metsulfuron methyl may effectively and selectively control invasive species such as Old World climbing fern ( <i>Lygodium microphyllum</i> ) within habitat dominated by grass and sedge species. However, where susceptible non-target species are common, there is high potential for severe nontarget damage and conservative ground applications should be implemented instead of aerial applications."
	Páez Falcón, Y. et al. (2004). Evaluation of the postemergent herbicide fluroxypyr (Matabú EC 20) for broadleaf weed control in irrigated rice. Pp. 16-19 in III Congreso 2004 Sociedad Cubana de Malezología, Memorias, Jardín Botánico Nacional, Ciudad Habana, 28, 29 y 30 de abril del 2004	[Reported to be tolerant to hormone type herbicides] "Broad leaf weeds are a problem many times neglected, due to the frequent presence of more aggressive to rice, grass species. However, there are broadleaves that are as competitive and cause as much damage as any grass to rice, as <i>Vigna vexillata</i> , <i>Aeschynomene americana</i> and <i>Thalia geniculata</i> , all highly tolerant to hormone type herbicides. In search for new alternatives for chemical control of broadleaf weeds we evaluated the postemergente herbicide fluroxypyr (Matabú EC 20) in irrigated rice, in early and intermediate postemergene with satisfactory results in their efficacy and without causing any phytotoxic damage to the rice crop. Since there were no significant differences between early and intermediate postemergence, the former is recommended at 0.25 kg ai/ha, because it is more economical."
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Gardenia. (2024). <i>Thalia geniculata</i> 'Ruminoides' (Red Stemmed Alligator-Flag). <a href="https://www.gardenia.net/plant/thalia-geniculata-ruminoides">https://www.gardenia.net/plant/thalia-geniculata-ruminoides</a> . [Accessed 14 May 2024]	"Cut back in late fall in preparation for winter."
	Brink, M. & Achigan-Dako, E.G. (2012). <i>Fibres. Plant Resources of Tropical Africa. Volume 16. PROTA</i> , Wageningen, Netherlands	"The seeds and rhizome pieces are dispersed by water." [May persist from rhizome fragments if damaged]
	Cassani, J. R. (1983). Arrowroot. <i>Aquatics</i> 5(2): 12-13	[Resprouts from rhizomes after dry periods. Suggests plants will recover from removal of stems and leaves without herbicide treatment] "During particularly dry winter and spring seasons in South Florida, the vegetative portion of the plant will become extremely dry, breaking down and almost completely disappear from the site. At this time other plant species more tolerant to dry conditions establish themselves. As the wet season starts <i>Thalia</i> regrowth from underground rhizomes begins and dominance is re-established by June or July. During a wet spring season, much of the vegetative portions remain green and regrowth begins earlier."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). Personal Communication	Unknown

**Summary of Risk Traits:**

*Thalia geniculata*, bent alligator-flag, fire-flag) is a semi-aquatic plant native to the southeastern United States and other parts of the Americas, including Mexico and the Caribbean. This plant typically grows in wetlands, marshes, and along the edges of ponds and streams. *Thalia geniculata* is characterized by its tall, erect stems that can reach heights of up to 3 meters (10 feet) and with short rhizomes. The leaves are large, lance-shaped, and often have prominent veins. The plant produces clusters of striking purple flowers, which are held above the foliage on tall stalks. It is often cultivated as an ornamental plant in water gardens and ponds due to its attractive foliage and flowers. Additionally, it provides habitat and food for various aquatic wildlife, making it beneficial for ecosystem health. However, it can also become invasive in some areas where it is introduced outside of its native range, can form dense stands that may compete with other vegetation and was recently reported as naturalized on the island of Oahu.

**High Risk / Undesirable Traits**

- Broad elevation range in tropical climates
- Naturalized on Oahu (Hawaiian Islands), Africa and Australia
- An aggressive, weedy plant with the potential to become an environmental weed, recommended for eradication or control in parts of Australia
- A potential weed of rice crops
- A potential environmental weed
- Other species may be invasive
- Forms dense thickets that may exclude other vegetation
- Reproduces by seeds and rhizomes
- Capable of self-pollination
- Seeds and rhizomes dispersed by water, and as dumped garden waste, as well as through intentional cultivation
- Tolerates and resprouts after cutting or top damage

**Low Risk Traits**

- Unarmed (no spines, thorns, or burrs)
- Palatable to browsing animals
- Non-toxic
- Restricted to poorly drained, wet soils associated with aquatic and semi-aquatic habitats
- Certain herbicides may provide effective control

