

Taxon: <i>Salvia hispanica</i> L.	Family: Lamiaceae
Common Name(s): chia mexikansk chia-salvia	Synonym(s): <i>Salvia officinalis</i> L.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 15 Mar 2021
WRA Score: 1.0	Designation: L	Rating: Low Risk

Keywords: Annual Herb, Naturalized, Edible, Self-Pollinated, Prolific Seeder

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	y
102	Has the species become naturalized where grown?	y=1, n=-1	y
103	Does the species have weedy races?		
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		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	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	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	n
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	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
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	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	y
	Source(s)	Notes
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). <i>Journal of Ethnobiology</i> , 25(2), 155-174	"The group of full domesticates is defined by their closed calyxes, larger seeds, variability in calyx pubescence, and gigantism. Closed calyxes prevent seed dispersal and effectively prevent survival of fully domesticated varieties outside of human cultivation. This character meets the criterion for "full domestication" as described by Harlan (1975) or "agricultural domestication" as described by others. None of the herbarium specimens of wild populations or wild material sampled for this study exhibit any degree of closure of calyxes. To date, the trait has been observed only in the fully domesticated varieties of <i>Salvia hispanica</i> and has not been reported in wild populations or related species of <i>Salvia</i> . Like other qualitative traits in the species, closure of calyxes could have developed as the result of conscious human selection."
	Jamboonsri, W., Phillips, T. D., Geneve, R. L., Cahill, J. P., & Hildebrand, D. F. (2012). Extending the range of an ancient crop, <i>Salvia hispanica</i> L.—a new omega 3 source. <i>Genetic Resources and Crop Evolution</i> , 59(2), 171-178	"While photoperiod insensitivity may be the most essential trait for expansion of dispersal, domestication syndrome traits also facilitate successful expansion beyond the Mesoamerican center of crop diversity. Chia is no exception exhibiting the results of human selection for, among other traits: yield components, vigor, plant architecture, uniform maturation, and nonshattering, the latter achieved by calyxes that remain closed at seed maturity effectively eliminating natural dispersal and confining domesticated varieties to human cultivation."

102	Has the species become naturalized where grown?	y
	Source(s)	Notes
	Estilai, A., Hashemi, A., & Truman, K. (1990). Chromosome number and meiotic behavior of cultivated chia, <i>Salvia hispanica</i> (Lamiaceae). <i>HortScience</i> , 25(12), 1646-1647	"Comparisons of the mature plants with herbarium specimens of the Rancho Santa Ana Botanical Garden, Claremont, Calif., indicated that they belonged to <i>Salvia hispanica</i> , an annual species that is distributed in Mexico and Peru and is naturalized in the West Indies (Bailey, 1976)."
	Wood, J., & Harley, R. (1989). The Genus <i>Salvia</i> (Labiatae) in Colombia. <i>Kew Bulletin</i> , 44(2), 211-278	"Of the 42 species of <i>Salvia</i> found in Colombia three are relatively recent introductions which occur as escapes from cultivation in a few isolated localities (<i>S. hispanica</i> and <i>S. leucantha</i> from Mexico and <i>S. splendens</i> from Brazil). The remaining 39 species are all native."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). <i>Plant Resources of South-East Asia No 14. Vegetable oils and fats</i> . Backhuys Publishers, Leiden	" <i>S. hispanica</i> originates from southern Mexico and northern Guatemala. Its earliest cultivation and utilization was by the Aztecs in Central America. It was introduced and naturalized in the West Indies, Spain and West Java."
	Starr, F. & Starr, K. (2021). Maui Early Detection Botanists, pers. comm. 02 March	" <i>Salvia hispanica</i> (chia) - Scattered plants growing on the side of the road in Piihola."

103	Does the species have weedy races?	
	Source(s)	Notes

Qsn #	Question	Answer
	Motis, T. (2011). Chia (<i>Salvia hispanica</i> L.): An Ancient Food Crop with Rediscovered Potential for Providing Nutrition . ECHO Development Notes no. 110	"In Central America, some consider chia weedy because if it is allowed to remain in the field long enough, the crop will reseed itself."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	[Described as a weed, but with no impacts specified] "In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m. In West Java it can be found in open areas, road sides, fallow or weedy agricultural land and low brushwood at altitudes of 900-1700 m."
	Verloove , F. (2021). <i>Salvia hispanica</i> . On: Manual of the Alien Plants of Belgium. Botanic Garden, Meise, Belgium. http://alienplantsbelgium.be . [Accessed 12 Mar 2021]	[No impacts described] " <i>Salvia hispanica</i> L. (syn.: <i>S. chia</i> Sessé et Moc.) (Mexico, Guatemala) – A rare and ephemeral alien. Discovered in 2014 in two localities near to Antwerpen: at first alongside a railway track at the Albertkanaal between Merksem and Schoten, subsequently in Mortsel. In both instances <i>Salvia hispanica</i> was seen in quantity."
	WRA Specialist. (2021). Personal Communication	Unknown. Often labeled or referred to as a "weed" or "weedy", but these terms appear to be used interchangeably with, or as synonyms of "naturalized" in many cases.

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. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 12 Mar 2021]	"Native Northern America REGION: Mexico (c. & s.) Southern America CENTRAL AMERICA: Guatemala"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 12 Mar 2021]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Jamboonsri, W., Phillips, T. D., Geneve, R. L., Cahill, J. P., & Hildebrand, D. F. (2012). Extending the range of an ancient crop, <i>Salvia hispanica</i> L.—a new omega 3 source. <i>Genetic Resources and Crop Evolution</i> , 59(2), 171-178	"Chia grows well in Kentucky and has low requirement for pesticides, fertilizer and irrigation. It produces flower buds in short days of October and is killed by frost before seeds set. Seed production cannot be attained in most areas of North America."

Qsn #	Question	Answer
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	"In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m. In West Java it can be found in open areas, road sides, fallow or weedy agricultural land and low brushwood at altitudes of 900-1700 m. In north-western Argentina it is grown at elevations of 300-1350 m, with maximum temperatures of about 30°C and minimum temperatures of 12.5°C. Rainfall in this region varies between 100-1000 mm per year. This is a species for the semi-arid areas."
	Mascia, P. N., & Scheffran, J. (2010). Plant biotechnology for sustainable production of energy and co-products. Springer-Verlag, Berlin Heidelberg	Chia is grown commercially in tropical and subtropical areas. It is cultivated in Argentina, Bolivia, Colombia, Mexico and Peru, where latitudes range from 20 degrees 55 minutes N to 25 degrees 5 minutes S and it is very frost sensitive.
	Peel, M. C., Finlayson, B. L., & McMahon, T. A. (2007). Updated world map of the Köppen-Geiger climate classification. <i>Hydrology and Earth System Sciences</i> , 4(2), 439-473	Native distribution apparently in more than three climatic groups (Af, Am, Aw, BSk, Cwa, Cwb), and possibly additional climatic groups (BSh, Cfa, Cfb).
	Kintzios, S.E. 2000. Sage: the genus <i>Salvia</i> . Harwood Academic Publishers, Amsterdam	Seeds of <i>Salvia hispanica</i> were germinated at 1500 m elevation, in Venezuela from a batch of Mexican origin.

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	" <i>S. hispanica</i> originates from southern Mexico and northern Guatemala. Its earliest cultivation and utilization was by the Aztecs in Central America. It was introduced and naturalized in the West Indies, Spain and West Java. It is grown commercially in central Mexico, Guatemala, United States (southern California, south-eastern Texas), northwestern Argentina and occasionally in West Java, Peninsular Malaysia and Singapore."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Chia is grown commercially in Argentina, Australia, Ecuador, Guatemala, Bolivia and Mexico." [Recent resurgence in interest of this species]
	Mascia, P. N., & Scheffran, J. (2010). Plant biotechnology for sustainable production of energy and co-products. Springer-Verlag, Berlin Heidelberg	"Chia is grown commercially in tropical and subtropical areas. It is cultivated in Argentina, Bolivia, Colombia, Mexico and Peru, where latitudes range from 20 degrees 55 minutes N to 25 degrees 5 minutes S and it is very frost sensitive."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	" <i>S. hispanica</i> originates from southern Mexico and northern Guatemala. Its earliest cultivation and utilization was by the Aztecs in Central America. It was introduced and naturalized in the West Indies, Spain and West Java. It is grown commercially in central Mexico, Guatemala, United States (southern California, south-eastern Texas), northwestern Argentina and occasionally in West Java, Peninsular Malaysia and Singapore."

Qsn #	Question	Answer
301	Naturalized beyond native range	y
	Source(s)	Notes
	Wood, J., & Harley, R. (1989). The Genus <i>Salvia</i> (Labiatae) in Colombia. <i>Kew Bulletin</i> , 44(2), 211-278	"Of the 42 species of <i>Salvia</i> found in Colombia three are relatively recent introductions which occur as escapes from cultivation in a few isolated localities (<i>S. hispanica</i> and <i>S. leucantha</i> from Mexico and <i>S. splendens</i> from Brazil). The remaining 39 species are all native."
	Starr, F. & Starr, K. (2021). Maui Early Detection Botanists, pers. comm. 02 March	[Escaped, and potentially naturalized, or naturalizing, on Maui, Hawaiian Islands] " <i>Salvia hispanica</i> (chia) - Scattered plants growing on the side of the road in Piipiholo."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). <i>Plant Resources of South-East Asia No 14. Vegetable oils and fats</i> . Backhuys Publishers, Leiden	[Naturalized in the West Indies, Spain and West Java] " <i>S. hispanica</i> originates from southern Mexico and northern Guatemala. Its earliest cultivation and utilization was by the Aztecs in Central America. It was introduced and naturalized in the West Indies, Spain and West Java. It is grown commercially in central Mexico, Guatemala, United States (southern California, south-eastern Texas), northwestern Argentina and occasionally in West Java, Peninsular Malaysia and Singapore."
	Estilai, A., Hashemi, A., & Truman, K. (1990). Chromosome number and meiotic behavior of cultivated chia, <i>Salvia hispanica</i> (Lamiaceae). <i>HortScience</i> , 25(12), 1646-1647	According to Bailey (1976), <i>Salvia hispanica</i> is naturalized in the West Indies.
	Imada, C. (2019). Hawaiian Naturalized Vascular Plants Checklist (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No record at the time of publication

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Kaiser, C. & Ernst, M. (2016). Chia. Cooperative Extension Service. University of Kentucky, Lexington	"Despite the fact that chia is an aggressive crop, researchers are not concerned that it could become invasive or present a problem for subsequently planted crops; most commonly used herbicides tested against chia have succeeded in killing it, and mowing or light tillage can be effective in controlling any volunteers in subsequent years."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). <i>Plant Resources of South-East Asia No 14. Vegetable oils and fats</i> . Backhuys Publishers, Leiden	[Described as a weed, but with no impacts specified] "In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m. In West Java it can be found in open areas, road sides, fallow or weedy agricultural land and low brushwood at altitudes of 900-1700 m."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	[Negative impacts not documented in the cited references] "Major Pathway/s: Contaminant, Crop, Herbal, Ornamental Dispersed by: Humans References: United States of America-N-101, Mexico-W-735, Australia-ZD-1675, Colombia-N-1856."
	WRA Specialist. (2021). Personal Communication	Unknown. Often labeled or referred to as a "weed" or "weedy", but these terms appear to be used interchangeably with, or as synonyms of "naturalized" in many cases. No evidence of negative impacts has been found

303	Agricultural/forestry/horticultural weed	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	y
	Source(s)	Notes
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. (2013). Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	[<i>Salvia aethiopsis</i>] "Impacts: Mediterranean sage has spread over 1.3 million acres in the western United States with new infestations occurring each year. It is unpalatable to livestock, but is not considered toxic. It can spread rapidly in degraded big sagebrush communities. Wind-blown plants can lodge in large masses along fencerows. Western states listed as Noxious Weed: California, Colorado, Nevada, Oregon, Washington"
	Shao, M. N., Qu, B., Drew, B. T., Xiang, C. L., Miao, Q., & Luo, S. H. (2019). Outbreak of a new alien invasive plant <i>Salvia reflexa</i> in north-east China. Weed Research, 59(3), 201-208	[<i>Salvia reflexa</i>] "The establishment of invasive species is widely recognised as a pivotal issue in the preservation of biodiversity. <i>Salvia reflexa</i> , a species native to the southcentral United States and Mexico, has been widely introduced in Argentina, Australia, New Zealand and Japan. In China, the first population of this plant was found growing adjacent to a grain depot in Shahai village, Jianping County, Liaoning Province, on 25 July 2007. Since the grain depot imported foodstuffs from regions where the plant is native, we infer that <i>S. reflexa</i> was introduced into China via imported foodstuff in the early to mid-2000s. Based on field observations, at least seven populations of this plant were observed in northeast China. The plants displayed vigorous growth in midsummer and produced prolific seeds to overcome the cold environment in winter. <i>Salvia reflexa</i> occurred in both dense monocultures and in mixed stands with native plants. In order to validate a system for recognising and categorising non-native plants in China, the Australian Weed Risk Assessment system was used to assess the invasiveness status of 19 exotic and 16 native plants in north-east China. <i>Salvia reflexa</i> exhibited a high score of 10, suggesting it is a potentially pernicious alien invasive plant. Although the current distribution of <i>S. reflexa</i> is restricted to Liaoning province and thus far has limited impact on local environments, local regulatory authorities should pay close attention to this plant and take measures to stop its expansion. This is the first time that an invasive plant from the Lamiaceae (mint family) has been documented from cold environments in China."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes

Qsn #	Question	Answer
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	[No evidence] "Erect or ascending herb, 0.5-1 m tall or more; stem and branches quadrangular, villous and hispid. Leaves opposite, thin; petiole slender, 1-6 cm long; blade oblong-lanceolate to ovate, 3-8 cm × 1-4.5 cm, base obtuse and abruptly attenuate, margin entire at base and elsewhere serrate or serrulate, apex acute or acuminate, both surfaces pubescent. Inflorescence consisting of verticillasters of 6-10 zygomorphic flowers, these congested in a dense, terminal false spike 5-25 cm × 1.5 cm; internodes 2-5 mm long; bracts ovate-acuminate, 6-8 mm long, persistent; calyx tubular but 2-lipped, slightly inflated below, 6-8 mm long, in fruit 8-11 mm, densely pilose, upper lip strongly keeled, sharply pointed, lower lip 2-toothed; corolla tubular, 2-lipped, blue or purplish-blue, the lips shortly exposed, tube 4.5-5.5 mm long, upper lip rounded, 3 mm long, sericeous outside, lower lip 3-lobed; 3.5-5 mm long; stamens 4, didynamous, hardly exposed, lower pair fertile, lower connective branch swollen; disk prominent; ovary superior, style 2-branched, upper branch long and slender, 2.5 mm long, pointed, lower one short, club-shaped; the main style articulate above the base. Fruit consisting of 4 schizocarpous nutlets, each one ellipsoid, 1.8 mm long, mottled with black and grey."

402	Allelopathic	
	Source(s)	Notes
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). <i>Journal of Ethnobiology</i> , 25(2), 155-174	[Possibly] "Numerous studies have implicated cultivation and agriculture as causative factors in the development of allelopathy (Einhellig 1996; Seigler 1996). The beneficial chemical and ecological characteristic of allelopathy has accompanied advanced full domestication. Preliminary experiments with aqueous root leachates of the morphologically advanced domesticates of <i>Salvia hispanica</i> applied to <i>Echinochloa</i> and <i>Amaranthus</i> seeds show statistically significant inhibition of germination of <i>Echinochloa</i> seeds, but not for wild or any of the other domesticated varieties tested (see Table 3). Further experimentation is needed, both in isolating chemical compounds involved and identifying common weeds associated with <i>Salvia hispanica</i> monocrop systems in Mexico."

403	Parasitic	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	No evidence. Lamiaceae.

Qsn #	Question	Answer
404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Chia has recently become popular with the realisation that it is an invaluable oilseed. Between 25 and 40% of the seeds is oil, which is useful for food, industrial applications, and cosmetic products. After the oil has been extracted from the seeds, the remaining oilcake is high in protein, and can be used to feed humans and livestock. Chia stems and foliage constitute an excellent livestock feed, but should be consumed prior to flowering, when protein content decreases significantly in the green parts."

405	Toxic to animals	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Chia has recently become popular with the realisation that it is an invaluable oilseed. Between 25 and 40% of the seeds is oil, which is useful for food, industrial applications, and cosmetic products. After the oil has been extracted from the seeds, the remaining oilcake is high in protein, and can be used to feed humans and livestock."
	Plants for a Future. (2021). <i>Salvia hispanica</i> . https://pfaf.org . [Accessed 15 Mar 2021]	"Known Hazards -None known"
	Quattrocchi, U. (2012). <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	[No evidence] "Mucilaginous nuts in water used a substitute for <i>Ocimum basilicum</i> ."

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). <i>Plant Resources of South-East Asia No 14. Vegetable oils and fats</i> . Backhuys Publishers, Leiden	"Few diseases and pests seriously affect <i>S. hispanica</i> . Charcoal rot (<i>Macrophomina phaseolina</i>) occasionally causes damage."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Chia has recently become popular with the realisation that it is an invaluable oilseed. Between 25 and 40% of the seeds is oil, which is useful for food, industrial applications, and cosmetic products. After the oil has been extracted from the seeds, the remaining oilcake is high in protein, and can be used to feed humans and livestock."
	Jamboonsri, W., Phillips, T. D., Geneve, R. L., Cahill, J. P., & Hildebrand, D. F. (2012). Extending the range of an ancient crop, <i>Salvia hispanica</i> L.—a new omega 3 source. <i>Genetic Resources and Crop Evolution</i> , 59(2), 171-178	"Chia, <i>Salvia hispanica</i> L., has long been cultivated and domesticated. It was widely used in pre-Columbian Mesoamerica as a major commodity."
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). <i>Journal of Ethnobiology</i> , 25(2), 155-174	"Since dried calyx trichomes can induce sneezing, decreased calyx pubescence relieves the hand thresher from incessant irritation. The popular Mexican varieties chia poblana from Cuatepec, Puebla, and others grown in Sonora typify fully domesticated varieties with decreased density of calyx pubescence."

Qsn #	Question	Answer
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[<i>Salvia hispanica</i> . No evidence] "Mucilaginous nuts in water used a substitute for <i>Ocimum basilicum</i> ."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	"In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m. In West Java it can be found in open areas, road sides, fallow or weedy agricultural land and low brushwood at altitudes of 900-1700 m. In north-western Argentina it is grown at elevations of 300-1350 m, with maximum temperatures of about 30°C and minimum temperatures of 12.5°C. Rainfall in this region varies between 100-1000 mm per year. This is a species for the semi-arid areas." [No evidence of fire promotion in native or introduced ranges]

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Plants for a Future. (2021). <i>Salvia hispanica</i> . https://pfaf.org . [Accessed 15 Mar 2021]	"Requires a light to medium well-drained fertile soil in a warm sunny position" ... " It cannot grow in the shade."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Plants for a Future. (2021). <i>Salvia hispanica</i> . https://pfaf.org . [Accessed 15 Mar 2021]	"Suitable for: light (sandy) and medium (loamy) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	"Erect or ascending herb, 0.5-1 m tall or more; stem and branches quadrangular, villous and hispid."

412	Forms dense thickets	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	[Grows in thickets, but no evidence that this species forms dense monocultures that exclude other vegetation] "In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m. In West Java it can be found in open areas, road sides, fallow or weedy agricultural land and low brushwood at altitudes of 900-1700 m."

Qsn #	Question	Answer
501	Aquatic	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	[Terrestrial] "In its natural area, <i>S. hispanica</i> grows in moist or dry thickets, in open, often dry rocky slopes, sometimes on sandbars along streams and often as a weed, at altitudes 1150-2500 m."

502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 15 Mar 2021]	Family: Lamiaceae (alt. Labiatae) Subfamily: Nepetoideae Tribe: Mentheae Subtribe: Salviinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 15 Mar 2021]	Family: Lamiaceae (alt. Labiatae) Subfamily: Nepetoideae Tribe: Mentheae Subtribe: Salviinae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	Fast growing annual herbs.

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Wild populations of <i>S. hispanica</i> are uncommon today, and indeed may also have been so in ancient times. They are found growing in isolated populations in mountainous regions of Mexico and Central America, including the Sierra Madre Occidental, trans-volcanic belt of Mexico, the Sierra Madre del Sur, and the volcanic highland of Guatemala." [No evidence]

602	Produces viable seed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). <i>Journal of Ethnobiology</i> , 25(2), 155-174	"Informant Jesus de Latorre Guterrez of Acatic, Jalisco, described his method for mechanical planting of <i>Salvia hispanica</i> . He plows furrows approximately 8 cm apart. On the ridges between the furrows, the machinery punches holes about 2.5 cm in diameter, 5 cm deep, and 50 cm apart. He then drops several seeds in each hole which is left open. The mesic microenvironment in the holes facilitates germination and within a few days the seedlings emerge. With other planting techniques, hydrated seeds tend to dry out, inhibiting germination and increasing predation by birds and ants."
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). <i>Plant Resources of South-East Asia No 14. Vegetable oils and fats</i> . Backhuys Publishers, Leiden	" <i>S. hispanica</i> is grown from seeds. The germination rate of good seed averages 98%, declining to 75% after 1 year. The seed rate is about 6 kg/ha. The seeds are sown in rows that are 70-80 cm. apart. "
	Kintzios, S.E. 2000. <i>Sage: the genus Salvia</i> . Harwood Academic Publishers, Amsterdam	"Seeds of <i>Salvia hispanica</i> were geminated at 1500 m elevation, in Venezuela from a batch of Mexican origin."

603	Hybridizes naturally	n
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"No evidence of interspecies hybridization has surfaced for <i>Salvia hispanica</i> and hybridization among Calosphace species is reportedly rare (Ramamoorthy and Elliott 1993)."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Joseph, C. P. (2004). Genetic diversity among varieties of chia (<i>Salvia hispanica</i> L.). <i>Genetic Resources and Crop Evolution</i> , 51(7), 773-781	"Haque and Ghoshal (1981) determined that a highly self-pollinated system accompanies the minute homostylous flowers of <i>S. hispanica</i> ."
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	Self-pollinating.

605	Requires specialist pollinators	n
	Source(s)	Notes
	Haque, M. S., & Ghoshal, K. K. (1981). Floral biology and breeding system in the genus <i>Salvia</i> L. <i>Proceedings of the Indian National Science Academy</i> B47(5): 716-724	[Self-pollinated] "Five species, <i>S. rejiexa</i> , <i>S. tiliifolia</i> , <i>S. hispanica</i> , <i>S. verbenacca</i> and <i>S. aegyptica</i> had very minute flowers and all are supposedly self-pollinated and seed setting by open pollination was extremely high, almost all the flowers produced seeds. As the flowers were minute, bagging and artificial selfing was not possible. However,' in each of the species one plant was kept isolated from the others and then percentage of seed setting was recorded. In this condition also, almost cent per cent of the flowers produced seeds. It indicates that probably self-pollination is the rule in these species."
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	Self-pollinating.

Qsn #	Question	Answer
606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	"S. hispanica is grown from seeds."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. Biodiversity, 12 (1), 49-56	"Fast-growing annual herb.
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). Journal of Ethnobiology, 25(2), 155-174	Annual.

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). Economic Botany, 57(4), 604-618	"Calyxes are the keystone of domestication for <i>Salvia hispanica</i> , preventing seed dispersal and effectively eliminating survival of domesticated varieties outside of human cultivation."
	Small, E. (2011). 34. Chia—not just a pet. Biodiversity, 12 (1), 49-56	"Discarded Chia Pets covered with seedlings have been claimed to be a source of introduced <i>S. hispanica</i> in New Mexico and elsewhere. However, Chia has only occasionally been collected growing outside of cultivation in the United States, and does not seem to represent an invasive weed threat."
	Zona, S. (2017). Fruit and seed dispersal of <i>Salvia</i> L. (Lamiaceae): a review of the evidence. The Botanical Review, 83(2), 195-212	"Many <i>Salvia</i> species are well known for their mucilaginous fruits (Hedge, 1970; Ryding, 2001). The mucilage has been assumed to be instrumental in adhering the mericarps to animals (Ridley, 1930; Melcher et al., 2000; Melendo et al., 2003; Sales et al., 2010), but direct, observational evidence for epizoochory of mucilaginous <i>Salvia</i> mericarps is lacking." [<i>S. hispanica</i> has mucilaginous seeds that could potentially adhere to equipment, footwear, or vehicles]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	van der Vossen, H.A.M. and Umali, B.E. (Eds). (2001). Plant Resources of South-East Asia No 14. Vegetable oils and fats. Backhuys Publishers, Leiden	" <i>S. hispanica</i> originates from southern Mexico and northern Guatemala. Its earliest cultivation and utilization was by the Aztecs in Central America. It was introduced and naturalized in the West Indies, Spain and West Java. It is grown commercially in central Mexico, Guatemala, United States (southern California, south-eastern Texas), northwestern Argentina and occasionally in West Java, Peninsular Malaysia and Singapore."
	Small, E. (2011). 34. Chia—not just a pet. Biodiversity, 12 (1), 49-56	Chia is grown commercially in Argentina, Australia, Ecuador, Guatemala, Bolivia and Mexico.

703	Propagules likely to disperse as a produce contaminant	

Qsn #	Question	Answer
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"Seed needs to be threshed to be released from the calyx."
	Wilson, C. E., Castro, K. L., Thurston, G. B., & Sissons, A. (2016). Pathway risk analysis of weed seeds in imported grain: A Canadian perspective. <i>NeoBiota</i> , 30: 49–74	[Possibly. Further evidence needed] "Table 5. Contaminants that represent potential new weed species introductions to Canada, reported in imported grain crops examined in a Canadian sampling program 2007–2015. #Reports indicates the number of samples a species was reported in of a possible 947, and #Crops indicates the number of crops it was reported in, of a possible 10." [<i>Salvia hispanica</i> reported as a contaminant in one crop]

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"A single Chia plant can produce thousands of seeds (technically, Chia ‘seeds’ are one-seeded fruits). The small seeds are 1–2mm (0.04–0.08 in.) long. They are oval, mottled with brown, grey, or black, or sometimes white in cultivated varieties."
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"Closed calyxes are the keystone of domestication for <i>Salvia hispanica</i> , preventing seed dispersal and effectively eliminating survival of domesticated varieties outside of human cultivation."

705	Propagules water dispersed	n
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"Closed calyxes are the keystone of domestication for <i>Salvia hispanica</i> , preventing seed dispersal and effectively eliminating survival of domesticated varieties outside of human cultivation."
	Cahill, J. P., & Provance, M. C. (2002). Genetics of qualitative traits in domesticated chia (<i>Salvia hispanica</i> L.). <i>Journal of Heredity</i> , 93(1), 52-55	"Subsequent to fertilization, the calyxes close in all varieties of <i>S. hispanica</i> , thereby protecting the seeds during development. Seed maturity coincides with cell death in the calyx walls. As the cells die and dehydrate, the calyx opens, allowing seed dispersal in wild types. In all domesticated parental lines, the cells of the calyx walls die, however, the function of opening upon dehydration has been lost. Human selection has resulted in plants incapable of dispersing seed, and therefore unable to survive outside of cultivation. This characteristic is a hallmark of plant domestication."
	Zona, S. (2017). Fruit and seed dispersal of <i>Salvia</i> L. (Lamiaceae): a review of the evidence. <i>The Botanical Review</i> , 83(2), 195-212	"Table 1. Experiments in <i>Salvia mericarp</i> floatation" [<i>S. officinalis</i> - Percent (%) of floating after 6 hrs = 0; Percent (%) of floating after 24 hrs = 0]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica</i> L (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"Closed calyxes are the keystone of domestication for <i>Salvia hispanica</i> , preventing seed dispersal and effectively eliminating survival of domesticated varieties outside of human cultivation."

707	Propagules dispersed by other animals (externally)	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Cahill, J. P. (2003). Ethnobotany of chia, <i>Salvia hispanica L</i> (Lamiaceae). <i>Economic Botany</i> , 57(4), 604-618	"Closed calyxes are the keystone of domestication for <i>Salvia hispanica</i> , preventing seed dispersal and effectively eliminating survival of domesticated varieties outside of human cultivation."
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica L.</i>). <i>Journal of Ethnobiology</i> , 25(2), 155-174	"Informant Jesus de Latorre Guterrez of Acatic, Jalisco, described his method for mechanical planting of <i>Salvia hispanica</i> . He plows furrows approximately 8 cm apart. On the ridges between the furrows, the machinery punches holes about 2.5 cm in diameter, 5 cm deep, and 50 cm apart. He then drops several seeds in each hole which is left open. The mesic microenvironment in the holes facilitates germination and within a few days the seedlings emerge. With other planting techniques, hydrated seeds tend to dry out, inhibiting germination and increasing predation by birds and ants.

708	Propagules survive passage through the gut	
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"Chia stems and foliage constitute an excellent livestock feed, but should be consumed prior to flowering, when protein content decreases significantly in the green parts." [Unknown if viable seeds survive gut passage if inadvertently consumed by animals]

801	Prolific seed production (>1000/m2)	y
	Source(s)	Notes
	Small, E. (2011). 34. Chia—not just a pet. <i>Biodiversity</i> , 12 (1), 49-56	"A single Chia plant can produce thousands of seeds (technically, Chia 'seeds' are one-seeded fruits). The small seeds are 1–2mm (0.04–0.08 in.)"
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica L.</i>). <i>Journal of Ethnobiology</i> , 25(2), 155-174	"With each mature plant capable of producing a thousand seeds or more, the progeny of a single plant could supply a large portion of the next year's crop."

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2021) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/ . [Accessed 15 Mar 2021]	"Storage Behaviour: Orthodox"
	Cahill, J.P. (2005). Human selection and domestication of chia (<i>Salvia hispanica</i> L.). <i>Journal of Ethnobiology</i> , 25(2), 155-174	[Longevity of seeds unknown. Plants may be recruiting from previous year's seed production, and may persist for more than one year] "The sporadic chia plants standing in stark contrast to the neatly harvested and cleared field emphasize the value of the species and the effort put into its cultivation. When asked if the seeds were planted, the response was an emphatic no, and informants went on to explain that seedlings just appeared in the same place year after year and were intentionally spared when weeding. Plants do not spread within fields from year to year and do not appear on margins or outside of the fields as weeds."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Kaiser, C. & Ernst, M. (2016). Chia. Cooperative Extension Service. University of Kentucky, Lexington	"Despite the fact that chia is an aggressive crop, researchers are not concerned that it could become invasive or present a problem for subsequently planted crops; most commonly used herbicides tested against chia have succeeded in killing it, and mowing or light tillage can be effective in controlling any volunteers in subsequent years."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Kaiser, C. & Ernst, M. (2016). Chia. Cooperative Extension Service. University of Kentucky, Lexington	[Mowing and tillage are effective control methods] "Despite the fact that chia is an aggressive crop, researchers are not concerned that it could become invasive or present a problem for subsequently planted crops; most commonly used herbicides tested against chia have succeeded in killing it, and mowing or light tillage can be effective in controlling any volunteers in subsequent years."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability
- Able to naturalized and spread in regions with tropical climates
- Naturalized in a number of introduced locations; showing signs of naturalization on Maui (Hawaiian Islands)
- Reported to be weedy, but negative impacts are generally not documented
- Other *Salvia* species are weedy and/or invasive
- Tolerates many soil types
- Reproduces through prolific seed production
- Self-pollinated
- An annual, reaching maturity in under one year
- Seeds dispersed by gravity, people, possibly as a contaminant, and potentially by adhering to dispersal vectors
- Seeds may form a persistent seed bank (longevity to be determined)

Low Risk Traits

- A domesticated and widely cultivated species with no negative impacts reported from introduce range
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock
- Non-toxic
- Thrives in full sun (dense shade may inhibit ability to establish or spread)
- Not reported to hybridize
- Not reported to spread vegetatively
- Chemical and mechanical control methods are effective if needed

Second Screening Results for Herbs or Low Stature Shrubby Life Forms

(A) Reported as a weed of cultivated lands? No

(B) Unpalatable to grazers or known to form dense stands? No

Outcome = Accept (Low Risk)

