

**Family:** *Euphorbiaceae*

**Taxon:** *Cnidoscolus aconitifolius*

**Synonym:** *Jatropha aconitifolia* Mill. (*basionym*)  
*Cnidoscolus chayamansa* McVaugh

**Common Name:** Tree spinach  
Chaya  
Cabbage star

<b>Questionnaire :</b>	current 20090513	<b>Assessor:</b>	Chuck Chimera	<b>Designation:</b> H(HPWRA)
<b>Status:</b>	Assessor Approved	<b>Data Entry Person:</b>	Chuck Chimera	<b>WRA Score</b> 10
101	Is the species highly domesticated?		y=-3, n=0	n
102	Has the species become naturalized where grown?		y=1, n=-1	
103	Does the species have weedy races?		y=1, n=-1	
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)		y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0	y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs		y=1, n=0	y
402	Allelopathic		y=1, n=0	n
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	
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	
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	
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)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	
704	Propagules adapted to wind dispersal	y=1, n=-1	
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	y=1, n=-1	
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	
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)	y=-1, n=1	

Designation: H(HPWRA)

WRA Score 10

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**Supporting Data:**

101	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Is the species highly domesticated? No. Certain cultivars are highly domesticated, but this assessment addresses the wild type] "The taxon includes a diverse array of plants, spanning the range from wild to completely domesticated. Based on our observations and collections, we have identified four cultivated varieties of chaya, the taxonomy of which will be dealt with in a later paper...The cultivated material differs from the wild only in the apparent paucity of stinging hairs...Chaya is a plant of ancient origin, with a long history of human use, propagation, and domestication. It is currently a widespread cultivar of increasing popularity, and both historic and ethnographic evidence suggest that it has been a plant of some importance as food and medicine."
102	2011. WRA Specialist. Personal Communication.	NA
103	2011. WRA Specialist. Personal Communication.	NA
201	2005. Abdala-Roberts, L./Parra-Tabla, V.. Artificial Defoliation Induces Trichome Production in the Tropical Shrub <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Biotropica</i> . 37(2): 251–257.	[Species suited to tropical or subtropical climate(s) 2-high] " <i>Cnidoscolus aconitifolius</i> is a tropical shrub, 3–5 m tall, distributed throughout most of the Yucatan Peninsula."
202	2005. Abdala-Roberts, L./Parra-Tabla, V.. Artificial Defoliation Induces Trichome Production in the Tropical Shrub <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Biotropica</i> . 37(2): 251–257.	[Quality of climate match data? 2-high] " <i>Cnidoscolus aconitifolius</i> is a tropical shrub, 3–5 m tall, distributed throughout most of the Yucatan Peninsula."
203	2004. Grubben, G.J.H. (ed.). <i>Vegetables. Volume 2 of Plant resources of tropical Africa</i> . PROTA, Wageningen, Netherlands	[Broad climate suitability (environmental versatility)? Yes] "Under natural conditions in Central America <i>Cnidoscolus aconitifolius</i> grows in moist and dry thickets in open forest, often in open rocky localities, from se-level to 1300 m altitude." [Elevation range exceeds 1000 m, demonstrating potential environmental versatility]
204	2005. Abdala-Roberts, L./Parra-Tabla, V.. Artificial Defoliation Induces Trichome Production in the Tropical Shrub <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Biotropica</i> . 37(2): 251–257.	[Native or naturalized in regions with tropical or subtropical climates? Yes] " <i>Cnidoscolus aconitifolius</i> is a tropical shrub, 3–5 m tall, distributed throughout most of the Yucatan Peninsula."
205	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Does the species have a history of repeated introductions outside its natural range? Yes] "Throughout its "native" range chaya is cultivated, often only as an ornamental or living fence-post. Cultivated material, however, has spread in recent times to Cuba, Florida, and the Mexican states of Mexico, Morelos, and Puebla. Even more recently, chaya has spread to Maya families in urban and suburban areas throughout Mexico and the Southwest United States. In 1977 chaya was introduced to Ghana from an agricultural research station in Puerto Rico (Newton 1984), and in 1979 brought to Brunei (Peregrine 1983) as a potential agricultural crop."
301	1967. Woodson, Jr., R.E./Schery, R.W./Webster, G.L./Burch, D.. <i>Flora of Panama</i> . Part VI. Family 97. Euphorbiaceae. <i>Annals of the Missouri Botanical Garden</i> . 54(3): 211-350.	[Naturalized beyond native range? Possibly Panama] "Native probably to eastern Mexico according to McVaugh ( <i>The Mexican species of Jatropha</i> , 13, Rubber Dev. Corp., 1943); widely cultivated in Central America as a hedgerow plant. The species is extensively grown in Panama, and at least one herbarium record (Hunter & Allen 672) suggests that it has become naturalized."
301	1991. Francis, J.K./Liogier, H.A.. <i>Naturalized Exotic Tree Species in Puerto Rico</i> . General Technical Report SO-82. United States Department of Agriculture Forest Service, New Orleans, LA	[Naturalized beyond native range? Yes] "Table 1 -Naturalized and escaped exotic trees in Puerto Rico ... <i>Cnidoscolus aconitifolius</i> ... Location of reproduction; number of plants or area covered ... Widespread; more than 1000 plants"
301	2011. Parker, J.. BIISC Early Detection Botanist. Pers. Comm. 06 September 2011.	[Naturalized beyond native range? Possibly yes on Hawaii Island] "There are definitely two distinct varieties that we're seeing down near the coast there in Kalapana and Kapoho. The one which we thought was most likely naturalized had no stinging hairs on the leaves, very succulent stems, and 3-lobed leaves..."
302	2007. Randall, R.P.. <i>Global Compendium of Weeds - Cnidoscolus aconitifolius</i> [Online Database]. <a href="http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/">http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/</a>	[Garden/amenity/disturbance weed? No] No evidence
303	2007. Randall, R.P.. <i>Global Compendium of Weeds - Cnidoscolus aconitifolius</i> [Online Database]. <a href="http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/">http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/</a>	[Agricultural/forestry/horticultural weed? No] No evidence

304	2007. Randall, R.P.. Global Compendium of Weeds - <i>Cnidoscopus aconitifolius</i> [Online Database]. <a href="http://www.hear.org/gcw/species/cnidoscopus_aconitifolius/">http://www.hear.org/gcw/species/cnidoscopus_aconitifolius/</a>	[Environmental weed? No] No evidence
305	1972. Cardenas, Juan/Reys, C.E./Doll, J.D./Pardo, F.. Tropical weeds; malezas tropicales, vol. 1.. International Plant Protection Center, Oregon State University, Corvallis, OR	[Congeneric weed? Yes] "Perennial, stinging tree-like nettle found in perennial crops, pastures, roadsides and ditchbanks" [ <i>Cnidoscopus urens</i> ]
305	2007. Randall, R.P.. Global Compendium of Weeds - Index [Online Database]. <a href="http://www.hear.org/gcw/">http://www.hear.org/gcw/</a>	[Congeneric weed? Yes] [ <i>Cnidoscopus albomaculatus</i> , <i>Cnidoscopus phyllacanthus</i> , <i>Cnidoscopus stimulosus</i> , <i>Cnidoscopus texanus</i> , <i>Cnidoscopus urens</i> listed as weeds of one kind]
401	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscopus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Produces spines, thorns or burrs? No. Not in cultivated form] "A widespread belief in Mesoamerica is that one has to ask a chaya plant for permission before harvesting leaves to avoid being stung by its spines. It is also believed by some that the plant, and thus its spines, wakes up in the early morning with the arrival of the sun, and that to harvest leaves safely, they should be cut in the early morning or late evening. We have found that wearing gloves or even thin plastic bags is also effective for preventing being stung during harvest, and that these are useful even with glabrous plants, because long-term contact with the white sap can cause skin irritation."
401	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Produces spines, thorns or burrs? Possibly, although some cultivars lack stinging hairs] "Monoecious shrub or small tree, up to 6 m all, containing white latex, with a thick pale trunk, plants usually armed with stinging hairs, but cultivated forms unarmed."
401	2005. Abdala-Roberts, L./Parra-Tabla, V.. Artificial Defoliation Induces Trichome Production in the Tropical Shrub <i>Cnidoscopus aconitifolius</i> (Euphorbiaceae). <i>Biotropica</i> . 37(2): 251-257.	[Produces spines, thorns or burrs? Possibly. Stinging trichomes are produced to deter herbivory from Lepidoptera] "C. aconitifolius presents glandular trichomes on most of its aerial structures, which produce stinging compounds (L. Abdala Roberts, pers. obs.). These compounds (i.e., serotonin) have shown to confer resistance against herbivores (Pollard&Briggs 1984) and are found in other species of the same genus (e.g., C. texanus; Lookadoo & Pollard 1991)." [But see Ross-Ibarra and Molina-Cruz (2002) regarding its use as a leafy vegetable]
401	2011. Parker, J.. BIISC Early Detection Botanist. Pers. Comm. 06 September 2011.	[Produces spines, thorns or burrs? Possibly not in cultivated forms found in Hawaii] "There are definitely two distinct varieties that we're seeing down near the coast there in Kalapana and Kapoho. The one which we thought was most likely naturalized had no stinging hairs on the leaves, very succulent stems, and 3-lobed leaves (possibly two points where the 4th and 5th lobes would be). The other variety we haven't gotten as close to and that has deeply bisected, many lobed leaves, a taller woodier habit, and not sure about the stinging hairs"
402	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscopus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Allelopathic? No] No evidence
402	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Allelopathic? No] No evidence
403	2011. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network (GRIN) [Online Database Index]. National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Parasitic? No] Euphorbiaceae [Not parasitic]
404	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscopus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Unpalatable to grazing animals? No] "Plants are grown primarily for human consumption or medicinal use, though it is not infrequent to find chaya greens being used as a feed for animals-mainly for pigs, chicken, iguanas, ducks, and goats, and occasionally for cattle."
404	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Unpalatable to grazing animals? No] "Chaya is also used as forage for domestic animals."
404	2005. Abdala-Roberts, L./Parra-Tabla, V.. Artificial Defoliation Induces Trichome Production in the Tropical Shrub <i>Cnidoscopus aconitifolius</i> (Euphorbiaceae). <i>Biotropica</i> . 37(2): 251-257.	[Unpalatable to grazing animals? No. Trichomes produced to deter Lepidopteran herbivory] "C. aconitifolius presents glandular trichomes on most of its aerial structures, which produce stinging compounds (L. Abdala Roberts, pers. obs.). These compounds (i.e., serotonin) have shown to confer resistance against herbivores (Pollard&Briggs 1984) and are found in other species of the same genus (e.g., C. texanus; Lookadoo & Pollard 1991)."

405	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Toxic to animals? No] "Chaya is also used as forage for domestic animals."
406	2002. National Research Council. Underexploited Tropical Plants with Promising Economic Value. Books For Business, New York - Hong Kong	[Host for recognized pests and pathogens? No] "So far, chaya appears free of the pests and diseases that plague green garden vegetables in tropical climates, an important economic and ecological advantage. However, horn worms can rapidly defoliate it (but the plants quickly recover their leaves.)"
406	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Host for recognized pests and pathogens? No] "Though occasional predation by herbivorous insects is apparent, no significant pests or diseases have been reported for chaya. In Yucatan, 23 of 33 collections of chaya were found infected with the cassava common mosaic virus, but the effect of this pathogen on chaya is minimal, because viral symptoms were not obvious in most of the plants collected (Elliot and Zettler 1987). The virus is presumably transmitted mechanically through infected knives or machetes during cutting of stems (Lozano et al. 1981)."
406	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Host for recognized pests and pathogens? No] "With its easy propagation, its tolerance of harsh conditions and absence of serious diseases or pests, it is a promising species worthwhile for trying in many locations in tropical Africa."
407	1996. Kuti, J.O./Torres, E.S.. Potential nutritional & health benefits of tree spinach. Pp. 516-520. In: J. Janick (ed.), <i>Progress in new crops</i> . ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-516.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-516.html</a>	[Causes allergies or is otherwise toxic to humans? Potentially if eaten uncooked] "Like most food plants such as lima beans, cassava, and many leafy vegetables, the leaves contain hydrocyanic glycosides, a toxic compound easily destroyed by cooking. Even though some people tend to eat raw chaya leaves, it is unwise to do so."
407	2002. National Research Council. Underexploited Tropical Plants with Promising Economic Value. Books For Business, New York - Hong Kong	[Causes allergies or is otherwise toxic to humans? Possibly] "Chaya must be cooked before eating: the fresh leaves contain toxic hydrocyanic glycosides, but cooking inactivates them."
407	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Causes allergies or is otherwise toxic to humans? Possible if eaten uncooked] "Chaya leaves and young shoots are still eaten today throughout Mesoamerica. Fresh chaya leaves are often sold in food markets in the Yucatan, and their consumption, though variable, is as frequent as several times per week in some families. As a food, Chaya is most popular in the small villages of the state of Yucatan, but is still common throughout the Maya region ... We also received reports of people eating wild chaya leaves-boiled to remove the spines and toxins-in times of extreme scarcity ... We have found that wearing gloves or even thin plastic bags is also effective for preventing being stung during harvest, and that these are useful even with glabrous plants, because long-term contact with the white sap can cause skin irritation."
407	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Causes allergies or is otherwise toxic to humans? Possibly, perhaps if administered at incorrect dosage or if handled frequently] "Medicinally, chaya has numerous characteristics, ranging from the ability to strengthen fingernails and darken graying hair. It is also used to cure alcoholism, diabetes, insomnia, skin disorders, venereal diseases, gout, scorpion stings and to improve brain function and memory..." "Harvesting is best done with protected hands, because even in unarmed plants, long-term contact with the white sap can cause skin irritation."
408	1992. Rico-Gray, V./García-Franco, J.G.. Vegetation and Soil Seed Bank of Successional Stages in Tropical Lowland Deciduous Forest. <i>Journal of Vegetation Science</i> . 3(5): 617-624.	[Creates a fire hazard in natural ecosystems? No] No evidence
408	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Creates a fire hazard in natural ecosystems? No] No evidence
409	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Is a shade tolerant plant at some stage of its life cycle? Yes. Low light conditions] "The chaya plant itself seems to adapt equally well to humid or dry areas. We have successfully cultivated chaya in low light conditions with permanently inundated soil, as well as non-irrigated desert conditions in practically full sun."
409	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Is a shade tolerant plant at some stage of its life cycle? Yes] "It can survive harsh conditions of high temperatures, deep shade, inundations or droughts."

410	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Tolerates a wide range of soil conditions ? Yes. Presumably, if able to tolerate poor soils and fertile soils] "...the fact that chaya grows well in the thin, dry limestone soil of the Yucatan Peninsula suggests that chaya could be used in other areas of the world with poor soil. Indeed, it is likely that the higher frequency of chaya in the northern Yucatan Peninsula compared to the more fertile southern areas of Mesoamerica may be due to the lack of other edible greens that can tolerate such poor soil."
411	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153-160.	[Climbing or smothering growth habit? No] " <i>Cnidoscolus aconitifolius</i> (Mill.) I. M. Johnstone (Euphorbiaceae) is a tall shrub (1.2 m-4.5 m), and like other species in the genus □ <i>C. urens</i> (Dillon et al. 1983) and <i>C. spinosus</i> (Bullock 1982)), exhibits a highly urticant pubescence on stems, leaves, flowers and fruits."
412	2002. National Research Council. Underexploited Tropical Plants with Promising Economic Value. Books For Business, New York - Hong Kong	[Forms dense thickets? Unknown if able to exclude other vegetation] "Native chaya grows in thickets or open forest..."
501	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Aquatic? No] "Under natural conditions in Central America <i>Cnidoscolus aconitifolius</i> grows in moist and dry thickets in open forest, often in open rocky localities, from se-level to 1300 m altitude." [Terrestrial]
502	2011. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network (GRIN) [Online Database Index]. National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Grass? No] Euphorbiaceae
503	2011. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network (GRIN) [Online Database Index]. National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Nitrogen fixing woody plant? No] Euphorbiaceae
504	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Monoecious shrub or small tree up to 6 m tall..."
601	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153-160.	[Evidence of substantial reproductive failure in native habitat? No]
601	2011. Jara-Guerrero, A./De la Cruz, M./Méndez, M.. Seed Dispersal Spectrum of Woody Species in South Ecuadorian Dry Forests: Environmental Correlates and the Effect of Considering Species Abundance. <i>Biotropica</i> . doi: 10.1111/j.1744-7429.2011.00754.x: 1-9.	[Evidence of substantial reproductive failure in native habitat? No]
602	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Produces viable seed? Yes. Wild type] "The cultivated varieties of chaya are reproduced almost exclusively by stem cuttings. 'Picuda' is occasionally reproduced by seed, but the other three varieties are only propagated vegetatively."
602	2004. Grubben, G.J.H. (ed.). Vegetables. Volume 2 of Plant resources of tropical Africa. PROTA, Wageningen, Netherlands	[Produces viable seed? Possibly No] "Forms without stinging hairs used as a vegetable are classified as a cultivar-group: Chayamansa Group (synonym: <i>Cnidoscolus chayamansa</i> McVaugh). Plants of this cultivar-group produce functionally sterile flowers (very rarely fruits are produced) and are propagated by cuttings; at least 4 cultivars are known."
603	2011. WRA Specialist. Personal Communication.	[Hybridizes naturally? Unknown]
604	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153-160.	[Self-compatible or apomictic? Yes] "The inflorescences of <i>C. aconitifolius</i> have a dichotomous branching pattern (tricotomous in the first division), and female and male flowers. These are distributed like those of <i>C. spinosus</i> , female on the base and male on the top of the inflorescence (Bullock 1982). <i>C. aconitifolius</i> is self-compatible, flowers are white, tubular, about 2 cm long, and remain open one day."

605	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153–160.	[Requires specialist pollinators? No] "The main pollinators are butterflies and several bee species, including the honey bee <i>Apis mellifera</i> (Carbajal 1998). Bees mainly visit male flowers to collect nectar and pollen."
605	2009. Arceo-Gomez, G./Parra-Tabla, V./Navarro, J.. Changes in Sexual Expression as Result of Defoliation and Environment in a Monoecious Shrub in Mexico: Implications for Pollination. <i>Biotropica</i> . 41(4): 435–441.	[Requires specialist pollinators? No] "The study species usually flowers and fruits from July to October (rainy season). Flowers remain open for only one day and are visited by at least 10 bee species such as <i>Apis mellifera</i> , <i>Trigona nigra</i> , <i>T. fulviventris</i> , as well as by ca 40 species of butterfly (Rodriguez 2004). Bees prefer male flowers as they are searching for both nectar and pollen, while butterflies visit both types of flowers indistinctively (Carbajal 1998). Although pollinators have shown little variation in their species composition between study sites (Rodriguez 2004), apparently there exists an important spatial variation in the male (pollen removal) and female (pollen load) pollination success (V. Parra-Tabla & C. H. Herrera, unpubl. data)...Previous observations and those from this study indicate that <i>C. aconitifolius</i> pollination strategy is promiscuous as it is normally visited by at least 40 species of generalist butterflies, as well as by a great number of bee species (Rodriguez 2004). Such high pollinator abundance and diversity can constrain natural selection on floral traits for the study species if they are equally efficient (Herrera 1996)."
606	2002. National Research Council. Underexploited Tropical Plants with Promising Economic Value. Books For Business, New York - Hong Kong	[Reproduction by vegetative fragmentation? Probably yes] "Chaya is propagated from stem cuttings, and woody stem sections germinate readily." [Fragments of plants likely to root if broken off]
607	2007. Randall, R.P.. Global Compendium of Weeds - <i>Cnidoscolus aconitifolius</i> [Online Database]. <a href="http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/">http://www.hear.org/gcw/species/cnidoscolus_aco_nitifolius/</a>	[Minimum generative time (years)? Probably <4 years] "Chaya, a fast-growing ornamental and shade shrub, is a source of nutritious green leaves and shoots."
701	2011. Parker, J.. BIISC Early Detection Botanist. Pers. Comm. 06 September 2011.	[Propagules likely to be dispersed unintentionally? Potentially] "...it seems likely that the plants we're seeing actually just move around vegetatively and may pop up in debris piles."
702	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Propagules dispersed intentionally by people? Yes] "Throughout its "native" range chaya is cultivated, often only as an ornamental or living fence-post. Cultivated material, however, has spread in recent times to Cuba, Florida, and the Mexican states of Mexico, Morelos, and Puebla. Even more recently, chaya has spread to Maya families in urban and suburban areas throughout Mexico and the Southwest United States. In 1977 chaya was introduced to Ghana from an agricultural research station in Puerto Rico (Newton 1984), and in 1979 brought to Brunei (Peregrine 1983) as a potential agricultural crop."
702	2011. Parker, J.. BIISC Early Detection Botanist. Pers. Comm. 06 September 2011.	[Propagules dispersed intentionally by people? Yes] "...it seems likely that the plants we're seeing actually just move around vegetatively and may pop up in debris piles. This plant is being promoted around here for a nutritious source of greens that is easy to grow and we're likely to see more of it..."
703	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153–160.	[Propagules likely to disperse as a produce contaminant? Potentially] "The fruits of <i>C. aconitifolius</i> are schizocarpic, have three seeds, and are dehiscent by explosion..." [No evidence, but if wild-type is accidentally grown with other produce, seeds could potentially be dispersed as a contaminant]
704	2004. Parra-Tabla, V./Rico-Gray, V./Carbajal, M.. Effect of defoliation on leaf growth, sexual expression and reproductive success of <i>Cnidoscolus aconitifolius</i> (Euphorbiaceae). <i>Plant Ecology</i> . 173: 153–160.	[Propagules adapted to wind dispersal? Possibly short distances] "The fruits of <i>C. aconitifolius</i> are schizocarpic, have three seeds, and are dehiscent by explosion (Standley and Steyermark 1949)."
705	2011. Jara-Guerrero, A./De la Cruz, M./Méndez, M.. Seed Dispersal Spectrum of Woody Species in South Ecuadorian Dry Forests: Environmental Correlates and the Effect of Considering Species Abundance. <i>Biotropica</i> . doi: 10.1111/j.1744-7429.2011.00754.x: 1-9.	[Propagules water dispersed? No] "We registered five polychorous species. Three of these species ( <i>Cnidoscolus aconitifolius</i> , <i>Croton menthodorus</i> and <i>Croton wagneri</i> ) presented fruits with explosive dehiscence, which is characteristic to active autochorous diaspores, and seeds with elaiosome, characteristic of myrmecochorous diaspores."
706	2008. Gargiullo, M.B./Magnuson, B.L./Kimball, L.D.. A field guide to plants of Costa Rica. Oxford University Press US, New York, NY	[Propagules bird dispersed? No] "Fruit dry, to 1.8 cm long, 1 cm wide, 3-parted, with stinging hairs." [Not fleshy-fruited]
707	1967. Woodson, Jr., R.E./Schery, R.W./Webster, G.L./Burch, D.. Flora of Panama. Part VI. Family 97. Euphorbiaceae. <i>Annals of the Missouri Botanical Garden</i> . 54(3): 211-350.	[Propagules dispersed by other animals (externally)? No] "Capsules unarmed, green, minutely rugose, 8 12 mm long; seeds elliptic, compressed, 6-8.5 mm long, 4-5.5 mm broad, pale to dark brown and mottled, the caruncle deltoid-cordate, 1.5-2 mm high, 2-2.8 mm broad." [No means of external attachment]

708	2011. Jara-Guerrero, A./De la Cruz, M./Méndez, M.. Seed Dispersal Spectrum of Woody Species in South Ecuadorian Dry Forests: Environmental Correlates and the Effect of Considering Species Abundance. <i>Biotropica</i> . doi: 10.1111/j.1744-7429.2011.00754.x: 1-9.	[Propagules survive passage through the gut? Unknown] "We registered five polychorous species. Three of these species ( <i>Cnidoscolus aconitifolius</i> , <i>Croton menthodorus</i> and <i>Croton wagneri</i> ) presented fruits with explosive dehiscence, which is characteristic to active autochorous diaspores, and seeds with elaiosome, characteristic of myrmecochorous diaspores." [Seeds unlikely to be consumed]
801	1996. Kuti, J.O./Torres, E.S.. Potential nutritional & health benefits of tree spinach. Pp. 516-520. In: J. Janick (ed.), <i>Progress in new crops</i> . ASHS Press, Arlington, VA <a href="http://www.hort.purdue.edu/newcrop/proceedings1996/v3-516.html">http://www.hort.purdue.edu/newcrop/proceedings1996/v3-516.html</a>	[Prolific seed production (>1000/m2)? No] "Mature seeds and fruit are rare and unknown (McVaugh 1944)." [Apparently rare outside native range]
802	1992. Rico-Gray, V./García-Franco, J.G.. Vegetation and Soil Seed Bank of Successional Stages in Tropical Lowland Deciduous Forest. <i>Journal of Vegetation Science</i> . 3(5): 617-624.	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Table 1. Abundance values for woody plants with dbh > 1.0 cm. p = present; * = in seed bank. S = Slashed; SB = Slashed-and-burned; 1 - 100: successional stages with years of regrowth. Not included are 24 unidentified species of the vegetation, and 26 of the soil seed bank." [ <i>C. aconitifolius</i> documented in seed bank up to 7 years]
803	2011. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No information on herbicide efficacy or chemical control of this species
804	2002. National Research Council. <i>Underexploited Tropical Plants with Promising Economic Value</i> . Books For Business, New York - Hong Kong	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Because of the softness of the wood, the plant is easily pruned and maintained within reach of the ground. The plants tolerate heavy rainfall and respond with luxurious growth. Drought is also tolerated, and plants recover well when the rain returns."
804	2002. Ross-Ibarra, J./Molina-Cruz, A.. The Ethnobotany of Chaya ( <i>Cnidoscolus aconitifolius</i> ssp. <i>aconitifolius</i> Breckon): A Nutritious Maya Vegetable. <i>Economic Botany</i> . 56(4): 350-365.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "The chaya plant can grow into a five to six meter shrub, but its weak branches are easily broken by the wind. It is therefore recommended to cut the plant to maintain a height of less than two meters. This is common practice in home gardens, and is probably the reason that the maximum height of cultivated chaya is often cited as 1.5-2 m. Despite the need to keep the plants relatively small, chaya actively produces large amounts of leaf material."
805	2011. WRA Specialist. Personal Communication.	[Effective natural enemies present locally? Unknown]