

Key Words: High Risk, Naturalized, Invasive, Spiny form, Edible Fruit, Food Crop

Family: *Solanaceae*

Taxon: *Solanum quitoense*

Synonym: *Solanum angulatum* Ruiz & Pav.
Solanum quitense Kunth

Common Name: Quito orange
Naranjilla
Morelle de Quito
Lulo

Questionnaire : current 20090513 **Assessor:** Chuck Chimera **Designation:** H(HPWRA)
Status: Assessor Approved **Data Entry Person:** Chuck Chimera **WRA Score** 11

101	Is the species highly domesticated?	y=-3, n=0	
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)	y
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)	
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	
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	
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	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	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	
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)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: H(HPWRA)

WRA Score **11**

Supporting Data:

101	1972. Heiser, Jr., C.B.. The Relationships of the Naranjilla, <i>Solanum quitoense</i> . <i>Biotropica</i> . 4(2): 77-84.	[Is the species highly domesticated? Possibly] "The details concerning the origin of the plant are unknown." ... "Two of the species, <i>S. quitoense</i> and <i>S. topiro</i> , are domesticated species; the others are more or less weedy, usually occurring in openings in forests, along roadsides, or in disturbed areas near human habitations."
101	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Is the species highly domesticated? Possibly] "The usually spineless naranjilla is believed to be indigenous and most abundant in Peru, Ecuador and southern Colombia. The forms found in the rest of Colombia and in the central and northern Andes of Venezuela and interior mountain ranges of Costa Rica may vary from partly to very spiny. Some botanists have suggested that these spiny forms belong to the botanical variety <i>septentrionale</i> . In Ecuador, 90% of commercial naranjilla cultivation is in a 15-mile area in the valley and adjacent hillsides of the Pastaza River, a tributary of the Amazon." ... "The fruit of seedling plants shows much variation. However, there seems to be little or no effort to select and name superior cultivars."
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Species suited to tropical or subtropical climate(s) 2-High] " <i>Solanum quitoense</i> is presumed to be a native of Peru, Ecuador, or Colombia and is introduced to Panama."
202	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Quality of climate match data? 2-High] " <i>Solanum quitoense</i> is presumed to be a native of Peru, Ecuador, or Colombia and is introduced to Panama."
203	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Broad climate suitability (environmental versatility)? Maybe No] "Naranjilla may be suitable for cultivation in cool, moist areas of Hawaii, but it is susceptible to attack by root knot nematode and other pests and has exacting climatic and cultural requirements."
203	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	[Broad climate suitability (environmental versatility)? Yes] "Open sites in mountain areas, roadsides, pastures; also widely cultivated for fruit. Altitude: 900-2000 m, mostly above 1300 m." [Elevation range exceeds 1000 m, demonstrating environmental versatility]
204	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Native or naturalized in regions with tropical or subtropical climates? Yes] " <i>Solanum quitoense</i> is presumed to be a native of Peru, Ecuador, or Colombia and is introduced to Panama."
205	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Does the species have a history of repeated introductions outside its natural range? Yes] "Seeds were first sent to the United States Department of Agriculture from Colombia in 1913; from Ecuador in 1914 and 1916. Many other introductions were made but the resulting plantings in California, Florida and northern greenhouses flourished only briefly, some set fruit, and all died. Trial plantings were made in the Philippines about 1922." ... "In the early 1950's, plantings were made in Puerto Rico, Jamaica, Panama, Hawaii and Queensland, and in the Meseta Central of Costa Rica where one of several growers set out 70,000 plants of the local wild variety which bears a larger fruit than the non-spiny South American type."
301	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Naturalized beyond native range? Yes] "This species is cultivated in crop fashion in the Chiriqui mountains for the juice of its fruits, but at the present time (1972) it must be ranked as a minor or experimental crop. Most Panamanian collections are presumed to be escapes from cultivation. It may be persistent in areas of frequent disturbance. <i>Solanum quitoense</i> is presumed to be a native of Peru, Ecuador, or Colombia and is introduced to Panama"
301	1986. D'Arcy, W.G.. Solanaceae, biology and systematics. Columbia University Press, New York, NY	[Naturalized beyond native range? Yes] " <i>Solanum quitoense</i> Lam., a native of northern South America, has escaped cultivation in upland Panama and Costa Rica following cultivation for its edible fruits. It is a crop plant in the highlands of Ecuador."
301	2000. Liogier, A.H./ Martorell, L.F.. Flora of Puerto Rico and adjacent islands: a systematic synopsis. La Editorial, UPR, San Juan, Puerto Rico	[Naturalized beyond native range? Yes] "...collected as an escape in Toro Negro Mountains, Puerto Rico; ..."

301	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	[Naturalized beyond native range? Yes] "Native to mountains of S Americ. Now found Nic-Pr; introduced and invasive in the Galapagos."
301	2010. Gardener, M.R./Atkinson, R./Renteria, J. L.. Eradications and People: Lessons from the Plant Eradication Program in Galapagos. Restoration Ecology. 18(1): 20–29.	[Naturalized beyond native range? Yes] "Solanum quitoense is widespread, at low densities and has naturalized, and so is unlikely to be eradicated." [Galapagos]
301	2011. Guézou, A. et al.. CDF Checklist of Galapagos Introduced Plants. In: Bungartz, F. et al. (eds.). CDF Galapagos Species Checklist. Charles Darwin Foundation, Puerto Ayora, Galapagos http://www.darwinfoundation.org/datazone/checklists/ecological-group	[Naturalized beyond native range? Yes] "Origin: Introduced, Escaped. Galapagos Distribution: Floreana, Isabela, San Cristóbal, Santa Cruz, Santiago."
302	2010. Gardener, M.R./Atkinson, R./Renteria, J. L.. Eradications and People: Lessons from the Plant Eradication Program in Galapagos. Restoration Ecology. 18(1): 20–29.	[Garden/amenity/disturbance weed? Yes] "Ten species were selected because of their invasive behavior on another island in Galapagos (Aristolochia odoratissima, Citrus spp., Furcraea hexapetala, Lantana camara, Leucaena leucocephala, Rubus niveus, Persea americana, Sapindus saponaria, Solanum quitoense..." ... "Solanum quitoense is widespread, at low densities and has naturalized, and so is unlikely to be eradicated." [Targeted for control, but impacts to natural ecosystems unspecified]
303	2007. Randall, R.P.. Global Compendium of Weeds - Solanum quitoense [Online Database]. http://www.hear.org/gcw/species/solanum_quitoense/	[Agricultural/forestry/horticultural weed? No] No evidence
304	2010. Gardener, M.R./Atkinson, R./Renteria, J. L.. Eradications and People: Lessons from the Plant Eradication Program in Galapagos. Restoration Ecology. 18(1): 20–29.	[Environmental weed? Potentially] "Ten species were selected because of their invasive behavior on another island in Galapagos (Aristolochia odoratissima, Citrus spp., Furcraea hexapetala, Lantana camara, Leucaena leucocephala, Rubus niveus, Persea americana, Sapindus saponaria, Solanum quitoense..." ... "Solanum quitoense is widespread, at low densities and has naturalized, and so is unlikely to be eradicated." [Targeted for control, so presumably a weed of environmental concern]
305	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Congeneric weed? Yes] Solanum laxum. Solanum linnaeanum, Solanum mauritanium, Solanum nigrum, Solanum pseudocapsicum, Solanum tampicense, Solanum viarum listed as weeds of natural areas
305	2006. USDA Natural Resources Conservation Service. Federal noxious weed list. http://plants.usda.gov/java/noxious?rptType=Federal	[Congeneric weed? Yes] Solanum tampicense and Solanum viarum listed as Federal noxious weeds
401	1972. Heiser, Jr., C.B.. The Relationships of the Naranjilla, Solanum quitoense. Biotropica. 4(2): 77-84.	[Produces spines, thorns or burrs? Potentially Yes] "Two varieties of this species have been recognized: var. quitoense, a spineless form, found in southern Colombia and Ecuador, and a form with spines, var. septentrionale Schultes & Cuatrecasas of central Colombia, Panama, and Costa Rica."
401	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Produces spines, thorns or burrs? Yes] "Large herb or small shrub to 3 m tall; twigs stout, tomentose with long-armed, multangulate hairs on long, multiseriate stalks and armed with short or long, stout, flattened, yellowish spines. Leaves large, often exceeding 30 cm long, broadly ovate, shallowly sinuate lobed, the lobes acuminate, the tips often glabrous above and mucronate, above with a mixture of sessile, porrect, pauci- radiate hairs with long midpoints and long, multiseriate, stalked, multangulate hairs, these latter often deciduous, beneath more densely clothed with mostly stalked stellae and suffused with purple, at least when young, armed or not on the major veins; petioles to 15 cm long, stout, tomentose and often armed." ... "The typical form of this species is unarmed, and collections of such plants are indicated below by an asterisk. Plants with spines may be referred to as fo. Septentrionale (R. E. Schultes & Cuatrec.) D'Arcy"
401	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (Solanum quitoense). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Produces spines, thorns or burrs? Potentially Yes] "The naranjilla plant is a spreading, herbaceous shrub to 8 ft (2.5 m) high with thick stems that become somewhat woody with age; spiny in the wild, spineless in cultivated plants."
401	2012. Learn 2 Grow. Solanum quitoense. http://www.learn2grow.com/plants/solanum-quitoense/	[Produces spines, thorns or burrs? Yes] "The frighteningly prickly yet architecturally appealing naranjilla has fuzzy green leaves and yellow stems lined with slender, purple red, thorny protrusions." ... "Even though its spines are not dangerously sharp, it is best to place it away from pedestrian areas or where children play."

402	2012. WRA Specialist. Personal Communication.	[Allelopathic? Unknown]
403	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Parasitic? No] "Large herb or small shrub to 3 m tall..." [Solanaceae]
404	2012. WRA Specialist. Personal Communication.	[Unpalatable to grazing animals? Unknown]
405	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Toxic to animals? No] No evidence
405	2012. Specialized Information Services, U.S. National Library of Medicine. TOXNET toxicology data network [online database]. National Institutes of Health, http://toxnet.nlm.nih.gov/	[Toxic to animals? No] No evidence
406	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Host for recognized pests and pathogens? Potentially] "The chief enemies of the naranjilla are the rootknot nematodes (<i>Meloidogyne</i> sp.) and grafting on nematode-resistant rootstock is essential to fruit production in southern Florida. In the Chinchiná coffee-growing region of Caldas, Colombia, nematicide treatment of the soil each time it is invaded is considered too expensive, and the plants can therefore be kept in production only one year before they succumb to nematode damage. Nematodes are causing a drop in naranjilla production in various parts of the country and Dr. Charles Heiser of Indiana University is studying the possibility of hybridization with nematode-resistant wild relatives in order to save the industry. Measures to reduce nematode populations in Guatemalan fields include discarding nursery seedlings and adult plants that show typical symptoms (chlorosis, dwarfing, rachitic appearance), mulching, or frequent plowing during hot, dry spells. In Panama, the main stem and branches, and sometimes even the fruits, of mature plants are attacked by the cochinita blanca (white, or West Indian, peach scale, <i>Pseudaulacaspis pentagona</i>)."
406	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Host for recognized pests and pathogens? Potentially] "Pests recorded - Insects: <i>Anastrepha fraterculus</i> (South American fruit fly) Fungus diseases: <i>Fusarium oxysporum</i> "
407	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Causes allergies or is otherwise toxic to humans? Mild irritation from fruit hairs, otherwise no evidence] "Ripe naranjillas, freed of hairs, may be casually consumed out-of-hand by cutting in half and squeezing the contents of each half into the mouth. The empty shells are discarded. The flesh, complete with seeds, may be squeezed out and added to ice cream mix, made into sauce for native dishes, or utilized in making pie and various other cooked desserts." ... "People with very sensitive skin may find the hairs on the fruits irritating and should protect the hands when rubbing off the fuzz."
407	2012. Dave's Gardern. PlantFiles: Naranjilla, Quito Orange, Golden Fruit of the Andes, Bed of Nails - <i>Solanum quitoense</i> . http://davesgarden.com/guides/pf/go/57815/	[Causes allergies or is otherwise toxic to humans? Minor problems] "Handling plant may cause skin irritation or allergic reaction Plant has spines or sharp edges; use extreme caution when handling"
408	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Creates a fire hazard in natural ecosystems? No] No evidence
408	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	[Creates a fire hazard in natural ecosystems? No] No evidence
408	2010. Gardener, M.R./Atkinson, R./Renteria, J. L.. Eradications and People: Lessons from the Plant Eradication Program in Galapagos. Restoration Ecology. 18(1): 20-29.	[Creates a fire hazard in natural ecosystems? No] No evidence
409	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Is a shade tolerant plant at some stage of its life cycle? Yes] "It is not adapted to full sun but favors semi shade."

410	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Tolerates a wide range of soil conditions? Yes] "The plant does best in a rich, organic soil; also grows well on poor, stony ground, and on scarified limestone. It must have good drainage. In Latin America, naranjillas are planted on virgin soil in tracts where the large trees have been felled and the undergrowth burned off. The remaining trees provide semi shade and wind protection."
410	2012. Learn 2 Grow. <i>Solanum quitoense</i> . http://www.learn2grow.com/plants/solanum-quitoense/	[Tolerates a wide range of soil conditions? Yes] "Grow naranjilla in full sun to partial (dappled) shade in any average garden soil that has good drainage."
411	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Climbing or smothering growth habit? No] "Large herb or small shrub to 3 m tall..."
412	2000. Liogier, A.H./ Martorell, L.F.. Flora of Puerto Rico and adjacent islands: a systematic synopsis. La Editorial, UPR, San Juan, Puerto Rico	[Forms dense thickets? No evidence from Puerto Rico] "...collected as an escape in Toro Negro Mountains, Puerto Rico; ..."
412	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	[Forms dense thickets? No evidence from Costa Rica]
412	2010. Gardener, M.R./Atkinson, R./Renteria, J. L.. Eradications and People: Lessons from the Plant Eradication Program in Galapagos. Restoration Ecology. 18(1): 20-29.	[Forms dense thickets? No] "Solanum quitoense is widespread, at low densities and has naturalized, and so is unlikely to be eradicated." [No evidence from Galapagos, where it is being controlled]
501	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Aquatic? No] "Large herb or small shrub to 3 m tall..." [Terrestrial]
502	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Grass? No] Solanaceae
503	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Nitrogen fixing woody plant? No] Solanaceae
504	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. Annals of the Missouri Botanical Garden. 60: 573-780.	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Large herb or small shrub to 3 m tall; twigs stout, tomentose with long-armed, multangulate hairs on long, multiseriate stalks and armed with short or long, stout, flattened, yellowish spines."
601	2007. Almanza Fandiño, M.T.. Management of <i>Bombus atratus</i> bumblebees to pollinate Lulo (<i>Solanum quitoense</i> L), a native fruit from the Andes of Colombia. Cuvillier Verlag, Göttingen	[Evidence of substantial reproductive failure in native habitat? No] No evidence
602	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Produces viable seed? Yes] "The naranjilla can be propagated by air layering or by cuttings of mature wood. In Latin America, it is commonly grown from seeds which must first be spread out in the shade to ferment slightly to eliminate the mucilage, then washed, air-dried, and dusted with fungicide."
603	1972. Heiser, Jr., C.B.. The Relationships of the Naranjilla, <i>Solanum quitoense</i> . Biotropica. 4(2): 77-84.	[Hybridizes naturally? Possibly Yes] "A study of morphology and crossing behavior was made with <i>Solanum hirtum</i> , <i>S. hirsutissimum</i> , <i>S. pseudolulo</i> , <i>S. quitoense</i> , <i>S. tequilense</i> , <i>S. topiro</i> (two varieties), and <i>S. vestissimum</i> . <i>Solanum quitoense</i> , the "naranjilla" or "lulo," and <i>S. topiro</i> var. <i>topiro</i> , the "cocona" or "topiro," are cultivated for their edible fruits; the others are all wild species. Crosses have been attempted between the species in all possible combinations; four were successful. Hybrids between <i>S. tequilense</i> and <i>S. topiro</i> show considerable sterility and meiotic irregularities. Hybrids of <i>S. quitoense</i> with <i>S. hirtum</i> , <i>S. tequilense</i> , and <i>S. vestissimum</i> show slight reductions in fertility and have a normal meiosis. The hybrids were obtained most readily with <i>S. hirtum</i> ; those with <i>S. vestissimum</i> were obtained only through embryo culture. Fertile intraspecific hybrids were obtained between different accessions of <i>S. pseudolulo</i> , <i>S. quitoense</i> , <i>S. tequilense</i> , and the two varieties of <i>S. topiro</i> . No fruits were secured in crosses between the accessions of <i>S. hirtum</i> from Costa Rica and Trinidad. A numerical taxonomic analysis was carried out to study relationships. <i>Solanum tequilense</i> proved to be the species most similar to <i>S. quitoense</i> ."

604	1981. Whalen, M.D./Anderson, G.J.. Distribution of Gametophytic Self-Incompatibility and Infrageneric Classification in Solanum. <i>Taxon</i> 30(4): 761-767. 30(4): 761-767.	[Self-compatible or apomictic? Yes] "Table 1. Taxonomic distribution of compatibility systems in Solanum." ... "S. quitoense Lam = ;S C = self-compatible"
604	2007. Almanza Fandiño, M.T.. Management of <i>Bombus atratus</i> bumblebees to pollinate Lulo (<i>Solanum quitoense</i> L), a native fruit from the Andes of Colombia. Cuvillier Verlag, Göttingen	[Self-compatible or apomictic? Yes] "Second, hand-pollination assays show that <i>S. quitoense</i> is self-compatible. This is a common trait shared by species from the <i>Leptostemonum</i> subgenus to which <i>S. quitoense</i> belongs (Whalen and Costich 1986). However, fruits obtained from cross-pollination treatment show significantly more seeds than with geitonogamy and self-pollination, thus showing that exogamy is advantageous even though self-compatibility is possible."
605	2007. Almanza Fandiño, M.T.. Management of <i>Bombus atratus</i> bumblebees to pollinate Lulo (<i>Solanum quitoense</i> L), a native fruit from the Andes of Colombia. Cuvillier Verlag, Göttingen	[Requires specialist pollinators? Possibly] "Because pollen is enclosed in the poricidal anthers and can only be liberated through vibrations, the flower of <i>S. quitoense</i> is classified as buzz pollinated." [Introduced carpenter bees may serve as pollinators in the Hawaiian Islands]
606	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Reproduction by vegetative fragmentation? No] "The naranjilla can be propagated by air layering or by cuttings of mature wood. In Latin America, it is commonly grown from seeds which must first be spread out in the shade to ferment slightly to eliminate the mucilage, then washed, air-dried, and dusted with fungicide."
607	1987. Morton, J.F.. Fruits of warm climates - Naranjilla (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Minimum generative time (years)? 1] "Fruiting begins 10 to 12 months from seed and is continuous for 3 years in Panama. When the plants reach 4 years of age, productivity declines and they begin to die. In Costa Rica, they are said to bear until 4 to 7 years old. Grafted plants begin to bear about 1 year from planting in the field. In Florida, they continue fruiting for 2 years, then they die back and are replaced by young ones."
701	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules likely to be dispersed unintentionally? Unlikely] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular discoid, scrobiculate, with narrow but distinct wings, 3-4 mm across overall." ... "This species is cultivated in crop fashion in the Chiriqui mountains for the juice of its fruits, but at the present time (1972) it must be ranked as a minor or experimental crop. Most Panamanian collections are presumed to be escapes from cultivation. It may be persistent in areas of frequent disturbance" [Fruits & seeds lack a means of external attachment. Distribution suggests movement is intentional, or aided by animals]
702	1972. Heiser, Jr., C.B.. The Relationships of the Naranjilla, <i>Solanum quitoense</i> . <i>Biotropica</i> . 4(2): 77-84.	[Propagules dispersed intentionally by people? Yes] " <i>Solanum quitoense</i> , known under the common names of "naranjilla" and "lulo," is an old cultivated plant of Colombia and Ecuador (Patiño 1963), and in recent years it has become cultivated in parts of Central America. The plant is grown for its fruits, used to prepare beverages and desserts, which are much esteemed in the northern Andean region"
702	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Propagules dispersed intentionally by people? Yes] " <i>Solanum quitoense</i> Lamarck, Lulo or Naranjilla, is another South American fruit that appears in Hawaiian grocery stores."
703	1972. Heiser, Jr., C.B.. The Relationships of the Naranjilla, <i>Solanum quitoense</i> . <i>Biotropica</i> . 4(2): 77-84.	[Propagules likely to disperse as a produce contaminant? No] "The plant is grown for its fruits, used to prepare beverages and desserts, which are much esteemed in the northern Andean region" [No evidence. Because fruit are harvested as a product, they are unlikely to become a contaminant of other produce]
704	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules adapted to wind dispersal? No] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular-discoid, scrobiculate, with narrow but distinct wings, 3-4 mm across overall." [Despite wings, seeds are enclosed in a fleshy fruit and are adapted for animal dispersal]
705	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules water dispersed? No] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular-discoid, scrobiculate, with narrow but distinct wings, 3-4 mm across overall." [Although theoretically possible, fruit and seeds are adapted for consumption and internal dispersal]
706	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. Flora of Panama. Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules bird dispersed? Potentially Yes] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular-discoid, scrobiculate, with narrow but distinct wings, 3-4 mm across overall."

706	2007. Chiarini, F.E./Barboza., G.E.. Placentation patterns and seed number in fruits of South American <i>Solanum</i> subgen. <i>Leptostemonum</i> (Solanaceae) species. <i>Darwiniana</i> . 45(2): 163-174.	[Propagules bird dispersed? Yes] "On one hand, species with big, fleshy fruits (i.e. <i>S. alternatopinnatum</i> , <i>S. robustum</i> , <i>S. lycocarpum</i> , <i>S. quitoense</i>) would be adapted to be dispersed by large vertebrates, such as mammals or parrots."
707	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. <i>Flora of Panama</i> . Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules dispersed by other animals (externally)? No] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular-discoïd, scrobiculate, with narrow but distinct wings, 3-4 mm across overall." [Although theoretically possible, fruit and seeds lack an obvious means of external attachment and are adapted for consumption and internal dispersal]
708	1973. Woodson, Jr., R.E./Schery, R.W./D'Arcy, W.G.. <i>Flora of Panama</i> . Part IX. Family 170. Solanaceae. <i>Annals of the Missouri Botanical Garden</i> . 60: 573-780.	[Propagules survive passage through the gut? Presumably Yes] "Fruits large, to 6 cm across, a yellow-orange, juicy berry, glabrescent but scabridulous until maturity, the pericarp thin, 5-10 mm thick, enclosing large, many-seeded locules; seeds lenticular-discoïd, scrobiculate, with narrow but distinct wings, 3-4 mm across overall."
708	2007. Chiarini, F.E./Barboza., G.E.. Placentation patterns and seed number in fruits of South American <i>Solanum</i> subgen. <i>Leptostemonum</i> (Solanaceae) species. <i>Darwiniana</i> . 45(2): 163-174.	[Propagules survive passage through the gut? Presumably Yes] "On one hand, species with big, fleshy fruits (i.e. <i>S. alternatopinnatum</i> , <i>S. robustum</i> , <i>S. lycocarpum</i> , <i>S. quitoense</i>) would be adapted to be dispersed by large vertebrates, such as mammals or parrots."
801	1987. Morton, J.F.. <i>Fruits of warm climates - Naranjilla</i> (<i>Solanum quitoense</i>). J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/naranjilla_ars.html	[Prolific seed production (>1000/m ²)? Unknown, but possibly high seed production] "The fruit, crowned with the persistent, 5 pointed calyx, is round or round-ovate, to 2 1/2 in (6.25 cm) across and contains 4 compartments separated by membranous partitions and filled with translucent green or yellowish, very juicy, slightly acid to acid, pulp of delicious flavor which has been likened to pineapple-and-lemon. There are numerous pale-buff seeds, thin, flat, hard and 1/8 in (3 mm) in diameter." ... "A healthy plant bears 100 to 150 fruits a year. A good annual yield is 135 fruits–20 lbs (9 kg)–per plant." [Data are from cultivated plants. Unknown for wild individuals]
801	2007. Chiarini, F.E./Barboza., G.E.. Placentation patterns and seed number in fruits of South American <i>Solanum</i> subgen. <i>Leptostemonum</i> (Solanaceae) species. <i>Darwiniana</i> . 45(2): 163-174.	[Prolific seed production (>1000/m ²)? Yes] "The number of seeds per fruit ranges from 27 (<i>S. consimile</i>) to ca. 370 (<i>S. viarum</i>), exceptionally many more in <i>S. lycocarpum</i> (up to 600) or in <i>S. quitoense</i> (ca. 1400) (Table 1)."
802	2008. Royal Botanic Gardens Kew. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/	[Evidence that a persistent propagule bank is formed (>1 yr)? Unknown] "Storage Behaviour: Orthodox Storage Conditions: Long-term storage under IPGRI preferred conditions at RBG Kew, WP. Oldest collection 3 years" [Unknown from field conditions]
803	2003. Motooka, P./Castro, L./Nelson, D./Nagai, G./Ching, L.. <i>Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide</i> . CTAHR, UH Manoa, Honolulu, HI http://www.ctahr.hawaii.edu/invweed/weedsHi.html	[Well controlled by herbicides? Yes] " <i>Solanum torvum</i> ... Management: Sensitive to foliar applied triclopyr and soil applied tebuthiuron." ... " <i>Solanum linnaeanum</i> ... Sensitive to foliar-applied dicamba. Susceptible to soil-applied tebuthiuron at 2 lb/acre(48). Goats control apple-of-Sodom (An Peischel). Seedlings are easily killed by cultivation or pulling(61)." [No specific control methods found for <i>S. quitoense</i> , but other weedy <i>Solanum</i> species are sensitive to herbicides]
804	2012. WRA Specialist. Personal Communication.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Unknown]
805	2005. Staples, G.W./Herbst, D.R.. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Possibly] "Naranjilla may be suitable for cultivation in cool, moist areas of Hawaii, but it is susceptible to attack by root-knot nematode and other pests and has exacting climatic and cultural requirements."
805	2012. Bolay, J.-C./Schmid, A./Tejada, G./Hazboun, E.. <i>Technologies and Innovations for Development: Scientific Collaboration for a Sustainable Future</i> . Springer-Verlag, Paris	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Possibly] "The production of Lulo has been reported as a challenging task due to limited genetic diversity and the high incidence of pests and diseases affecting its healthy growth."