

Taxon: <i>Smallanthus sonchifolius</i> (Poepp.) H. Rob.	Family: Asteraceae
Common Name(s): aricama Bolivian sunroot earth apple strawberry jicama sweet root yacón yacon strawberry	Synonym(s): Polymnia edulis Wedd. Polymnia sonchifolia Poepp.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 1 Aug 2019
WRA Score: -1.0	Designation: L	Rating: Low Risk

Keywords: Perennial Herb, Naturalized, Edible Roots, Non-Seeding, Propagated Vegetatively

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	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		
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

Qsn #	Question	Answer Option	Answer
406	Host for recognized pests and pathogens		
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
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	y
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed		
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
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	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	National Research Council. 1989. Lost Crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. National Academy Press, Washington. D.C.	[Long history of cultivation, but no evidence that yacon has been highly domesticated] "Origin. Yacon grows wild in Colombia, Ecuador, and probably Peru, and it is commonly naturalized at medium altitudes in South America. It has been found in pre-Incan tombs in Peru, indicating a wide dispersal in early times."
	Dempewolf, H., Rieseberg, L. H., & Cronk, Q. C. (2008). Crop domestication in the Compositae: a family-wide trait assessment. Genetic Resources and Crop Evolution, 55(8), 1141-1157	[Semi-domesticated] "An additional five taxa were categorized as semi-domesticated: cardoon (<i>Cynara cardunculus</i> var. <i>altilis</i>), globe artichoke (<i>Cynara cardunculus</i> var. <i>scolymus</i>), noug (<i>Guizotia abyssinica</i>), Jerusalem artichoke (<i>Helianthus tuberosus</i>), and Yacon (<i>Smallanthus sonchifolius</i>)."
	Svobodová, E. et al. (2013). Genetic diversity of yacon (<i>Smallanthus sonchifolius</i> (Poepp. & Endl.) H. Robinson) and its wild relatives as revealed by ISSR markers. Biochemical Systematics and Ecology, 50, 383-389	[Some selection has occurred for cultivated yacon plants that distinguish them from wild relatives, but the plant has not been heavily domesticated] "In conclusion, all the <i>S. sonchifolius</i> accessions samples showed generally a very low genetic variability. This is probably because of the clonal way of propagation of yacon as well as due to the acquirement of the accessions samples in regions, where the plants from one country could have been easily replaced by those from another country, e.g. in the local markets. The wild relatives involved in the study remained separated from yacon. Their ability to flower and thus to propagate also in a generative way may be an important feature for future breeding of the plant. For now, the conservation of both wild and cultivated plants is highly recommended for the survival of such an important crop plant."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 31 Jul 2019]	"Native Southern America WESTERN SOUTH AMERICA: Bolivia, Colombia, Ecuador, Peru"

202	Quality of climate match data	High
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Qsn #	Question	Answer
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 31 Jul 2019]	

203	Broad climate suitability (environmental versatility)	Y
	Source(s)	Notes
	National Research Council. 1989. Lost Crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. National Academy Press, Washington. D.C.	"Daylength. The plant is daylength neutral for stem- and root-tuber formation, at least for some clones. Rainfall. The annual foliage and perennial underground stems make yacon adaptable to seasonal cycles of drought or cold. Altitude. Generally between 900–2,750 m in the Andes, but it has been grown at sea level in New Zealand and the United States and reported at elevations up to 3,500 m in Ecuador. Low Temperature. Although foliage is damaged or killed by frost, apparently the underground tissues are not affected unless frozen. High Temperature. Tolerant of a wide range of temperatures. Soil Type. Although it grows in a wide range of soil conditions, yacon does best in well-cultivated, rich, well-drained soil."
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon will grow in a range of climates (temperate and subtropical) and soils from sea level up to 3,200 m elevation. Optimal growth has been reported in temperatures ranging from 18 to 25 °C; aerial organs cannot withstand frost and sustain damage in temperatures below -1 °C. Mean annual rainfall of 800 mm or more is deemed optimum."

204	Native or naturalized in regions with tropical or subtropical climates	Y
	Source(s)	Notes
	Guézou, A., Trueman, M., Buddenhagen, C. E., Chamorro, S., Guerrero, A. M., Pozo, P., & Atkinson, R. (2010). An extensive alien plant inventory from the inhabited areas of Galapagos. PLoS One, 5(4), e10276	"Table S1 Complete list of the alien vascular plant taxa encountered in the inhabited areas of Galapagos." [Smallanthus sonchifolius - Cu Cultivated (introduced for cultivation, not naturalized)]
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is indigenous to the humid slopes of northern and central Andes from southern Columbia to northern Argentina. The area with the largest clone diversity extends from northern Bolivia to central Peru where native Quechua and Aymara names are used. Diversity of clones is more reduced in Ecuador. The plant has naturalized elsewhere in South America."

205	Does the species have a history of repeated introductions outside its natural range?	Y
	Source(s)	Notes

Qsn #	Question	Answer
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The plant has naturalized elsewhere in South America. It has become an important crop in Brazil especially in the state of Sao Paulo. It grows well in southern Australia, Tasmania and New Zealand, where the climate is mild and the growing season long. It has recently been introduced to the Philippines, Malaysia (Cameron Highlands), southern USA, Czech Republic, Russia, Taiwan, Korea and Japan and is now widely available in local markets."

301	Naturalized beyond native range	y
	Source(s)	Notes
	National Research Council. 1989. Lost Crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. National Academy Press, Washington. D.C.	"Origin. Yacon grows wild in Colombia, Ecuador, and probably Peru, and it is commonly naturalized at medium altitudes in South America. It has been found in pre-Incan tombs in Peru, indicating a wide dispersal in early times."
	Guézou, A., Trueman, M., Buddenhagen, C. E., Chamorro, S., Guerrero, A. M., Pozo, P., & Atkinson, R. (2010). An extensive alien plant inventory from the inhabited areas of Galapagos. PLoS One, 5(4), e10276	"Table S1 Complete list of the alien vascular plant taxa encountered in the inhabited areas of Galapagos." [Smallanthus sonchifolius - Cu) Cultivated (introduced for cultivation, not naturalized)]
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is indigenous to the humid slopes of northern and central Andes from southern Columbia to northern Argentina. The area with the largest clone diversity extends from northern Bolivia to central Peru where native Quechua and Aymara names are used. Diversity of clones is more reduced in Ecuador. The plant has naturalized elsewhere in South America."
	Wagner, W.L., Herbst, D.R. & Lorence, D.H. (2019). Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/ . [Accessed 31 Jul 2019]	No evidence in the Hawaiian Islands to date

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

303	Agricultural/forestry/horticultural weed	n
	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	

Qsn #	Question	Answer
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Cited as a weed. Unable to verify negative impacts] "Smallanthus uvedalius (L.) Mack. ex Small Asteraceae Synonym/s (n° of refs): Polymnia uvedalia (L.) L. (4) Total N° of Refs: 7 Preferred Climate/s: Tropical Major Pathway/s: Crop, Herbal References: United States of America-W- 1104, China-I-1769, China-W-1977."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[No evidence] "The yacon is an erect perennial herb, 1.5–2.5 m tall (Plate 1). The root system is composed of 4–20 fleshy tuberous, fusiform storage roots that can reach a length of 25 cm by 10 cm in diameter (Plates 5 and 6), with an extensive system of thin fibrous roots. The aerial stems are cylindrical or subangular, hollow at maturity with few branches in most cultivars or ramified in others, densely pubescent, green to purplish. Lower leaves are broadly ovate and hastate or subhastate, connate and auriculate at the base, densely pubescent (Plate 2). Upper leaves are deltoid and hastate to 33 cm long by 22 cm wide, dentate, densely pubescent, with lateral wings, connate and auriculate at the base. Lower and upper epidermises have trichomes (0.8–1.5 mm long, 0.05 mm diameter) and glands. Inflorescences are terminal, composed of 1–5 axes, each one with 3 capitula, peduncles densely pilose (Plate 3). Phyllaries 5, uniseriate and ovate, 15 mm long, 10 mm wide."

402	Allelopathic	
	Source(s)	Notes
	Morikawa, C. I. O., Miyaura, R., Tapia Y Figueroa, M. D. L., Rengifo Salgado, E. L., & Fujii, Y. 2012. Screening of 170 Peruvian plant species for allelopathic activity by using the Sandwich Method. Weed Biology and Management, 12 (1): 1-11	[Smallanthus sonchifolius evaluated and not found to inhibit radicle elongation] "A rate of inhibition of lettuce radicle elongation of between 80 and 100% was observed in six species, between 60 and 79% in 22 species, between 40 and 59% in 55 species, and between 20 and 39% in 55 species; the remaining species showed a level of inhibition of <19% and some of them showed no inhibition at all. As for the lettuce hypocotyl, the elongation was inhibited by >60% in only six species; that is, Aristeguietia ballii, Spondias mombin, Diplostegium foliosissimum, P. vulgaris (cv. Canario and cv. Ñuña), Nicotiana tabacum, and Lycopersicon peruvianum. The nine species for which bark was used showed a low inhibition rate of the lettuce radicle and hypocotyl."

Qsn #	Question	Answer
403	Parasitic	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The yacon is an erect perennial herb, 1.5–2.5 m tall" [Asteraceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Saeed, M. et al. (2017). Nutritional and healthical aspects of yacon (<i>smallanthus sonchifolius</i>) for human, animals and poultry. <i>International Journal of Pharmacology</i> , 13(4): 361-369	"Dietary yacon tuberous roots as well as leaves and stems showed positive effects on growth performance in cattle ²³ . In another study the effect of yacon and black maca's extract was investigated in diabetic mice which showed a positive effect on glycemic levels and male reproductive function." ... "The <i>Smallanthus sonchifolius</i> tuberous roots as well as leaves and stems could be used in the diet of cattle and other domestic animals to enhance their production performance ⁴⁹ ."
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	" <i>Smallanthus sonchifolius</i> (yacon) is a perennial plant mostly cultivated in South America, primarily for use of the tubers as a food crop and the leaves as fodder for livestock (Joung et al. 2010)."

Qsn #	Question	Answer
405	Toxic to animals	n
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Leaves antiseptic, stomachic"
	Gardenersworld.com. (2019). <i>Smallanthus sonchifolius</i> . https://www.gardenersworld.com/plants/smallanthus-sonchifolius/ . [Accessed 1 Aug 2019]	" <i>Smallanthus sonchifolius</i> has no toxic effects reported. No reported toxicity to: No reported toxicity to Birds No reported toxicity to Cats No reported toxicity to Dogs No reported toxicity to Horses No reported toxicity to Livestock No reported toxicity to people"
	Saeed, M. et al. (2017). Nutritional and healthical aspects of yacon (<i>smallanthus sonchifolius</i>) for human, animals and poultry. <i>International Journal of Pharmacology</i> , 13(4): 361-369	"The <i>Smallanthus sonchifolius</i> tuberous roots as well as leaves and stems could be used in the diet of cattle and other domestic animals to enhance their production performance ⁴⁹ . The tuberous roots of yacon similar to sweet potatoes have a much sweeter taste and crunchy flesh."
	Lim, T.K. 2015. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[Possibly after prolonged exposure to leaf extract] "A repeated-dose toxicity study in Wistar rats for 90 days found that renal damage was associated with increased blood glucose levels after prolonged oral administration of the yacon leaf extract (de Oliveira et al. (2011). This observation suggested that the hypoglycaemic effect observed after treatment for 30 days in an earlier study was reversible and was likely the result of renal injury caused by the toxicity of yacon. Sesquiterpene lactones were detected in both aqueous leaf tea infusion and leaf rinse extract, suggesting that these sesquiterpene lactones were the main toxic compounds in yacon leaves."

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Tudu, B., Barma, P., Patra, B., Baskey, S., & Gurung, S. (2017). Pests Spectrum of Yacon (<i>Smallanthus</i> spp: Asteraceae) - A Review. <i>Journal of Agroecology and Natural Resource Management</i> 4(3): 224-226	"Abstract—The detail information on pests spectrum of Yacon is meager. Pests reported from different Yacon growing parts of World which causes damage belongs to order Lepidoptera, Hemiptera, Thysanoptera, Coleoptera, Diptera, Orthoptera, Nematodes, Acarina and some vertebrate pests i.e. rodents and deer . Of which, <i>Mamestra brassicae</i> , <i>Sacropolia illoba</i> , <i>Spodoptera eridania</i> , <i>Chlosyne lacinia saundersii</i> , <i>Papilio</i> sp., <i>Platyptilia fatfarella</i> , <i>Agrotis ipsilon</i> , <i>Copitarsia turbata</i> , <i>Agriolimax</i> sp., Lopper caterpillar (Lepidoptera); <i>Liriomyza</i> sp.(Diptera); <i>Lagria villosa</i> , <i>Cerotoma arcuata</i> , <i>Diabrotica speciosa</i> , <i>Diabrotica</i> sp., <i>Golofa aegeon</i> , <i>Passalus</i> sp., (Coleoptera); <i>Aphis gossypii</i> , <i>Myzus persicae</i> , <i>Empoasca</i> sp., Sting bugs, white fly, (Hemiptera); <i>Schistocerca</i> sp. (Orthoptera); <i>Dasiprocta</i> (rodent); <i>Tetranychus ludeni</i> (Acarina) were reported to cause injury to the Yacon plants. The caterpillar <i>C. lacinia saundersii</i> , known as sunflower caterpillar and <i>Trialeurodes vaporariorum</i> were the most important species, being observed throughout the yacon cycle. The data base on pests i.e. seasonal occurrence, nature and symptoms of damage, management strategies of Yacon is weak. This is urgent for formulation of specific pest control strategies in Yacon."

Qsn #	Question	Answer
	Hermann, M. & Heller, J. (1997). Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon. International Plant Genetic Resources Institute, Rome, Italy	"In cloud forest areas, like the Cusco region, Peru, yacon crops are affected by a wide range of insects. However, natural control agents are present and effective (Lizarraga et al. 1997). Pest pressure is much lower in the dry intermontane valleys. In any case, control measures are not commonly used in the Andes. Table 5 lists some of the species associated with yacon. A few bacteria and fungi have been cited affecting the underground organs and stems of yacon. Fusarium in Peru (Lizarraga et al. 1997) and Erwinia chrysanthemi in Japan (Mizuno et al. 1993) have been identified as causal factors of wilting, while an unidentified rot affects the xylem of stems in Bolivia. Sclerotinia causes soft rot of the tuberous roots in Peru (Lizarraga et al. 1997). Alternaria has been found producing marginal necrosis of the leaves in Ayacucho, Peru (Barrantes 1988)."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Leaves antiseptic, stomachic"
	Gardenersworld.com. (2019). Smallanthus sonchifolius. https://www.gardenersworld.com/plants/smallanthus-sonchifolius/ . [Accessed]	"Smallanthus sonchifolius has no toxic effects reported. No reported toxicity to: No reported toxicity to Birds No reported toxicity to Cats No reported toxicity to Dogs No reported toxicity to Horses No reported toxicity to Livestock No reported toxicity to people"
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[Numerous edible uses, but allergic response reported from one person consuming yacon roots] "Yacon tubers are crisp and sweet tasting and can be eaten raw after peeling the skin; it has a texture and flavour described as a blend of apple and watermelon. In yacon producing countries, products made from yacon root includes flour, dehydrated products, slice or chips, juices, purees and sweeteners in the form of syrup or tea with high fructooligosaccharide (FOS), and yacon leaves are dried and used for tea (NRC 1989)." ... "A 55-year-old woman who developed syncope and generalised urticaria after ingesting yacon roots was reported by Yun et al. (2010). The patient had positive skin prick and intradermal tests to yacon extract. An open food challenge test was performed to confirm food anaphylaxis and was positive 10 minutes after the consumption of yacon roots."

Qsn #	Question	Answer
408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[No evidence. A perennial herb that grows in relatively wet, cool areas] "The native habitat of yacon is in areas with tropical montane climates between 1,800 and 2,800 m altitude. Although the mountain forests of central Peru and northern Bolivia are evergreen and supplied with abundant rainfall and mist during most of the year, they are subjected to a relatively dry winter period lasting 2–4 months."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Plants for a Future. (2019). Polymnia sonchifolia. https://pfaf.org/user/Plant.aspx?LatinName=Polymnia+sonchifolia . [Accessed 1 Aug 2019]	"It cannot grow in the shade."
	Dave's Garden. (2019). Peruvian Ground Apple, Yacon, Yacon - <i>Smallanthus sonchifolius</i> . https://davesgarden.com/guides . [Accessed 1 Aug 2019]	"Sun Exposure: Full Sun Sun to Partial Shade"
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon thrives best in light, deep, well-drained soils rich in organic matter and with neutral to slightly acidic pH."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	National Research Council. 1989. Lost Crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. National Academy Press, Washington. D.C.	"Soil Type. Although it grows in a wide range of soil conditions, yacon does best in well-cultivated, rich, well-drained soil."
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon will grow in a range of climates (temperate and subtropical) and soils from sea level up to 3,200 m elevation."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The yacon is an erect perennial herb, 1.5–2.5 m tall"

412	Forms dense thickets	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The native habitat of yacon is in areas with tropical montane climates between 1,800 and 2,800 m altitude."

Qsn #	Question	Answer
	National Research Council. 1989. Lost Crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. National Academy Press, Washington. D.C.	"Yacon grows wild in Colombia, Ecuador, and probably Peru, and it is commonly naturalized at medium altitudes in South America." [No evidence in this publication or in other published literature]

501	Aquatic	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[Terrestrial] "The native habitat of yacon is in areas with tropical montane climates between 1,800 and 2,800 m altitude. Although the mountain forests of central Peru and northern Bolivia are evergreen and supplied with abundant rainfall and mist during most of the year, they are subjected to a relatively dry winter period lasting 2–4 months."

502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 31 Jul 2019]	Asteraceae (alt.Compositae)

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 31 Jul 2019]	Asteraceae (alt.Compositae)

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The yacon is an erect perennial herb, 1.5–2.5 m tall (Plate 1). The root system is composed of 4–20 fleshy tuberous, fusiform storage roots that can reach a length of 25 cm by 10 cm in diameter (Plates 5 and 6), with an extensive system of thin fibrous roots."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes

Qsn #	Question	Answer
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[No evidence] "Yacon is indigenous to the humid slopes of northern and central Andes from southern Columbia to northern Argentina. The area with the largest clone diversity extends from northern Bolivia to central Peru where native Quechua and Aymara names are used. Diversity of clones is more reduced in Ecuador. The plant has naturalized elsewhere in South America. It has become an important crop in Brazil especially in the state of Sao Paulo. It grows well in southern Australia, Tasmania and New Zealand, where the climate is mild and the growing season long. It has recently been introduced to the Philippines, Malaysia (Cameron Highlands), southern USA, Czech Republic, Russia, Taiwan, Korea and Japan and is now widely available in local markets."

602	Produces viable seed	
	Source(s)	Notes
	Plants for a Future. (2019). Polymnia sonchifolia. https://pfaf.org/user/Plant.aspx?LatinName=Polymnia+sonchifolia . [Accessed 31 Jul 2019]	"Propagation. Seed - sow mid winter in a warm greenhouse and only just cover the seed[1]. Prick out the seedlings into individual pots as soon as they are large enough to handle and plant them out after the last expected frosts. Consider giving them some protection such as a cloche until they are growing away well. Plants do not usually produce flowers in Britain and therefore seed has to be obtained from other countries[K]."
	Douglas, J. A., Follett, J. M., & Waller, J. E. (2005). Effect of propagule weight on production of yacon (<i>Smallanthus sonchifolius</i>). <i>New Zealand Journal of Crop and Horticultural Science</i> , 33(2), 143-148	"The seed set of yacon is poor and mostly non-viable and consequently vegetative propagation is the main form of plant multiplication (Grau & Rea 1997)."
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed."
	Ashworth, S. 2002. Seed to Seed: Seed Saving and Growing Techniques for the Vegetable Gardener. Seed Savers Exchange, Decorah, Iowa	"Yacon plants are grown in the Andes Mountains of South America for their crunchy, sweet tubers. The plants are not daylength sensitive and will grow in the mild climate areas of the United States. Unfortunately, the small daisy-like yellow flowers rarely set seeds. Yacon is propagated from small offshoots and also from tuber cuttings."

Qsn #	Question	Answer
603	Hybridizes naturally	
	Source(s)	Notes
	Gurung, S. (2018). An Introduction to Ground Apple (<i>Smallanthus sonchifolius</i>): A Review. <i>International Journal of Genetics</i> , 10(4): 401-404	[Artificial hybrids possible] "Yacon has several close relatives that may be suitable for hybridization. Cross breeding with wild relatives may be particularly valuable because genetic analysis of yacon accessions have shown a low degree of variability between varieties [9]. Hybrids of yacon with <i>Smallanthus riparius</i> have probably already been achieved [10]. <i>Smallanthus macroscyphus</i> and <i>S. connatus</i> also seem promising for hybridization [11]. <i>S. connatus</i> , also known as yacon gaucho, is a wild South American relative of yacon that may be sufficiently compatible for hybridization."

604	Self-compatible or apomictic	
	Source(s)	Notes
	Hermann, M. & Heller, J. (1997). <i>Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon</i> . International Plant Genetic Resources Institute, Rome, Italy	"At present there are still many important gaps in the knowledge of yacon reproductive biology. Most perennial crops are outbreeders and this behaviour is also present in sunflower (<i>Helianthus annuus</i>) and topinambur (<i>Helianthus tuberosus</i>), two crop species in the same tribe as yacon. But there is no experimental report on the yacon mating system."
	Ibañez, M. S., Mercado, M. I., Aráoz, M. C., Zannier, M. L., Grau, A., & Ponessa, G. I. (2017). Flower structure and developmental stages of the capitulum of <i>Smallanthus sonchifolius</i> (Asteraceae): reproductive implications. <i>Journal of Plant Research</i> , 130(2), 327-337	"Manrique et al. (2014) made cross-pollinations between six accesions of yacon. They obtained 4.5% of filled seeds in one location and no seed in other locality, suggesting that this could be because of environmental conditions. Also, they suggested that a percentage of seeds obtained could be the result of self or cross-pollination before artificial crosses or by apomixis."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Lim, T.K. 2015. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Flowers are yellow to bright orange; ray flowers 13–15, with 2- or 3-toothed ligule, to 12 mm long by 7 mm broad, pistillate; and disc flowers about 60 or more, about 7 mm long, pubescent staminate"
	Mansilla, R., López, C., Flores, M., & Espejo, R. (2010). Estudios de la biología reproductiva en cinco accesiones de <i>Smallanthus sonchifolius</i> (Poepp. & Endl.) Robinson. <i>Ecología Aplicada</i> , 9(2), 167-175	"Taking into account its pollination habits, we consider that it is an insect dependant plant, as evident from insect attraction by the ray floret, the high frequency of visits and insect behavior. The high receptivity of the stigmas present during inflorescence development, contrasts with poor in vitro germination of pollen, few achenes with seeds and low seed viability."

606	Reproduction by vegetative fragmentation	
	Source(s)	Notes
	Lim, T.K. 2015. <i>Edible Medicinal And Non-Medicinal Plants</i> . Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation."

Qsn #	Question	Answer
	Hermann, M. & Heller, J. (1997). Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon. International Plant Genetic Resources Institute, Rome, Italy	[Propagated vegetatively. Unknown if natural vegetative spread occurs. No evidence found] "Yacon is propagated vegetatively with 8-12 cm long offsets ('seeds') taken from the underground and aboveground rootstock ('crown'), with a few or no roots attached. The rootstock can be divided into pieces easily, and these offsets are normally obtained during the harvesting of the roots. Storage roots with no stem attached are not able to produce shoots. Aerial stem cuttings can be easily rooted if protected from desiccation. Rooting is best under mist, and it can be significantly accelerated using auxins (Indol-butyric acid)."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Hermann, M. & Heller, J. (1997). Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon. International Plant Genetic Resources Institute, Rome, Italy	"In the Cajamarca region flowering begins 6-7 months and peaks 8-9 months after planting. But even in the areas where flowering is abundant, seed set is frequently poor or nonexistent and a high proportion of the seeds are non-viable or show low vigour." [Flowers in <1 year after planting, but rarely sets seeds]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [Lack of seed production reduces risk of inadvertent dispersal]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Wu, Z. Y., Raven, P. H. & Hong, D. Y., (eds.). 2011. Flora of China Volume 20-21 (Asteraceae). Science Press, Beijing & Missouri Botanical Garden Press, St. Louis	"Cultivated in Fujian, Guizhou, Hainan, Hebei, Hubei, Hunan, Shandong, Taiwan, Yunnan, and Zhejiang [native to South America (Bolivia, Colombia, Ecuador, Peru)]."
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The plant has naturalized elsewhere in South America. It has become an important crop in Brazil especially in the state of Sao Paulo. It grows well in southern Australia, Tasmania and New Zealand, where the climate is mild and the growing season long. It has recently been introduced to the Philippines, Malaysia (Cameron Highlands), southern USA, Czech Republic, Russia, Taiwan, Korea and Japan and is now widely available in local markets."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes

Qsn #	Question	Answer
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Immature cypselas are purple and turn dark brown or black at maturity." ... "Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

705	Propagules water dispersed	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Immature cypselas are purple and turn dark brown or black at maturity." ... "Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Immature cypselas are purple and turn dark brown or black at maturity." ... "Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Immature cypselas are purple and turn dark brown or black at maturity." ... "Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

Qsn #	Question	Answer
708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Immature cypselas are purple and turn dark brown or black at maturity." ... "Yacon is commonly propagated vegetatively from its fleshy rhizome by partitioning it into 6–14 propagules. Alternatively, nodal or stem cuttings can be rooted for vegetative propagation. Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed." [No evidence. Lack of seed production reduces risk of inadvertent dispersal]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Lim, T.K. 2015. Edible Medicinal And Non-Medicinal Plants. Volume 9, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Sexual reproduction of yacon is difficult because of the lack of fertile botanical seeds formed."
	Douglas, J. A., Follett, J. M., & Waller, J. E. (2005). Effect of propagule weight on production of yacon (<i>Smallanthus sonchifolius</i>). <i>New Zealand Journal of Crop and Horticultural Science</i> , 33(2), 143-148	"The seed set of yacon is poor and mostly non-viable and consequently vegetative propagation is the main form of plant multiplication (Grau & Rea 1997)."
	Ashworth, S. 2002. Seed to Seed: Seed Saving and Growing Techniques for the Vegetable Gardener. Seed Savers Exchange, Decorah, Iowa	"Unfortunately, the small daisy-like yellow flowers rarely set seeds. Yacon is propagated from small offshoots and also from tuber cuttings."

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Hermann, M. & Heller, J. (1997). <i>Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon</i> . International Plant Genetic Resources Institute, Rome, Italy	"It is also unknown whether yacon seeds are orthodox or recalcitrant." [But limited or lack of seed production would make it unlikely that any seed bank is formed]

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species, and no evidence that this species is being controlled using chemical methods

Qsn #	Question	Answer
804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Hermann, M. & Heller, J. (1997). Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon. International Plant Genetic Resources Institute, Rome, Italy	[Possibly, although storage roots without stems will not produce shoots] "Yacon is propagated vegetatively with 8-12 cm long offsets ('seeds') taken from the underground and aboveground rootstock ('crown'), with a few or no roots attached. The rootstock can be divided into pieces easily, and these offsets are normally obtained during the harvesting of the roots. Storage roots with no stem attached are not able to produce shoots."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability and elevation range, demonstrating environmental versatility
- Thrives in tropical climates
- Naturalized in South America (but no evidence in Hawaiian Islands to date)
- Tolerates many soil types
- Possesses tuberous roots (a geophyte)
- Reaches maturity in <1 year (but seed set is limited or absent)
- Dispersed intentionally by people

Low Risk Traits

- No reports of invasiveness or negative impacts outside native range
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock
- Cultivated for its edible roots
- Limited or absent seed set
- Lack of seed production reduces risk of accidental dispersal