

Taxon: <i>Actinidia deliciosa</i>	Family: Actinidiaceae
Common Name(s): Chinese gooseberry kiwi kiwifruit	Synonym(s): <i>A. chinensis</i> var. <i>deliciosa</i> (A. Chev.) <i>A. chinensis</i> var. <i>hispida</i> C. F. Liang <i>A. latifolia</i> var. <i>deliciosa</i> A. Chev.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 21 Jan 2015
WRA Score: 6.5	Designation: H(HPWRA)	Rating: High Risk

Keywords: Invasive, Liana, Horticultural Crop, Smothering, Bird-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
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	n
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)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
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		
405	Toxic to animals		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems		
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	y
412	Forms dense thickets		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
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	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed		
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/m ²)		
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	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	[Domestication has not prevented this species from naturalizing in parts of New Zealand] "The familiar green and hairy kiwifruit belongs to <i>A. deliciosa</i> . Until recently, <i>A. deliciosa</i> was treated as a variety of <i>A. chinensis</i> and was raised to species status only in 1984: prior to that date, most references in the literature to <i>A. chinensis</i> actually refer to what is now known as <i>A. deliciosa</i> ." ... "In most countries with commercial kiwifruit orchards, 'Hayward' (<i>A. deliciosa</i>) is the only fruiting cultivar grown and it has become the kiwifruit in the marketplace (Table A.2). Thus 'Hayward' currently accounts for about 75% of world kiwifruit production, 97.5% of kiwifruit production outside of China. It was originally selected because its fruit are large, have a good flavour and can be stored for extended periods while still remaining acceptable to consumers. The relative flowering times of 'Hayward' and its pollinators can vary according to climate so, although 'Hayward' is grown in many different countries, the accompanying males grown may vary from country to country."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2015. 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"	Low
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	" <i>Actinidia deliciosa</i> is a temperate species. In its native area, it occurs in the mountain forests at 800–1,400 m altitudes in Chongqing, Gansu, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Yunnan."

202	Quality of climate match data	High
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	

203	Broad climate suitability (environmental versatility)	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	[Grown in temperate to subtropical latitudes at an elevation range >1000 m, demonstrating some environmental versatility] "Actinidia deliciosa is a temperate species. In its native area, it occurs in the mountain forests at 800–1,400 m altitudes" ... "Elsewhere it is widely cultivated at altitudes of 600–2,000 m between latitudes 20° and 45° north and south. Kiwifruit is frost sensitive. Kiwifruit vines are killed by plunge in temperature below –1.67°C."

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"The species is native to China in the temperate provinces of Chongqing, Gansu, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Yunnan and Fukien and Zhejiang Province on the coast of eastern China." ... "Actinidia deliciosa is a temperate species. In its native area, it occurs in the mountain forests at 800–1,400 m altitudes in Chongqing, Gansu, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Yunnan."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Imada, C.T., Staples, G.W. & Herbst, D.R. 2005. Annotated Checklist of Cultivated Plants of Hawai'i. http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/ . [Accessed 20 Jan 2015]	"Actinidia deliciosa (A. Chevalier) C. F. Liang & A. R. Ferguson (Confirmed) Common Names: Chinese-gooseberry, Kiwi Misapplied Names: Actinidia chinensis First Collected: 1990 Locations: Maui Agricultural Research Center (Kula Experimental Farm) (Confirmed)"
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"It is cultivated extensively in New Zealand, USA and southern Europe."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Sullivan, J. J., Mather, J., & Stahel, W. (2007). Control of wild kiwifruit (<i>Actinidia</i> species) in Bay of Plenty, New Zealand. <i>Acta Horticulturae</i> , 753(2): 583	"A large population of wild kiwifruit, mostly <i>Actinidia deliciosa</i> , has grown in the Bay of Plenty region of New Zealand over the past 30 years, fueled by the increasing commercial success of kiwifruit production. This fast-growing non-native woody vine has invaded native forest and scrub and commercial <i>Pinus radiata</i> plantations. The environmental impacts of wild <i>Actinidia</i> have led it to be listed as a Total Control Pest Plant in the Environment Bay of Plenty Regional Pest Management Strategy."
	Howell, C. J., & Sawyer, J. W. (2006). New Zealand naturalised vascular plant checklist. New Zealand Plant Conservation Network, Wellington, NZ	"Actinidia deliciosa - Naturalised plant status = Fully naturalized"

Qsn #	Question	Answer
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	"All <i>Actinidia</i> species are perennial vines that fruit annually. Most naturalised or wild vines are <i>A. deliciosa</i> , but recently, wild <i>A. chinensis</i> and <i>A. arguta</i> , and the non-commercial species <i>A. eriantha</i> Benth. and <i>A. polygama</i> (Sieb. et Zucc.) Maxim., have been found growing wild."
	Wagner, W.L., Herbst, D.R. & Lorence, D.H. 2015. <i>Flora of the Hawaiian Islands</i> . Smithsonian Institution, Washington, D.C. http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/index.htm . [Accessed 21 Jan 2015]	No evidence in Hawaiian Islands to date

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. 2012. <i>A Global Compendium of Weeds</i> . 2nd Edition. Department of Agriculture and Food, Western Australia	Listed as an Environmental Weed. See 3.04

303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	Bay of Plenty Regional Council. 2012. Landowners urged to help halt spread of wild kiwifruit. Tuesday, 22 May 2012 10:45 a.m. http://www.boprc.govt.nz/news-centre/media-releases/media-releases-2012/may-2012/landowners-urged-to-help-halt-spread-of-wild-kiwifruit/ . [Accessed 21 Jan 2015]	[Impacts pine plantations and hosts diseases that impact cultivated kiwifruit] "Wild kiwifruit vines strangle and kill native bush and host trees such as pine trees." ... "Bay of Plenty Regional Council Group Manager Land Management Warwick Murray said wild kiwifruit vines are of concern because, as vigorous growers, they can smother large areas of bush and forest very quickly and can potentially be carriers of diseases such as PSA, which is currently imposing significant costs on the kiwifruit industry."

304	Environmental weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Sullivan, J. J., Mather, J., & Stahel, W. (2007). Control of wild kiwifruit (<i>Actinidia</i> species) in Bay of Plenty, New Zealand. <i>Acta Horticulturae</i>, 753(2): 583</p>	<p>"A large population of wild kiwifruit, mostly <i>Actinidia deliciosa</i>, has grown in the Bay of Plenty region of New Zealand over the past 30 years, fueled by the increasing commercial success of kiwifruit production. This fast-growing non-native woody vine has invaded native forest and scrub and commercial <i>Pinus radiata</i> plantations. The environmental impacts of wild <i>Actinidia</i> have led it to be listed as a Total Control Pest Plant in the Environment Bay of Plenty Regional Pest Management Strategy. Wild vines can be reliably killed with any of sprayed Tordon® Brushkiller (picloram/triclopyr), Grazon® (triclopyr) and stump treatment with Vigilant™ gel (picloram). \$NZ523,000 was spent from 1998 to 2005 on controlling wild <i>Actinidia</i> in the Bay of Plenty, funded by partnerships between the kiwifruit industry and Environment Bay of Plenty. The four control seasons of 2001/2002 through to 2004/2005 more than 21,000 vines have been killed. Similar control efforts each season have found progressively fewer vines (almost 6000 fewer vines in 2004/2005 than 2001/2002), indicating that the population is being successfully reduced. Between 67% and 96% of the pre-control population of established wild vines are estimated to have been removed. Sustained control over several more years will be required to reduce this population to an easily manageable size. This is complicated by continued recruitment into the wild population from commercial crops, principally via birds feeding on reject kiwifruit fed out to farm stock. We suggest that other countries that commercially propagate wild kiwifruit outside of its native range take care to prevent wild populations from establishing in surrounding vegetation. "</p>
	<p>Newstrom, L.E., Armstrong, T., Robertson, A. W., Lee, W. G., Heenan, P. B., Peltzer, D., Wilton, A. D., FitzJohn, R.G., Breitwieser, I. & Glenny, D. 2003. Environmental risks to the New Zealand flora from transgenic crops: the role of gene flow. <i>Landcare Research</i>, Lincoln, NZ</p>	<p>"An example of a crop that has escaped from cultivation while in New Zealand is the recently domesticated kiwifruit, <i>Actinidia deliciosa</i>, which demonstrates the process of naturalization leading to an environmental weed (Sullivan & Williams 2002 unpubl. report). Kiwifruit vines were introduced to New Zealand in 1904 but the first plant found in the wild was not discovered until 54 years later, a lag time typical of many naturalisations. Sullivan & Williams (2002) report that naturalised kiwifruit has become a serious environmental weed with high scores in the Department of Conservation's weed priority ranking system and the MAF's (Ministry of Agriculture and Forestry) NZ Weed Risk Assessment model."</p>
	<p>Bay of Plenty Regional Council. 2015. Case study - Many hands needed to control wild kiwifruit. http://www.boprc.govt.nz/environment/pest-management/case-study-many-hands-needed-to-control-wild-kiwifruit/. [Accessed 21 Jan 2015]</p>	<p>"Wild kiwifruit is spread predominantly by birds, rats and possums that have eaten waste fruit and transported many tiny seeds in their droppings, often across many kilometres. If left uncontrolled, wild kiwifruit forms a mound of tangled stems that can grow up and over trees, smothering and killing them. Without active control, areas of native bush would eventually disappear under a blanket of kiwifruit."</p>

Qsn #	Question	Answer
305	Congeneric weed	
	Source(s)	Notes
	Newstrom, L.E., Armstrong, T., Robertson, A. W., Lee, W. G., Heenan, P. B., Peltzer, D., Wilton, A. D., FitzJohn, R.G., Breitwieser, I. & Glenny, D. 2003. Environmental risks to the New Zealand flora from transgenic crops: the role of gene flow. Landcare Research, Lincoln, NZ	"Other kiwifruit species (<i>Actinidia arguta</i> and <i>A. polygama</i>) have also escaped, but are so recently introduced (1970s) that they have not had the time to spread or revert to the wild state."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	[No evidence] "A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith. Young branchlets and petioles are brownish and strigose. Leaves are alternate, suborbicular or obovate orbicular, 6–17 × 7–15 cm, base subcordate, margin setose-serrulate, apex truncate to emarginate to abruptly cuspidate, usually glabrous adaxially, occasionally puberulent, especially more densely so on midvein and lateral veins (Plate 2)."

402	Allelopathic	
	Source(s)	Notes
	Nakamura, Y., Umemiya, Y., Masuda, K., Inoue, H., Fujii, Y., & Moriguchi, T. 2004. Impact assessment of transgenic kiwifruit [<i>Actinidia deliciosa</i>] on allelopathic effect and soil microflora. Horticultural Research (Japan) 3(4)	[No evidence for transgenic kiwi fruit on lettuce sprouts] "The influences of transformed kiwifruit with glucanase or chitinase genes on the non-rhizosphere and rhizosphere soil were investigated to accumulate basic information in terms of allelopathic effects and soil microflora. When the allelopathic effects were evaluated using lettuce sprouts that are sensitive to allelopathic substances, there was no detectable difference in the growth of the lettuce sprouts with root and shoot tissue of both transformants and non-transformants. There was also no difference on the soil microflora of pot soil between transformants and non-transformants, in which the number of mold fungi, actinomycetes and bacteria in the nonrhizosphere and rhizosphere were not significantly different from transformants and non-transformants. Kanamycin-resistant bacteria were present in soils from both transformants and non-transformants. To identify the origin of kanamycin-resistance, PCR using primer combinations corresponding to transformant-specific marker genes were carried out. The results showed that the kanamycin-resistant bacteria were not due to horizontal gene transfer of transgenic from transformants to micro-organism, indicating that these bacteria were present in the soil regardless of transformants or non-transformants. Collectively, these results suggested that the influences of transformed kiwifruit with glucanase or chitinase genes on the non-rhizosphere and rhizosphere soil are substantially the same as those of non-transformants. "

Qsn #	Question	Answer
403	Parasitic	n
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith." [No evidence. Actinidiaceae]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	[Fruit palatable to animals] "On the farm: If reject fruit is being used for stockfeed, ensure piles of fruit are well covered with windbreak cloth or similar. Only feed out quantities of fruit from the stockpile which can be eaten quickly by the stock. This avoids large quantities of fruit being available for mass feeding by birds."
	WRA Specialist. 2015. Personal Communication	Palatability to grazing animals unknown

405	Toxic to animals	
	Source(s)	Notes
	Morton, J.F. 1987. Fruits of warm climates. J.F. Morton, Miami, FL	[Unknown if any negative effects occur with animals consuming fruit or other plant parts] "The hairs on the skin can cause throat irritation if ingested. It might be wise to avoid excessive consumption of raw kiwifruits until more is known of the body's reaction to actinidin."

Qsn #	Question	Answer
406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Similar types of pests occur on kiwifruit in the countries in which they are grown and all tend to be generalists affecting a broad range of plants. Armoured scales are generally the most serious but although the species involved are cosmopolitan, the abundance of a particular species varies according to country. The other main group of pests, the leafrollers, tend to be specific to each country and are therefore a quarantine problem as well as damaging the fruit. Nematodes are a problem in some countries. Kiwifruit are also susceptible to bacterial and fungal diseases. Pseudomonas species cause bacterial canker, bacterial necrosis and, potentially most serious, bacterial blossom blight. Sclerotinia can also affect fruit on the vine but the other serious fungal diseases are those that develop while the fruit is in storage (mainly Botrytis cinerea) or after the fruit is taken from storage (e.g. Botryosphaeria dothidea). When kiwifruit were domesticated, they were freed of many of the pests and diseases to which they are prone in China. However, as plantings have increased so too have the problems. Fortunately, the number of pests on kiwifruit is still fairly limited and they can be well controlled by integrated pest management systems. Organic production is realistic."
	Bay of Plenty Regional Council. 2015. Case study - Many hands needed to control wild kiwifruit. http://www.boprc.govt.nz/environment/pest-management/case-study-many-hands-needed-to-control-wild-kiwifruit/ . [Accessed 21 Jan 2015]	"The ten-year collaboration between the Regional Council and New Zealand Kiwifruit Growers Inc. (NZKGI) has led to a significant reduction in wild kiwifruit in the Bay of Plenty. With the emergence of kiwifruit vine disease Psa (Pseudomonas syringae pv. Actinidiae) in the region, control of wild kiwifruit that may host the disease is even more important."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Morton, J.F. 1987. Fruits of warm climates. J.F. Morton, Miami, FL	"The hairs on the skin can cause throat irritation if ingested. It might be wise to avoid excessive consumption of raw kiwifruits until more is known of the body's reaction to actinidin."
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	[Possibly Yes to susceptible individuals] "On the down side, kiwi fruit can cause allergy and its oxalate content is an antinutrient. Allergy to kiwi fruit was first described in 1981, and there have since been reports of the allergy presenting a wide range of symptoms from localized oral allergy syndrome (OAS) to life-threatening anaphylaxis (Lucas et al. 2003)."

Qsn #	Question	Answer
408	Creates a fire hazard in natural ecosystems	
	Source(s)	Notes
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	[Unlikely. Does not occur in fire prone habitats] "In the Bay of Plenty, wild <i>A. deliciosa</i> has often been found growing near streams and tree-fall gaps in native and exotic forests (Sullivan and Williams, 2002; J. Mather, Environment Bay of Plenty, Mt. Maunganui, pers. comm.). In China, wild kiwifruit generally grow in relatively damp conditions, often at the edge of clearings and streams,,,"

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits.</i> Springer, New York	"The vine does best in full sun although young vines require partial shade."
	Janick, J.& Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts.</i> CABI Publishing, Wallingford, UK	"Wild <i>A. chinensis</i> and <i>A. deliciosa</i> occur mostly on steep hills and mountain slopes. They grow in relatively damp and sheltered areas and are seldom found where there is little shade or moisture or where they are exposed to strong winds. Young plants in particular do best in shade but sun is required for fruiting."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Morton, J.F. 1987. <i>Fruits of warm climates.</i> J.F. Morton, Miami, FL	"For good growth, the vine needs deep, fertile, moist but well-drained soil, preferably a friable, sandy loam. Heavy soils subject to water logging are completely unsuitable. In Kiangsi Province, China, the wild plants flourish in a shallow layer of "black wood earth" on top of stony, red subsoil."
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits.</i> Springer, New York	"Kiwifruit performs best in deep, fertile, moist but well-drained soil, preferably a friable, sandy loam. Heavy soils subject to water logging are completely unsuitable. In Kiangsi Province, China, the plants flourish in a shallow layer of 'black wood earth' on top of stony, red subsoil."

411	Climbing or smothering growth habit	y
	Source(s)	Notes
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits.</i> Springer, New York	"A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith."
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	"Wild kiwifruit rapidly forms a dense, heavy blanket of growth which smothers and eventually kills, or topples, trees and shrubs beneath. It's a significant threat to native bush and forestry."

412	Forms dense thickets	
	Source(s)	Notes

Qsn #	Question	Answer
	Bay of Plenty Regional Council. 2015. Case study - Many hands needed to control wild kiwifruit. http://www.boprc.govt.nz/environment/pest-management/case-study-many-hands-needed-to-control-wild-kiwifruit/ . [Accessed 21 Jan 2015]	[Climbing & smothering. Unknown if plants also form dense stands which exclude other vegetation and/or impede movement] "If left uncontrolled, wild kiwifruit forms a mound of tangled stems that can grow up and over trees, smothering and killing them. Without active control, areas of native bush would eventually disappear under a blanket of kiwifruit."

501	Aquatic	n
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	[Terrestrial] "Wild <i>A. chinensis</i> and <i>A. deliciosa</i> occur mostly on steep hills and mountain slopes."

502	Grass	n
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith." [Actinidiaceae]

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith." [Actinidiaceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	"Kiwifruit are vigorous vines which, in the wild, can grow to the tops of trees, 5–6 m high." [No evidence]

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. The Encyclopedia of Fruit & Nuts. CABI Publishing, Wallingford, UK	[No evidence] " <i>Actinidia chinensis</i> and <i>A. deliciosa</i> are widespread in China and appreciable quantities of fruit (100,000–150,000 t) are collected from the wild each year. About two-thirds of this is of <i>A. chinensis</i> , one-third of <i>A. deliciosa</i> ..."

602	Produces viable seed	y
	Source(s)	Notes
	Morton, J.F. 1987. Fruits of warm climates. J.F. Morton, Miami, FL	"Inasmuch as seedlings show great variation, it is not recommended that the vine be grown from seed except in experimental plots for clone selection or to produce rootstocks for budding or grafting. To obtain the small seeds, ripe fruits are pulped in an electric blender and then the pulp is strained through a fine screen."

Qsn #	Question	Answer
	Lim, T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	"The flesh is firm until fully ripe, juicy, sweet to subacid, bright-green with white, succulent center surrounded by numerous tiny, purplish-black seeds"

603	Hybridizes naturally	
	Source(s)	Notes
	Liu, Y., Liu, Y., & Huang, H. 2010. Genetic variation and natural hybridization among sympatric <i>Actinidia</i> species and the implications for introgression breeding of kiwifruit. <i>Tree Genetics & Genomes</i> , 6(5): 801-813	[Possibly occurred in the past. Unknown if natural hybridization currently occurs] "For example, <i>A. chinensis</i> generally occur in the central-eastern China with an altitude range of 200–1,900 m whereas <i>A. deliciosa</i> is colder hardy distributing in central-western China and the distribution upper limit can reach altitude 2,000 m (Cui et al. 2002). Therefore, gene flow occurring in geographical proximity suggests the presence of hybridization through secondary contact of the two species, albeit possibly in combination with some level of ancestral polymorphism." ... "For example, the numerous hybrids or introgressed lineages of <i>A. chinensis</i> and <i>A. deliciosa</i> detected in the HX, SN, WF, and ZY populations are new pools with different levels of variation, termed "hybrid swarms." They are enriched with diverse genetic compositions, together with improved or new adaptive or morphological attributes. Thus, for kiwifruit that have been subjected to little selection pressure and are still similar to wild-type plants (Ferguson 2007), introgression breeding is a process to directly select the materials that contain the desirable traits from these hybrid zones. Our study thus provides the first step to understand the genetic basis and gene flow dynamics of sympatric <i>Actinidia</i> species in the wild and gives a model system for further studying the theoretical basis and methodologies of introgression breeding for fruit trees."

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	"All <i>Actinidia</i> species are functionally dioecious: flowers of pistillate kiwifruit may look perfect but the pollen produced is non-viable; staminate plants produce viable pollen but have only a vestigial ovary and poorly developed styles."
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants</i> . Volume 1, Fruits. Springer, New York	[Dioecious] "A vigorous, climbing, woody, deciduous, dioecious vine with whitish to brown, large, lamellate pith." ... "Inflorescences are cymose, 1-3-flowered, white silky-tomentose or yellowish brown, velutinous. Flowers are unisexual, orangeyellow on brown-villous pedicels. Sepals usually 5, persistent, broadly ovate to oblong-ovate, both surfaces densely yellowish tomentose. Petals usually 5, broadly obovate, shortly clawed at base, rounded at apex; stamens numerous with yellow, oblong anthers, ovary superior, globose, golden-strigose, styles free."

605	Requires specialist pollinators	n
	Source(s)	Notes

Qsn #	Question	Answer
	Miñarro, M., & Twizell, K. W. 2014. Pollination services provided by wild insects to kiwifruit (<i>Actinidia deliciosa</i>). <i>Apidologie</i> , 1-10. DOI: 10.1007/s13592-014-0321-2	"Abstract – Managed bees are used to transfer pollen from male to female flowers in kiwifruit, but the contribution of wild insects has been long overlooked. We approached such contribution with multiple criteria (pollinator abundance, foraging behavior, pollinating efficiency, and response to weather conditions) in the absence of imported colonies. An abundant and rich community of pollinators (57% were non- <i>Apis</i> insects) visited kiwifruit flowers and assured a fruit set and size not different from those obtained by optimal hand pollination. Honeybees were more abundant and visited more flowers per time but bumblebees were more efficient on a per visit basis. Other taxa are expected to contribute less because of their lower numbers (hoverflies, wild bees, butterflies, beetles) or their passive behavior (non-syrphid flies). Visitation patterns of pollinators were complementary. Our results highlight the important contribution of wild insects to the pollination of kiwifruit." ... "Kiwifruit is dioecious, and insects are needed to transfer pollen from male to female vines because wind pollination is insufficient for a successful kiwifruit yield (Donovan and Read 1990; Costa et al. 1993; Vaissiere et al. 1996; González et al. 1998; Howpage et al. 2001; Pomeroy and Fisher 2002)."
	Janick, J.& Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	"Most pollen transfer is effected by honeybees which are brought into the orchard as female vines start flowering. Kiwifruit flowers are not particularly attractive to bees and many aspects of orchard layout and management are designed to keep bees working, thereby ensuring good pollination. Mechanical pollination, using pollen collected from male vines, is sometimes used to supplement natural pollination."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	[Only documented spreading from seed] "How does it spread? Seed is spread by birds, especially waxeyes, eating the fruit left on vines in orchards. It's also spread by humans dropping fruit remains. Many plants spread from reject fruit being transported and dumped for use as stockfood."

607	Minimum generative time (years)	3
	Source(s)	Notes
	Janick, J.& Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	[3+ years] "Flowers are borne either singly (as in most female cultivars) or in small inflorescences of five to seven flowers (as in most male cultivars). In general, vines do not flower until 3 or 4 years old, but <i>A. chinensis</i> is noticeably more precocious than <i>A. deliciosa</i> ."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes

Qsn #	Question	Answer
	Bay of Plenty Regional Council. 2012. Landowners urged to help halt spread of wild kiwifruit. Tuesday, 22 May 2012 10:45 a.m. http://www.boprc.govt.nz/news-centre/media-releases/media-releases-2012/may-2012/landowners-urged-to-help-halt-spread-of-wild-kiwifruit/ . [Accessed 21 Jan 2015]	"Members of the public: - Be careful with the disposal of kiwifruit, particularly while out in the bush. - Keep an eye out for wild kiwifruit and call Bay of Plenty Regional Council on 0800 884 880 and ask to speak to a biosecurity officer if you suspect you have seen a wild kiwifruit vine."
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	"Seed is spread by birds, especially waxeyes, eating the fruit left on vines in orchards. It's also spread by humans dropping fruit remains. Many plants spread from reject fruit being transported and dumped for use as stockfood."
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	[Rare, but possible in dumped garden waste or cuttings] "Kiwifruit are thought to have become naturalised after dumping of vines, vine prunings and reject fruit and by dispersal of kiwifruit seed by birds and other frugivores (Sullivan and Williams, 2002)." ... "Dumping reject fruit and prunings in bush in the Bay of Plenty is probably now rare but dispersal of seed is likely to remain an on-going source of new plants."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants</i> . Volume 1, Fruits. Springer, New York	"It is cultivated extensively in New Zealand, USA and southern Europe."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	[No evidence] "Seed is spread by birds, especially waxeyes, eating the fruit left on vines in orchards. It's also spread by humans dropping fruit remains. Many plants spread from reject fruit being transported and dumped for use as stockfood."

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Lim, T.K. 2012. <i>Edible Medicinal and Non-Medicinal Plants</i> . Volume 1, Fruits. Springer, New York	[No evidence. Fleshy-fruited] "Fruit is subglobose to cylindrical or ovoid, 5–6 cm, densely hispid even when mature. The flesh is firm until fully ripe, juicy, sweet to subacid, bright-green with white, succulent center surrounded by numerous tiny, purplish-black seeds"

705	Propagules water dispersed	
	Source(s)	Notes

Qsn #	Question	Answer
	Wildland Consultants. 2010. State of the Environment Assessment for the Catchments of the Kaimai Range and Northern Mamaku Plateau. Report No. 2075. Crown Copyright: Department of Conservation Te Papa Atawhai, Environment Bay of Plenty, Environment Waikato	[Actinidia fruits primarily adapted for dispersal by frugivores, but distribution at lower end of forest gullies suggests some secondary dispersal by water may be occurring] "The general pattern of weed invasion is replicated in gully remnants throughout the Tauranga Harbour catchment. At the lower end of forested gullies heavy infestations of weeds including Chinese privet (<i>Ligustrum sinense</i>), tree privet (<i>Ligustrum lucidum</i>), kiwifruit (<i>Actinidia deliciosa</i>), and Taiwan cherry (<i>Prunus campanulata</i>) have become numerically dominant and have replaced indigenous vegetation in some places. Further up gullies, the edges may be heavily invaded in places but they retain intact indigenous canopies (Wildland Consultants 2008). In upper catchments, the level of weed invasion around forest edges is generally low."

706	Propagules bird dispersed	y
	Source(s)	Notes
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	"Abstract: Silvereyes, <i>Zosterops lateralis</i> Latham, commonly feed on kiwifruit rejected for export and either stored in open bins at packhouses or in piles ready to be fed to livestock, and may play a role in the spread of wild kiwifruit in native and exotic forest in the Bay of Plenty, New Zealand. We determined the germination rate and percentage germination of <i>Actinidia chinensis</i> Planch. seed sown (1) after gut passage through silvereyes, (ingested seed), (2) after a standard laboratory fruit pulp removal method (enzyme-extracted seed), (3) as entire fruit and (4) as fruit sections. Ingested and enzyme-extracted seed sown in trays in a glasshouse had nearly identical percentage germination (63.7% and 64.7% respectively) after 71 days. No seed germinated from intact fruit or fruit slices during the experiment. Gut-passage accelerated the germination rate compared with enzyme-extracted seed. This study supports the view that <i>Z. lateralis</i> is involved in dispersing kiwifruit seed into native and exotic forest."
	Sullivan, J. J., Mather, J., & Stahel, W. (2007). Control of wild kiwifruit (<i>Actinidia</i> species) in Bay of Plenty, New Zealand. <i>Acta Horticulturae</i> , 753(2): 583	"Sustained control over several more years will be required to reduce this population to an easily manageable size. This is complicated by continued recruitment into the wild population from commercial crops, principally via birds feeding on reject kiwifruit fed out to farm stock."
	Janick, J. & Paull, R.E. 2008. <i>The Encyclopedia of Fruit & Nuts</i> . CABI Publishing, Wallingford, UK	"The fruit is a berry with many small seeds embedded in the juicy flesh"

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Bay of Plenty Regional Council. 2015. Case study - Many hands needed to control wild kiwifruit. http://www.boprc.govt.nz/environment/pest-management/case-study-many-hands-needed-to-control-wild-kiwifruit/ . [Accessed 21 Jan 2015]	[Seeds presumably internally dispersed] "Wild kiwifruit is spread predominantly by birds, rats and possums that have eaten waste fruit and transported many tiny seeds in their droppings, often across many kilometres."

708	Propagules survive passage through the gut	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	"Gut-passage accelerated the germination rate compared with enzyme-extracted seed. This study supports the view that <i>Z. lateralis</i> is involved in dispersing kiwifruit seed into native and exotic forest."
	Bay of Plenty Regional Council. 2015. Case study - Many hands needed to control wild kiwifruit. http://www.boprc.govt.nz/environment/pest-management/case-study-many-hands-needed-to-control-wild-kiwifruit/ . [Accessed 21 Jan 2015]	"Wild kiwifruit is spread predominantly by birds, rats and possums that have eaten waste fruit and transported many tiny seeds in their droppings, often across many kilometres."

801	Prolific seed production (>1000/m ²)	
	Source(s)	Notes
	Bay of Plenty Regional Council. 2012. Landowners urged to help halt spread of wild kiwifruit. Tuesday, 22 May 2012 10:45 a.m. http://www.boprc.govt.nz/news-centre/media-releases/media-releases-2012/may-2012/landowners-urged-to-help-halt-spread-of-wild-kiwifruit/ . [Accessed 21 Jan 2015]	[Possibly] "A single kiwifruit contains about 1000 seeds. Half of those have the potential to produce a growing vine. When you consider that one 30-year-old vine can smother 1000 square metres of native bush, then you begin to comprehend the potential for problems."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Newstrom, L.E., Armstrong, T., Robertson, A. W., Lee, W. G., Heenan, P. B., Peltzer, D., Wilton, A. D., FitzJohn, R.G., Breitwieser, I. & Glenny, D. 2003. Environmental risks to the New Zealand flora from transgenic crops: the role of gene flow. Landcare Research, Lincoln, NZ	"It has a short-lived seed bank (3–5 years) and late age to reproduction (5 years) making control options practical for some areas, but monitoring will be needed to detect new populations."
	Overdyck, E. 2014. Thresholds for sustainable regeneration in urban restoration plantings in Hamilton City, New Zealand (Doctoral dissertation, University of Waikato, Hamilton, New Zealand)	"The smothering lianes <i>Lonicera japonica</i> and <i>Hedera helix</i> were widespread in seed rain, while <i>Leycesteria formosa</i> , <i>Rubus fruticosus</i> and <i>Actinidia deliciosa</i> were found to form persistent soil seed banks – the former two able to produce dense stands impenetrable to native species (McQueen 1993) and the latter able to invade closed-canopy forest (Sullivan et al. 2007)."
	Logan, D. P., & Xu, X. 2006. Germination of kiwifruit, <i>Actinidia chinensis</i> , after passage through Silvereyes, <i>Zosterops lateralis</i> . <i>New Zealand Journal of Ecology</i> , 30(3): 407-411	[Possibly] "There is some evidence that kiwifruit seed can remain dormant and germinate several years after development (Sullivan and Williams, 2002; Kasperek, 2003), but this needs to be confirmed by studies of the relative size and longevity of kiwifruit seedbanks."

Qsn #	Question	Answer
803	Well controlled by herbicides	y
	Source(s)	Notes
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	"Spraying: Individual vines are often difficult to trace to the roots in which case spraying is an effective treatment. Spray from November to March with brushkiller (e.g. Tordon Brushkiller, Agpro Tricloram brushkiller) With knapsack or CDAX unit use 60 ml per 10 L of water. With handgun use 600 ml per 100 L of water."
	Sullivan, J. J., Mather, J., & Stahel, W. (2007). Control of wild kiwifruit (<i>Actinidia</i> species) in Bay of Plenty, New Zealand. <i>Acta Horticulturae</i> , 753(2): 583	"Wild vines can be reliably killed with any of sprayed Tordon® Brushkiller (picloram/triclopyr), Grazon® (triclopyr) and stump treatment with Vigilant™ gel (picloram)."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Bay of Plenty Regional Council. 2013. Wild kiwifruit <i>Actinidia</i> spp. Pest Plant Control 18. http://www.boprc.govt.nz/media/321627/PP18-Wild-kiwifruit.pdf . [Accessed 21 Jan 2015]	[Recommendations to treat stumps with herbicide indicates plants will likely resprout if cut back to the stump] "Stump treatment: Use from November to March where vine stems are easy to find. Where they are growing into tall trees, this is the best method. Cut the vines close to the ground. Use Vigilant gel. Apply a blob of gel to the freshly cut surface.

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	Unknown. No native or naturalized (to date) Actinidiaceae present in the Hawaiian Islands

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m in temperate, demonstrating environmental versatility (May only pose a threat to higher elevations in tropical island ecosystems)
- Naturalized in New Zealand
- Invades native forest & forest plantations
- Hairs on fruit may cause throat irritation & some people may be allergic to fruit
- Shade tolerant
- Smothers native vegetation and plantation trees
- Seeds dispersed by birds & intentionally & accidentally by people
- Seeds may form a persistent seed bank
- Able to resprout after cutting to stump (may require herbicide treatment)

Low Risk Traits

- A temperate species that may only threaten higher elevations of tropical island ecosystems
- Unarmed (no spines, thorns or burrs)
- Important commercial crop for edible fruit
- Dioecious
- Not reported to spread vegetatively
- Requires 3+ years to reach maturity