

Taxon: *Raphanus sativus L. var. oleiformis Pers.*

Family: Brassicaceae

Common Name(s): fodder radish
oil radish

Synonym(s): *Raphanus sativus var. oleiferus Stokes*

Assessor: Chuck Chimera

Status: Assessor Approved

End Date: 5 Jun 2017

WRA Score: 7.0

Designation: H(HPWRA)

Rating: High Risk

Keywords: Cover Crop, Crop Weed, Annual, Fodder, Self-incompatible

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	y
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?	y=1, n=-1	y
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)	Intermediate
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
203	Broad climate suitability (environmental versatility)	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates		
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		
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)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals		
406	Host for recognized pests and pathogens	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
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	y
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	1
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		
704	Propagules adapted to wind dispersal		
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
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?	y
	Source(s)	Notes
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 3. Springer-Verlag, Berlin, Heidelberg, New York	"This old and world-wide cultivated oil, vegetable and forage crop is extremely variable; there is a vast literature on its variation and infraspecific classification." ... "As centre of the domestication of the species the E-Mediterranean region and adjacent Near East had been proposed." ... "Since long times cultivated as seed oil crop in E Asia, Egypt, perhaps also in India, since the 19th cent. also in some European countries."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Species naturalized. Not necessarily referring to fodder radish] "Raphanus sativus" ... "Native to Eurasia, now widely naturalized especially in temperate regions; in Hawai'i sparingly naturalized on all of the main islands except Ni'ihau and Lana'i, but especially common on Hawai' i. First collected on O'ahu in 1909 (Forbes s.n., BISH)"
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Weedy, but not known from wild] "This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed." ... "Radish varieties have been domesticated since ancient times and were originally cultivated in China (Navazio, 2007). Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009). It is widely distributed around the world in cultivation, including the United States and Canada."

103	Does the species have weedy races?	y
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Intermediate
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Jun 2017]	"Cultivated: Africa Northern Africa: Egypt Southern Africa: South Africa Asia-Temperate China: China Eastern Asia: Japan Asia-Tropical Malesia: Indonesia Europe : Europe"

202	Quality of climate match data	Low
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Jun 2017]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	Useful Tropical Plants Database. 2017. <i>Raphanus sativus oleiformis</i> . http://tropical.theferns.info/viewtropical.php?id=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"A plant of the temperate zone, though it is often cultivated and can be grown in the tropics at higher latitudes of more than 10° N or S, or at elevations above 1,000 metres[299, 418]. It grows best in areas where annual daytime temperatures are within the range 12 - 25°C, but can tolerate 5 - 30°C[418]. It prefers a mean annual rainfall in the range 800 - 1,000mm, but tolerates 500 - 1,500m [418]."
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish grows best in cool, moist growing conditions (most often during the fall)."

204	Native or naturalized in regions with tropical or subtropical climates	
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Eurasia, now widely naturalized especially in temperate regions; in Hawai'i sparingly naturalized on all of the main islands except Ni'ihau and Lana'i, but especially common on Hawai'i. First collected on O'ahu in 1909 (Forbes s.n., BISH)"

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Jun 2017]	[Cultivated in tropical regions] "Cultivated: Africa Northern Africa: Egypt Southern Africa: South Africa Asia-Temperate China: China Eastern Asia: Japan Asia-Tropical Malesia: Indonesia Europe : Europe"
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Not known from wild] "Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009). It is widely distributed around the world in cultivation, including the United States and Canada."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 2 Jun 2017]	Cultivated: Africa Northern Africa: Egypt Southern Africa: South Africa Asia-Temperate China: China Eastern Asia: Japan Asia-Tropical Malesia: Indonesia Europe : Europe

301	Naturalized beyond native range	
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Eurasia, now widely naturalized especially in temperate regions; in Hawai'i sparingly naturalized on all of the main islands except Ni'ihau and Lana'i, but especially common on Hawai' i. First collected on O'ahu in 1909 (Forbes s.n., BISH)"
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes

Qsn #	Question	Answer
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Crop weed] "To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."

303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[May become a crop weed] "To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[<i>Raphanus sativus L. var. oleiformis</i> may also be an agricultural weed] "Although both species grow wild and both are commonly called wild radish, <i>Raphanus sativus</i> is the (escaped) cultivated plant, while <i>R. raphanistrum</i> is its wild relative. (<i>Sativus</i> means "cultivated" in Latin.)" ... "Wild radishes are capable of excluding native plant species. Both radish species are also agricultural weeds. <i>R. raphanistrum</i> seeds in large quantities may be poisonous to livestock."

304	Environmental weed	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Crop weed] "To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[<i>Raphanus sativus L. var. oleiformis</i> a potential crop weed] "Wild radishes are capable of excluding native plant species. Both radish species are also agricultural weeds. <i>R. raphanistrum</i> seeds in large quantities may be poisonous to livestock."

305	Congeneric weed	y
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	"Although both species grow wild and both are commonly called wild radish, <i>Raphanus sativus</i> is the (escaped) cultivated plant, while <i>R. raphanistrum</i> is its wild relative. (<i>Sativus</i> means "cultivated" in Latin.)" ... "Wild radishes are capable of excluding native plant species. Both radish species are also agricultural weeds. <i>R. raphanistrum</i> seeds in large quantities may be poisonous to livestock"

Qsn #	Question	Answer
	California Invasive Pest Council. 2017. <i>Raphanus sativus</i> (radish). http://www.cal-ipc.org/ . [Accessed 5 Jun 2017]	" <i>Raphanus sativus</i> (radish) is an annual or occasionally a perennial (family Brassicaceae) that frequently invades grasslands and open/disturbed areas, including roadsides in California. Wild radish may also be found in wetland areas. Wild radishes are capable of excluding native plant species and are, on rare occasion, toxic to livestock."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[No evidence] "Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987). Leaves are deeply dissected in shape and grow in a basal rosette to 2-3 feet tall (SARE, 2010). Seed stalks elongate from the rosette. Flowers emerge in the spring. They have four petals and are pink, white, or lavender in color (Radford et al., 1987). Fruits are called siliques and look like small bean pods. Siliques have two valves that separate seeds by a thin, papery septum (Harris and Harris, 2006)."

402	Allelopathic	
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Possibly. Effects soil pests & pathogens. Effect on weed suppression unclear] "Weed Management: Under favorable conditions, oilseed radish seedlings can emerge as soon as 3 days after planting, and provide full canopy cover to shade out weeds in 3-4 weeks (Weil et al., 2006). Studies in Michigan found that oilseed radish reduced weed biomass by 4,000 lb/acre when compared to a fallow site (Snapp and Mutch, 2003). Biomass decomposes quickly and leaves the seedbed ready for planting, without the need to till or remove leftover residue." ... "Pest Management: Like other plants in the mustard family (Brassicaceae), the roots of oilseed radish exude chemicals that help suppress soil pests such as nematodes. These chemicals, called glucosinolates, discourage infestations of soil-borne diseases (Ngouajio and Mutch, 2004). Breakdown of these chemicals in the soil produces compounds similar to the commercial soil fumigant VapamP®P (metham sodium) (Ngoujio and Mutch, 2004). Roots of oilseed radish trap sedentary beet cyst nematode (BCN) (<i>Heterodera schachtii</i>) and prevent reproduction (Budahn et al., 2009). This nematode can damage broccoli, cabbage, and other crops in the mustard family."

403	Parasitic	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987)." [No evidence]

Qsn #	Question	Answer
404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Forage: Oilseed radish produces up to 2 ton/acre of high quality above ground biomass (Dean and Weil, 2009). Forage is highly digestible and can be used as early and late season grazing by all classes of livestock (Ngouajio and Mutch, 2004). Mix oilseed radish with a grass species or supplement with hay to minimize bloating and other animal health disorders in cattle (McCartney et al., 2009)."

405	Toxic to animals	
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[No evidence] "Forage: Oilseed radish produces up to 2 ton/acre of high quality above ground biomass (Dean and Weil, 2009). Forage is highly digestible and can be used as early and late season grazing by all classes of livestock (Ngouajio and Mutch, 2004). Mix oilseed radish with a grass species or supplement with hay to minimize bloating and other animal health disorders in cattle (McCartney et al., 2009)."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Seeds potentially toxic in large quantities] " <i>Raphanus raphanistrum</i> ... This plant, like the cultivated radish (<i>Raphanus sativus</i>), contains glucosinolates in the seeds, which can cause poisoning if eaten in sufficient quantities by livestock"

406	Host for recognized pests and pathogens	y
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Avoid planting oilseed radish as a cover crop when the cash crop includes broccoli, cabbage, radish, or other members of the mustard family, it can encourage the establishment of pathogens and pests. Brassicas are susceptible to clubroot disease caused by the soil-borne fungus <i>Plasmodiophora brassicae</i> , cabbage root maggot (<i>Delia radicum</i>), and flea beetle (<i>Phyllotreta</i> spp.) (Ngouajio and Mutch, 2004). Harlequin bugs 5T(<i>Murgantia histrionica</i>) 5Tand flea beetles may attack oilseed radish if it survives the winter (Weil et al., 2006). Flea beetles can host bacteria causing Stewart's wilt of sweet corn (1TErwinia stewartii) (Midwest Cover Crops Council, 2012). 1TRotate other cover crop species with oilseed radish to avoid pest and pathogen problems."

Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Plants for a Future. 2017. <i>Raphanus sativus oleiformis</i> . http://www.pfaf.org/User/Plant.aspx?LatinName=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"Fodder radishes are grown mainly for their leaves and oil-rich seeds, they are used as a green manure or stock feed though they can also be eaten by people."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Seeds potentially toxic to livestock] "This plant, like the cultivated radish (<i>Raphanus sativus</i>), contains glucosinolates in the seeds, which can cause poisoning if eaten in sufficient quantities by livestock."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[No evidence and unlikely given habit and habitat] "Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987). Leaves are deeply dissected in shape and grow in a basal rosette to 2-3 feet tall (SARE, 2010). Seed stalks elongate from the rosette." ... "Oilseed radish grows best in cool, moist growing conditions (most often during the fall)."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Plants are not tolerant of shade, standing water, or severely nitrogen-"

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish plants tolerate soils with pH values of 6.0-7.5 (Midwest Cover Crops Council, 2012). Oilseed radish can be limited by soil nitrogen levels, though the degree of limitation depends on soil texture and history of nutrient application. Often, planting occurs after manure, sludge, or fertilizer application because oilseed radish is highly responsive to nitrogen fertilization (Midwest Cover Crops Council, 2012)."
	Useful Tropical Plants Database. 2017. <i>Raphanus sativus oleiformis</i> . http://tropical.theferns.info/viewtropical.php?id=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"Prefers a rich soil that is well-drained but with ample moisture[16, 52, 418]. Dislikes very heavy or acid soils[16, 37]. Plants are susceptible to drought and require irrigation during dry spells in the summer or the root quality will rapidly deteriorate and the plant will go to seed. Prefers a pH in the range 6 - 6.5, tolerating 5 - 7.5[418]."
	Plants for a Future. 2017. <i>Raphanus sativus oleiformis</i> . http://www.pfaf.org/User/Plant.aspx?LatinName=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"Prefers a rich soil with ample moisture[16, 52]. Dislikes very heavy or acid soils[16, 37]. Plants are susceptible to drought and require irrigation during dry spells in the summer or the root quality will rapidly deteriorate and the plant will go to seed."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987). Leaves are deeply dissected in shape and grow in a basal rosette to 2-3 feet tall (SARE, 2010). Seed stalks elongate from the rosette."

412	Forms dense thickets	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[May become weedy and displace desirable vegetation, but no evidence that it forms dense stands] "Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009)." ... "To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."

Qsn #	Question	Answer
501	Aquatic	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Terrestrial herb] "Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987)."
502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 2 Jun 2017]	Family: Brassicaceae (alt.Cruciferae) Tribe: Brassiceae
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 2 Jun 2017]	Family: Brassicaceae (alt.Cruciferae) Tribe: Brassiceae
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Deep taproot, but an annual] "Oilseed radish differs from typical radish because it develops a thick, white taproot that can grow 1-2 inches in diameter and up to 1 foot in length (Magdoff and Van Es, 2009). Plants give off a foul rotten egg-like odor when they decompose in the spring (Weil et al., 2006)."
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009). It is widely distributed around the world in cultivation, including the United States and Canada." [No evidence]
602	Produces viable seed	y
	Source(s)	Notes
	Plants for a Future. 2017. <i>Raphanus sativus oleiformis</i> . http://www.pfaf.org/User/Plant.aspx?LatinName=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"Propagation Seed - sow spring in situ. Germination should take place within 2 weeks."

Qsn #	Question	Answer
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown." ... "Adjust seeding rate based on goals. Lower planting rates of 5-6 lb/acre of pure live seed (PLS) produce larger taproots, which may assist with soil compaction. Higher planting rates of 15-20 PLS produce smaller taproots and weaker plants; however, more root surface area may help trap more nematodes or assist with soil-borne pest suppression."

603	Hybridizes naturally	y
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Some confusion exists as to the exact taxonomic classification of oilseed radish. Some literature separates forage radish and oilseed radish as different varieties with oilseed radish having a stubbier, more branched root and a greater degree of winter hardiness than forage radish (Weil et al., 2006). However, varieties of radish can readily hybridize and true distinctions are poorly understood. Recommendations for management and use are generally the same for most varieties (Weil et al., 2006)." ... "Radish is a cross-pollinated species and seed set benefits from pollination; however, wild radish (<i>Raphanus raphanistrum</i>) can cross-pollinate with oilseed radish if within one mile of the crop (Novazio, 2007)."

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Karron, J. D., Marshall, D. L., & Oliveras, D. M. (1990). Numbers of sporophytic self-incompatibility alleles in populations of wild radish. <i>Theoretical and Applied Genetics</i> , 79(4), 457-460	"Both <i>Raphanus sativus</i> and closely related <i>Raphanus raphanistrum</i> exhibit homomorphic sporophytic incompatibility, with multiple S-alleles present at a single locus (Bateman 1955; Sampson 1957, 1964, 1967)."
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Radish is a cross-pollinated species and seed set benefits from pollination; however, wild radish (<i>Raphanus raphanistrum</i>) can cross-pollinate with oilseed radish if within one mile of the crop (Novazio, 2007)."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Plants for a Future. 2017. <i>Raphanus sativus oleiformis</i> . http://www.pfaf.org/User/Plant.aspx?LatinName=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"The flowers are hermaphrodite (have both male and female organs) and are pollinated by Bees, flies."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes

Qsn #	Question	Answer
	Plants for a Future. 2017. <i>Raphanus sativus oleiformis</i> . http://www.pfaf.org/User/Plant.aspx?LatinName=Raphanus+sativus+oleiformis . [Accessed 5 Jun 2017]	"Propagation Seed - sow spring in situ. Germination should take place within 2 weeks."
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Annual. Reproduces by seed] "Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987)."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Annual] "Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987). Leaves are deeply dissected in shape and grow in a basal rosette to 2-3 feet tall (SARE, 2010). Seed stalks elongate from the rosette."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). <i>The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants</i> . The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Description of wild type applies to fodder radish, which also reproduces by seeds] "Wild radishes reproduce only by seed. Seeds can remain viable for at least 5 years and reportedly up to 20 years. Seeds are generally wind-dispersed, but are also spread by water and machinery. Germination takes place in spring and fall."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009). It is widely distributed around the world in cultivation, including the United States and Canada."

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Possibly yes if grown with crops] "To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 5 Jun 2017]	[Wild type a seed contaminant] "' <i>Raphanus sativus L.</i> ... Weed: potential seed contaminant (fide Weed CIBA) "

Qsn #	Question	Answer
704	Propagules adapted to wind dispersal	
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Description of siliques and seeds suggests wind dispersal is unlikely] "Fruits are called siliques and look like small bean pods. Siliques have two valves that separate seeds by a thin, papery septum (Harris and Harris, 2006)." ... "Harvest seeds when pods turn from green to yellow/brown. Seedpods do not readily shatter and require mechanical separation using stationary threshers with rollers to remove chaffy material (Navazio, 2007). Large-scale harvest of seed is difficult. Using a combine to harvest seeds requires custom attachments (Steve Groff, personal communication 2012). One pound of seed contains an average of 34,000 seeds (Midwest Cover Crops Council, 2012)."
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Description of wild type applies to fodder radish, which also reproduces by seeds] "Wild radishes reproduce only by seed. Seeds can remain viable for at least 5 years and reportedly up to 20 years. Seeds are generally wind-dispersed, but are also spread by water and machinery. Germination takes place in spring and fall."

705	Propagules water dispersed	y
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Description of wild type applies to fodder radish, which also reproduces by seeds] "Wild radishes reproduce only by seed. Seeds can remain viable for at least 5 years and reportedly up to 20 years. Seeds are generally wind-dispersed, but are also spread by water and machinery. Germination takes place in spring and fall."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[No evidence. Description of wild type applies to fodder radish, which also reproduces by seeds] "Wild radishes reproduce only by seed. Seeds can remain viable for at least 5 years and reportedly up to 20 years. Seeds are generally wind-dispersed, but are also spread by water and machinery. Germination takes place in spring and fall."
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[No evidence] "Seedpods do not readily shatter and require mechanical separation using stationary threshers with rollers to remove chaffy material (Navazio, 2007)."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Description of wild type applies to fodder radish, which also reproduces by seeds] "Wild radishes reproduce only by seed. Seeds can remain viable for at least 5 years and reportedly up to 20 years. Seeds are generally wind-dispersed, but are also spread by water and machinery. Germination takes place in spring and fall."

Qsn #	Question	Answer
708	Propagules survive passage through the gut	
	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	[Unknown if seeds remain viable following ingestion] "Raphanus raphanistrum ... This plant, like the cultivated radish (<i>Raphanus sativus</i>), contains glucosinolates in the seeds, which can cause poisoning if eaten in sufficient quantities by livestock"

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	[Seed densities unknown] "Harvest seeds when pods turn from green to yellow/brown. Seedpods do not readily shatter and require mechanical separation using stationary threshers with rollers to remove chaffy material (Navazio, 2007). Large-scale harvest of seed is difficult. Using a combine to harvest seeds requires custom attachments (Steve Groff, personal communication 2012). One pound of seed contains an average of 34,000 seeds (Midwest Cover Crops Council, 2012)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	"Seeds can remain viable for at least 5 years and reportedly up to 20 years."
	Jacobs, A. A. 2012. Plant Guide for oilseed radish (<i>Raphanus sativus L.</i>). USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR	"Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown."

803	Well controlled by herbicides	
	Source(s)	Notes
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Unknown for fodder radish] "Foliar spray. Some weed workers spray a 1 percent solution of glyphosate on the leaves before the plant flowers. However, wild radishes are reportedly developing resistance to several herbicides. Glyphosate application might best be reserved for follow-up spot treatment."
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	2,4-D, Dicamba (Banvel, Clarity), Imazapic (Plateau), Rimsulfuron (Matrix), Hexazinone (Velpar L) suggested for use on <i>Raphanus sativus L.</i> ; radish <i>Raphanus raphanistrum L.</i> ; wild radish. Effectiveness unspecified

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes

Qsn #	Question	Answer
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	[Pulling & tilling effective. Mowing not effective] "Hand-pull, removing most of the root system, before plants produce seed. Hand weeding may need to be repeated to control later developing plants. Mowing can help reduce seed production but does not harm the basal leaves, thus allowing plants to regrow. Repeated mowing is required to prevent seed set. This is not an effective means of control. Tillage is a common and effective method of control in agricultural areas and would also be effective, if practical, in natural areas or other non-crop sites."
	Holloran, P., Mackenzie, A., Ferrell, S., & Johnson, D. (2004). The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants. The Watershed Project and California Invasive Plant Council, Richmond & Berkeley, CA	[Wild radish may resprout] "Mow or brush cut wild radish if it covers a large area. It's important to do the first mowing before any seed pods develop. Mow as close to the ground as feasible, as the plants often resprout."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Unknown, but wild type apparently not limited by natural enemies] "Native to Eurasia, now widely naturalized especially in temperate regions; in Hawai'i sparingly naturalized on all of the main islands except Ni'ihau and Lana'i, but especially common on Hawai' I."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Can become a weed of crops if allowed to set seed
- *Raphanus sativus* (wild radish) has become invasive
- Seeds potentially toxic to livestock if eaten in large quantities
- Host of pests and pathogens of crop plants such as broccoli, cabbage, radish, or other members of the mustard family
- Reproduces by seeds
- Hybridizes with other *Raphanus* species & varieties
- Annual. Reproductive in one growing season
- Seeds may be dispersed by machinery, water, possibly wind or as a produce contaminant, & intentionally by people
- Seeds may form a persistent seed bank (5+ years_
- May tolerate glyphosate & mowing

Low Risk Traits

- Variety reported to be weedy, but not naturalized
- Regarded as a beneficial cover crop in certain circumstances
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock
- Ornamental
- Requires full sun
- Self-incompatible
- Not reported to spread vegetatively
- Certain herbicides, hand pulling, & tilling may provide some effective control