

Taxon: <i>Sonchus arvensis L.</i>	Family: Asteraceae
Common Name(s): corn sow thistle field sow thistle perennial sow thistle	Synonym(s): <i>Hieracium arvense</i> (L.) Scop. <i>Sonchoseris arvensis</i> Fourr. <i>Sonchus exaltatus</i> Wallr. <i>Sonchus hantoniensis</i> Sweet

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 18 Mar 2019
WRA Score: 17.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Perennial Herb, Temperate Crop Weed, Palatable, Self-Incompatible, Wind-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)		
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		
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	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		

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
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	y
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	n
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m ²)	y=1, n=-1	y
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?	n
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	[No evidence] "Sonchus arvensis is a perennial herbaceous plant found throughout the temperate regions of the world. A native of Europe, it now occurs in nearly 60 countries. The species is adapted to a wide range of edaphic conditions and its extensive horizontal and vertical root system make it very difficult to control. The Greek derivation of Sonchus is from sonchos, which means "hollow" and refers to the stems; arve11sis refers to plants that grow in cultivated fields."

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

Qsn #	Question	Answer
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
	<p>USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Mar 2019]</p>	<p>"Native Asia-Temperate WESTERN ASIA: Turkey CAUCASUS: Armenia, Georgia, Russian Federation, [Dagestan] Russian Federation-Ciscaucasia [Ciscaucasia] SIBERIA: Russian Federation-Eastern Siberia, [Eastern Siberia] Russian Federation-Western Siberia [Western Siberia] MIDDLE ASIA: Kazakhstan, Kyrgyzstan, Uzbekistan MONGOLIA: Mongolia RUSSIAN FAR EAST: Russian Federation-Far East [Far East] Europe NORTHERN EUROPE: Denmark, Faroe Islands, Finland, Ireland, Norway, Sweden, United Kingdom MIDDLE EUROPE: Austria, Belgium, Czech Republic, Germany, Hungary, Netherlands, Poland, Slovakia, Switzerland EASTERN EUROPE: Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation-European part, [European part] Ukraine (incl. Krym) SOUTHEASTERN EUROPE: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Italy (incl. Sardinia), Macedonia, Montenegro, Romania, Serbia, Slovenia SOUTHWESTERN EUROPE: France, Spain"</p>

202	Quality of climate match data	High
	Source(s)	Notes
	<p>USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Mar 2019]</p>	

203	Broad climate suitability (environmental versatility)	
	Source(s)	Notes
	<p>Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532</p>	<p>"Climatic requirements - <i>Sonchus arvensis</i> is widely distributed in temperate regions and is absent from the tropics. Neither the climatic conditions required for successful establishment nor the conditions, if any, favoring var. <i>arvensis</i> over var. <i>glabrescens</i> have been established."</p>
	<p>Smith, A.C. 1991. Flora Vitiensis Nova: a new flora of Fiji Volume 5. National Tropical Botanical Garden, Lawai, HI</p>	<p>"Coarse, freely branched herb 0.3-2 m. high, perennial, with abundant milky latex, found as a naturalized weed in open places, along roadsides, and sometimes in openings along streams in dense forest from near sea level to 400 m." ... "DISTRIBUTION: Eurasia, now naturalized elsewhere, but not as widespread in the Pacific or in Fiji as the following species."</p>

Qsn #	Question	Answer
204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Smith, A.C. 1991. Flora Vitiensis Nova: a new flora of Fiji Volume 5. National Tropical Botanical Garden, Lawai, HI	"Coarse, freely branched herb 0.3-2 m. high, perennial, with abundant milky latex, found as a naturalized weed in open places, along roadsides, and sometimes in openings along streams in dense forest from near sea level to 400 m." ... "DISTRIBUTION: Eurasia, now naturalized elsewhere, but not as widespread in the Pacific or in Fiji as the following species."
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Mar 2019]	"Naturalized ... Asia-Tropical MALESIA: Indonesia, Philippines ... Pacific SOUTHWESTERN PACIFIC: Fiji, New Caledonia"

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	"A native of Europe, it now occurs in nearly 60 countries."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	"A native of Europe, it now occurs in nearly 60 countries."

Qsn #	Question	Answer
	<p>USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 18 Mar 2019]</p>	<p>"Naturalized Asia-Temperate EASTERN ASIA: Japan [Ryukyu Islands] Asia-Tropical MALESIA: Indonesia, Philippines Australasia AUSTRALIA: Australia [South Australia] NEW ZEALAND: New Zealand Northern America SUBARCTIC AMERICA: Canada, [Northwest Territories, Yukon] United States [Alaska] EASTERN CANADA: Canada, [New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Quebec] St. Pierre and Miquelon WESTERN CANADA: Canada [Alberta, British Columbia, Manitoba, Saskatchewan] NORTHEASTERN U.S.A.: United States [Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Connecticut] NORTH-CENTRAL U.S.A.: United States [Iowa, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Illinois, Wisconsin] NORTHWESTERN U.S.A.: United States [Colorado, Idaho, Montana, Oregon, Washington, Wyoming] SOUTHEASTERN U.S.A.: United States [Delaware, Kentucky, Maryland, North Carolina, Virginia, Tennessee] SOUTHWESTERN U.S.A.: United States [California, Nevada, Utah] Pacific SOUTHWESTERN PACIFIC: Fiji, New Caledonia Southern America SOUTHERN SOUTH AMERICA: Argentina, [Mendoza] Chile"</p>
	<p>Bishop Museum.(2019). Online Natural Sciences Collections. http://nsdb.bishopmuseum.org/. [Accessed 18 Mar 2019]</p>	<p>No collection in the Hawaiian Islands to date</p>
	<p>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 18 Mar 2019]</p>	<p>No evidence in Hawaiian Islands to date</p>

Qsn #	Question	Answer
302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed]	"Field sowthistle is found in a wide range of habitats. It occurs in cultivated fields of both small grains and row crops, in disturbed areas, "waste grounds," meadows, sloughs, woods, lawns, and along roadsides, beaches, ditches, and river and lake shores [109,110]." [Disturbance-adapted weed that impacts agriculture and the natural environment]
	Weber, E. 2017. <i>Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds</i> . CABI Publishing, Wallingford, UK	"The plant is invasive because it forms dense patches, displacing native species. The weed invades a wide range of habitats including species-rich mountain grassland, open forests, wetlands and moist sites within desert grassland (McWilliams, 2004)."

303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	" <i>Sonchus arvensis</i> is locally common in various cereal and oilseed crops of the northern prairies of Canada and the United States (Peschken et al. 1983) and is regarded as a serious weed problem in several countries, including Hungary, Norway, Poland, and the Soviet Union (Holm et al. 1979). Economic losses from perennial sowthistle infestations result from reduced crop yield, increased cultivation and herbicide expense, and land depreciation. <i>Sonchus arvensis</i> was ranked among the 15 most abundant weeds in fields surveyed in Alberta (Thomas and Wise 1986a), Manitoba (Thomas and Wise 1984, 1988), and Saskatchewan (Thomas and Wise 1983, 1987a). The weed tended to be more abundant in barley and oats than in wheat (Thomas and Wise 1983, 1987a 1988) and was more abundant in winter wheat than in spring wheat (Thomas and Wise 1986d, 1987b). <i>S. arvensis</i> was found in 21 and 67 % of Saskatchewan mustard and dry pea fields, respectively, but only in 5 and 14 % of lentil and sunflower fields, respectively (Thomas and Wise 1986b, c). In the United States, <i>S. arvensis</i> was found in 11 % of surveyed fields at a mean density of 5.5 plants m ⁻² in a survey of small grain, flax, and sunflower in North Dakota (Dexter et al. 1981)."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Canola, Carrots, Cereals, Cotton, Grapevines, Lupins, Nursery Production, Orchards & Plantations, Pastures, Potatoes, Sunflowers, Vegetables"

304	Environmental weed	y
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Field sowthistle is listed as a nonnative plant occurring in critical habitat of the threatened desert tortoise in the Mojave and Colorado deserts. It is of concern because it competes with native plants vital to the tortoises' survival [17]."

Qsn #	Question	Answer
	Weber, E. 2017. Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CAB International, Wallingford, UK	"The plant is invasive because it forms dense patches, displacing native species. The weed invades a wide range of habitats including species-rich mountain grassland, open forests, wetlands and moist sites within desert grassland (McWilliams, 2004). In the deserts of the southwestern USA the plant threatens habitat of desert tortoises (<i>Gopherus agassizii</i>). The weed displaces native plants that are important food sources to the tortoises (Brooks and Esque, 2002; Kaufman and Kaufman, 2012)."

305	Congeneric weed	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	" <i>Sonchus asper</i> ... Weed of: Canola, Cereals, Cotton, Grapevines, Nursery Production, Orchards & Plantations, Pastures, Pome Fruits, Sunflowers, Vegetables" ... " <i>Sonchus brachyotus</i> ... Weed of: Cereals" ... " <i>Sonchus maritimus</i> ... Weed of: Cereals" ... " <i>Sonchus oleraceus</i> ... Weed of: Bananas, Canola, Carrots, Cereals, Cotton, Cucurbits/Melons, Cutflowers, Grapevines, Nursery Production, Orchards & Plantations, Pastures, Pome Fruits, Potatoes, Sunflowers, Vegetables" ... " <i>Sonchus palustris</i> ... Weed of: Pastures" ... " <i>Sonchus tenerrimus</i> ... Weed of: Cereals" ... " <i>Sonchus wightianus</i> ... Weed of: Orchards & Plantations"

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	" <i>Sonchus arvensis</i> is similar vegetatively to prickly lettuce (<i>Lactuca scariola</i> L.) and to blue lettuce ([<i>L. pulchella</i> (Pursh) DC.]. However, prickly lettuce possesses stiff, sharp prickles on the lower midvein surface that are lacking in <i>S. arvensis</i> and blue lettuce has blue flowers, beaked achenes, and lacks prickles on leaf edges (Frankton and Mulligan 1987)."
	Flora of North America. (2019). <i>Sonchus arvensis</i> . http://www.efloras.org . [Accessed 18 Mar 2019]	[No evidence] "Perennials, 0–150(–200) cm, usually rhizomatous or stoloniferous. Stem bases hard, some-times ± woody. Leaves: blades of mid cauline oblong to lanceolate, (3–)6–40 × 2–15 cm, bases auriculate, auricles straight or curved, rounded, margins usually pinnately lobed, lobes ± deltate, not constricted at bases, terminals usually larger than laterals, dentate or entire."

402	Allelopathic	
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Very little is known about allelopathic effects of <i>S. arvensis</i> on crops. Leaf and stem extracts of <i>S. arvensis</i> reduced root growth of wheat seedlings but did not reduce epicotyl length or dry weight (Bhatia et al. 1982). In contrast, extracts from root tissue appeared to stimulate wheat root growth."

403	Parasitic	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Vigorous, deep-rooted perennial herb" [Asteraceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Field sowthistle is "good" as a livestock feed [111,129]. Sheep and cattle will eat new growth and sometimes roots [133], and pronghorns were observed utilizing field sowthistle in central Montana during the fall [24]. Field sowthistle is considered "excellent" forage for rabbits [118] and Martin and others (as reported in [133], a literature review) state field sowthistle is a minor element in the diet of some North American birds. "
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	" <i>Sonchus arvensis</i> is acceptable as a livestock feed, and patches of the weed were cut for hay or were pastured as an early control measure (Batho 1936; Stevens 1926). The plant is an excellent feed for foraging animals such as rabbits (Szczaewski and Turner 1978). <i>Sonchus arvensis</i> has equal or higher in vitro digestible dry matter, micro- and micromineral content and crude protein and lower neutral detergent fiber compared to alfalfa (Martin et al. 1987). Dry <i>S. arvensis</i> was about 10% crude protein by weight (Buchanan et al. 1978a, b). However, the palatability of <i>S. arvensis</i> to lambs was lower compared to alfalfa and grasses, and infestations of the weed in pastures and hayfields may decrease overall forage feeding value (Martin et al. 1987)."

405	Toxic to animals	
	Source(s)	Notes
	Elias T. S. & Dykeman, P. A. (1990). <i>Edible Wild Plants: A North American Field Guide</i> . Sterling Publishing Company, New York	"Caution: Sow thistle occasionally contains toxic levels of nitrates." [May be indirectly toxic]
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Field sowthistle is "good" as a livestock feed [111,129]. Sheep and cattle will eat new growth and sometimes roots [133], and pronghorns were observed utilizing field sowthistle in central Montana during the fall [24]."
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	"Toxic to cattle." [Toxicity reported here may be indirect due to nitrate accumulation. Other references report on the palatability of this species to livestock and grazing animals with no mention of toxic effects]

Qsn #	Question	Answer
406	Host for recognized pests and pathogens	y
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	" <i>Sonchus arvensis</i> is a host of several economically important plant pests and parasites"

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Elias T. S. & Dykeman, P. A. (1990). Edible Wild Plants: A North American Field Guide. Sterling Publishing Company, New York	"Harvest: Locate by noting concentrations of mature plants the previous year. Pick when only a few inches tall; leaves become increasingly bitter with age." ... "Preparation: If not too bitter, cut and mix leaves with other, blander salad greens. Boil in very little water for 3-4 min, change water, and then boil until tender. Serve with butter and seasonings or vinegar." ... "Poisonous look-alikes: none."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Plant diuretic, antiseptic, sedative, hypnotic, useful in the treatment of cough and asthma; plant paste for stomach acidity; juice applied to wounds and cuts to relieve pain. Crushed seeds for fever and coughs; seeds used as demulcent. Leaf paste for boils; crushed leaves applied on cuts to check bleeding. Root given in jaundice; root chewed to relieve acidity and stomachache; roots crushed in watered rice and the extract drunk by women for lactation; roots and leaves diuretic, febrifuge. Milky juice for heart palpitations and nervousness. Toxic to cattle."

408	Creates a fire hazard in natural ecosystems	
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Fire regimes: As of this writing (2004), no information regarding fire regimes in which field sowthistle evolved was found in the available literature; nor was information available regarding impacts of field sowthistle invasion on fuel characteristics or fire regimes in native North American plant communities."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Province of British Columbia. (2002). Guide to Weeds in British Columbia. British Columbia Ministry of Agriculture, Food and Fisheries	"General requirements: This weed grows in a wide range of environments but does best on fertile, moist soils in full sunlight."
	Dave's Garden. (2019). Perennial Sowthistle - <i>Sonchus arvensis</i> . https://davesgarden.com/guides/pf/go/31951/ . [Accessed 18 Mar 2019]	"Sun Exposure: Full Sun Sun to Partial Shade Light Shade Partial to Full Shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. <i>World Weeds: Natural Histories and Distribution</i> . John Wiley and Sons, Inc., New York, NY	"A native of Europe, it now occurs in nearly 60 countries. The species is adapted to a wide range of edaphic conditions and its extensive horizontal and vertical root system make it very difficult to control."
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: <i>Fire Effects Information System</i> , [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Field sowthistle is adapted to many soil types but appears to prefer fine-textured soils and does not thrive on dry, coarse-textured sand. Field sowthistle seems to prefer slightly alkaline or neutral soils and does not thrive in acid soils, salt marshes, or highly alkaline areas [110]. However, Zollinger and Kells [132] determined soil pH had little effect on leaf production, plant height, or number of capitula produced."
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	" <i>Sonchus arvensis</i> is adapted to many soil types, but most references indicate that it prefers low, fine-textured soils and that it does not thrive on dry, coarse-textured sand (Frankton and Mulligan 1987; Korsmo 1954; Stevens 1924). The weed occurred more frequently on loam (moderately fine to moderately coarse textured) compared to heavy clay (fine textured), sandy, or gravelly soils (Thomas and Wise 1983, 1986b). The role of soil type in determining distribution is unclear because the rainfall patterns closely follow shifts in soil type. Generally, <i>S. arvensis</i> is located in regions of the prairie provinces that receive the most precipitation. One variety, <i>S. arvensis</i> var. <i>maritimus</i> , has adapted in The Netherlands to coastal dune sands that contain only small amounts of nitrate, phosphorus, humus, and clay (Pegtel 1973, 1974). <i>Sonchus arvensis</i> seems to prefer slightly alkaline or neutral soils and does not thrive in acid soils, salt marshes, or highly alkaline areas (Groh 1942; Stevens 1924). Greenhouse-grown plants had 44 % less total dry weight when grown at pH 5.2 compared to 7.2 (Zollinger and Kells 1987)."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	"Vigorous, deep-rooted perennial herb"

412	Forms dense thickets	y
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	"In Michigan, Zollinger and Kells (1993) found that natural infestations of <i>S. arvensis</i> at densities from 61 to 96 shoots m ⁻² reduced yields of soybean, <i>Glycine max</i> (L.) Merrill, by up to 87% and dry edible bean, <i>Phaseolus vulgaris</i> L., by up to 84%."
	Weber, E. 2017. <i>Invasive Plant Species of the World</i> , 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The plant is invasive because it forms dense patches, displacing native species."

Qsn #	Question	Answer
501	Aquatic	n
	Source(s)	Notes
	Flora of North America. (2019). <i>Sonchus arvensis</i> . http://www.efloras.org . [Accessed 18 Mar 2019]	[Terrestrial herb] "Perennials, 0–150(–200) cm, usually rhizomatous or stoloniferous." ...
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 18 Mar 2019]	Family: Asteraceae (alt.Compositae) Subfamily: Cichorioideae Tribe: Cichorieae Subtribe: Hyoseridinae
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 18 Mar 2019]	Family: Asteraceae (alt.Compositae) Subfamily: Cichorioideae Tribe: Cichorieae Subtribe: Hyoseridinae
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Vigorous, deep-rooted perennial herb; reproducing by seeds, by vertical, thickened roots, and by cylindrical, horizontal, spreading roots; entire plant filled with milky latex." [No bulbs, corms or tubers]
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	[No evidence] "A native of Europe, it now occurs in nearly 60 countries. The species is adapted to a wide range of edaphic conditions and its extensive horizontal and vertical root system make it very difficult to control."
602	Produces viable seed	y
	Source(s)	Notes
	Weber, E. 2017. Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Perennial sow thistle reproduces both by seeds and vegetatively by its numerous buds on rhizomes and stolons."
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Seed production: Field sowthistle can produce large numbers of seeds [31,53,110,112]. Seeds produced by self pollination are generally nonviable and smaller than those produced by cross pollination [31,110]."

Qsn #	Question	Answer
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	" <i>Sonchus arvensis</i> achenes are capable of germination about 5 d after pollination (Stevens 1924; Kinch and Termunde 1957; Derscheid and Schultz 1960). Viability increased from low to none at 4 d after flowering to a maximum at 7-9 d after flowering."

603	Hybridizes naturally	
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	[Potentially. Artificial hybrids possible] "Hybrids have been made artificially of <i>S. arvensis</i> var. <i>glabrescens</i> with <i>S. oleraceus</i> and <i>S. asper</i> (Alam 1972; Hsieh et al. 1972; Bell et al. 1973a). F ₁ hybrids between <i>S. arvensis</i> var. <i>glabrescens</i> (2n = 36) and <i>S. oleraceus</i> (2n = 36) had a chromosome number of 2n = 36 and were intermediate for most morphological characteristics between the two parents (Alam 1972; Hsieh et al. 1972). F ₁ hybrids were highly sterile and produced few pollen grains and achenes, and these achenes produced only weak plants that did not flower."

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Flowers of <i>S. arvensis</i> are perfect and generally self-incompatible (Derscheid and Schultz 1960). Seeds produced by self pollination are generally shriveled and nonviable (Derscheid and Schultz 1960; Stevens 1924)."
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	" <i>S. arvensis</i> is self-sterile. Few if any seeds are formed if pollen from the same flower head or from flower heads on the same plant is used (Derscheid and Schultz 1960). An average of 58 achenes/flower head were obtained when cross pollinated by bees and these seeds were 80% viable."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Flowers nearest the edge of the head are the first to open and to mature (Derscheid and Schultz 1960). <i>S. arvensis</i> is pollinated by insects, e. g., honeybees and other bees, hover flies, and blister beetles (Stevens 1924). Flowers generally open 2-3 h after sunrise and close near noon, but opening and closing is hastened by high temperatures and is delayed by cool temperatures or cloudy conditions."
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Pollination: Field sowthistle is pollinated by insects including honeybees and other bees, hover flies, and blister beetles [31,110]."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes

Qsn #	Question	Answer
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"The subterranean spreading roots are the major means of vegetative propagation and enable the plant to colonize new areas rapidly and to persist despite cultivation and other disturbances. These roots, frequently 0.25-0.5 cm in diameter (rarely exceeding 1 cm) (Stevens 1924), are found from 5-12 cm below the surface (Arny 1932). They originate from short, spindle-shaped, somewhat branched primary roots (Korsmo 1954). Additional root branches can form from preexisting spreading roots or from adventitious roots that develop from underground portions of aerial stems. Vertical roots can penetrate 2 m deep and can produce vegetative buds as deep as 50 cm below the soil surface (Stevens 1924; Arny 1932)."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Michigan State University Extension. (2019). https://www.canr.msu.edu/weeds/extension/perennial-sowthistle . [Accessed 18 Mar 2019]	"Life Cycle: Perennial. Emerges in the spring, flowers throughout the summer, and sets seed in the fall. Aboveground plant tissue dies after the first frost."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Flyers, Vehicles, Water, Wind"
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Wind is the primary agent for achene dispersal (Stevens 1924). Achenes also can adhere to animals, vehicles, farm implements, etc."

702	Propagules dispersed intentionally by people	n
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Wind is the primary agent for achene dispersal (Stevens 1924). Achenes also can adhere to animals, vehicles, farm implements, etc." [No evidence of intentional dispersal]

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental"
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Seeds also are dispersed as contaminants in crop seed or hay."

Qsn #	Question	Answer
704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Wind is the primary agent for achene dispersal (Stevens 1924). Achenes also can adhere to animals, vehicles, farm implements, etc."

705	Propagules water dispersed	y
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Flyers, Vehicles, Water, Wind"
	White, M. R. (2008). Field Guide to Noxious and Invasive Weeds Known to Occur or are Potentially Occurring on the Apache-Sitgreaves National Forests. MR-R3-01-2. USDA Forest Service, Southwestern Region	"Seedlings are typically found along pond and river margins and in lawns, moist meadows, and uncultivated fields." ... "Seed disperses with wind, water, and by clinging to the fur or feathers of animals and clothing of people."

706	Propagules bird dispersed	y
	Source(s)	Notes
	Province of British Columbia. (2002). Guide to Weeds in British Columbia. British Columbia Ministry of Agriculture, Food and Fisheries	"Dispersal: Mainly by wind, but some birds feed on the seeds."
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"In addition to wind dispersal, seeds of field sowthistle may be dispersed by birds and other animals. Martin and others (as reported in [133], a literature review) state field sowthistle is a minor element in the diet of some North American birds, and some seeds may germinate after ingestion and excretion by birds and animals."

707	Propagules dispersed by other animals (externally)	y
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Hooked cells at the tips of pappus hairs allow the pappus to cling to clothes and animal hairs and aid in seed dispersal [110,133]."
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532	"Wind is the primary agent for achene dispersal (Stevens 1924). Achenes also can adhere to animals, vehicles, farm implements, etc."

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"Martin and others (as reported in [133], a literature review) state field sowthistle is a minor element in the diet of some North American birds, and some seeds may germinate after ingestion and excretion by birds and animals."

Qsn #	Question	Answer
801	Prolific seed production (>1000/m ²)	y
	Source(s)	Notes
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. 1997. <i>World Weeds: Natural Histories and Distribution</i> . John Wiley and Sons, Inc., New York, NY	"Estimates vary greatly on the number of seeds produced per plant. In Russia, Abramov (1969) reported 35,000 seeds/plant (and a root biomass of over 3 ton/ha dry weight!) while Howitt (1908) found 2000 seeds/plant in Ontario, Canada. In Sweden, each head can form 150 to 200 seeds and each flowering stem over 6000 seeds (Korsmo et al 1981)."
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	" <i>Sonchus arvensis</i> can typically produce an average of 30 achenes per head and up to 50 000 achenes per 0.9 m ² (Dorph-Peterson 1924; Stevens 1924). One main stalk with relatively little competition produced 62 heads and 9750 well-developed achenes in North Dakota (Stevens 1932)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	McWilliams, J. (2004). <i>Sonchus arvensis</i> . In: <i>Fire Effects Information System</i> , [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/forb/sonarv/all.html . [Accessed 18 Mar 2019]	"A study of field sowthistle seed dormancy suggests that some seed may remain viable for 3 or more years in cultivated soils [23]."

803	Well controlled by herbicides	
	Source(s)	Notes
	Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. <i>Canadian Journal of Plant Science</i> , 70(2), 509-532	[Resistant to many herbicides. Susceptible to some] " <i>Sonchus arvensis</i> is relatively resistant to many common broadleaf herbicides compared to most annual broadleaf weeds. Thus, the best systems for control often include a combination of cultural and chemical treatments that are designed to reduce competition, prevent seed production, and reduce the reproductive capacity of roots (Derscheid and Parker 1972; Fryer and Makepeace 1982)." ... " <i>Sonchus arvensis</i> is susceptible to atrazine at 17 and 22 kg ha ⁻¹ , simazine at 22 kg ha ⁻¹ , bromacil at 5.6 and 12 kg ha ⁻¹ , and monuron and diuron at 18 and 27 kg ha ⁻¹ , (Fryer and Makepeace 1982). Dichlobenil at 2.2 and 4.5 kg ha ⁻¹ , used for 4 successive yr has reduced <i>S. arvensis</i> in alfalfa (Waddington 1980). Some sulfonylurea herbicides (DPXL5300 and metsulfuron) provided control similar to auxin-type herbicides, but chlorsulfuron provided poor control (Schimming 1987)."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Province of British Columbia. (2002). <i>Guide to Weeds in British Columbia</i> . British Columbia Ministry of Agriculture, Food and Fisheries	"Cultural/Preventive: New populations can be prevented by hand-pulling or cultivation before their extensive root systems establish."

Qsn #	Question	Answer
	<p>Lemna, W. K., & Messersmith, C. G. (1990). The biology of Canadian weeds. 94. <i>Sonchus arvensis</i> L. Canadian Journal of Plant Science, 70(2), 509-532</p>	<p>[Efficacy depends on growth stage] "Tillage generally reduces <i>S. arvensis</i> stands, but its effectiveness depends upon plant growth characteristics at the time of tillage and the type of tillage being used. Growth of <i>S. arvensis</i> after plant burial to simulate tillage was correlated positively with dry matter, watersoluble carbohydrates, and nitrogen content in vegetative roots (Amy 1932; Hakansson 1969). Plants tolerated burial least at the 6-leaf-rosette stage, which was the stage of minimum dry weight just prior to secondary root thickening (Hakansson 1969; Hakansson and Wallgren 1972a)."</p>

805	<p>Effective natural enemies present locally (e.g. introduced biocontrol agents)</p>	
	<p>Source(s)</p> <p>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 18 Mar 2019]</p>	<p>Notes</p> <p>Not currently documented to be naturalized in the Hawaiian Islands</p>

Summary of Risk Traits:

High Risk / Undesirable Traits

- A temperate herb capable of growing in regions with tropical climates (e.g. Fiji)
- Widely introduced and naturalized, but no evidence in the Hawaiian Island to date
- A disturbance-adapted weed that impacts several crops
- An environmental weed, impacting desert tortoise habitat
- Other *Sonchus* species are invasive
- May contain toxic levels of nitrates
- Host of several economically important plant pests and parasites
- Shade tolerant
- Tolerates many soil types
- Forms dense patches that can exclude other vegetation
- Reproduces by seeds and vegetatively by subterranean roots
- Able to reach maturity in one growing season
- Seeds dispersed by wind, water, by adhering to animals, vehicles, other machinery, as a produce contaminant, and internally by animals
- Capable of prolific seed production
- Seeds may persist in the soil for up to 3 years
- Resistant to several herbicides
- Mechanical control measures may be ineffective at later stages of growth

Low Risk Traits

- A temperate weed that may only be a threat at higher elevations
- Unarmed (no spines, thorns, or burrs)
- Palatable to livestock (in spite of possible nitrate toxicity)
- Largely self-incompatible
- Certain herbicides may provide effective control