

Assessment date 9 March 2018

<i>Brassica carinata</i> ALL ZONES		Answer	Score
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to Florida's USDA climate zones (0-low; 1-intermediate; 2-high) North Zone: suited to Zones 8, 9 Central Zone: suited to Zones 9, 10 South Zone: suited to Zone 10	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	y	1
2.04	Native or naturalized in habitats with periodic inundation North Zone: mean annual precipitation 50-70 inches Central Zone: mean annual precipitation 40-60 inches South Zone: mean annual precipitation 40-60 inches	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	n	-2
3.02	Garden/amenity/disturbance weed	unk	
3.03	Weed of agriculture	n	0
3.04	Environmental weed	n	0
3.05	Congeneric weed	y	2
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic	unk	0
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	n	-1
4.05	Toxic to animals	y	1
4.06	Host for recognised pests and pathogens	y	1
4.07	Causes allergies or is otherwise toxic to humans	y	1
4.08	Creates a fire hazard in natural ecosystems	n	0
4.09	Is a shade tolerant plant at some stage of its life cycle	unk	0
4.10	Grows on infertile soils (oligotrophic, limerock, or excessively draining soils). North & Central Zones: infertile soils; South Zone: shallow limerock or Histisols.	y	1
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	n	0
5.01	Aquatic	n	0
5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0

5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	y	1
6.04	Self-compatible or apomictic	y	1
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative propagation	n	-1
6.07	Minimum generative time (years)	1	1
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y	1
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	y	1
7.04	Propagules adapted to wind dispersal	n	-1
7.05	Propagules water dispersed	n	-1
7.06	Propagules bird dispersed	?	
7.07	Propagules dispersed by other animals (externally)	n	-1
7.08	Propagules dispersed by other animals (internally)	?	
8.01	Prolific seed production	y	1
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	n	-1
8.03	Well controlled by herbicides	y	-1
8.04	Tolerates, or benefits from, mutilation or cultivation	unk	-1
8.05			
Total Score			6
Implemented Pacific Second Screening			Yes
Risk Assessment Results			Low

section	# questions answered	satisfy minimum?
A		10 yes
B		10 yes
C		20 yes
total		40 yes

	Reference	Source data
1.01		cultivated, but no evidence of selection for reduced weediness
1.02		
1.03		
2.01	<p>1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgn.d.tif). 2. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?409896 (0-00-0000).</p>	<p>No computer analysis was performed. 1. Global hardiness zone: 9, 10, 11, 12; equivalent to USDA Hardiness zones: USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F) USDA Zone 11a: to USDA Zone (40 °F) USDA Zone 11b: to (45 °F) USDA Zone 12a: to (50 °F) USDA Zone 12b: to (55 °F). 2. Native to Northeast Tropical Africa: Ethiopia</p>
2.02		
2.03	<p>1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf). 2. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Biology Document BIO2017-02, Plant and Biotechnology Risk Assessment Unit Plant Health Science Division, Canadian Food Inspection Agency Ottawa, Ontario (http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 accessed 3/9/2018).</p>	<p>1. Distribution in the native/cultivated range occurs in three or more Köppen Geiger climate classification categories including Cfa, Cfb, Dfb, and Bsk</p>
2.04	<p>1. Climate Charts. World Climate Maps. http://www.climate-charts.com/World-Climate-Maps.html#rain (8-19-2015) 2. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. Native regions with 10 to 58 inches of rain annually 2. Thrives in 24 to 40 inches of rain annually.</p>

2.05	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p> <p>2. Khangura R, Aberra M. 2006. Strains of Leptosphaeria maculans with the capacity to cause crown canker on Brassica carinata are present in Western Australia. Plant Disease 90(6):832. 3. University of Florida, IFAS http://programs.ifas.ufl.edu/carinata/ (11-5-2018)</p>	<p>1. Introduced in Asia, Africa, South America, North America, Europe, and Australia. 2. Introduced and cultivated in Australia. 3. Introduced to USA</p>
3.01	<p>1. Kull, C. A., J. Tassin, S. Moreau, H. R. Ramiarantsoa, C. Blanc-Pamard, and S. M. Carriere. 2012. The introduced flora of Madagascar. Biological Invasions 14:875-888. 2. USDA APHIS (2014) Weed Risk Assessment for Brassica carinata A. Braun (Brassicaceae) – Ethiopian mustard. (https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Brassica-carinata.pdf)</p>	<p>1. Naturalized in Madagascar [limited evidence of naturalization] 2. "We found no evidence that Brassica carinata naturalizes and spreads where it has been introduced."</p>
3.02	<p>1. Hanson, C. G., and J. L. Mason. 1985. Bird seed aliens in Britain. Watsonia 15:237-252. 2. Mendenhall, N. 2013. Certification evaluation report: Brassica carinata. Scientific Certification Systems, Inc. 18 pp.</p>	<p>1. Casual escape in Great Britain 2. Casual escape in Canada</p>
3.03		no evidence
3.04		Although widely introduced, but no evidence of weediness in natural areas
3.05	<p>1. Holm, LeRoy G. A Geographical Atlas of World Weeds. Malabar, FL: Krieger Pub., 1991. Print. 2. Weber, E. 2003. Invasive plant species of the world: a reference guide to environmental weeds. CABI Publishing, Wallingford, U.K. 3. Bangle, D. N., Walker, L. R., & Powell, E. A. (2008). Seed germination of the invasive plant Brassica tournefortii (Sahara mustard) in the Mojave Desert. Western North American Naturalist, 68(3), 334-342.</p>	<p>1. Brassica campestris is a serious weed in Mexico and Venezuela, Brassica juncea is a principle weed in Canada. 2. Brassica tournefortii is invasive in Australia and the United States. 3. In the southwestern United States, Brassica tournefortii (Gouan) is a highly invasive plant that threatens native annuals.</p>
4.01	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	no evidence of these features
4.02		no evidence

4.03	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>no evidence of these features</p>
4.04	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. Birds, mule deer, squirrel, and cattle are known to feed on the plant. B. carinata may also be used as livestock fodder, or its meal may be used as a high protein animal feed when mixed with other protein sources.</p>
4.05	<p>1. Marillia, E. F., T. Francis, K. C. Falk, M. Smith, and D. C. Taylor. 2014. Palliser's promise: Brassica carinata, an emerging western Canadian crop for delivery of new bio-industrial oil feedstocks. <i>Biocatalysis and Agricultural Biotechnology</i> 3(1):65-74. 2. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 3. Getinet, A., G. Rakow, and R. K. Downey. 1996. Agronomic performance and seed quality of abyssinian mustard in Saskatchewan. <i>Canadian Journal of Plant Science</i> 76:387-392.</p>	<p>1. Brassicaceae plants produce a group of compounds known as glucosinolates (GSLs), which, when broken down, yield potential toxins. "The goitrogenic nature of this glucosinolate poses a serious constraint to the commercial use of B. carinata meal in animal feed capacity" 2. Birds, mule deer, squirrel, and cattle are known to feed on the plant. B. carinata may also be used as livestock fodder, or its meal may be used as a high protein animal feed when mixed with other protein sources. 3. Varieties that produce lower levels of toxins in the seeds are under development for use as animal feed [although there is no evidence of livestock death by B. carinata consumption, production of toxic chemicals is uniform across the family and yields a Yes answer]</p>

4.06	<p>1. R. Seepaul, C. M. Bliss, D. L. Wright, J. J. Marois, R. Leon, N. Dufault, S. George, and S. M. Olson. 2015 Production Manual for the Southeastern United States. Carinata, the Jet Fuel Cover Crop. http://agrisoma.com/wp-content/uploads/2015/09/Carinata_2015_SE-Production-Overview.pdf (10-23-2017) 2. CABI http://www.cabi.org/isc/datasheet/10091 (10-23-2017) 3. University of Florida, IFAS http://programs.ifas.ufl.edu/carinata/ (11-5-2018)</p>	<p>1. Since carinata is in the same family as canola, other mustards, and cabbage, their insect pests may be similar. Scouting for insect pests is a necessary management practice. Potential pests may include aphids (such as root aphid), cabbage seedpod weevil (<i>Ceutorhynchus obstrictus</i>), silverleaf whitefly (<i>Bemisia argentifolii</i>), and worm complex, which includes diamondback moth (<i>Plutella xylostella</i>), cabbage looper (<i>Trichoplusia ni</i>), and cabbageworm (<i>Pieris rapae</i>). This species is susceptible to the following pathogens: white mold, leaf spot, fusarium seed rot, and turnip mosaic virus. 2. Major host of: Beet western yellows virus (turnip (mild) yellows); <i>Galinsoga parviflora</i> (gallant soldier); <i>Phyllotreta cruciferae</i> (crucifer flea beetle); Minor host of: <i>Erysiphe cruciferarum</i> (powdery mildew of crucifers); <i>Sclerotinia sclerotiorum</i> (cottony soft rot); Turnip mosaic virus (cabbage A virus mosaic) 3. The isothiocyanates released by the hydrolysis of glucosinolates present in carinata are potent bio fumigants that could control soil borne diseases, insects, and weeds. Additionally, resistance of carinata to diseases such as black leg and <i>Sclerotinia</i> stem rot is superior to that displayed by other brassicas.</p>
4.07	<p>1. Singh, A., Shahi, S., Katiyar, R. K., Gaur, S., & Jain, V. (2014). Hypersensitivity to pollen of four different species of Brassica: a clinico-immunologic evaluation in patients of respiratory allergy in India. <i>Asia Pacific Allergy</i>, 4(4), 197–205. 2. Plants for a Future http://www.pfaf.org/User/Plant.aspx?LatinName=Brassica+carinata (10-23-2017) 3. University of Florida, IFAS http://programs.ifas.ufl.edu/carinata/ (11-5-2018)</p>	<p>1. Congeners were found to cause allergies in humans: "Out of the 159 atopic subjects tested, 21.38% were positive to at least one or other species of Brassica pollen, with highest skin positivity (13.20%) to <i>B. campestris</i> extract." 2. The oil contained in the seed of this species is rich in erucic acid which is toxic. However, modern cultivars have been selected which are almost free of erucic acid. 3. High erucic acid and glucosinolates make it unfit for human and animal consumption.</p>
4.08		no evidence
4.09		no evidence [grows as a cover crop, so it is unlikely to be shade tolerant]
4.10	<p>1. R. Seepaul, C. M. Bliss, D. L. Wright, J. J. Marois, R. Leon, N. Dufault, S. George, and S. M. Olson. 2015 Production Manual for the Southeastern United States. Carinata, the Jet Fuel Cover Crop. http://agrisoma.com/wp-content/uploads/2015/09/Carinata_2015_SE-Production-Overview.pdf (10-23-2017) 2. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 3. USDA Global Soils Map https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054013 (11-8-2017)</p>	<p>1. <i>B. carinata</i> performs well on sandy soils and sandy loam soils. 2. In Canada, <i>B. carinata</i> grows well in soil that is characterized by an organic decomposition layer, cool temperatures, and moderate drainage 3. Soil types in native regions match soil types in all three Florida zones.</p>

4.11	1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)	1. Plants have an erect bearing, averaging 1.4 m in height. [no evidence of smothering or climbing growth]
4.12		no evidence
5.01	Encyclopedia of Life http://eol.org/pages/490690/details (11-1-2017)	Family: Brassicaceae
5.02	Encyclopedia of Life http://eol.org/pages/490690/details (11-1-2017)	Family: Brassicaceae
5.03	Encyclopedia of Life http://eol.org/pages/490690/details (11-1-2017)	Herbaceous
5.04	Encyclopedia of Life http://eol.org/pages/490690/details (11-1-2017)	Herbaceous without underground storage organs.
6.01		no evidence
6.02	1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 2. Mnzava, N.A. & Schippers, R.R., 2007. Brassica carinata A. Braun In: van der Vossen, H.A.M. & Mkamilo, G.S. (Editors). PROTA 14: Vegetable oils/Oléagineux. [CD-Rom]. PROTA, Wageningen, Netherlands. 3. Plants for a Future http://www.pfaf.org/User/Plant.aspx?LatinName=Brassica+carinata (10-23-2017)	1. Produces viable seed 2. Reproduces by seed 3. Reproduces by seed
6.03	1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 2. Joshi P, Choudhary BR. 1999. Interspecific hybridization in Brassica. I. B. carinata x B. tournefortii. Proceedings of the 10th International Rapeseed Congress, Canberra, Australia. 26–29 Sept, 1999. Contribution No. 517. 3. Séguin-Swartz, G., H. J. Beckie, S. I. Warwick, V. Roslinsky, J. A. Nettleton, E. N. Johnson, and K. C. Falk. 2013. Pollen-mediated gene flow between glyphosate-resistant Brassica napus canola and B. juncea and B. carinata mustard crops under large-scale field conditions in Saskatchewan. Canadian Journal of Plant Science 93(6):1083-1087.	1. Brassica carinata can successfully hybridize with other Brassicaceae, such as B. napus, B. nigra, B. oleracea, B. rapa, B. tournefortii, B. juncea, Orychophragmus violaceus, Raphanus sativus and Sinapsis arvensis. 2. Demonstrated hybridization with other Brassicaceae, such as B. napus, B. nigra, B. oleracea, B. rapa, B. tournefortii 3. A field study with four hectare plots of B. carinata and glyphosate-resistant B. napus planted next to each other demonstrated these species can cross with each other under field conditions, albeit at a low rate

6.04	<p>1. Plants for a Future http://www.pfaf.org/User/Plant.aspx?LatinName=Brassica+carinata (10-23-2017) 2. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 3. Labana KS, Ahuja KL, Banga SS. 1987. Evaluation of some Ethiopian mustard (<i>Brassica carinata</i>) genotypes under Indian conditions. Proceedings of the 7th International Rapeseed Congress, Poznan, Poland, May 11–14, 1987. pp. 115.</p>	<p>1. The flowers are hermaphrodite (have both male and female organs). The plant is self-fertile. 2. Self-compatible 3. Self-pollination has been reported to occur from 46–88% of the time in 39 analyzed <i>B. carinata</i> accessions</p>
6.05		<p>no evidence, see 6.04 for evidence supporting self-pollination</p>
6.06	<p>1. Warwick SI, Francis A, Gugel RK. 2009. Guide to Wild Germplasm of Brassica and Allied Crops (tribe Brassiceae, Brassicaceae), 3rd Edition. PART III. Interspecific and intergeneric hybridization data. 2. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. no evidence of vegetative reproduction in the Brassica family 2. does not demonstrate potential for vegetative reproduction</p>
6.07	<p>1. R. Seepaul, C. M. Bliss, D. L. Wright, J. J. Marois, R. Leon, N. Dufault, S. George, and S. M. Olson. 2015 Production Manual for the Southeastern United States. Carinata, the Jet Fuel Cover Crop. http://agrisoma.com/wp-content/uploads/2015/09/Carinata_2015_SE-Production-Overview.pdf (10-23-2017) 2. Alemayehu, N., & Becker, H. (2002). Genotypic diversity and patterns of variation in a germplasm material of Ethiopian mustard (<i>Brassica carinata</i> A. Braun). Genetic Resources and Crop Evolution, 49(6), 573-582.</p>	<p>1. When planted in early November, seedling emergence and establishment occurs from 7 to 20 days after planting (DAP), 50% flowering occurs from 110 to 125 DAP, and pod development and maturation occur from 125 to 200 DAP, depending on variety. 2. In this experiment, plants matured from seed in 101-111 days.</p>
7.01	<p>The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Biology Document BIO2017-02, Plant and Biotechnology Risk Assessment Unit Plant Health Science Division, Canadian Food Inspection Agency Ottawa, Ontario (http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 accessed 3/9/2018).</p>	<p>Environmental dispersal through human intervention occurs occasionally from transport trucks, railcars and improperly cleaned harvesters – similar to <i>Brassica napus</i></p>

7.02	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of <i>Brassica carinata</i> (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 2. Stace, C. 2010. <i>New Flora of the British Isles</i> (3rd ed.). Cambridge University Press, Cambridge, United Kingdom. 1130 pp. 3. University of Florida, IFAS http://programs.ifas.ufl.edu/carinata/ (11-5-2018)</p>	<p>1. Introduced worldwide for cultivation and agricultural consideration 2. Grown as a game-cover in England 3. Being explored in the United States a bioenergy feedstock and bio-diesel</p>
7.03	<p>1. Weedy mustards, Brassicaceae (Cruciferae) of Canada (slightly modified from Mulligan, Gerald A. 2002. Weedy mustards (Brassicaceae) of Canada. <i>Canadian Field-Naturalist</i> 116: 623-631) http://weedscanada.ca/Weedy_mustards.htm (11-5-2017) 2. Hanson, C. G., and J. L. Mason. 1985. Bird seed aliens in Britain. <i>Watsonia</i> 15:237-252. 3. Clement, E. J., and M. C. Foster (eds.). 1994. <i>Alien Plants of the British Isles: A Provisional Catalogue of Vascular Plants (excluding grasses)</i>. Botanical Society of the British Isles, London, U.K. 590 pp.</p>	<p>1. Close congeners, <i>B. nigra</i> and <i>B. juncea</i> were introduced to Canada as seed contaminants. 2. This species is a known contaminant of bird seed in Great Britain 3. Bird seed contaminant in Great Britain</p>
7.04	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of <i>Brassica carinata</i> (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017) 2. Adeniji OT, Aloyce AA. 2012. Floral and seed variability patterns among Ethiopian mustard (<i>B. carinata</i> A. Braun) of East Africa. <i>Tropiculture</i> 30(3):133–140.</p>	<p>Furthermore, <i>B. carinata</i> seed does not possess wing or feather-like structures, so wind-mediated dispersal is expected to be negligible.</p>
7.05	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of <i>Brassica carinata</i> (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. It is unlikely water is a viable dispersal vector, only 5.5% and 0.2% of seeds float in non-turbulent and turbulent water respectively</p>

7.06	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p> <p>2. Zanetti F, Monti A, Berti MT. 2013. Challenges and opportunities for new industrial oilseed crops in EU-27: A review. <i>Industrial Crops and Products</i> 50:580–595.</p>	<p>1. While <i>B. carinata</i> dispersal through animal intervention has been proposed to occur through bird feeding, 2. observed feeding rates have been reported to be low</p>
7.07	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. No mechanism for attachment</p>
7.08	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. While <i>B. carinata</i> dispersal through animal intervention has been proposed to occur through bird feeding, 2. observed feeding rates have been reported to be low</p>

8.01	<p>1. R. Seepaul, C. M. Bliss, D. L. Wright, J. J. Marois, R. Leon, N. Dufault, S. George, and S. M. Olson. 2015 Production Manual for the Southeastern United States. Carinata, the Jet Fuel Cover Crop. http://agrisoma.com/wp-content/uploads/2015/09/Carinata_2015_SE-Production-Overview.pdf (10-23-2017)</p> <p>2. United States Department of Agriculture Animal and Plant Health Inspection Service December 1, 2014 Version 1 Weed Risk Assessment for Brassica carinata A. Braun (Brassicaceae) – Ethiopian mustard [citations: Getinet, A., G. Rakow, and R. K. Downey. 1996. Agronomic performance and seed quality of abyssinian mustard in Saskatchewan. Canadian Journal of Plant Science 76:387-392.; Alemayehu, N., and H. Becker. 2002. Genotypic diversity and patterns of variation in a germplasm material of Ethiopian mustard (Brassica carinata A. Braun). Genetic Resources and Crop Evolution 49(6):573-582.; Séguin-Swartz, G., H. J. Beckie, S. I. Warwick, V. Roslinsky, J. A. Nettleton, E. N. Johnson, and K. C. Falk. 2013. Pollen-mediated gene flow between glyphosate-resistant Brassica napus canola and B. juncea and B. carinata mustard crops under large-scale field conditions in Saskatchewan. Canadian Journal of Plant Science 93(6):1083-1087.; Warwick, S. I., R. K. Gugel, T. McDonald, and K. C. Falk. 2006. Genetic variation of Ethiopian mustard (Brassica carinata A. Braun) germplasm in western Canada. Genetic Resources and Crop Evolution 53(2):297-312.] Zanetti F, Monti A, Berti MT. 2013. Challenges and opportunities for new industrial oilseed crops in EU-27: A review. Industrial Crops and Products 50:580–595.</p>	<p>1. Pods are 1.5" to 2" long with an average of 10 to 16 seeds per pod and a 1000-seed weight ranging from 2.9 to 3.2 grams.</p> <p>2. "We found no information on seed production in natural populations, but there was some information on agronomic yield. In a study of plant traits under agronomic conditions, plants produced an average of 270 pods (range = 179 to 352) and 3300 seeds (range = 1900 to 5200) per plant (Alemayehu and Becker, 2002). Assuming at least two plants per square meter and 98 percent seed viability (Séguin-Swartz et al., 2013), two plants alone would be sufficient to meet the threshold of 5000 seeds per square meter. In another study, seed yield was 597 and 1267 kg/ha in 1984 and 1985, respectively (Getinet et al., 1996), with thousand-seed weights ranging from 3.7 g to 4.6 g in 1984 and from 4.9 g to 5.7 g in 1985 (Getinet et al., 1996). Using the heaviest estimates of seed weight, this yield converts to 13,000 and 22,000 seeds per square meter. Other studies reported similar thousand-seed weights: 3.48 g (Alemayehu and Becker, 2002) and 2.0 to 3.9 g (Warwick et al., 2006). Therefore, under field production where water, herbicides, and fertilizers may be used to maximize yield, B. carinata is a prolific reproducer."</p>
8.02	<p>1. Tokumasu, S., I. Kanada, and M. Kato. 1985. The change of dormancy and mustard oil content in seeds of Brassica juncea and B. carinata. Journal of the Japanese Society for Horticultural Science 54:75-81.</p>	<p>1. Seeds can survive dormant for several weeks [no other evidence of seed dormancy found]</p>
8.03	<p>1. Biology Document BIO2017-02: A companion document to Directive 94-08 (Dir94-08), Assessment Criteria for Determining Environmental Safety of Plant with Novel Traits. The Biology of Brassica carinata (A.) Braun (Abyssinian cabbage). Plant and Biotechnology Risk Assessment Unit, Plant Health Science Division, Canadian Food Inspection Agency. Ottawa, Ontario. Accessed at http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/brassica-carinata/eng/1501087371874/1501087468251 (11-1-2017)</p>	<p>1. Brassica carinata can be controlled with 2,4-D, or any broadleaf herbicide registered to control wild mustard or volunteer canola.</p>
8.04		no evidence
8.05		no evidence