Taxon: Lens culinaris Medik.

Family: Fabaceae

Common Name(s): lentil

Synonym(s):
Cicer lens (L.) Willd.
Ervum lens L.
Lathyrus lens (L.) Bernh.
Lens abyssinica Alef.
Lens camelorum (Spreng.) Webb &
Lens disperma (Roxb.) Webb & Berth.
Lens esculenta Moench
Lens lens Huth.
Lens nummularia Alef.
Lens sativa Heller
Lens vulgaris Delarbre
Lentilla lens (L.) W.Wight ex
Vicia lens (L.) Cosson & Germain
Vicia pisicarpa H. Léveillé

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 22 Apr 2022

WRA Score: **-1.5** **Designation:** L **Rating:** Low Risk

Keywords: Domesticated Crop, Annual, Edible, Self-Fertile, Human Dispersed

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

Qsn #	Question	Answer Option	Answer
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	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	n
604	Self-compatible or apomictic	y=1, n=-1	y
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	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)		

Qsn #	Question	Answer Option	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**y**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Lentil (Lens culinaris Med. ssp. culinaris) is indigenous to the Near East and central Asia (Ladizinsky 1979). Helena Barulina (1930) in her classic monograph on the genus Lens has suggested that the cultivated lentils originated from the wild species Lens orientalis (Boiss.) Handel- Mazetti now Lens culinaris ssp. orientalis (Boiss.) Ponert as one of the first domesticated crop plant in eastern Mediterranean region most likely in eastern Turkey and northern Syria. This had been confirmed recently also by various molecular markers (Sharma et al. 1995b) . The variation of subsp. culinaris is considerable, a primary centre of diversity is located from Hindukush to Afghanistan, secondary ones are in Ethiopia and the Mediterranean countries. The infraspecific variations has been studied by Barulina (1930) , Sharma et al. (1995a, b) Ladizinsky Abbo (1996) – three subspecies, several geographical groups (greges) and more than 50 botanical varieties. Domestication of the lentil lead to the evolution of two major seed groups (formerly subspecies) – cultivar group macrosperma (6–9 mm seed diameter) in Mediterranean Europe, Asia minor and Americas and the cultivar group microsperma (2–6 mm diameter) mainly in western Asia and Ethiopia (Sharma et al. 1995a) ."

102	**Has the species become naturalized where grown?**	**y**
	Source(s)	**Notes**
	DiTomaso, J. (2007). Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Annual crop; uncommon escape; disturbed sites; ID, LA, ne states; native to old world"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as a weed of unspecified or unsubstantiated impacts in a number of locations.

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Lentil is a poor competitor with weeds, especially when young. It should be sown in a clean field and weeding should generally be done within 3 weeks after sowing."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as a weed of unspecified or unsubstantiated impacts in a number of locations.

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**

Qsn #	Question	Answer
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 19 Apr 2022]	"Asia-Temperate WESTERN ASIA: Afghanistan (e.), Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey CAUCASUS: Azerbaijan, Georgia MIDDLE ASIA: Kazakhstan (s.), Tajikistan, Turkmenistan, Uzbekistan Asia-Tropical INDIAN SUBCONTINENT: Pakistan (n.w.) Europe SOUTHEASTERN EUROPE: Greece"
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"They are not suited to the hot, humid tropics where they are grown in the cool highlands above 3,000 m altitude."

202	Quality of climate match data	High
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 19 Apr 2022]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Lentil is adapted to cool growing conditions, and the young plants are tolerant of spring frosts allowing early spring planting dates. They are not suited to the hot, humid tropics where they are grown in the cool highlands above 3,000 m altitude. Lentil tolerates a mean annual temperature range of 6–27°C but 24°C is the optimum mean temperature for high economic yield. Lentils will produce high yields of good quality seed in areas with 750 mm per year but will tolerate mean annual rainfall of 280–2,430 mm. Lentils have been grown extensively in the semiarid parts of the world, where they have slightly lower yields, but good seed quality. High humidity and excessive rainfall during the season encourages vegetative growth, which prevents good yield and can reduce seed quality. Excessive drought and/or high temperatures during the fl owering and pod-fi ll period also reduce yields. Lentils are long-day plants though some cultivars are day-neutral."
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil is grown as a summer annual in temperate regions and as a winter annual in subtropical regions. In the tropics it is cultivated at higher elevations (1800–2500(– 2700) m in Ethiopia) or as a cool season crop. It grows at mean temperatures of 6–27°C, but lentil is not suited to the hot and humid tropics. Intense or prolonged frost and temperatures much higher than 27ºC seriously affect growth. Lentil requires an annual rainfall of about 750 mm, with dry conditions around harvest time, but an annual rainfall of 300–2400 mm is tolerated. It is moderately tolerant to drought, but differences exist between cultivars."

Qsn #	Question	Answer
204	**Native or naturalized in regions with tropical or subtropical climates**	**n**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"They are not suited to the hot, humid tropics where they are grown in the cool highlands above 3,000 m altitude."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"The main lentil producers are India, Turkey and Syria and other countries of SW and S Asia, S Europe, Ethiopia and north America. Today, Canada is the world's largest exporter of lentils to the global marketplace, selling to over 100 countries each year. The most commonly grown lentils in Canada are the large green lentil (Laird-type) and the red lentil. Small and medium sized green lentils are also common as well as limited quantities of Spanish brown, French green and beluga lentils."

Qsn #	Question	Answer
301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	DiTomaso, J. (2007). Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Annual crop; uncommon escape; disturbed sites; ID, LA, ne states; native to old world"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"References: United States of America-CW-34, Finland-U-42, United States of America-N-101, New Zealand-UW-280, United Kingdom-UZD-314, Czech Republic-U-400, Canary Islands-N-305, United Kingdom-N-519, New Zealand-N-534, Australia-Z-611, Ukraine-UC-643, Austria-UC-708, Canada and United States of America-N-725, Lithuania-I-737, Crete-N-771, Mexico-N-791, Spain-W-807, United Kingdom-U-812, Ireland-U-894, New Zealand-U-919, Mozambique-nC-943, United Kingdom-Z-944, India-N-976, France-N-1006, France-N-1006, Greece-N-1006, Portugal-N-1006, Portugal-N-1006, Slovakia-N-1006, Turkey-N-1006, Europe-N-1072, Portugal-N-898, Europe-N-819, Greece-U-1142, Spain-U-1149, Crete-U-1150, Belgium-UD-1220, Norway-N-1243, Georgia-UR-1250, Italy-U-251, Italy-N-1265, Ukraine-N-1335, Sardinia-U-1336, Sardinia-U-1381, Spain-U-1454, Spain-U-1455, Slovakia-U-1484, Global-ZD-1495, Czech Republic-U-1522, Ethiopia-ZD-1437, Estonia-W-1609, Austria-W-1609, Denmark-W-1609, Russia-W-1609, Germany-W-1609, Lithuania-W-1609, Norway-W-1609, Sweden-W-1609, Global-CD-1611, Australia-ZD-1675, Czech Republic-U-1731, Croatia-N-1747, Australia-Z-1768, Ukraine-N-1813, Sardinia-U-1393, Chile-I-1872, Mexico-N-1881, Italy-U-1887, Sardinia-U-1917, Nepal-A-1932, Nepal-A-1981, Bosnia and Herzegovina-U-1987, Estonia-N-1997, Ukraine-U-2014, Spain-N-2027, New Zealand-U-2048, Austria-W-1977, Belgium-W-1977, Canada-W-1977, Chile-W-1977, Croatia-W-1977, Cyprus-W-1977, Czech Republic-W-1977, Denmark-W-1977, France-W-1977, Germany-W-1977, Greece-W-1977, Italy-W-1977, Lithuania-W-1977, Mexico-W-1977, Mongolia-W-1977, Norway-W-1977, Portugal-W-1977, Slovakia-W-1977, Spain-W-1977, Sweden-W-1977, Turkey-W-1977."

302	Garden/amenity/disturbance weed	
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 20 Apr 2022]	"Lentil is a poor competitor with weeds, especially when young. It should be sown in a clean field and weeding should generally be done within 3 weeks after sowing."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as a weed of unspecified or unsubstantiated impacts in a number of locations.
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	Site includes a list of pests and pathogens affecting Lens culinaris subsp. culinaris (lentil) but does not describe this species as a weed of agriculture or the natural environment.

303	Agricultural/forestry/horticultural weed	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals" [Cited references do not describe or specify impacts]
	Sharma, L. N., Chaudhary, R. P., & Gupta, V. N. P. (2010). Weed diversity in the trans-himalayan wheat fields of Upper Manang, Nepal. Sustainable Use of Biological Resources in Nepal. Ecological Society (ECOS), Kathmandu, 72-78	[Includes in a list of weeds in wheat fields, but impacts described are potentially positive] "The leguminous weeds in the crop field were found in good number. Medicago sativa was found located in almost all sampling plots. Other species of legumes present in the field were M. lupulina, Trigonella emodi, Lens culinaris and Argyrolobium roseum but they were found less frequent in occurrence. Being the nitrogen fixing plant species the leguminous weeds enjoy special status. Its higher frequency occurrence in cropfield is beneficial as green manure and also as nutritive fodder."
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	Site includes a list of pests and pathogens affecting Lens culinaris subsp. culinaris (lentil) but does not describe this species as a weed of agriculture or the natural environment.

304	Environmental weed	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil is a poor competitor with weeds, especially when young. It should be sown in a clean field and weeding should generally be done within 3 weeks after sowing. Lentil normally responds well to P fertilizer."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Other species potentially weedy. Impacts unverified

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Slender, semi-erect, annual plant with compact growth, 10–50 cm tall. Stem pubescent, angular and branched from the base. Stipules 3–7 mm, oblong, elliptic or lanceolate, entire, white and villous. Leaves alternate, compound with tendril at the tip, rachis densely hairy with 4–12 pairs of sessile, oval, pubescent leaflets, 6–20 × 2–5 mm"

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Paul, N. K., & Begum, N. (2010). Allelopathic effect of argemone mexicana L. On germination and seedling growth characteristics of lentil (lens culinaris). Journal of Bio-science, 18: 146-147	[Unknown. No evidence found. Several studies, such as the one cited here, evaluate the allelopathic effects of weeds on lentils and other crops] "Weeds are considered unwanted plants that cause damage to agricultural crop plants. They compete with crops, harbour diseases and insects and act as alternate host when present in the fields. Argemone mexicana L. is a notorious weed and is found growing abundantly along with many crop plants. Little work has been done to evaluate its allelopathic effect (Pandey et al. 1980). Molisch (1973) coined the term allelopathy which refers to all the biochemical interactions (stimulatory or inhibitory) among the plants. The present investigation deals with the study of allelopathic effect of A. mexicana on germination and seeding growth characteristics of lentil."

403	Parasitic	n
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Slender, semi-erect, annual plant with compact growth, 10–50 cm tall." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Plants for a Future. (2022). Lens culinaris. https://pfaf.org. [Accessed 22 Apr 2022]	"Known Hazards None known"
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Lentil seeds are occasionally fed to animals as a source of protein, particularly to poultry. They are sometimes used as a source of starch for the textile and printing industries. The husks, bran and fresh or dried leafy stems provide fodder for livestock. Lentil is sometimes grown for forage or as green manure, though the dry matter production is low."

405	Toxic to animals	n
	Source(s)	**Notes**
	Plants for a Future. (2022). Lens culinaris. https://pfaf.org. [Accessed 22 Apr 2022]	"Known Hazards None known"
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[No evidence] "Lentil seeds are occasionally fed to animals as a source of protein, particularly to poultry. They are sometimes used as a source of starch for the textile and printing industries. The husks, bran and fresh or dried leafy stems provide fodder for livestock. Lentil is sometimes grown for forage or as green manure, though the dry matter production is low."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"In crop rotations planting lentil after other legumes, Brassica crops, sunflower or potato should be avoided because these are susceptible to the same diseases." ... "The economically most important diseases of lentil are rust (Uromyces viciae-fabae), Ascochyta blight (Ascochyta fabae f.sp. lentis), grey mould (Botrytis cinerea), Stemphylium blight (Stemphylium botryosum), collar rot (Sclerotium rolfsii) and fusarium wilt (Fusarium oxysporum f.sp. lentis). Other fungal diseases include Rhizoctonia root rot (Rhizoctonia solani), powdery mildew (Erysiphe polygoni, Leveillula taurica), anthracnose (Colletotrichum spp.), leaf spot (Alternaria alternata) and Sclerotinia stem and root rot (Sclerotinia sclerotiorum). Rust, fusarium wilt and root rot are the most important diseases in Sudan, Eritrea and Ethiopia. Yield losses of 10% due to rust and 50% due to fusarium wilt and root rot have been recorded on Vertisol-grown lentil in Ethiopia. Symptoms of rust are leaves and stems losing their green colour and turning purple, in case of serious infection leading to death of the plant. The spread of rust is favoured by high humidity and moderate temperatures (17–25ºC). Control measures include destruction of diseased plants, treatment of seed with fungicide, and the use of resistant cultivars. Fusarium wilt causes leaf curling, followed by wilting of individual branches or the whole plant. It is favoured by light, dry soils. Suggested control measures are crop rotation, treatment of seed with fungicide, and the use of resistant cultivars. Integrated disease management packages have been developed to control wilt and root rot in Ethiopia and Sudan. Seed treatment compounds should be selected and used with care as they can interfere with the nodulation process. Several virus diseases affect lentil, the most important being cucumber mosaic virus (CMV), faba bean necrotic yellows virus (FBNYV), alfalfa mosaic virus (AMV) and tomato spotted wilt virus (TSWV). Pea seed-borne mosaic virus (PSbMV) is common in Ethiopia. Among the common insect pests of lentil, aphids are important. The pea aphid (Acrythosiphon pisum) is the most important aphid in Ethiopia, causing up to 25% yield loss. Stored seeds are attractive to bruchids (Callosobruchus spp.). Broomrape (Orobanche spp.) is an important parasitic weed on lentil in the Mediterranean region and western Asia; it is difficult to control by management practices or genetic means."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Plants for a Future. (2022). Lens culinaris. https://pfaf.org. [Accessed 22 Apr 2022]	"Known Hazards None known"

Qsn #	Question	Answer
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Lentil is primarily grown for its mature seeds, which are consumed mainly in sauces and soups. In Ethiopia they are used in 'kik wot' (sauce of split seeds), soup (from whole seeds or flour), 'nufro' (boiled and salted), 'azifa' (cooked and mashed) and 'elbet' (paste from flour). Many other dishes are prepared from lentil in different countries. Some of these are: spicy lentil salad, lentil burgers with coriander-yoghurt sauce, lentil and mushroom cottage pie and lentil potatoes. In India split seeds (dhal) are used in soups and the whole seed is eaten salted and fried. The seeds are ground into flour used for cakes and bread and for the preparation of special foods, e.g. for infants and invalids. Young pods, sprouted seeds and leaves are eaten as vegetable. Lentil seeds are occasionally fed to animals as a source of protein, particularly to poultry. They are sometimes used as a source of starch for the textile and printing industries. The husks, bran and fresh or dried leafy stems provide fodder for livestock. Lentil is sometimes grown for forage or as green manure, though the dry matter production is low. Lentil straw is used as fuel. The seeds are believed to remedy constipation and other intestinal problems. In India they are applied as a poultice to slow-healing sores. In Ethiopia the seeds are credited with aphrodisiac properties."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence. Medicinal uses] "Used in Ayurveda and Unani. Lentils mucilaginous, aphrodisiac and laxative, used in the treatment of constipation and gastrointestinal disorders, a decoction in warm water taken in smallpox; a paste applied to ulcers, slow-healing sores and wounds; covering styptic and astringent."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[No evidence. Primarily a cultivated crop, although plants may persist or locally naturalize from cultivated sites] "Lentil is grown as a summer annual in temperate regions and as a winter annual in subtropical regions. In the tropics it is cultivated at higher elevations (1800–2500(– 2700) m in Ethiopia) or as a cool season crop. It grows at mean temperatures of 6–27°C, but lentil is not suited to the hot and humid tropics. Intense or prolonged frost and temperatures much higher than 27ºC seriously affect growth. Lentil requires an annual rainfall of about 750 mm, with dry conditions around harvest time, but an annual rainfall of 300–2400 mm is tolerated. It is moderately tolerant to drought, but differences exist between cultivars. Lentil normally requires long daylengths for flowering, but the response varies among genotypes, and some cultivars are daylength insensitive."

Qsn #	Question	Answer
409	**Is a shade tolerant plant at some stage of its life cycle**	**n**
	Source(s)	**Notes**
	Tropical Plants Database, Ken Fern. (2022). Lens culinaris. http://tropical.theferns.info. [Accessed 19 Apr 2022]	"An easily grown plant[K], it prefers a sandy soil in a warm sunny sheltered position[27, 37, 200]."
	Plants for a Future. (2022). Lens culinaris. https://pfaf.org. [Accessed 19 Apr 2022]	"It cannot grow in the shade."

Qsn #	Question	Answer
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil can be grown on a wide range of soil types, from sandy to fairly heavy clay soils, but does not tolerate flooded or waterlogged soils. A pH near 7.0 is best for lentil production, but it tolerates a pH of 4.5–9.0. Lentil is generally very sensitive to salinity."
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Lentil is adapted to all soil types, including sandy, light loams, alluvial, clayey and black cotton soils provided there is good drainage. Lentil does not tolerate flooded or waterlogged soils, and does best on deep, sandy loam soils high in phosphorus and potassium. Lentils tolerate a pH range of 4.5–8.2 but thrive best at pH of 5.5–7."

Qsn #	Question	Answer
411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Slender, semi-erect, annual plant with compact growth, 10–50 cm tall. Stem pubescent, angular and branched from the base."

Qsn #	Question	Answer
412	**Forms dense thickets**	**n**
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[No evidence. Primarily a cultivated crop, although plants may persist or locally naturalize from cultivated sites] "Lentil is a poor competitor with weeds, especially when young."

Qsn #	Question	Answer
501	**Aquatic**	**n**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	[Terrestrial] "Slender, semi-erect, annual plant with compact growth, 10–50 cm tall."

Qsn #	Question	Answer
502	**Grass**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 19 Apr 2022]	"Family: Fabaceae (alt. Leguminosae) Subfamily: Faboideae Tribe: Fabeae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	[N-fixing herb] "Lentil is effectively nodulated by Rhizobium leguminosarum."

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Erect, pale green annual herb up to 60(–75) cm tall; stem square, much-branched; taproot slender."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[No evidence] "Lentil is one of the oldest pulse crops and of ancient cultivation in western Asia, Egypt and southern Europe. It probably originated in western Asia, from where it spread into the Mediterranean region, Asia, Africa and Europe. Lentil was a common part of the diet of the ancient Greeks, Jews and Romans and was the mainstay of the poor, especially in Egypt. It was associated with many legends, tales and customs, and it is the first pulse crop mentioned in the Bible. The oldest archaeological remains of lentil are from Greece, dated 11,000 BC, and Syria, dated 8500–7500 BC. However, it is uncertain whether they were from cultivated plants or from wild ones. It is from the 5th millennium BC that unequivocally domesticated lentil seeds have been found. Lentil has been introduced into the Americas, New Zealand and Australia. It is now widely cultivated in temperate and subtropical regions, and in the tropics at higher elevations and in cool seasons. In tropical Africa it is grown in Sudan, Eritrea, Ethiopia (mainly in the northern, central and eastern Highlands), Kenya, Tanzania, Malawi, Zimbabwe, Madagascar, Réunion and Mauritius. It is also cultivated in Morocco, Tunisia, Algeria, Libya, Egypt and South Africa."

602	Produces viable seed	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil is propagated by seed. The 1000-seed weight ranges from 10–90 g. Seeds remain viable for more than 5 years under cool and dry storage conditions. A dormancy period of 4–6 weeks is common, and some cultivars have been found to be responsive to vernalization. The minimum temperature for germination is 15ºC and the optimum temperature 18–21ºC; temperatures above 27ºC are harmful. A firm, smooth seedbed is best for lentil. The seed is broadcast, or planted in rows 20–90 cm apart with 5–25 cm between plants within the row. Seed rates range from only 10 kg/ha in intercropping systems to 150 kg/ha for sole-cropped large-seeded cultivars. The sowing depth is 1–6 cm depending on seed size and moisture availability."

603	Hybridizes naturally	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[No evidence of natural hybridization] "Wild relatives are considered potentially valuable to improve the tolerance to environmental stresses. Different institutions are studying crossability of these wild relatives among themselves and with cultivated lentil. Crosses between Lens culinaris and Lens ervoides or Lens nigricans usually abort, but F1 hybrids can be rescued and produce viable and largely fertile F2 segregates."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil is usually self-fertilized, but up to 1% cross-pollination by insects may occur."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Lentil is usually self-fertilized, but up to 1% cross-pollination by insects may occur."

Qsn #	Question	Answer
606	**Reproduction by vegetative fragmentation**	**n**
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Lentil is propagated by seed."

607	**Minimum generative time (years)**	**1**
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"At optimum temperatures lentil seeds germinate in 5–6 days. Flowering starts 6–7 weeks after sowing. Lentil is usually self-fertilized, but up to 1% cross-pollination by insects may occur. The growth cycle ranges from 80–110 days for early-maturing cultivars to 125–130 days for late-maturing ones."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	Online Atlas of the British and Irish flora. (2022). Lens culinaris. https://www.brc.ac.uk/plantatlas/plant/lens-culinaris. [Accessed 19 Apr 2022]	"An annual found on rubbish tips and waste ground where it arises from grain and food-refuse. Lowland."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Horse, Livestock, Sheep, Vehicles, Escapee"

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"The main lentil producers are India, Turkey and Syria and other countries of SW and S Asia, S Europe, Ethiopia and north America. Today, Canada is the world's largest exporter of lentils to the global marketplace, selling to over 100 countries each year. The most commonly grown lentils in Canada are the large green lentil (Laird-type) and the red lentil. Small and medium sized green lentils are also common as well as limited quantities of Spanish brown, French green and beluga lentils."

703	**Propagules likely to disperse as a produce contaminant**	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Potentially as a cultivated crop, but unable to corroborate from cited references] "Major Pathway/s: Contaminant, Crop, Herbal, Ornamental Dispersed by: Humans, Animals, Cattle, Horse, Livestock, Sheep, Vehicles, Escapee"

704	**Propagules adapted to wind dispersal**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	"Legume yellow, oblong, inflated or compressed, smooth, 10–20 mm long. Seed small, 2–7 mm, round, biconvex, lens-shaped, yellow, greenish, tan, brown, red (Plates 3 – 5), black, purplish or mottled with red, orange, yellow or green to greenish yellow cotyledons." [No adaptations for wind dispersal]

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Horse, Livestock, Sheep, Vehicles, Escapee"
	Ladizinsky, G. (1979). Seed Dispersal in Relation to the Domestication of Middle East Legumes. Economic Botany, 33(3), 284-289	"Plants of L. orientalis are tiny, producing several pods which dehisce and immediately shatter their seeds when dry. In the cultivated lentil the dry pods remain intact for a long time and thus can be harvested and threshed." [Unlikely]

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Horse, Livestock, Sheep, Vehicles, Escapee"
	Lim, T.K. (2012). Edible Medicinal and Non-Medicinal Plants. Volume 2, Fruits. Springer, New York	[Not fleshy-fruited] "Legume yellow, oblong, infl ated or compressed, smooth, 10–20 mm long. Seed small, 2–7 mm, round, biconvex, lens-shaped, yellow, greenish, tan, brown, red (Plates 3– 5), black, purplish or mottled with red, orange, yellow or green to greenish yellow cotyledons."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Fruit a rhomboid, laterally compressed pod, 6–20 mm × 3.5–12 mm, short-beaked, 1–2(–3)-seeded. Seeds lens-shaped, 2–9 mm × 2–3 mm, grey, green, brownish green, pale red speckled with black, or black; hilum minute." [No means of external attachment]

708	Propagules survive passage through the gut	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, Cattle, Horse, Livestock, Sheep, Vehicles, Escapee"
	Seman, R. (2007). Dung seed bank of livestock in Weberi Addis Ababa, Ethiopia. MSc Thesis. Addis Ababa University, Addis Ababa, Ethiopia	[Seeds collected in cattle dung] "In dung samples the density of seeds fluctuated within sampling period, it was the highest in November (Table 4.2.2 a-e). Latirus sativus and Lens culinaris (Fabaceae) were found only in February and March (Table.4.4)."

801	Prolific seed production (>1000/m2)	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	[Potentially in cultivation. Unknown in natural conditions] "The average lentil seed yield in Ethiopia is about 600 kg/ha, which is below the average world yield of about 800 kg/ha. In the Ethiopian highlands, where the growing period is long, yields of about 4 t/ha have been obtained in experiments, and more than 2 t/ha in farmer's fields when the recommended agronomic package was applied. In Asia average seed yields are 300–600 kg/ha in mixed crops and 900–1100 kg/ha for sole crops. Leafy stem yields of up to 7 t/ha are possible for late-type lentils in Ethiopia."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 19 Apr 2022]	"Seeds remain viable for more than 5 years under cool and dry storage conditions. A dormancy period of 4–6 weeks is common, and some cultivars have been found to be responsive to vernalization." [Unknown, but possible, under natural conditons]

803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	Rizwan, M., Aslam, M., Asghar, M. J., Abbas, G., Shah, T. M., & Shimelis, H. (2017). Pre-breeding of lentil (Lens culinaris Medik.) for herbicide resistance through seed mutagenesis. PloS one, 12(2), e0171846	[Potentially if bred and selected for herbicide resistance] "Lentil is a poor competitor of weeds and its sensitivity to herbicides is a major hurdle for large scale production. The present study was conducted to select herbicide resistant lentil genotypes through seed mutagenesis. Seeds of three advanced lentil genotypes (LPP 11001, LPP 11100 and LPP 11116) were treated with two different concentrations of ethyl methanesulfonate (EMS; 0.1 and 0.2%), hydrazine hydrate (HH; 0.02 and 0.03%) and sodium azide (SA; 0.01 and 0.02%) to develop M1 seed. The M2 was screened against two herbicides including Ally Max 28.6% SG (X = 34.58 g/ha and 1.5X = 51.87 g/ha) and Atlantis 3.6% WG (X = 395.2 g/ha and 1.5X = 592.8 g/ha) using the following three screening methods: post plant emergence (PPE), pre-plant incorporation (PPI) and seed priming (SP). Data were recorded on survival index and survival percentage from each experimental unit of every population. Plants in all populations were categorized following their reaction to herbicides. The newly developed populations showed greater variation for herbicide resistance when compared to their progenitors. Phenotypic traits were significantly reduced in all the screening environments. Overall, 671 herbicide resistant mutants were selected from all testing environments. The seeds from selected plants were re-mutagenized at 150 Gy of gamma radiation and evaluated against higher dose of herbicides. This allowed selection of 134 herbicide resistant mutants. The selected mutants are useful germplasm for herbicide resistance breeding of lentil."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bejiga, G. (2006). Lens culinaris Medik. [Internet] Record from PROTA4U. Brink, M. & Belay, G. (Editors). PROTA (Plant Resources of Tropical Africa), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 22 Apr 2022]	"Lentil is a poor competitor with weeds, especially when young. It should be sown in a clean field and weeding should generally be done within 3 weeks after sowing." [Unlikely. An annual that does not compete well with weeds. Suggests it will not resprout if damaged by mechanical means or fire]

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• A widely cultivated, domesticated crop that is either naturalized or escaped and persisting in places where cultivated
• Potential host of crop pests and pathogens
• Tolerates many soil types (not substrate limited)
• Reproduces by seeds
• Self-fertile
• Reaches maturity in 6-7 weeks from seed
• Seeds dispersed in grain and food waste, in animal dung, and through intentional cultivation
• Seeds remain viable for up to 5 years in cool, dry storage (potential to form a seed bank under certain natural conditions)

Low Risk Traits
• A widely cultivated, domesticated crop with no definitive reports of negative impacts to agriculture or the natural environment
• Unarmed (no spines, thorns, or burrs)
• Palatable to animals and humans
• Non-toxic
• Grows best in high light environments (dense shade may inhibit spread)
• Relatively large seeds unlikely to be accidentally dispersed long distances