

Taxon: Cannabis sativa L.	Family: Cannabaceae
Common Name(s): marijuana Paka lōlō dagga dope grass hemp mota pot reefer	Synonym(s): Cannabis indica Lam. Cannabis ruderalis Janisch. Cannabis sativa L. subsp. indica Cannabis sativa L. subsp. indica

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 27 Feb 2019
WRA Score: 12.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Domesticated Plant, Weedy Varieties, Medicinal, Mostly Dioecious, 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?	y=1, n=-1	y
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Intermediate
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	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)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	n
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	y
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
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	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	y=1, n=-1	y
604	Self-compatible or apomictic		
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)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal		
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
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
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Presumed to be native to central Asia, but one of the most ancient of cultivated species" ... "A large number of species and infraspecific taxa have been described for this plant. The intoxicant cultivars have been referred to subsp. indica. Most of the variation appears to be the result of its long history of cultivation, perhaps for as much as 8,500 years (Small & Cronquist, 1976)."

102	Has the species become naturalized where grown?	y
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). Cannabis: Evolution and Ethnobotany. University of California Press, Berkeley and Los Angeles, CA	"Presently, Cannabis has a wide natural or naturalized range existing as feral and possibly wild populations across much of temperate Eurasia, having evolved into two extant species encompassing four cultivated and two feral subspecies"

103	Does the species have weedy races?	y
	Source(s)	Notes
	Small, E. (2017). Classification of Cannabis sativa L. in relation to agricultural, biotechnological, medical and recreational utilization. Pp. 1-62 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). Cannabis sativa L.- Botany and Biotechnology. Springer, Cham, Switzerland	"The many different kinds of plant of C. sativa can be grouped into four basic utilitarian categories, including: (1) "wild" (weedy) plants that have escaped from cultivation and grow independently in nature; and three groups of cultivated plants that have been selected for distinctive economic products" ... "Ditchweed is a pejorative American (U.S.) term originally referring to wild-growing low-THC weedy plants common in the eastern U.S. and adjacent Canada, capable only of yielding low-quality marijuana." ... "The "seeds" (achenes) of weedy plants differ dramatically from those of plants domesticated for fiber, oilseed or illicit drugs (Small 1975; Fig. 1.3). Usually the seeds of wild plants are smaller than 3.8 mm in length, in contrast to the larger seeds of domesticated selections."

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Intermediate
	Source(s)	Notes
	Duke, J. A. (1983). Cannabis sativa. Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 26 Feb 2019]	"Native to Central Asia, and long cultivated in Asia, Europe, and China. Now a widespread tropical, temperate and subarctic cultivar and waif."

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 26 Feb 2019]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	CABI. (2019). <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. www.cabi.org/isc	" <i>C. sativa</i> grows from sea level to 3700 m in altitude, and from the equator to approximately 63° latitude (such as in Finland). Fibre hemp cultivars grow well at 40-55° latitude, and they perform poorly in semi-tropical and tropical latitudes. However, drug varieties were bred in semitropical and tropical locations, and have poor growth at high latitudes (above 45°), because frost often kills the plants before flowering."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	" <i>Cannabis</i> is particularly adept at naturalizing to a range of temperate and subtropical climates."
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 26 Feb 2019]	"Plants very adaptable to soil and climatic conditions. Hemp for fiber requires a mild temperate climate with at least 67 cm annual rainfall, with abundant rain while seeds are germinating and until young plants become established. Thrives on rich, fertile, neutral to slightly alkaline, well drained silt or clay loams with moisture retentive subsoils; does not grow well on acid, sandy soils. Of the many types of hemp, some are adapted to most vegetated terrains and climates. Ranging from Cool Temperate Steppe to Wet through Tropical Very Dry to Wet Forest Life Zones, marijuana is reported to tolerate annual precipitation of 3 to 40 dm (mean of 44 cases = 9.9 dm), annual temperature of 6 to 27°C (mean of 44 cases = 14.4), and pH of 4.5 to 8.2 (mean of 38 cases 6.5) (Duke, 1978, 1979)."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Small, E. (2017). Classification of <i>Cannabis sativa</i> L. in relation to agricultural, biotechnological, medical and recreational utilization. Pp. 1-62 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). <i>Cannabis sativa</i> L.- Botany and Biotechnology. Springer, Cham, Switzerland	"Both wild and cultivated plants that grow for many generations in a particular location have evolved adaptations to their local climates, and these adaptations may make a given biotype quite unsuitable for a foreign location. Compared to marijuana strains, which typically originate from semi-tropical and/or very dry regions, most hemp biotypes are comparatively better adapted to temperate, mild, relatively cool, moist conditions. Nevertheless, optimal temperature for hemp germination is frequently about 24°C, a rather elevated temperature reflecting adaptation to a relatively warm subtropical climate."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i widely cultivated in small, hidden plots throughout the islands for illicit drug trade or personal use. Although .not known to be naturalized in Hawai'i, <i>Cannabis</i> is included because it is encountered in cultivation so frequently in native habitats."

Qsn #	Question	Answer
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 26 Feb 2019]	"Native to Central Asia, and long cultivated in Asia, Europe, and China. Now a widespread tropical, temperate and subarctic cultivar and waif."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Presumed to be native to central Asia, but one of the most ancient of cultivated species, widely cultivated and naturalized in many areas"

301	Naturalized beyond native range	y
	Source(s)	Notes
	Mack, R. (2003). Plant Naturalizations and Invasions in the Eastern United States: 1634-1860. <i>Annals of the Missouri Botanical Garden</i> , 90(1), 77-90	" <i>Cannabis saliva</i> is widely naturalized in the eastern half of the U.S. north of the 37° latitude (Haney & Bazzaz, 1970)."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"in Hawai'i widely cultivated in small, hidden plots throughout the islands for illicit drug trade or personal use. Although .not known to be naturalized in Hawai'i, <i>Cannabis</i> is included because it is encountered in cultivation so frequently in native habitats."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Presently, <i>Cannabis</i> has a wide natural or naturalized range existing as feral and possibly wild populations across much of temperate Eurasia, having evolved into two extant species encompassing four cultivated and two feral subspecies."

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Although <i>Cannabis</i> is well adapted to naturally disturbed environments as well as weedy habitats or other areas disturbed by humans, it probably did not evolve as a weed in cultivated fields." ... "Escaped and weedy <i>Cannabis</i> grows along roadsides, in ditches, and on fallow land or fields sown in <i>Cannabis</i> or other crops." [Disturbance-adapted and may impact agriculture]

303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	Tiourebaev, K. S., et al. (2001). Biological control of infestations of ditchweed (<i>Cannabis sativa</i>) with <i>Fusarium oxysporum</i> f. sp. <i>cannabis</i> in Kazakhstan. <i>Biocontrol Science and Technology</i> , 11(4), 535-540	"Ditchweed (<i>Cannabis sativa</i> L.) is widely distributed throughout the southeast part of Kazakhstan, infesting both grassland and agricultural areas. In South Kazakhstan, non-cultivated <i>Cannabis</i> plants can be found in spatially continuous stands, with one such stand in the Chu River Valley covering approximately 125 000 ha. Chemical and manual methods of weed management have provided minimal long-term control of this persistent weed in this area."

Qsn #	Question	Answer
	Pandey, J. (1989). Effect of Cannabis sativa infestation on yield of rabi maize. Indian Journal of Agronomy, 34(1), 109-110	"Field trials during rabi 1981-82 in Bihar showed that hand weeding 25 or 25 and 45 days after sowing (DAS), pre-em. metribuzin at 0.5 kg/ha and pendimethalin at 1.0 kg/ha, and post-em. 2,4-D at 0.8 kg/ha all increased maize yield and suppressed C. sativa growth, with metribuzin, pendimethalin and hand weeding twice being the most effective treatments."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Lupins, Orchards & Plantations, Pastures, Vegetables"

304	Environmental weed	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Although not known to be naturalized in Hawai'i, Cannabis is included because it is encountered in cultivation so frequently in native habitats."
	Small, E. (2017). Classification of Cannabis sativa L. in relation to agricultural, biotechnological, medical and recreational utilization. Pp. 1-62 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). Cannabis sativa L.- Botany and Biotechnology. Springer, Cham, Switzerland	"The many different kinds of plant of C. sativa can be grouped into four basic utilitarian categories, including: (1) "wild" (weedy) plants that have escaped from cultivation and grow independently in nature; and three groups of cultivated plants that have been selected for distinctive economic products" ... "Ditchweed is a pejorative American (U.S.) term originally referring to wild-growing low-THC weedy plants common in the eastern U.S. and adjacent Canada, capable only of yielding low-quality marijuana."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Lupins, Orchards & Plantations, Pastures, Vegetables"

305	Congeneric weed	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"A genus of one extremely variable species that has diversified further under cultivation as a source of fiber or of the psychotropic drugs marijuana and hashish."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Stout annual herbs 1-3 m tall. Leaflets (1-)3-7(-11), narrowly lanceolate to linear, 5-15 cm long, 0.3-1.5 cm wide. Staminate sepals ca. 4-5 mm long. Achenes pale yellow to brown, smooth, shiny, 4-5 mm long, the fruiting bract up to ca. 8 mm long."

402	Allelopathic	n
	Source(s)	Notes
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. Cannabis sativa L. Canadian Journal of Plant Science, 83(1), 217-237	"Cannabis sativa has minor allelopathic properties [for information, see Inam et al. (1989), McPartland (1997b) and McPartland et al. (2000)]."

403	Parasitic	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Stout annual herbs 1-3 m tall. Leaflets (1-)3-7(-11), narrowly lanceolate to linear, 5-15 cm long, 0.3-1.5 cm wide." [Cannabaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Van Jaarsveld, E. (2004). Aloe L. <i>Cannabis sativa</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/cannabis-sativa . [Accessed 27 Feb 2019]	"Deer, birds, beetles, leaf-eating larvae and slugs feed on the plant."
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	"Domesticated mammalian grazers, especially cattle, horses, and goats, have been observed to nibble small amounts of cultivated hemp, but they do not cause significant damage (McPartland et al. 2000). Wild mammals, including deer, rabbits, raccoons, rats, field voles, mice, and woodchucks (groundhogs) have caused significant feeding damage to hemp (McPartland et al. 2000). Woodchucks especially are capable of causing great destruction to young plantation of hemp (McPartland et al. 2000). A woodchuck was observed eating the tops of numerous young plants in an experimental plantation near Ottawa (A. McElroy, personal communication)."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Whole plants serve as fodder"

405	Toxic to animals	y
	Source(s)	Notes
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	"As presented in Section 13, some herbivores readily eat Cannabis. However, the herbaceous material (not the seeds) appears to have toxic potential if eaten in very large amounts. Driemeier (1997) reported that four of five cattle died after consuming bales of dried marijuana leaves. In general, Cannabis is not considered to be significantly poisonous."
	Burrows, G. E., & Tyrl, R. J. (2013). <i>Toxic Plants of North America</i> . Second Edition. Wiley-Blackwell, Hoboken, NJ	"Intoxications involving Cannabis are primarily related to its use for psychoactive experiences by humans and either inadvertent or intentional exposure of pets. Most animal species are probably susceptible. Intoxications have been reported for cattle, horses, dogs, and ferrets (Cardassis 1951; Frye 1968; Meriwether 1969; Clarke et al. 1971; Silverman 1974; Jones 1978; Godbold et al. 1979; Crow and Sokolow 1980; Jain and Arora 1988; Valentine 1992). Pets may eat fresh plants, dried plant products, for example, brownies or cookies, or the more refined resins and related products. The overall effects of Cannabis include impairment of reaction time, motor coordination, and visual perception."
	Knight, A.P. and R. G. Walter (Eds.). 2002. <i>A Guide to Plant Poisoning of Animals in North America</i> . Teton NewMedia, Jackson WY	"Poisoning in animals is rarely seen as the plant is fairly unpalatable. The most prevalent sign of poisoning in dogs is depressed nervous system. Other animals may show hyperexcitability, vomiting, salivation, ataxia."

Qsn #	Question	Answer						
406	Host for recognized pests and pathogens							
	<table border="1"> <thead> <tr> <th data-bbox="175 283 818 329">Source(s)</th> <th data-bbox="818 283 1570 329">Notes</th> </tr> </thead> <tbody> <tr> <td data-bbox="175 329 818 699"> Duke, J. A. (1983). <i>Cannabis sativa</i>. Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology. [Accessed 27 Feb 2019] </td> <td data-bbox="818 329 1570 699"> "Among diseases of Cannabis are: Botryosphaeria marconii (stem canker, wilt), Botrytis cinerea (gray mold), Cylindrosporium sp. (leaf spot), Fusarium sp. (canker, stem rot), Gibberella saubinetii (stem rot), Hypomyces cancri (?root rot), Macrophomina phaseoli, Phomopsis cannabina, Phymatotrichum omivorum (root rot), Sclerotinia sclerotiorum (stem rot, wilt), Sclerotium rolfsii (southern blight), Septoria cannabis (leaf spot). Nematodes include: Ditylenchus dipsaci, Heterodera humuli, Longidorus maximus, Meloidogyne hapla, M. incognita, M. incognita acrita, M. spp., and Pratylenchus coffeae (Golden, p.c., 1984). Occasionally Orobanche ramosa is paratitic on the roots. " </td> </tr> <tr> <td data-bbox="175 699 818 1190"> Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. Cannabis sativa L. Canadian Journal of Plant Science, 83(1), 217-237 </td> <td data-bbox="818 699 1570 1190"> "Fungi — Fungi are responsible for most diseases of Cannabis. McPartland (1999) recorded 88 species of fungi (represented in the literature by over 400 names), and concluded that only a few cause economic losses." ... "Bacteria — Four bacteria are significant pathogens of C. sativa (McPartland et al. 2000), with one of these split into four “pathovarieties” ... "Viruses — Five viruses regularly infect European cultivated C. sativa (McPartland et al. 2000): hemp streak virus (HSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), arabis mosaic virus (ArMV), and hemp mosaic virus (HMV). Aphids are the most important transmitters of viruses in C. sativa (McPartland et al. 2000). Presumably ruderal hemp in Canada is subject to the same viruses, but this has not yet been studied." ... "Two vascular plant parasitic genera occur on Cannabis: broomrape (Orobanche) on the roots, and dodder (Cuscuta) on the stalks and branches." </td> </tr> </tbody> </table>	Source(s)	Notes	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 27 Feb 2019]	"Among diseases of Cannabis are: Botryosphaeria marconii (stem canker, wilt), Botrytis cinerea (gray mold), Cylindrosporium sp. (leaf spot), Fusarium sp. (canker, stem rot), Gibberella saubinetii (stem rot), Hypomyces cancri (?root rot), Macrophomina phaseoli, Phomopsis cannabina, Phymatotrichum omivorum (root rot), Sclerotinia sclerotiorum (stem rot, wilt), Sclerotium rolfsii (southern blight), Septoria cannabis (leaf spot). Nematodes include: Ditylenchus dipsaci, Heterodera humuli, Longidorus maximus, Meloidogyne hapla, M. incognita, M. incognita acrita, M. spp., and Pratylenchus coffeae (Golden, p.c., 1984). Occasionally Orobanche ramosa is paratitic on the roots. "	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. Cannabis sativa L. Canadian Journal of Plant Science, 83(1), 217-237	"Fungi — Fungi are responsible for most diseases of Cannabis. McPartland (1999) recorded 88 species of fungi (represented in the literature by over 400 names), and concluded that only a few cause economic losses." ... "Bacteria — Four bacteria are significant pathogens of C. sativa (McPartland et al. 2000), with one of these split into four “pathovarieties” ... "Viruses — Five viruses regularly infect European cultivated C. sativa (McPartland et al. 2000): hemp streak virus (HSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), arabis mosaic virus (ArMV), and hemp mosaic virus (HMV). Aphids are the most important transmitters of viruses in C. sativa (McPartland et al. 2000). Presumably ruderal hemp in Canada is subject to the same viruses, but this has not yet been studied." ... "Two vascular plant parasitic genera occur on Cannabis: broomrape (Orobanche) on the roots, and dodder (Cuscuta) on the stalks and branches."	
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Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	y
	Source(s)	Notes
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 27 Feb 2019]	"Non-users may suffer muscular incoordination (9 of 22 persons), dizziness (8), difficulty concentrating (8), confusion (7), difficulty walking (7), dysarthria (7), dry mouth (7), dysphagia (5), blurred vision (5), and vomiting (1), following oral ingestion of THC disguised in cookies (MMWR, October 20, 1978). People working with the plant or the fiber may develop dermatitis. In larger doses, hemp drugs may induce catalepsy, followed by coma and DEATH from cardiac failure (C.S.I.R., 1948-1976)."
	Burrows, G. E., & Tyrl, R. J. (2013). <i>Toxic Plants of North America</i> . Second Edition. Wiley-Blackwell, Hoboken, NJ	"Pathology and Treatment—Cannabis does not generally produce fatal disease, and pathologic changes are not anticipated. Mild intoxication requires only careful observation or perhaps some sedation of the affected individual. In more severe cases, induced emesis, activated charcoal given orally, bowel evacuation, and/or purgatives may be helpful in limiting the severity and duration of the effects. It is important to maintain body temperature with a covered heating pad, and stimulants may also be appropriate."
	Knight, A.P. and R. G. Walter (Eds.). 2002. <i>A Guide to Plant Poisoning of Animals in North America</i> . Teton NewMedia, Jackson WY	"Pollen from the flowers is a cause of allergies in humans. There are a wide variety of signs of marijuana poisoning that have been reported in humans."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	CABI. (2019). <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. www.cabi.org/isc	[No evidence] " <i>C. sativa</i> grows from sea level to 3700 m in altitude, and from the equator to approximately 63° latitude (such as in Finland). Fibre hemp cultivars grow well at 40-55° latitude, and they perform poorly in semi-tropical and tropical latitudes. However, drug varieties were bred in semitropical and tropical locations, and have poor growth at high latitudes (above 45°), because frost often kills the plants before flowering."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	No evidence
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. <i>Canadian Journal of Plant Science</i> , 83(1), 217-237	No evidence

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Although Cannabis plants are thermophilic (warmth-loving) and heliotropic (sunloving), they are more tolerant of shade than many crop plants and may survive in shaded areas, but their biomass and production of pollen and seed will be greatly reduced. Cannabis thrives best in exposed places where it does not have to compete with taller plants for available sunlight."

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Kumar, S., Singh, R., Kumar, V., Rani, A., & Jain, R. (2017). <i>Cannabis sativa: A Plant Suitable for Phytoremediation and Bioenergy Production</i> . Pp. 269-285 In K. Baudh et al. (eds.). <i>Phytoremediation Potential of Bioenergy Plants</i> . Springer, Singapore	"C. sativa is adaptive to various climatic conditions and wide ranges of soil. It requires mild temperate (14–21 °C) climate with minimum of 67 cm annual rainfall; abundant rainfall is required when the seeds are germinating till young plantlets are established. It can tolerate annual temperature of 6–27 °C, precipitation of 3–40 dm and pH ranging from 4.5 to 8.2. It grows well on nitrogen-rich, fertile, neutral to slightly alkaline, well-drained silt or clay loam soil. It has around 1 m-deep roots that grow fast and easily form dense stands."
	Duke, J. A. (1983). <i>Cannabis sativa</i> . <i>Handbook of Energy Crops</i> . https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 27 Feb 2019]	"Plants very adaptable to soil and climatic conditions. Hemp for fiber requires a mild temperate climate with at least 67 cm annual rainfall, with abundant rain while seeds are germinating and until young plants become established. Thrives on rich, fertile, neutral to slightly alkaline, well drained silt or clay loams with moisture retentive subsoils; does not grow well on acid, sandy soils."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Stout annual herbs 1-3 m tall."

412	Forms dense thickets	y
	Source(s)	Notes
	Żuk-Gołaszewska, K., & Gołaszewski, J. (2018). <i>Cannabis sativa</i> L. – cultivation and quality of raw material. <i>Journal of Elementology</i> , 23(3), 971-984	"Cannabis is a fast-growing species that forms dense stands."
	Tiourebaev, K. S., et al. (2001). Biological control of infestations of ditchweed (<i>Cannabis sativa</i>) with <i>Fusarium oxysporum</i> f. sp. <i>cannabis</i> in Kazakhstan. <i>Biocontrol Science and Technology</i> , 11(4), 535-540	"Ditchweed (<i>Cannabis sativa</i> L.) is widely distributed throughout the southeast part of Kazakhstan, infesting both grassland and agricultural areas. In South Kazakhstan, non-cultivated <i>Cannabis</i> plants can be found in spatially continuous stands, with one such stand in the Chu River Valley covering approximately 125 000 ha."
	Kumar, S., Singh, R., Kumar, V., Rani, A., & Jain, R. (2017). <i>Cannabis sativa: A Plant Suitable for Phytoremediation and Bioenergy Production</i> . Pp. 269-285 In K. Baudh et al. (eds.). <i>Phytoremediation Potential of Bioenergy Plants</i> . Springer, Singapore	"It grows well on nitrogen-rich, fertile, neutral to slightly alkaline, well-drained silt or clay loam soil. It has around 1 m-deep roots that grow fast and easily form dense stands."

501	Aquatic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Terrestrial] "Stout annual herbs 1-3 m tall."

Qsn #	Question	Answer
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 26 Feb 2019]	Family: Cannabaceae

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 26 Feb 2019]	Family: Cannabaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Stout annual herbs 1-3 m tall. Leaflets (1-)3-7(-11), narrowly lanceolate to linear, 5-15 cm long, 0.3-1.5 cm wide. Staminate sepals ca. 4-5 mm long." [Annual herbs, no underground storage units]

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Presumed to be native to central Asia, but one of the most ancient of cultivated species, widely cultivated and naturalized in many areas;" [Not applicable to a domesticated crop with a long history of cultivation]

602	Produces viable seed	y
	Source(s)	Notes
	Chandra, S., Lata, H., Khan, I. A., & ElSohly, M. A. (2017). <i>Cannabis sativa</i> L.: botany and horticulture. Pp. 79-100 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). <i>Cannabis sativa</i> L. - Botany and Biotechnology. Springer, Cham, Switzerland	"For cultivation of Cannabis, seeds has been the main source of propagation."
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 27 Feb 2019]	"Propagation mainly by seed. Experimentally, drug plants have been propagated from cuttings but such plants do not come true as to drug content of parent."

603	Hybridizes naturally	y
	Source(s)	Notes

Qsn #	Question	Answer
	Small, E., & Cronquist, A. (1976). A Practical and Natural Taxonomy for Cannabis. Taxon, 25(4), 405-435	"Aside from some experimentally produced polyploids, all Cannabis is diploid (n = 10), and there appear to be no barriers to successful hybridization within the genus." ... "Critical factors influencing populational structure in Cannabis are that the genus is entirely diploid, with n = 10 (although some polyploids have been artificially produced; Small, 1972a), that the plants are wind-pollinated, that there appear to be no internal barriers to successful hybridization (Vavilov, 1926 = Vavilov, 1965; Small, 1972a) and that cultivated plants readily escape to the wild (Janischevsky, 1924; Vavilov, 1926; Vavilov and Bukinich, 1929; Scholz, 1957)."
	Small, E. (2017). Classification of Cannabis sativa L. in relation to agricultural, biotechnological, medical and recreational utilization. Pp. 1-62 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). Cannabis sativa L.- Botany and Biotechnology. Springer, Cham, Switzerland	"Sativa-type" and "indica-type" (the inappropriateness of these entrenched labels is pointed out above) represent two discernibly different groups of high-THC cannabis plants domesticated in Asia. The ancient distribution of these is shown in Fig. 1.7, where it is noted that the indica-type probably arose from the sativa-type. The much more popular sativa-type has been distributed in much of the world, and extensive hybrids have been generated between the two kinds."

604	Self-compatible or apomictic	
	Source(s)	Notes
	Punja, Z. K., Rodriguez, G., & Chen, S. (2017). Cannabis sativa L.: botany and horticulture. Pp. 395-418 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). Cannabis sativa L. - Botany and Biotechnology. Springer, Cham, Switzerland	[Mostly self-incompatible, but some selfing may occur in the wild] "Cannabis sativa is an obligately outbreeding species under natural conditions and is dioecious (male and female flowers occur on different plants). An estimated 48.7% of plant species overall are either dioecious or self-incompatible, making them obligate out-crossers (Ilgic and Kohn 2006). It is also estimated that about 42% of flowering plants exhibit a mixed mating system in nature. In the most common kind of mixed mating system, individual plants produce a single type of flower and seeds may be the result of self-pollination, out-crossing or a mixture of progeny types (Goodwillie et al. 2005). Similarly, in hemp and marijuana strains, there are a range of possibilities regarding mating systems."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Chandra, S., Lata, H., Khan, I. A., & ElSohly, M. A. (2017). Cannabis sativa L.: botany and horticulture. Pp. 79-100 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). Cannabis sativa L. - Botany and Biotechnology. Springer, Cham, Switzerland	"Cannabis is a wind pollinated plant which is highly allogamous in nature."
	Small, E., & Cronquist, A. (1976). A Practical and Natural Taxonomy for Cannabis. Taxon, 25(4), 405-435	"the plants are wind-pollinated"

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes

Qsn #	Question	Answer
	Chandra, S., Lata, H., Khan, I. A., & ElSohly, M. A. (2017). <i>Cannabis sativa L.: botany and horticulture</i> . Pp. 79-100 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). <i>Cannabis sativa L. - Botany and Biotechnology</i> . Springer, Cham, Switzerland	[No evidence] "For cultivation of Cannabis, seeds has been the main source of propagation." ... "Vegetative propagation, also referred as cloning, the technique of growing plants from cuttings from a selected mother plant is a great way to generate crop of consistent quality. Once, a particular clone is screened and selected, a fresh nodal segment about 6–10 cm in length containing at least two nodes from the mother plant can be used for vegetative/conventional propagation either in solid (soil) or in liquid medium (hydroponics)"

607	Minimum generative time (years)	1
	Source(s)	Notes
	Chandra, S., Lata, H., Khan, I. A., & ElSohly, M. A. (2017). <i>Cannabis sativa L.: botany and horticulture</i> . Pp. 79-100 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). <i>Cannabis sativa L. - Botany and Biotechnology</i> . Springer, Cham, Switzerland	"Cannabis sativa L. is an annual plant that can be grown 'indoor' and 'outdoor' efficiently. However, each cultivation option has its advantages and disadvantages. Under the outdoor conditions, life cycle of the plant completes in five to seven months depending on the time of plantation and the variety whereas, growing indoor, flowering can be triggered by regulating the photoperiod."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Stout annual herbs 1-3 m tall."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Escaped and weedy Cannabis grows along roadsides, in ditches, and on fallow land or fields sown in Cannabis or other crops." [Possibly Yes. Occurs in heavily trafficked areas. Small seeds could adhere to footwear, vehicles or other machinery in soil]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Chandra, S., Lata, H., Khan, I. A., & ElSohly, M. A. (2017). <i>Cannabis sativa L.: botany and horticulture</i> . Pp. 79-100 In Chandra, S., Lata, H. and ElSohly, Mahmoud A. (eds.). <i>Cannabis sativa L. - Botany and Biotechnology</i> . Springer, Cham, Switzerland	"Cannabis (<i>Cannabis sativa L.</i>) is an annual herb which has been dispersed and cultivated by humans in almost all parts of the world from the tropics, to alpine foothills."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Presumed to be native to central Asia, but one of the most ancient of cultivated species, widely cultivated and naturalized in many areas"
	Staples, G.W. & Herbst, D.R. 2005. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	"Some have claimed that it is the state's most valuable agricultural product, although in recent years determined efforts by state and federal drug enforcement agencies have curtailed production. In 1999 the State Legislature of Hawai'i changed state regulations to permit the growing of hemp for industrial research purposes - fiber, oil, building materials - with appropriate permits from drug enforcement agencies."

Qsn #	Question	Answer
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	"Dispersed by: Humans, Animals, Escapee" ... "Weed of: Cereals, Lupins, Orchards & Plantations, Pastures, Vegetables" [Possibly, if weedy or naturalized plants occur with other crops]

704	Propagules adapted to wind dispersal	
	Source(s)	Notes
	Van Jaarsveld, E. (2004). Aloe L. <i>Cannabis sativa</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/cannabis-sativa . [Accessed 27 Feb 2019]	"Marijuana seed is dispersed by wind and water."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	[Possibly during strong wind events] "Wind serves to dislodge seeds from mature flowers so they drop to the ground. This is especially true for wild and self-sown feral <i>Cannabis</i> plants with readily shattering inflorescences. Since <i>Cannabis</i> seeds are relatively small but not as tiny as other widely dispersed species such as red poppy (<i>Papaver rhoeas</i> L.), wind dispersal to any great distance would require gale force winds. Wind, therefore, is a very unlikely or only occasionally effective physical agent to move <i>Cannabis</i> seed more than a very short distance. Water and wind mitigated long-range dispersal are certainly possible, but like most nonbiotic dispersals would have to occur over short distances and repeat through many generations."

705	Propagules water dispersed	y
	Source(s)	Notes
	Van Jaarsveld, E. (2004). Aloe L. <i>Cannabis sativa</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/cannabis-sativa . [Accessed 27 Feb 2019]	"Marijuana seed is dispersed by wind and water."
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. <i>Canadian Journal of Plant Science</i> , 83(1), 217-237	"the common association of hemp with alluvial sites suggests that flood waters also frequently serve to distribute the seeds."
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	[Able to be water-dispersed, but low buoyancy limits dispersal distance] "Streams and rivers are physical agents that may pick up a fallen seed and carry it downstream. If this occurs, it might be deposited near the surface of finely sorted alluvium, which as it drains, provides an excellent medium for germination and growth. However, low buoyancy of seeds seems important in limiting their dispersal by stream flow very far from the parent plant."

706	Propagules bird dispersed	
	Source(s)	Notes

Qsn #	Question	Answer
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"A common natural means of seed dispersal involves transportation in the digestive tracts of birds. Birds kept as pets feed on commercial hemp seed (Steyermark 1963; Booth 2003), and this is a strong indication that some wild species forage for it (e.g., the hemp linnet, <i>Carduelis cannabina L.</i> , a widely distributed migrating bird)." ... "Most <i>Cannabis</i> seeds are cracked by feeding birds and are thus destroyed, although some species may occasionally swallow them whole."
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa L.</i> <i>Canadian Journal of Plant Science</i> , 83(1), 217-237	[Possibly on a limited basis] "Ruderal hemp depends heavily on humans for dispersal, but birds are strongly attracted to the seeds, and are likely the most important wild animals distributing them in North America (Haney and Bazzaz 1970). B.J. Eaton (unpublished typescript circulated 1972) fed wild hemp seeds to upland game birds, observing that quail passed approximately one viable seed/700 seeds consumed, and doves passed one viable seed/12 400 seeds consumed. In view of these limited survival rates, he suggested that humans, domestic animals and water appear to be the chief disseminating agents for wild hemp in North America."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	[Speculative, but possibly yes] "The chances that a dispersed seed may come to rest in a favorable environment are enhanced by the natural foraging of animals. Polunin (1960) states that "animals, like plants, tend to keep, as birds tend to alight, within a single habitat range, so increasing the chances a dispersed seed would have of coming to rest in a place suitable for germination and successful establishment." A hoofed mammal, such as a horse, goat, or pig, for instance, browsing around <i>Cannabis</i> plants, may step on a fallen seed, and the seed may become trapped in the hoof and be dispersed to a similar habitat in another location as foraging continues. If such mammals move out of their range under environmental pressure, they could disseminate seeds into new habitats. Wild horse ancestors may have spread seeds either internally or externally throughout the Eurasian steppes"

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	McPartland, J. M., & Naraine, S. G. (2018). Experimental Endozoochory of <i>Cannabis sativa</i> Achenes. <i>Medical Cannabis and Cannabinoids</i> , 1(2), 96-103	"In conclusion, endozoochory of <i>C. sativa</i> achenes can be vectored by mammals, with a high survival rate. Mastication, rather than digestive enzymes, is the survival limiting step. <i>C. sativa</i> achenes express an adaption to endozoochory – a thick pericarp – but they are larger than optimal for mammalian endozoochory. The vectors used in this experiment (dog and human) evolved after the early evolutionary history of <i>Cannabis</i> . We plan to test mammals that have a longer evolutionary history in Central Asia, such as rabbits and horses. Comparing the survival rates of wild-type versus domesticated achenes will also be informative."

Qsn #	Question	Answer
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	[Very limited internal bird dispersal] "B.J. Eaton (unpublished typescript circulated 1972) fed wild hemp seeds to upland game birds, observing that quail passed approximately one viable seed/700 seeds consumed, and doves passed one viable seed/12 400 seeds consumed. In view of these limited survival rates, he suggested that humans, domestic animals and water appear to be the chief disseminating agents for wild hemp in North America."

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Duke, J. A. (1983). <i>Cannabis sativa</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Cannabis_sativa.html#Ecology . [Accessed 27 Feb 2019]	[High seed production possible in cultivation. Natural seed densities unknown] "In India, plants remaining in the field after harvesting for fiber are allowed to set seed. They are cut after the fruits are ripened and dried and threshed for seed collection. Grown solely for seeds, an average crop yields 1.3 to 1.6 MT/ha seed. The world low production yield was 288 kg/ha in Democratic People's Republic of Korea, the international production yield was 613 kg/ha, and the world high production yield was 3,842 kg/ha in People's Republic of China. "

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Clarke, R. C., & Merlin, M. D. (2013). <i>Cannabis: Evolution and Ethnobotany</i> . University of California Press, Berkeley and Los Angeles, CA	"Fresh and fully mature seeds approach 100 percent viability, but this decreases with age. For example, usually at least 50 percent of seeds will germinate after three to five years of storage at room temperature, but without refrigeration, viability of seeds rarely exceeds 10 years. On the other hand, uninterrupted freezing can preserve seeds for decades."
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	[Some wild seeds persist for 3-4 years] "However, in London, Canada, seeds of several hemp varieties germinated intermittently over several months (Pocock and Cavers, unpublished). Wild seeds, by contrast, germinate variably. In the United States, Goss (1924) tested germination of hemp seeds that had been buried in soil for 24 years, and observed no germination in tests conducted over several years. In Japan, Kondo et al. (1950) found that hemp seeds, stored for 19 yr under desiccated conditions, germinated. Haney and Kutscheid (1975) reported that seeds from ruderal Kansas populations declined in viability from 70 to 4.4% in 15 mo of soil burial, an observation suggesting that seeds do not persist in a viable state in the soil for more than 2 or 3 yr. Indeed, recommendations to control weedy volunteer hemp often mention that the site should be viewed for possible reappearance of the plant for 2 or 3 yr (e.g., Illinois Bureau of Investigation, undated; Eaton 1972). Volunteer plants appeared for 4 yr following the experimental cultivation in Ottawa of several hundred kinds of wild and domesticated hemp (Small, personal observation), thus at least some kinds of wild hemp have seeds capable of surviving in the soil for this period."

803	Well controlled by herbicides	y

Qsn #	Question	Answer
	Source(s)	Notes
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	"In trials in Ridgetown, Ontario in 1999 and 2000, bentazon (Basagran Forte, applied 1.75–2.25 L a.i. ha ⁻¹) and thifensulphuron-methyl (Pinnacle, applied 5.5–8 g a.i. ha ⁻¹ + surfac-tant) provided excellent control of volunteer hemp in soybeans (P. Sikkema, personal communication). For volunteer hemp in corn, atrazine (1.12–1.65 kg a.i. ha ⁻¹), dicamba/diflufenzopyr (0.285 kg ha ⁻¹), dicamba/atrazine (3.7–4.5 L ha ⁻¹), bromoxynil (1 L ha ⁻¹) + atrazine (2.1–3.1 L ha ⁻¹) and dicamba (0.14 kg ha ⁻¹) + prosulphuron (10–13.3 g ha ⁻¹ + non-ionic surfactant) all gave excellent control (P. Sikkema, personal communication). Weber (1978) provided extensive recommendations for herbicide control of Cannabis, as follows. In noncrop areas, 2,4-D, amitrole, and 2,4-DP (dichlorprop) have given excellent control. Where total vegetation control is acceptable, the nonselective herbicides glyphosate and bromacil have proven effective. Simazine applied preemergence has given excellent control in corn, as well as 2,4-D, and linuron applied postemergence. In soybeans, metribuzin and linuron applied preemergence, or linuron plus bentazon applied postemergence, have provided control. In pastures and rangelands, control is possible with 2,4-D or 2,45-T applied either preemergence or postemergence provided that the plants are less than 60 cm tall. Other herbicides that have been used effectively on Cannabis include MCPB, paraquat, picloram and oxadiazon. It is important to spray while the plants are small, as application of herbicides becomes progressively less effective as the plants grow."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Small, E., Pocock, T., & Cavers, P. B. (2003). The biology of Canadian weeds. 119. <i>Cannabis sativa</i> L. Canadian Journal of Plant Science, 83(1), 217-237	"Mowing, tillage and liquid-propane flaming are all used to control <i>C. sativa</i> , and are effective while the plants are still reasonably immature. However, in Kansas most wild hemp stands were found to be not tillable (Eaton et al. 1972), and disturbing the soil frequently assists wild hemp to invade and establish. Planting a competitive perennial grass such as fescue or smooth bromegrass has been recommended to eliminate the recurrence of plants in non-crop areas (Weber 1978)."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Although .not known to be naturalized in Hawai'i, Cannabis is included because it is encountered in cultivation so frequently in native habitats"

Qsn #	Question	Answer
	<p>Tiourebaev, K. S., et al. (2001). Biological control of infestations of ditchweed (<i>Cannabis sativa</i>) with <i>Fusarium oxysporum</i> f. sp. <i>cannabis</i> in Kazakhstan. <i>Biocontrol Science and Technology</i>, 11(4), 535-540</p>	<p>[Unknown if fungus limits spread in Hawaiian Islands] "Ditchweed (<i>Cannabis sativa</i> L.) is widely distributed in the Chu Valley of southeast Kazakhstan and is difficult to control using conventional chemical or mechanical control. Thus, plant pathogens were investigated as potential biocontrol agents. <i>Fusarium oxysporum</i> was isolated from symptomatic <i>C. sativa</i> plants from this area. Twenty-five of the isolated strains of <i>F. oxysporum</i> were pathogenic and host-specific to <i>C. sativa</i> in greenhouse studies. These strains of <i>F. oxysporum</i> f. sp. <i>cannabis</i> were further evaluated as mycoherbicides for control of ditchweed in natural field infestations. Twelve strains showed field control of <i>C. sativa</i>, and the most virulent strain elicited wilt symptoms within 2 weeks of inoculation of field plants. Three different mycoherbicide formulations were evaluated. A birch sawdust formulation was the most effective carrier in the field. Food based formulations were heavily predated by birds, rodents and insects."</p>

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability and elevation range, demonstrating environmental versatility
- Grows in temperate to subtropical climates
- Widely naturalized (cultivated on main Hawaiian Islands)
- A disturbance-adapted plant; weedy types may adversely impact agriculture
- May be toxic to certain animals
- May cause adverse effects to humans; pollen may be allergenic
- Sun-loving, but can tolerate shade
- Tolerates many soil types
- Weedy types may form dense stands
- Reproduces by seeds
- Domesticated and wild types can freely hybridize
- Mostly self-incompatible (or dioecious), but low levels of selfing may occur in some wild types
- Able to reach maturity in under one year
- Seeds dispersed by humans, animals, water, possibly wind and birds
- Viable seeds can survive gut passage
- Some viable seeds may persist in the soil for three to four years

Low Risk Traits

- Long history of domestication; domesticated types cultivated for medicinal uses less likely to escape
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock (palatable despite some toxic properties)
- Not reported to spread vegetatively
- Mostly self-incompatible (or dioecious), but low levels of selfing may occur in some wild types
- Herbicides and mechanical methods may provide effective control if removal is desired