

Taxon: <i>Melilotus albus</i> Medik.	Family: Fabaceae
Common Name(s): Bokhara clover honey clover white melilot white sweet clover	Synonym(s): M. albus var. annuus H. S. Coe M. leucanthus W. D. J. Koch ex DC. M. officinalis ssp. albus (Medik.) H. Melilotus alba Medik.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 15 Sep 2017
WRA Score: 23.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Weedy Herb, Fodder, N-Fixing, Water-Dispersed, Animal-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
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	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic	y=1, n=0	y
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	y
406	Host for recognized pests and pathogens	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems		

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	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)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m ²)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	No evidence
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	No evidence

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	NA

Qsn #	Question	Answer
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 14 Sep 2017]	"Native: Africa Northern Africa: Egypt; Libya Asia-Temperate Arabian Peninsula: Oman; Saudi Arabia; Yemen Caucasus: Armenia; Azerbaijan; Georgia; Russian Federation - Dagestan; Russian Federation-Ciscaucasia - Ciscaucasia China: China Middle Asia: Kazakhstan; Kyrgyzstan; Tajikistan; Turkmenistan; Uzbekistan Siberia: Russian Federation-Western Siberia - Western Siberia Western Asia: Afghanistan; Cyprus; Iran; Iraq; Israel; Jordan; Lebanon; Turkey Asia-Tropical Indian Subcontinent: Bhutan; India; Pakistan Indo-China: Myanmar Europe Eastern Europe: Belarus; Estonia; Latvia; Lithuania; Moldova; Russian Federation-European part - European part; Ukraine Middle Europe: Austria; Czechoslovakia; Germany; Hungary; Poland Southeastern Europe: Albania; Bulgaria; Former Yugoslavia; Greece; Italy; Romania Southwestern Europe: France; Spain"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 14 Sep 2017]	Native range well known

203	Broad climate suitability (environmental versatility)	Y
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Both species are adapted to a wide range of climatic conditions. They are drought-tolerant (Butovssii 1971), only requiring enough moisture for establishment after which they will develop under extremely dry conditions."

Qsn #	Question	Answer
	<p>Gucker, C. L. 2009. <i>Melilotus alba</i>, <i>M. officinalis</i>. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]</p>	<p>"Climate: The wide distribution of sweetclover implies wide climatic tolerance. Moisture is important for sweetclover seedling establishment, but once established, plants tolerate extremely dry conditions. In the fall, contractile roots pull sweetclover root crowns beneath the soil surface (≥2 inches (5 cm)), protecting plants from freezing temperatures (review by [251]). Yellow sweetclover is considered more heat and drought tolerant than white sweetclover (reviews by [220,254]). Although yellow sweetclover has also been described as more cold hardy than white sweetclover (review by [254]), current distributions suggest this may not be true (see General Distribution). In Alaska, sweetclover occupies habitats with extreme weather. In Ketchikan, annual precipitation averages 160 inches (3,940 mm) and temperatures average 45 °F (7.2 °C). In interior Alaska, annual precipitation can be as low as 6 inches (170 mm), and the average annual temperature can be as low as 26 °F (-3.3 °C) [37]. During growth chamber experiments, researchers found that 1- to 4-week-old yellow sweetclover seedling survival was high at 21 °F (-6 °C). Survival was much lower at 18 °F (-8 °C) [165]."</p>

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 14 Sep 2017]</p>	<p>"Native: Africa Northern Africa: Egypt; Libya Asia-Temperate Arabian Peninsula: Oman; Saudi Arabia; Yemen Caucasus: Armenia; Azerbaijan; Georgia; Russian Federation - Dagestan; Russian Federation-Ciscaucasia - Ciscaucasia China: China Middle Asia: Kazakhstan; Kyrgyzstan; Tajikistan; Turkmenistan; Uzbekistan Siberia: Russian Federation-Western Siberia - Western Siberia Western Asia: Afghanistan; Cyprus; Iran; Iraq; Israel; Jordan; Lebanon; Turkey Asia-Tropical Indian Subcontinent: Bhutan; India; Pakistan Indo-China: Myanmar Europe Eastern Europe: Belarus; Estonia; Latvia; Lithuania; Moldova; Russian Federation-European part - European part; Ukraine Middle Europe: Austria; Czechoslovakia; Germany; Hungary; Poland Southeastern Europe: Albania; Bulgaria; Former Yugoslavia; Greece; Italy; Romania Southwestern Europe: France; Spain Naturalized: Africa Macaronesia: Portugal - Azores, - Madeira Islands; Spain - Canary Islands Southern Africa: South Africa Asia-Temperate Arabian Peninsula: Qatar; United Arab Emirates Australasia Australia: Australia New Zealand: New Zealand Europe Northern Europe: United Kingdom Northern America : Canada; South America; United States Pacific North-Central Pacific: United States - Hawaii Southern America : Canada; South America; United States Central America: Central America"</p>

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 14 Sep 2017]	"It has been introduced to many parts of Europe outside its native range, as well as to North and South America, Australasia and southern Africa, often as a crop or potential crop (Turkington et al., 1978). In the USA, the species is considered most common in the upper Midwest and Great Plains regions, including Kentucky, Nebraska, Tennessee and Wisconsin (Gucker, 2009; USDA NRCS, 2013)."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Europe, widely introduced as a fodder plant"

301	Naturalized beyond native range	y
	Source(s)	Notes
	Shannon, R. K. & Wagner, W. L. 1996. New records of Hawaiian flowering plants primarily from the United States National Herbarium. Bishop Museum Occasional Papers. 46: 13-15	"As noted by Degener on the specimen label, the following collection represents a new island record for Moloka'i. It was previously known only from Midway Atoll and Hawai'i (Wagner et al. 1990: 686). Material examined. MOLOKA'I: Maunahui, 8 Apr 1928, Degener 11095 (US)."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Europe, widely introduced as a fodder plant; in Hawai'i apparently uncommon in disturbed sites, 5- 1,340 m, on Midway Atoll and Hawai'i. First collected on Midway Atoll in 1980 (Herbst & Takeuchi 6363, BISH), although Rock (1920a) reports this species as cultivated by the Hawaiian Sugar Planters' Association and presumably escaped."
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 14 Sep 2017]	"Naturalized: Africa Macaronesia: Portugal - Azores, - Madeira Islands; Spain - Canary Islands Southern Africa: South Africa Asia-Temperate Arabian Peninsula: Qatar; United Arab Emirates Australasia Australia: Australia New Zealand: New Zealand Europe Northern Europe: United Kingdom Northern America : Canada; South America; United States Pacific North-Central Pacific: United States - Hawaii Southern America : Canada; South America; United States Central America: Central America"
	Oppenheimer, H. L. 2004. New Hawaiian plant records for 2003. Bishop Museum Occasional Papers. 79: 8-20	"Reported from Midway Atoll and Hawai'i (Wagner et al., 1999: 686-687) and subsequently from East Maui (Wagner & Herbst, 1995: 20) and Moloka'i (Shannon & Wagner, 1996: 14), the following collection represents a significant range extension to West Maui. Material examined: MAUI: West Maui, Wailuku Distr, Wailuku, 73 m, in sandy soil near golf course, 4 Nov 2002, Oppenheimer H110203."

Qsn #	Question	Answer
302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	Agricultural and environmental weed. See 3.03 & 3.04

303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"M. albus is regarded as a weed of wheat and barley in Canada (Turkington et al., 2013). As a weed of wheat, M. albus can cause melilot or sweet-clover taint of wheat, caused when still green sweetclover is harvested with wheat, allowing wheat can absorb the odour of sweet clover (Greenshields, 1957). Royer and Dickinson (1999, cited in Gucker, 2009) noted the association of M. albus with 28 viral plant diseases including beety curly tip, cucumber mosaic and tobacco streak virus. Sweet clover disease is a haemorrhagic disease of cattle, occurring mostly in the USA and Canada when mouldy or spoiled sweet clover hay is fed to cattle (Connor, 1997). Large obvious swellings representing subcutaneous haemorrhages are the first clinical signs, usually accompanied by internal haemorrhaging. Sweet clover disease can also occur in sheep, but they are less sensitive. The mycotoxin is dicoumarol, an anti-coagulant, produced from coumaric and melilotic acids in plant tissue by action of the fungi in the hay."
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Sweet-clover has been considered a noxious weed in Iowa, New England and the central U.S.A. because it sometimes occurs as "an adulteration in other crops" (cited in York and Pammel 1919). Both sweet-clover species have been classed as noxious weeds in various publications (e.g. Pammel 1912, cited in York and Pammel 1919; Mulligan 1976)." ... "A condition known as sweet clover disease (Greenshields 1957) or 'bleeding disease' (Smith and Gorz 1965) in cattle frequently results from the feeding of spoiled sweet-clover hay or ensilage' It is generally believed that cattle are more susceptible to the disease than sheep (Linton et al. 1963). M. alba is a weed of wheat crops (Pirzada and Rajput 1969). Melilot taint of wheat, also referred to as sweet-clover taint, is caused by sweetclover in wheat fields being harvested with the wheat. If the sweet-clover is still green or if the harvesting is done in wet conditions. the wheat absorbs the characteristic odor of sweet-clover (Greenshields 1957)."

304	Environmental weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc</p>	<p>"In the USA, many studies have shown that <i>M. albus</i> adversely affects native grass and forb recruitment and growth, as well as restricting the establishment and growth of woody plant species (Gucker, 2009). <i>M. albus</i> is typically more problematic or invasive in northern rather than southern temperate US grasslands, notably in the upper Midwest and Great Plains regions (Gucker, 2009). Spellman and Wurtz (2011) studied the effects of <i>M. albus</i> on river floodplains in interior Alaska, USA, and found that its invasion had created a novel shade environment in early seral floodplain plant communities. They recommended that the species should be actively managed to prevent its spread into more glacial rivers in Alaska. <i>M. albus</i> is a particular threat to prairies because it easily invades open areas and may compete for resources with native species, besides fixing nitrogen and thus affecting edaphic conditions. It is also undesirable on prairie reserves because it is a highly visible exotic when in flower. As a nitrogen fixer, <i>M. albus</i> also has the potential to alter the soil nutrient status and modify the environment in nitrogen-poor ecosystems, often making them more attractive to other invasive species. It has been suggested that the use of <i>Melilotus</i> species for roadside vegetation and rangeland improvement should be discontinued until its effects on ecosystems has been better determined (Lesica and DeLuca, 2000). "</p>
	<p>Gucker, C. L. 2009. <i>Melilotus alba</i>, <i>M. officinalis</i>. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 15 Sep 2017]</p>	<p>"Native grasses and forbs: The majority, but not all, greenhouse and field studies show that sweetclover negatively impacts native grass and forb recruitment and growth. In greenhouse experiments, C3 and C4 prairie grasses were seeded with and without yellow sweetclover in soil collected from the field in Fort Riley, Kansas. Grass abundance was lower with than without yellow sweetclover. Species richness and diversity increased over time without yellow sweetclover but decreased with it. Although most grasses germinated in the presence of yellow sweetclover, grass seedling survival was low. When seeded into established cover of western wheatgrass (<i>Pascopyrum smithii</i>) or smooth brome (<i>Bromus inermis</i>), yellow sweetclover germinated and grew well. In the greenhouse, yellow sweetclover grew rapidly, quickly shading grass seedlings. Several months into the experiments, soil moisture was lower in containers with than without yellow sweetclover, and in the early developmental stages, yellow sweetclover took up large amounts of nitrogen [47]." ... "Impacts on ecosystem processes: In restored tallgrass prairie at Fermilab's National Environmental Research Park in Batavia, Illinois, cumulative daily exchange of carbon was much lower when sweetclover dominated than when it did not dominate aboveground biomass. In 2005 when white sweetclover occurred as a rosette and did not dominate aboveground biomass, the net ecosystem exchange was 437.7 g carbon/m². In 2006 when white sweetclover bolted, flowered, and dominated the aboveground biomass, and net ecosystem exchange was 239.8 g carbon/m². Because white sweetclover senesced by late July or early August in 2006, the photosynthetically positive active days were reduced by 42%, which may partly explain the reduced carbon exchange. While a dramatic decrease in carbon exchange occurred when white sweetclover dominated, in both study years, net ecosystem exchange was high compared to other published values for North American grasslands [81]."</p>

Qsn #	Question	Answer
305	Congeneric weed	y
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Sweet-clover has been considered a noxious weed in Iowa, New England and the central U.S.A. because it sometimes occurs as "an adulteration in other crops" (cited in York and Pammel 1919). Both sweet-clover species have been classed as noxious weeds in various publications (e.g. Pammel 1912, cited in York and Pammel 1919; Mulligan 1976)."
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] "Annual or short-lived perennial herbs; stems erect, 3-15(-30) dm long. Leaflets elliptic to obovate, 10-30(-40) mm long, 5-20 mm wide, margins serrate, stipules lanceolate, not widened at base, margins not scarious."
402	Allelopathic	y
	Source(s)	Notes
	Shinwari, M.I., Shinwari, M.I. & Fujii, Y. 2013. Allelopathic evaluation of shared invasive plants and weeds of Pakistan and Japan for environmental risk assessment. Pak. J. Bot., 45: 467-474	" <i>Melilotus alba</i> Desr., a leguminous weed, grows as a competitor in wheat fields, has been evaluated for allelopathic effects of its roots and shoots. The different concentrations of root and shoot extracts of <i>M. alba</i> were tested on the seed germination and seedling establishment of wheat and was observed that the seed germination was more affected by the root extracts than shoot extracts and the seedling establishment was also inhibited by root extracts. Hence, a decrease in the percentage of seed germination and seedling establishment was recorded with the increasing concentration of aqueous extracts (Shweta & Sharma, 2008)."
	Mardani, H., Kazantseva, E., Onipchenko, V., & Fujii, Y. (2016). Evaluation of allelopathic activity of 178 Caucasian plant species. International Journal of Basic and Applied Sciences, 5(1), 75-81	"Table 1: Effects of Leaf Litter of 178 Caucasian Plants on Lettuce (<i>L. Sativa</i>) Radicle and Hypocotyl Lengths (%)." [Melilotus albus exhibits allelopathic effects on lettuce radicles] ... "Shinwari et al. [24] recently reported allelopathic activity of an-other Fabaceae family member, <i>Melilotus albus</i> Medikus, which is also known for its medicinal properties and poisonous effects."
403	Parasitic	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.	"Annual or short-lived perennial herbs; stems erect, 3-15(-30) dm long." [Fabaceae. No evidence]
404	Unpalatable to grazing animals	n
	Source(s)	Notes

Qsn #	Question	Answer
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"Large mammals: Deer, antelope, elk, and livestock feed on sweetclover. When diets of co occurring elk, deer, and livestock were compared, sweetclover was often a larger component of native ungulate diets than cattle diets."
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	" <i>M. albus</i> has long been valued for its potential as a fodder crop, for soil and land reclamation, for stabilising soil and roadside cuttings and for honey production. "
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Europe, widely introduced as a fodder plant"
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Sweet-clovers have a variety of uses in agriculture. As pasture plants they are amongst the most productive available if properly managed (Greenshields 1957); they can provide good quality hay rich in protein and minerals (Smith and Gorz 1965); they are satisfactory for making good quality silage (Smith and Gorz 1965) and when harvested for seed, the straw will provide a roughage of considerable value (Greenshields 1957)."

405	Toxic to animals	y
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Moderate toxicity, this plant contains a glycoside with a coumarin fraction; when sweet-clover is harvested for feed, the succulent stems usually mold before drying. The molds metabolize the glycoside into dicoumarol, which interrupts vitamin K activation of prothrombin, necessary in blood clotting. Cattle, horses and sheep have been poisoned, all animals that eat affected hay may be poisoned. Symptoms of moldy sweet-clover poisoning may appear without any obvious cause."
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Sweet clover disease is a haemorrhagic disease of cattle, occurring mostly in the USA and Canada when mouldy or spoiled sweet clover hay is fed to cattle (Connor, 1997). Large obvious swellings representing subcutaneous haemorrhages are the first clinical signs, usually accompanied by internal haemorrhaging. Sweet clover disease can also occur in sheep, but they are less sensitive. The mycotoxin is dicoumarol, an anti-coagulant, produced from coumaric and melilotic acids in plant tissue by action of the fungi in the hay."

406	Host for recognized pests and pathogens	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Royer and Dickinson (1999, cited in Gucker, 2009) noted the association of <i>M. albus</i> with 28 viral plant diseases including beety curly tip, cucumber mosaic and tobacco streak virus. "

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL</p>	<p>[Medicinal & toxic to animals. Possibly toxic to people if ingested] "Whole plant aromatic, antidote, febrifuge, anticoagulant, carminative, digestive, emollient. Moderate toxicity, this plant contains a glycoside with a coumarin fraction; when sweet-clover is harvested for feed, the succulent stems usually mold before drying. The molds metabolize the glycoside into dicoumarol, which interrupts vitamin K activation of prothrombin, necessary in blood clotting. Cattle, horses and sheep have been poisoned, all animals that eat affected hay may be poisoned. Symptoms of moldy sweet-clover poisoning may appear without any obvious cause."</p>

408	Creates a fire hazard in natural ecosystems	
	Source(s)	Notes
	<p>Gucker, C. L. 2009. <i>Melilotus alba</i>, <i>M. officinalis</i>. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]</p>	<p>[Unknown] "Fuels: As of 2010, there was little information about sweetclover fuel characteristics. During an early May prescribed fire in the Curtis Prairie in Madison, Wisconsin, fire did not carry well through yellow sweetclover patches occupying a natural drainage [74]. Whether poor fire spread was a result of drainage, plant characteristics, or other factors affecting fire behavior is unknown. Fire regimes: Information on the typical fire regimes in native sweetclover habitats was lacking. In North America, sweetclover occurs in communities with wide ranging fire regime characteristics. As of 2010, effects of large, invasive sweetclover populations on fire frequency or fire severity were not described. "</p>

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes

Qsn #	Question	Answer
	<p>CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc</p>	<p>[Full sun to partial shade] "Shade: Most reviews and studies indicate that sweetclover grows best in full sun or partial shade. A review of Upper Midwest habitats indicates that sweetclover is most frequent in open, disturbed upland prairies, savannas, and dunes (review by [45]). Other reviews report that sweetclover is less "vigorous" and produces fewer seeds in shade than in full sun [251]; however, shade tolerance may be greater in hot, dry climates [222]. Most studies and observations indicate that although sweetclover is common on open sites, some degree of shade tolerance also exists. At the Mammoth campground in Yellowstone National Park, yellow sweetclover was positively associated with open canopy conditions (P<0.02), and 75% of yellow sweetclover occurrences were beneath canopies of 10% or less [1]. In the Swan Valley of northwestern Montana, yellow sweetclover cover was much greater on logged (14%) than unlogged (<1%) coniferous forests. Logging occurred up to 30 years earlier [67]. Along rivers in Alaska, white sweetclover did not occur beneath dense alder (<i>Alnus</i> spp.) or balsam poplar (<i>Populus balsamifera</i>) canopies [37]. In quaking aspen (<i>P. tremuloides</i>) woodlands that dominated about 90 years after deforestation of the boreal mixed-wood forest in Alberta, white sweetclover was restricted to within 49 feet (15 m) of the deforested edge [71]. Some studies indicate mild to substantial shade tolerance in sweetclovers. In a savanna in the University of Wisconsin-Madison Arboretum, white sweetclover cover was 7.5% beneath oak (<i>Quercus</i> spp.) canopies and 6.7% outside of the canopies. Photosynthetically active radiation was 52% to 83% lower beneath than outside oak canopies [131]. Along portions of the Rio Grande in New Mexico, sweetclover often dominated beneath a dense overstory of Fremont cottonwood (<i>P. fremontii</i>), Goodding willow (<i>Salix gooddingii</i>), and Russian-olive (<i>Elaeagnus angustifolia</i>). In these habitat types, litter was 1 to 6 inches (2.5-20 cm) deep [25], suggesting that sweetclover seedlings as well as mature plants were tolerating heavy shade."</p>

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	" <i>M. alba</i> is found growing on a wide range of soil types and textures, from Fargo clay (Stoa 1933) and loam to dune sand and river gravel. It is found most commonly on calcareous soils (Dunham 1933), and is reported to be unsuited to acid soils (Smith and Gorz 1965), although Ramakrishnan (1968a,b, 1970) has identified calcicole and calcifuge populations in Southern Ontario. Greenshields (1957) has reported that best growth occurs on rich foams and clay loams. <i>M. alba</i> has also been observed to invade and grow on coal ash dumps with no pathological alteration in morphology (Seraya and Komov 1971)."
	CABI, 2017. Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Soils: Sweetclover grows on a variety of alkaline or slightly acidic soils ([33,37], review by [220]). Very low nutrient levels and fine- and coarse-textured soils are tolerated ([37,167,245,279], review by [233]). Several reviews indicate that yellow sweetclover tolerates nutrient-poor and dry soils better than white sweetclover [49,89,219,254]. Sweetclover occupies a variety of soil types and textures but growth and productivity can vary by soil type and region."

411	Climbing or smothering growth habit	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.	"Annual or short-lived perennial herbs; stems erect, 3-15(-30) dm long."

412	Forms dense thickets	y
	Source(s)	Notes
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"In a New Jersey state-agency publication, sweetclover is reported in globally rare plant communities along the Delaware River. Agency officials cautioned that sweetclover has the potential to form dense stands, prevent native plant establishment, alter community structure, and disrupt succession [221]. Dense patches of white sweetclover also occur where narrow endemics, Williams' milkvetch (<i>Astragalus williamsii</i>) and Setchell's willow (<i>Salix setchelliana</i>), grow in Alaska [37]."

501	Aquatic	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.	[Terrestrial] "Annual or short-lived perennial herbs" ... "in Hawai'i apparently uncommon in disturbed sites, 5- 1,340 m, on Midway Atoll and Hawai'i."

502	Grass	n
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Qsn #	Question	Answer
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 13 Sep 2017]	Family: Fabaceae (alt.Leguminosae) Subfamily: Papilionoideae Tribe: Trifolieae

503	Nitrogen fixing woody plant	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.	"Annual or short-lived perennial herbs; stems erect, 3-15(-30) dm long." [N-fixing herb]

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.	"Annual or short-lived perennial herbs; stems erect, 3-15(-30) dm long."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Perennial non-climbing herb, branching, sweet-smelling, erect, leafy, strong taproot,"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[No evidence] "M. albus is native to much of Asia and southern Europe, from France and Spain to Kazakhstan and Myanmar, and also north-east Africa (USDA-ARS, 2014)."

602	Produces viable seed	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.	"Pods pale to dark brown at maturity, 3-4(-5) mm long, strongly reticulate-veined. Seeds usually 1."
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"Sweetclover reproduces from seed. Cases of vegetative sprouting after damage have been reported, but are rare"

603	Hybridizes naturally	
	Source(s)	Notes

Qsn #	Question	Answer
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	[Possibly rare] "Natural interspecific hybrids in <i>Melilotus</i> are rare. Most reports of natural hybrids are subject to doubt (Stevenson 1969). practically all sweet-clovers in cultivation are varieties and not hybrids. Artificially produced interspecific hybrids have been reported by numerous authors (Greenshields 1954; Kirk 1929. 1931a; Smith 1954; Smith and Gon 1965; Stevenson and Kirk 1935; Webster 1955)."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Floral biology - Kirk and Stevenson (1931b) pointed out that in <i>M. alba</i> , the close proximity of stigmas and anthers seems to facilitate self-pollination, but this does not always hold with <i>M. officinalis</i> . with <i>M. alba</i> , Clarke (1935) found that when pistil and stamens are of the same length, self-pollination readily takes place, but when the pistil is longer than the stamens, there is very little self-pollination." ... "More recently, Barcikowska (1966) found that white sweet clover, although cross-fertile, sometimes exhibits high self-fertility in both the annual and biennial forms, contrary to yellow sweet-clover which has little self-fertility."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"Pollination and breeding system: Sweetclover flowers are perfect [55,158], and although experiments have shown that seed can be produced by self-fertilized flowers, this rarely occurs in natural conditions [34], especially for yellow sweetclover [122]. Sweetclover flower structure encourages cross pollination by insects. When insects land on lower flower petals, stigma and anthers bend and contact the insect body [10]. Bees are the most common sweetclover pollinators; honey bees, bumble bees, and leaf-cutter bees were reported as important pollinators ([144,285], review by [55]). Successful pollination by insects can be affected by season and weather. Cloudy, wet weather decreases bee activity [10,285], and Bare [10] reports that the honey production capacity of sweetclover is greater in early summer than late summer and greater for areas west of the Mississippi River than areas east of the River. "
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Sweet-clover is highly attractive to honey bees. Although the honey bee is the most important pollinator, Bohart (cited in Smith and Gorz 1965) indicated that <i>M. officinalis</i> is attractive also to a number of bee species and halictids, and <i>M. alba</i> is attractive to a much wider array of insects, including many wasps and flies. Coe and Martin (1920) listed a wide variety of insects pollinating sweet-clover blossoms."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes

Qsn #	Question	Answer
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"Sweetclover reproduces from seed. Cases of vegetative sprouting after damage have been reported, but are rare"

607	Minimum generative time (years)	1
	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.	"Annual or short-lived perennial herbs"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Propagules with the outer fruit layers attached will become attached to both wet and dry clothing (unpublished undergraduate experiments, University of Western Ontario)."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"The risk of deliberate introduction to further countries is high as <i>M. albus</i> is sometimes seen as a potentially high value fodder crop."

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seeds of <i>M. albus</i> are also sometimes introduced as impurities in seeds of other crops such as lucerne (<i>Medicago sativa</i>) (Gucker, 2009)." ... "Conn (2010) found seeds of <i>Melilotus</i> (species not determined) in samples of crop, grass and bird seed imported into Alaska, USA. <i>M. albus</i> seeds have been reported as being introduced in imported bird seed (Hanson and Mason, 1985)."
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Sweet-clover seeds are readily dispersed with crop seeds as the Canadian Seed Regulations (Agriculture Canada 1967) attest."

Qsn #	Question	Answer
704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seed dispersal: Because sweetclover lacks appendages for wind dispersal, most seed falls near the parent plant (review by [49])"
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"The large seeds can be blown over short distances (a few meters) by strong winds, but rain wash and stream flow are probably much more important for dispersal."

705	Propagules water dispersed	y
	Source(s)	Notes
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"The large seeds can be blown over short distances (a few meters) by strong winds, but rain wash and stream flow are probably much more important for dispersal. In tests in 2 successive yr in London more than 213 of the seeds of <i>M. alba</i> remained floating after 15 min in violently agitated water."
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Water: Several sources suggest that sweetclover seed is dispersed by water. Based on plant distributions along waterways in Alaska [37,225], Montana [14], Arizona [237], and New Jersey [221], sweetclover seed dispersal by water seems likely. Experiments conducted in London, Ontario, showed that over 65% of white sweetclover seeds were still floating after 15 minutes in violently agitated water (unpublished experiments described in [251])."

Qsn #	Question	Answer
706	Propagules bird dispersed	n
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[Seeds depredated by birds] "Sweetclover seeds and/or insect visitors are important forage for waterfowl, game birds, and song birds (reviews by [156,230,240]). As with mammals, bird use of sweetclover may vary by season. Sweetclover seeds were recovered from the crops of winter-killed gray partridge, ring necked pheasants, and California quail. The largest volume (19.5%) of sweetclover was recovered from California quail crops. Much less sweetclover was recovered from summer- or fall-collected crops of any bird species [130]. In Idaho, sweetclover is important forage for sage grouse broods [4]. In Nevada, white-crowned sparrows, house finches, and mourning doves are commonly flushed from sweetclover vegetation when seeds are ripening. Sweetclover seeds are also utilized by Gambel's quail, California quail, and ring-necked pheasants in the Intermountain West (review by [84]). Up to 10% of Gambel's quail diets in Nevada were sweetclover (review by [156]). In the Nebraska Sandhills, yellow sweetclover was recovered from crops or gizzards of adult sharp-tailed grouse collected in the summer. Yellow sweetclover occurred in 18% of samples. Yellow sweetclover was not recovered from crops or gizzards of young sharp-tailed grouse [132]. In the Great Plains, yellow sweetclover attracts insects that are consumed by songbirds and upland game birds (review by [240]). In Minnesota, sweetclover occurred in gray partridge diets (review by [156])."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	[Seeds could possibly adhere to animals] "Animal: Observations and experiments leave little doubt that sweetclover seed is transported by animals. In the Intermountain West, sweetclover spread along cattle trails was reported [11], and in the Missouri Ozarks, sweetclover was restricted to horse trails [236]. While collecting sweetclover seeds for later experiments, students found that sweetclover seeds with fruit layers attached were transported on human clothing (unpublished experiments described in [251]). "

708	Propagules survive passage through the gut	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Gucker, C. L. 2009. <i>Melilotus alba</i>, <i>M. officinalis</i>. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/. [Accessed 14 Sep 2017]</p>	<p>"Animal: Observations and experiments leave little doubt that sweetclover seed is transported by animals. In the Intermountain West, sweetclover spread along cattle trails was reported [11], and in the Missouri Ozarks, sweetclover was restricted to horse trails [236]. While collecting sweetclover seeds for later experiments, students found that sweetclover seeds with fruit layers attached were transported on human clothing (unpublished experiments described in [251]). Experiments show that viable sweetclover seed can be recovered from animal feces. When white-tailed deer pellets were collected from mixed-deciduous forests in Ithaca, New York, a maximum of 13 white sweetclover seeds germinated/pellet group [171]. Three white sweetclover seeds were collected from crops of mourning doves, and 1 seed germinated. A seed recovered from the gizzard did not germinate [8]. When calves, horses, sheep, hogs, and chickens were fed a known quantity of white sweetclover seed, 17.7%, 10%, 17.1%, 11%, and 0% of the seed germinated from collected feces, respectively. When recovered seeds were treated with sulfuric acid, germination rates increased by 40% or more, indicating that a large portion of white sweetclover seeds were still hard after passing through these animals (see Germination for more about hard sweetclover seed). Five percent of white sweetclover seeds that remained inside calves for up to 48 hours germinated. Ten percent of seeds recovered after 48 to 80 hours inside calves germinated. Sweetclover seeds may also be transported in partially composted manure. Two percent of white sweetclover seeds germinated after 2 months of burial in manure [92]."</p>
	<p>CABI, 2017. Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc</p>	<p>"<i>M. albus</i> seeds can pass in a germinable state through the digestive system of the moose (<i>Alces alces</i>), at the rate of about 16% of seeds ingested (3,595 of 22,000), most being defecated 2 to 3 days after feeding, but with small numbers sometimes still being defecated 11 days after feeding (Seefeldt et al., 2010). Seeds have also been found to survive passage through white-tailed deer, calves, horses, sheep and pigs (Harmon and Keim, 1934; Myers et al., 2004)."</p>

801	Prolific seed production (>1000/m2)	y
	Source(s)	Notes
	<p>CABI, 2017. Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc</p>	<p>"High levels of seed production are reported for sweetclover ([228], Rempel and Cavers unpublished data cited in [251]), and available reports indicate that white sweetclover generally produces more seed than yellow sweetclover (Rempel and Cavers unpublished data cited in [251]). However, seed production estimates using calculations that assume all flowers produce fruits and all fruits produce 1 seed can largely overestimate production [126]. Methods used to determine seed production in the following studies were not reported. In London, Ontario, large white sweetclover growing in open conditions produced 200,000 to 350,000 seeds/plant. Large yellow sweetclover growing under similar conditions rarely produced more than 100,000 seeds/plant (Rempel and Cavers unpublished data cited in [251]). In North Dakota, an average sized white sweetclover with 5 stems produced 14,235 seeds [228]."</p>

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seed banking: Studies clearly indicate that sweetclover produces a seed bank; however, estimates of the longevity of seed in the soil vary from >2.5 [126,260] to 81 years (review by [204]). Sweetclover seeds have germinated after 81 years of storage (Becquerel 1934 cited in [41]), but field studies involving the recovery and germination of buried seed over time are lacking."
	Turkington, R. A., Cavers, P. B., & Rempel, E. (1978). The biology of Canadian weeds. 29. <i>Melilotus alba</i> Desr. and <i>M. officinalis</i> (L.) Lam. Canadian Journal of Plant Science, 58(2), 523-537	"Stoa (1941, in Smith and Gorz 1965) noted that hard seeds of sweet-clover remained viable in the soil for more than 20 yr, and Munn (1954, in Smith and Gorz 1965) found that 17% of an original lot of hard seeds remained hard for almost 40 yr when stored in stoppered vials in a dry room, but 60% of them germinated when scarified. Stoa (1933) documented work in North Dakota where sweet-clover (species not mentioned) was allowed to mature in plots in 1918."

803	Well controlled by herbicides	y
	Source(s)	Notes
	CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Chemical control Turkington et al. (1978) reported that <i>Melilotus</i> spp. are extremely sensitive to damage from widely used herbicides such as 2,4-D, MCPA, MCPB, 2,4-DB and dicamba, although it becomes harder to kill by its second year. In Alaska, where <i>M. officinalis</i> is proving invasive, Conn and Seefeldt (2009) tested different herbicides in both glasshouse and field for their effectiveness. In the field they found that chlorsulfuron both reduced plant biomass and prevented seed production. Although clopyralid, 2,4-D and triclopyr reduced biomass, results using these chemicals varied from year to year."
	Gucker, C. L. 2009. <i>Melilotus alba</i> , <i>M. officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]	"Chemical control: Herbicides provide control of sweetclover. Herbicides may be most effective on 1st-year sweetclover (review by [251]) and when used with other control methods. In early May following a fall fire in little bluestem prairie in Mason County, Illinois, the burned site was covered with a "carpet" of white sweetclover seedlings. Seedlings were successfully controlled with herbicide [210]. In Alaska, several herbicide treatments were tested on white sweetclover populations. Most herbicide types and rates decreased white sweetclover biomass and seed production. Only 1 herbicide treatment eliminated seed production [38]. Herbicides are effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [21]. See the Weed control methods handbook [250] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals."

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

Qsn #	Question	Answer
	<p>Gucker, C. L. 2009. <i>Melilotus alba</i>, <i>M. officinalis</i>. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ . [Accessed 14 Sep 2017]</p>	<p>[May tolerate fire depending on growth stage. Cutting or mowing give mixed results] "Fire adaptations: Sweetclover is well adapted to survive fire. Established 2nd-year plants often survive dormant-season fires [96,128], and seed survival and subsequent establishment are likely even if growing-season fires kill all plants. Seeds are heat tolerant [29,200], and germination can be stimulated by fire [129,197,218]. Sprouting after fire: The potential for sweetclover to sprout after fire may depend on plant phenology and fire timing. Sprouting after aboveground damage may be limited to 1st-year plants with large crown buds [289] or 2nd-year plants that have not yet produced flower buds (review by [45]). By late summer or early fall, 1st-year sweetclover plants have considerable carbohydrate stores and regrowth potential [118,157,216,289]. Additional protection from fire may be provided by sweetclover's contractile roots, which pull the root crown underground in the fall and protect its buds from extreme temperatures (review by [251]). In oak savannas on the Sherburne National Wildlife Refuge, "vigorous" yellow sweetclover sprouts were observed the growing season following a spring prescribed fire [182]." ... "Physical or mechanical control: Hand-pulling, cutting, and mowing can be useful for controlling sweetclover. Hand-pulling has been successful for controlling small sweetclover populations on Nature Conservancy preserves across the country [250]. Hand-pulling is most effective when the ground is moist (early spring or late fall) and complete root removal is most likely. At these times, stress on associated vegetation should be low (reviews by [35,277]). Another review recommends that 1st-year sweetclover be pulled after the root crown has developed [45]. However, failure to remove the entire root could mean plant survival, since sweetclover is "nearly impossible" to kill after large crown buds are produced from August to November [289]."</p>

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	<p>CABI, 2017. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc</p>	<p>"No biocontrol agents have been used for its control, although White et al. (1999) suggested that the American native sweetclover weevil (<i>Sitona cylindricollis</i>) may provide some control when present in large numbers."</p>
	<p>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.</p>	<p>[Unknown] "in Hawai'i apparently uncommon in disturbed sites, 5-1,340 m, on Midway Atoll and Hawai'i."</p>

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability
- Grows in temperate to tropical climates
- Naturalized on Hawaii, Maui, Molokai & Midway Island; widely naturalized elsewhere
- Agricultural weed
- Environmental weed
- Other *Melilotus* species are invasive weeds
- Allelopathic
- Can be toxic to animals
- Host of 28 viral plant diseases
- Tolerates many soil types
- Forms dense patches that can exclude other vegetation
- Reproduces by seed
- Self-fertile
- Can reach maturity in <1 year (but often >1 growing season)
- Seeds dispersed by water, internally by animals, as a contaminant of other crops & seed mixes & intentionally by people
- Prolific seed production
- Forms a persistent seed bank
- May tolerate fire and cutting at certain growth stages

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock (palatable despite reports of toxicity)
- N-fixing (improves soil fertility)
- Not reported to spread vegetatively
- Beneficial to bees & other pollinators