

<b>Taxon:</b> <i>Melilotus officinalis</i> (L.) Lam.	<b>Family:</b> Fabaceae
<b>Common Name(s):</b> common melilot field melilot ribbed melilot yellow melilot yellow sweet clover yellow trefoil	<b>Synonym(s):</b> <i>Melilotus arvensis</i> Wallr. <i>Melilotus officinalis</i> var. <i>micranthus</i> <i>Melilotus vulgaris</i> Hill, nom. inval. <i>Trifolium officinale</i> L.

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 1 Mar 2019
<b>WRA Score:</b> 14.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> 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)	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)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals		
406	Host for recognized pests and pathogens		

Qsn #	Question	Answer Option	Answer
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
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		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	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/m2)	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
	Wiersema, J.H. & León, B. (2013). World Economic Plants: A Standard Reference. Second Edition. CRC Press, Boca Raton, FL	[No evidence] "Melilotus officinalis ... ECON: Addit. (flavoring); Bee (honey production); Environ. (soil improver); Forage (fodder, forage); Medic. (folklore); Poison (mammals); Weed (also poss. seed contam.)"
	Gucker, C. L. 2009. Melilotus alba, M. officinalis. In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	No evidence

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

Qsn #	Question	Answer
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Intermediate
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 28 Feb 2019]	"Native Asia-Temperate WESTERN ASIA: Afghanistan, Iran, Iraq (n.e.), Turkey CAUCASUS: Armenia, Azerbaijan, Georgia, Russian Federation, [Dagestan] Russian Federation-Ciscaucasia [Ciscaucasia] SIBERIA: Russian Federation-Eastern Siberia, [Eastern Siberia] Russian Federation-Western Siberia [Western Siberia] MIDDLE ASIA: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan CHINA: China (w.) Asia-Tropical INDIAN SUBCONTINENT: India, [Himachal Pradesh, Jammu and Kashmir] Pakistan (n.) Europe MIDDLE EUROPE: Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland EASTERN EUROPE: Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation-European part [European part] SOUTHEASTERN EUROPE: Albania, Bulgaria, Former Yugoslavia, Greece, Italy (incl. Sardinia), Romania SOUTHWESTERN EUROPE: France, Spain (incl. Balears)"

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

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	"Climatic requirements - Both species are adapted to a wide range of climatic conditions. They are drought-tolerant (Butovsiii 1971), only requiring enough moisture for establishment after which they will develop under extremely dry conditions. Kirk (1931b, cited in Dunham 1933) grew both sweet-clover species in Saskatchewan with precipitation ranging from 18 to 26 cm. Both species are winter-hardy and have extended their ranges into high latitudes including the Yukon and the North West Territories"

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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	"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]."
	Roecklein, J.C. & Leung, P. (eds.). (1987). A Profile of Economic Plants. Transaction Publishers, New Brunswick, NJ	[Broad elevation range] "Plants are native to Europe, Asia, and North Africa and have been introduced to North and South America where they thrive from sea level to 4,000 m in neutral, well-drained soils. They are fairly drought-resistant."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	" <i>Melilotus officinalis</i> is a herbaceous legume species, native to parts of Asia and possibly Europe (sources differ on this), that has been extensively introduced to be used as a forage and nitrogen fixing crop. It has escaped from cultivation and become an invasive weed in many temperate and tropical regions"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	" <i>Melilotus officinalis</i> is a herbaceous legume species, native to parts of Asia and possibly Europe (sources differ on this), that has been extensively introduced to be used as a forage and nitrogen fixing crop. It has escaped from cultivation and become an invasive weed in many temperate and tropical regions"
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 28 Feb 2019]	"Naturalized Africa NORTHERN AFRICA: Morocco EAST TROPICAL AFRICA: Kenya SOUTHERN AFRICA: South Africa [Western Cape, Gauteng] Asia-Temperate WESTERN ASIA: Lebanon EASTERN ASIA: Japan Australasia AUSTRALIA: Australia NEW ZEALAND: New Zealand Europe NORTHERN EUROPE: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom Northern America Canada, United States Southern America SOUTHERN SOUTH AMERICA: Argentina, Chile, Uruguay"

Qsn #	Question	Answer
205	Does the species have a history of repeated introductions outside its natural range?	y
	<b>Source(s)</b>	<b>Notes</b>
	Wiersema, J.H. & León, B. (2013). World Economic Plants: A Standard Reference. Second Edition. CRC Press, Boca Raton, FL	"DIST: native: Asia-Temp.; Ind. Subcont.; Eur. natzd. : N. Afr., E. Trop. Afr., S. Afr.; W. Asia, E. Asia; Austral., N. Zeal.; N. Eur.; Can., U.S.A.; S. S.Amer. cult.: also cult."
	Roecklein, J.C. & Leung, P. (eds.). (1987). A Profile of Economic Plants. Transaction Publishers, New Brunswick, NJ	"Plants are native to Europe, Asia, and North Africa and have been introduced to North and South America where they thrive from sea level to 4,000 m in neutral, well-drained soils."
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"The native distribution range of <i>M. officinalis</i> is still unclear. While some authors consider it to be native to Europe and Asia (USDA-ARS, 2017), others consider it native to Asia and introduced elsewhere (DAISIE, 2018). It has been widely introduced and can currently be found naturalized across Europe, Asia, Africa, the Americas, the West Indies, Australia and New Zealand (DAISIE, 2017; ILDIS, 2017; USDA-NRSC, 2017; USDA-ARS, 2017)."

Qsn #	Question	Answer
301	<b>Naturalized beyond native range</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It has been widely introduced and can currently be found naturalized across Europe, Asia, Africa, the Americas, the West Indies, Australia and New Zealand (DAISIE, 2017; ILDIS, 2017; USDA NRSC, 2017; USDA-ARS, 2017)."
	Van Riper, L., & Larson, D. (2009). Role of Invasive <i>Melilotus officinalis</i> in Two Native Plant Communities. <i>Plant Ecology</i> , 200(1), 129-139	" <i>Melilotus officinalis</i> (L.) Lam. (hereafter <i>Melilotus</i> ) is a biennial legume (Fabaceae) native to Eurasia that has become naturalized throughout the world (Klebesadel 2001; Turkington et al. 1978; Wu et al. 2003) and has been recognized as a conservation problem in natural areas in North America (Lesica and DeLuca 2000; Turkington et al. 1978; Weaver et al. 2001; Wolf et al. 2003)."
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 28 Feb 2019]	"Naturalized Africa NORTHERN AFRICA: Morocco EAST TROPICAL AFRICA: Kenya SOUTHERN AFRICA: South Africa [Western Cape, Gauteng] Asia-Temperate WESTERN ASIA: Lebanon EASTERN ASIA: Japan Australasia AUSTRALIA: Australia NEW ZEALAND: New Zealand Europe NORTHERN EUROPE: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom Northern America Canada, United States Southern America SOUTHERN SOUTH AMERICA: Argentina, Chile, Uruguay"
	Wagner, W.L., Herbst, D.R. & Lorence, D.H. (2019). <i>Flora of the Hawaiian Islands</i> . Smithsonian Institution, Washington, D.C. <a href="http://botany.si.edu/">http://botany.si.edu/</a> . [Accessed 28 Feb 2019]	No evidence in the Hawaiian Islands to date

302	<b>Garden/amenity/disturbance weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	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. <i>Canadian Journal of Plant Science</i> , 58(2), 523-537	"Since they are invading species, they quickly colonize freshly disturbed soils on well-drained river banks, construction sites etc. and reduce soil erosion." [Disturbance-adapted weed that impacts the natural environment and agriculture]

303	<b>Agricultural/forestry/horticultural weed</b>	
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	Ghaderi-Far, F., Gherekhloo, J., & Alimagham, M. (2010). Influence of environmental factors on seed germination and seedling emergence of yellow sweet clover ( <i>Melilotus officinalis</i> ). <i>Planta Daninha</i> , 28(3), 463-469	"In recent years, <i>M. officinalis</i> has become a problematic weed in canola and wheat fields in almost all parts of Golestan province, in Iran (Yones-Abadi, 2003). This plant substantially reduces the yield of several major crops (Turkington et al., 1978), but its interference with the canola harvesting and the reduction of the crop seed quality is probably the most important economic consequence of the presence of this weed on the fields."
	CABI. (2019). <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"The species is also a problematic weed in canola and wheat fields (Turkington et al., 1978; Ghaderi-Far et al., 2010; USDA-NRCS, 2017), and is listed as a noxious weed in Canada and the USA."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Grapevines, Orchards & Plantations, Pastures, Pome Fruits, Sunflowers, Vegetables"

304	Environmental weed	y
	Source(s)	Notes
	CABI. (2019). <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"Impact on Habitats - <i>Melilotus officinalis</i> is an aggressive allelopathic weed that forms dense monospecific stands that displace and inhibit the establishment of native vegetation (Klein, 2011; USDA-NRCS, 2017). As a nitrogen-fixing legume with large taproots, it has the potential to alter soil conditions and nutrient cycling. In invaded ecosystems, changes in the nitrogen distribution may ultimately shift the composition and structure of native plant communities (Wolf et al., 2004). It can also reduce light and soil moisture levels in highly invaded areas (YISC, undated; USDA NRCS, 2017). It also alters the frequency of natural fires in invaded ecosystems. In North America, it reduces the occurrence of natural fires and consequently degrades native grassland communities that depend on recurrent fires (USDA-NRCS, 2017). Ecosystems invaded by <i>M. officinalis</i> include Alaska glacial river floodplains and roadsides adjacent to natural areas (Conn and Seefeldt, 2009; USDA-NRCS, 2017), prairies across Canada, and national parks and protected areas in the United States such as the Rocky Mountain National Park in Colorado, the Badlands National Park and the North American Great Plains (Wolf and Rohrs, 2001; Wolf et al., 2004; Riper and Larsob, 2009; YISC, undated). Impact on Biodiversity <i>Melilotus officinalis</i> is an aggressive weed with the potential to strongly decrease the diversity and abundance of all other native and alien plant species (Conn and Seefeldt, 2009; Wolf and Rohrs, 2001; Wolf et al., 2004; Riper and Larsob, 2009; YISC, undated; USDA-NRCS, 2017). For more information on its effects on their habitats, see above under 'Impact on Habitats'."

305	Congeneric weed	y
	Source(s)	Notes



Qsn #	Question	Answer
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Melilotus indica ... Weed of: Cereals, Cotton, Grapevines, Orchards & Plantations, Pastures, Pome Fruits" ... "Melilotus indicus ... Weed of: Cereals, Orchards & Plantations, Pastures, Pome Fruits, Vegetables" ... "Melilotus parviflora ... Weed of: Cereals, Orchards & Plantations, Pastures" ... "Melilotus sulcata ... Weed of: Cereals, Orchards & Plantations, Vegetables" ... "Melilotus sulcatus ... Weed of: Cereals"
	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
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Biennial herbs, sparsely puberulent to glabrescent. Stems erect, 40–100(–250) cm, longitudinally ridged. Stipules linear-falcate, 3–5(–7) mm, entire or with 1 tooth at base; petiole slender; leaflets obovate, broadly ovate, oblanceolate, to linear, 15– 25(–30) × 5–15 mm, lateral veins running into teeth, 8–12 pairs, margins shallowly serrate."

402	Allelopathic	
	Source(s)	Notes
	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	"Fig. 2: Normal Distribution of Screened Plants with Medicinal or Poisonous Properties in Comparison with other Screened Plant Using Sandwich Method." [Melilotus officinalis - exhibits significant inhibitory activity]
	Umer, A., Yousaf, Z., Khan, F., Hussain, U., Anjum, A., Nayyab, Q., & Younas, A. (2010). Evaluation of allelopathic potential of some selected medicinal species. African Journal of Biotechnology, 9(37), 6194-6206	[Extracts may be allelopathic] "In the present study, allelopathic behaviour of <i>M. officinalis</i> was evaluated. The concentration of 5 g leaves stimulate the growth up to 50% of radicle and plumule in case of <i>P. sativum</i> (Figure 15), but completely inhibited or retarded the growth of <i>T. aestivum</i> (Figure 16). However, 3 g root showed 40% radicle and 60% plumule growth of wheat (Figure 16). But the same concentration (3 g root) exhibited 80% growth of radicle of pea. These findings revealed that it has significant effect on monocotyledons and dicotyledons"

403	Parasitic	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Biennial herbs, sparsely puberulent to glabrescent. Stems erect, 40–100(–250) cm, longitudinally ridged." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Wiersema, J.H. & León, B. (2013). <i>World Economic Plants: A Standard Reference</i> . Second Edition. CRC Press, Boca Raton, FL	"ECON: Addit. (flavoring); Bee (honey production); Environ. (soil improver); Forage (fodder, forage); Medic. (folklore); Poison (mammals); Weed (also poss. seed contam.)"
	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. <i>Canadian Journal of Plant Science</i> , 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)."
	Roecklein, J.C. & Leung, P. (eds.). (1987). <i>A Profile of Economic Plants</i> . Transaction Publishers, New Brunswick, NJ	"Yellow melilot ( <i>Melilotus officinalis</i> ) is a biennial herb to 130 cm in height cultivated for forage, hay, and pasture."

405	Toxic to animals	
	<b>Source(s)</b>	<b>Notes</b>
	CABI. (2019). <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"Improperly cured forage from <i>Melilotus officinalis</i> can be toxic to livestock (USDA-ARS, 2017)"
	Burrows, G. E., & Tyrl, R. J. (2013). <i>Toxic Plants of North America</i> . Second Edition. Wiley-Blackwell, Hoboken, NJ	[May cause problems if improperly cured/dried sweetclover is fed to livestock] "Disease Problems—Sweet clovers became increasingly popular as forages in the early 1920s, about the same time that a seemingly new clostridial -type hemorrhagic or blackleg-type disease was being recognized. Eventually feeding of sweet clover hay was linked to the disease (Schofi eld 1924; Roderick and Schalk 1931). It was noted that there was no problem when sweet clover pasture was grazed. The characteristic manifestation of the disease was intractable bleeding due to inhibition or retardation of blood coagulation (Roderick 1929, 1931)." ... "Disease problems are more likely to appear in winter when animals are fed <i>Melilotus</i> hay put up in large round bales during a wet summer. These conditions of large bales and moist plants make curing of the tougher stems more difficult. Problems may also appear when more mature, coarser hay is put up (Roderick and Schalk 1931). Because species of <i>Melilotus</i> often readily invade sites, they may present problems as weedy contaminants in grass hays (Yamini et al. 1995). Silage is less often a problem, but it is still a risk, especially in dairy cattle (Puschner et al. 1998). Although all animals are at some risk, this hemorrhagic disease occurs primarily in cattle that have eaten improperly cured plants for several weeks. It appears infrequently in horses and other livestock (McDonald 1980). Sheep are less susceptible than are cattle (Linton et al. 1963). Thus, there is little likelihood of problems at lambing and in newborns."

406	Host for recognized pests and pathogens	
	<b>Source(s)</b>	<b>Notes</b>

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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]	"Impacts on agriculture: Sweetclover may negatively impact agriculture. White sweetclover is associated with 28 viral plant diseases including beet curly tip, cucumber mosaic, and tobacco streak (review by [204]). If sweetclover infects wheat crops and is still green at harvest, wheat can take on a sweetclover odor; this is referred to as "sweetclover taint" (review by [251])."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Pollen Library. (2019). Yellow Sweet-Clover ( <i>Melilotus officinalis</i> ). <a href="http://www.pollenlibrary.com/Specie/Melilotus+officinalis/">http://www.pollenlibrary.com/Specie/Melilotus+officinalis/</a> . [Accessed 1 Mar 2019]	"Allergenicity: Yellow Sweet-Clover ( <i>Melilotus officinalis</i> ) is a mild allergen."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Medicinal, and potentially toxic to animals] "Used in Ayurveda and Unani. Moderate toxicity, when cut for feed, molding usually occurs because of the succulent stems; the molds can metabolize coumarin which is hydrolyzed from a plant glycoside; dicoumarol is produced, which is toxic to animals, all animals that eat affected hay may be poisoned. Whole plant aromatic, antidote, febrifuge, anticoagulant, carminative, digestive, emollient, astringent, styptic and emollient, used for diarrhea, colic, sciatic neuralgia, dysmenorrhea. Drops of fresh leaves juice poured in eyes to cure conjunctivitis, and for clearing eye sight.)"

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"In North America, infestations reduce the occurrence of natural fires and degrade native grassland communities that depend on frequent fires."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Plants for a Future. (2019). <i>Melilotus officinalis</i> . <a href="https://pfaf.org/user/Plant.aspx?LatinName=Melilotus+officinalis">https://pfaf.org/user/Plant.aspx?LatinName=Melilotus+officinalis</a> . [Accessed 1 Mar 2019]	"It cannot grow in the shade."
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It grows well in direct sunlight and in partially shaded sites"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	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	" <i>M. officinalis</i> is a pioneer species on asbestos tips (Banasova 1970) and occurs on gypsum tips (Roland and Smith 1969). Salt tolerance has been shown by Lavado and Nella (1972) for <i>M. officinalis</i> in Argentina and by Shestakov and Vladimirov (1973) for <i>M. alba</i> in Moldavia. Ashford and Bolton (1961) have shown that a sulphur deficiency restricts growth and that nitrogen application depresses fixation and nodulation. Sweet-clover is quite tolerant of high boron concentrations (Holliday et al. 1958)."
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]	"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
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Biennial herbs, sparsely puberulent to glabrescent. Stems erect, 40–100(–250) cm, longitudinally ridged."

412	Forms dense thickets	y
	Source(s)	Notes
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It is allelopathic and so forms dense monospecific stands that displace and inhibit the establishment of native vegetation."
	Conn, J. S., & Seefeldt, S. S. (2009). Invasive white sweetclover ( <i>Melilotus officinalis</i> ) control with herbicides, cutting, and flaming. <i>Invasive Plant Science and Management</i> , 2(3), 270-277	"Spellman (2008) found 50% fewer seedlings of native species occurred in plots where white sweetclover was growing in dense populations on the Nenana River floodplain in Alaska compared with plots where white sweetclover had been removed."
	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 possesses typical weedy attributes, i.e. reproduces in large numbers, is persistent and grows singly or in small clumps along roadside edges, railway rights-of-way, pastures and disturbed areas. Its tall and vigorous growth often masks guide rails and sign posts, creating a hazard for motorists."

501	Aquatic	n
	Source(s)	Notes
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial herb] "Biennial herbs, sparsely puberulent to glabrescent. Stems erect, 40–100(–250) cm, longitudinally ridged." ... "Sandy grasslands, hillsides, ravine shores, margins of mixed woodlands."

502	Grass	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 28 Feb 2019]	Family: Fabaceae (alt.Leguminosae) Subfamily: Faboideae Tribe: Trifolieae

503	Nitrogen fixing woody plant	n
	<b>Source(s)</b>	<b>Notes</b>
	Van Riper, L., & Larson, D. (2009). Role of Invasive <i>Melilotus officinalis</i> in Two Native Plant Communities. <i>Plant Ecology</i> , 200(1), 129-139	[N-fixing non-woody herb] "Melilotus may cause ecosystem-level changes due to its association with <i>Sinorhizabium meliloti</i> bacteria, which allows it to fix atmospheric N and thus potentially enrich the soil (Turkington et al. 1978; Wivstad 1999; Zakhia and de Lajudie 2001)."

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	<b>Source(s)</b>	<b>Notes</b>
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	"Sweetclover produces strong and deep penetrating taproots that can loosen and aerate compacted soils." [No bulbs, corms or tubers]

601	Evidence of substantial reproductive failure in native habitat	n
	<b>Source(s)</b>	<b>Notes</b>
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	[No evidence] "The native distribution range of <i>M. officinalis</i> is still unclear. While some authors consider it to be native to Europe and Asia (USDA-ARS, 2017), others consider it native to Asia and introduced elsewhere (DAISIE, 2018). It has been widely introduced and can currently be found naturalized across Europe, Asia, Africa, the Americas, the West Indies, Australia and New Zealand (DAISIE, 2017; ILDIS, 2017; USDA-NRSC, 2017; USDA-ARS, 2017)."

Qsn #	Question	Answer
602	<b>Produces viable seed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It is a prolific seeder with the potential to produce between 35,000 and 100,000 seeds/plant. Seeds can remain viable in the soil for up to 30 years (Klein, 2011; USDA-NRCS, 2017)."
	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	"Large plants of <i>M. officinalis</i> seldom produced more than 100,000 seeds."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Seeds 1 or 2, yellowish brown, ovoid, ca. 2.5 mm, smooth."

603	<b>Hybridizes naturally</b>	
	<b>Source(s)</b>	<b>Notes</b>
	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	<b>Self-compatible or apomictic</b>	
	<b>Source(s)</b>	<b>Notes</b>
	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	"Brink ( 1934) has shown that self-incompatibility in <i>M. officinalis</i> is caused by a reduced rate of germination of a plant's own pollen on its stigma and the subsequent slow growth of the pollen tube. 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."
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	" <i>Melilotus officinalis</i> produces numerous hermaphroditic flowers that grow in long slender spike like clusters. Anthesis is diurnal and the nectar attracts many kinds of insects, including bees, wasps, flies, butterflies and beetles (Hilty, 2016). In North America, this species shows high out crossing rates and a very low incidence of self-pollination"
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	[Some level of self-compatibility may be possible in certain plants] "When yellow sweetclover flowers were artificially self pollinated, fruit set ranged from 0 to 69.2% and averaged 19.3% [206]. In a field experiment along the Rio Grande in Albuquerque, New Mexico, fruit set was low when yellow sweetclover racemes were protected from insect visitors. Fruit set by protected racemes (6%) was significantly (P<0.001) lower than that set by unprotected racemes (44%) [163]."

605	<b>Requires specialist pollinators</b>	<b>n</b>
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	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	"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."
	Roecklein, J.C. & Leung, P. (eds.). (1987). A Profile of Economic Plants. Transaction Publishers, New Brunswick, NJ	"Its flowers attract bees and are used as honey pasture on bee farms."

606	Reproduction by vegetative fragmentation	n
	<b>Source(s)</b>	<b>Notes</b>
	Sullivan, J. (1992). <i>Melilotus officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	"No vegetative reproduction appears to occur in this species [64,67]."
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 28 Feb 2019]	"Sweetclover reproduces from seed. Cases of vegetative sprouting after damage have been reported, but are rare"

607	Minimum generative time (years)	1
	<b>Source(s)</b>	<b>Notes</b>
	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 annual or biennial herbs; the presence of a single gene pair distinguishing between annual and biennial forms (Clarke 1935)."
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	" <i>M. officinalis</i> is an annual or biennial herb, but under suitable conditions it can also grow as a short-lived perennial (Ogle et al., 2008; USDA-NRCS, 2017)."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"Seeds of <i>M. officinalis</i> can be dispersed on vehicle tyres and agricultural machinery and as a contaminant in cereal grains and soil (Klein, 2011; USDA-NRCS, 2017)."

702	Propagules dispersed intentionally by people	y
	<b>Source(s)</b>	<b>Notes</b>



Qsn #	Question	Answer
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The native distribution range of <i>M. officinalis</i> is still unclear. While some authors consider it to be native to Europe and Asia (USDA-ARS, 2017), others consider it native to Asia and introduced elsewhere (DAISIE, 2018). It has been widely introduced and can currently be found naturalized across Europe, Asia, Africa, the Americas, the West Indies, Australia and New Zealand (DAISIE, 2017; ILDIS, 2017; USDA-NRSC, 2017; USDA-ARS, 2017)."

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	Notes
	Kloot, P. M. 1987. The naturalised flora of South Australia 4. Its manner of introduction. Journal of the Adelaide Botanic Garden, 10: 223-240	"Contaminated seed - This is a particularly effective means of introduction for should a weed be successful enough to reproduce and contaminate the crop with which it is competing, then it is likely to be able to succeed again, when the contaminated seed is moved and sown elsewhere." ... "Loudon (1835) lists the following weeds as infesting the English cereal sample at that time - <i>Lolium temulentum</i> , <i>Agrostemma githago</i> , <i>Ervum tetraspermum</i> (= <i>Vivia tetrasperma</i> ), <i>Melilotus officinalis</i> , <i>Avena fatua</i> , <i>Galium aparine</i> , <i>Scandix pectens</i> (= <i>S. pecten-veneris</i> ), <i>Polygonum convolvulus</i> , <i>Polygonum lapathifolium</i> , <i>Sinapis</i> , <i>Brassica</i> and <i>Raphanus</i> ."
	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."

704	Propagules adapted to wind dispersal	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]	"Seed dispersal: Because sweetclover lacks appendages for wind dispersal, most seed falls near the parent plant (review by [49]), but observations and experiments indicate that long-distance dispersal by animals and water is possible. Long-distance dispersal may also occur through the transport of contaminated seed or animal feed ([14], 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
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Rainwater runoff and stream flow are the most important means of seed dispersal"
	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."



Qsn #	Question	Answer
706	Propagules bird dispersed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Cattle, Livestock, Sheep, Vehicles, Water, Wind, Escapee"

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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed ]	[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
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]	"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]."

Qsn #	Question	Answer
801	<b>Prolific seed production (&gt;1000/m<sup>2</sup>)</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It is a prolific seeder with the potential to produce between 35,000 and 100,000 seeds/plant. Seeds can remain viable in the soil for up to 30 years (Klein, 2011; USDA-NRCS, 2017)."
	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	"Large plants of <i>M. officinalis</i> seldom produced more than 100,000 seeds. Damaged plants, those in sterile ground, or those suffering intense competition may produce fewer than 100 seeds each (Rempel and Cavers, unpublished)."

802	<b>Evidence that a persistent propagule bank is formed (&gt;1 yr)</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	"Crocker ( 1938) cites several different records of seed longevity; <i>M. alba</i> 33% after 40 yr, 1.25% after 41 yr, 0.6% after 81 yr; <i>M. officinalis</i> 33% after 40 yr."
	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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]	"Field conditions: Field studies suggest that sweetclover seed remains viable after 14 to 17 years in the soil but may survive over 50 years in the soil. Several researchers indicate that sweetclover can be abundant even after "several years" without mature plants on a site ([115], review by [187]). After 5 years of underwater storage in Prosser, Washington, a small proportion of white sweetclover seed germinated, but 42% of seeds were still firm [36]. In North Dakota, sweetclover remained viable in the soil for at least 14 years. Sweetclover was planted and allowed to produce seed on 2 agricultural plots. In the following years, plots were cultivated and planted to other crops. Sweetclover seedlings emerged almost every spring for 14 years, even though 1st-year plants were killed each year [233]. On experimental plots at the University of Saskatchewan, white sweetclover seed survived 17 years in the soil. Crop history records and the distribution and quantity of seed led the researcher to conclude that white sweetclover germinated from soil-stored seed, not dispersed seed [13]. In another field study, a researcher visited several areas where circumstances would indicate long-lived, soil-stored seed. In Copenhagen, Denmark, a pork market that was built in 1910 was torn down in 1961. Some archaeological digging occurred, and by 1963, yellow sweetclover was growing on site. Because wind-dispersal is unlikely, the researcher speculated that yellow sweetclover germinated from soil-stored seed [176]."
	Sullivan, J. (1992). <i>Melilotus officinalis</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed ]	"The seeds remain viable for 40 or more years"

803	<b>Well controlled by herbicides</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	<p>Conn, J. S., &amp; Seefeldt, S. S. (2009). Invasive white sweetclover (<i>Melilotus officinalis</i>) control with herbicides, cutting, and flaming. <i>Invasive Plant Science and Management</i>, 2(3), 270-277</p>	<p>"White sweetclover is invading the Alaska glacial river floodplains and roadsides adjacent to natural areas, and control methods are needed. Chlorsulfuron, 2,4-DB, clopyralid, triclopyr, and 2,4-D controlled white sweetclover seedlings below recommended rates in the greenhouse. Biomass of established plants in the field was reduced by chlorsulfuron at recommended (17.6 g ai/ha), 1/2, and 1/4 rates and was reduced by triclopyr and 2,4-D at recommended rates (1,260 and 1,600 g ai/ha). Herbicides were more effective at reducing white sweetclover viable seed production in 2007 than in 2006. Only chlorsulfuron at 17.6 g ai/ha (recommended rate) eliminated seed production in both years. Flaming killed first-year plants, but some second-year plants resprouted and produced viable seed. Cutting at the 2.5 or 10 cm height did not control first-year plants because of regrowth, and second-year plant density and seed production was reduced by cutting at 2.5 cm but not by cutting at 10 cm."</p>

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	<p>CABI. (2019). <i>Invasive Species Compendium</i>. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a></p>	<p>"Small infestations of <i>Melilotus officinalis</i> may be controlled by hand pulling before seeds are set, and mowing close to the ground. The stands should be cut just before flowering, and checked a week later for missed or partly cut plants (USDA-NRCS, 2017). Pulling or cutting will have to be repeated over a number of years to deplete the seed bank (YISC, undated)."</p>

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. <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 1 Mar 2019]</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
	WRA Specialist. (2019). Personal Communication	Unknown

**Summary of Risk Traits:**

High Risk / Undesirable Traits

- Broad climate suitability
- Grows in temperate to tropical climates
- Widely naturalized (but no evidence in Hawaiian Islands to date)
- Agricultural weed
- Environmental weed
- Other *Melilotus* species are invasive weeds
- May be allelopathic
- Improperly cured or dried plants may be harmful to animals
- Tolerates many soil types
- Forms dense cover that can exclude other vegetation
- Tolerates many soil types
- Reproduces by seeds
- Some plants may be self-fertile (with low seed set)
- 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
- Herbicides may provide effective control if removal is desired