

Taxon: <i>Trifolium incarnatum</i> L.	Family: Fabaceae
Common Name(s): carnation clover crimson clover Italian clover scarlet clover	Synonym(s): <i>Trifolium incarnatum</i> var. <i>incarnatum</i>

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 4 Oct 2017
WRA Score: 4.5	Designation: L	Rating: Low Risk

Keywords: Annual, Herb, Naturalized, Fodder, Self-Compatible

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)	Low
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	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)	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
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	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	y
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

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

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Osborne, J. 2011. <i>Trifolium incarnatum</i> . The IUCN Red List of Threatened Species 2011: e.T176390A7231548. http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T176390A7231548.en . [Accessed 4 Oct 2017]	[Assessment of wild type. Cultivars may have increased or decreased potential for weediness & would need to be evaluated on an individual basis] "Wild forms of <i>T. incarnatum</i> are potential gene donors for cultivated types, which are currently used as pasture and hay crops, as well as for making green manure and improving soil (Duke 1981). It is also a potential gene donor to the cultivated crops crimson clover (<i>T. incarnatum</i> L.) and red clover (<i>Trifolium pratense</i> L.) (USDA, ARS, National Genetic Resources Program 2010). Natural wild populations are grazed by wild and domesticated animal species. "

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

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Low
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 4 Oct 2017]	"Native: Africa Macaronesia: Portugal - Madeira Islands Asia-Temperate Western Asia: Turkey Europe Northern Europe: United Kingdom Southeastern Europe: Albania; Bulgaria; Former Yugoslavia; Greece; Italy; Romania Southwestern Europe: France; Portugal; 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 4 Oct 2017]	

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 2 Oct 2017]	"Adapted to a wide range of soil and climatic conditions – more so than other annual forage legumes – though not to poorly-drained or saline soils."
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"It is now grown widely as a winter annual in the Southeast from Kentucky southward and from eastern Texas to the Atlantic Coast (USDA Hardiness Zones 6–9) (Ball and Lacefield, 2000; Clark, 2007). It is also grown as a winter annual in the Pacific Northwest and California, and as a summer annual in the extreme northern US and parts of Canada (Hardiness Zones 3–4). There are naturalized populations of crimson clover in the southeastern and temperate western United States (Vincent and Isely, 2012)."

204	Native or naturalized in regions with tropical or subtropical climates	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.	"Native to western and southern Europe; in Hawai'i cultivated and at least sparingly naturalized in upper Kula area, Maui First and only collection made in 1982 (Hobby 1412, BISH)." [Middle elevation tropical climate]
	Osborne, J. 2011. <i>Trifolium incarnatum</i> . The IUCN Red List of Threatened Species 2011: e.T176390A7231548. http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T176390A7231548.en . [Accessed 4 Oct 2017]	" <i>T. incarnatum</i> is native to much of southern Europe, as well as the UK and Turkey. It is naturalized and widely cultivated in many temperate regions (USDA, ARS, National Genetic Resources Program 2010)."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Native to southern Europe where grown as a winter annual for forage. Grown in moist winter areas of south-eastern and Pacific-coastal USA for cool-season growth (Knight, 1985a). Has non agricultural use to stabilise and beautify steep banks and roadside verges. Can also be used as a summer annual for green manure in cooler northern latitudes (Hoveland and Evers, 1995). Used as a high-quality forage for hay or silage in high-rainfall regions of southern Australia."
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 4 Oct 2017]	"Naturalized: . natzd. elsewhere in temperate regions Cultivated: . also cult. in temperate regions"

Qsn #	Question	Answer
301	Naturalized beyond native range	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to western and southern Europe; in Hawai'i cultivated and at least sparingly naturalized in upper Kula area, Maui. First and only collection made in 1982 (Hobdy 1412, BISH)."

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Vegetables" [Cited as a general weed, crop weed & environmental weed, but mostly considered a desirable plant, or an unintentional naturalized plants. Other than possible harm to horses, impacts unspecified in most references]
	Dave's Garden. 2017. Crimson Clover, Italian Clover - <i>Trifolium incarnatum</i> . http://davesgarden.com/guides/pf/go/2230/ . [Accessed 4 Oct 2017]	[Regarded as invasive by one commenter] "On Jul 10, 2013, firsttwelve from South Bend, IN (Zone 5a) wrote: This exotic, invasive plant can be found in the wild in 43 states. It was introduced in the US for forage and cover crop. Please do not encourage it's presence as it crowds out our native species of plants AND animals, including insects. One comment claimed "thousands upon thousands of crimson blossoms saturate the garden". This scares me. Sounds invasive. And "it's plenty cheap". Yes, for good reason. It is a weed. And "it reseeds itself readily". Difficult to eradicate. We have MANY species of native legumes that provide proper and healthy nectar and seed for wildlife while replenishing the soil with nitrogen. Please consider growing some of our beautiful, beneficial species. Crimson Clover is from Europe: let it stay there. It is damaging to our ecosystems and hurting our bees and butterflies."

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Vegetables" [Potentially. Impacts unverified]

304	Environmental weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Cited in 3 references as an environmental weed. Impacts unverified

305	Congeneric weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Virginia Tech Weed Identification Guide. 2016. Red Clover: <i>Trifolium pratense</i> . http://oak.ppws.vt.edu/~flessner/weedguide/trfpr.htm . [Accessed 4 Oct 2017]	"Weed Description: A perennial with trifoliolate leaves and pink to red flowers. Red clover is often planted as a component of pasture and forage mixes, but sometimes escapes to become a weed of turfgrass, lawns, landscapes, and orchards. Red clover is distributed throughout the United States."
	USDA NRCS. 2006. Plant Fact Sheet - White Clover <i>Trifolium repens</i> . http://plants.usda.gov/factsheet/pdf/fs_trre3.pdf . [Accessed 4 Oct 2017]	"Weediness This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."
	UC IPM. 2014. White clover (<i>Trifolium repens</i>). Agriculture and Natural Resources, UC Davis, CA. http://www.ipm.ucdavis.edu/PMG/WEEDS/white_clover.html . [Accessed 4 Oct 2017]	"White clover is a creeping perennial broadleaf plant. Except for deserts, it is found throughout California, to about 4900 feet (about 1500 m). White clover invades agricultural land and other disturbed sites."
	Virginia Tech Weed Identification Guide. 2016. White Clover: <i>Trifolium repens</i> . http://oak.ppws.vt.edu/~flessner/weedguide/trfre.htm . [Accessed 4 Oct 2017]	"White clover is often planted in pasture and forage mixes but also occurs as a weed of lawns, turfgrass, landscapes, and orchards. White clover is found throughout the United States."

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 herbs; stems erect or ascending, 1-5 dm long, unbranched or with a few branches from base, appressed pubescent to villous. Leaflets broadly obovate-cuneate to suborbicular, 10-25 mm long, 10-15 mm wide, margins denticulate toward apex, stipules elliptic, adnate to petioles ca. 3/, their length."

402	Allelopathic	
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Compatible with grasses such as bahia grass and Bermuda grass."
	White, R. H., Worsham, A. D., & Blum, U. (1989). Allelopathic potential of legume debris and aqueous extracts. <i>Weed Science</i> , 37(5), 674-679	[Possibly. Concentrated extracts demonstrate allelopathic potential] "Cotton and pitted morningglory emergence and dry weight decreased approximately 60 to 80% when these plants were grown under greenhouse conditions in the presence of increasing amounts (0.8 to 6.7 mg debris/g soil) of field-grown crimson clover or hairy vetch debris incorporated into the soil medium." ... "Germination and seedling growth of corn, Italian ryegrass, cotton, pitted morningglory, and wild mustard decreased progressively, with species dependent variation, when exposed to increasing concentrations (8.3 to 33.3 g debris/L) of aqueous crimson clover and hairy vetch extract. Mustard and ryegrass germination and growth were almost completely inhibited by full-strength extracts of both legumes." ... "Emergence and growth of corn and cotton were not affected when planted into soil samples, containing root biomass and possible leaf and root exudates, collected from beneath field-grown hairy vetch and crimson clover plants."

Qsn #	Question	Answer
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 herbs; stems erect or ascending, 1-5 dm long, unbranched or with a few branches from base, appressed pubescent to villous." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Livestock: Crimson clover forage is highly nutritious, with over 25% crude protein that can be 80% digestible in early spring growth, and may contain 12 to 14% crude protein and 60 to 65% digestible nutrients on a dry matter basis even at full bloom (Ball and Lacefield, 2000; Harper, 2004). Although bloat is much less likely in animals grazing crimson clover than white clover or alfalfa, it should generally be used in mixtures with grasses to reduce this risk (Knight, 1985). The barbed hairs on overly-mature crimson clover flower heads can be problematic for horses, but can be avoided by harvesting hay promptly when it begins to bloom."
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Native to southern Europe where grown as a winter annual for forage." ... "Used as a high-quality forage for hay or silage in high-rainfall regions of southern Australia." ... "Highly acceptable forage for grazing, silage or hay (though not at mature hay stage)." ... "Protein-rich forage especially at leafy growth stage."

405	Toxic to animals	n
	Source(s)	Notes
	Gibbons, J. W., Haynes, R. R. & Thomas, J. L. 1990. Poisonous Plants and Venomous Animals of Alabama and Adjoining States. University of Alabama Press, Tuscaloosa, AL	[Not toxic, but may cause mechanical damage to horses] " <i>Trifolium incarnatum</i> ... Toxic Properties: The stiff and wiry hairs of overripe crimson clover can be dangerous to horses. Death from impaction has followed ingestion in Delaware, Virginia, and North Carolina. Dense, feltlike bulbs with a diameter of 8-11 cm composed almost entirely of crimson clover hairs have been removed from their intestines."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	y
	Source(s)	Notes
	Locke, M. A., Reddy, K. N., & Zablotowicz, R. M. (2002). Weed management in conservation crop production systems. <i>Weed Biology and Management</i> , 2(3), 123-132	"Certain legumes such as clover (<i>Trifolium</i> sp.) and vetch (<i>Vicia</i> sp.) species can provide overwintering habitats for plant pathogens and insects. For example, crimson clover (<i>Trifolium incarnatum</i> L.) is an alternate host for <i>Heliothis</i> , which presents a problem for cotton (<i>Gossypium hirsutum</i> L.)."

Qsn #	Question	Answer
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Crimson clover is a secondary host plant to pests such as corn earworm and cotton bollworm in the genus <i>Heliothus</i> , and has been removed from roadsides in Mississippi due to concerns over increased populations of those pests (Clark, 2007)."
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Diseases - Clover rot (<i>Sclerotinia trifoliorum</i>) is the most serious disease. Spread and subsequent plant loss can be rapid in dense swards during wet winters. Other potential diseases are <i>Phytophthora</i> foot rot (<i>Phytophthora megasperma</i>), <i>Fusarium</i> wilt (<i>Fusarium oxysporum</i>), <i>Fusarium</i> root rot (<i>Fusarium</i> spp.). Viruses - Susceptible to a number of viruses. Pests - In the USA, insects which affect young stands include army worms (<i>Spodoptera frugiperda</i>) and <i>S. ornithogalli</i> . The clover head weevil (<i>Hymenia mele</i>) and lesser clover weevil (<i>H. nigrirostris</i>) attack the seed heads, reducing seed yields (Hoveland and Evers, 1995)."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Pollen Library. 2017. Crimson Clover (<i>Trifolium incarnatum</i>). http://www.pollenlibrary.com/Specie/Trifolium+incarnatum/ . [Accessed 4 Oct 2017]	"Allergenicity: Crimson Clover (<i>Trifolium incarnatum</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	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Osborne, J. 2011. <i>Trifolium incarnatum</i> . The IUCN Red List of Threatened Species 2011: e.T176390A7231548. http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T176390A7231548.en . [Accessed 4 Oct 2017]	" <i>T. incarnatum</i> grows in fields, meadows, pastures and roadsides (Zohary and Heller 1984). It is an annual species, flowering between May and August. It favours sandy and clay soils, and is tolerant of an average annual precipitation of 920 mm, temperatures between 5.9°C and 21.3°C, and soil pH ranging from 4.8 to 8.2 (Duke 1981). In the UK <i>Trifolium incarnatum</i> ssp. <i>molinerii</i> is a lowland species which is strictly maritime as it only grows within 200 m of the sea (Preston et al. 2002). It prefers open habitats such as cliff slopes that are severely droughted in the summer (Preston et al. 2002)." [May contribute to fuel load in fire prone areas, but no evidence that fire risk is increased in areas in which it occurs]

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Adapted to a wide range of soil and climatic conditions – more so than other annual forage legumes – though not to poorly-drained or saline soils. Vigorous seedling growth. Not tolerant of shade."

Qsn #	Question	Answer
	Dave's Garden. 2017. Crimson Clover, Italian Clover - <i>Trifolium incarnatum</i> . http://davesgarden.com/guides/pf/go/2230/ . [Accessed 4 Oct 2017]	"Sun Exposure: Full Sun"
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 2 Oct 2017]	"Adapted to a wide range of soil and climatic conditions – more so than other annual forage legumes – though not to poorly-drained or saline soils."
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 herbs; stems erect or ascending, 1-5 dm long, unbranched or with a few branches from base, appressed pubescent to villous."
412	Forms dense thickets	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.	"in Hawaj]" cultivated and at least sparingly naturalized in upper Kula area, Maui." [No evidence]
501	Aquatic	n
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 2 Oct 2017]	[Terrestrial herb] "Pubescent annual, semi-erect to erect growing with a crown rosette of very hairy stems, 0.3-0.6 cm, which have few side branches." ... "Native to southern Europe where grown as a winter annual for forage."
502	Grass	n
	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 4 Oct 2017]	Family: Fabaceae (alt.Leguminosae) Subfamily: Papilionoideae Tribe: Trifolieae

Qsn #	Question	Answer
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	[A non-woody nitrogen fixing annual] "Pubescent annual, semi-erect to erect growing with a crown rosette of very hairy stems, 0.3-0.6 cm, which have few side branches." ... "A pure-sown stand fixed 155 kg N/ha (Brink, 1990). If used as green manure, maximum herbage N (70 kg/ha) achieved at late-bloom stage (Ranells and Waggar, 1992)."

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Pubescent annual, semi-erect to erect growing with a crown rosette of very hairy stems, 0.3-0.6 cm, which have few side branches. Leaves broad and round- tipped; stipules rounded with purple edging developing with age. Tap-rooted with many finely-branched lateral roots."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Osborne, J. 2011. <i>Trifolium incarnatum</i> . The IUCN Red List of Threatened Species 2011: e.T176390A7231548. http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T176390A7231548.en . [Accessed 4 Oct 2017]	" <i>Trifolium incarnatum</i> is a common species with a widespread distribution and with no major threats, therefore it is classified as Least Concern. "

602	Produces viable seed	y
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Because of the high production of soft seed and rapid softening of hard seed, germination of seed can occur in summer rather than in the autumn, thus limiting optimal, timely self-reseeding (Hoveland and Evers, 1995)."
	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 ovoid, enclosed in calyx. Seed 1, greenish yellow to reddish brown, ovoid, 2-2.5 mm long."

Qsn #	Question	Answer
603	Hybridizes naturally	
	Source(s)	Notes
	Abberton, M. T. (2007). Interspecific hybridization in the genus <i>Trifolium</i> . <i>Plant Breeding</i> , 126(4), 337-342	[Hybridization documented in genus. Unknown for <i>T. incarnatum</i>] "Another long running thread in the history of <i>Trifolium</i> interspecific hybridization involves crosses between <i>T. occidentale</i> and related species. <i>Trifolium occidentale</i> is a diploid, perennial, stoloniferous species closely related to white clover. Gibson and Beinhart (1969) first demonstrated the potential of crossing this species with both white clover and <i>T. nigrescens</i> . Backcrosses of the triploid hybrids to <i>T. occidentale</i> were obtained and were compatible in crosses with <i>T. repens</i> establishing the potential of this approach for the improvement of white clover."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Inflorescences are terminal conical racemes up to 5 cm long and some distance above last stem leaf. Florets, 75-125 in number, are rich crimson, self-fertile."
	Knight, W. E. (1969). Inheritance of Multifoliolate Leaves, Glabrous Leaves, and Petiolulate Leaflet Attachment in Crimson Clover, <i>Trifolium incarnatum</i> L. <i>Crop Science</i> , 9(2), 232-235	"This species is self- fertile but is normally cross-pollinated."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Beneficial insect habitat: The flowers produce abundant nectar and pollen that attract European honey bees, as well as a wide variety of native bees. Honey bees make a light, good quality honey from the nectar. The flowers also harbor minute pirate bug (<i>Orius tristicolor</i>), a beneficial insect that feeds on many agricultural pest species, including thrips (UC SAREP, 2012)."
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Inflorescences are terminal conical racemes up to 5 cm long and some distance above last stem leaf. Florets, 75-125 in number, are rich crimson, self-fertile." ... "Pollinated by bumble bees and honey bees."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Ability to spread naturally - Because of the high production of soft seed and rapid softening of hard seed, germination of seed can occur in summer rather than in the autumn, thus limiting optimal, timely self-reseeding (Hoveland and Evers, 1995)."

607	Minimum generative time (years)	1
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Qsn #	Question	Answer
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs; stems erect or ascending, 1-5 dm long"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Norden, H., & Kirkman, L. K. (2006). Field guide to common legume species of the longleaf pine ecosystem. Joseph W. Jones Ecological Research Center, Newton, Georgia	[Occurs along roadsides, Seeds lack means of external attachment, but may be moved inadvertently along heavily trafficked corridors] "Crimson clover was introduced from Europe as a forage crop and for soil improvement, but it has become naturalized throughout the eastern United States. It can be found along roadsides, pastures, and other disturbed areas."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Cover crop: Crimson clover is commonly used as a winter or summer annual cover crop in rotation with vegetables or field crops (Clark, 2007)." ... "Crimson clover is reportedly "among the most widely planted annual forage legumes in the United States" (Ball and Lacefield, 2000). It has been a popular winter pasture crop in the South since the 1940's due to its good growth under cool temperatures and its ability to produce a substantial seed crop if livestock are removed six to eight weeks prior to flowering (Hollowell, 1951)."
	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	"Cultivated as an adaptable forage crop with hopeful prospects in China, escaped. Hebei, Jiangsu, Shaanxi, Shandong [native to Mediterranean region]."
	WRA Specialist. 2017. Personal Communication	Seeds sold separately and in seed mixes

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Rare and local, usually appearing from seed impurity in pasture and cultivated land."

704	Propagules adapted to wind dispersal	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.	"Pods ovoid, enclosed in calyx. Seed 1, greenish yellow to reddish brown, ovoid, 2-2.5 mm long."

705	Propagules water dispersed	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Pods ovoid, enclosed in calyx. Seed 1, greenish yellow to reddish brown, ovoid, 2-2.5 mm long." [Buoyancy of seeds and pods unknown, but no evidence of water dispersal found]

706	Propagules bird dispersed	
	Source(s)	Notes
	Twigg, L. E., Lowe, T. J., Taylor, C. M., Calver, M. C., Martin, G. R., Stevenson, C., & How, R. (2009). The potential of seed-eating birds to spread viable seeds of weeds and other undesirable plants. <i>Austral Ecology</i> , 34(7), 805-820	[Potentially, but may be rare in nature] "The potential for seed-eating birds to spread viable seeds was investigated using captive feeding trials to determine seed preference, passage time through the gut, and viability of passed seeds for bronzewing pigeons (<i>Phaps chalcoptera</i>), peaceful doves (<i>Geopelia striata</i>), crested pigeons (<i>Ocyphaps lophotes</i>), Senegal doves (<i>Streptopelia senegalensis</i>), zebra finches (<i>Taeniopygia guttata</i>), black ducks (<i>Anas superciliosa</i>) and wood ducks (<i>Chenonetta jubata</i>)." ... "Despite bladder clover and crimson clover being acceptable food items, several birds seemed reluctant to consume large amounts of these seeds even in the absence of other food. The contribution of test seed to daily food intake was highly variable ranging from 0% to 19.5% for crimson clover..."

707	Propagules dispersed by other animals (externally)	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.	"Pods ovoid, enclosed in calyx. Seed 1, greenish yellow to reddish brown, ovoid, 2-2.5 mm long." [No evidence and no means of external attachment]

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	Twigg, L. E., Lowe, T. J., & Martin, G. R. (2009). The presence and implications of viable seed in the faeces of invasive free-ranging European rabbits and red foxes. <i>Pacific Conservation Biology</i> , 15(3), 158-170	"Whole seeds were only recovered from the faecal pellets during the Crimson Clover and Gorse trials. With Crimson Clover, four (57.1%) of the seven recovered seeds germinated" ... "The germination of Crimson Clover and Gorse seeds recovered from faecal pellets during our passage time trials was also reduced compared to that of control seeds (57%, 14% vs. 100%, 84%)."
	Twigg, L. E., Lowe, T. J., Taylor, C. M., Calver, M. C., Martin, G. R., Stevenson, C., & How, R. (2009). The potential of seed-eating birds to spread viable seeds of weeds and other undesirable plants. <i>Austral Ecology</i> , 34(7), 805-820	[One intact seed found in gut of pigeon] "Table 3. The number of faecal pellets examined for whole seed, and the estimated number of seeds ingested, for each bird species tested during the captive feeding trials" [Pellets with seed/no. pellets examined (%) - Crested pigeons = 1/244 (0.4%)]

Qsn #	Question	Answer
801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"fruit contains a single seed" ... "Seeds oval to spherical, 2.5 mm long, and cream to light brown in colour." ... "Number of seeds per kg - 310 000 to 330 000." [High numbers reported from cultivated settings]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Because of the high production of soft seed and rapid softening of hard seed, germination of seed can occur in summer rather than in the autumn, thus limiting optimal, timely self-reseeding (Hoveland and Evers, 1995)."
	Ball, D.M., and Lacefield, G.D. 2000. Crimson clover. Circular 00-1. Oregon Clover Commission, Salem. http://www.oregonclover.org/ . [Accessed 4 Oct 2017]	"It is relatively easy to manage crimson clover for reseeding, but it requires sacrificing some of the forage potential of a stand. Some varieties were selected for a higher percentage of hard seed, but hard seed of crimson clover do not persist in the soil as long as is the case with some other winter annual clovers. Thus, if reseeding is desired, crimson clover should be allowed to make seed every year."
	Royal Botanic Gardens Kew. (2017) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 4 Oct 2017]	"Storage Behaviour: Orthodox Storage Conditions: 11% germination following 10 years open storage at room temperature (Ewart, 1908); 16% germination following 30 years open storage at room temperature (Harrington, 1972); p50= 5.25 years for seeds under open storage in a temperate climate (Priestley, 1986); long-term storage under IPGRI preferred conditions at RBG Kew, WP. Oldest collection 14 years; germination change 94 to 92%, 13 years, 1 collection"
	Maccherini, S., & De Dominicis, V. (2003). Germinable soil seed bank of former grassland converted to coniferous plantation. <i>Ecological Research</i> , 18(6), 739-751	"The grassland seed-bank was dominated by <i>Saxifraga tridactylites</i> and <i>Veronica agrestis</i> ; the seed-bank of plots of scattered cedars was dominated by <i>Trifolium incarnatum</i> ssp. <i>molinerii</i> ; and that of dense cedar plantations was dominated by <i>Campanula rapunculus</i> "Species with the highest density of individuals were generally those related to cultivated or abandoned fields, such as <i>Campanula rapunculus</i> , <i>Veronica agrestis</i> and <i>Trifolium incarnatum</i> ssp. <i>Molinerii</i> , and indeed, it is well known that species characteristic of disturbed habitats have seeds with high persistence in the soil (Thompson et al. 1998)."
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"While some varieties of crimson clover have been selected for hard seed, seed does not persist long in the soil, so stands should still be allowed to make seed every year if reseeding is desired (Ball and Lacefield, 2000)."
	WRA Specialist. 2017. Personal Communication	Longevity of seeds under natural conditions unknown

803	Well controlled by herbicides	y
	Source(s)	Notes

Qsn #	Question	Answer
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Crimson clover is easily killed mechanically by mowing or by spraying with herbicide after early bud stage, but N gains are maximized by waiting until late bloom or early seed set (Clark, 2007). If spraying as part of a conservation tillage system, a systemic herbicide will produce a more complete kill than a contact herbicide (Owsley, 2012)."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Young-Mathews, A. 2013. Plant guide for crimson clover (<i>Trifolium incarnatum</i>). USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR	"Clover can also be killed by a roller-crimper or rolling stalk chopper ahead of a no-till transplanter if it is in full bloom. In northern regions (Hardiness Zone 5 and colder), crimson clover is used to provide a winterkilled mulch that can then be disked or directly planted into in the spring."
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	"Poor regrowth after grazing. Close grazing should be avoided in winter so as not to affect spring growth or seed production adversely."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	FAO. 2017. Grassland Species Profiles - <i>Trifolium incarnatum</i> . http://www.fao.org/ag/agp/agpc/doc/gbase/data/pf000502.htm . [Accessed 4 Oct 2017]	[Status of pests & diseases in Hawaii unknown] "Diseases - Clover rot (<i>Sclerotinia trifoliorum</i>) is the most serious disease. Spread and subsequent plant loss can be rapid in dense swards during wet winters. Other potential diseases are Phytophthora foot rot (<i>Phytophthora megasperma</i>), Fusarium wilt (<i>Fusarium oxysporum</i>), Fusarium root rot (<i>Fusarium</i> spp.). Viruses - Susceptible to a number of viruses. Pests - In the USA, insects which affect young stands include army worms (<i>Spodoptera frugiperda</i>) and <i>S. ornithogalli</i> . The clover head weevil (<i>Hymenia meles</i>) and lesser clover weevil (<i>H. nigrirostris</i>) attack the seed heads, reducing seed yields (Hoveland and Evers, 1995)."
	WRA Specialist. 2017. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability (but may be restricted to higher elevation of tropical & subtropical islands)
- Naturalized on Maui, Hawaiian Islands and widely naturalized elsewhere
- A disturbance and minor crop weed
- Other *Trifolium* species are invasive
- Not toxic, but may cause mechanical damage to horses
- Host of crop pathogens
- Tolerates many soil types
- Reproduces by seeds
- Self-compatible (but primarily outcrossing)
- Annual (reaches maturity in 1 growing season)
- Seeds dispersed by animals & intentionally by people
- Seeds able to be stored for extended periods; May form a persistent seed bank

Low Risk Traits

- Despite reports of invasiveness and naturalization, impacts are unspecified; generally regarded as a desirable plant
- Unarmed (no spines, thorns, or burrs)
- Provides fodder for livestock
- Requires full sun
- Not reported to spread vegetatively
- Herbicides, mowing and tillage may provide effective control

Second Screening Results for Herbs or Low Stature Shrubby Life Forms

(A) Reported as a weed of cultivated lands? Yes. Minor agricultural weed

(B) Unpalatable to grazers or known to form dense stands? No. Palatable to grazing animals & not known to form dense stands.

Outcome = Accept (Low Risk)