Taxon: Trifolium arvense L. **Family:** Fabaceae

Common Name(s): hare-foot clover
hare-foot trefoil
rabbit-foot clover
stone clover

Synonym(s):

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 22 Feb 2016

WRA Score: 13.5 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Annual Herb, Temperate, Weedy, Fodder, N-Fixing

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		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
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)		
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
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	y=1, n=-1	y
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**
	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] "Our plants are referred to var. arvense, characterized by a robust habit."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. 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, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Feb 2016]	"Native: Africa Macaronesia: Portugal - Madeira Islands; Spain - Canary Islands Northeast Tropical Africa: Djibouti; Ethiopia; Sudan Northern Africa: Algeria; Egypt; Libya; Morocco; Tunisia Asia-Temperate Caucasus: Armenia; Azerbaijan; Georgia; Russian Federation - Dagestan; Russian Federation-Ciscaucasia - Ciscaucasia Middle Asia: Kazakhstan; Turkmenistan Siberia: Russian Federation-Western Siberia - Western Siberia Western Asia: Cyprus; Iran; Iraq; Israel; Lebanon; Syria; Turkey Europe East Europe: Belarus; Estonia; Latvia; Lithuania; Moldova; Russian Federation-European part - European part; Ukraine Middle Europe: Austria; Belgium; Czechoslovakia; Germany; Hungary; Netherlands; Poland; Switzerland Northern Europe: Denmark; Finland; Ireland; Norway; Sweden; United Kingdom Southeastern Europe: Albania; Bulgaria; Former Yugoslavia; Greece; Italy; Romania Southwestern Europe: France; Portugal; Spain"

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed]	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Boswell, C.C., Lucas, R.J., Lonati, M., Fletcher, A. and Moot, D.J. 2003. The ecology of four annual clovers adventives. In: Legumes for dryland pastures. New Zealand Grasslands Research and Practice Series No. 11: 175-184	"Ehrman & Cocks (1990) showed that the distributions of cluster, haresfoot and subterranean clovers in Syria were governed by differences in environments. They found haresfoot clover better adapted to lower rainfall (400-520 mm yr-1) and extreme temperature environments (cold inland mountains and hot plains) compared with cluster and subterranean clover."
	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.	[Elevation range exceeds 1000 m, demonstrating environmental versatility] "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i."

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.	[Naturalized in mid to upper elevation areas of tropical/subtropical islands] "Native to Europe and the Middle East; in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 18 Feb 2016]	[Widely introduced and naturalized] "Naturalized: Africa: Macaronesia: Portugal - Azores; Australasia: Australia: Australia, New Zealand: New Zealand; Northern America: United States - Pacific: North-Central Pacific: United States - Hawaii"

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 Europe and the Middle East; in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i. First collected on Hawai'i in 1932 (Ewart III160, BISH)"

Qsn #	Question	Answer
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Feb 2016]	"Naturalized: Africa Macaronesia: Portugal - Azores Australasia Australia: Australia New Zealand: New Zealand Northern America : United States Pacific North-Central Pacific: United States - Hawaii"

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	National Park Service. 2012. Invasive Plants of Haleakala National Park. http://www.nps.gov/hale/naturescience/upload/Invasive Plants.pdf. [Accessed 22 Feb 2016]	"Park Location: Crater, primarily in disturbed areas and trails." [Disturbance adapted weed]
	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.	[Invades disturbed areas] "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i."

303	Agricultural/forestry/horticultural weed	
	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 in Hawaiian Islands] "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i."
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Potentially. Included in several citations documenting agricultural weed

304	Environmental weed	
	Source(s)	**Notes**
	Urban Forest Associates Inc. 2002. Invasive Exotic Species Ranking for Southern Ontario. http://chapter.ser.org/ontario/files/2012/08/exotics.pdf. [Accessed 22 Feb 2016]	"Category 4 Exotic species that do not pose a serious threat to natural areas unless they are competing directly with more desirable vegetation. These can often be tolerated in restoration projects if they are already present. They may eventually be replaced through natural succession or management. Control where necessary and limit their spread to other areas." [Includes Trifolium arvense]
	Queensland Government. 2011. Weeds of Australia - Hare's-foot clover - Trifolium arvense. http://keyserver.lucidcentral.org/weeds/data/080c0106-040c-4508-8300-0b0a06060e01/media/html/Trifolium_arvense.htm. [Accessed 22 Feb 2016]	[Possibly, although impacts are unspecified] "Hare's-foot clover (Trifolium arvense) is regarded as an environmental weed in Western Australia and Victoria."

305	Congeneric weed	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Virginia Tech Weed Identification Guide. 2016. Red Clover: Trifolium pratense. http://oak.ppws.vt.edu/~flessner/weedguide/trfpr.htm. [Accessed 18 Feb 2016]	"Weed Description: A perennial with trifoliate 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 Trifolium repens. http://plants.usda.gov/factsheet/pdf/fs_trre3.pdf. [Accessed 18 Feb 2016]	"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 (Trifolium repens). Agriculture and Natural Resources, UC Davis, CA. http://www.ipm.ucdavis.edu/PMG/WEEDS/white_clover.html. [Accessed 18 Feb 2016]	"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: Trifolium repens. http://oak.ppws.vt.edu/~flessner/weedguide/trfre.htm. [Accessed 18 Feb 2016]	"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."
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	A number of species are listed as weeds

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.	"Annual herbs; stems 1-4 dm long, many-branched, appressed villous. Leaflets elliptic to linear-elliptic or linear, 8-25 mm long, 2-4 mm wide, soft pubescent, margins weakly serrulate toward apex, stipules lanceolate- subulate, adnate to petioles only at base."

402	Allelopathic	
	Source(s)	**Notes**
	Scott, D. (1975). Allelopathic interactions of resident tussock grassland species on germination of oversown seed. New Zealand Journal of Experimental Agriculture, 3 (2), 135-141	[Potentially Yes. Demonstrated in laboratory conditions] "Plants are known to exude or release by decay a large range of chemical substances which may affect the behaviour of other plants and animals in their proximity (Tukey 1969; Hale et al. 1971). This phenomenon has already been recognised in New Zealand as it causes problems when establishing legumes in swards dominated by Notodanthonia spp. (Beggs 1964; Janson & White 1971). This paper describes a laboratory investigation of the germination of legumes and grasses when oversown on the moistened shoot and root material of a range of tussock grassland species." ... "Shoot material of T. repens was among the most depressive materials excluding T. pratense. T. arvense was also generally depressive except on M. sativa."

403	Parasitic	n

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 1-4 dm long, many-branched, appressed villous." [Fabaceae]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Hackney, B., Dear, B. & Crocker, G. 2007. Naturalised pasture legumes. PRIMEFACT 651. NSW Department of Primary Industries. www.dpi.nsw.gov.au/primefacts	"Haresfoot clover (Trifolium arvense) is an annual legume. It is commonly found in NSW, from very low rainfall areas of the western division through to high rainfall tableland pastures. Its year to-year occurrence is highly sporadic. In some years at some sites, it can be one of the most dominant species present, while in other years its density is very low. Haresfoot clover is well adapted to low fertility conditions and very coarse textured soils. It is not a highly productive species, but provides reasonable quality forage in late winter and early spring, if present in dense enough stands."
	Hosaka, E. Y. & Ripperton, J. C. 1954. Legumes of the Hawaiian ranges. Bulletin Number 93. University of Hawaii, Honolulu, HI	"Importance and use: Rabbit-foot clover is well eaten by sheep and other grazing animals."
	Asadova, K. K. (2012). Dynamics of Fodder Resources of the Most Important Fodder Plants of the Winter Pasturesof North-western Part of Azerbaijan. Sustainable Agriculture Research, 2(2), 29-36	"Leguminous grasses differ with their high content of fodder protein. Due to its chemical content the plants of this family are the most valuable component of pasture forage. As a part of steppe herbages in different variants Lucerne/Medicago minima (L.) Bartalini, sickle alfalfa (Medicago falcata), Lucerne crescent/M. rigidula (L.) All., Lucerne blue/M. coerulea Less. et Ledeb., et al. can be widely presented. Good fodder plants of this fodder group are also Trifolium arvense L., Trigonella orthoceras Kar. et Kit., Melilotus albus et al"

405	Toxic to animals	
	Source(s)	**Notes**
	New England Wild Flower Society. 2016. Go Botany [2.3.1].https://gobotany.newenglandwild.org/. [Accessed 19 Feb 2016]	"Rabbit-foot clover is a Eurasian species that can be toxic to livestock, with symptoms including photosensitivity and liver damage."
	Hansen, A. A. (1924). Mechanical Injuries Caused by Weeds and Other Plants. Proceedings of the Indiana Academy of Science 34: 229-254	[May cause physical discomfort] "Rabbit foot or field clover {Trifolium arvense) . The fuzzy heads are capable of forming hair-balls in the stomachs of grazing animals. Horses seem particularly susceptible to injury from this species."

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**

Qsn #	Question	Answer
	CABI, 2016. Faba bean necrotic yellows virus. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"FBNYV has a relatively narrow host range, mostly restricted to leguminous species. Faba bean is the main natural host, but other legume crops such as chickpea, lentil, dry bean, pea and cowpea are also natural hosts of FBNYV (Makkouk et al., 1992; Katul et al., 1993; Franz et al., 1995; Horn et al., 1995). The virus also occurs naturally in the wild legume species Lathyrus sativus, L. gorgonei, L. annuus, L. hierosolyminatus, Medicago polymorpha, M. praecox, M. rigidula, M. rotata, M. scutellata, Melilotus officinalis, Tetragonolobus purpureus, Trifolium arvense, T. hirtum, T. lappaceum, T. subterraneum, Vicia ervilia, V. hybrida, V. palaestina and V. sativa, as well as in perennial species of the genus Onobrychis and in Medicago sativa; the virus also occurs naturally in some non-leguminous species including Amaranthus blitoides, A. retroflexus and A. viridis (Mouhanna et al., 1994a; Franz et al., 1997)."
	Bendixen, L. E., Reynolds, D. A., & Riedel, R. M. (1979). An annotated bibliography of weeds as reservoirs for organisms affecting crops. 1. Nematodes. Research Bulletin 1109, Ohio Agricultural Research and Development Center, Wooster, Ohio	"The bulb nematode, Anguillilina dipsaci, was found infecting 29 species of weeds. Among them are 21 plants not previously reported as hosts." [Includes Trifolium arvense]

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**
	Pollen Library. 2016. Rabbit-Foot Clover (Trifolium arvense). http://www.pollenlibrary.com/Specie/Trifolium+arvense/. [Accessed 17 Feb 2016]	"Allergenicity: Rabbit-Foot Clover (Trifolium arvense) is a mild allergen."

408	Creates a fire hazard in natural ecosystems	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.	[May contribute to fuel load in fire prone areas, but no evidence that fire risk is increased in areas in which it occurs] "Annual herbs; stems 1-4 dm long, many-branched, appressed villous." ... "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows"

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	Dave's Garden. 2016. Rabbitfoot Clover - Trifolium arvense. http://davesgarden.com/guides/pf/go/53180/. [Accessed 22 Feb 2016]	"Sun Exposure: Full Sun"
	Hilty, J. (2016). Weedy Wildflowers of Illinois - Rabbit-Foot Clover - Trifolium arvense. http://www.illinoiswildflowers.info/weeds/plants/rf_clover.html. [Accessed 22 Feb 2016]	"The preference is full sun, dry-mesic conditions, and sandy soil."
	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.	[Occurs in high light environments] "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows"

Qsn #	Question	Answer
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	
	Source(s)	**Notes**
	Boswell, C.C., Lucas, R.J., Lonati, M., Fletcher, A. and Moot, D.J. 2003. The ecology of four annual clovers adventives. In: Legumes for dryland pastures. New Zealand Grasslands Research and Practice Series No. 11: 175-184	"Common to locally abundant in dry waste places, river beds, modified tussock grassland at low altitudes, pastures on light soils both islands" ... "Competitive on driest soils"
	Hosaka, E. Y. & Ripperton, J. C. 1954. Legumes of the Hawaiian ranges. Bulletin Number 93. University of Hawaii, Honolulu, HI	"In the Territory it is found only in the Humuula region on the island of Hawaii, at 6,000 to 8,000 feet altitude in zones El and E., where the climate is dry and the soil rocky and shallow."
	Hilty, J. (2016). Weedy Wildflowers of Illinois - Rabbit-Foot Clover - Trifolium arvense. http://www.illinoiswildflowers.info/weeds/plants/rf_clover.html. [Accessed 22 Feb 2016]	"The preference is full sun, dry-mesic conditions, and sandy soil."

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 1-4 dm long, many-branched, appressed villous."

412	**Forms dense thickets**	**y**
	Source(s)	**Notes**
	Kaczmarek, F.S. (2009). New England Wildflowers: A Guide to Common Plants. The Globe Pequot Press, Guilford, CT	"Introduced from Europe, it is usually found growing in dense stands."
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"Natural colonies probably start as scattered plants each producing a large number of seeds. grow to dense colonies where intra-specific competition is important and where each plant produces a small number of seeds. and reduce to scattered plants each producing a small amount of seed as competition from other plants increases. In ephemeral situations the cycle may be repeated from old viable seed after disturbance. while in more permanent habitats. dense populations may persist for a long time. In one dense population studied in 1969. up to 3.000 seedlings per square foot were counted in September. producing up to 250 mature plants per square foot. Three samples each from one square foot produced 6. 27. and 94 mature plants and 850. 1040. and 630 seeds. In this year. which was much drier than normal. these populations may not have produced enough seed to maintain dense population numbers."

Qsn #	Question	Answer
501	**Aquatic**	**n**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Terrestrial] "Annual herbs" ... "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows"

502	**Grass**	**n**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Feb 2016]	"Family: Fabaceae (alt.Leguminosae) Subfamily: Faboideae Tribe: Trifolieae"

503	**Nitrogen fixing woody plant**	**n**
	Source(s)	**Notes**
	Boswell, C. C., Lowther, W. L., & Rutherford, A. J. (2007). Symbiotic nitrogen fixation by Trifolium arvense in semi-arid short tussock grasslands. New Zealand Journal of Agricultural Research, 50(4), 511-521	[A nitrogen-fixing herbaceous plant] "We have measured symbiotic N fixation from the widespread annual Trifolium arvense (haresfoot clover) in two studies in the semi-arid zone of the Mackenzie Basin using a 15N dilution technique over two growing seasons. Apart from one low value of 69%, the percentage of plant nitrogen derived from the atmosphere (%Ndfa) was consistently high in one study at Tomahawk Gully (82–91%). Calculated inputs of symbiotic N fixation from T. arvense was highly variable over the landscape, and between seasons. Calculated symbiotic N fixation inputs on different landscape units in Tomahawk Gully ranged from <0.1 to 3.4 kg N ha-1 in 2000–01, and from <0.1 to 11.4 kg N ha-1 in 2001–02 when there was more favourable summer rainfall. Weighted mean rates of N fixation over the whole Tomahawk Gully catchment were 0.5 and 1.6 kg N ha-1, in the respective seasons. In a study at St Cuthbert, the results were variable in the absence of sulphur (S) fertiliser (56–76%). However, the application of 25 kg ha-1 of fertiliser S was associated with an increase in the %Ndfa to 89–92% and a 5½-fold increase in the symbiotically fixed N. Application of small amounts of S fertiliser to areas with naturalised legumes within semi-arid grassland offers potential for improving the sustainability of grazed tussock grasslands."

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs; stems 1-4 dm long, many-branched, appressed villous."

601	**Evidence of substantial reproductive failure in native habitat**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 18 Feb 2016]	No evidence. Widespread native & naturalized range

602	Produces viable seed	y
	Source(s)	**Notes**
	Boswell, C.C., Lucas, R.J., Lonati, M., Fletcher, A. and Moot, D.J. 2003. The ecology of four annual clovers adventives. In: Legumes for dryland pastures. New Zealand Grasslands Research and Practice Series No. 11: 175-184	"Haresfoot clover flowers continue to develop on the flower head, while ripe seed may be shed from lower on the flower head. A large proportion of the fresh seed is hard and will not germinate unless it is scarified."
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"Plants produce one or many cylindrical flower heads containing few or many seeds. Each flower produces a single-seeded pod, and ripe seeds may be shed from the base of the flower heads while the upper flowers are still blooming."
	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 the calyx. Seeds 1 (2), yellow, globose, ca. 1 mm long."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Honkanen, J., & Ryöppy, P. (1989). Somatic hybridization ir Trifolium. In Plant Protoplasts and Genetic Engineering I (pp. 397- 409). Springer, Berlin Heidelberg	[Unknown for T. arvense] "Very few natural hybrids between species are known, although species within sections can be hybridized by applying the embryo rescue technique (Merker 1984)."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Boswell, C.C., Lucas, R.J., Lonati, M., Fletcher, A. and Moot, D.J. 2003. The ecology of four annual clovers adventives. In: Legumes for dryland pastures. New Zealand Grasslands Research and Practice Series No. 11: 175-184	"Saleem & Gliddon (1989) found that populations of haresfoot clover were self-compatible and were capable of inbreeding, which is an advantage for plant survival in harsh environments. Similarly, Palmer (1972) showed that reproduction in haresfoot clover was predominantly by self-pollination and between closely related individuals."

Qsn #	Question	Answer
605	**Requires specialist pollinators**	**n**
	Source(s)	**Notes**
	Boswell, C.C., Lucas, R.J., Lonati, M., Fletcher, A. and Moot, D.J. 2003. The ecology of four annual clovers adventives. In: Legumes for dryland pastures. New Zealand Grasslands Research and Practice Series No. 11: 175-184	"Palmer (1972) showed that reproduction in haresfoot clover was predominantly by self-pollination and between closely related individuals."
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"The flowers are self-fertile and produce seed without the aid of pollinators. They are visited by honey bees and bumble bees. so there is opportunity for some cross-fertilisation."

606	**Reproduction by vegetative fragmentation**	**n**
	Source(s)	**Notes**
	Hilty, J. (2016). Weedy Wildflowers of Illinois - Rabbit-Foot Clover - Trifolium arvense. http://www.illinoiswildflowers.info/weeds/plants/rf_clover.html. [Accessed 22 Feb 2016]	"This wildflower reproduces by reseeding itself, often forming colonies of plants at favorable sites."

607	**Minimum generative time (years)**	**1**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Annual] "Annual herbs; stems 1-4 dm long, many-branched, appressed villous."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	National Park Service. 2012. Invasive Plants of Haleakala National Park. http://www.nps.gov/hale/naturescience/upload/InvasivePlants.pdf. [Accessed]	"Remove any seeds from clothing and boots before hiking out of the Crater."
	Hovstad, K. A., Borvik, S., & Ohlson, M. (2009). Epizoochorous seed dispersal in relation to seed availability–an experiment with a red fox dummy. Journal of Vegetation Science, 20(3), 455-464	[Hairs on T. arvense may facilitate attachment to clothing] "Species with high seed retention in fur, evaluated by the main effect of species in the analysis, were Agrimonia eupatoria, Geum rivale, Phleum pratense, Leucanthemum vulgare and Trifolium arvense. All these species, except L. vulgare, have diaspores with hairs, hooks or a combination of both."
	Western Australian Herbarium (1998–2016). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/. [Accessed 22 Feb 2016]	[Possibly] "Dispersal. Agricultural activities." ... "Seed and fruit have no specialised dispersal mechanism. "

Qsn #	Question	Answer
702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	B & T World Seeds. 2016. Trifolium arvense. https://b-and-t-world-seeds.com/cartall.asp?species=Trifolium%20arvense&sref=15306. [Accessed 22 Feb 2016]	Seeds available for purchase online

703	**Propagules likely to disperse as a produce contaminant**	
	Source(s)	**Notes**
	Western Australian Herbarium (1998–2016). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/. [Accessed 22 Feb 2016]	"Dispersal. Agricultural activities." ... "Seed and fruit have no specialised dispersal mechanism. " [Possibly moved as a contaminant of produce]
	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.	[Possible contaminant of hay if occurring in pastures] "in Hawai'i naturalized in disturbed, arid to wet areas such as along roadsides, on lava, and in open meadows, 850-2,740 m, on Maui and Hawai'i."

704	**Propagules adapted to wind dispersal**	**y**
	Source(s)	**Notes**
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"The ripe seed pod is enclosed in a persistent. feathery calyx. and can be distributed by light winds or by water. and probably over longer distances by sticking to animal coats. though most seeds settle close to the parent plant."

705	**Propagules water dispersed**	**y**
	Source(s)	**Notes**
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"The ripe seed pod is enclosed in a persistent. feathery calyx. and can be distributed by light winds or by water. and probably over longer distances by sticking to animal coats. though most seeds settle close to the parent plant."
	Kelley, A. D., & Bruns, V. F. (1975). Dissemination of weed seeds by irrigation water. Weed Science, 23(6): 486-493	[Viable seeds of Trifolium arvense among those collected in irrigation water] "Abstract. Irrigation laterals PL.15.LR and S2.15W, in the Yakima Valley of Washington and the Columbia River near Paterson, Washington, were sampled for weed seeds during 1970, 1971, and 1973-74, respectively. Weekly or biweekly screenings of the water in the three systems during the irrigation season yielded seeds of 137, 84, and 77 plant species, respectively. In the same order, the total number of seeds per 254 kl of water averaged 2,220, 682, and 292 for the season. Moreover, if the seeds were evenly distributed in the average amount of water used to irrigate the land during the season, the number of seeds disseminated would average 94,500, 10,400, and 14,100 per hectare. Weed control practiced by water users along certain sections of S2.15W markedly reduced both the kind and number of weed seeds found in the water when compared with PL.15.LR on which no weed control measures were used."

706	**Propagules bird dispersed**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Western Australian Herbarium (1998–2016). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/. [Accessed 22 Feb 2016]	"Seed and fruit have no specialised dispersal mechanism."
	Moore, R. 2008. Winter Diet of Streaked Horned Larks in Oregon. Unpublished report submitted to U.S. Fish and Wildlife Service	[Possibly bird-dispersed] "Trifolium arvense seeds with coverings intact (right, from fecal samples), and bare (left). This species and the one shown above were the major food sources for strigata at dredge material deposition site at the Rivergate section of the Port of Portland. Smallest gradations are 1mm."

707	**Propagules dispersed by other animals (externally)**	**y**
	Source(s)	**Notes**
	Western Australian Herbarium (1998–2016). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/. [Accessed 22 Feb 2016]	"Seed and fruit have no specialised dispersal mechanism."
	Hovstad, K. A., Borvik, S., & Ohlson, M. (2009). Epizoochorous seed dispersal in relation to seed availability–an experiment with a red fox dummy. Journal of Vegetation Science, 20(3), 455-464	"Species with high seed retention in fur, evaluated by the main effect of species in the analysis, were Agrimonia eupatoria, Geum rivale, Phleum pratense, Leucanthemum vulgare and Trifolium arvense."
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	'The ripe seed pod is enclosed in a persistent. feathery calyx. and can be distributed by light winds or by water. and probably over longer distances by sticking to animal coats. though most seeds settle close to the parent plant."

708	**Propagules survive passage through the gut**	**y**
	Source(s)	**Notes**
	Hogan, J. P., & Phillips, C. J. C. (2011). Transmission of weed seed by livestock: a review. Animal Production Science, 51(5), 391-398	"Hard seed survives passage through the digestive tract better because it is relatively impermeable to water and, if it escapes damage from mastication, may pass through the digestive tract with little loss of viability. Alomar et al. (1994) showed that with seed of red, white and subterranean clover (Trifolium arvense, T. repens and T. subterraneum) 20–43% survived."

Qsn #	Question	Answer
	Cosyns, E., Delporte, A., Lens, L., & Hoffmann, M. (2005). Germination success of temperate grassland species after passage through ungulate and rabbit guts. Journal of Ecology, 93(2), 353-361	"Seeds were fed to domesticated rabbits (Oryctolagus cuniculus L.; caecum fermenters) and to four domesticated ungulate species that are regularly used to aid conservation of semi-natural grasslands, two of which are ruminants (cattle (Bos Taurus L.) and sheep (Ovis aries L.)) and two colon fermenters (donkey (Equus asinus L.) and horse (Equus cabbalus L.)). The animal species were assumed to have a different mean retention time because of variation in body mass and digestive system (Illius & Gordon 1992)." ... "Seeds were fed to domesticated rabbits (Oryctolagus cuniculus L.; caecum fermenters) and to four domesticated ungulate species that are regularly used to aid conservation of semi-natural grasslands, two of which are ruminants (cattle (Bos Taurus L.) and sheep (Ovis aries L.)) and two colon fermenters (donkey (Equus asinus L.) and horse (Equus cabbalus L.)). The animal species were assumed to have a different mean retention time because of variation in body mass and digestive system (Illius & Gordon 1992). arvense had a significantly higher germination success than seeds of most other plant species except T. campestre and several graminoids, i.e. Agrostis capillaris, Poa pratensis, Luzula campestris and Carex arenaria L.."
	Weaver, V., & Adams, R. (1996). Horses as vectors in the dispersal of weeds into native vegetation. In Proceedings of the 11th Australian Weeds Conference (Vol. 30, pp. 383 -397)	"Six species, Holcus lanatus, Medicago truncatula, Poa annua, Stellaria media, Trifolium arvense and Oxalis sp. were found in all three National Parks and all except Oxalis occurred in more than 10% of the manure samples. Two of these, Poa annua and Trifolium arvense were found in manure from all nine tracks/holding yards in the three National Parks. Poa annua occurred in over 63.5% of the total manure samples, and Trifolium arvense occurred in 31.7 % of the total samples."

801	Prolific seed production (>1000/m2)	y
	Source(s)	**Notes**
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"Large plants may produce 20.000 or more seeds. A large proportion of the fresh seed is hard. and will not germinate unless scarified. Presumably some of this hard seed will remain viable in the soil for many years."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	**Notes**
	Palmer, T. P. (1972). Variation in Flowering Time among and within Populations of Trifolium arvense L. in New Zealand. New Zealand Journal of Botany, 10(1), 59-68	"Large plants may produce 20.000 or more seeds. A large proportion of the fresh seed is hard. and will not germinate unless scarified. Presumably some of this hard seed will remain viable in the soil for many years."
	Royal Botanic Gardens Kew. (2016) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 17 Feb 2016]	"Storage Behaviour: Orthodox Storage Conditions: 20% germination following 68 years in herbarium (Becquerel, 1934); long term storage under IPGRI preferred conditions at RBG Kew, WP. Oldest collection 16 years; average germination change 93.3 to97.7%, mean storage period 13 years, 18 collections"

803	Well controlled by herbicides	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Western Australian Herbarium (1998–2016). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/. [Accessed 22 Feb 2016]	"Suggested method of management and control. Spot spray with 1% glyphosate before flowering, otherwise spot spray Lontrel® 3 ml/10 L (150 ml/ha) up to the 6 leaf stage."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**
	Source(s)	**Notes**
	National Park Service. 2012. Invasive Plants of Haleakala National Park. http://www.nps.gov/hale/naturescience/upload/InvasivePlants.pdf. [Accessed 22 Feb 2016]	[Mechanical control is effective] "Manual Control Methods: Pulling is an effective method of controlling rabbit-foot clover. Care should be taken to remove as much of the root system as possible. After pulling seed heads and flowers should be double bagged and disposed. Remove any seeds from clothing and boots before hiking out of the Crater."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Elevation range exceeds 1000 m, demonstrating environmental versatility
• Naturalized in mid to upper elevation areas of tropical/subtropical islands
• Naturalized on Maui & Hawaii, Hawaiian Islands & elsewhere
• Disturbance weed
• Other Trifolium species have become invasive
• Capable of forming dense cover
• Reproduces by seeds
• Self-compatible
• Reaches maturity in one growing season
• Seeds dispersed internally & externally by animals, by water & both intentionally & accidentally by people
• Capable of prolific seed production
• Forms a persistent seed bank

Low Risk Traits
• Unarmed (no spines, thorns or burrs)
• Provides fodder for livestock
• Thrives in high light environments
• Not reported to spread vegetatively
• Effectively controlled by herbicides & mechanical means