Taxon: Verbascum virgatum Stokes **Family:** Scrophulariaceae

Common Name(s): green mullein
twiggy mullein
virgate mullein
wand mullein

Synonym(s): Blattaria virgata (Stokes) Fourr.
Celsia viscosa Wight ex Benth.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 16 Feb 2016

WRA Score: 9.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Biennial Herb, Temperate, Environmental Weed, Low Palatability, Small-Seeded

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		
303	Agricultural/forestry/horticultural weed		
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	y
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)	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	2
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		
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)		
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**
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	No evidence

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 13 Feb 2016]	"Native: Africa Macaronesia: Portugal - Madeira Islands; Spain - Canary Islands Europe Northern Europe: United Kingdom Southeastern Europe: Italy Southwestern Europe: France; Portugal; Spain"

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 13 Feb 2016]	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Queensland Government. 2016. Weeds of Australia - Twiggy mullein - Verbascum virgatum. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbascum_virgatum.htm. [Accessed 15 Feb 2016]	"A weed of pastures, roadsides, railways, disturbed sites, waste areas, stony river-beds and cultivation in temperate, sub-tropical and sometimes also semi-arid regions."

Qsn #	Question	Answer
	Chileflora. . 2009. Verbascum virgatum. http://www.chileflora.com/Florachilena/FloraEnglish/HighResPages/EH0203.htm. [Accessed 15 Feb 2016]	[Within native range, elevation exceeds 1000 m, demonstrating environmental versatility] "Habitat according to altitude: Low altitude, interior valleys Coastal mountains, 500 - 2000 m. Coastal areas, 0 - 500 m" "This species has the following hardiness: USDA Hardiness Zone 9. The plant does not tolerate snow, but can tolerate occasional freezing spells of about - 5° C (the typical morning frost of central Chile)."

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.	"in Hawai'i sparingly naturalized near Hale Pohaku Ranger Station and known from additional collections in the koa forest near the David Douglas monument and Ka'ii District, Hawai'i. Cultivated as early as 1943 (Fagerlund & Mitchell 641, BISH) , but first naturalized collection made in 1981 (Davis 613, BISH)."
	Queensland Government. 2016. Weeds of Australia - Twiggy mullein - Verbascum virgatum. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbascum_virgatum.htm. [Accessed 15 Feb 2016]	"Widely naturalised overseas, including in tropical Asia, La R union, New Zealand, North America (i.e. Alaska, the USA and Canada), Hawaii and southern South America. Habitat A weed of pastures, roadsides, railways, disturbed sites, waste areas, stony river-beds and cultivation in temperate, sub-tropical and sometimes also semi-arid regions."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Queensland Government. 2016. Weeds of Australia - Twiggy mullein - Verbascum virgatum. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbascum_virgatum.htm. [Accessed 15 Feb 2016]	"Widely naturalised in southern and eastern Australia (i.e. in south-eastern Queensland, New South Wales, the ACT, Victoria, Tasmania, south-eastern South Australia and the coastal districts of south-western Western Australia). Also naturalised on Norfolk Island. Widely naturalised overseas, including in tropical Asia, La R union, New Zealand, North America (i.e. Alaska, the USA and Canada), Hawaii and southern South America."

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.	"in Hawai'i sparingly naturalized near Hale Pohaku Ranger Station and known from additional collections in the koa forest near the David Douglas monument and Ka'ii District, Hawai'i. Cultivated as early as 1943 (Fagerlund & Mitchell 641, BISH) , but first naturalized collection made in 1981 (Davis 613, BISH)."

Qsn #	Question	Answer
	Queensland Government. 2016. Weeds of Australia - Twiggy mullein - Verbascum virgatum. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbascum_virgatum.htm. [Accessed 13 Feb 2016]	"Widely naturalised in southern and eastern Australia (i.e. in many parts of Queensland, New South Wales, the ACT, Victoria, Tasmania, South Australia the coastal and sub-coastal districts of south-western Western Australia). Also naturalised naturalised on Lord Howe Island and Norfolk Island. Widely naturalised overseas in southern Africa, New Zealand, North America (i.e. eastern Canada and the USA), southern South America and many Pacific islands (i.e. Hawaii, Melanesia and Polynesia)."

302	Garden/amenity/disturbance weed	
	Source(s)	**Notes**
	Bass Coast Shire Council. 2015. Common Weeds of Gippsland. Weed Identification. www.basscoast.vic.gov.au	"Invades: Roadsides, railway lines, waste areas and degraded agricultural land."
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[A disturbance adapted weed with negative environmental impacts] "A plant that rapidly colonizes disturbed sites and forms dense patches due to the large rosette leaves. Native plants are crowded out and their establishment is prevented"

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"As Twiggy Mullein cannot compete with established plants, it is not considered a serious agricultural weed and is easily crowded out in cultivation, except in areas where vegetation is sparse to begin with."
	Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. & Leigh, J.H. 2011. Plants of Western New South Wales. CSIRO Publishing, Collingwood, Australia	"Considered a weed because its robust growth reduces the growth of the more palatable pasture plants, but rarely occurs in sufficient density to be regarded as troublesome ."
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	"The Problem: Twiggy mullein is not a problematic weed in cotton, but is an alternative over-wintering host for heliothus and as such is undesirable in and around cotton fields."
	T.E.R:R.A.I.N. 2016. Verbascum virgatum (Twiggy Mullein). http://www.terrain.net.nz/friends-of-te-henui-group/weeds-by-scientific-names/moth-mullein-verbascum-virgatum.html. [Accessed 16 Feb 2016]	[Naturalized, but not regarded as an agricultural weed] "It is a tall-growing biennial herb reaching a height of between 1 and 2 metres. The flowers are 3 to 4 cm in diameter and are yellow with a purple centre. The species is native to the United Kingdom, Italy, France, Spain and is now it is naturalised in New Zealand. Its leaves are not as woolly as Verbsacum thapsus and it has larger flowers and is found growing in open disturbed places with damp soils. It is not as common as the Wolley mullein which is found in dry areas."
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Cited as a weed of agriculture. Impact unspecified

304	Environmental weed	y
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"Ecological: Infestations can decrease forage for wildlife and decrease local plant biodiversity."

Qsn #	Question	Answer
	Friends of The Pinnacle. 2010. Community Weed Management Plan for The Pinnacle Nature Reserve (2010-2020). http://www.ginninderralandcare.org.au. [Accessed 13 Feb 2016]	"There is little documentation on V. virgatum, however, it is similar ir form and seeding as V. thapsus, is commonly found in patches with thapsus, and is given the same priority for treatment as V. thapsus. V thapsus and V. virgatum are found as isolated individuals and significant patches, mostly across the south western portion of the reserve and adjacent to the boundary fence. Combined there were more than 1,200 individuals across the reserve, with patches covering an area of 7.5ha."
	Queensland Government. 2016. Weeds of Australia - Twiggy mullein - Verbascum virgatum. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbascum_virgatum.htm. [Accessed 13 Feb 2016]	"Twiggy mullein (Verbascum virgatum) is regarded as a significant environmental weed in Victoria, and as a minor environmental weed or potential environmental weed in other parts of Australia."
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Verbascum virgatum … A plant that rapidly colonizes disturbed sites and forms dense patches due to the large rosette leaves. Native plants are crowded out and their establishment is prevented."

305	Congeneric weed	y
	Source(s)	**Notes**
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The plant spreads rapidly after disturbances and forms a continuous cover, eliminating the native vegetation."
	Parker, I. M., Rodriguez, J., & Loik, M. E. (2003). An evolutionary approach to understanding the biology of invasions: local adaptation and general-purpose genotypes in the weed Verbascum thapsus. Conservation Biology, 17(1), 59-72	"Verbascum thapsus is a serious weed pest of roadsides and industrial areas (Semenza et al. 1978), but because it is often restricted to disturbed sites, it has not been considered a major noxious invader in most areas of California (Hoshovsky 1986). However, in areas with thin soils and open vegetation, or in forested sites after fire, V. thapsus can form thick stands (Pitcairn 2000). It is reported to displace native herbs and grasses in undisturbed meadows in the Owens Valley (Pitcairn 2000)."

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] "Biennial herbs 6-12(-15) dm tall in the second year, glandular puberulent and hispid throughout, the hairs forked or simple. Basal leaves obovate, 10-30 cm long, 4.5-9 cm wide, margins crenate to dentate; cauline leaves becoming progressively smaller toward the inflorescence, lanceolate, subsessile and somewhat clasping the stem."

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Pardo, F., Perich, F., Torres, R., & Delle Monache, F. (1998) Phytotoxic iridoid glucosides from the roots of Verbascum thapsus. Journal of chemical ecology, 24(4), 645-653	[Unknown. Allelopathic properties reported in V. thapsus] "The iridoid glucosides lateroside 1, harpagoside 2, ajugol 3, and aucubin 4 were isolated from an ethanolic extract of the roots of the weed Verbascum thapsus that exhibits antigermination activity on seeds of barley (Hordeum vulgare). Bioassays indicated that at 3 mM concentration, compounds 1, 2, and 4 showed moderate inhibition of seed germination. These compounds also reduced root length when they were assayed on pregerminated seeds at 1 mM to 0.001 mM concentration range. Of all compounds tested, aucubin 4 was the most active against root elongation. Compound 3 showed no activity in the bioassays." [demonstrates allelopathic potential from root extracts in laboratory setting]
	Alarcon, J., Gonzalez, R., Ferrada, D., Campos, J., Finot, V., Werner, E., & Cespedes, C. L. (2014). Germination inhibitory activity of selected plants from Central South of Chile. Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas, 13(4), 351-358	[Verbascum virgatum extracts demonstrate some inhibitory activity] "Abstract: Methanol extract obtained from aerial parts of 24 selected plants from Central Valley and Pre-andean foothill from Ñuble Province of Chile were tested for its inhibitory germination activity against Trifolium repens and Raphanus sativus. Many extracts (13/24 = 54%) showed inhibition of T. repens germination with IG% > 50%, but none on R. sativus."

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.	"Biennial herbs 6-12(-15) dm tall in the second year, glandular puberulent and hispid throughout, the hairs forked or simple." [No evidence]

404	Unpalatable to grazing animals	y
	Source(s)	**Notes**
	Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. & Leigh, J.H. 2011. Plants of Western New South Wales. CSIRO Publishing, Collingwood, Australia	"Considered a weed because its robust growth reduces the growth of the more palatable pasture plants, but rarely occurs in sufficient density to be regarded as troublesome ."
	Croker, B. H. (1959). A method of estimating the botanical composition of the diet of sheep. New Zealand Journal of Agricultural Research, 2(1), 72-85	"Fragments of plant cuticile found in the faeces are compared with a set of references prepared from the leaves of known plants. The cuticle patterns, as far as studied, are characteristic for each species and the fragments can be used to identify the plants grazed and an estimate made of the botanical composition of the diet. The results presented in this preliminary study are purely qualitative." [Verbascum virgatum cuticle fragments found in sheep droppings]
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"Palatability to Livestock: Animals rarely graze it because of its irritating hairs."

405	Toxic to animals	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 16 Feb 2016]	"Toxicity to Species: Unknown"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	McKenzie, E. H. C., & Dingley, J. M. (1996). New plant disease records in New Zealand: miscellaneous fungal pathogens III. New Zealand Journal of Botany, 34(2): 263-272	"Erysiphe cichoracearum DC. On * Verbascum virgatum Stokes (Scrophulariaceae) Nelson, City, track to Fringed Hill, R. E. Beever, 29 Aug 1991, PDD 60222." [Erysiphe cichoracearum is a plant pathogen that causes powdery mildew disease of cucurbits]
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	"The Problem: Twiggy mullein is not a problematic weed in cotton, but is an alternative over-wintering host for heliothus and as such is undesirable in and around cotton fields."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence, although a related taxon, Verbascum thapsus, is reported to cause contact dermatitis

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Smith, C.W. 1985. Impact of Alien Plants on Hawaii's Native Biota. Pp. 180-250 in Stone & Scott (eds.). Hawaii's terrestrial ecosystems: preservation & management. CPSU, Honolulu, HI	"Verbascum thapsus" ... "Fires are retarded in stands of this plant under normal conditions." [No evidence that V. virgatum increases fire hazards in native ecosystems. Likely to have a similar effect as V. thapsus]

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	Dave's Garden. 2016. Wand Mullein - Verbascum virgatum. davegarden.me/guides/pf/go/2747/	"Sun Exposure: Full Sun"
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 16 Feb 2016]	[Unlikely. High light habitats] "Habitat: Grasslands, shrubby areas, dry open forests and bushlands. Disturbed sites such as roadsides, pastures, and rangelands. Can inhabit dry to moist areas."
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	[Unlikely. Occurs in high light habitats] "Ecology: Adapted to a range of soil types but most common on roadsides, in pastures and disturbed areas."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	"Ecology: Adapted to a range of soil types but most common on roadsides, in pastures and disturbed areas."

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.	"Biennial herbs 6-12(-15) dm tall in the second year, glandular puberulent and hispid throughout, the hairs forked or simple."

412	Forms dense thickets	y
	Source(s)	**Notes**
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"A plant that rapidly colonizes disturbed sites and forms dense patches due to the large rosette leaves. Native plants are crowded out and their establishment is prevented"

501	Aquatic	n
	Source(s)	**Notes**
	Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. & Leigh, J.H. 2011. Plants of Western New South Wales. CSIRO Publishing, Collingwood, Australia	[Terrestrial] "Stiff erect biennial forb, 1-2 m high, covered with short soft hairs." ... "HA8ITAT: Roadsides, occasionally in pastures, often in disturbed or cultivated areas."

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 13 Feb 2016]	"Genus: Verbascum Family: Scrophulariaceae Tribe: Scrophularieae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Biennial herbs 6-12(-15) dm tall in the second year," [Scrophulariaceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	"Plants – an erect biennial weed, 0.5 - 2 m tall with branching, erect stems. Plants die after reproducing."

Qsn #	Question	Answer
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 16 Feb 2016]	"the plant has a large taproot." [But not a geophyte]

601	Evidence of substantial reproductive failure in native habitat	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 16 Feb 2016]	No evidence. Widespread native & introduced ranges

602	Produces viable seed	y
	Source(s)	**Notes**
	Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. & Leigh, J.H. 2011. Plants of Western New South Wales. CSIRO Publishing, Collingwood, Australia	"Fruit a globular capsule. about 9 mm diameter; seeds brown, cylindrical, 1 mm long."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Ellis, B., & Pearman, D. 2010. New names and taxa in the third edition of Stace – part 2. BSBI News 115: 42-50	Verbascum virgatum × V. nigrum & Verbascum virgatum × V. pulverulentum are reported. Unknown if natural hybrids occur

604	Self-compatible or apomictic	
	Source(s)	**Notes**
	Donnelly, S. E., Lortie, C. J., & Aarssen, L. W. (1998). Pollination in Verbascum thapsus (Scrophulariaceae): the advantage of being tall. American Journal of Botany, 85 (11), 1618-1625	[Related taxon is self-compatible] "Plants in natural populations with excluded pollinators produced seeds via a delayed selfing mechanism. However, delayed selfing under pollinator exclusion resulted in only 75% of the seed set obtained with natural pollinators...Comparison of seed set and seed mass in plants that were artificially selfed and artificially crossed (in both the greenhouse and in natural populations) indicated that plants were fully self-compatible with no evidence of early-acting inbreeding depression."

605	Requires specialist pollinators	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.	[Floral morphology similar to V. thapsus] "Flowers in clusters of 1-5 per node, forming a racemose inflorescence, pedicels 2-5 mm long; calyx 5.5-8(-9) mm long, the lobes lanceolate, glandular pubescent; corolla yellow, 15-20 mm long, the lobes pubescent externally; upper 3 staminal filaments densely white or violet villous, the lower 2 violet villous."

Qsn #	Question	Answer
	Donnelly, S. E., Lortie, C. J., & Aarssen, L. W. (1998). Pollination in Verbascum thapsus (Scrophulariaceae): the advantage of being tall. American Journal of Botany, 85 (11), 1618-1625	[V. thapsus pollinated by bees] "The main stalk and any branches that are produced terminate in a single indeterminate inflorescence spike of bright yellow flowers that are visited by pollinators, primarily bees."

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	[No evidence] "Plants – an erect biennial weed, 0.5 - 2 m tall with branching, erect stems. Plants die after reproducing."

607	Minimum generative time (years)	2
	Source(s)	**Notes**
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	"Lifecycle / Biology: Seedlings emerge in autumn and spring, growing over summer. Plants enter the reproductive phase in the following year flowering in late spring to early autumn."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	**Notes**
	Bass Coast Shire Council. 2015. Common Weeds of Gippsland. Weed Identification. www.basscoast.vic.gov.au	"Dispersal: By seed through road machinery, grading, slashing."
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"Seeds can also be spread in mud caught in tire tread or undercarriages of vehicles or machinery."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Fair Dinkum Seeds. 2016. Wand Moth Mullein Verbascum Virgatum Seeds. http://fairdinkumseeds.com/products-page/ethnobotanical-or-medicinal-plants/wand-moth-mullein-verbascum-virgatum-seeds/. [Accessed 16 Feb 2016]	"Packet of 200+ seeds of this interesting species!" [Seeds sold commercially]

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 16 Feb 2016]	[Unknown, but possible that small seeds could become a produce contaminant if growing in proximity to crops] "Dispersal: Seeds can be dispersed on or through the digestive system of birds, wildlife, and livestock. Seeds can also be spread in mud caught in tire tread or undercarriages of vehicles or machinery. Seeds caught in the wind are light and can be blown meters."

704	Propagules adapted to wind dispersal	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Gremmen, N. & Halbertsma, R.L. 2009. Alien plants and their impact on Tristan da Cunha - Part 1: General account. Data-analyse Ecologie, Diever, The Netherlands	"Other species, however, produce large numbers of small seeds, that are easily blown away by wind, and thus disperse easily into new areas. Examples are Twiggy Mullein, (Verbascum virgatum), Annual Pearlwort (Sagina apetala), White Cudweed (Vellereophyton dealbatum), Sticky Mouse-ear (Cerastium glomeratum), and Toad Rush (Juncus bufonius)."
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"Seeds caught in the wind are light and can be blown meters."

705	**Propagules water dispersed**	
	Source(s)	**Notes**
	Victorian Resources Online. 2016. Twiggy mullein (Verbascum virgatum). http://vro.agriculture.vic.gov.au/. [Accessed 16 Feb 2016]	[Seeds not specifically adapted for water dispersal, but small size may contribute to their movement by water when growing in riparian habitat] "Occurs in disturbed sites, often along roadsides and near habitation (Harden 1992). It is a common weed in much of Victoria south of Echuca and Horsham (Faithfull 2000). Twiggy Mullein invades lowland grassland and grassy woodland, dry sclerophyll forest and woodland, riparian vegetation, rock outcrop vegetation, warm temperate rainforest, and alpine and subalpine vegetation (Carr et al 1992)."

706	**Propagules bird dispersed**	**y**
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed]	"Seeds can be dispersed on or through the digestive system of birds, wildlife, and livestock."

707	**Propagules dispersed by other animals (externally)**	
	Source(s)	**Notes**
	Wells, H., & Wells, P. H. (1980). Are geographic populations equivalent to genetic populations in biennial species? A study using Verbascum virgatum (Scrophulariaceae). Genetical Research, 36 (01), 17-28	"Seeds are less than 1 mm in diameter with no obvious means of dispersal." [Small size may allow for attachment to furs, feather, or mud stuck to animals]
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 16 Feb 2016]	"Seeds can be dispersed on or through the digestive system of birds, wildlife, and livestock."

Qsn #	Question	Answer
708	**Propagules survive passage through the gut**	
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	"Seeds can be dispersed on or through the digestive system of birds, wildlife, and livestock." [Possible, although low palatability may minimize ingestion of seeds]

801	**Prolific seed production (>1000/m2)**	
	Source(s)	**Notes**
	Smiley, F.J. 1922. Weeds of California and Methods of Control. Department of Agriculture, Sacramento, CA	"central ovary developing to a 2-celled capsule containing numerous wrinkled brown seeds."
	Charles, G. 2014. WEEDpak section A2 Weed and Plant Identification Guide July 2014 Update. www.cottoninfo.com.au	[Possibly, but numbers unknown] "Seedpods – are a brown and woody globe, 5 – 9 mm across, borne on short stems, 3 - 6 mm long. The pods are made of 4 segments that come together in a central peak. Each pod contains numerous seeds."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Royal Botanic Gardens Kew. (2016) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 16 Feb 2016]	"Storage Behaviour: Orthodox Storage Conditions: Long-term storage under IPGRI preferred conditions at RBG Kew, WP. Oldest collection 16 years; germination change 80 to 78%, 14 years, 1 collection"
	Gerlach Jr, J. D., Moore, P. E., Lubin, D. M., Johnson, B., Roy, G., Whitmarsh, P., Graber, D. M. & Keeley, J. E. (2001) Exotic Species Threat Assessment and Management Prioritization for Sequoia Kings Canyon and Yosemite National Parks. v	"Verbascum virgatum (wand mullein) is a 0.6 to 1.2 m tall biennial that has not been considered for ranking by CalEPPC." ... "There is very little published information on this species but if it is similar to V. thapsus (woolly mullein) it will establish a large and long-lived seedbank."

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Elwood, H. & Ransom, C. 2011. Wand mullein (Verbascum virgatum) control two years after herbicide application. P. 17 in Rauch, T. & Campbell, J. (eds.). Western Society of Weed Science Research Progress Report 2011, Spokane, Washington, USA 7-10 March 2011. WSWS, Las Cruces, New Mexico	"Wand mullein (Verbascum virgatum S.) is a non-native biennial introduced from Europe that has been found spreading on western rangelands. Fall herbicide applications were made in October 2008 and spring herbicide applications were made in May 2009 on Antelope Island State Park. Individual plots measuring 10 by 30 feet were arranged in a randomized complete block design with four replications. All herbicides were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 19 gallons per acre. Non-ionic surfactant was added to all treatments at the rate of 0.25% v/v. Two years after application, data was collected on June 1, 2010. Plots were visually evaluated and density counts of bolted plants and rosettes were made. No significant application timing by herbicide interactions were observed so data are presented averaged over application timing. Chlorsulfuron provided the least control at 28%. Aminopyralid had less control than some of the best treatments, providing 80% control, while all other treatments continued to provide excellent control after two years. The number of bolted plants and rosettes per plot was not different among treatments except for chlorosulfuron. The number of plants found in plots treated with chlorsulfuron was similar to the untreated." [A number of herbicides provide effective control

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	**Notes**
	Snowy River Shire Council. 2012. T.I.P.S. Targeted Invasive Plant Species - Twiggy Mullein . verbascum virgatum. https://www.snowyriver.nsw.gov.au/DocumentCenter/Home/View/407. [Accessed 13 Feb 2016]	Mechanical Control Pulling may be an effective control method for small infestations Pulling or digging should be performed before seeds mature and while soil is moist. If seeds are mature, cut and bag seed heads prior to mechanical control Ploughing/harrowing and seeding with grass species appears to be effective for large infestations Bio-Control Cultivation, summer cropping. The plant can be out competed. Chipping and digging is also efficient in the control, though the plant has a large taproot

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	Juvik, J.O. & Juvik, S.P. 1992. Mullein (Verbascum thapsus):the Spread & Adaptation of a Temperate Weed in the Montane Tropics. Pp.254-270 in Stone et al. (eds.). Alien Plant Invasions in Native Ecosystems of Hawaii: Management & Research. UH CPSU, Honolulu, HI	[Unknown for V. virgatum] "The possibility of biological control for heavily infested areas of Hawaii also bears serious investigation. The weevil Gymnetron tetrum is a major seed predator of V. thapsus throughout its natural range and may prove a viable control agent in Hawaii. Recent comments (Smith 1985) that population size and range of V. thapsus have been significantly reduced by a gall-forming insect are not supported by our data. There are presently no significant insect predators, and the species continues to expand its range and population size in favorable upland environments."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Elevation range exceeds 1000 m, demonstrating environmental versatility
• Naturalized on Hawaii Island & elsewhere
• A disturbance-adapted environmental weed
• Other Verbascum species (e.g. V. thapsus) are invasive
• Potentially allelopathic
• Low palatability may give plants a competitive edge over more preferred browse species
• Forms dense cover that can exclude other vegetation
• Tolerates many soil types
• Reproduces by seeds
• As a biennial, reaches maturity in 2 years
• Small seeds dispersed by wind, stuck to vehicles, equipment, mud, & animals
• Prolific seed production (numbers unspecified)

Low Risk Traits
• Unarmed (no spines, thorns or burrs)
• Ornamental
• Not reported to spread vegetatively
• Herbicides provide effective control
• Cultivation & mechanical methods may provide effective control