Family: ***Scrophulariaceae***

Taxon: ***Verbascum thapsus***

Synonym: *NA*

Common Name common mullein
flannelleaf
velvet-dock
hag taper

Questionaire : current 20090513 **Assessor:** Chuck Chimera **Designation:** H(Hawai'i)
Status: Assessor Approved **Data Entry Person:** Chuck Chimera **WRA Score 11**

101	**Is the species highly domesticated?**	**y=-3, n=0**	**n**
102	**Has the species become naturalized where grown?**	**y=1, n=-1**	
103	**Does the species have weedy races?**	**y=1, n=-1**	
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)**	**Intermediate**
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)**	
303	**Agricultural/forestry/horticultural weed**	**n=0, y = 2*multiplier (see Appendix 2)**	**n**
304	**Environmental weed**	**n=0, y = 2*multiplier (see Appendix 2)**	**y**
305	**Congeneric weed**	**n=0, y = 1*multiplier (see Appendix 2)**	**y**
401	**Produces spines, thorns or burrs**	**y=1, n=0**	**n**
402	**Allelopathic**	**y=1, n=0**	
403	**Parasitic**	**y=1, n=0**	**n**
404	**Unpalatable to grazing animals**	**y=1, n=-1**	**y**
405	**Toxic to animals**	**y=1, n=0**	**n**
406	**Host for recognized pests and pathogens**	**y=1, n=0**	**n**
407	**Causes allergies or is otherwise toxic to humans**	**y=1, n=0**	
408	**Creates a fire hazard in natural ecosystems**	**y=1, n=0**	**n**
409	**Is a shade tolerant plant at some stage of its life cycle**	**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**	**y=1, n=-1**	**y**
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**	**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**	**y=1, n=-1**	**n**
704	**Propagules adapted to wind dispersal**	**y=1, n=-1**	
705	**Propagules water dispersed**	**y=1, n=-1**	**n**
706	**Propagules bird dispersed**	**y=1, n=-1**	**n**
707	**Propagules dispersed by other animals (externally)**	**y=1, n=-1**	**n**
708	**Propagules survive passage through the gut**	**y=1, n=-1**	
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**	
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	**y=-1, n=1**	**n**

Designation: H(Hawai'i) **WRA Score** **11**

Supporting Data:

101	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Is the species highly domesticated? No] No evidence
102	2011. WRA Specialist. Personal Communication.	NA
103	2011. WRA Specialist. Personal Communication.	NA
201	1992. Juvik, J.O./Juvik, S.P.. 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	[Species suited to tropical or subtropical climate(s)? 0 - low] "The area of major mullein invasion and spread corresponds generally to that part of the Island with a temperate, summer-dry climate analogous to that found in the species' native range (Mediterranean Europe)." [native range within temperate region]
201	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Species suited to tropical or subtropical climate(s)? 0 - low] "It is reported to require a cold period (vernalization) (Glier and Caruso 1973), after which it begins to bolt and subsequently produce flowers in the second spring or summer...Studies in temperate habitats indicate that V. thapsus requires a cold period (below 10 C) for bolting (Glier and Caruso 1973). But even in temperate habitats, only rosettes that have reached a threshold size become vernalized (Gross 1981). Plants at the lowest elevation (1,670 m) in our study do not typically experience temperatures below 10 C, yet nearly 60% of surviving V. thapsus plants at this site had flowered by the end of our study. Furthermore, we have also observed flowering V. thapsus plants at much warmer sites near sea level. This suggests that seasonal cues might not be so critical for flowering in V. thapsus." [temperate species, but capable of flowering at sea level in tropics. Climate suitability unresolved.]
202	1992. Juvik, J.O./Juvik, S.P.. 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	[Quality of climate match data? 1 - intermediate] "The area of major mullein invasion and spread corresponds generally to that part of the Island with a temperate, summer-dry climate analogous to that found in the species' native range (Mediterranean Europe)."
202	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Quality of climate match data? 1-intermediate] "...we have also observed flowering V. thapsus plants at much warmer sites near sea level. This suggests that seasonal cues might not be so critical for flowering in V. thapsus." [although from a temperate climate, this species demonstrates plasticity in its introduced range which suggests it can tolerate low elevation tropical climates and even reproduce successfully within them]
203	1992. Juvik, J.O./Juvik, S.P.. 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	[Broad climate suitability (environmental versatility)? Yes] "The species tolerates a wide range of environmental conditions and is particularly adapted as an early successional pioneer in disturbed dry and rocky sites...In its native European habitat and other temperate areas, mullein is an early succession colonizer of disturbed dry and rocky sites and is able to survive under a broad range of environmental conditions (Williams et al. 1975; Semenza and Evans 1978; Reinartz 1984a)."
203	2011. Dave's Garden. PlantFiles: Great Mullein, Common Mullein, Aaron's Rod, Adam's Flannel, Fairy Tale Plant - Verbascum thapsus. http://davesgarden.com/guides/pf/go/849/	[Broad climate suitability (environmental versatility)? Yes] "Hardiness: USDA Zone 4a: to -34.4 °C (-30 °F) USDA Zone 4b: to -31.6 °C (-25 °F) USDA Zone 5a: to -28.8 °C (-20 °F) USDA Zone 5b: to -26.1 °C (-15 °F) USDA Zone 6a: to -23.3 °C (-10 °F) USDA Zone 6b: to -20.5 °C (-5 °F) USDA Zone 7a: to -17.7 °C (0 °F) USDA Zone 7b: to -14.9 °C (5 °F) USDA Zone 8a: to -12.2 °C (10 °F) USDA Zone 8b: to -9.4 °C (15 °F) USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F)"

204	1992. Juvik, J.O./Juvik, S.P.. 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	[Native or naturalized in regions with tropical or subtropical climates? Yes] "Verbascum thapsus was introduced to the island of Hawai`i sometime around 1900 and has since spread into dry montane environments on the slopes of Mauna Kea, Mauna Loa, and Hualalai volcanoes. On the Indian Ocean island of La Reunion (environmentally similar to Hawai`i), mullein has also recently become established in comparable montane zones...Common mullein (Verbascum thapsus: Scrophulariaceae), a monocarpic and biennial Eurasian weed, is widely naturalized in North America and other temperate areas of the world including Australia and New Zealand. Various medicinal properties and other folk culture uses (e.g, piscicide) are attributed to the plant and may, in part, explain its widespread introduction (Wilhelm 1974)...The major areas of heavy mullein invasion on the island of Hawaii generally include the leeward uplands (3,940 to 9,840 ft or 1,200-3,000 m) of Mauna Loa, Mauna Kea, and Hualalai (Fig. 2). The species also occurs sporadically in areas outside this zone, including windward Mauna Loa and even a few sea level locations on the arid west coast of the Island."
205	1992. Juvik, J.O./Juvik, S.P.. 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	[Does the species have a history of repeated introductions outside its natural range? Yes] "Common mullein (Verbascum thapsus) is a rosette, biennial weed native to temperate Eurasia and naturalized worldwide in suitable mid-latitude environments, where it frequently is considered a pest."
301	1992. Juvik, J.O./Juvik, S.P.. 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	[Naturalized beyond native range? Yes] "Common mullein (Verbascum thapsus) is a rosette, biennial weed native to temperate Eurasia and naturalized worldwide in suitable mid-latitude environments, where it frequently is considered a pest...The major areas of heavy mullein invasion on the island of Hawaii generally include the leeward uplands (3,940 to 9,840 ft or 1,200-3,000 m) of Mauna Loa, Mauna Kea, and Hualalai (Fig. 2). The species also occurs sporadically in areas outside this zone, including windward Mauna Loa and even a few sea level locations on the arid west coast of the Island."
301	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Naturalized beyond native range? Yes] Naturalized in temperate and tropical Asia, Australia, New Zealand, North America (including Canada, Alaska, Southeastern USA, Western USA, Remaining USA, South America (Chile and Argentina) and Hawaii
302	1992. Juvik, J.O./Juvik, S.P.. 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	[Garden/amenity/disturbance weed? Yes to question 3.04]"Mullein has become an aggressive adventive in most temperate areas of introduction, but little has been written on the impact of this species in the montane tropics…Over the past 70 years, mullein has rapidly invaded montane areas on the island of Hawaii. As an early successional colonizer of disturbed sites, the successful spread of V. thapsus has been greatly facilitated by native forest and ground cover disturbance associated with the grazing and browsing of both feral and domestic ungulates (Juvik and Juvik 1984). (2)For V. thapsus, at least a small amount of bare ground is critical for establishment. Gross (1980) found emergence of V. thapsus seedlings to increase with the number of plant categories (grasses, grasses + biennials and grasses + biennials + perennial dicotyledons) removed and that establishment of seedlings was limited to the most open plots." [a disturbance weed with ecological impacts]
303	2003. Guertin, P./Halvorson, W.L.. USGS weeds in the west project: status of introduced plants in southern Arizona parks. Factsheet for Verbascum thapsus L.. USGS/Southwest Biological Science Center, Sonoran Desert Field Station, U. of Arizona, Tucson, AZ	[Agricultural/forestry/horticultural weed? No] "Zimmerman (1996) points out that because this species is not considered an agricultural weed, although much is known about its biology, not much is known about how it impacts native biota or its extent of infestation."
303	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Agricultural/forestry/horticultural weed? No] No evidence
304	1992. Juvik, J.O./Juvik, S.P.. 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	[Environmental weed? Yes] On the island of Hawaii, mullein provides a classic example of an introduced temperate weed that has successfully spread throughout mid- and high elevation areas of the Island, achieving serious pest status (Smith 1985)...The potential invasion of summit cinder cones of Mauna Kea would be an aesthetic blight (notwithstanding recent tourist literature that has touted the "particularly photogenic" qualities of the "furry leafed" mullein, e.g., Uprichard 1986) and would have serious ecological consequences. It is particularly ironic that mullein appears to be filling a niche similar to that vacated by Hawaii's endemic "rosette species," the silversword (Argyroxiphium sandwicense), which unlike the unpalatable Verbascum has been nearly eradicated from Mauna Kea by browsing of feral ungulates."

304	2003. Parker, I.M,/Rodriguez, J./Loik, M.E.. 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.	[Environmental weed? Yes] "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)."
304	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Environmental weed? Yes] "The plant spreads rapidly after disturbances and forms a continuous cover, eliminating the native vegetation."
304	2005. Remaley, T.. PCA fact sheet: Common Mullein - Verbascum thapsus. Plant Conservation Alliance®s Alien Plant Working Group, http://www.nps.gov/plants/alien/fact/veth1.htm	[Environmental weed? Yes] "Common mullein threatens natural meadows and forest openings, where it adapts easily to a wide variety of site conditions. Once established, it grows more vigorously than many native herbs and shrubs, and its growth can overtake a site in fairly short order. Common mullein is a prolific seeder and its seeds last a very long time in the soil. An established population of common mullein can be extremely difficult to eradicate."
305	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Congeneric weed? Yes] "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."
401	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Produces spines, thorns or burrs? No] "Stout biennial herbs 3-20 dm tall in the second year, densely yellowish woolly tomentose throughout, the hairs stellate or dendritic. Basal leaves obovate to oblanceolate, 8-50 cm long, 2.5-14 cm wide, densely yellowish or whitish woolly tomentose, margins entire to shallowly crenate; cauline leaves becoming progressively smaller toward the inflorescence, oblanceolate, sessile and decurrent on stem."
402	1998. Pardo, F./Perich, F./Torres, R./Delle Monache, F.. Phytotoxic Iridoid Glucosides from the Roots of Verbascum thapsus. Journal of Chemical Ecology. 24(4): 645-653..	[Allelopathic? Possibly] "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]
403	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Parasitic? No] "Stout biennial herbs 3-20 dm tall in the second year, densely yellowish woolly tomentose throughout, the hairs stellate or dendritic."
404	1992. Juvik, J.O./Juvik, S.P.. 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	[Unpalatable to grazing animals? Yes] "The plant does not appear to be eaten by cattle even under poor forage conditions, as V. thapsus colonies were well distributed throughout pastures even in overgrazed areas."
404	2006. Schwartz, D.. kingdomPlantae.net. Species pages - Verbascum thapsus (Common Mullein). http://www.kingdomplantae.net/commonMullein.php	[Unpalatable to grazing animals? Yes] "Animals won't eat mullein, because all those little hairs irritate their mucous membranes, but insects don't mind them. If you're trying to grow it, watch for weevils and slugs. Mullein also attracts a wide variety of pollinators, including bees, flies, and butterflies."
405	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Toxic to animals? No] No evidence of toxicity to animals
405	2006. Schwartz, D.. kingdomPlantae.net. Species pages - Verbascum thapsus (Common Mullein). http://www.kingdomplantae.net/commonMullein.php	[Toxic to animals? No] "Mullein also contains coumarin and rotenone, a natural insecticide and fish poison, which is supposed to be non toxic to mammals. It's important to use caution with medicinal or edible plants until you're familiar with their effects on your system. Start small, pay attention, and remember that all things are best in moderation."
406	1992. Juvik, J.O./Juvik, S.P.. 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	[Host for recognized pests and pathogens? No evidence] "There are presently no significant insect predators, and the species continues to expand its range and population size in favorable upland environments."

407	2002. Turker, A.U./Camper, N.D.. Biological activity of common mullein, a medicinal plant. Journal of Ethnopharmacology. 82: 117-125.	[Causes allergies or is otherwise toxic to humans? Potentially] "Common Mullein (Verbascum thapsus L., Scrophulariaceae) is a medicinal plant that has been used for the treatment of inflammatory diseases, asthma, spasmodic coughs, diarrhea and other pulmonary problems. The objective of this study was to assess the biological activity of Common Mullein extracts and commercial Mullein products using selected bench top bioassays, including antibacterial, antitumor, and two toxicity assays*/brine shrimp and radish seed. Extracts were prepared in water, ethanol and methanol. Antibacterial activity (especially the water extract) was observed with Klebsiella pneumonia, Staphylococcus aureus , Staphylococcus epidermidis and Escherichia coli . Agrobacterium tumefaciens induced tumors in potato disc tissue were inhibited by all extracts. Toxicity to Brine Shrimp and to radish seed germination and growth was observed at higher concentrations of the extracts." [No evidence of accidental or inadvertent toxicity to humans]
407	2006. Schwartz, D.. kingdomPlantae.net. Species pages - Verbascum thapsus (Common Mullein). http://www.kingdomplantae.net/commonMullein.php	[Causes allergies or is otherwise toxic to humans? Potentially] "The leaves are a rubefacient, which means that if you rub them against your skin it will become red and irritated, which is something to remember when you're in the woods looking for toilet paper substitutes. It also means that when you've been handling it, your hands get a warm, fuzzy feeling. Some people have used this property to their supposed advantage as a natural sort of makeup, which is how mullein acquired the name 'Quaker rouge'. "
407	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Causes allergies or is otherwise toxic to humans? Potentially] May cause contact dermatitis, but exact details not known
407	2011. Dave's Garden. PlantFiles: Great Mullein, Common Mullein, Aaron's Rod, Adam's Flannel, Fairy Tale Plant - Verbascum thapsus. http://davesgarden.com/guides/pf/go/849/	[Causes allergies or is otherwise toxic to humans? Potentially] "Danger: Parts of plant are poisonous if ingested (3)May cause contact dermatitis, but exact details not known."
408	1985. Smith, C.W.. 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	[Creates a fire hazard in natural ecosystems? No] "Fires are retarded in stands of this plant under normal conditions."
409	1998. Donnelly, S.E./Lortie, C.J./Aarssen, L.W.. Pollination in Verbascum thapsus (Scrophulariaceae): the advantage of being tall. American Journal of Botany. 85(11): 1618–1625.	[Is a shade tolerant plant at some stage of its life cycle? No] "It is an early colonizer of disturbed habitats, requiring bare soils and high light exposure for spring germination (Semenza, Young, and Evans, 1978; Gross, 1980)."
409	2003. Guertin, P./Halvorson, W.L.. USGS weeds in the west project: status of introduced plants in southern Arizona parks. Factsheet for Verbascum thapsus L.. USGS/Southwest Biological Science Center, Sonoran Desert Field Station, U. of Arizona, Tucson, AZ	[Is a shade tolerant plant at some stage of its life cycle? No] "Although Verbascum thapsus can germinate over a wide range of environmental conditions, after germination both moisture and light are required for a plant to successfully establish and reproduce (Gross 1980 in Zimmerman 1996)."
409	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Is a shade tolerant plant at some stage of its life cycle? No] "Since light was not a limiting factor in this habitat, rosettes at higher elevations seem to have responded by investing relatively more in inflorescences than in the length of stalk supporting the inflorescence."
410	2003. Guertin, P./Halvorson, W.L.. USGS weeds in the west project: status of introduced plants in southern Arizona parks. Factsheet for Verbascum thapsus L.. USGS/Southwest Biological Science Center, Sonoran Desert Field Station, U. of Arizona, Tucson, AZ	[Tolerates a wide range of soil conditions? Yes] "Verbascum thapsus is often found where the soil is dry and gravelly or stony (Gross and Werner 1978 in Hoshovsky 1986, Page and Weaver, Jr. 1975, Uva et al. 1997), but is found in chalk and limestone areas in England. In Canada it grows in well drained soils of pastures with a pH of 6.5-7.8, although it is not restricted to these areas (Gross and Werner 1978 in Hoshovsky 1986)."
410	2011. Dave's Garden. PlantFiles: Great Mullein, Common Mullein, Aaron's Rod, Adam's Flannel, Fairy Tale Plant - Verbascum thapsus. http://davesgarden.com/guides/pf/go/849/	[Tolerates a wide range of soil conditions? Yes] "Soil pH requirements: 6.6 to 7.5 (neutral) 7.6 to 7.8 (mildly alkaline) 7.9 to 8.5 (alkaline)"
411	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Climbing or smothering growth habit? No] "Stout biennial herbs 3-20 dm tall in the second year, densely yellowish woolly tomentose throughout, the hairs stellate or dendritic."

412	1985. Smith, C.W.. 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	[Forms dense thickets? Yes] "This wooly, biennial, rosette plant forms a dense ground cover displacing slower-growing native species."
412	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Forms dense thickets? Yes] "The plant spreads rapidly after disturbances and forms a continuous cover, eliminating the native vegetation."
501	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Aquatic? No] "Stout biennial herbs 3-20 dm tall in the second year, densely yellowish woolly tomentose throughout, the hairs stellate or dendritic."
502	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Grass? No] Scrophulariaceae
503	1999. Wagner, W.L./Herbst, D.R./Sohmer, S.H.. Manual of the flowering plants of Hawaii. Revised edition.. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Nitrogen fixing woody plant? No] Scrophulariaceae
504	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "In general during the first summer after germination, it produces a rosette of leaves and a tap root. It continues to grow vegetatively into late autumn and over winters as a vegetative rosette." [not a true geophyte]
601	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Evidence of substantial reproductive failure in native habitat? No] No evidence.
602	1992. Juvik, J.O./Juvik, S.P.. 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	[Produces viable seed? Yes] "The flowering spike (up to 6.5 ft or 2 m in height) may produce 150,000 seeds of comparatively small size (0.03 in. or 0.65-0.75 mm) with no specific adaptations for dispersal (Baskin and Baskin 1981)."
603	2001. Daehler, C.C./Carino, D.A.. Chapter 5. Hybridization Between Native & Alien Plants & its Consequences. Pp. 81-102 in Lockwood, J.L./McKinney, M.L. (eds.). Biotic homogenization. Springer, New York, NY	[Hybridizes naturally? Yes] "Table 5. Hybridization Between Native and Alien Plants." [hybrid reported between Verbascum phlomoides x V. thapsus, Verbascum pyramidatum x V. thapsus; Verbascum thapsus & V. speciosum. Number of intergeneric hybrids suggest that natural hybridization does occur]
604	1998. Donnelly, S.E./Lortie, C.J./Aarssen, L.W.. Pollination in Verbascum thapsus (Scrophulariaceae): the advantage of being tall. American Journal of Botany. 85(11): 1618–1625.	[Self-compatible or apomictic? Yes] "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	1998. Donnelly, S.E./Lortie, C.J./Aarssen, L.W.. Pollination in Verbascum thapsus (Scrophulariaceae): the advantage of being tall. American Journal of Botany. 85(11): 1618–1625.	[Requires specialist pollinators? No] "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	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Reproduction by vegetative fragmentation? No] "It does not have any form of clonal growth and relies entirely on seeds for reproduction (Gross and Werner 1978)."
607	1992. Juvik, J.O./Juvik, S.P.. 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	[Minimum generative time (years)? 2 = 0] "The species is generally characterized as an obligate biennial, with flowering dependent on the number of growing seasons required to reach a critical size. However, naturalized populations in North America range from annuals (Georgia) to triennials (Canada) as a function of both environmental and competitive factors (Gross 1981; Reinartz 1984b)."

607	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Minimum generative time (years)? 2 = 0] "...in general V. thapsus plants in the south behaved as annuals, mid-latitudinal plants behaved as biennials, and those in northern latitudes sometimes delayed their reproduction to 3 years and beyond."
701	1992. Juvik, J.O./Juvik, S.P.. 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	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? Yes] "On both Mauna Kea and Mauna Loa, the plant occurs only along the edges of access roads at the upper elevational limit, suggesting that the automobile (tire tread mud) may be a significant mode of dispersal at high elevation, since the seeds of mullein are not specifically adapted for long-distance dispersal."
702	1992. Juvik, J.O./Juvik, S.P.. 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	[Propagules dispersed intentionally by people? Yes] "Various medicinal properties and other folk culture uses (e.g, piscicide) are attributed to the plant and may, in part, explain its widespread introduction (Wilhelm 1974)."
703	1982. Gross, K.L./Werner, P.A.. Colonizing Abilities of 'Biennial' Plant Species in Relation to Ground Cover: Implications for their Distributions in a Successional Sere. Ecology. 63(4): 921-931.	[Propagules likely to disperse as a produce contaminant? No] "Seeds of these two species have no specialized morphological adaptions for dispersal and are not widely dispersed upon release from the parent"
704	1985. Smith, C.W.. 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	[Propagules adapted to wind dispersal? Possibly short distances] "The seeds are wind-dispersed."
704	1992. Juvik, J.O./Juvik, S.P.. 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	[Propagules adapted to wind dispersal? Possibly short distances] "The flowering spike (up to 6.5 ft or 2 m in height) may produce 150,000 seeds of comparatively small size (0.03 in. or 0.65-0.75 mm) with no specific adaptations for dispersal (Baskin and Baskin 1981). Indeed, studies have shown that under normal conditions more than 80% of all seedfall occurs within 23 ft (7 m) of the parent plant (Gross and Werner 1978)."
705	2010. Ansari, S./Daehler, C.C.. Life history variation in a temperate plant invader, Verbascum thapsus along a tropical elevational gradient in Hawaii. Biological Invasions. 12: 4033–4047.	[Propagules water dispersed? No] "It does not have any special adaptations for seed dispersal, and the seeds (0.5–1 mm long) mostly fall within few meters of the parent plant (Gross and Werner 1978)." [no evidence, although small seeds may be transported by water runoff during storms]
706	1992. Juvik, J.O./Juvik, S.P.. 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	[Propagules bird dispersed? No] "The flowering spike (up to 6.5 ft or 2 m in height) may produce 150,000 seeds of comparatively small size (0.03 in. or 0.65 0.75 mm) with no specific adaptations for dispersal (Baskin and Baskin 1981). Indeed, studies have shown that under normal conditions more than 80% of all seedfall occurs within 23 ft (7 m) of the parent plant (Gross and Werner 1978)."
707	1992. Juvik, J.O./Juvik, S.P.. 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	[Propagules dispersed by other animals (externally)? No] "The flowering spike (up to 6.5 ft or 2 m in height) may produce 150,000 seeds of comparatively small size (0.03 in. or 0.65-0.75 mm) with no specific adaptations for dispersal (Baskin and Baskin 1981). Indeed, studies have shown that under normal conditions more than 80% of all seedfall occurs within 23 ft (7 m) of the parent plant (Gross and Werner 1978)."
708	2011. WRA Specialist. Personal Communication.	[Propagules survive passage through the gut? Unknown] Seeds unlikely to be ingested
801	1992. Juvik, J.O./Juvik, S.P.. 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	[Prolific seed production (>1000/m2)? Yes] "The flowering spike (up to 6.5 ft or 2 m in height) may produce 150,000 seeds of comparatively small size (0.03 in. or 0.65-0.75 mm) with no specific adaptations for dispersal (Baskin and Baskin 1981)."

802	1992. Juvik, J.O./Juvik, S.P.. 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	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Control and eradication of mullein is made difficult by extensive seed viability (up to 100 years)...It appears that the early successional strategy of mullein rests more on extreme seed viability (50-100 years or more) than on long-distance dispersal (Kivilaan and Bandurski 1933; Manning 1965). Mullein cannot compete under situations of dense herbaceous groundcover, but seeds can remain dormant in the soil until vegetation disturbance provides suitable conditions for germination."
803	2003. Motooka, P./Castro, L./Nelson, D./Nagai, G./Ching,L.. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI http://www.ctahr.hawaii.edu/invweed/weedsHi.html	[Well controlled by herbicides? Yes] "Very sensitive to metsulfuron at 0.1 oz./acre. Young plants sensitive to 2,4-D and glyphosate. HAVO staff have controlled mullein with glyphosate at 1% of product in water formulation in foliar application (Chris Zimmer, HAVO)"
803	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Well controlled by herbicides? Yes] "Chemical control is done by spraying rosettes with 2,4-D, glyphosate or tebuthiuron. Repeated applications may be necessary to control regrowth"
804	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Tolerates, or benefits from, mutilation, cultivation, or fire? Possibly] Individual plants can be killed by cutting c. 8 cm below the soil surface to remove the top of the taproot [possibly tolerant of mutilation & cutting if taproot is not removed]
804	2005. Remaley, T.. PCA fact sheet: Common Mullein - Verbascum thapsus. Plant Conservation Alliance®s Alien Plant Working Group, http://www.nps.gov/plants/alien/fact/veth1.htm	[Tolerates, or benefits from, mutilation, cultivation, or fire? Possibly] "Mullein plants are easily hand pulled on loose soils due to relatively shallow tap roots. This is an extremely effective method of reducing populations and seed productivity, especially if plant is pulled before seed set. If blooms or seed capsules are present, reproductive structures should be removed, bagged, and properly disposed of in a sanitary landfill. Care should be taken, however, to minimize soil disturbance since loose soil will facilitate mullein seed germination."
805	1992. Juvik, J.O./Juvik, S.P.. 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	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? No] "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."