Taxon: Plantago major L. **Family:** Plantaginaceae

Common Name(s): broadleaf plantain
common plantain
greater plantain
large plantain
plantain

Synonym(s): Plantago major var. paludosa Bég.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 8 Mar 2019

WRA Score: 18.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Naturalized Herb, Weed, Fodder Plant, Self-Compatible, Easily Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Intermediate
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans		

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets		
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	n
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	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**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	[No evidence] "Plantago comprises nearly 270 species and is cosmopolitan, but mostly temperate in distribution. Plantago major is a variable species in which several subspecies and varieties have been described, but these are connected by a series of intermediates. At higher altitudes the leaves tend to be more lanceolate and more pubescent, while the spikes tend to be more compact."

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

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

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**Intermediate**
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major originated in Europe but has become cosmopolitan. It is essentially temperate in its distribution. In the tropics Plantago major is most common in mountainous regions. In Africa it is most common in southern Africa, including South Africa."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	

Qsn #	Question	Answer
203	**Broad climate suitability (environmental versatility)**	**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 naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m" [Elevation range exceeds 1000 m, demonstrating environmental versatility]
	Plants for a Future. (2019). Plantago major. https://pfaf.org/user/plant.aspx?LatinName=Plantago+major. [Accessed 7 Mar 2019]	USDA hardiness: 3-12

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 naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m, on Midway Atoll and all of the main islands except Ni'ihau and Kaho'olawe."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major originated in Europe but has become cosmopolitan. It is essentially temperate in its distribution. In the tropics Plantago major is most common in mountainous regions. In Africa it is most common in southern Africa, including South Africa."

205	**Does the species have a history of repeated introductions outside its natural 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 northern and central Asia, now virtually cosmopolitan; in Hawai'i naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m, on Midway Atoll and all of the main islands except Ni'ihau and Kaho'olawe."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major originated in Europe but has become cosmopolitan. "

Qsn #	Question	Answer
301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Europe and northern and central Asia, now virtually cosmopolitan; in Hawai'i naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m, on Midway Atoll and all of the main islands except Ni'ihau and Kaho'olawe. First collected on O'ahu in 1864-1865 (Mann & Brigham 423, BISH)."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major originated in Europe but has become cosmopolitan. It is essentially temperate in its distribution. In the tropics Plantago major is most common in mountainous regions. In Africa it is most common in southern Africa, including South Africa."

302	**Garden/amenity/disturbance weed**	**y**
	Source(s)	**Notes**
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A weed in cultivated areas and lawns."
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"First collected on Oahu in 1864-1865, it is common in pastures and disturbed mesic and wet forests, from sea level to 1250m elevation. Introduced passive-invasive" [Disturbance adapted weed. Not identified as a driver of ecosystem degradation]
	Hessayon, D. G. (2002). The Lawn Expert. Sterling Publishing Company, New York	"Importance In British lawns - Major weed - a serious nuisance in many lawns" … "Control - Isolated plantains can be removed by hand weeding with a small fork when grass and weeds are actively growing. Lawn Sand has little effect but all plantains are extremely sensitive lo selective weed--killers. Any product containing MCPA or 2 4·D will kill this weed."

303	**Agricultural/forestry/horticultural weed**	**y**
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Once Plantago major has become established, it can become a noxious weed, as is the case in sugarcane fields in the Mascarene Islands."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Bulbs, Carrots, Cereals, Cotton, Cutflowers, Grapevines, Nursery Production, Orchards & Plantations, Pastures, Pome Fruits, Vegetables"

304	**Environmental weed**	**y**
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"First collected on Oahu in 1864-1865, it is common in pastures and disturbed mesic and wet forests, from sea level to 1250m elevation. Introduced passive-invasive" [Disturbance adapted weed. Not identified as a driver of ecosystem degradation]

Qsn #	Question	Answer
	Plantwise. (2019). Plantwise Technical Factsheet. broad-leaved plantain (Plantago major). https://www.plantwise.org. [Accessed 8 Mar 2019]	"Impact - P. major has been described as an agricultural, pastoral and environmental weed competing with other plants for light, water and nutrients and replacing preferred vegetation. P. lanceolate and P. major have together been reported as weeds in over 50 countries affecting a wide range of crops (Holm et al., 1977). It is a field rather than field margin weed, although it colonizes disturbed margins (Kress, 1988). In the UK it affects the majority of local authority owned sports turf (Raikes et al., 1994). In Prince Edward Island, Canada, it is present in 80% of cereal fields with a mean density of over 14 plants per m² (Thomas and Ivany, 1990). Summary of invasiveness - P. major is native to Europe and Asia but is now widely distributed around the world, particularly in temperate, but also tropical parts. It is easily distributed and maintained by anthropogenic activities, particularly soil disturbance and compaction. Its small seeds may be spread as a contaminant. There is a possibility for invasion of naturally disturbed habitats (e.g. riparian) as well as anthropogenically disturbed areas and grasslands."
	Queensland Government. (2019). Weeds of Australia. Plantago major. http://keyserver.lucidcentral.org. [Accessed 8 Mar 2019]	[Identified as an environmental weed of unspecified impacts] "Widely naturalised in southern and eastern Australia (i.e. in south-eastern Queensland, eastern New South Wales, the ACT, Victoria, Tasmania, south-eastern South Australia and south-western Western Australia). Also naturalised in northern Queensland, and on Lord Howe Island, Norfolk Island and Christmas Island. Notes Greater plantain (Plantago major) is regarded as an environmental weed in Victoria, New South Wales and Western Australia."
	U.S. Fish and Wildlife Service. (2016).Endangered and Threatened Wildlife and Plants; Endangered Status for 49 Species From the Hawaiian Islands. Final Rule. Federal Register Vol. 81, No. 190: 67786-67860	[Plantago major identified as one of the weed threats to Microlepia strigosa var. mauiensis] "Habitat modification and destruction by feral pigs and goats is a threat to Microlepia strigosa var. mauiensis (Oppenheimer 2007, in litt.; Bily 2009, in litt.; HBMP 2010). Herbivory by feral pigs is a threat to M. strigosa var. mauiensis (Oppenheimer 2007, in litt.; Bily 2009, in litt.; HBMP 2010). Ungulates are managed in Hawaii as game animals, but public hunting does not adequately control the numbers of ungulates to eliminate habitat modification and destruction or herbivory by these animals (Anderson et al. 2007, in litt.; HAR–DLNR 2010, in litt.). Nonnative plants, such as Ageratina adenophora, Juncus acuminatus (rush), Plantago major (broad-leaved plantain), and Tibouchina herbacea, degrade habitat and outcompete this variety on Maui (Oppenheimer 2007, in litt.)."

305	Congeneric weed	y
	Source(s)	**Notes**
	Weber, E. 2017. Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Plantago coronopus … The plant is invasive because it forms dense mats of small rosettes, displacing native vegetation and preventing regeneration of native plants." … "Plantago lanceolata … The plant has become naturalized in many regions, and it can form dense swards crowding out native vegetation and preventing the establishment of native species."

401	Produces spines, thorns or burrs	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.	[No evidence] "Perennial herbs, roots fibrous, primarily adventitious, caudex short. Leaves basal, ovate to broadly ovate or broadly elliptic, 3-40 cm Jong, 2-12(-15) cm wide, 5-7- nerved, glabrous to sparsely pilose at least on veins, rarely moderately pilose, margins usually with a few blunt teeth, base abruptly cuneate, petioles 2-18 cm long."

402	Allelopathic	
	Source(s)	**Notes**
	Shinwari, M.I., Shinwari, M.I. & Fujii, Y. 2013. Allelopathic evaluation of shared invasive plants and weeds of Pakistan and Japan for environmental risk assessment. Pak. J. Bot., 45: 467-474	"Table 2. Three dimensional assessment by calculation of percentage growth inhibition of radicals of shared invasive plants and weeds of Pakistan & Japan through Sandwich (SW), Dish Pack (DP) and Plant Box (PB) methods." [Plantago major was not identified as having inhibitory activity greater than the mean +1 standard deviation]

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.	"Perennial herbs, roots fibrous, primarily adventitious, caudex short." [No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Both species are eaten by domestic animals" … "Neither species is known to be toxic to farm animals or man. Pollen from both species shed in large amounts may cause hay fever."

405	Toxic to animals	n
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Both species are eaten by domestic animals" … "Neither species is known to be toxic to farm animals or man. Pollen from both species shed in large amounts may cause hay fever."
	Bryson, C.T.& DeFelice, M.S. 2009. Weeds of the South. University of Georgia Press, Athens, GA	"Toxic Properties: None reported"

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

Qsn #	Question	Answer
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"In New Jersey, P. rugelii and, to a lesser extent, P. major may be reservoirs for strains of tobacco-virus mosaic (Marmor tabaci H.) that causes internal browning of tomato (Lycopersicon esculentum Mill.) fruits (Holmes 1950). About 35% of the tomato plants in one field in New Jersey were affected. P. major may be a host of aster yellows disease that is transmitted by the six-spotted leaf hopper, Macrosteles fascifrons Stal. (Pirone 1970; Freitag and Smith 1969). In Italy, petunia asteroid mosaic virus has been isolated from roots of P. major (Lovisolo et al. 1965) and in the Netherlands, P. major is a host for Verticillium alboatrum Reinke & Berth. and V. lecanii, which cause serious wilting in lucerne (Medicago sativa L.) (Kort and Van Rheenen 1959). In Ontario P. major is used as a transient host by the pear psylla, Psylla pyricola Poer., when the weed is the prominent field plot cover crop (Wilde 1970)."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major acts as a reservoir for several viruses, such as potato virus Y (PVY) and cucumber mosaic virus (CMV), and also for bacterial leaf blight of rice (Xanthomonas oryzae)."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**
	Plants for a Future. (2019). Plantago major. https://pfaf.org/user/plant.aspx?LatinName=Plantago+major. [Accessed 8 Mar 2019]	"High doses may cause a fall in blood pressure and diarrhoea. Possible allergic contact dermatitis. Avoid in patients with intestinal obstruction or abdominal discomfort"
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	[Potential allergen] "Neither species is known to be toxic to farm animals or man. Pollen from both species shed in large amounts may cause hay fever."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Used medicinally. No evidence] "Used in Ayurveda, Unani and Sidha. Plant astringent, tonic, deurative, diuretic; plant decoction taken as vermifuge; leaves of Blumea balsamifera boiled with those of Centella asiatica and the liquid drunk against fever, when mixed with Plantago major the juice taken to cure diabetes. Whole plant and seeds used for urinary stones and infections, diarrhea, bronchitis, cold, cough, acute conjunctivitis; seeds used with sugar for dysentery, gastric complaints, burning sensation in stomach; external use, apply crushed fresh herb, for skin inflammation and boils, ointment for burns. Leaves cooling and diuretic, antiseptic, analgesic and demulcent, used for headaches, infantile diseases, insect bites and stings; pounded leaves applied to cuts, bruises and wounds as a hemostatic and to promote healing; root or leaf decoction taken as an antipyretic; roots and leaves for coughs and tuberculosis; leaf maceration after childbirth as a postpartum remedy. Flowering spikes and root used in cases of bleeding piles and chronic colitis. Veterinary medicine, extract of whole plant as antiseptic dressing."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"P. major has spread from Europe throughout North America. Its northern limit appears to be influenced by cold temperatures and is 200- 500 km south of the tree line. It is rarely found in shaded sites or in sites that are continually wet during the growing season." [No evidence. Unlikely given habit and habitat]
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Plantago major occurs mainly in disturbed areas. Because of its tough leaves appressed to the ground, it is well-adapted to withstand trampling by livestock and humans. Plantago major can tolerate more water-logging and compacted soils than Plantago lanceolata L., and is found along roadsides, in gardens and open grassland, but also in wet and muddy localities." [No evidence. A low growing herb that is unlikely to contribute to fuel load or increase fire risk]

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Elmore, C. L., Cudney, D. W., and McGiffen Jr, M. E. (2007). Plantains. Pest Notes. Publication 7478. University of California Agriculture and Natural Resources, Davis, CA	"Broadleaf plantain (Fig. 1) is a perennial plant that grows best in moist areas with full sun or partial shade and compacted soil."
	van der Toorn, J., & Pons, T. L. (1988). Establishment of Plantago lanceolata L. and Plantago major L. among grass. Oecologia, 76(3), 341-347	"Contrary to expectation P. major-seedlings had a higher shade tolerance than those of P. lanceolata."
	Plants for a Future. (2019). Plantago major. https://pfaf.org/user/plant.aspx?LatinName=Plantago+major. [Accessed 8 Mar 2019]	"It cannot grow in the shade."
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"It is rarely found in shaded sites or in sites that are continually wet during the growing season."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Both species occupy a wide range of soils such as loam, clay and sand but not sphagnum peat (Sagar and Harper 1964; Tessene 1968; I. J. Bassett, personal communication) ."
	Plants for a Future. (2019). Plantago major. https://pfaf.org/user/plant.aspx?LatinName=Plantago+major. [Accessed 8 Mar 2019]	"Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers moist 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.	"Perennial herbs, roots fibrous, primarily adventitious, caudex short."

412	Forms dense thickets	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Both species are nuisances that mar, according to some, the appearance of lawns, gardens, roadsides, and waste places. They are also found in damp shorelines, open woods, and pastures." [No evidence]
	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 naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest" [No evidence from Hawaiian Islands]
	Elmore, C. L., Cudney, D. W., and McGiffen Jr, M. E. (2007). Plantains. Pest Notes. Publication 7478. University of California Agriculture and Natural Resources, Davis, CA	"When plantains infest turfgrass or ornamental plantings, they usually form dense populations of individual plants. Plantain crowds out desirable species and reduces the vigor of those plants that survive." [Generic description]

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] "in Hawai'i naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest"

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 6 Mar 2019]	Family: Plantaginaceae Tribe: Plantagineae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 6 Mar 2019]	Family: Plantaginaceae Tribe: Plantagineae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Small perennial herb up to 30(–70) cm tall, with numerous fibrous and whitish roots."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	[No evidence] "Plantago major is common and extremely widespread and not threatened by genetic erosion. Several small genebank collections exist, especially in South America and Europe. Selections for ornamental purposes are marketed in the United States."

602	Produces viable seed	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.	"Capsules ellipsoid to oblong-ellipsoid, (1.5-)2-3 mm long, dehiscent at or slightly below middle. Seeds 6-16, dark brown, irregular, ca. 1 mm long."
	Plants for a Future. (2019). Plantago major. https://pfaf.org/user/plant.aspx?LatinName=Plantago+major. [Accessed 7 Mar 2019]	"Propagation: Seed - sow spring in a cold frame. When they are large enough to handle, prick the seedlings out into individual pots and plant them out in early summer. A sowing can be made outdoors in situ in mid to late spring if you have enough seeds."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"The seeds can remain viable for up to 60 years in the soil. They have a dormancy period of one to several months, which can be broken by dry storage at 5°C for several weeks or at 20°C for several months. Germination is best at temperatures of 25–30°C, and a long photoperiod (16 hours)."

603	Hybridizes naturally	n
	Source(s)	**Notes**
	Cavers, P. B., Basset, I. J. and Compton, C. W. 1980. The biology of Canadian weeds. 47. Plantago lanceoata L. Canadian Journal of Plant Science 60: 1269-1282	"Rahn (1957) attempted to cross P. lanceolata with P. major, P. media and P. lagopus L. but was unsuccessful. Sagar and Harper (1964) reported that all attempts to produce artificial hybrids between P. lanceolata, P. media and P. major have failed. They concluded that there is an absolute barrier to hybridization between these species."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Lotz, L. A. P., & Blom, C. W. P. M. (1986). Plasticity in life-history traits of Plantago major L. ssp. pleiosperma Pilger. Oecologia, 69(1), 25-30	"Plasticity in life-history characteristics was investigated in three populations of Plantago major L. ssp. pleiosperma (Pilger), a self-compatible, wind pollinated species with a high self-fertilization rate."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Self-pollination is common, but the flowers can also be wind-pollinated."

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.	"Scapes 6-40 cm long, spikes 2.5-25 cm long, glabrous to sparsely pilose, flowers relatively crowded, bracts elliptic, 2.5-3 mm long, usually glabrous; sepals subequal, distinct, ovate to suborbicular, 2-2.5 mm long, glabrous; corolla lobes spreading, lanceolate, 1.2-1.6 mm long; ovary with 6-16 ovules."

Qsn #	Question	Answer
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Self-pollination is common, but the flowers can also be wind-pollinated."

606	Reproduction by vegetative fragmentation	
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	[Rarely] "Both species are hemicryptophytes. They are capable of vegetative reproduction but it is of local importance and relatively rare (Hawthorn 1973)." … "Although reproduction is primarily by seed, about 20% of the sampled populations of both species in laneway and recently disturbed sites had reproduced vegetatively by producing ramets from buds on the persistent crown (Table 4). No plants in pasture produced ramets. The ramet remains attached to the parent plant for 2-3 yr at which time the bond breaks and the ramet initiates root development. Ramets are immediately capable of seed production. Seed production by the entire plant is greater than if the plant had produced spikes from one caudex."

607	Minimum generative time (years)	1
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"In the tropics Plantago major may flower all year round, with a life cycle that may be accomplished in 6 weeks. In temperate regions the plants overwinter below ground in open areas, or as small rosettes if more cover is present."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	**Notes**
	Hodkinson, D. J., & Thompson, K.. (1997). Plant Dispersal: The Role of Man. Journal of Applied Ecology, 34(6), 1484–1496	"In all, 37 species were identified from deposits on cars during this study. The most frequent species were Plantago major (29·2%), Poa annua (16·5%), Poa trivia/ is (10·5%), Urtica dioica (6·4%) and Matricaria discoidea (5·6%)." … "The most common species in the car-borne seed bank were Plantago major, Poa annua, Poa trivialis, Urtica dioica and Matricaria discoidea. In other studies of the car-borne flora of Western Europe, Milberg (1991) found that the four most common species were unidentified Poaceae, Matricaria discoidea, Polygonum aviculare and Plantago major."
	Elmore, C. L., Cudney, D. W., and McGiffen Jr, M. E. (2007). Plantains. Pest Notes. Publication 7478. University of California Agriculture and Natural Resources, Davis, CA	"Once a few plants become established in turfgrass or ornamental areas, seed and plant parts can contaminate equipment, particularly lawn mowers, and spread to new areas. Cleaning equipment prior to moving to a new area can reduce the spread of plantains and other weeds."
	DiTomaso, J. 2007. Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Reproduce by seed. Seeds become sticky with mucilage when moistened. Seeds fall near the parent plant and disperse to greater distances with water, soil movement, mud, as a seed contaminant, and on vehicle tires and landscape and agricultural equipment." [Description for Plantago coronopus, P. lanceolata, and P. major]

Qsn #	Question	Answer
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Seeds readily adhere to animals or people through their mucilaginous seed coat which promotes dispersal. They can also be transported by water."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	GrowOrganic.com. (2019). Strictly Medicinal Organic Plantain Broadleaf. https://www.groworganic.com/hh-plantain-broadleaf.html. [Accessed 8 Mar 2019]	"Certified organic, 100 seeds/pkt" [Numerous companies currently sell Plantago major seeds. Potential for reintroduction and further cultivation is high]

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental, Pasture"
	Mack, R., & Erneberg, M. (2002). The United States Naturalized Flora: Largely the Product of Deliberate Introductions. Annals of the Missouri Botanical Garden, 89(2), 176-189	"Table 4. Non-indigenous species detected repeatedly as seed contaminants in domestic and imported crop seeds in the late 19th century (Chester, 1889)." [Includes Plantago major L. (Plantago major)]

704	Propagules adapted to wind dispersal	n
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Seeds readily adhere to animals or people through their mucilaginous seed coat which promotes dispersal. They can also be transported by water."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	DiTomaso, J. 2007. Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Reproduce by seed. Seeds become sticky with mucilage when moistened. Seeds fall near the parent plant and disperse to greater distances with water, soil movement, mud, as a seed contaminant, and on vehicle tires and landscape and agricultural equipment." [Description for Plantago coronopus, P. lanceolata, and P. major]
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Seeds readily adhere to animals or people through their mucilaginous seed coat which promotes dispersal. They can also be transported by water."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	DiTomaso, J. 2007. Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Reproduce by seed. Seeds become sticky with mucilage when moistened. Seeds fall near the parent plant and disperse to greater distances with water, soil movement, mud, as a seed contaminant, and on vehicle tires and landscape and agricultural equipment." [Description for Plantago coronopus, P. lanceolata, and P. major]

Qsn #	Question	Answer
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Seeds readily adhere to animals or people through their mucilaginous seed coat which promotes dispersal. They can also be transported by water." [Could be externally dispersed by birds, but unlikely to be internally dispersed]

707	Propagules dispersed by other animals (externally)	y
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"Seeds readily adhere to animals or people through their mucilaginous seed coat which promotes dispersal. They can also be transported by water."

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Mouissie, A., Van Der Veen, C. E., Veen, G. C., & Van Diggelen, R. (2005). Ecological correlates of seed survival after ingestion by fallow deer. Functional Ecology, 19(2): 284-290	[Dispersed by deer] "In total, 2696 seedlings of 24 species emerged from the droppings. The only species of which no seedlings were recorded in the deer droppings was Arctium lappa. Recovered fraction of seeds fed, of the other species, ranged from 0·001 for Sanguisorba minor to 0·20 for Plantago major."
	Kuiters, A. T., & Huiskes, H. P. J. (2010). Potential of endozoochorous seed dispersal by sheep in calcareous grasslands: correlations with seed traits. Applied Vegetation Science, 13(2): 163-172	[Sheep dispersed] "By far the most abundant and most frequently occurring species obtained from the dung samples was Urtica dioica (stinging nettle): 81% of all seedlings. Other abundant species were Agrostis stolonifera, Plantago major, Agrostis capillaris and Hypericum perforatum."

801	Prolific seed production (>1000/m2)	y
	Source(s)	**Notes**
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"A seed production per plant of 14,000–20,000 seeds/year has been reported."
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Table 2. Data on reproduction for Plantago major and P. rugelii in pasture fields at London, Ontario" [P. major - Seeds/m2 = 53675]

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	**Notes**
	DiTomaso, J. 2007. Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Some buried seeds can survive for up to 40 years."
	Gurib-Fakim, A. (2006). Plantago major L. In: Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands	"The seeds can remain viable for up to 60 years in the soil. They have a dormancy period of one to several months, which can be broken by dry storage at 5°C for several weeks or at 20°C for several months."

803	Well controlled by herbicides	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Plantains in general are susceptible to 2,4-D; 2,4,5-T; MCPA; fenoprop and to greater applications of 2,4-DB; MCPB; and dicamba (Switzer 1969)."
	Elmore, C. L., Cudney, D. W., and McGiffen Jr, M. E. (2007). Plantains. Pest Notes. Publication 7478. University of California Agriculture and Natural Resources, Davis, CA	[Certain herbicides are not effective] "Preemergent turfgrass herbicides commonly used for crabgrass control have not been successful in limiting germination of plantain. Isoxaben, a relatively new broadleaf preemergent herbicide, has been effective in limiting germination of plantain in turfgrass. Postemergent broadleaf herbicides (2,4-D, triclopyr, MCPA, and mecoprop) can control plantain seedlings, but control of established plantain plants with postemergent treatment is much more difficult. For established plants, 2,4-D works best while triclopyr, MCPA, and mecoprop will only reduce its vigor. Best control is achieved from a fall application. Repeat applications are needed to kill weakened perennial weeds and new germinating seedlings."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**
	Source(s)	**Notes**
	Hawthorn, W. R. (1974). The biology of Canadian weeds. 4. Plantago major and P. rugelii. Canadian Journal of Plant Science, 54(2), 383-396	"Both species in pasture benefit from occasional mowing, as the tall vegetation of competing species is temporarily eliminated."
	Elmore, C. L., Cudney, D. W., and McGiffen Jr, M. E. (2007). Plantains. Pest Notes. Publication 7478. University of California Agriculture and Natural Resources, Davis, CA	"Buds grow from the uppermost area of the root, producing a crown that can regenerate “new” plants even when the plant is cut off at or below the soil surface."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	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.	[Unknown, but widely distributed in the Hawaiian islands] "in Hawai'i naturalized and often locally common in pastures, lawns, along roadsides, and disturbed parts of virtually all vegetation types from coastal, disturbed forest to wet forest, 0-1,250 m, on Midway Atoll and all of the main islands except Ni'ihau and Kaho'olawe."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad distribution, climate tolerance, & elevation range exceeds 1000 m, demonstrating environmental versatility
• Grows in temperate and tropical climates
• Naturalized on Kauai, Oahu, Maui, Molokai, Lanai, Hawaii and Midway (Hawaiian Islands), and widely naturalized worldwide
• Weed of disturbed sites, agriculture and the natural environment
• Identified as a threat to the endangered fern Microlepia strigosa var. mauiensis
• Other Plantago species are invasive
• Host for recognized pests and pathogens
• Prolific pollen can cause hay fever
• Partial shade tolerance
• Tolerates many soil types
• May form dense stands that can exclude other vegetation
• Produces seeds which are dispersed by adhering to people, animals and equipment
• Self-compatible
• Seeds also dispersed by water and internally by other animals
• Able to reach maturity in 1 year
• Prolific seed production
• Can form a persistence seed bank (seeds viable for 40+ years)
• Can tolerate mowing and resprouts after cutting

Low Risk Traits
• Unarmed (no spines, thorns, or burrs)
• Provides fodder for livestock
• Non-toxic
• Not able to hybridize with other Plantago species
• Herbicides provide effective control