Taxon: Withania somnifera (L.) Dunal **Family:** Solanaceae

Common Name(s): ashwagandha
Indian ginseng
poison gooseberry
winter cherry

Synonym(s): Physalis somnifera L.
Withania kansuensis Kuang & A. M.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 6 Oct 2021

WRA Score: 12.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Perennial Herb, Disturbance Weed, Medicinal, Toxic Properties, Bird-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)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		
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	y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
408	Creates a fire hazard in natural ecosystems		

Qsn #	Question	Answer Option	Answer
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	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
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)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
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**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Long history of cultivation, but no evidence of domestication] "Withania somnifera is of ancient use; it is mentioned in Ayurvedic literature as an important medicine, but it is difficult to ascertain whether the drug then described was Withania somnifera. It is mostly collected from wild stands, but in India it has been cultivated for centuries, mainly in Madhya Pradesh and Rajasthan."

102	Has the species become naturalized where grown?	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	**Notes**
	WRA Specialist. (2021). 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"	High
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 22 Sep 2021]	"Native Africa MACARONESIA: Spain [Canarias] NORTHERN AFRICA: Algeria, Egypt, Tunisia NORTHEAST TROPICAL AFRICA: Ethiopia, Chad EAST TROPICAL AFRICA: Tanzania WEST TROPICAL AFRICA: Mali, Nigeria, Senegal SOUTH TROPICAL AFRICA: Mozambique, Malawi, Zambia, Zimbabwe SOUTHERN AFRICA: Botswana, Lesotho, Eswatini, South Africa WESTERN INDIAN OCEAN: Madagascar, Mauritius, Reunion Asia-Temperate ARABIAN PENINSULA: Saudi Arabia WESTERN ASIA: Lebanon, Turkey CAUCASUS: Georgia Asia-Tropical INDIAN SUBCONTINENT: India [Tamil Nadu] INDO-CHINA: Myanmar (s.), Thailand (n.), Vietnam (s.) MALESIA: Indonesia [Kalimantan] Europe SOUTHEASTERN EUROPE: Greece (incl. Crete), Italy (incl. Sicily) SOUTHWESTERN EUROPE: Spain (incl. Baleares)"

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 22 Sep 2021]	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Broad distribution and elevation range] "The distribution area of Withania somnifera extends from the Canary Islands and the Mediterranean region through Africa, the Middle East, India and Sri Lanka to China. It also occurs in Australia. In Africa it occurs wild or naturalized throughout the drier parts of the continent including South Africa and in several Indian Ocean islands." ... "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude. It is grown in areas with 500–750 mm annual rainfall and prefers well-drained soil; waterlogging is harmful."

204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Sudha, P., & Reni, A. (2016). Ashwagandha. Pp. 19-26 in Ambrose, D. C.P. et al. (Eds.). Leafy Medicinal Herbs. Botany, Chemistry, Postharvest Technology and Uses. CABI, Wallingford, UK	"Ashwagandha is a xerophytic plant that is found mostly in the drier parts of India, Sri Lanka, Afghanistan, Baluchistan and Sind, but it is also distributed in the Mediterranean regions, the Canary Islands of Spain and the Cape of Good Hope in South Africa (Uddin et al., 2012)."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 5 Oct 2021]	"It is cultivated in gardens in the warmer parts of Europe and has become a naturalised weed in South Australia and New South Wales."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"The distribution area of Withania somnifera extends from the Canary Islands and the Mediterranean region through Africa, the Middle East, India and Sri Lanka to China. It also occurs in Australia. In Africa it occurs wild or naturalized throughout the drier parts of the continent including South Africa and in several Indian Ocean islands."
	Hawai'i Seed Growers Network. (2021). Ashwagandha. https://www.hawaiiseedgrowersnetwork.com/product-page/ashwagandha. [Accessed 5 Oct 2021]	Seeds sold for cultivation in the Hawaiian Islands

Qsn #	Question	Answer
301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"In Africa it occurs wild or naturalized throughout the drier parts of the continent including South Africa and in several Indian Ocean islands." ... "Withania somnifera occurs naturally or has become naturalized in many parts of the tropics ."
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 1 Oct 2021]	"It is cultivated in gardens in the warmer parts of Europe and has become a naturalised weed in South Australia and New South Wales."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 1 Oct 2021]	"Naturalized (natzd. elsewhere)"

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 5 Oct 2021]	"Unfortunately it can become a weed in disturbed areas, cultivated lands and overgrazed pasture."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Cotton, Orchards & Plantations, Pastures, Vegetables"
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Grows in disturbed habitats] "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude. "
	WRA Specialist. (2021). Personal Communication	A disturbance weed of cultivated lands, with potential to impact other crops.

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Cultivated, but also occurring in disturbed habitats and on cultivated land, potentially as a crop weed] "Withania somnifera is of ancient use; it is mentioned in Ayurvedic literature as an important medicine, but it is difficult to ascertain whether the drug then described was Withania somnifera. It is mostly collected from wild stands, but in India it has been cultivated for centuries, mainly in Madhya Pradesh and Rajasthan." ... "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Identified as a weed of crops, but impacts not quantified] "Weed of: Cereals, Cotton, Orchards & Plantations, Pastures, Vegetables"

Qsn #	Question	Answer
304	**Environmental weed**	**n**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence. Classified as a disturbance and/or weed of cultivated lands.

305	**Congeneric weed**	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Withania coagulans, Withania obtusifolia and Withania qaraitica are potential weeds of crops or disturbed sites. Impacts unverified

401	**Produces spines, thorns or burrs**	**n**
	Source(s)	**Notes**
	Wu, Z. Y. & P. H. Raven, (eds). (1994). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.	[No evidence] "Herbs perennial, 30–150 cm tall, pubescent with dendritic hairs. Stems woody proximally, erect or reclining, branched, tomentose. Petiole 1–2 cm; leaf blade ovate, obovate, or oblong, 2.5–12 × 2–7 cm, glabrescent adaxially except along midvein, pubescent abaxially, base cuneate, apex acute. Inflorescences subsessile clusters of 4–6 flowers; peduncle obsolete. Pedicel ca. 5 mm. Calyx campanulate, 3–5 mm, tomentose; lobes deltate, 1–2 mm. Corolla yellowish green, narrowly campanulate, 5–8 mm, tomentose at throat; lobes ovate, spreading or recurving, 2–2.5 mm. Filaments ca. 1.8 mm; anthers yellow, ovoid, ca. 1 mm, minutely apiculate. Style exserted. Fruiting calyx becoming brown and translucent, globose or ovoid, truncate at base, 1–2.2 cm; lobes short, somewhat urceolate. Berry shiny, scarlet, globose, 5–8 mm. Seeds drying pale brown, reniformdiscoid, 2–2.5 × 2 mm."

402	**Allelopathic**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Hayyat, M. S. et al. (2020). Allelopathy of waste-land weeds: A review. International Journal of Botany Studies, 5(3), 97-02	[Potentially yes. Extracts demonstrate allelopathic activity] "Javaid et al. (2009) [37] conducted an experiment to determine the herbicidal effect of medicinal plant Withania somnifera and Datura alba nees against the Rumex dentatus L. one of the problematics weeds of wheat in Pakistan result showed that germination of Rumex dentatus was less susceptible but root growth was highly susceptible to all aqueous extract. Application of extracts caused 68 percent reduction of germination, 62 percent shoot length, 96 percent in root length and 68 percent seedling biomass. The experiment was conducted to evaluate the allelopathic effect of hydroalcohlic extract of Withania somnifera L. on germination and radical growth of Cicer arietinum L. and Triticum aestivum L. seeds. The extract at different concentrations was incubated in controlled conditions with the surface sterilized seeds of C. arietinum and T. aestivum and observed periodically for seed germination and radicle growth to assess the allelopathic behavior. Extract of different concentration were applied mainly the higher concentration were showed significantly inhibit the seedling germination and radical elongation of testing species. T. aestivum was found to be a more sensitive compared with Cicer arietinum L. (Chandra et al., 2012) [13]. Alam and Azmi (1989) [2] conducted an experiment to evaluate the inhibitory effect of Withania somnifera L., Abutilon indicum L., Antigonon leptopus L., Prosopis glandulosa L. against wheat cultivar. Results show there was no inhibitory effect of plants residues on seed germination. P. glandulosa residues show inhibitory effect on shoot and root growth. Root growth was more sensitive compared with shoot growth. W.somnifera, A. leptopus and A. indicum residues show similar inhibitory effect on seedling growth of T.aestivum."

403	Parasitic	n
	Source(s)	**Notes**
	Wu, Z. Y. & P. H. Raven, (eds). (1994). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.	"Herbs perennial, 30–150 cm tall, pubescent with dendritic hairs. Stems woody proximally, erect or reclining, branched, tomentose." [Solanaceae. No evidence]

404	Unpalatable to grazing animals	y
	Source(s)	**Notes**
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"ungrazed and unpalatable"

405	Toxic to animals	
	Source(s)	**Notes**
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Possibly, although animals may avoid plant and minimize risk of poisoning] "ungrazed and unpalatable" ... "Poisoning due to seeds."

Qsn #	Question	Answer
	Plants for a Future. (2021). Withania somnifera. https://pfaf.org/User/Plant.aspx?LatinName=Withania+somnifera. [Accessed 5 Oct 2021]	[Potentially. Toxicity reported for humans if used medicinally] "The plant is toxic if eaten[238]. Can induce dependence [301]. May decrease the effectiveness of allopathic immunosuppressant drugs. Avoid with sleeping tablets (barbiturates) [301]."

406	Host for recognized pests and pathogens	n
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Diseases and pests No serious diseases or pests have been reported. Damping off and root rot of young plants caused by Fusarium solani can be controlled by seed treatment or fungicide application."

407	Causes allergies or is otherwise toxic to humans	y
	Source(s)	**Notes**
	Plants for a Future. (2021). Withania somnifera. https://pfaf.org/User/Plant.aspx?LatinName=Withania+somnifera. [Accessed 5 Oct 2021]	"Known Hazards - The plant is toxic if eaten[238]. Can induce dependence [301]. May decrease the effectiveness of allopathic immunosuppressant drugs. Avoid with sleeping tablets (barbiturates) [301]."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Poisoning due to seeds."
	Iwu, M.M. 2014. Handbook of African Medicinal Plants, Second Edition. CRC Press, Boca Raton, FL	"Toxicity — No serious effects or toxicity have been attributed to the consumption of Withania. The plant is regarded in India as a general tonic and a casual adaptogen, with ginseng-like activities. In Sri Lanka, an extract of the plant has been reported to have caused marked lesions in feeding experiments with rats."

408	Creates a fire hazard in natural ecosystems	
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Unknown, but not described as a highly flammable species] "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude. It is grown in areas with 500–750 mm annual rainfall and prefers well-drained soil; waterlogging is harmful"

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Hawai'i Seed Growers Network. (2021). Ashwagandha. https://www.hawaiiseedgrowersnetwork.com/product-page/ashwagandha. [Accessed 5 Oct 2021]	"Full Sun"
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"It thrives in full sun, but tolerates some shade."

Qsn #	Question	Answer
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**n**
	Source(s)	**Notes**
	Plants for a Future. (2021). Withania somnifera. https://pfaf.org/User/Plant.aspx?LatinName=Withania+somnifera. [Accessed 5 Oct 2021]	"A fairly easily grown plant, it requires a warm sheltered position in full sun and a well-drained moderately fertile soil[169, K]. Prefers a dry stony soil[238]."
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 5 Oct 2021]	"Soil type: Loam"
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude. It is grown in areas with 500–750 mm annual rainfall and prefers well-drained soil; waterlogging is harmful. It grows well in sandy loams and stony red clay soils with pH 7.5–8."

411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Wu, Z. Y. & P. H. Raven, (eds). (1994). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.	"Herbs perennial, 30–150 cm tall, pubescent with dendritic hairs. Stems woody proximally, erect or reclining, branched, tomentose."

412	**Forms dense thickets**	**n**
	Source(s)	**Notes**
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 5 Oct 2021]	[No evidence. Sometimes weedy] "Withania somnifera is widespread but not common in all provinces of South Africa and also Namibia, Botswana, Swaziland and Lesotho. It is, however, absent from the western halves of the Northern and Western Cape Provinces. It grows in a large number of vegetation types in dry areas to areas with a fairly high rainfall such as coastal vegetation, grassland (also on termite mounds), karoo, savanna, scrubland, woodland, often in margins of forests and thickets, also near water, such as on river banks. It is found in light shade as well as full sun, often among rocks where the roots are kept cool. Unfortunately it can become a weed in disturbed areas, cultivated lands and overgrazed pasture."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[No evidence] "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude. It is grown in areas with 500–750 mm annual rainfall and prefers well-drained soil; waterlogging is harmful."

Qsn #	Question	Answer
501	**Aquatic**	**n**
	Source(s)	**Notes**
	Sudha, P., & Reni, A. (2016). Ashwagandha. Pp. 19-26 in Ambrose, D. C.P. et al. (Eds.). Leafy Medicinal Herbs. Botany, Chemistry, Postharvest Technology and Uses. CABI, Wallingford, UK	[Terrestrial] "Ashwagandha is a xerophytic plant that is found mostly in the drier parts of India, Sri Lanka, Afghanistan, Baluchistan and Sind, but it is also distributed in the Mediterranean regions, the Canary Islands of Spain and the Cape of Good Hope in South Africa (Uddin et al., 2012)."

502	Grass	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 1 Oct 2021]	Family: Solanaceae Subfamily: Solanoideae Tribe: Physaleae Subtribe: Withaninae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 1 Oct 2021]	Family: Solanaceae Subfamily: Solanoideae Tribe: Physaleae Subtribe: Withaninae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Wu, Z. Y. & P. H. Raven, (eds). (1994). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.	"Herbs perennial, 30–150 cm tall, pubescent with dendritic hairs. Stems woody proximally, erect or reclining, branched, tomentose."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Withania somnifera occurs naturally or has become naturalized in many parts of the tropics. Although it is nowhere common, it is unlikely to be liable to genetic erosion. The Regional Research Laboratory of the Indian Council of Agricultural Research (ICAR), Jammu Tawi, India maintains a collection of germplasm."
	Sudha, P., & Reni, A. (2016). Ashwagandha. Pp. 19-26 in Ambrose, D. C.P. et al. (Eds.). Leafy Medicinal Herbs. Botany, Chemistry, Postharvest Technology and Uses. CABI, Wallingford, UK	[No evidence] "Ashwagandha is a xerophytic plant that is found mostly in the drier parts of India, Sri Lanka, Afghanistan, Baluchistan and Sind, but it is also distributed in the Mediterranean regions, the Canary Islands of Spain and the Cape of Good Hope in South Africa (Uddin et al., 2012)."

Qsn #	Question	Answer
602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Withania somnifera is propagated by seed, either sown in a nursery or directly in the field."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Kadereit, J.W. & Bittrich, V. (eds.). (2016). The Families and Genera of Vascular Plants. Volume XIV. Flowering Plants. Eudicots: Aquifoliales, Boraginales, Bruniales, Dipsacales, Escalloniales, Garryales, Paracryphiales, Solanales (except Convolvulaceae), Icacinaceae, Metteniusaceae, Vahliaceae. Springer International Publishing, Switzerland	[Unknown. No evidence found] "Almost 20 Old World spp. The taxonomy and phylogeny of the genus need clarification."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Kaul, M. K., Kumar, A., & Sharma, A. (2005). Reproductive biology of Withania somnifera (L.) Dunal. Current Science, 88(9), 1375–1377	"The manual-pollination experiments revealed predominant self-compatible nature of the species (Table 2). Autogamy and open pollination resulted in high fruit/seed set (81.83% ± 1.94 and 86.66% ± 1.74; 83.10% ± 3.90 and 87 .30% ± 3.08 respectively)."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Kaul, M. K., Kumar, A., & Sharma, A. (2005). Reproductive biology of Withania somnifera (L.) Dunal. Current Science, 88(9), 1375–1377	[Mostly selfing, but some insect facilitated cross-pollination may occur] "The species bears scentless flowers with unattractive colour. Nevertheless, the flowers are visited by Apis dorsata, Apis florea, butterflies and some species of flies." ... "The behaviour of insects on flowers and the insignificant pollen load carried by them further reduce the chances for cross-pollination. Similarly, seed-set percentages in autogamy and controlled cross-pollination (Table 2) also rule out any significant contribution of insects in the pollination of the species. Nevertheless, theoretically, the probability of a small degree of cross-pollination cannot be ruled out due to insect visits."

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Withania somnifera is propagated by seed, either sown in a nursery or directly in the field."

607	Minimum generative time (years)	1
	Source(s)	**Notes**

Qsn #	Question	Answer
	Hawai'i Seed Growers Network. (2021). Ashwagandha. https://www.hawaiiseedgrowersnetwork.com/product-page/ashwagandha. [Accessed 5 Oct 2021]	"Days to Maturity: 365"
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"In India Withania somnifera is grown as an annual."
	Plants for a Future. (2021). Withania somnifera. https://pfaf.org/User/Plant.aspx?LatinName=Withania+somnifera. [Accessed 5 Oct 2021]	"This species is not hardy in temperate climates but it can be grown as an annual, flowering and fruiting in its first year from seed[169]."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Occurs along roadsides. Seeds small but lack means of attachment. Could be moved in soil sticking to footwear, vehicles or equipment] " Seeds lens-shaped to kidney-shaped, 2–2.5 mm × 1.5–2 mm, orange, bright red or pale brown, reticulately wrinkled." ... "Withania somnifera occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea-level up to 2300 m altitude."

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Hawai'i Seed Growers Network. (2021). Ashwagandha. https://www.hawaiiseedgrowersnetwork.com/product-page/ashwagandha. [Accessed 5 Oct 2021]	Seeds sold for cultivation in the Hawaiian Islands

703	**Propagules likely to disperse as a produce contaminant**	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Classified as a contaminant. Unable to verify, but presence as a crop weed suggests seeds may be inadvertently transported due to agricultural activities] "Major Pathway/s: Contaminant, Crop, Herbal, Ornamental"

704	**Propagules adapted to wind dispersal**	**y**
	Source(s)	**Notes**
	Leistner, O. A. (1996). The subcanopy flora in the dynamics of the Kalahari Thornveld. In The Biodiversity of African Plants (pp. 163-179). Springer, Dordrecht	"Table 1. The 40 most common subcanopy species, recorded in 129 survey sites by I.P.H. Acocks (unpublished notes)," [Withania somnifera - Seed dispersal: B = birds, Vi = ingested by vertebrates, W = wind]

Qsn #	Question	Answer
	Alfarhan, A. H. (2002). Dispersal mechanisms of flowering plants in the Central Region of Saudi Arabia. JKAU: Met., Env. & Arid Land Agric. Sci, 13, 17-39	[A percentage of seeds may be locally wind-dispersed] "Jactitation is the term used by Ridley (1930) for the process by which seeds are dispersed due to shaking of the plant by wind. In species like Matricaria au- rea, Trigonella hamosa, Diplotaxis harra, Portulaca oleracea, Datura innoxia, Withania somnifera, Reseda muricata, Scrophularia deserti, etc., more than 80% of the seeds will remain attached to the wall of the dehisced fruits. These seeds are gradually ejected as the plant is shaken during windy days. The fallen seeds remain at the base of the mother plant and, often, compete among themselves, unless some of the seeds are washed away by rainwater."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Flesh-fruited] "Fruit a pendulous, globose berry 5–7 mm in diameter, orange to red, many-seeded, enclosed by persistent, membranous to papery calyx 10–24 mm × 8–17 mm, somewhat 5-angled, brownish. Seeds lens-shaped to kidney-shaped, 2–2.5 mm × 1.5–2 mm, orange, bright red or pale brown, reticulately wrinkled."

705	Propagules water dispersed	
	Source(s)	**Notes**
	Alfarhan, A. H. (2002). Dispersal mechanisms of flowering plants in the Central Region of Saudi Arabia. JKAU: Met., Env. & Arid Land Agric. Sci, 13, 17-39	[Possibly] "Jactitation is the term used by Ridley (1930) for the process by which seeds are dispersed due to shaking of the plant by wind. In species like Matricaria aurea, Trigonella hamosa, Diplotaxis harra, Portulaca oleracea, Datura innoxia, Withania somnifera, Reseda muricata, Scrophularia deserti, etc., more than 80% of the seeds will remain attached to the wall of the dehisced fruits. These seeds are gradually ejected as the plant is shaken during windy days. The fallen seeds remain at the base of the mother plant and, often, compete among themselves, unless some of the seeds are washed away by rainwater."

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Leistner, O. A. (1996). The subcanopy flora in the dynamics of the Kalahari Thornveld. In The Biodiversity of African Plants (pp. 163-179). Springer, Dordrecht	"Table 1. The 40 most common subcanopy species, recorded in 129 survey sites by I.P.H. Acocks (unpublished notes)," [Withania somnifera - Seed dispersal: B = birds, Vi = ingested by vertebrates, W = wind]
	Welman, M. (2011). Withania somnifera. PlantZAfrica. SANBI. http://pza.sanbi.org/withania-somnifera. [Accessed 5 Oct 2021]	"The fruit is relished by birds."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Flesh-fruited] "Fruit a pendulous, globose berry 5–7 mm in diameter, orange to red, many-seeded, enclosed by persistent, membranous to papery calyx 10–24 mm × 8–17 mm, somewhat 5-angled, brownish. Seeds lens-shaped to kidney-shaped, 2–2.5 mm × 1.5–2 mm, orange, bright red or pale brown, reticulately wrinkled."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Leistner, O. A. (1996). The subcanopy flora in the dynamics of the Kalahari Thornveld. In The Biodiversity of African Plants (pp. 163-179). Springer, Dordrecht	"Table 1. The 40 most common subcanopy species, recorded in 129 survey sites by I.P.H. Acocks (unpublished notes)," [Withania somnifera - Seed dispersal: B = birds, Vi = ingested by vertebrates, W = wind]

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Presumably Yes] "Fruit a pendulous, globose berry 5–7 mm in diameter, orange to red, many-seeded, enclosed by persistent, membranous to papery calyx 10–24 mm × 8–17 mm, somewhat 5-angled, brownish. Seeds lens-shaped to kidney-shaped, 2–2.5 mm × 1.5–2 mm, orange, bright red or pale brown, reticulately wrinkled."
	Leistner, O. A. (1996). The subcanopy flora in the dynamics of the Kalahari Thornveld. In The Biodiversity of African Plants (pp. 163-179). Springer, Dordrecht	[Presumably Yes] "Table 1. The 40 most common subcanopy species, recorded in 129 survey sites by I.P.H. Acocks (unpublished notes)," [Withania somnifera - Seed dispersal: B = birds, Vi = ingested by vertebrates, W = wind]

801	Prolific seed production (>1000/m2)	
	Source(s)	**Notes**
	Shrivastava, A. K., Upadhyay, V. B., Gautam, D. S., Sarvade, S., & Sahu, R. K. (2018). Effect of integrated nutrient management on growth and productivity of Withania somnifera (L.) Dunal in Kymore Plateau and Satpura hills of Madhya Pradesh, India. Archives of Agriculture and Environmental Science, 3(2), 202-208	[Mean number of seeds per plant may range from 2,249.9 to 5,976.6. Soil seed densities could therefore hypothetically exceed 1000 m-2] "The mean number of berries per plant of W. somnifera varied from 16.98 to 30.78 under different nutrient treatments (Table 1)." ... "The mean number of seeds per berry of W. somnifera was ranged between 132.50 to 194.17 under different treatments (Table 1)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	**Notes**
	Khanna, P. K., Kumar, A., Chandra, R., & Verma, V. (2013). Germination behaviour of seeds of Withania somnifera (L.) Dunal: a high value medicinal plant. Physiology and Molecular Biology of Plants, 19(3), 449-454	"In Withania somnifera there are short-lived seeds, whose longevity is about 12 months. The short-lived seeds can be classified into two types by their physiological characteristics in shortage- one endures dry conditions and the other type- such as recalcitrant seeds loses viability during desiccation. Our results have shown that Withania somnifera fits in first type as evidenced by its natural preference to grow in dry conditions."

Qsn #	Question	Answer
	Parmar, Y. S. (2018). Effect of seed storage conditions on seed germination and vigor of Withania somnifera. Journal of Pharmacognosy and Phytochemistry, 7(6), 1409 -1413	[Germination not observed in seeds stored for 10 months] "The present communication describes seed germination behaviour of Withania somnifera, a commercial medicinal herb, under different storage conditions viz; temperature and duration. Seeds stored for 2 months showed significantly lower germination percentage (44.0% - 58.0%) indicating the requirement of after-ripening after the harvest. Maximum germination percentage (99.0%), emergence index (0.41), germination energy (7.09), germination speed (18.61) and seedling vigour index I (619.76) & II (66.09) were observed in seeds stored at 00C for 4 months. Similarly, earliest onset and completion of germination and minimum mean germination time to germinate was also observed in seeds stored at 00C for 4 months. However, germination was not observed in seeds stored for 10 months at either of the temperatures."
	Lyaruu, H. V. M. (2008). Seed longevity of dominant plant species from degraded savanna in semi-arid Tanzania. Tanzania Journal of Science, 34(1): 11-20	[Roughly half of seeds lose viability in 187 days] "Since it is assumed that seeds buried under natural conditions exhibit exponential decay in the soil, the parameter half-life quantifies the time required by viable seeds of any species to be reduced by half their original numbers. Species with persistent seed banks are associated with very low decay constants." [Table 2: Withania somnifera - Half life days = 187]

803	Well controlled by herbicides	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	Unknown

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	**Notes**
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Possibly not. A perennial, but whole plants harvested in cultivation, rather than cut back and regrown] "In India cultivated plants start flowering in December and the crop is ready for harvesting in January–March, about 6 months after sowing when leaves start to wilt and fruits are ripe. Whole plants are uprooted and roots are cut from the plant about 2 cm above the collar."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	NA

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad distribution and elevation range
• Thrives, and able to spread, in regions with tropical climates
• Naturalized in South Australia and New South Wales, parts of Africa and islands of the Indian Ocean, and potentially elsewhere (but not in the Hawaiian Islands to date)
• A weed of disturbed areas, cultivated lands and overgrazed pasture, which may negatively impact agricultural crops
• Unpalatable to grazing animals
• Potentially toxic to humans and animals if eaten
• Reproduces by bird, and wind-dispersed seeds
• Self-compatible
• Reaches maturity in in its first year from seed
• In addition to birds, and wind, seeds may be dispersed by water and intentionally cultivated by people
• Prolific seed production

Low Risk Traits
• Despite naturalization and reports of weediness, also intentionally cultivated as a medicinal plant
• Unarmed (no spines, thorns, or burrs)
• Grows in full sun to part shade (dense shade may inhibit spread)
• Not reported to spread vegetatively
• Short-lived seeds lose viability in about 12 months (should not form a persistent seed bank)