

**Taxon:** *Gymnanthemum amygdalinum* (Delile) Sch. Bip. **Family:** Asteraceae  
**Common Name(s):** bitterleaf **Synonym(s):** *Vernonia amygdalina* Delile

**Assessor:** Chuck Chimera **Status:** Assessor Approved **End Date:** 9 Jun 2020  
**WRA Score:** 7.0 **Designation:** H(HPWRA) **Rating:** High Risk

**Keywords:** Tropical Tree, Naturalized Elsewhere, Edible Leaves, Wind-Dispersed, Coppices

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	?
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)	n
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	y=1, n=0	n
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		
407	Causes allergies or is otherwise toxic to humans		
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

Qsn #	Question	Answer Option	Answer
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		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	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	y
801	Prolific seed production (>1000/m <sup>2</sup> )	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	[No evidence of domestication] "No cultivar research or any breeding activities take place at the official research centres, although farmers make and maintain their own selections."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2020). 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. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 5 Jun 2020]	"Native Africa NORTHEAST TROPICAL AFRICA: Eritrea, Ethiopia, Sudan EAST TROPICAL AFRICA: Kenya, Tanzania, Uganda WEST-CENTRAL TROPICAL AFRICA: Cameroon, Democratic Republic of the Congo, Equatorial Guinea WEST TROPICAL AFRICA: Benin, Cote D'Ivoire, Ghana, Guinea, Liberia, Mali, Nigeria, Sierra Leone SOUTH TROPICAL AFRICA: Angola, Malawi, Mozambique, Zambia, Zimbabwe SOUTHERN AFRICA: Botswana, Eswatini, South Africa [KwaZulu-Natal, Limpopo, Mpumalanga] Asia-Temperate ARABIAN PENINSULA: Yemen"

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 5 Jun 2020]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R. & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/">http://www.worldagroforestry.org/</a> . [Accessed 5 Jun 2020]	"Altitude: (min. 600) 1250-2800 m, Mean annual rainfall: 750-2000 mm"
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	" <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude." [Elevation range in tropics exceeds 1000 m, demonstrating some environmental versatility]

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	" <i>Vernonia amygdalina</i> occurs wild in most countries of tropical Africa, from Guinea east to Somalia and south to north-eastern South Africa, and in Yemen. It is commonly grown as a vegetable in Benin, Nigeria, Cameroon, Gabon and DR Congo, and to a lesser extent in their neighbouring countries. The Luhya people in western Kenya use <i>Vernonia amygdalina</i> as a vegetable, but do not cultivate it."

205	Does the species have a history of repeated introductions outside its natural range?	?
	Source(s)	Notes
	Dave's Garden. (2020). <i>Gymnanthemum</i> Species, African Bitterleaf - <i>Gymnanthemum amygdalinum</i> . <a href="https://davesgarden.com/guides/pf/go/221062/">https://davesgarden.com/guides/pf/go/221062/</a> . [Accessed 8 Jun 2020]	"This plant has been said to grow in the following regions: Birmingham, Alabama"
	Iwu, M.M. 2014. Handbook of African Medicinal Plants, Second Edition. CRC Press, Boca Raton, FL	[Cultivated within native range] "The plant grows in coastal savanna, but it is often cultivated in many parts of the continent as an edible vegetable. It is distributed from Sudan in the north to southern Africa."
	WRA Specialist. (2020). Personal Communication	Most cultivation appears to occur within native range, but there are a number of websites that suggest its availability may be increasing as a novelty crop

Qsn #	Question	Answer
301	<b>Naturalized beyond native range</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Swamy, J., Prabhakar, G., Rasingam, L., & Kamalakar, P. (2015). <i>Gymnanthemum amygdalinum</i> (Asteraceae)-A New Addition to the Flora of Peninsular India. <i>International Journal of Advanced Research in Science and Technology</i> , 4(7), 449-451	"During a short visit to the Sriramagiri forests of Warangal district, the authors have collected a <i>Gymnanthemum</i> species in flowering and fruiting, which was later identified as <i>G. amygdalinum</i> . Scrutiny of literatures revealed that this species has been so far reported from Bihar, Madhya Pradesh, Odisha and West Bengal of North India (Bhattacharjee et al. 2013) and not from South India. Hence, it is reported here as a new addition to the flora of Peninsular India."
	Bhattacharjee, B., Lakshminarasimhan, P., Bhattacharjee, A., Agrawala, D. K., & Pathak, M. K. (2013). <i>Vernonia amygdalina</i> Delile (Asteraceae)—An African medicinal plant introduced in India. <i>Zoo's Print</i> , 28(5), 18-20	"During the revisionary study of the tribe Vernonieae for 'Flora of India' by one of us (BB) and on the basis of different collections from Bihar (Bhagalpur), Odisha (Jokhipali), West Bengal (Howrah) it has been found that 'African bitter leaf' is now being cultivated as well as found to grow as an escape from cultivation in different parts of Central and Eastern India, at least for more than a decade, where some local people are consuming its leaves as herbal remedy for diabetes."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	[Reported as a weed of crops within native range, but no evidence of naturalization] "References: Ghana-A-2064, Ethiopia-ZD- 1437, Cameroon-A-1867."
	Imada, C. (2019). <i>Hawaiian Naturalized Vascular Plants Checklist</i> (February 2019 update). Bishop Museum Technical Report 69. Bishop Museum, Honolulu, HI	No evidence

302	<b>Garden/amenity/disturbance weed</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed ]	[Establishes in disturbed sites and may impact agriculture] " <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude. It often occurs in disturbed localities such as abandoned farmland, and can be found growing spontaneously in secondary forest."

303	<b>Agricultural/forestry/horticultural weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Ndam, L. M., Enang, J. E., Mih, A. M., & Egbe, A. E. (2014). Weed diversity in maize ( <i>Zea mays</i> L.) fields in South Western Cameroon. <i>International Journal of Current Microbiology and Applied Sciences</i> , 3(11), 173-180	"Table.1 Diversity of weed species associated with maize production in South West region of Cameroon" [Includes <i>Vernonia amygdalina</i> . No impacts specified]
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations"

Qsn #	Question	Answer
	Essandoh, P. K., Armah, F. A., Odoi, J. O., Yawson, D. O., & Afrifa, E. K. (2011). Floristic composition and abundance of weeds in an oil palm plantation in Ghana. <i>ARPN Journal of Agricultural and Biological Science</i> , 6(1), 20-31	[Classified as a weed of palm plantations, but no impacts are identified] "The weed flora in an oil palm plantation situated in a semi-deciduous forest zone in Central Region of Ghana was assessed to identify the weeds and evaluate their abundance. The comprehensive stock of weeds obtained was analysed to determine the relative abundance of taxa and life forms. One hundred and thirty six weed species belonging to 33 dicot families, 3 monocot families and 8 families of Pteridophyta were identified. The weed families derived from seven subclasses; the most diverse of the dicots were the Rosidae and Asteridae. The monocots present were from the Commelinidae. Eight plant life forms were identified; the most diverse were the herbs, which consisted of 79 species and 56 genera; and the shrubs which consisted of 32 species and 26 genera. In terms of abundance and distribution, weeds of Poaceae and Asteraceae were found to be far more invasive. <i>Chromolaena odorata</i> , <i>Aspilia africana</i> and <i>Melanthera scandens</i> of the Asteraceae, <i>Panicum maximum</i> and <i>Imperata cylindrica</i> of the Poaceae and <i>Mallotus oppositifolius</i> of the Euphorbiaceae were widespread and problematic. The diversity of weed species was high in the oil palm plantation."

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations"

305	Congeneric weed	n
	Source(s)	Notes
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	Potentially. A number of <i>Vernonia</i> species are designated as weeds, but no <i>Gymnanthemum</i> species are listed.

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	[No evidence] "Shrub or small tree up to 10 m tall, much branched; trunk up to 40 cm in diameter; bark grey to brown, smooth, becoming fissured; young branches densely pubescent. Leaves alternate, simple; stipules absent; petiole 0.2–4 cm long; blade ovate-elliptical to lanceolate, 4–15(–28) cm × 1–4(–15) cm, cuneate or rounded at base, shortly acuminate at apex, margin minutely toothed to coarsely serrate, finely pubescent but often glabrescent, pinnately veined."

402	Allelopathic	n
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Bassey, C. S., &amp; Okoi, E. P. (2018). Comparative evaluation of the allelopathic effects of the leaf extracts of three Asteraceae species (<i>Ageratum conyzoides</i>, <i>Vernonia amygdalina</i>, <i>Artemisia annua</i>). <i>Archives of Current Research International</i>, 15(3): 1-8</p>	<p>[Enhances <i>Lactuca sativa</i> seed germination, root elongation and plant height, in contrast to other species which inhibit these same parameters.] "Search for an alternative to chemical herbicides have prompted researchers to investigate the allelopathic potential of plants, which would serve as a remedy for contamination of soil, water bodies and crops products with toxic chemical residues derived from using synthetic herbicides. The allelopathic effects of the aqueous leaf extracts of <i>Ageratum conyzoides</i>, <i>Vernonia amygdalina</i> and <i>Artemisia annua</i> at 0.05, 0.1, 0.2 and 0.5 (part per volume) concentrations were evaluated on seed germination, root length and height of seedlings of <i>Lactuca sativa</i> after 28 days in vitro. Results obtained showed significant differences <math>P=[0.5]</math> among the different concentrations of aqueous leaf extracts used when compared with the control in all the three parameters studied. Significant reduction in seed germination, growth of root and height of seedlings were observed in all the treatments but at varying levels from moderate to severe effects for aqueous leaf extract of <i>A. conyzoides</i> and <i>A. annua</i> respectively, while on the contrary, aqueous extracts of <i>V. amygdalina</i> enhanced seed germination, root elongation and plant height. Cytological studies conducted to observe the mitotic behaviour of cells in root tips obtained from highest concentration of the leaf extracts indicated that aqueous leaf extracts of <i>A. conyzoides</i> and <i>A. annua</i> lowered the mitotic index of cells in root tips of <i>Lactuca sativa</i> while that of <i>V. amygdalina</i> greatly increased the mitotic index of cells in the root tips when compared with the control. For the number of dividing cells, Ttest showed significance <math>P=[0.001]</math> only in aqueous leaf extract of <i>A. conyzoides</i>. ... "However, despite the non significance of the allelopathic effect of <i>V. amygdalina</i> leaf extract on all the parameters under study, its ability to enhance growth of treated seedlings shows that it can be utilised to develop ecofriendly, cheap and effective green growth promoter."</p>

403	Parasitic	n
	Source(s)	Notes
	<p>Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. &amp; Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a>. [Accessed 5 Jun 2020]</p>	<p>"Shrub or small tree up to 10 m tall, much branched; trunk up to 40 cm in diameter" [Asteraceae. No evidence]</p>

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	<p>Orwa C., Mutua, A., Kindt R., Jamnadass, R., &amp; Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0</i>. <a href="http://www.worldagroforestry.org">http://www.worldagroforestry.org</a>. [Accessed 5 Jun 2020]</p>	<p>"Fodder: Produces a large mass of forage from the leaves and shoots and therefore is a good fodder species."</p>

405	Toxic to animals	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org">http://www.worldagroforestry.org</a> . [Accessed ]	[No evidence] "Fodder: Produces a large mass of forage from the leaves and shoots and therefore is a good fodder species."

406	Host for recognized pests and pathogens	
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"Apart from a leaf curl virus, there are no major diseases that affect production. Pests do not cause major damage either, although many pest species have been recorded on bitterleaf in northern Nigeria. They include thrips, aphids, ants, white fly, <i>Empoasa</i> spp., <i>Sphearocoris annulus</i> , <i>Fabricius</i> spp., <i>Ptyelus grossus</i> , <i>Polyclaeis</i> spp. and <i>Xanthochelus vulneratus</i> . As a remedy, people traditionally sprinkle wood ash on the leaves to keep ants and aphids away. The bitterleaf weevil <i>Lixus camerunus</i> may damage stems and branches by making tunnels, causing branches to break."

407	Causes allergies or is otherwise toxic to humans	
	<b>Source(s)</b>	<b>Notes</b>
	Plants for a Future. (2020). <i>Gymnanthemum amygdalinum</i> . <a href="https://pfaf.org">https://pfaf.org</a> . [Accessed 5 Jun 2020]	"Known Hazards - None known"
	Iwu, M.M. 2014. Handbook of African Medicinal Plants, Second Edition. CRC Press, Boca Raton, FL	" <i>Vernonia amygdalina</i> is consumed throughout West and Central Africa as a vegetable and is generally considered nontoxic, but excessive consumption of the leaves is purgative."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Toxic roots, unlikely to poison humans. Leaves typically consumed] "Root very poisonous, abortifacient, hypotensive. Young branches as chewing stick. Leaves and stem bark tonic, pectoral, stomachic, febrifuge, antiseptic, for cough. Leaves for gastrointestinal disorders; leaves chewed against snakebite; leaves decoction for anorexia, cough, malaria, fevers, acute pain, piles, ringworm, venereal diseases. Bark pounded together with other plants to make an arrow poison."

408	Creates a fire hazard in natural ecosystems	n
	<b>Source(s)</b>	<b>Notes</b>
	Nangendo, G., Stein, A., Gelens, M., de Gier, A., & Albricht, R. (2002). Quantifying differences in biodiversity between a tropical forest area and a grassland area subject to traditional burning. <i>Forest Ecology and Management</i> , 164 (1-3), 109-120	[Killed, but regenerates rapidly following fire. No indication that it increases fire risk] "The western part of the area (i.e. the area west of the corridor) and the isolated part in the south are currently burned on an annual basis. These parts are dominated by tree species such as <i>Combretum collinum</i> , <i>Acacia hockii</i> , <i>Acacia seyal</i> , <i>Terminalia glaucescens</i> and <i>Annona senegalensis</i> , which have characteristics that protect them from fire, such as thick bark. These parts also contain many saplings and seedlings of <i>Vernonia amygdalina</i> , a species easily destroyed by fire, but with the capacity to regenerate rapidly."



Qsn #	Question	Answer
409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"It often occurs in disturbed localities such as abandoned farmland, and can be found growing spontaneously in secondary forest. It requires full sunlight in cultivation."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"It prefers a humid environment although it is fairly drought tolerant. It can be found on all soil types, but performs best in humus-rich soils."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"Shrub or small tree up to 10 m tall, much branched; trunk up to 40 cm in diameter"

412	Forms dense thickets	n
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org">http://www.worldagroforestry.org</a> . [Accessed 8 Jun 2020]	[Forms clumps, but no evidence of dense stand formation] "Afro-montane rainforest, undifferentiated afro-montane forest (broadleaved forest, mixed Podocarpus forest) and dry single-dominant afro-montane forest ( <i>Juniperus</i> and <i>Juniperus-Olea</i> ); also in secondary montane evergreen bushland and sometimes forming clumps in upland wooded grassland. Elsewhere also in lowland humid rangeland, savannah and riverine fringes, often associated with termite mounds."
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 8 Jun 2020]	[No evidence] " <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude. It often occurs in disturbed localities such as abandoned farmland, and can be found growing spontaneously in secondary forest. It requires full sunlight in cultivation."

501	Aquatic	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	[Terrestrial] " <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude."

502	Grass	n
	<b>Source(s)</b>	<b>Notes</b>
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 5 Jun 2020]	Family: Asteraceae (alt.Compositae) Subfamily: Cichorioideae Tribe: Vernonieae Subtribe: Gymnantheminae

503	Nitrogen fixing woody plant	n
	<b>Source(s)</b>	<b>Notes</b>
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. <a href="https://npgsweb.ars-grin.gov/">https://npgsweb.ars-grin.gov/</a> . [Accessed 5 Jun 2020]	Family: Asteraceae (alt.Compositae) Subfamily: Cichorioideae Tribe: Vernonieae Subtribe: Gymnantheminae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"Shrub or small tree up to 10 m tall, much branched; trunk up to 40 cm in diameter; bark grey to brown, smooth, becoming fissured; young branches densely pubescent."

601	Evidence of substantial reproductive failure in native habitat	n
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	[No evidence] "No germplasm collections of <i>Vernonia amygdalina</i> are known to exist. The plant grows in many African countries and under different conditions, so that there is probably ample diversity for plant breeders to select from. As commercial cultivars are not yet used, there is no threat yet of genetic erosion."

602	Produces viable seed	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	"Propagation is possible by seed, but most farmers use stem cuttings." ... "Seed may be collected from dry flower heads. It is broadcast on nursery beds prepared of humus-rich soil and shaded from excessive heat and sunlight. Seed takes 2–3 weeks to germinate."

603	Hybridizes naturally	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2020). Personal Communication	Unknown. No evidence found

604	Self-compatible or apomictic	
	<b>Source(s)</b>	<b>Notes</b>
	Dumas, N. G. E., Louis, Z., Godswill, N. N., Carine, T. N., & Emmanuel, Y. (2017). Assessment of the modes of pollen dispersal of <i>Vernonia amygdalina</i> Del. and <i>Vernonia calvoana</i> Hook. <i>African Journal of Plant Science</i> 11(9): 362-368	[Suspected of being outcrossing, but further study is required] "The study of pollen dispersal and mode of fertilization of <i>Vernonia amygdalina</i> and <i>Vernonia calvoana</i> is a prerequisite to the understanding of genetic diversity and elaboration of improvement programs for the <i>Vernonia</i> genus. In this study, precise experimental designs were made for morphological and biological observations on <i>Vernonia</i> species capitulum in order to assess the distinctive effects of each of the three possible pollen transportation agents (insects, wind and rain water) on pollination. Results obtained show that the exclusive mode of pollen dispersal is entomophilous. Even though allogamy and autogamy are observed as two possible modes of fertilization in <i>Vernonia</i> spp., some arguments tend to favour allogamy. However, there is no clear cut position on the issue, hence the need for confirmation by further experimentation in controlled pollination. This study paves the way for the establishment of a genetic improvement program for this genus based on the results on pollen dispersal."

605	Requires specialist pollinators	n
	<b>Source(s)</b>	<b>Notes</b>
	Dumas, N. G. E., Louis, Z., Godswill, N. N., Carine, T. N., & Emmanuel, Y. (2017). Assessment of the modes of pollen dispersal of <i>Vernonia amygdalina</i> Del. and <i>Vernonia calvoana</i> Hook. <i>African Journal of Plant Science</i> 11(9): 362-368	"In this study, precise experimental designs were made for morphological and biological observations on <i>Vernonia</i> species capitulum in order to assess the distinctive effects of each of the three possible pollen transportation agents (insects, wind and rain water) on pollination. Results obtained show that the exclusive mode of pollen dispersal is entomophilous."

Qsn #	Question	Answer
	Fohouo, F. N. T., Tope, S. F., Mbianda, A. P., Messi, J., & Brückner, D. (2010). Foraging behaviour of <i>Apis mellifera adansonii</i> (Hymenoptera: Apidae) on <i>Combretum nigricans</i> , <i>Erythrina sigmoidea</i> , <i>Lannea kerstingii</i> and <i>Vernonia amygdalina</i> flowers at Dang (Ngaoundéré, Cameroon). <i>International Journal of Tropical Insect Science</i> , 30(1), 40-47	"Since <i>C. nigricans</i> , <i>E. sigmoidea</i> , <i>L. kerstingii</i> and <i>V. amygdalina</i> are highly nectariferous bee plants, they should be planted and protected to increase honey production. Besides, <i>V. amygdalina</i> pollen has been identified in one of the seven honey samples collected in the study area in 1999 (Mbofung et al., 2000)." ... "As highly polliniferous bee plants, <i>L. kerstingii</i> and <i>V. amygdalina</i> can permit the increase of pollen production as a hive product." ... "Foragers carried pollen from a flower of one tree to the stigma of another flower of the same tree (geitonogamy) or to that of another tree (xenogamy). Consequently, <i>A. m. adansonii</i> workers increase the pollination possibilities of <i>C. nigricans</i> , <i>E. sigmoidea</i> , <i>L. kerstingii</i> and <i>V. amygdalina</i> ."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0.</i> <a href="http://www.worldagroforestry.org">http://www.worldagroforestry.org</a> . [Accessed 8 Jun 2020]	"A medium to fast growing tree suited to coppicing." [But no evidence of natural vegetative spread]
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 8 Jun 2020]	[No evidence of suckering, or natural vegetative spread] "Propagation is possible by seed, but most farmers use stem cuttings. Cuttings used for propagation from mature stems are selected on the basis of attributes such as degree of bitterness, leaf size and growth characteristics. In home gardens more than one type is often grown because young people prefer the sweeter, less bitter types and elderly people the more bitter ones. Cuttings may be planted erect or slanting at an angle of 45° to obtain more sideshoots. Cuttings grow faster than seedlings."

607	Minimum generative time (years)	
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed ]	[Unknown] " <i>Vernonia amygdalina</i> can grow into a tree, but in cultivation it is mostly pruned to a shrub or hedge. Once established in a garden, leaves or young shoots can be picked for up to 7 years, but for commercial production farmers prefer younger plants. Plants flower in the dry season (January and early February in West and Central Africa). Regular harvesting of the shoots stimulates new growth thus retarding flower initiation. Harvesting of only leaves hampers regrowth. Towards the dry season new leaves become smaller and become dark greyish green in colour; these are very coarse and bitter, especially those close to the inflorescence. "

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Senbeta, F., Teketay, D., & Näslund, B. Å. (2002). Native woody species regeneration in exotic tree plantations at Munessa-Shashemene Forest, southern Ethiopia. <i>New Forests</i> , 24(2), 131-145	"Table 2. The most common naturally regenerated woody plants beneath different forest types at Munessa-Shashemene Forest Project Area" [ <i>Vernonia amygdalina</i> - DA = dispersal agent - W = wind]

Qsn #	Question	Answer
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed ]	" <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude. It often occurs in disturbed localities such as abandoned farmland, and can be found growing spontaneously in secondary forest." [In disturbed habitats, but not generally found in heavily trafficked areas]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 8 Jun 2020]	"It is commonly grown as a vegetable in Benin, Nigeria, Cameroon, Gabon and DR Congo, and to a lesser extent in their neighbouring countries. The Luhya people in western Kenya use <i>Vernonia amygdalina</i> as a vegetable, but do not cultivate it."
	Dave's Garden. (2020). <i>Gymnanthemum</i> Species, African Bitterleaf - <i>Gymnanthemum amygdalinum</i> . <a href="https://davesgarden.com/guides/pf/go/221062/">https://davesgarden.com/guides/pf/go/221062/</a> . [Accessed 8 Jun 2020]	Promoted on this and other plant websites
	Plants for a Future. (2020). <i>Gymnanthemum amygdalinum</i> . <a href="https://pfaf.org">https://pfaf.org</a> . [Accessed 8 Jun 2020]	Promoted on this and other plant websites
	eBay. (2020). Bitter Leaf ( <i>Vernonia amygdalina</i> ) Leafy Green Plant. <a href="https://www.ebay.com/">https://www.ebay.com/</a> . [Accessed 8 Jun 2020]	Seeds sold online

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	[Reported to be a crop contaminant. Unable to verify in literature cited] "Major Pathway/s: Contaminant, Crop, Forestry, Herbal, Ornamental"

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 8 Jun 2020]	"Fruit a 10-ribbed achene 1.5–3.5 mm long, pubescent and glandular, brown to black, crowned by the much longer pappus bristles."
	Senbeta, F., Teketay, D., & Näslund, B. Å. (2002). Native woody species regeneration in exotic tree plantations at Munessa-Shashemene Forest, southern Ethiopia. <i>New Forests</i> , 24(2), 131-145	"Table 2. The most common naturally regenerated woody plants beneath different forest types at Munessa-Shashemene Forest Project Area" [ <i>Vernonia amygdalina</i> - DA = dispersal agent - W = wind]

705	Propagules water dispersed	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 5 Jun 2020]	[Occurs in riparian habitats. Water like facilitates dispersal of wind-dispersed seeds] " <i>Vernonia amygdalina</i> occurs naturally along rivers and lakes, in forest margins, woodland and grassland, up to 2000 m altitude."

706	Propagules bird dispersed	n
	<b>Source(s)</b>	<b>Notes</b>
	Tom-Dery, D., & Schroeder, J. M. (2011). Tree species abundance and regeneration potential of semi-deciduous forest fragments of the Ashanti Region of Ghana. <i>Journal of the Botanical Research Institute of Texas</i> , 5(2), 733-742	"Wind plays an important role in the dissemination of pioneer species' seeds, which are light, often winged and can be carried to considerable distances. The recorded small tree species <i>Vernonia amygdalina</i> is an example for seed dispersal by wind."

707	Propagules dispersed by other animals (externally)	n
	<b>Source(s)</b>	<b>Notes</b>
	Ucheck Fomum, F. (2004). <i>Vernonia amygdalina</i> Delile. [Internet] Record from PROTA4U. Grubben, G.J.H. & Denton, O.A. (Editors). PROTA (Plant Resources of Tropical Africa, Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 9 Jun 2020]	"Fruit a ribbed achene 3-6.5 mm long, glabrous to slightly pubescent, dark brown, crowned by the much longer, caducous pappus bristles." [Wind-dispersed, but it may be possible that pappus bristles could aid in external attachment at times. No evidence found]

708	Propagules survive passage through the gut	y
	<b>Source(s)</b>	<b>Notes</b>
	Seman, R. (2007). Dung seed bank of livestock in Weberi Addis Ababa, Ethiopia. MSc Thesis. Addis Ababa University, Addis Ababa, Ethiopia	"Table 4.4. Species found in the dung seed bank and control" [Vernonia amygdalina - Number of seeds in dung source - cattle = 4]

801	Prolific seed production (>1000/m <sup>2</sup> )	y
	<b>Source(s)</b>	<b>Notes</b>
	Teklu Ayele, Y. (2014). Soil Seed Bank Study at Gera Moist Evergreen Afromontane Forest, Jimma Zone of Oromia Regional State, Southwest Ethiopia. MSc Thesis. Addis Ababa University, Addis Ababa, Ethiopia	"Appendix 4: List of species recorded from the soil sample in each of the five habitat types with the total number of seedlings" [Vernonia amygdalina - Seed/m <sup>2</sup> = 10,933]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	<b>Source(s)</b>	<b>Notes</b>
	Royal Botanic Gardens Kew. (2020) Seed Information Database (SID). Version 7.1. Available from: <a href="http://data.kew.org/sid/">http://data.kew.org/sid/</a> . [Accessed 9 Jun 2020]	"Storage Behaviour: Orthodox"

Qsn #	Question	Answer
	Reubens, B., Heyn, M., Gebrehiwot, K., Hermy, M., & Muys, B. (2007). Persistent soil seed banks for natural rehabilitation of dry tropical forests in northern Ethiopia. <i>Tropicultura</i> , 25(4), 204-214	[Present in seed bank. Longevity unspecified] "From the 17 woody species that germinated in the seed bank samples, 14 species could be identified: two <i>Hibiscus</i> spp., <i>Kalanchoe</i> sp., <i>Ficus</i> sur, <i>F. vasta</i> , <i>Grewia ferruginea</i> , <i>Abutilon longicuspe</i> , <i>Acacia saligna</i> , <i>Olea europaea</i> subsp. <i>cuspidata</i> , <i>Euclea schimperii</i> , <i>Cordia africana</i> , <i>Juniperus procera</i> , <i>Vernonia amygdalina</i> and <i>Maesa lanceolata</i> ."

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide</i> version 4.0. <a href="http://www.worldagroforestry.org">http://www.worldagroforestry.org</a> . [Accessed 5 Jun 2020]	"A medium to fast growing tree suited to coppicing."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2020). Personal Communication	Unknown

**Summary of Risk Traits:**

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Grows in tropical climates
- Naturalized in India
- Reported to be a crop weed within native range
- Other species in the genus *Vernonia* are regarded as invasive; some treatments still include bitterleaf in this genus
- Roots reported to be toxic
- Tolerates many soil types
- Reproduces by seeds
- Seeds dispersed by wind, moved by water, and intentionally cultivated by people
- Prolific seed production
- Able to coppice after cutting

Low Risk Traits

- Unarmed (no spines, thorns or burrs)
- Provides fodder for livestock and edible leaves for human consumption (palatable despite reports of root toxicity)
- Requires full sunlight (dense shade may limit ability to spread)
- Not reported to spread vegetatively