

Taxon: Markhamia lutea	Family: Bignoniaceae
Common Name(s): Nile trumpet Nile tulip siala tree	Synonym(s): Dolichandrone hildebrandtii Baker Dolichandrone platycalyx Baker Markhamia hildebrandtii (Baker) ~Markhamia platycalyx (Baker) ~Spathodea lutea Benth. (basionym)

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 6 Feb 2020
WRA Score: 6.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Naturalized, Tropical Tree, Ornamental, 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	n
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		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	n
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		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n

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	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	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		
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed		
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		
801	Prolific seed production (>1000/m ²)	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
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Results from provenance and progeny trials with <i>M lutea</i> revealed high genetic variation among and within provenances and progenies for height and d.b.h., but not for strength properties and wood density (Muga et al., 1997). Such results indicate that breeding for growth characteristics may be worthwhile, but not for wood properties." [No evidence]
102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	NA
103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2014. 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
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> occurs from Côte d'Ivoire east to Kenya and south to DR Congo and Tanzania."
202	Quality of climate match data	High
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. lutea grows at elevations of 700-2400 m and in areas receiving 700-1700 mm annual rainfall (Noad and Birnie, 1989; Albrecht, 1993; Mbuya et al., 1994)." [Elevation range exceeds 1000 m, demonstrating environmental versatility]

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Parker, J.L. & Parsons, B. 2016. New Plant Records from the Big Island for 2015. Bishop Museum Occasional Papers 118: 17–22	"Bignoniaceae <i>Markhamia lutea</i> (Benth.) K.Schum. New naturalized record Nile tulip is a tree with pinnately compound leaves, broadly bell-shaped yellow flowers with red lines inside the tube, incompletely spathe-like calyxes, and leafy false stipules. It is native to tropical Africa, where it is a fast-growing second-growth tree, and is rarely cultivated elsewhere (Staples & Herbst 2005). In Hawai'i, Nile tulip has been observed spreading in two locations in the Puna and North Kona districts. Cultivated specimens are often seen fruiting heavily, and with its wind-dispersed seeds, this species has been suggested to the committee to become an eradication target. Material examined. HAWAII: Puna Distr., Hwy 11, Mountain View, 2162718N 278366E, trees to 40 ft tall, 6 Jan 2014, J. Parker & R. Parsons BIED175."
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> occurs from Côte d'Ivoire east to Kenya and south to DR Congo and Tanzania."

205	Does the species have a history of repeated introductions outside its natural range?	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"It is commonly planted in some regions within its distribution area, particularly in Kenya, Uganda and Tanzania, and sometimes elsewhere, e.g. in Ethiopia and in the southern parts of the United States."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"There have been no reports on large scale planting of this species worldwide."

301	Naturalized beyond native range	y
	Source(s)	Notes

Qsn #	Question	Answer
	Parker, J.L. & Parsons, B. 2016. New Plant Records from the Big Island for 2015. Bishop Museum Occasional Papers 118: 17–22	"Bignoniaceae <i>Markhamia lutea</i> (Benth.) K.Schum. New naturalized record Nile tulip is a tree with pinnately compound leaves, broadly bell-shaped yellow flowers with red lines inside the tube, incompletely spathe-like calyxes, and leafy false stipules. It is native to tropical Africa, where it is a fast-growing second-growth tree, and is rarely cultivated elsewhere (Staples & Herbst 2005). In Hawai'i, Nile tulip has been observed spreading in two locations in the Puna and North Kona districts. Cultivated specimens are often seen fruiting heavily, and with its wind dispersed seeds, this species has been suggested to the committee to become an eradication target. Material examined. HAWAII: Puna Distr., Hwy 11, Mountain View, 2162718N 278366E, trees to 40 ft tall, 6 Jan 2014, J. Parker & R. Parsons BIED175."
	Tropical Species Database. 2014. <i>Markhamia lutea</i> . http://theferns.info/tropical/viewtropical.php?id=Markhamia+lutea . [Accessed 21 Apr 2014]	"Range - East Africa - Ethiopia, Kenya, Uganda, Rwanda and Tanzania Naturalized in parts of west Africa."
	Negi, P. S., & Hajra, P. K. 2007. Alien flora of Doon Valley, Northwest Himalaya. <i>Current Science</i> 92(7): 968-978	"This communication is an attempt to prepare an up-to-date account of alien/exotic flora of the Doon Valley." ... "Naturalized and widely cultivated exotics are marked by asterisks in the enumeration." ... "Table 1. Exotics of the Doon Valley (enumeration)" [Includes <i>Dolichandrone platycalyx</i> , a synonym for <i>Markhamia lutea</i> , which is not marked by an asterisk, and is therefore not known to be naturalized in this region]
	Parsons, R. & Parker, J. 2014. BIISC Early Detection Botanist. Pers. Comm. 10 April	"We found <i>Markhamia lutea</i> (Nile tulip) in October popping up on the side of the road in Mountain View in a "forest reserve park". " ... "On Tuesday we were at UHH and noticed what appeared to be another one fruiting like crazy." [Naturalizing on Hawaii Island]

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. 2012. <i>A Global Compendium of Weeds</i> . 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Possibly. Competes with crops for nutrients] "Although <i>M. lutea</i> is a popular agroforestry species, it has a negative net effect when planted with crops (such as bananas, beans and maize) especially those nearest to the tree (Yamoah et al., 1989; Aluma et al., 1992; Peden et al., 1993). This is mainly due to root competition which rapidly reduces subsoil nitrate levels and its dense crown (Okorio et al., 1994; Akyeampong et al., 1995; Jama et al., 1998). To reduce the effects of competition, trees may be planted far apart; dense shade and fibrous roots can be reduced by pruning and crops around trees may be heavily manured. Its negative effects on crops does not reduce the popularity of this species with farmers." ... "Although <i>M. lutea</i> has several advantages, such as fast growth and ease of management, it has the major disadvantage of competing with crops due to its large fibrous roots and dense shading effects. Crops grown in conjunction with it in agroforestry systems may not be able to derive the full benefits of soil improvement, as leaf decomposition is rather slow."
	WRA Specialist. 2014. Personal Communication	Planted intentionally, but may cause problems for associated crops due to shading and root competition [See CABI 2005]

304	Environmental weed	
	Source(s)	Notes
	Parker, J.L. & Parsons, B. 2016. New Plant Records from the Big Island for 2015. Bishop Museum Occasional Papers 118: 17–22	"Cultivated specimens are often seen fruiting heavily, and with its wind-dispersed seeds, this species has been suggested to the committee to become an eradication target." [Identified as a potential environmental weed]
	Big Island Invasive Species Committee (BIISC). (2019). Nile Tulip - <i>Markhamia lutea</i> . https://www.biisc.org/nile-tulip/ . [Accessed 1 Nov 2019]	"Impact: Fast growing tree with the ability to spread into disturbed forests; produces viable wind dispersed seeds within two years." [Potential environmental weed]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

Qsn #	Question	Answer
401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. lutea is an upright evergreen tree, usually 6-30 m high with a tall trunk and a narrow, sometimes irregular crown. Beentje (1994) and Mbuya et al. (1994) describe it as having a light brown bark with fine vertical fissures; the bole in old trees is fluted. Foliage: Leaves compound, up to 30 cm in length, often in terminal groups; leaflets dark green above with a wavy, corrugated appearance, three to five pairs plus a terminal leaflet each up to 10 cm long, wider towards the apex and narrowing towards the base; veins prominent below and side veins loop before the margin. A pair of round, leafy stipules appear at the base of the leaf stalk."

402	Allelopathic	
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. lutea is fast growing, not nitrogen fixing, has a large tap root and exhibits some negative effects on crops when used in agroforestry systems." ... "Although M. lutea is a popular agroforestry species, it has a negative net effect when planted with crops (such as bananas, beans and maize) especially those nearest to the tree (Yamoah et al., 1989; Aluma et al., 1992; Peden et al., 1993). This is mainly due to root competition which rapidly reduces subsoil nitrate levels and its dense crown (Okorio et al., 1994; Akyeampong et al., 1995; Jama et al., 1998). To reduce the effects of competition, trees may be planted far apart; dense shade and fibrous roots can be reduced by pruning and crops around trees may be heavily manured. Its negative effects on crops does not reduce the popularity of this species with farmers." [Potentially Yes]

403	Parasitic	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. lutea is an upright evergreen tree, usually 6-30 m high with a tall trunk and a narrow, sometimes irregular crown." [No evidence]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Colobus monkeys and chimpanzees commonly feed on the leaves." [Suggests leaves could also be palatable to grazing animals]
	Olupot, W. 2004. Boundary edge effects in Bwindi Impenetrable National Park. Institute of Tropical Forest Conservation, Kabale, Uganda	" <i>Markhamia lutea</i> " ... "Not consumed by domestic animals" [Possibly unpalatable to domestic animals, in contrast to other references]

Qsn #	Question	Answer
	Mwilawa, A.J. 2003. Assessment of Potential Rangeland Resources in Selected Areas towards Designing a Livestock Development Strategy in Rufiji District. Technical Report No. 40. Rufiji Environment Management Project, Dar-es-Salaam, Tanzania	"Table 6 and 7 presents a list of forage species observed in the area." ... "Table 7: Observed tree/ shrub browse species situated in various potential extensive grazing land visited" [Includes <i>Markhamia lutea</i> . Suggests palatability]

405	Toxic to animals	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed]	"Colobus monkeys and chimpanzees commonly feed on the leaves." [No evidence of toxicity to these animals]
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"There have been no major pests reported on <i>M. lutea</i> . Although the timber is known to be termite resistant, there have been unconfirmed reports of damage by <i>Cryptotermes</i> spp. (Campbell, 1974). Young shoots may also be attacked by borers, resulting in crooked stems (Katende et al., 1995)."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	[Medicinal uses, but no evidence of acute or dermal toxicity] "Roots, bark and leaves are used in traditional medicine. Leaves and bark are used to treat toothache, stomach-ache and headache. Roots are administered to children to treat convulsions, and root and bark decoctions are taken against asthma, cough and gonorrhoea. Root decoctions are applied to treat earache and bark decoctions as aphrodisiac. Ground leaves and bark are applied externally to treat skin complaints and wounds. Leaves are used for the treatment of snakebites and young shoots to treat throat complaints, lumbago and diarrhoea. Leaf extracts are taken to treat cough and malaria. In Uganda the roots are a constituent of a complex herbal preparation used in the alleviation of AIDS symptoms. <i>Markhamia lutea</i> can be used for control of the parasitic weed <i>Striga</i> in cereals by inducing germination in the absence of a host."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Tropical Species Database. 2014. <i>Markhamia lutea</i> . http://theferns.info/tropical/viewtropical.php?id=Markhamia+lutea . [Accessed 21 Apr 2014]	"A plant of the moist tropics, where it is found at elevations from 700 - 2,000 metres"" [No evidence, and unlikely given natural distribution in moist tropics]
	Olupot, W. 2004. Boundary edge effects in Bwindi Impenetrable National Park. Institute of Tropical Forest Conservation, Kabale, Uganda	" <i>Markhamia lutea</i> " ... "Fairly fire-resistant" [Unlikely to carry fire]

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> often colonizes gaps in the forest, forest edges and formerly cultivated land. Seedlings can be found in full sun or light shade, but do not tolerate long dry periods."
	Top Tropicals. 2014. <i>Markhamia</i> - a rare find beauty from Africa. http://toptropicals.com/html/toptropicals/plant_wk/markhamia.htm . [Accessed 21 Apr 2014]	"The tree will take both sun or shade, grows well even in poor soils."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It grows best in deep, well-drained red loams and also gravel loams or sandy soil. It can tolerate acid, heavy clay soils, but not waterlogging (Katende et al., 1995), and growth may be stunted on shallow infertile soils (Otieno, 1992)."
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> prefers deep, well-drained red loamy soils, but also grows on gravelly loams, sandy soils and acidic clay soils as long as these are well drained."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>M. lutea</i> is an upright evergreen tree, usually 6-30 m high with a tall trunk and a narrow, sometimes irregular crown."

412	Forms dense thickets	n
	Source(s)	Notes

Qsn #	Question	Answer
	Chapman, C. A., Chapman, L. J., Struhsaker, T. T., Zanne, A. E., Clark, C. J., & Poulsen, J. R. 2005. A long-term evaluation of fruiting phenology: importance of climate change. <i>Journal of Tropical Ecology</i> , 21(1): 31-45	"Here we use two data sets (1970–1983 and 1990–2002) to describe the fruiting patterns of the tropical tree community in Kibale National Park, Uganda." ... "The 10 most abundant species and their densities are the following: <i>Uvariopsis congensis</i> (60.4 trees ha ⁻¹), <i>Markhamia lutea</i> (formerly <i>M. platycalyx</i> , 50.0 trees ha ⁻¹) ... " [No evidence of dense thicket formation in this study]
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> occurs naturally in evergreen forest, riverine forest, forest edges and wooded savanna" [No evidence of dense stand formation]

501	Aquatic	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>M. lutea</i> occurs naturally in riverine and evergreen forests, forest edges and occasionally in savannah woodlands." [Terrestrial]

502	Grass	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>M. lutea</i> is an upright evergreen tree, usually 6-30 m high with a tall trunk and a narrow, sometimes irregular crown." [Bignoniaceae]

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>M. lutea</i> is fast growing, not nitrogen fixing, has a large tap root and exhibits some negative effects on crops when used in agroforestry systems." [Bignoniaceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>M. lutea</i> is an upright evergreen tree, usually 6-30 m high with a tall trunk and a narrow, sometimes irregular crown. Beentje (1994) and Mbuya et al. (1994) describe it as having a light brown bark with fine vertical fissures; the bole in old trees is fluted."

601	Evidence of substantial reproductive failure in native habitat	
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>M. lutea</i> flowers for most of the year. In western Kenya, flowering occurs from August to September, whereas in eastern Kenya it occurs from December to January." [No evidence]

Qsn #	Question	Answer
	<p>Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 21 Apr 2014]</p>	<p>"<i>Markhamia lutea</i> is widely distributed in a variety of habitats and is additionally commonly planted. This makes that it is not in danger of genetic erosion, as seems to be the case for the other African <i>Markhamia</i> spp."</p>
	<p>Chapman, C. A., Bonnell, T. R., Sengupta, R., Goldberg, T. L., & Rothman, J. M. 2013. Is <i>Markhamia lutea</i>'s abundance determined by animal foraging?. <i>Forest ecology and management</i>, 308: 62-66</p>	<p>[Yes in Uganda] "Using 14 years of data from Kibale National Park, Uganda, we quantify <i>M. lutea</i> flower and fruit production. Similarly, using 21 years of data, we quantify temporal changes in the abundance of stems in size classes from 1 m tall and above. Our analyses demonstrate that <i>M. lutea</i> is rarely able to produce fruit and that this corresponds to a general decline in its abundance across all size classes. Moreover, using 7 years of feeding records, we demonstrate that red colobus feed on <i>M. lutea</i>, consuming large amounts of leaf and flower buds whenever they were available, suggesting that this behavior limits fruit production. Therefore, we suggest that red colobus are presently important for structuring the distribution and abundance of <i>M. lutea</i> in Kibale. This dynamic raises the intriguing question of how a large <i>M. lutea</i> population was able to originally establish. There is no evidence of a change in red colobus population size; however, if this old-growth forest is in a non-equilibrium state, <i>M. lutea</i> may have become established when red colobus ate a different diet."</p>

602	Produces viable seed	y
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"It is propagated by seedlings, wildings and cuttings, although coppicing is the most popular."

603	Hybridizes naturally	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown

604	Self-compatible or apomictic	
	Source(s)	Notes
	<p>Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp. [Accessed 21 Apr 2014]</p>	<p>[Self-compatibility unknown] "Flowers bisexual, zygomorphic, large and showy, scented; pedicel c. 0.5 cm long; calyx spathe shaped, 2–2.5(–3) cm long, covered with small scales; corolla golden yellow, with brownish purple or red veins or spots at the throat, with tube (2–)3–4.5 cm long and 2-lipped and 5-lobed limb, lobes (1–)1.5–2.5 cm long and wide, glandular; stamens 4, 2–3 cm long, 2 longer and 2 shorter, inserted on the corolla tube, included; disk 5-lobed; ovary superior, oblong, 0.5–1 cm long, 2-celled, style 2–2.5 cm long. "</p>

605	Requires specialist pollinators	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Munyuli, T. M. B. 2011. Pollinator biodiversity in Uganda and in Sub-Sahara Africa: landscape and habitat management strategies for its conservation. <i>International Journal of Biodiversity and Conservation</i> , 3(11): 551-609	"By planning multiple uses (multi-purposes) native tree species wisely, it is possible for farmers from Uganda to gain some cash or income at the same moment providing nesting and foraging opportunities to pollinators. For example, several known native apiary tree species (<i>Markhamia lutea</i> , etc) that are rated as good producers of nectar and or pollen, can be used when establishing forest plantations." [Presumably bee-pollinated]
	Schmidt, L. & Mborara, A. 2008. Seed Leaflet No. 140. <i>Markhamia lutea</i> (Benth) K. Schum. Forest & Landscape Denmark, Copenhagen, Denmark	"Pollination is by insects e.g. bees."
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"The flowers are a source of nectar for honey bees." ... "Flowers bisexual, zygomorphic, large and showy, scented; pedicel c. 0.5 cm long; calyx spathe-shaped, 2–2.5(–3) cm long, covered with small scales; corolla golden yellow, with brownish purple or red veins or spots at the throat, with tube (2–)3–4.5 cm long and 2-lipped and 5-lobed limb, lobes (1–)1.5–2.5 cm long and wide, glandular; stamens 4, 2–3 cm long, 2 longer and 2 shorter, inserted on the corolla tube, included; disk 5-lobed; ovary superior, oblong, 0.5–1 cm long, 2-celled, style 2–2.5 cm long."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"It is propagated by seedlings, wildings and cuttings, although coppicing is the most popular." [Coppices, but no evidence of vegetative spread]

607	Minimum generative time (years)	2
	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> . http://www.worldagroforestry.org . [Accessed 1 Nov 2019]	" <i>M. lutea</i> grows fast in good forest soil, and plants can attain growth rates of more than 2 m/year."
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 20 Apr 2014]	"Planted trees grow fast, up to 2 m per year." ... "Under favourable conditions, young trees may start flowering when only 3 m tall." [Potentially able to reproduce in second year of growth]
	Dave's Garden. 2014. <i>PlantFiles: Markhamia, Nile Tulip Tree - Markhamia lutea</i> . http://davesgarden.com/guides/pf/go/76637/ . [Accessed 21 Apr 2014]	"Started this plant from seed and has grown to a 20 foot tree in about four years. Did not flower until it was four years old." [Comment from California. May take longer to reach maturity in cooler climates]
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"The species is fast growing and may attain a height of over 2 m in 1 year under favourable conditions (Albrecht, 1993)."

Qsn #	Question	Answer
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Fruit a linear, curved capsule 35–80 cm × 1–2 cm, flattened, covered with small scales, dehiscent with 2 valves, many-seeded. Seeds irregularly rectangular, with 2 lateral wings, 0.5–1 cm × 2. –3.5 cm including wings, yellow-white. Seedling with epigeal germination." ... "The winged seeds are dispersed by wind." [Unlikely. Fruits & seeds lack means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>M. lutea</i> is a popular agroforestry species and farmers plant it on external boundaries, around homesteads, scattered within fields and in woodlots. It can also be used as a screen within golf courses. In the western parts of Kenya, <i>M. lutea</i> is the second most frequently planted tree species by farmers and has a wide variety of uses (Pawlick, 1989), being especially prized as fuel for curing tobacco."
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> is an important agroforestry tree. It is used as shade tree in crops such as banana, beans and maize, and as a wind break. It is useful for erosion control and soil conservation, and provides good mulch. It is planted as an ornamental tree in gardens and parks because of its showy flowers, but also in hedges and live fences, and as a boundary marker."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Fruit a linear, curved capsule 35–80 cm × 1–2 cm, flattened, covered with small scales, dehiscent with 2 valves, many-seeded. Seeds irregularly rectangular, with 2 lateral wings, 0.5–1 cm × 2. –3.5 cm including wings, yellow-white. Seedling with epigeal germination." ... "The winged seeds are dispersed by wind." [No evidence]

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Fruit long, thin, brown capsules 40-80 cm long, hanging in spiralling clusters, splitting on the tree to release abundant seed with flat transparent wings 2.5 cm long. Mature seed is yellow-white, although turns black if prematurely collected." ... "Seeds are easily dispersed by wind and germinate readily when they fall on a suitable substrate."

705	Propagules water dispersed	
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Qsn #	Question	Answer
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	" <i>Markhamia lutea</i> occurs naturally in evergreen forest, riverine forest, forest edges and wooded savanna, at 600–2400 m altitude." [Seeds adapted for wind dispersal, but possibly secondarily dispersed by water in riverine habitats]
706	Propagules bird dispersed	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Fruit long, thin, brown capsules 40-80 cm long, hanging in spiralling clusters, splitting on the tree to release abundant seed with flat transparent wings 2.5 cm long. Mature seed is yellow-white, although turns black if prematurely collected." [No evidence. Not fleshy-fruited]
707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Fruit a linear, curved capsule 35–80 cm × 1–2 cm, flattened, covered with small scales, dehiscing with 2 valves, many-seeded. Seeds irregularly rectangular, with 2 lateral wings, 0.5–1 cm × 2. –3.5 cm including wings, yellow-white. Seedling with epigeal germination." ... "The winged seeds are dispersed by wind." [Unlikely. Fruits and seeds lack means of external attachment]
708	Propagules survive passage through the gut	
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Seeds are commonly attacked by seed-boring beetles and rodents. Young trees are commonly attacked by shoot borers, which may result in crooked boles." [Probably No]
801	Prolific seed production (>1000/m²)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Seed development is within 6 months after pollination by insects and trees seed prolifically throughout the year, yielding approximately 75,000 seeds per kg (Albrecht, 1993)."
802	Evidence that a persistent propagule bank is formed (>1 yr)	

Qsn #	Question	Answer
	Source(s)	Notes
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"Seeds are usually sown when they are fresh. Fresh seed has a germination rate of 30–60% in –4 weeks. For storage, the seeds should be dried in the sun to a moisture content of 5–10% and then threshed gently to remove the wings, followed by winnowing. Properly dried seeds can be stored in airtight containers or sacks at 3°C for several years without much loss in viability." [Possibly No]
	Royal Botanic Gardens Kew. 2008. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/ . [Accessed 21 Apr 2014]	"Storage Behaviour: Orthodox p Storage Conditions: Short-lived in open storage at room temperature (Dent, 1948); viability can be maintained for several years in hermetic storage at 3°C with 5-10% mc (Albrecht, 1993)" [Open storage, similar to field conditions, results in loss of viability]
	Oluka-Akileng, I., Esegu, J.F., Kaudia, A.A. & Lwakuba, A. 2000. Agroforestry Handbook for the Banana-Coffee Zone of Uganda: Farmers' Practices and Experiences. The Regional Land Management Unit, RELMA/Sida, Nairobi, Kenya	"Table 2 Simple seed treatment methods for some agroforestry trees and shrubs" ... " <i>Markhamia lutea</i> ... Seed does not store well; sow fresh seed" [Unlikely to form a long lived seed bank]
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"They can be stored for 2-3 years in sacks or airtight containers in a cool place when mature and properly dried."
	Parker, J. (2020). BIISC Early Detection Botanist. Pers. Comm. 06 Feb	"we've been pulling <i>Markhamia</i> seedlings at the Kona property since 2015" [Reproductive tree moved years ago, but seedling continue to emerge, suggesting the possibility of a persistent seed bank]

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown. No information found on herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" Ability to regenerate rapidly; coppice; pollard" ... "The most popular method of management is by coppicing as <i>M. lutea</i> coppices extremely well and for many years. Branch pruning and pollarding may also be done and heaping and burning rubbish on stools results in massive, healthy regrowth. When used as a hedge, spacing should be dense (0.8-1.5 m) thus making the hedge sufficiently impenetrable (Gautier, 1992)."
	Oluka-Akileng, I., Esegu, J.F., Kaudia, A.A. & Lwakuba, A. 2000. Agroforestry Handbook for the Banana-Coffee Zone of Uganda: Farmers' Practices and Experiences. The Regional Land Management Unit, RELMA/Sida, Nairobi, Kenya	"It is difficult to remove <i>Kalitunsi</i> (<i>Eucalyptus</i> species) and <i>Nsambya</i> (<i>Markhamia lutea</i>) stumps after establishment when one wants to change land use to other activities;"

Qsn #	Question	Answer
	Maroyi, A., 2012. <i>Markhamia lutea</i> (Benth.) K.Schum. [Internet]Record from PROTA4U. Lemmens, R.H.M.J., Louppe, D. & Oteng Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp . [Accessed 21 Apr 2014]	"When planted in hedges, spacing should be 80–150 cm and plants can be pruned for the first time after 2 years. Trees are pruned to obtain a regular bole for timber. They coppice well, producing vigorous shoots which can reach 7 cm in diameter after 2–3 years on good soils, and poles of 10–12 cm in diameter some years later."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Elevation range exceeds 1000 m
- Naturalized on Hawaii island, as well as parts of west Africa
- Root competition and shade can be detrimental to crops
- Tolerates many soil types
- Shade tolerant (a pioneer species capable of establishing in shade)
- Produces wind-dispersed seeds
- Can become mature in two years
- Coppices readily

Low Risk Traits

- Unarmed (lacks spines, thorns, or burrs)
- Non-toxic
- Ornamental
- Does not spread vegetatively

Second Screening Results

(A) Shade tolerant or know to form dense stands> Yes (Shade Tolerant)

(B) Bird- or clearly wind-dispersed> Yes (Wind-dispersed)

(C) Life cycle < 4 years? Yes. Reaches maturity in 2nd year of growth

Outcome = Reject (High Risk)