

**LOCAL NAMES**

Amharic (zogdom); English (pepper-bark tree, Kenya green heart, greenheart, East African greenheart, East African green wood); Luganda (muwiya, mukuzanume)

**BOTANIC DESCRIPTION**

*Warburgia ugandensis* is a spreading evergreen tree 4.5-30 m tall, 70 cm in diameter, bark smooth or scaly, pale green or brown, slash pink; bole short and clear of branches for about 3 m; crown rounded.

Leaves alternate, simple, dotted with glands, stipules absent; petiole 1-5 mm long; blade oblong-lanceolate, elliptic or oblong-elliptic, 3-15 x 1.4-5 cm, apex and base tapering, margins entire, glossy dark green above, paler green and dull below, midrib frequently slightly off-centre.

Flowers solitary or in small 3-4 flowered cymes, axillary, regular, bisexual; bracts ovate to kidney shaped, thick, 3 x 3-3.5 mm, covering only the young buds. Sepals green, ovate, 6-7 mm long, 4-4.5 mm wide; petals 10, in whorls, white or greenish-yellow, obovate 5-7 x 2.5-3 mm, dotted with glands, overlapping; stamens 10, united in a tube 4-5 mm long 2-3 mm in diameter, enveloping the ovary and most of the style; ovary oblong-elongate, 2.6-4 mm long.

Fruit a berry, at first green and ellipsoidal, later subspherical and turning purplish, 3-5 cm in diameter, skin leathery, glandular. Seeds 2 or more with oily endosperm, compressed, more or less cordate, yellow-brown, 1-1.5 cm long.

The genus is named after Dr. Otto Warburg (1859-1938), born in Hamburg, lecturer in botany at the University of Berlin and author of numerous botanical papers.

**BIOLOGY**

*W. ugandensis* is hermaphroditic, flowering at the beginning of the rainy season. Fruiting follows later in the rainy season; fruits may remain on the tree for a long time. In Kenya, the species flowers in December-January and seeds in May.



foliage and fruit (Bob Bailis)



Tree on farm (Bob Bailis)



Warburgia ugandensis foliage (AFT team)

**ECOLOGY**

*W. ugandensis* occurs in lowland rainforest, upland dry evergreen forest and its relicts in secondary bushland and grassland; also on termitaria in swamp forest.

**BIOPHYSICAL LIMITS**

Altitude: 100-2 200 m

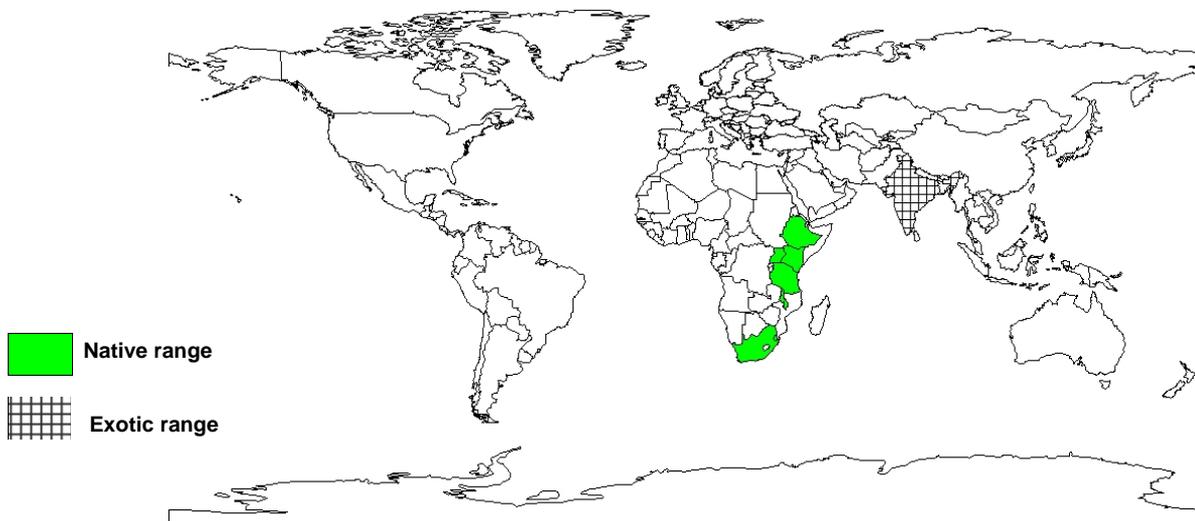
Mean annual rainfall: 1 000-1 500 mm

Soils: Can withstand swamp forest soils.

**DOCUMENTED SPECIES DISTRIBUTION**

Native: Democratic Republic of Congo, Ethiopia, Kenya, Malawi, South Africa, Swaziland, Tanzania, Uganda

Exotic: India



The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species can not be planted in other countries than those depicted. Since some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

**PRODUCTS**

**Food:** Fruit edible; all parts have a hot peppery taste. The leaves and seeds are sometimes used to add flavour to curries.

**Fodder:** Leaves, pods and seeds are fed to livestock.

**Fuel:** The wood has a high oil content and burns well with an incense-like smell.

**Timber:** Heartwood yellow or greenish, becoming brown on exposure; very fragrant when freshly cut, the scent somewhat resembling that of sandalwood. Good timber for building and furniture, but not termite resistant. It saws easily, planes well and takes a high polish, but it is not durable and is liable to split on nailing. The wood somewhat resembles teak and shows a satin lustre; its fragrance persists over 4 years of storage. Milling of the wood gives rise to a dust that is very fragrant and causes sneezing.

**Gum or resin:** The resin is used locally as glue to fix tool handles.

**Poison:** The heartwood contains new sesquiterpenoids such as bemadienolide, cinnamide, drimenol, muzigadial, polygodial, warburganal, warburgiadione, warburgin, ugandensidial and ugandensolide. These compounds exhibit anti-feedant activity against armyworm (*Spodoptera littoralis* and *S. exepsta*), widely occurring African crop pests. The anti-feedant activities of warburganal and muzigadial are comparable. These two compounds belong to the strongest group of anti-feedants against African armyworm found so far. In addition, they exhibit very potent antifungal, antiyeast and plant-growth regulating activity.

**Medicine:** Dried bark is commonly chewed and the juice swallowed as a remedy for stomach-ache, constipation, toothache, cough, fever, muscle pains, weak joints and general body pains. It is also effective in powdered form for treating the same diseases. Fresh roots are boiled and mixed with soup for the prevention of diarrhoea. Leaf decoction baths are used as a cure for several skin diseases. The inner bark is reddish, bitter and peppery and has a variety of applications. It provides treatment for the common cold; dried and ground to a snuff it is used to clear sinuses; and it is chewed, or smoke from the burning bark inhaled, as a remedy for chest complaints. The bark, roots or leaves can be boiled in water and the decoction drunk to treat malaria, but this causes violent vomiting.

**SERVICES**

**Shade or shelter:** The crown provides shade.

**Soil improver:** Can provide green manure and mulch.

**Ornamental:** *W. ugandensis* is often planted for amenity purposes.

**TREE MANAGEMENT**

Deserves wide planting as a shapely garden or park tree, but young plants can be difficult to obtain. The bark is frequently removed for medicinal use, and care must be taken to avoid tree mortality. A fairly slow-growing tree, but once established it is hardy and coppicing can be practised.

**GERMPLASM MANAGEMENT**

*W. ugandensis* is classified as recalcitrant; however, with dry seed, viability can be maintained for 6 months at cool temperatures, storability is intermediate between orthodox and recalcitrant. In the short term, seeds can be stored in moist sawdust at 3 deg. C. Based on fruit structure, seed size and natural habitats, seed of this species may not be recalcitrant. More investigation is needed. A purity of 98% can be achieved. On average, there are 10 000 seed/kg, depending on the provenance and the climatic conditions of the ripening year.

**FURTHER READING**

- Albrecht J. ed. 1993. Tree seed hand book of Kenya. GTZ Forestry Seed Center Muguga, Nairobi, Kenya.
- Beentje HJ. 1994. Kenya trees, shrubs and lianas. National Museums of Kenya.
- Bekele-Tesemma A, Birnie A, Tengnas B. 1993. Useful trees and shrubs for Ethiopia. Regional Soil Conservation Unit (RSCU), Swedish International Development Authority (SIDA).
- Birnie A. 1997. What tree is that? A beginner's guide to 40 trees in Kenya. Jacaranda designs Ltd.
- Dale IR, Greenway PJ. 1961. Kenya trees and shrubs. Buchanan's Kenya Estates Ltd.
- Eggeling. 1940. Indigenous trees of Uganda. Govt. of Uganda.
- FAO. 1986. Some medicinal plants of Africa and Latin America. FAO Forestry Paper. 67. Rome.
- Friis I. 1992. Forests and forest trees of northeast tropical Africa. Her Majesty's Stationery Office, London.
- Hamilton A.C. 1981. A field guide to Uganda forest trees.
- Hong TD, Linington S, Ellis RH. 1996. Seed storage behaviour: a compendium. Handbooks for Genebanks: No. 4. IPGRI.
- ICRAF. 1992. A selection of useful trees and shrubs for Kenya: Notes on their identification, propagation and management for use by farming and pastoral communities. ICRAF.
- Katende AB et al. 1995. Useful trees and shrubs for Uganda. Identification, Propagation and Management for Agricultural and Pastoral Communities. Regional Soil Conservation Unit (RSCU), Swedish International Development Authority (SIDA).
- Kokwaro JO. 1976. Medicinal plants of East Africa. East African Literature Bureau.
- Mbuya LP et al. 1994. Useful trees and shrubs for Tanzania: Identification, Propagation and Management for Agricultural and Pastoral Communities. Regional Soil Conservation Unit (RSCU), Swedish International Development Authority (SIDA).
- Muchugi A, Muluvi GM, Simons AJ, Wachira FN, Jamnadass RH. 2008. Estimation of out-crossing rate in a natural breeding population of *Warburgia ugandensis* using AFLP marker: African Journal of Biotechnology. 7(2):139-146.
- Noad T, Birnie A. 1989. Trees of Kenya. General Printers, Nairobi.
- Palmer E, Pitman N. 1972. Trees of Southern Africa Vol. 2. A.A. Balkema Cape Town.

**SUGGESTED CITATION**

Orwa C, Mutua A, Kindt R, Jamnadass R, Simons A. 2009. Agroforestry Database: a tree reference and selection guide version 4.0 (<http://www.worldagroforestry.org/af/treedb/>)