Food and fruit-bearing forest species

1: Examples from Eastern Africa

Forest resources development branch
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ABSTRACT

Monographs of 40 forest food and fruit-bearing forest species have been prepared under the auspices of FAO by the Silvicultural Research Institute of the Forest Division, Ministry of Natural Resources and Tourism of the United Republic of Tanzania. Besides botanical and vernacular (Tanzanian) nomenclature and detailed descriptions, the illustrated monographs provide useful information on the ecology, distribution, main multiple uses, period of fruit collections, nutritional value, propagation, cultivation, economics and local marketing potential of the species covered.

FOREWORD

"Food from the Forests" was one of the topics discussed during the Eighth World Forestry Congress held in Djakarta, Indonesia, in October 1978 under the main theme "Forests for People".

In many developing countries rural populations derive a significant part of their food and energy requirements from trees which also improve the quality of life. The variety and nature of food and food products obtained from trees are not fully appreciated. Furthermore, many of these fruit-bearing species occur naturally in forest environments which are under pressure to yield land for agriculture. Greater knowledge of the potential of these species and their capacity to improve man's way of life will add weight to efforts to conserve these forests or woodlands, while making them more productive.

The introduction of forest food and fruit species to agricultural areas and their possible domestication and improvement through breeding offer considerable possibilities, not only in the improved nutrition of rural populations but in their economic potential to provide cash incomes derived from the sale of their raw fruits or processed products.

The monographs should therefore be a useful aid to government extension agents, workers and specialists in programmes dealing with forest management and forestry for local community development, as well as to those interested in the conservation of natural resources.

FAO is indebted to the detailed work of the director and staff of the Silvicultural Research Institute in Lushoto, Tanzania, who prepared the monographs and the assistance of the technical editor, Mr. R.L. Willan. These species descriptions will form part of a series of similar monographs covering other tropical regions of the world.

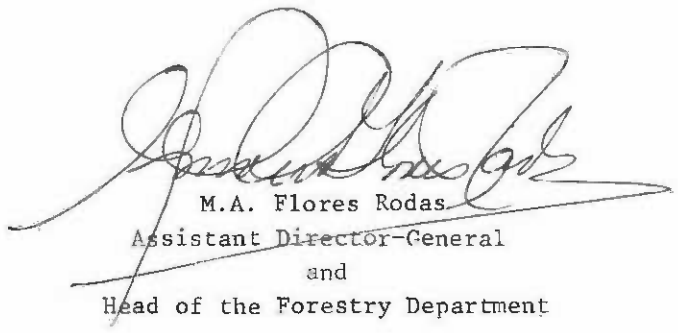

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TABLE OF CONTENTS

LIST OF PLATES

Plate XI *Diospyros mespiliformis* Hochet. ex A. DC.

XI_1 Tree at Rungwa, Manyoni, May 1982.

XI_2 Branchlet bearing mature fruits, Rungwa, Manyoni, May 1982.

Plate XII *Flacourtia indica* (Burm.f.) Merril

XII_1 Branchlet bearing mature and ripe fruits, at Beekeeping School, Tabora, May 1982.

Plate XIII *Friesodielsia obovata* (Benth.) Verdc.

$XIII_1$ Multistemmed shrub, at Beekeeping School, Tabora, May 1982.

$XIII_2$ Branchlets bearing mature and ripe fruits at Beekeeping School, Tabora, May 1982.

Plate XIV *Hexalobus monopetalus* var *obovatus* Brenan (A.Rich.) Engl. & Diels

XIV_1 Tree at Simbo Forest Reserve, Tabora, May 1982.

Plate XV *Manilkara mochisia* (Baker) Dubard

XV_1 Tree at Rungwa, Manyoni, May 1982. Note that it is on a termite mound in the maize farm.

XV_2 Branchlet and ripe fruits, at Rungwa Manyoni, May 1982.

Plate XVI *Manilkara obovata* (Sabine & G. Don) J.H. Hemsl.

XVI_1 Tree at Ilangali, Dodoma, April 1982.

XVI_2 Branchlet bearing mature fruits, at Ilangali Dodoma, April 1982.

Plate XVII *Myrianthus arboreus* P. Beauv.

$XVII_1$ Tree at left side of Amani stream near Amani pond, Amani montane forest, Tanga, January 1982.

$XVII_2$ Branchlet bearing leaves and young fruits at Amani, Tanga, January 1982.

Plate XVIII *Oldfieldia dactylophylla* J. Leonard

$XVIII_1$ Tree at Beekeeping School, Tabora, May 1982.

$XVIII_2$ Branchlet bearing flowers, at Beekeeping School, Tabora, May 1982.

$XVIII_3$ Branchlet bearing ripe fruits at Beekeeping School, Tabora, May 1982.

Plate XIX *Pachystela brevipes* (Bak.) Engl.

XIX_1 Tree 17 m high with DBH of 75 cm at Kalundwa village, Morogoro, February 1982.

XIX_2 Branchlet showing leaves and ripe fruits, at Kalundwa, Morogoro, February 1982.

Plate XX *Pachystela msolo* (Engl.) Engl.

XX_1 Heavily fluted bole of tree 20 m high, DBH 80 cm at Mombo arboretum, Tanga, January 1982.

XX_2 Tree 23 m high at Longuza near forest project office, Tanga, January 1982.

XX_3 Branchlet bearing leaves and fruits at Mombo Arboretum, Tanga.

Plate XXI *Parinari curatellifolia* (Planch.ex) Benth.

XXI_1 Tree at Isangu village, Mbozi district, Mbeya, June 1982. Note that it is a shade tree in coffee and banana plantations.

Plate XXII *Parinari excelsa* Sabine subsp. *holstii* (Engl) R. Grah

$XXII_1$ Tree 25 m high at Silviculture nursery, Lushoto Tanga, January 1982.

Plate XXIII *Saba florida* Benth. Bullock

$XXIII_1$ Investigators pulling climbers at Longuza, near forest project office, Tanga, January 1982.

$XXIII_2$ Fruit vending in a street in Wete, Pemba Island, May 1981.

Plate XXIV *Sorindeia madagascariensis* Thon.

$XXIV_1$ Tree at Korogwe, Tanga, February 1982.

$XXIV_2$ Branchlet bearing flower buds at Mombo, Korogwe, August 1982.

Plate XXV *Strychnos cocculoides* Baker

XXV_1 Tree at Goweko, Tabora, December 1981.

XXV_2 Fruit vending in Tabora Town, December 1981. Note the price per fruit is TShs. 0.50.

Plate XXVI *Strychnos innocua* Del.

$XXVI_1$ Tree at Rungwa, Manyoni, December 1981.

$XXVI_2$ Branchlet brearing young fruits at Urumwa, Tabora, May 1982.

$XXVI_3$ Ripe fruits at Goweko, Tabora, December 1981.

Plate XXVII *Syzygium guineense* (Willd.) DC.

$XXVII_1$ Tree 20 m high, 90 cm DBH at Dule near Bumbuli, Lushoto Tanga, January 1982.

$XXVII_2$ Branchlet bearing leaves, flower buds and flowers at Korogwe, Tanga, January 1982.

Plate XXVIII *Trichilia roka* (Forsk.) Chiov.

$XXVIII_1$ Tree 15 m high with fruits at Korogwe, Tanga, January 1982.

$XXVIII_2$ Branchlet bearing fruits and partly burnt leaves at Korogwe Tanga, January 1982.

Plate XXIX *Uapaca kirkiana* Müll. Arg.

$XXIX_1$ Tree at Lutngule village, Iringa, June 1982.

$XXIX_2$ Young fruits, Luingulo village, Iringa, June 1982.

Plate XXX *Vangueria linearisepala* K. Schum.

XXX_1 Tree 4 m high in flower at Kwemadala village Lushoto, Tanga, January 1982.

XXX_2 Branchlet bearing leaves, flower buds and flowers at Kwemadala, Lushoto, Tanga, January 1982.

XXX_3 Fruit vending at Lushoto market, Tanga, October 1981.

Plate XXXI *Vangueria madagascariensis* Gmel

$XXXI_1$ Tree near Roman Catholic Mission in Tabora, December 1981.

$XXXI_2$ Branchlets bearing flower buds and flowers at Karanga in Moshi, April 1982.

$XXXI_3$ Branchlets bearing flowers and young fruits, near Roman Catholic Mission, Tabora, December 1981.

Plate XXXII *Vangueria rotundata* Robyn.

$XXXII_1$ Shrub, at Ngaramutoni, Arusha, April 1982.

$XXXII_2$ Branchlet bearing flowers and young fruits, at Ngaramutoni, Arusha, April 1982.

Plate XXXIII *Vangueria tomentosa* Hochst.

$XXXIII_1$ Multistemmed small tree 5 m high with leaves partly shed at Kwamarukanga forest reserve, Korogwe, January 1982.

$XXXIII_2$ Branchlet bearing leaves and mature fruits at Kwamarukanga forest reserve, Korogwe, Tanga, January 1982.

$XXXIII_3$ Mature fruits at Kwamarukanga, Korogwe, Tanga, January 1982.

Plate XXXIV *Vangueriopsis lanciflora* (Hiern) Robyns

$XXXIV_1$ Tree at Mwitikio, Kiwere, Tabora, December 1981.

$XXXIV_2$ Ripe fruits at Mwitikio, Kiwere, Tabora, December 1981.

Plate XXXV *Vitex doniana* Sweet

$XXXV_1$ Tree 14.5 m high, 55 cm DBH at Kongowe forest project, Kibaha Dar-es-Salaam, February 1982.

$XXXV_2$ Branchlet bearing leaves and fruits of *V. doniana*, Kongowe, DSM, February 1982

Plate XXXVI *Vitex ferruginea* Schum & Thonn.

$XXXVI_1$ Tree at Vikonje, Dodoma, April 1982.

$XXXVI_2$ Branchlet bearing fruits at Vikonje, Dodoma, April 1982.

Plate XXXVII *Vitex mombassae* Vatke

$XXXVII_1$ Tree at Urumwa, Tabora, Nzega, May 1982.
Note sorghum plantation in the background.

$XXXVII_2$ Branchlet bearing fruits, at Iduguta, Nzega, May 1982.

Plate XXXVIII *Vitex payos* (Lour.) Merr.

$XXXVIII_1$ Tree at Urumwa, Tabora, Nzega, May 1982.

$XXXVIII_2$ Branchlet bearing fruits at Urumwa, Tabora, May 1982.

$XXXVIII_3$ Ripe fruits at Urumwa, Tabora, May 1982.

Plate XXXIX *Ximenia americana* L.

$XXXIX_1$ Shrub, at Mshome Village, Iringa, June 1982.

$XXXIX_2$ Branchlet bearing ripe fruits at Mshome village, Iringa, June 1982.

Plate XL *Ximenia caffra* Sond. var *natalensis* Sond

XL_1 Trees at Rungwa, Manyoni, May 1982.

XL_2 Branchlet bearing ripe fruits.

XL_3 Ripe fruits.

LIST OF ABBREVIATIONS

an	year
ha	hectare
dbh	diameter breast height
m	metre
m^2	square metre
m^3	cubic metre
cm	centimetre
mm	millimetre
t	metric tonne
kg	kilogramme
gm	gramme
^oC	degrees centigrade
GAPEX	General Agricultural Products Export Company (of Tanzania)

INTRODUCTION

This publication describes the fruit and food crops and products that can be obtained from wild forest trees. Many of the species described have other useful features: they provide protection from the environment, harbour for wildlife, wood, fibres and medicines for man's use. They also form an integral part of the forest landscape contributing to man's spiritual and psychological welfare.

These monographs, with their descriptions and illustrations, which cover, among other things, the natural distribution; forest type and abundance in natural stands; collection and processing of the edible parts; nutritional value (when this is available); natural and artificial regeneration and, where possible, potential economic importance. The botanical descriptions and illustrations assist in identifying the species and promoting an appreciation of their usefulness - both factors of immediate interest to the immigrant settler, the extension worker and the young forest manager who may not possess the knowledge of forest species and their uses held by local inhabitants of long standing.

Heightened knowledge and appreciation give rise to improved efforts to conserve and wisely use the forest habitat in which these species occur, providing a supplement to largely starchy diets based on subsistence crops. When other means fail, local inhabitants can rely for survival on the presence of these forest species and their continued production during "hard times" of crop failure.

The selection of species for private growing or community plantations should also stress the nutritional value of the produce in relation to the nutritional needs of the community. Whichever part of the tree is consumed, there are obviously those which will yield more calories and vitamins, matters which need to be discussed with national nutritionists and their institutions on the basis of their knowledge of the area and the diets and needs of the local populations.

It should also be remembered that truly impoverished rural dwellers do not have the facilities or even the fuel energy to convert foods into sophisticated preparations which may not, in any case, form part of their normal diet. Fruits or plant products requiring this type of preparation may not, therefore, be of much practical value unless included in some sort of cooperative scheme which could organize and finance the necessary preparation and thereby provide income opportunities for women's groups. The arrangement of practical courses and demonstrations in this aspect of tree crop introduction therefore forms a key part of the species introduction effort, following on the trial establishment of demonstration plots of the various species or the collection of products from natural food and fruit-bearing trees.

1. ALLANBLACKIA STUHLMANNII

1.0 NAMES: - Family Guttiferae
Botanical Allanblackia stuhlmannii (Engl.) Engl
Syn. Stearodendron stuhlmannii Engl.
Allanblackia sacleuxii Hua
Vernacular msambu (Kiswahili, Kishambaa); mwaka, mkange (Kiswahili); msambu-mbwiti (Kizigua); mkanye (Kishambaa, Kibondei); mkanyi (Kishambaa); mkani (Kiluguru)

2.0 DISTRIBUTION:

2.1 Locality: A. stuhlmannii is known to occur naturally in East and West Usambara, Nguru and Uluguru mountains. It is not known to occur elsewhere (Brenan and Greenway, 1949; Bamps, 1969; Bamps, et. al.; 1978).

2.2 Altitude: Brenan and Greenway (1949) observed that A. stuhlmannii occurs between 850 m and 1100 m a.s.l. On the other hand, Bamps, et. al. (1978) reports that the species occurs between 540 m and 1200 m (and up to 1600 m a.s.l.).

2.3 Climate: A. stuhlmannii grows naturally in areas getting over 1200 mm annual rainfall. Rainfall statistics from 1931 to 1973 for Amani show that the mean annual rainfall is 1953 ± 404 and there are 183 ± 22 rainy days. The mean annual temperature is 18° C, occasionally dropping to 3° C for certain nights in the June to August period. The temperature range is 9° C. Relative humidity varies between 75 and 90 percent (E.A. Met. Dept. 1975*; Nshubemuki, et. al., 1978). Uluguru and Nguru Mountains receive over 1270 mm annual rainfall in four years out of five (Morgan, 1972). The mean maximum and mean minimum annual temperatures are, respectively, 25° C and 12.8° C (United Republic of Tanzania, 1967).

2.4 Geology and soils: Geologically, Usambara Mountains' rocks are of gneisses, with varying amounts of pyroxene, hornblende and biotites. They are often intruded by quartzite veins. These rocks are late precambrian rocks of the Mozambican belt. The soils are laterized red earth with a shallow organic top soil and well developed on East Usambara and south-east of the West Usambara where the annual rainfall is above 1500 mm. They are highly weathered and leached acid, kaolinitic soils. The hillsides of the West Usambara Mountains are dominated by non-laterized red earth. These soils are normally deep and more fertile than the previous type owing to less intensive weathering and leaching (Lundgren, 1975; Lundgren, 1978; Rodgers and Homewood, n.d.).

Uluguru Mountains are dominated by yellow-red sandy loam soils delivered from granite, gneiss and sedimentary rocks at higher altitudes and red to yellow-red gritty, sandy clay loam soils delivered from coarse grained siliceous rocks and usually associated with "Inselbergs" at lower altitudes. This latter type of soil is also dominant in the Mguru Mountains. Generally, these mountains are dominated by latosols (Morgan, 1972).

2.5 Forest type: The species normally occur in intermediate evergreen - moist montane rain forests on the seaward slopes of Usambara, Nguru and Uluguru Mountains. The dominant associate tree species are Cephalosphaora usambarensis, Newtonia buchanannii, Beilschmedia kweo, Parinari excelsa, Myrianthus arboreus, Isoberlinia scheffleri and Macaranga kilimandscharica.

* East Africa Meteorological Department

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

In the East Usambara at Amani and Kwamkoro, the stocking of A. stuhlmannii is estimated to vary from 5 to 250 stems/ha. The frequency of A. stuhlmannii in forest reserves in the montane rain forest of West Usambara was worked out by Maagi, et. al. (1979). The number of trees per hectare on 9587 ha in successive DBH classes of 10 cm were 0.55, 0.14, 0.56, 0.12, 0.18, 0.24, 0.04, 0, 0.12, 0.07 trees, making a total of 2.05 stems/ha. No inventory data have been taken in the Nguru and Uluguru Mountains.

4.0 DESCRIPTION:

A. stuhlmannii is a tall evergreen tree, 12 to 36 m high, with a clean bole to about 9 m. The stem is smooth or buttressed with dark grey bark which may be smooth or flaking, and when slashed produces clean exudate which later turns into a yellowish and resinous latex. The branches of A. stuhlmannii are usually drooping. Leaves deep green, simple, opposite, shining, oblong, elliptic-oblong, 5 to 19 cm long and 2 to 7 cm wide, slight acuminate at apex, cuneate at base with many lateral nerves. The length of leaf stalks vary from 1 to 2 cm. The tree is dioecious. Male and female flowers large, fleshy, usually solitary, axillary and concentrated at the end of branchlets. Pedicels of A. stuhlmannii are longer than in A. ulugurensis, 6 to 8 cm long. Sepals red or pale yellow, petals cream or scarlet. Fruits brown or reddish brown, large and pendulous on tree, conic or cylindric-oblong, 16 to 34 cm long, 15 to 17 cm wide; and weigh about 2.5 to 5.8 kg. The fruit contains 12 to 28 seeds in each of the five locules. Seeds four-angled, about 4 cm long and 3 cm wide with fleshy arils. A kilogramme contains about 100 air dry seeds. Illustrations are shown in Figure 1 and Plate I.

5.0 MAIN USES:

The seed of Allanblackia stuhlmanii yields an edible fat used for cooking, lighting and as a liniment.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Mature A. stuhlmannii fruits fall on the ground from where they can be collected. However, seed collectors often fell fruiting trees in order to get large quantities of fruit per tree at a given time.

In order to get the seed, the fruit is opened. The toughness of the fruit depends on the age of the fruit. In freshly-fallen fruit the fresh inside is fairly tough; but as fruit decays, its toughness decreases. The seeds are extracted from decaying tissues and dried in the sun before they are sold to the General Agricultural Products Export Company - GAPEX or oil is locally extracted.

7.0 TIME (SEASON) OF COLLECTION OF EDIBLE PART:

According to Glendon (1946) A. stuhlmannii matures between November and January, i.e. during the short rains in the Usambaras. This is contrary to recent field observations in the Usambara, Nguru and Uluguru Mountains where A. stuhlmannii trees start flowering in either January or February, i.e. short dry season. Fruits mature about the third week in January and continue fruiting until the beginning of April. It is interesting to note that flowering and mature fruit falling occur simultaneously. From the above observation it is likely that it takes over one year from fertilization of the flower to the falling of mature fruit.

8.0 NUTRITIONAL VALUE:

According to Glendon (1946) sun-dried nuts contain approximately 51 percent of fat or 66 percent of the kernel weight equivalent to 71 percent expressed on a moisture-free basis. It is also reported that the residue meal left after the extraction of the fat contains the following constituents: moisture 13.1 percent; crude protein 14 percent; fat 7 percent; carbohydrates 55.3 percent; crude fibre 7.3 percent; and ash 8.3 percent. This meal is probably unsuitable for cattle because of a small amount of tannin which is present.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: A. stuhlmannii regeneration in natural forests occurs, but it is not adequate. Field observations show that usually the few seedlings or saplings, when present, are always near mature mother trees. This noted inadequate natural regeneration might be due to any of the following: A. stuhlmannii seed has a high market value, thus most of the seed is collected and sold to CAPEX; fruit borers and giant rats (probably Cricetomys emini) found in the Usambara attack the seed; and that sporadic and prolonged germination exposes the seed or seedling to detrimental environmental elements.

9.2 Artificial regeneration: Very little has been done to raise A. stuhlmannii from seed. Based on the poor germination of the seed, direct sowing is not recommended. However, it is suggested that pregerminated seed (in seed bed) should be sown directly into large polythene pots.

Recent laboratory work in Lushoto revealed that sowing of A. stuhlmannii seed in Copenhagen tank at temperature of 25 $\pm$ 1° C, improves germination to about 80 percent. The germination starts at four to five months and continues sporadically for two to three months. These results should, however, be treated with caution owing to the small sample used.

The use of natural seedlings (wildings) is another alternative. Wildings are collected from natural forests and potted. The results have been very discouraging owing to very low survival of potted wildings - 6 percent after six months. Grafting of potted and natural wildings has been tried with modest success. The survival of the grafted stock in the nursery is very low, and in trial plot growth is low. At age 4.4 years, survival was 53 percent and mean height was 39.6 cm (Mugasha, 1980).

10.0 POTENTIAL ECONOMIC IMPORTANCE:

A. stuhlmannii seed yields a high percent of a firm, white and somewhat brittle fat. There has been minimal exploitation of this resource in Tanzania, but with increasing shortage of edible fats, it is hoped that this species will be one of the important sources of fat. Thus, planting it on large plantation scale is highly recommended. Moreover, it will boost the economy of the people. This is because currently CAPEX is locally buying A. stuhlmannii seed at 2 to 3 T shillings per kilogramme.

PLATE I. Allanblackia stuhlmannii (Engl.) Engl.

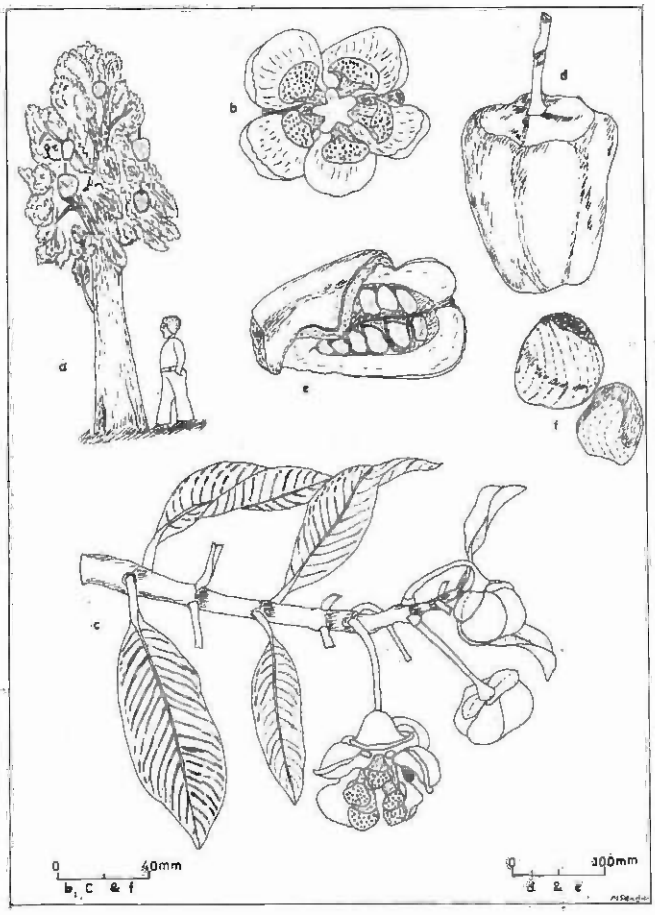


Plate I. Allanblackia stuhlmannii

a - tree
b - female flower, exteriour view
c - branchlet bearing flower-buds and flower
d - mature fruit
e - fruit in part section, showing seeds in situ
f - seeds

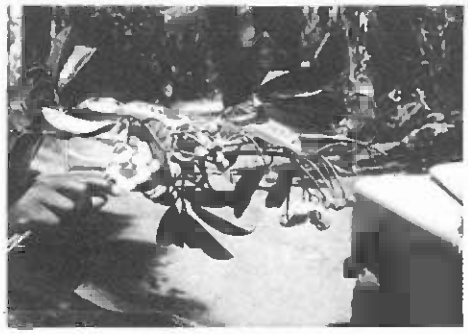


Plate I_1 Branchlet bearing leaves, flower buds and flowers from a tree at Amani Tanga, January 1982

Plate I_2 Part of fruit showing seeds at Kwamkoro, Tanga, January 1982

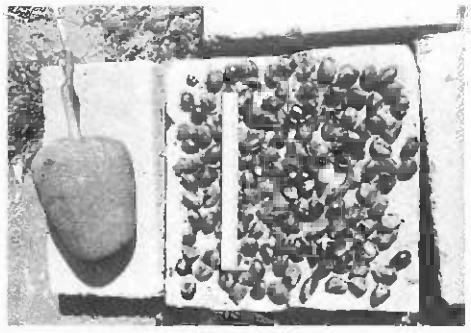


Plate I_3 Fruit and seeds at Kwamkoro, Tanga, January 1982

2. ALLANBLACKIA ULUGURENSIS

1.0 NAMES: - Family Guttiferae
Botanical Allanblackia ulugurensis Engl
Vernacular msambu (Kiswahili, Kishambaa); msambu-mbwiti (Kizigua); mkanye (Kishambaa, Kibondei); mkanyi (Kishambaa); mkani (Kiluguru)

2.0 DISTRIBUTION:

2.1 Locality: A. ulugurensis is known to occur only in Tanzania. This species is abundant in Morogoro District in the Uluguru Mountains, especially in the Morningside and Teketero areas, and in the Nguru Mountains at Manyangu and Maskati Forest Reserves. The species is also known to occur naturally in Iringa District, in the Ruaha Valley at Ukwama.

2.2 Altitude: Bamps, et. al. (1978) observed that A. ulugurensis occurs from 1000 to 2050 m a.s.l. A recent survey revealed that the species is found from 700 m a.s.l. at Manyangu Forest Reserve in the South Nguru Mountains.

2.3 Climate: Efforts to get climatic data from meteorological stations in the Uluguru and Nguru Mountains were fruitless. However, Morgan (1972) groups Uluguru and Nguru Mountains under the areas receiving over 1270 mm annual rainfall in four years out of five. The mean maximum and mean minimum temperatures are, respectively, 25° C and 12.8° C (United Republic of Tanzania, 1967).

2.4 Geology and soil: Uluguru Mountains are dominated by yellow-red sandy loam soils derived from granite, gneiss and sedimentary rocks at higher altitudes, and red to yellow-red, gritty, sandy clay loam soils derived from coarse-grained siliceous rocks and usually associated with "Inselbergs" at lower altitudes. This latter type of soil is also dominant in the Nguru Mountains. Generally, these mountains are dominated by latosols (Morgan, 1972).

2.5 Forest type: A. ulugurensis occurs naturally in the rain forests on the lower parts of Uluguru and Nguru Mountains. It is commonly associated with Cephalosphaera usambarensis, Isoberlinia scheffleri, Macaranga kilimandscharica, Newtonia buchananii, Parinari excelsa, Chrysophyllum albidum, Odyendea zimmermannii, Ochna holstii, Strombosia scheffleri, Myrianthus arboreus, Albizia gummifera, Anthocleista zambeziaca, Bombax rhodognaphalon, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

Although there has been no full-scale inventory, field observations revealed that A. ulugurensis is one of the dominant tree species in the rain forests where it occurs naturally. Moreover, in the Uluguru Mountains some A. ulugurensis trees were left standing when clearing the rain forest as a result of agricultural activities. In the Nguru Mountains (at Manyangu), it was estimated that the stocking varies from 10 to 250 stems/ha.

4.0 DESCRIPTION:

A. ulugurensis is an evergreen tree 5 to 30 m high with a slightly buttressed bole which may be unbranched to about 7.5 m. Bark brownish grey or red-brown, when blazed produces a yellowish resinous latex. The leaves are simple, deep green, opposite, leathery, oblong, elliptic or obovate-oblong, rounded or slightly emarginate at the apex and broadly cuneate at the base with many lateral nerves. The leaves in transverse section are usually curved upwards from the midrib, while their margins are curved downwards. The length of leaf stalks varies from 0.7 to 1.4 cm, while the length and width of leaf blades vary from 7.5 to 19.5 cm and 4 to 11 cm, respectively.

A. ulugurensis is dioecious. Bamps, et. al. (1978) report that the flowers are clustered towards the ends of the branchlets, axillary, fleshy, pedicles short, up to 0.5 cm, occasionally up to 1.2 cm long. The male flowers reddish pink; sepals red-brown, elliptic or almost round, the inner 4 to 7.5 mm long, 4 to 6.5 mm wide; the outer nearly round, up to 1.2 cm long and wide; petals pink or carmine or purplish, nearly 1 cm long and wide; staminal bundles clavate, 1 to 1.4 cm long, widened above, nearly 0.7 to 1.2 cm wide, angled and the angle pointing towards the centre of the flower. The fruits are reddish pink but ochraceous when dry, conical-oblong to conic, 10 to 13.5 cm long and 6.5 to 8 cm across. During the field survey, we noted that A. ulugurensis fruits are smaller than A. stuhlmannii. The mature fruit length and width vary from 20 to 22 cm and 13 to 16 cm, respectively. The seeds are covered with a fleshy aril on one angle and are irregular in shape. The size of the seeds varies from 3.0 to 3.6 cm in length and 2.2 to 2.3 cm in width. A kilogramme contains 115 air dry seeds. Illustrations are shown in Figure 2 and Plate II.

5.0 MAIN USES:

A. ulugurensis seed yields a white fat which is used for cooking and lighting.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are collected from the ground after falling. Seeds are extracted by breaking the fruits and the pulp around the seed cleaned by washing in water. The seeds are dried in the sun for several days, then pounded into powder and boiled in water. The fat/oil which floats on water is removed for use.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that A. ulugurensis flowers in January, April, October and November. The recent field survey revealed that the species flowers from October to January. Fruits start to ripen in December and continue until February. Seeds are collected during this period from freshly fallen fruits. Extraction of fat/oil from the seeds may take place from freshly collected seeds or from seeds which have been dried and stored for a long time.

8.0 NUTRITIONAL VALUE:

There are no available data on nutritional value of the fat/oil which is obtained from the seeds.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: Recent observations, carried out in natural forests at Teketero in the Uluguru Mountains and at Manyangu in the South Nguru Mountains, revealed that natural regeneration occurs but it is not adequate. The very few seedlings present are always found under the mother trees. However, the species seems to be regenerating well under trees left after clearing natural forests at the establishment of agricultural plantations. Here there were profuse seedlings. This implies that poor seed germination is not the cause of poor natural regeneration. The main cause of poor natural regeneration is that the seed is taken away by wild animals (giant rats) or collected for oil extraction and sale. Moreover, the sporadic and prolonged germination of A. ulugurensis seed leaves it exposed to destructive agents and could therefore restrict profuse regeneration.

9.2 Artificial regeneration: No efforts have been made to regenerate the species artificially. However, on the basis of its ecological demands, it seems as if the species could be handled the same way as A. stuhlmannii.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The seed is collected from natural forests and sold to General Agricultural Products Export Company (GAPEX) which exports it; thus it is a source of foreign currency. Cultivation of the species on a large scale will boost the economy. The sap obtained from the tree produces yellow dye. It yields timber of average quality.

PLATE II. Allanblackia ulugurensis Engl.

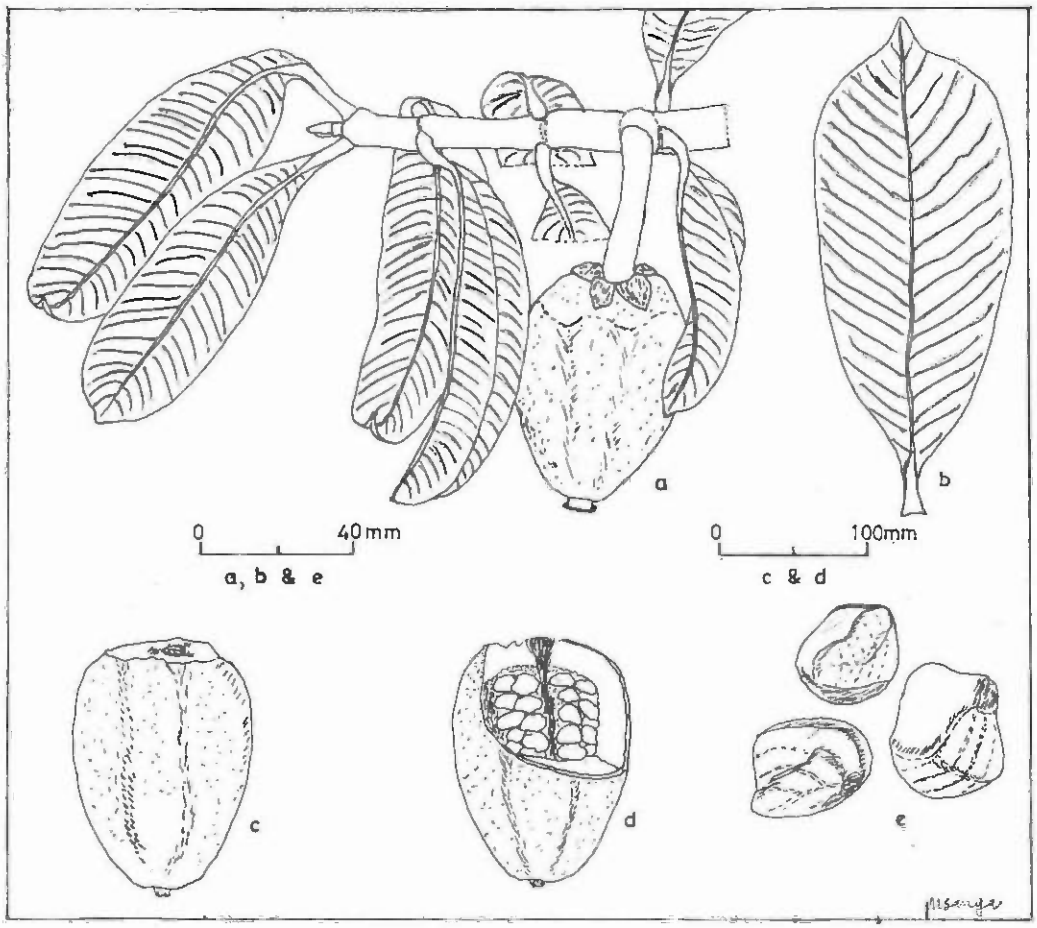


Plate II. Allanblackia ulugurensis Engl.

a - branchlet bearing a young fruit
b - leaf
c - mature fruit
d - part section of fruit showing seeds in situ
e - seeds

Plate II $_1$ - foliage, young and mature fruits at Kiswila village, Morogoro, February 1982

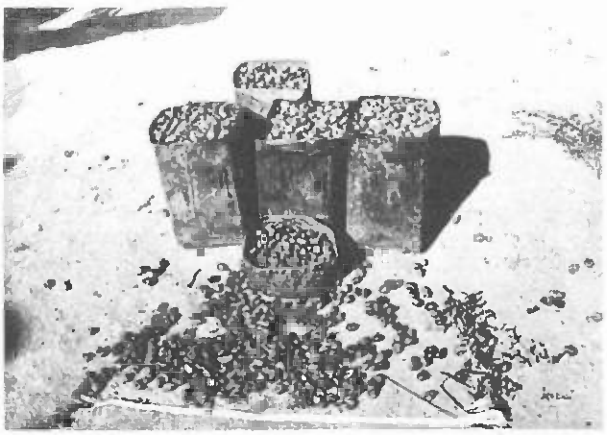


Plate II $_2$ - sun dry seeds at Kiswila village, Morogoro, February 1982

3. ANNONA SENEGALENSIS

1.0 NAMES: - Family: Annonaceae

Botanical: Annona senegalensis Pers.

Syn.:
- A. chrysophylla Boj.
- A. senegalensis Pers var. latifolia Oliv.
- A. porpetac Baill
- A. senegalensis Pers. var. porpetac (Baill.) Diels
- A. chrysophylla Boj. var.porpetac (Baill.) Robyns & Ghesq.
- A. senegalensis Pers. var. chrysophylla (Boj.) Sillans

Vernacular: mchekwa, mutopetope (Kiswahili); mfila, mtopetope, mkonola (Kinyamwezi); mtopetope (Kirufiji); mtonkwe, (Kibondei, Kishambaa, Kizigua); mtomoko mrisirisi (Kichaga).

Common English Name: Wild Custard Apple or Wild Soursop

2.0 DISTRIBUTION:

2.1 Locality: A. senegalensis is widely distributed almost throughout Tanzania. It occurs naturally in Biharamulo, Tanga, Korogwe, Mpanda, Muheza, Tabora, Handeni, Morogoro, Mpwapwa, Kondoa, Iringa, Mufindi, Songea, Lindi, Mtwara, Dar-es-Salaam and Kibaha areas; and on Zanzibar and Pemba Islands.

2.2 Altitude: Different authors report varying altitudinal ranges. Verdcourt (1971) reports that it occurs between 0 and 1800 m a.s.l. in Kenya. Dale and Greenway (1961) observed that in Kenya it occurs between 0 and 1520 m a.s.l. Exell and Wild (1960) observed that in East Africa A. senegalensis occurs from 0 to 2400 m a.s.l.

2.3 Climate: A. senegalensis occurs on a variety of sites with varying rainfall regimes. The mean minimum and mean maximum annual rainfall is, respectively, 716 mm for Mpwapwa and 2029 mm for Mkoani meterological stations (Nshubemuki, et. al., 1978; E.A. Meteorological Dept., 1975). The temperature and relative humidity for a few selected stations where the species occurs naturally are shown in Table 1.

Table 1. Temperature and relative humidity for a few selected stations in Tanzania where the species occurs naturally

Station (Period)*	Temperature °C			Relative humidity (%)		
	Min.	Max.	Range	0300 GMT	0600 GMT	1200 GMT
Zanzibar-Kisauni (1952-1970)	30.3	21.6	8.7	93	81	64
Tanga (1949-1970)	30.3	22.1	8.2	93	80	67
Morogoro (1946-1960)	30.0	18.6	11.4	90	84	55
Tabora (1952-1970)	29.4	16.7	12.7	83	72	44

* Years inclusive

Source: E.A. Met. Dept., 1975).

2.4 Geology and soils: The species occurs on varying soil types of varying origins. On Zanzibar and Pemba Islands, and along Tanzania mainland coast, it occurs on coral rocks dominated by sandy loam soils (Morgan, 1972). It is very abundant in most parts of Tanzania mainland with the exception of the dry belt of Dodoma and Masailand.

2.5 Forest type: A. senegalensis is widespread throughout Tanzania in Brachystegia woodland and Combretum, Terminalia, Xeroderris woodland, rare or absent in thornbush areas (Brenan and Greenway, 1949). Verdcourt (1971) observed that the species occurs naturally in grassland, grassland with scattered trees, thickets (coastal), open woodland, including Brachystegia. Julbernardia woodland, frequently in places subjected to burning.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The inventory data on A. senegalensis were worked out by C.D. Schultz and Company, Ltd. (1973). The inventory data for Mtwara, Tanga and Kilombero blocks are shown in Table 2.

Table 2. A. senegalensis inventory data in Kilombero, Mtwara, Tanga blocks in Tanzania

Block	Area (ha)	Number of stems per ha by DBH class				Total stems in block
		15-29	30-44	44-95	Total	
Kilombero	248 310	3.82	0.04	0.07	3.87	960 823
Mtwara	291	17.16			17.16	4 994
Tanga	40 960	4.05	0.02		4.07	166 707

Source: C.D. Schultz and Company, Ltd., 1973.

The above observations are confirmed by the results obtained from the field survey during the course of this study which show that the species is most abundant, or one of the dominant tree species, along some of the coastal areas and decreases towards the interior in the more lightly stocked areas of the Brachystegia Julbernardia woodland.

4.0 DESCRIPTION:

During the recent field survey, it was noted that A. senegalensis can grow up to 11 m in height and 28 cm in diameter at breast height. Polhill and Verdcourt (1971) report that the species is a shrub or small tree 1.5 to 10 m high. Bark grey-brown, often rough and corrugated; young stems mostly ferruginous, velvety to greyish tomentose, later becoming gladbrous. Leaves simple, alternate, stalks 0.5 to 2 cm long. Leaf blades ovate, oblong, oblong-elliptic, obovate-oblong with acute, obtuse, rounded or slightly emarginate apex and obtuse, acute or subcordate base. The size of leaf blades varies from 6 by 3 cm to 18 by 12 cm or more. They are bluish-green and slightly pubescent above, while the lower surfaces are paler and tomentellous with prominent venation. Flowers usually fragrant, solitary or in 2 to 4 fascicles. A. senegalensis has three green sepals and 6 petals which are greenish outside and yellowish inside. Stamens linear 1.2 to 2.5 cm long. Carpels cylindrical, 1 to 1.5 mm long. The unripe fruit is green and turns orange or yellow on ripening. It is ovoid or globose or subglobose, measuring 2.5 to 5.0 cm long and 2.5 to 4.0 cm wide. It is a many-seeded syncarp which, on ripening, produces a pleasant smell. Illustrations are shown in Figure 3 and Plate III.

5.0 MAIN USES:

The white pulp of the yellow to orange fleshy fruit of A. senegalensis is edible and has a pleasant pineapple-like odour and sweet taste.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe A. senegalensis fruits are collected from standing trees. Sometimes, green mature fruits are collected and stored for some days to ripen. Usually, fruits found on the ground are unsuitable for eating.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Throughout Tanzania, A. senegalensis flowers between October and December. However, along the coast flowering is between December and February. Fruit maturity takes place during the long rains. In western Tanzania, in the miombo woodland, fruit maturity starts towards the end of December up to March. In eastern Tanzania, especially along the coast, it takes place starting from March to May.

8.0 NUTRITIONAL VALUE (IF KNOWN):

A general analysis of the fruit is available in Wehmer (1929-31).

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: A. senegalensis is said to regenerate naturally through seed, root suckers and coppice. On disintegration of the fruit, the seed falls on the ground where it germinates. Seed germination is common in recently cultivated and burnt areas. Root suckers are produced soon after wounding the root by fire or cultivators. Coppices are produced after felling of the shrubs or small trees.

9.2 Artificial regeneration: No efforts have been made to regenerate the species artificially. However, seedlings can be raised in the nursery. For rapid germination the seed has to be scarified.

Bearing in mind that A. senegalensis is a light demander, the planting site should be cleared of all herbaceous vegetation before planting and there should be slashing of herbaceous vegetation, especially during the first few years after planting.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

If this species is fully known to people, it can be cultivated and fruits sold in the markets, contributing to their economy. The wood is used for tool handles (Brenan and Greenway, 1949); a yellow or brown dye is obtained from the bark (Dale and Greenway, 1961); the bark, roots and leaves are used in the preparation of traditional medicine (Watt and Breyer-Brandwijk, 1962).

PLATE III. Annona senegalensis Pers.

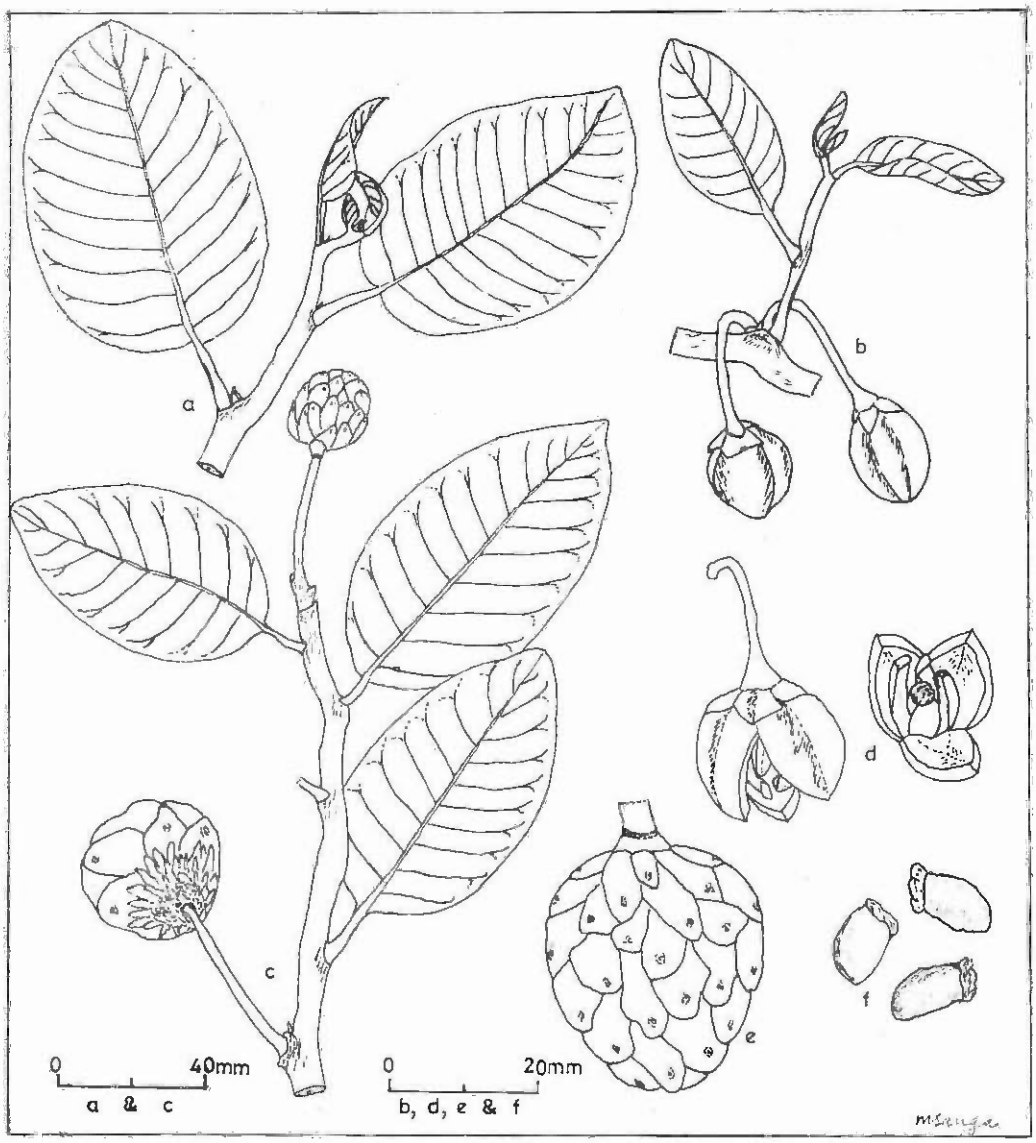


Plate III. Annona senegalensis Pers.
- a - young branchlet
- b - branchlet bearing flower buds
- c - mature branchlet bearing young fruits
- d - flowers
- e - mature fruits
- f - seed

Plate III$_1$ - tree 11 m high in fruit at Msingo forest, Longuza Tanga, January 1982

Plate III$_2$ - branchlets bearing leaves and young fruits at Msingo forest, Longuza Tanga, January 1982

4. AZANZA GARCKEANA

1.0 NAMES: - Family: Malvacaea
Botanical: Azanza garckeana (F. Hoffm.) Exell & Hillcoat
Syn.: Thespesia lampas sensu Mast
T. garckeana F. Hoffm.
T. trilebata Bak. f.
T. regersii S. Moore
Shantzia garckeana (F. Hoffm.) Lewton
Vernacular: mutwa, mtwa, msembere (Kirangi); mtowo (Kihehe); mtobo (Kibende) mtoo (Kinyasa); mutovo, mtovo, mutobo (Kinyamwezi); mtoyo (Kigogo); mutrogho (Kinyaturu); dong, xaxabo (Kisandawe); mtogho (Kinyiramba); mutogo (Kikimbu)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that A. garckeana is found throughout the Tanzanian mainland. This observation is supported by the results obtained during the survey carried out recently and the survey of the botanical specimens in Lushoto herbarium, which show that the species grows naturally in almost all regions of Tanzania.

2.2 Altitude: It has been noted from the results obtained during the field survey carried out recently, and the botanical specimens laid in Lushoto herbarium, that the species grows from the coast to about 1900 m a.s.l. in Mbulu.

2.3 Climate: A. garckeana grows naturally in areas with varying climate, from semi-arid areas of central Tanzania receiving between 254 and 508 mm annual rainfall to areas receiving between 762 and 1270 mm annual rainfall in four years out of five (Morgan, 1972). The relative humidity and mean annual temperatures for a few selected meteorological stations in Tanzania where A. garckeana grows naturally are shown in Table 3.

Table 3 Relative humidity and mean annual maximum and minimum temperatures for selected stations in Tanzania where A. garckeana grows naturally

Station	Mean temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Dodoma	28.9	16.4	12.5	89	75	44
Ilonga	30.1	18.9	11.2	-	80	55
Iringa	26.2	14.0	12.2	85	68	51
Mombo	31.0	18.9	12.1	92	78	50
Songea	26.4	15.7	10.7	90	79	53
Tabora	29.4	16.7	12.7	83	72	44

Source: E.A. Met. Dept., 1975.

2.4 Geology and soils: A. garckeana grows naturally on a variety of soils of varying rock origin. The species prefers mostly light yellow brown to reddish-yellow gritty, sandy clay loams and often on black to dark grey clays and brown clays (Morgan, 1972).

2.5 Vegetation types: A. garckeana grows naturally in wooded grasslands, open woodland and in thickets. The common associate tree species include: Berchemia discolor, Cassia abbreviata, C. singueana, Combretum molle, C. zeyheri, Dalbergia melanoxylon, Ehretia sp., Entandrophragma bussei, Grewia mollis, G. platyclada, Manilkara mochisia, Tamarindus indica, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

No inventory data have been recorded. However, a rough sampling carried out near Mtipa, Singida revealed that there was profuse natural regeneration of about 70 saplings and 6 mature trees in the 504 m^2 plot. The species is more abundant in wooded grassland areas than in open woodland or thickets. Occasionally, the species is dominant in the wooded grassland.

4.0 DESCRIPTION:

A. garckeana is a deciduous shrub or small spreading tree 3-13 m high and up to 25 cm d.b.h. Bark rough, greyish-black, fibrous with longitudinal fissures and brown to yellow slash. Young branchlets stellate - tomentose, becoming glabrescent when mature. Leaves alternate and palmate with 3-5 lobes up to 20 x 20 cm; suberbicular in outline, stellate-pubescent to nearly glabrous above, densely pubescent to tomentose beneath. The lobes are shallow and rounded or deeper and acute, cordate at base. Flowers large, up to 6 cm long, solitary, borne on long jointed pedicels in axils of uppermost leaves. Petals yellow or purplish with dark purple or dark red centre. Fruits thick, hairy, woody, subglobose or obovoid capsules up to 4 cm long, 3 cm thick, opening in 5-6 thick, red and glutinous segments. Seeds are hemispherical, up to 10 mm long, 7 mm thick with brownish and woolly floss. Illustrations are shown in Figure 4 and Plate IV.

5.0 MAIN USES:

A. garckeana ripe fruit carpels are edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

A. garckeana fruits are persistent, thus they are picked on ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that the species flowers in February. White (1964) observed that in Zambia, A. garckeana flowers between November and January, while fruit ripening occurs in April and August. Chingaipe (Pers. Comm.) observed that in Zambia fruit ripening takes place between July and September. A survey of the botanical specimens in Lushoto herbarium revealed that flowering takes place between November and January, while fruit ripening occurs in May and August. However, the species occasionally flowers in August in western Tanzania. The field survey carried out recently showed that flowering occurs from November to April, while fruit ripening takes place between May and August. From the above observations it can be concluded that flowering takes place during the rainy season, while fruit ripening takes place during the dry season. Moreover, it takes about six months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: A. garckeana regenerates naturally from seed, coppice and suckers. Field observations have shown that on ripening the fruit splits releasing the seed which falls on the ground. The seed germinates readily, especially when conditions are favourable. Coppice shoots are produced on felling of trees.

Root suckers are produced after wounding of the root, e.g. cultivators, fire, trampling by animals, etc. The stocking of A. garckeana in its natural habitat is being limited by annual fires which wipe out most of the young seedlings and saplings. Thus, partial protection of the woodland where the species grows naturally could help its propagation.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, because of the good germination of the seed, potted seedlings could be raised in the nursery and planted out in the field. Alternatively, direct sowing could be a feasible technique. The species is a light demander, thus the planting site should be subjected to partial clearing before planting out. Moreover, intensive weeding would be necessary during the first few years after planting out.

PLATE IV. Azanza garckeana (F. Hoffm.) Exell & Hill coat

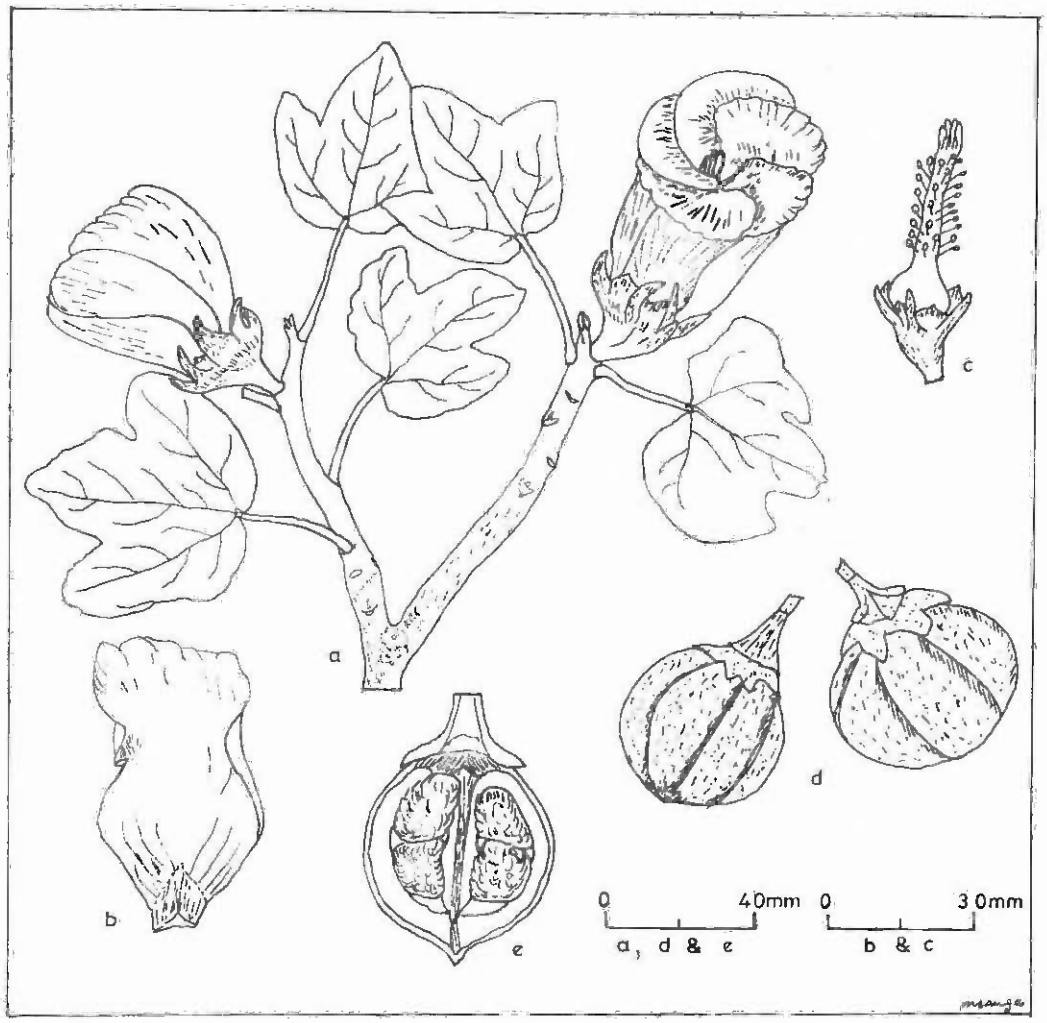


Plate IV. Azanza garckeana (F. Hoffm.) Exell & Hill coat

a - flowering branchlet
b - petal
c - gynaecium
d - fruits
e - part of fruit opened to show seeds

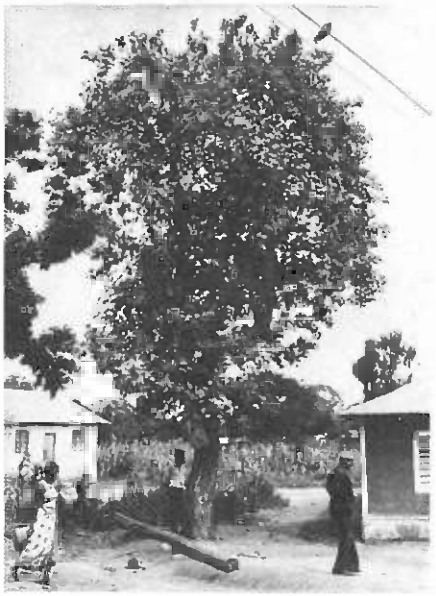


Plate IV$_1$ - tree at Mpwapwa Township April, 1982

Plate IV$_2$ - branchlet bearing mature fruits, Mpwapwa Township, April, 1982

5. BERCHEMIA DISCOLOR

1.0 NAMES:

Family	Rhamnaceae
Botanical	Berchemia discolor (Klotzsch) Hemsley
Syn.	Scutia discolor Klotzsch
	Phyllogeiton discolor (Klotzsch) Herzog
	Adolia discolor (Klotzsch) Kuntze
	Araliorhamnus punctulata H. Perr,
	A. vaginata H. Perr.
Vernacular	mgandu (Kigogo), mkuni (Kinyamwezi); mnago (Kiswahili); okoo (Kisandawi); nyahumbu (Kipogoro).

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that the species is widely distributed in Tanzania but nowhere common. Johnston (1972) reports that the species grows naturally in northern Tabora, Mpwapwa and Morogoro. The above observations are confirmed by our recent observations that the species grows naturally throughout Tanzania, except in the mountain forests, e.g. Kilimanjaro, Usambara, Uluguru, Nguru and Tukuyu areas.

2.2 Altitude: Johnston (1972) observed that B. discolor grows naturally from sea level to about 2000 m a.s.l.

2.3 Climate: The climate of the areas where B. discolor grows naturally has been described under Azanza garckeana.

2.4 Geology and soils: The geology and soils of the areas where B. discolor grows naturally are described under Azanza garckeana. However, the species is known to perform best in stream valleys or riverain soils. The species is often found growing naturally on termite mounds.

2.5 Vegetation types: Johnston (1972) observed that the species grows naturally in thicket, semi-desert grassland and wooded grasslands and riverain forests. The common associate tree species are Azanza garckeana, Balanites aegyptiaca, Cassia abbreviata, C. singueana, Combretum molle, C. zeyheri, Dalbergia melanoxylon, Entandrophragma bussei, Grewia bicolor, G. platyclada, Manilkara mochisia, Zanthoxylum chalybeum, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

Although no inventory data have been recorded on B. discolor, field observation carried out during the course of the study revealed that in most cases its abundance is very low. However, its abundance is relatively higher in the thickets of Dodoma and Itigi.

4.0 DESCRIPTION:

B. discolor is a shrub or tree, 3-20 m high with straight bole, rough dark-grey bark which flakes longitudinally, dense rounded crown, yellow slash and very hard and heavy wood. Young branches conspicuously lenticellate; branchlets glabrous or densely pubescent with short spreading whitish hairs. Leaves alternate or subopposite, entire or obscurely crenate, shining above, dull and glaucous below, broadly elliptic, ovate or obovate-elliptic-lanceolate, 2-9 cm long, 2-5 cm wide, obtuse or acute at the apex, rounded or cuneate at base. Leaf stalks glabrous or pubescent 1-1.8 cm long. Flowers small, solitary or in fascicles of 2-6 and axillary. Fruits small fleshy drupes 1-2 cm long, 0.5-1.3 cm thick, oblong or ellipsoid, greenish when young, turning yellowish after ripening. Illustrations are shown in Figure 5 and Plate V.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

B. discolor ripe fruits are collected from the ground or picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that B. discolor flowers in January and in November, while fruit maturing occurs in February. White (1962) observed that in Zambia B. discolor flowers between November and December, while fruit ripening occurs between January and March. The above observations are supported by the results obtained from a survey of the botanical specimens in Lushoto herbarium. Flowering occurs between November and January, and fruit ripening occurs in January. A field survey made during the course of this study revealed that flowering occurs between November and January, while fruit ripening occurs from March to May. The above observations revealed that it takes about four to five months from flower fertilization to fruit ripening. Moreover, flowering starts at the onset of the rains, while fruit ripening occurs towards the end of the long rains.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: B. discolor is said to regenerate naturally from seed, coppice and root suckers. The germination of the seed takes place after staying on the ground for quite some time owing to its hard seed coat. Forest fires help in reducing seed coat hardness. B. discolor coppice shoots are produced on felling of trees; while root suckers are produced after root wounding by any means, i.e. forest fires, trampling animals, animal burrows, cultivation, etc. It is, however, important to note that its natural regeneration is rare. It is thought that poor seed germination capacity and destruction of seedlings and saplings by forest fires may be the causes of the observed rare germination of B. discolor. Thus, partial protection of the forest from forest fires could promote natural regeneration.

9.2 Artificial regeneration: There have been no efforts to regenerate B. discolor artificially. However, there are possibilities that the species could be raised artificially. This can be achieved by pretreatment of seed, e.g. scarification of the seed. Potted stock can be raised in the nursery and planted in the field where the vegetation must be partially cleared as the species is a light demander. Moreover, there may be a need for applying fertilizers at the time of planting because the species is always found growing naturally on termite mounds. Termite mounds are always very fertile. Tending of the crop should include slashing and spot weeding until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruit is edible and has a sweetish flavour; the wood is yellow-brown and hard, making excellent furniture; it is used in making pestles, in building poles, hair combs, etc.

PLATE V. Berchemia discolor (Klotzsch) Hemsley

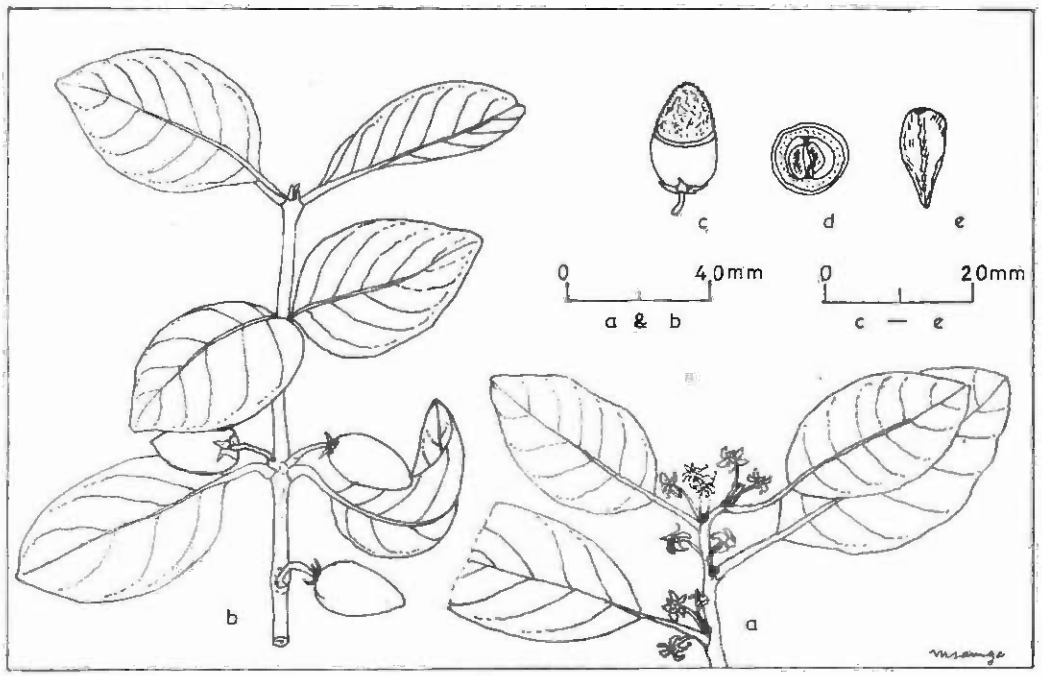


Plate V. Berchemia discolor (Klotzsch) Hemsley

a - flowering branchlet, pressed specimen No. FH 936 in Lushoto herbarium, January, 1951

b - branchlet bearing fruits, Simbo Forest Reserve, May 1982

c - fruit part of skin removed to show pulp

d - transverse section of fruit

e - seed

Plate V_1 - tree at Simbo Forest Reserve, Tabora, May 1982. Note the termite mound

Plate V_2 - branchlet bearing ripe fruits at Urumwa, Tabora, May, 1982

6. BUSSEA MASSAIENSIS

1.0 NAMES:

Family	Leguminosae
Sub-family	Caesalpinioideae
Botanical	Bussea massaiensis (Taub.) Harms
Syn.	Peltophorum massaiense Taub.
Vernacular	mbefu (Kogogo); mbetu (Kinyamwezi); mfetru (Kinyaturu)

2.0 DISTRIBUTION:

2.1 Locality: B. massaiensis is said to occur naturally in Dodoma (e.g. at Kigwe, Kigongwe Forest Reserve, Lamaiti, Mukonze, Makutopora and Mzakwe); Manyoni (throughout the thicket), Singida, Nzega, Tabora (East) and Kondoa 45 km south of Kondoa) districts. According to Brenan (1967) the species is not known to occur elsewhere.

2.2 Altitude: Brenan (1967) observed that the species occurs between 1070 and 1370 m above sea level. A field survey carried out revealed that the species grows naturally at about 960 m above sea level at Kigongwe near Dodoma. The above observations show that B. massaiensis' altitudinal range is between 960 m and 1370 m above sea level.

2.3 Climate: Dodoma is semi-arid with a five-to-six-month long dry season and a short rainy season with erratic and unreliable rains. The district mean annual rainfall is slightly over 500 mm with local variations. The mean maximum and mean minimum temperatures for Ikombo meteorological station are, respectively, 31° C and 19° C (Nshubemuki, 1979). According to Nshubemuki, et. al. (1978) Singida receives about 641 ± 182 mm mean annual rainfall and has 52 ± 13 rainy days. Manyoni receives 581 ± 183 mm mean annual rainfall and it has 52 ± 15 rainy days.

2.4 Geology and soils: Geologically, Dodoma district is dominated by precambrian metamorphic rocks with extensive granite intrusions which are now exposed. Lacustrine, alluvial and colluvial material derived from these rocks are deposited on the bedrock to form neogene deposits (Wade and Oates, 1938). Manyoni and Itigi are dominated by tertiary sediment rocks. In Singida and Nzega, B. massaiensis occurs naturally on light-yellowish brown to reddish yellow, gritty sandy clay loam soils derived from granites and granodiorite rocks (Morgan, 1972).

2.5 Vegetation: B. massaiensis is known to grow naturally in thickets, deciduous bushland and deciduous woodland. The common associate tree species include: Adansonia digitata, Afzelia quanzensis, Albizia amara, A. anthelmintica, A. harveyi, Combretum apiculatum, C. molle, C. zeyheri, Commiphora ugogensis, Entandrophramgma bussei, Lonchocarpus bussei, Terminalia sericea, Strychnos inocuum, Xeroderris stuhlmannii, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

B. massaiensis is one of the dominant tree species in the deciduous thicket but it decreases in abundance in the deciduous woodland. A rough estimate in the deciduous thicket of Kigwe in Dodoma revealed that the stocking of B. massaiensis is up to 10 stems per hectare.

4.0 DESCRIPTION:

B. massaiensis is a small or medium-sized tree up to 12 m high with smooth grey bark and spreading crown. Leaves bipinnate with rusty or brown pubescence on leaf rhachides. Leaflets usually 5 to 10 pairs per pinna, elliptic to oblong-elliptic, 0.5 to 3.6 cm long, 0.4 to 1.9 cm wide, unequal-sized base, obtuse to emarginate at apex, glabrous above and slightly pubescent beneath. Flowers yellowish, in close rusty tomentose terminal panicles. Stamen filaments 7 to 9 mm long. Pods erect, 7 to 12 cm long, 2.0 to 2.3 cm wide, very hard and woody, rusty-pubescent with a longitudinal groove down the middle. Seeds slightly hard, 1.6 to 2.0 cm long, 0.9 to 1.0 cm wide. Illustrations are given in Figure 6 and Plate VI.

5.0 MAIN USES:

B. massaiensis roasted seeds are edible. Alternatively, roasted seeds are pounded and used in making soup.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

On ripening and drying, the pods split open releasing the seeds which fall on the ground where they may be collected. Alternatively, ripe pods may be picked from the tree and sun dried, thereby splitting open to release the seed.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that the species flowers in December, i.e. during early rains. A survey of botanical specimens at Lushoto herbarium revealed that flowering is in October, i.e. towards the end of the dry season or at the onset of the rainy season. It was also noted that fruit maturing is between May and July. This is also in agreement with the results of our field survey that fruit maturing is between May and July, i.e. during the dry season. From the above observations, it can be concluded that flowering occurs during the rainy season, while fruit maturing occurs during the dry season and that it takes about six months from fertilization of the flower to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species is said to regenerate naturally from seed and coppice. It should be borne in mind that the species is not regenerating adequately, as only mature trees can be seen in natural forests. Other crop development stages are lacking. This might be because the seed is collected for food and also taken by domestic and wild animals. It is also possible that most seedlings succumb to drought. Moreover, there is a possibility that young trees, e.g. seedlings and saplings, are killed by forest fires. This process may be repeated yearly for several years until the root system has developed to the extent of producing shoots vigorous enough to resist forest fires. Coppice shoots are produced on felling of young or mature trees.

9.2 Artificial regeneration: Artificial regeneration has not been tried. However, the seed has a hard seed coat needing scarification in order to enhance germination. There are possibilities of raising it in the nursery. The species is a light demander, thus it should be planted on sites where some herbaceous vegetation has been cleared and tending should include slashing of herbaceous vegetation until the tree is fully established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

B. massaiensis timber is resistant to termites, thus it is suitable for construction of houses and for making pestles and tool handles; its leaves and seeds are eaten by sheep and goats; it is also suitable for ornamental planting and provision of shade.

PLATE VI. Bussea massaiensis (Taub.) Harms.

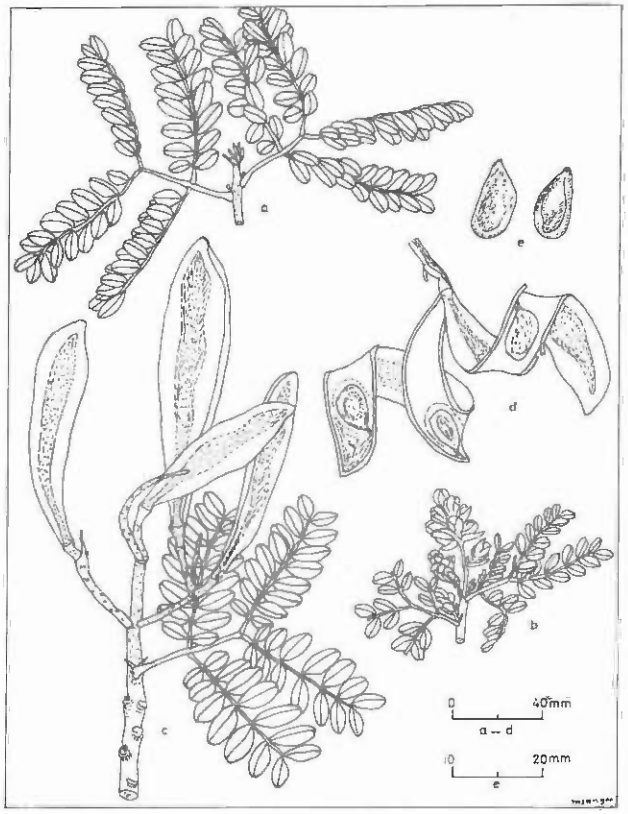


Plate VI. Bussea massaiensis (Taub.) Harms
a - branchlet
b - branchlet bearing flower buds
c - fruiting branchlet
d - split pod
e - seeds

Plate VI_1 - tree, in sorghum farm, Kigwe Dodoma May, 1982. Note the upward pointing pods

Plate VI_2 - branchlet bearing young pods, Kigwe, Dodoma May, 1982

7. CANTHIUM BURTTII

1.0 NAME:

Family	Rubiaceae
Botanical	Canthium burttii Bullock
Vernacular	mgubalu, mkamu (Kinyamwezi); mgango (Kizinza), nkamu (Kisukuma)

2.0 DISTRIBUTION:

2.1 Locality: The species occurs naturally in Tabora (i.e. near Beekeeping School, Ulyankulu and Simbo), Nzega (i.e. Mwanihala Forest Reserve, Mwambaha, Idudumo and around Nzega Town), Mwanza (near Kalumo Ferry), Geita, Singida (around Singida township) and Manyoni (Itigi thicket) Districts.

2.2 Altitude: C. burttii grows naturally between 1000 m and 1500 m above sea level.

2.3 Climate: The rainfall statistics for some stations where C. burttii occurs naturally are given in Table 4.

Table 4. Rainfall statistics for some stations where C. burttii occurs naturally

Station (period)*	Mean annual rainfall (mm)	Annual rain days
Geita (1961-73)	994	81
Manyoni Dist. (1931-73)	581 ± 183	52 ± 15
Mwanza Agric. (1931-60)	999 ± 211	107 ± 23
Nzega Dist. (1931-73)	798 ± 158	62 ± 17
Singida Dist. (1931-73)	641 ± 182	52 ± 13
Tabora Airport (1931-75)	927 ± 177	102 ± 13

*Years inclusive.

Source: Nshubemuki, et. al., 1978.

The temperature and relative humidity data for Tabora Airport and Ukiriguru Agricultural Meteorological stations are shown in Table 5.

Table 5. Temperature and relative humidity data for selected stations where C. burttii occurs naturally

Station (period)	Temperature means °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Tabora Airport (1949-70)	29	17	12	83	72	44
Ukiriguru Agric. (1963-70)	29	17	12	-	71	49

Source: E.A. Met. Dept (1975).

2.4 Geology and soils: The geology and soils of Tabora, Singida and Manyoni are described under Bussea massaiensis and Parinari curatellifolia. Geologically, Mwanza and Geita Districts are dominated by granites and granodiorite rocks on which lie red to dark red friable clays with laterite horizon (Morgan, 1972).

2.5 Vegetation types: Brenan and Greenway (1949) observed that C. burttii is common in thicket throughout central Tanzania and the Brachystegia woodland of western Tanzania. The common associate tree species are Acacia tanganyikensis, Albizia harveyi, A. petersiana, Brachystegia spiciformis, Combretum molle, C. zeyheri, Dalbergia melanoxylon, Feretia apodanthera, Grewia bicolor, G. platyclada, Hymenodictyon floribundum, Julbernardia globiflora, Xeroderris stuhlmannii, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

There has been no recording of inventory data in the forests where C. burttii occurs naturally. However, the preliminary field survey carried out recently revealed that the species is more abundant in thickets and that it decreases in abundance in Brachystegia woodland. It is estimated that the stocking in thickets varies from 5 to 8 trees per hectare, while in Brachystegia woodland it is about 2 trees per ha.

4.0 DESCRIPTION:

C. burttii is a deciduous shrub or small tree up to 7 m high with smooth grey bark and tough stem and branches. Branchlets usually opposite, reddish or greyish, tomentose. Leaves opposite, 4-9 cm long, 2.5-7.5 cm wide, densely velvet-pubescent on both sides, ovate, ovate-orbicular, cuspidate or rounded; acute or shortly acuminate at the apex and mostly confined towards the apex of branches. Venation closely reticulate and more prominent beneath. Leaf stalks very short, 2-5 mm long. Flowers pale greenish-yellow produced in axillary cymes. Fruits globose, 0.8-1.8 cm long, 0.5-1.7 cm wide, pale brown or greenish-yellow containing 1-2 seeds per fruit. Seeds small, conic and hard. Illustrations are shown in Figure 7 and Plate VII.

5.0 MAIN USES:

C. burttii fleshy ripe fruit pulp is slightly sour in taste and edible.

6.0 METHOD OF COLLECTION:

Mature fruits may be picked from the tree and stored for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that C. burttii flowers in December. A survey of the botanical specimens in Lushoto herbarium shows that C. burttii flowers in November at Ulyankulu (Tabora). It was also noted that the species fruits between December and January. A field survey carried out during the course of this study revealed that fruit maturing and ripening takes place from February to June. The above observations show that flowering takes place at the onset of the rains, while fruit ripening is towards the end of the rainy season and at the onset of the long dry season. It can also be inferred that it takes about four to five months from the fertilization of the flower to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates from seed and coppice. However, regeneration from seed is rare because the seed coat is hard requiring sowing pretreatment. A field survey revealed that saplings, poles and mature trees were present. The species is a shade demander. It is thought that regeneration inducement could be of value in improving the species' stocking in natural forests.

9.2 Artificial regeneration: Artificial regeneration has not been tried. However, bearing in mind that the species produces abundant seed yearly, it can be concluded that C. burttii could be regenerated artificially. It is possible to raise potted seedlings which could be planted in lanes along which woody vegetation has been cleared. Cutting of climbers and slashing of brambles along the cleared lanes should be undertaken until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Although C. burttii ripe fruits are not currently sold on local markets, large-scale planting of the species could contribute to the economy of fruit sellers as the fruit is popular; the tree is very hard and resistant to termites, therefore it is used for house construction and fences; it is also suitable for fuel-wood.

PLATE VII. Canthium burtii Bullock

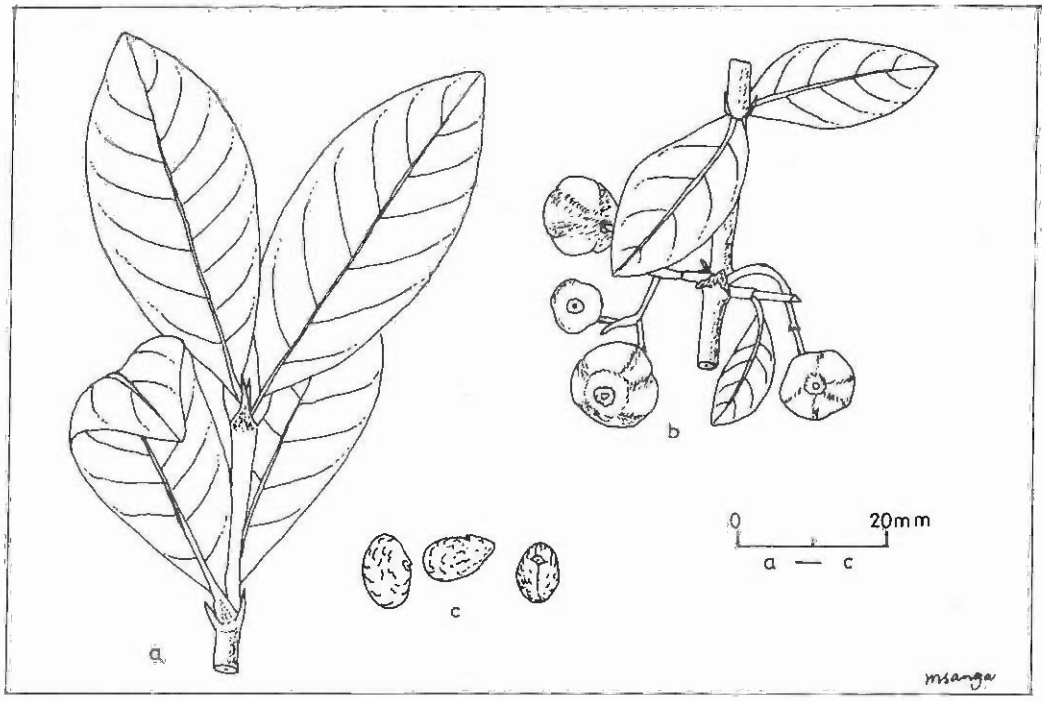


Plate VIII. Canthium burtii Bullock

a - branchlet
b - fruiting branchlet
c - seeds

Plate VII$_1$ - tree, at Mwanbaha, Nzega - May 1982. Note the over topping by Afzelia quanzensis

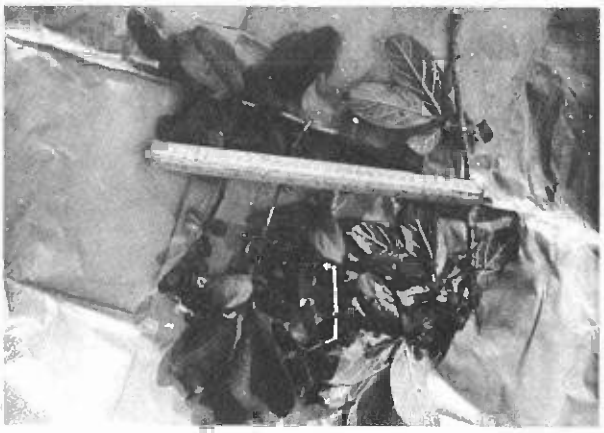


Plate VII$_2$ - branchlet bearing dry fruits, at Mwambaha, Nzega - May, 1982

8. CANTHIUM CRASSUM

1.0 NAMES:

Family	Rubiaceae
Botanical	Canthium crassum (Schweinf.) Hiern
Vernacular	muyogoyogo, mukukumba (Kinyamwezi); mugogolo (Kibende); musede (Kirangi); munyabitwa (Kizinga); ingulungulu (Kinyakyusa); mbwewe, muwewe (Kihehe, Kibena); nam (Kisandawi).

2.0 DISTRIBTUION:

2.1 Locality: Brenan and Greenway (1949) observed that the species grows naturally in Tukuyu (i.e. Kyimbila area); Manyoni (i.e. Kazikazi area) and Tabora (i.e. Simbo Forest Reserve) Districts. A survey of the botanical specimens in Lushoto herbarium and field survey carried out during the course of this study revealed that the species also grows naturally around Tabora Beekeeping School, Urumwa, Kigwa, Sikonge, Ichemba and Kiwele in Tabora District. The species was also found at Ndala, Makomelo, Idudumo and Iduguta in Nzega District. In Mpanda District the species grows naturally at Mwese, while in Kondoa it grows naturally on Kolo Hills. It is also known to grow near Chunya, in Kigoma at Kalinzi, and near Geita.

2.2 Altitude: A survey of the botanical specimens in Lushoto herbarium and the field survey carried out during the course of this study revealed that C. crassum grows naturally between 1150 m (at Urumwa) and 1820 m above sea level at Mwese Highlands in Mpanda District.

2.3 Climate: The climatic statistics for Tabora, Nzega and Manyoni Districts where C. crassum is known to grow naturally are given under Canthium burttii. According to Nshubemuki, et. al. (1978), Tukuyu District Office Meteorological Station mean annual rainfall is 2340 ± 649 with a total number of raindays of 149 ± 57 per year. Morgan (1972) observed that Chunya receives 508 to 762 mm annual rainfall in four years out of five. According to the United Republic of Tanzania (1967), the mean minimum and mean maximum annual temperatures are, respectively, 14° C and 25° C. This indicates that C. crassum grows in a variety of climatic conditions, ranging from semi-arid to wet areas.

2.4 Geology and soils: The geology and soils of Manyoni, Tabora, Nzega and Geita Districts are described under Parinari curatellifolia, Bussea massaiensis and Canthium burttii. In Mpanda and Chunya, C. crassum grows on red to yellow-red, gritty sandy clay loams (latosolic soils) and light yellow brown to reddish yellow, gritty, sandy clay loam, respectively, derived from Nyanzian-Kavirondoan rocks. The soils of Kolo Highland in Kondoa District are brown clay loams to clays derived from rocks of Mozambique belt. Tukuyu District is dominated by dark red sandy clay loams (latosolic soils) derived from tertiary-recent volcanics (Morgan, 1972).

2.5 Vegetation types: C. crassum is known to grow naturally in Brachystegia woodland. The common associate tree species include: Afzelia quanzensis, Albizia antunesiana, Brachystegia spiciformis, Burkea africana, Combretum collinum, C. molle, C. zeyheri, Flacourtia indica, Julbernardia globiflora, Pterocarpus angolensis, Terminalia sericea, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

Inventory data are not available. However, a rough count at Kitapilimwa Forest Reserve (Iringa) revealed that there was profuse natural regeneration of about 48 saplings and 3 mature trees in the 80 m^2 plot. During the course of this study it was noted that C. crassum is more abundant in the Brachystegia woodland in Iringa than in the Brachystegia woodland of central and western Tanzania. This might be caused by altitudinal differences, Iringa being higher than central and western Tanzania.

4.0 DESCRIPTION:

C. crassum is a deciduous shrub or small tree, up to 5 m high, with pale grey bark and robust opposite branchlets which are flattened below nodes. Branchlets usually glabrous with visible lenticels and deltoid acuminate stipules 1 cm long, 0.7 cm wide, more or less persistent, which later enlarge and become woody. Leaves opposite, sub-coriaceons, 7-23 cm long, 4-13 cm wide, elliptic to broadly obovate, rarely ovate, obtuse,

rounded or sub-acuminate at the apex, cuneate or rounded at base; glabrous and shiny green above, glabrous or slightly pubescent and paler or whitish with prominent venation beneath. Leaf stalks 0.3 to 2.0 cm long. Flowers greenish-yellow produced in dense axillary cymes. Fruits ellipsoid, or globose, 1.5-3 cm long, 1.0-2.5 cm wide, 1-2-seeded, yellowish or greenish yellow when ripe, containing hard seeds. Illustrations are shown in Figure 8 and Plate VIII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

C. crassum fruits are persistent, thus they are picked on ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that the species flowers between November and January, while ripening takes place in July.

A survey of botanical specimens in Lushoto herbarium shows that C. crassum flowers between November and April, while fruit ripening takes place between May and July. This implies that flowering takes place in the rainy season, while fruit ripening takes place during the dry season. It takes about six months from the fertilization of the flower to fruit ripening. From the above observation it is possible that most of the fruits which develop from March and April flowers die because of the incipient dry season.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: C. crassum regenerates naturally from seed, coppice and root suckers. However, it should be borne in mind that its natural regeneration is very rare; its abundance in the natural forests surveyed is very low. Moreover, only a few seedlings or suckers were noted, and no saplings were seen.

Natural regeneration could be improved by regeneration inducement techniques, e.g. hoeing and protection of the forests from annual forest fires, as the species appears to be fire tender.

9.2 Artificial regeneration: There has been no effort to regenerate the species artificially. However, there are possibilities of regenerating the species from seed. Owing to the hard seed coat, pretreatment by scarification could be essential. Potted seedlings or stumps could be suitable for planting out.

C. crassum appears to be a shade demander. Thus, it should be planted on selectively cleared sites.

In natural forests, where the species grows naturally, it is often not surrounded by dense vegetation. This implies that it cannot effectively compete with lower herbaceous vegetation. Thus, close planting should always be avoided and strip weeding and slashing of herbaceous vegetation should be practised.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

C. crassum ripe fruits are sweet and have a good taste. Thus, planting it on a large scale could help in improving the income of fruit collectors by selling it on the market.

PLATE VIII. Canthium crassum (Schweinf.) Hiern

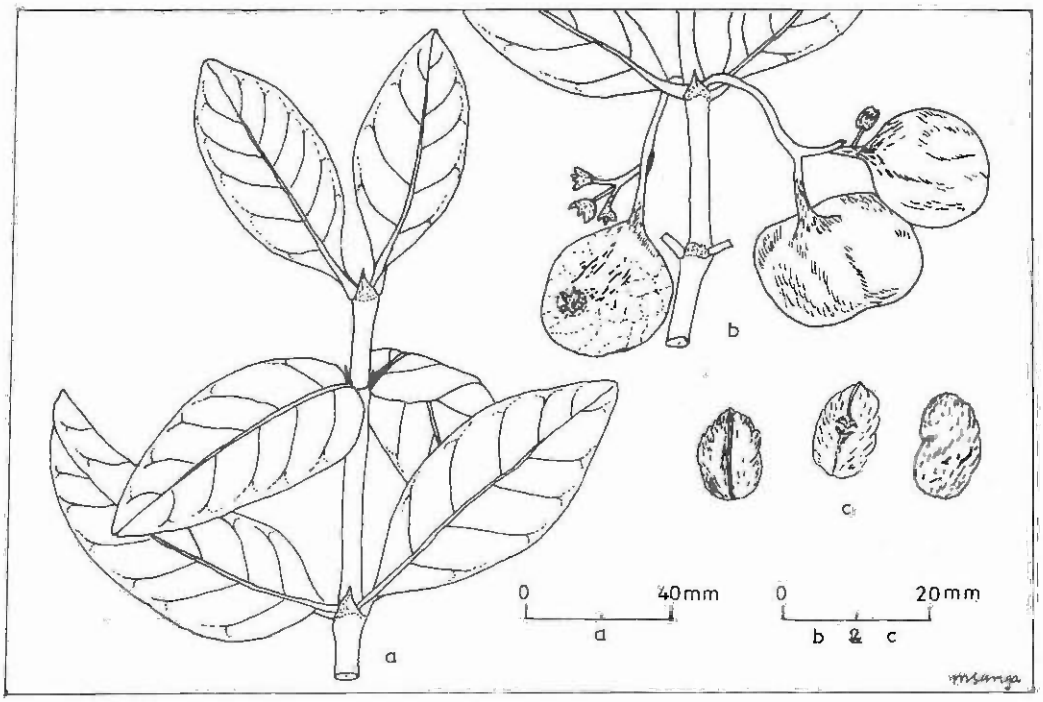


Plate VIII. Canthium crassum (Schweinf.) Hiern

a - branchlet
b - fruiting branchlet
c - seeds

Plate VIII$_1$ - small tree overshadowed by Brachystegia woodland at Simbo, Tabora - May, 1982

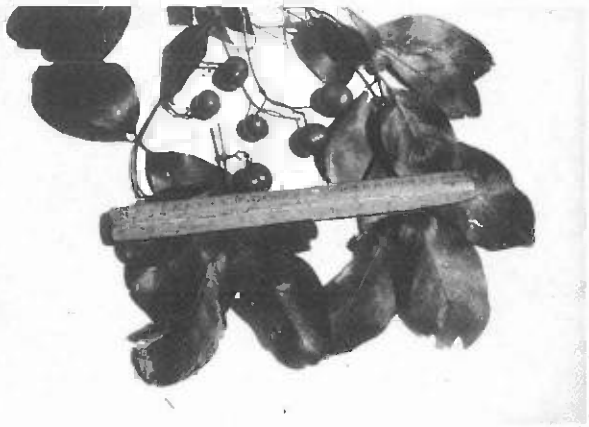


Plate VIII$_2$ - branchlets bearing young fruits at Simbo, Tabora - May, 1982

9. CORDYLA DENSIFLORA

1.0 NAMES:

Family	Leguminosae
Sub-family	Caesalpinioideae
Botanical	Cordyla densiflora Milne - Redh.
Vernacular	mkwata (Kigogo, Kihehe, Kikaguru)

2.0 DISTRIBUTION:

2.1 Locality: C. densiflora occurs naturally in Mpwapwa (e.g. Mbuyuni, Mpwapwa Mission, Kongwa Mission, Chinyika and Chibakwe areas), Kilosa (Kidete), Dodoma (e.g. Chipogolo and Ilangali areas) and Iringa (e.g. Ponda and Idodi areas). It is not known to occur elsewhere (Brenan and Greenway, 1949; Brenan, 1967).

2.2 Altitude: Brenan (1967) observed that C. densiflora occurs between 850 m and 1220 m above sea level. This was confirmed by recent observations. The species was noted to be growing naturally between 950 m and 1050 m above sea level in Mpwapwa and at about 1000 m above sea level at Ilangali in Dodoma.

2.3 Climate: C. densiflora grows naturally in semi-arid areas of Tanzania. Rainfall statistics from 1931 to 1973 for Mpwapwa Veterinary Office shows that the mean rainfall is 716 ± 167 mm and there are 80 ± 14 rainy days. Total annual potential evaporation is 1257 mm (Nshubemuki, et. al., 1978). Morgan (1972) observed that Mpwapwa receives between 508 and 762 mm annual rainfall in four years out of five. It was also observed that Ilangali receives between 254 and 508 mm annual rainfall in four out of five years. The mean minimum and mean maximum annual temperatures are 17° C and 27° C, respectively (United Republic of Tanzania, 1967). Nshubemuki (1979) observed that Ilangali (1966-75) receives 628 mm mean annual rainfall and the total rainy days are 47.7 ± 1.2.

2.4 Geology and soils: C. densiflora occurs in areas of rocks of varying origin. The rocks in Mpwapwa and Kilosa are of the Mozambique belt, while at Ilangali (Dodoma) the rocks are of acid gneisses, magnetites and associated granites and granodiorites. Mpwapwa and Kilosa are dominated by brown clay loams to clay; while Ilangali and Idodi areas are dominated by light yellowish brown to reddish-yellow gritty, sandy clay loams (Morgan, 1972).

2.5 Vegetation: Brenan (1967) observed that C. densiflora occurs naturally in deciduous woodland and bushland (Commiphora). Brenan and Greenway (1949) observed that the species is common in Commiphora thickets. Morgan (1972) reports that Mpwapwa, Kilosa and Ilangali areas where C. densiflora grows naturally are dominated by savanna vegetation. The dominant tree species are Acacia nigrescens, A. senegal, A. tortilis, Adansonia digitata, Albizia amara, A. harveyi, Calyptrotheca taitensis, Commiphora africana, C. ugogensis, Delonix elata, Entandrophragma bussei, Euphorbia candelabrum, Lonchocarpus capassa, Xeroderris stuhlmannii, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

From the field observations carried out in Mpwapwa, it was estimated that the stocking of C. densiflora varies between 8 to 20 stems per hectare; it was also noted that the species is more abundant in disturbed Acacia-Commiphora woodland in Mpwapwa than in similar undisturbed woodland at Ilangali (Dodoma).

4.0 DESCRIPTION:

C. densiflora is a deciduous tree, 4 to 10 m high with rough grey flaking bark and yellowish-green slash. Branchlets flexible, pendulous with visible lenticels. Leaves imparipinnate, 9 to 12 cm long. Leaflets 11 to 19, ovate-oblong or elliptic-oblong, 2.0 to 3.5 cm long, 1.0 to 2.3 cm wide, rounded or emarginate at apex, usually cordate, sometimes rounded or truncate at base, glabrous to pubescent above, pubescent beneath. The tree produces numerous flowers borne in racemes towards ends of branchlets when the tree is almost leafless. Petals absent. Stamens numerous, greenish-white, anthers, yellowish. Fruits subglobose or oblique with reddish-green streaks, 3.0 to 6.0 cm long, 2.5 to 5.0 cm wide and beaked. Seeds fleshy, 2.5 to 5.8 cm long, 2.2 to 4.8 cm wide. Illustrations are given in Figure 9 and Plate IX.

5.0 MAIN USES:

C. densiflora fruit pulp is edible. However, the fruit pulp produces a rather unpleasant odor.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

C. densiflora ripe fruits are collected from the ground or picked from the tree. It is also possible to collect fruits from trees and store them for ripening.

7.0 TIME (SEASON) OF COLLECTION OF EDIBLE PART:

A survey of the specimens in Lushoto herbarium shows that C. densiflora flowers between July and August at Kilosa and Iringa. However, a field survey carried out recently revealed that the species flowers between May and October. On the other hand, Brenan and Greenway (1949) observed that C. densiflora flowers in February, June, and August. This implies that flowering takes place towards the end of the rainy season, extending into the dry season.

The species' fruit ripening takes place between October and February, i.e. during the rainy season. From the above observations it is likely that it takes about six months from fertilization of the flower to the ripening of the fruit.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: C. densiflora regenerates naturally from seed and coppice. During a recent field survey, it was observed that only saplings to mature trees were present. There was no trace of seedlings. The absence of the seedlings in the field might be the result of the disturbances, e.g. grazing and annual forest fires which eradicate young seedlings. It is also possible that most seedlings succumb to drought during the dry season. Coppice shoots are produced on felling of young or mature trees.

9.2 Artificial regeneration: C. densiflora seeds heavily in most years. It is thought that most of the seeds are viable. Preliminary results obtained in Lushoto showed that the seed germinates during the fourth week after sowing. Thus, there is a possibility of raising it in the nursery and planting it in the field. The species prefers open sites; these sites should be partially cleared of natural vegetation and intensively weeded for a good start.

The species can also be regenerated by stake or truncheon planting. It is advisable that this should be done at the onset of the dry season in order to avoid having the stakes rot.

The fruit yield per tree may be increased by pruning.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Building poles; making traditional stools and grain mortars; live fences.

PLATE IX. Cordyla densiflora Milne-Redh.

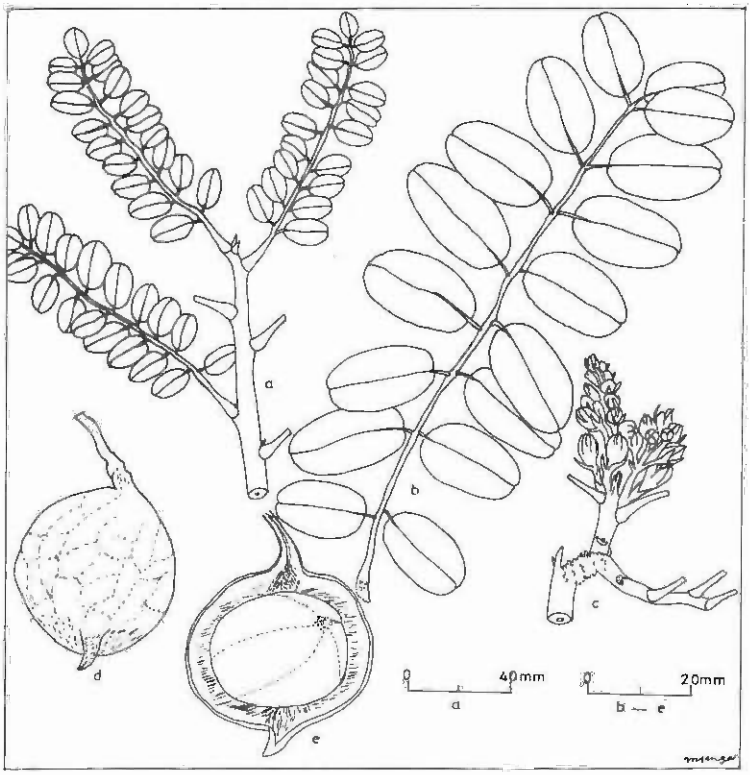


Plate IX. Cordyla densiflora Milne-Redh.

a - branchlet
b - leaf
c - branchlet bearing flower buds
d - fruit
e - fruit, part section showing seed

Plate IX$_1$ - tree at Mpwapwa, April, 1982

Plate IX$_2$ - branchlet bearing flower buds at Mpwapwa, April, 1982

Plate IX$_3$ - branchlet bearing mature fruit at Mpwapwa, February, 1982

10. DIOSPYROS KIRKII

1.0 NAMES:

Family	Ebenaceae
Botanical	Diospyros kirkii Hiern
Vernacular	mnumbulu (Kinyamwezi); mng'akora (Kimwera); mkokokivu (Kividunda).

2.0 DISTRIBUTION:

2.1 Locality: A survey of the specimens in Lushoto herbarium revealed that the species grows naturally in Masasi, Lindi, Mikumi, Mpanda, Kilosa and Uvinza areas. During the course of this study, the species was found growing naturally at Ruaha Valley, Rungwa in Manyoni, Igurusi near Mbeya, and Mikumi in Morogoro.

2.2 Altitude: D. kirkii appears to be growing between 400 m and 1250 m above sea level.

2.3 Climate: D. kirkii grows naturally in areas receiving from 508 mm to over 1270 mm of rain in four years out of five. These areas have mean minimum and mean maximum temperatures of 16° C and 27° C, respectively. Relative humidity data for the area where D. kirkii grows naturally are not available (United Republic of Tanzania, 1967).

2.4 Geology and soils: D. kirkii grows naturally on a variety of soils of varying rock origins. However, the species prefers mostly coarse sandy soils and vertisols.

2.5 Vegetation types: White (1962) observed that D. kirkii grows naturally in poor 'miombo' woodland, especially at edges of dambos and on escarpment slopes. The field survey carried out during the course of this study showed that D. kirkii is very common in Acacia-Combretum woodland. The common associate tree species included Acacia nigrescens, Albizia harveyi, Combretum fragrans, C. grandifolium, C. molle, C. obovatum, C. zeyheri, Commiphora africana, Diospyros mespiliformis, Grewia bicolor, G. mollis, G. platycladis, Manilkara mochisia, M. obovata, Tamarindus indica, Terminalia stuhlmannii, Zanthoxylum chalybeum, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The species occurs in open patches in the Combretum-Acacia woodland. Its stocking is extremely low.

4.0 DESCRIPTION:

D. kirkii is a deciduous or semi-deciduous tree, 10 m (or more) high with rounded crown, rough, longitudinally fissured bark and tomentellous shoots. Leaves alternate, broadly elliptic or elliptic-oblong, 16-19 cm long, 4-8.5 cm wide, almost glabrous above, presistently pubescent with spreading hairs and with prominent venation beneath, rounded at the apex and cuneate or rounded at base. Leaf stalks pubescent or glabrous, 0.3-1.5 cm long. Flowers dioecious, 5-merous and greenish-white. Male flowers hairy, produced in 3 or more axillary cymes. Female flowers solitary or paired in leaft axile and shortly pedicellate. Fruits globose, shortly-stalked, 2.5-3.5 cm long, 2.0-3.5 cm thick, greenish and pubescent when young, becoming almost glabrous when mature, persistent and yellow when ripe. Seeds dark brown, 1.2-1.7 cm long, 0.7-1.2 cm thick, bean-shaped, shiny and glabrous. Illustrations are shown in Figure 10 and Plate X.

5.0 MAIN USES:

The ripe fruit pulp of D. kirkii is edible.

6.0 METHOD OF COLLECTION:

D. kirkii ripe fruits are usually picked from the tree and, in rare cases, are collected from the ground.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

White (1962) observed that in Zambia D. kirkii flowers in October, while fruit ripening occurs from April to September. Chingaipe (Pers. Comm.) observed that in Zambia fruit ripening occurs between August and October. A survey of the botanical specimens in Lushoto herbarium shows that the species flowers between October and December, while fruit ripening occurs between April and July. This is also in agreement with the results obtained from field survey carried out during the course of this study. The above observations show that flowering occurs during the rainy season, while fruit ripening takes place during the dry season. Moreover, it takes about six months from the fertilization of the flower to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION OF THE SPECIES:

9.1 Natural regeneration: D. kirkii regenerates naturally from seed, coppice and suckers. The seed does not germinate readily owing to its hard seed coat and probably to seed dormancy. If the seeds germinate at all, the seedlings are sensitive to moisture stress or wiped out by fires. Coppice shoots are produced on felling of trees, while root suckers are produced on wounding of the root by any means, e.g. forest fires, burrowing animals, trampling animals and cultivation. In general, it can be concluded that natural regeneration of D. kirkii is rare.

9.2 Artificial regeneration: There have been no efforts to regenerate D. kirkii artificially. However, the species is semi-cultivated in areas where it is found growing naturally. D. kirkii is left standing on clearing of farms.

However, there are possibilities of raising it artifically. This can be achieved with the suitable pretreatment of the seed and raising of potted stock which could be planted out. The species is a light demander. Thus, it should preferably be planted on areas where there is partial clearing of natural vegetation and tending should include slashing and spot weeding until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruits are edible; its wood is used for making tool handles, gun stocks and fuel and young trees are suitable for provision of shade.

PLATE X. Diospyros kirkii Hiern

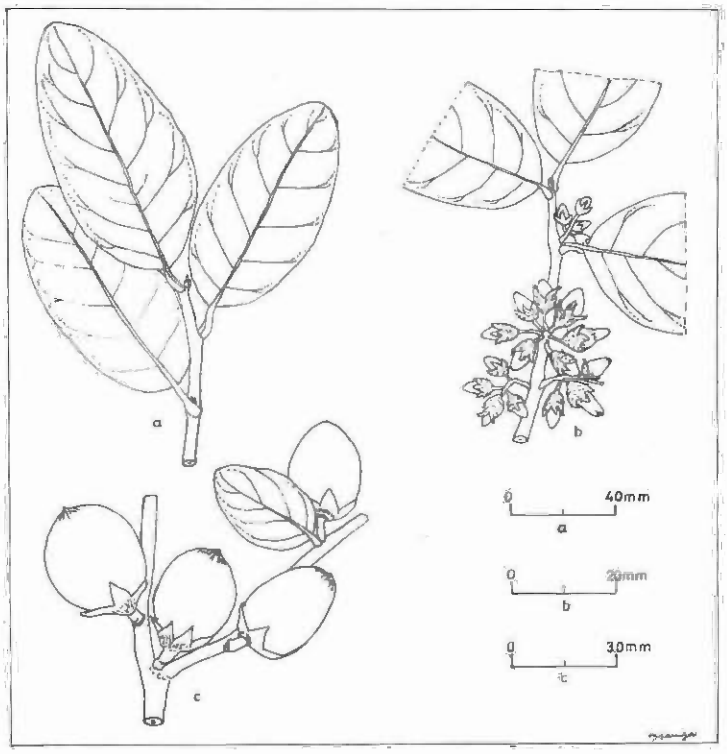


Plate X. Diospyros kirkii Hiern
a - branchlet
b - branchlet bearing flower buds
c - branchlet bearing fruits

Plate X_1 - tree at Rungwa, Manyoni, December, 1981

Plate X_2 - branchlet bearing mature fruits at Rungwa, Manyoni, May, 1982

11. DIOSPYROS MESPILIFORMIS

1.0 NAMES:

Family	Ebenaceae
Botanical	Diospyros mespiliformis Hochst. ex A. DC.
Vernacular	mhukwi, mkulwi, mkulwe (Kizigua); msindi, msinde, mkuare (Kichagga); mkoke (Kividunda); mtitu msindanguruwe, msindde (Kiluguru); mjongolo (Kipare); msinde, msindi (Kibende); msinde, mkinde (Kinyamwezi); mjoho mpweke (Kiswahili); African Ebony (English).

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) report that D. mespiliformis grows naturally in Bagamoyo, Tabora, Turu, Mpangara and Mafia. A survey of the botanical specimens in Lushoto herbarium shows that the species grows naturally in Moshi (i.e. Rau, Uru); Same (i.e. Kwizu stream), Korogwe (i.e. Mombo Arboretum); Handeni, Morogoro (i.e. Kimboza); Kilosa (i.e. Vigude); Mbeya (i.e. Chimala) districts. Moreover, a survey carried out recently revealed that the species grows naturally in Manyoni (i.e. Rungwa, Mwamagembe, Kipili) and Tabora (Kiwere, Sikonge, Urumwa Ichemba) districts. The observations show that the species is widespread throughout Tanzania.

2.2 Altitude: A survey of the botanical specimens in Lushoto herbarium shows that the species grows naturally between 500 m and 1250 m above sea level. However, during the course of this study, D. mespiliformis was found growing naturally at about 350 m above sea level at Kimboza in Morogoro. Thus, the altitudinal range for D. mespiliformis is 350 m and 1250 m above sea level.

2.3 Climate: The climatic data for localities where D. mespiliformis grows naturally have already been discussed under Diospyros kirkii. However, the species also grows in lowland rain forests receiving higher rainfall.

2.4 Geology and soils: D. mespiliformis grows on a variety of soils of varying origin. The species grows on red loam soils, volcanic soils and loamy sands. However, it prefers moist soils.

2.5 Vegetation types: D. mespiliformis grows naturally in lowland rain forests and riverain strips in Brachystegia woodland. The common associate tree species in lowland rain forests include: Albizia schimperana, A. gummifera, Antiaris usambarensis, Chlorophora excelsa, Croton macrostachys, Diospyros abyssinica, Newtonia buchannanii, Olea welwitschii, Pachystela brevipes, P. msolo, Sorindeia madagascariensis, Sterculia appendiculata, Trema orientalis and Trichilia roka, while in wooded grasslands and riverain Brachystegia woodland, the common associate tree species are Acacia sieberiana, Borassus aethiopum, Combretum fragrans, C. grandifolium, C. obovatum, C. zeyheri, Diospyros kirkii, Grewia bicolor, G. conocarpoides, Julbernardia globiflora, Kigelia aethiopica, Lonchocarpus capassa, Manilkara obovata, Parinari curatellifolia, Syzygium guineense, Tamarindus indica, Terminalia mollis and T. sericea.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

There are no records of inventory data on D. mespiliformis. However, field observations show that the species is more abundant on riverain soils along river courses and near swamps in the miombe woodland than in the wooded grassland and lowland rain forests. The above observation shows that the species prefers areas with permanent water which helps in seed germination and seedling establishment. Moreover, riverain soils are loose, thus seedlings get deep rooted before the onset of the dry season; also, on these soils competition from herbaceous vegetation is low. On the other hand, in lowland rain forest most seeds fail to germinate as these forests do not have permanent water and, if the seed germinates, it succumbs to weeds.

4.0 DESCRIPTION:

D. mespiliformis is a tall evergreen timber tree 15-45 m high, with dense rounded crown and buttressed stem. Bark grey-black or black, smooth in young trees, rough with small regular scales in older trees, pinkish when slashed. Young branchlets tomentellous with pinkish-white hairs, glabrescent later. Wood white or pinkish-white, hard and heavy with smooth texture. Leaves alternate, shiny-green above, paler beneath, 4-17 cm long, 1.5-5.5 cm wide, oblong-elliptic or oblanceolate-elliptic, rarely lanceolate-elliptic, pubescent when young, later becoming glabrescent or with few persistent, appressed hairs beneath, acute or subacuminate at the apex, cuneate or rounded at base with impressed midrib above, prominent beneath. Flowers dioecious, 5-merous, white and fragrant. Male flowers sessile, hairy and clustered on axillary peduncles. Female flowers solitary, shortly pedicillate and axillary. Fruits usually globose, up to 3 cm in diameter, greenish and pubescent when young, yellowish and glabrous when ripe. Seeds dark brown, bean-shaped shiny and glabrous. Illustrations are shown in Figure 11 and Plate XI.

5.0 MAIN USES:

The ripe pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits of D. mespiliformis are collected from the ground or picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that D. mespiliformis flowers in November, while fruit ripening occurs in April and in July and August. White (1962) reports that in Zambia D. mespiliformis flowers in November, while fruit ripening takes place between July and September. A survey of the botanical specimens in Lushoto herbarium shows that in lowland rain forests flowering occurs between November and April, while fruit ripening takes place between July and October. On the other hand, in the riverain vegatation flowering occurs in December, while fruits ripen between July and November. A field survey carried out during the course of this study revealed that in the riverain vegetation flowering occurs in October and November, while fruit ripening takes place between April and June. From the above observations it can be concluded that flowering takes place in the rainy season, while fruit ripening takes place in the dry season. Also, it takes about six to eight months from flower fertilization to fruit ripening. However, it should be noted that the time taken from flower fertilization to fruit ripening depends on the prevailing climate and vegetation type. The maturing period is shorter in hot, less humid woodland areas than in humid lowland forests.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: D. mespiliformis regenerates naturally from seed, coppice and root suckers. Field observations show that the seed does not germinate readily except on sites with permanent high soil moisture. Moreover, germination may be delayed by seed dormancy. Also, seeds are attacked by seed borers. Coppice shoots are produced on felling of trees. Root suckers are produced on root wounding by any means. D. mespiliformis' natural regeneration is not adequate; the stocking of pole sized and mature trees is low, while seedlings and saplings are rare. It is anticipated that crop refining and protection from fires could help in improving crop stocking in natural forests.

9.2 Artificial regeneration: There have been no efforts to regenerate the species. However, seeds can be collected, pretreated and raised in the nursery. Planting out should be done in areas where there is partial clearing of the vegetation and tending should include slashing and spot weeding until trees are well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Watt and Breyer-Brandwijk (1962) observed that the fruit is used in making 'brandy' and that it is dried and stored against shortage of food; the tree yields a useful timber which is resistant to termites, hard and heavy, and is used for making railway sleepers, tool handles, gun stocks, etc.

PLATE XI. Diospyros mespiliformis Hochst. ex A. DC.

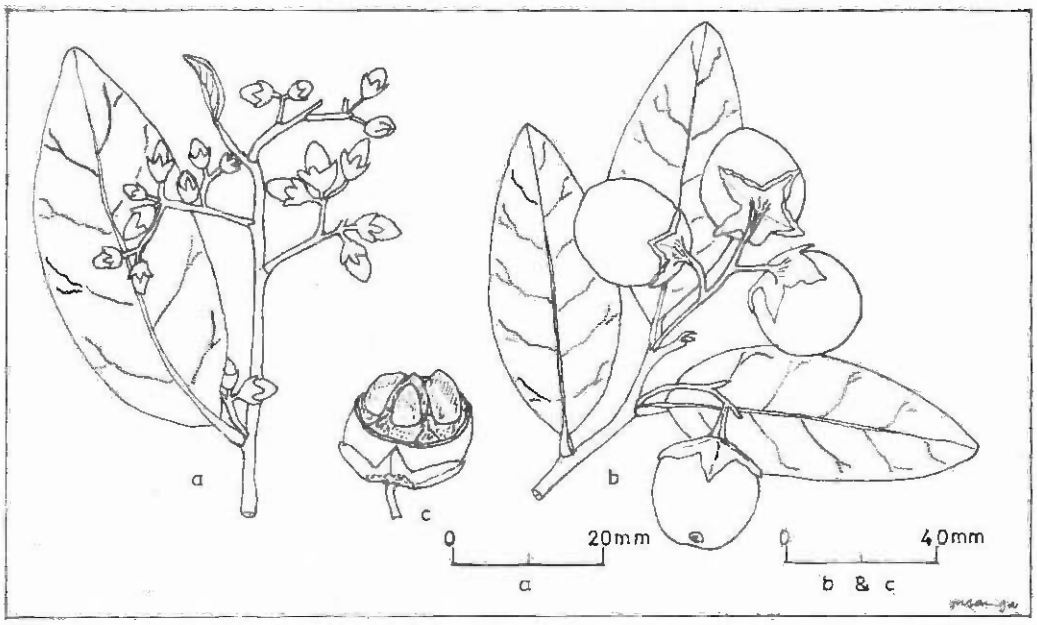


Plate XI. Diospyros mespiliformis Hochst. ex A. DC.

a - branchlet bearing flower buds
b - fruiting branchlet
c - fruit part section showing seeds

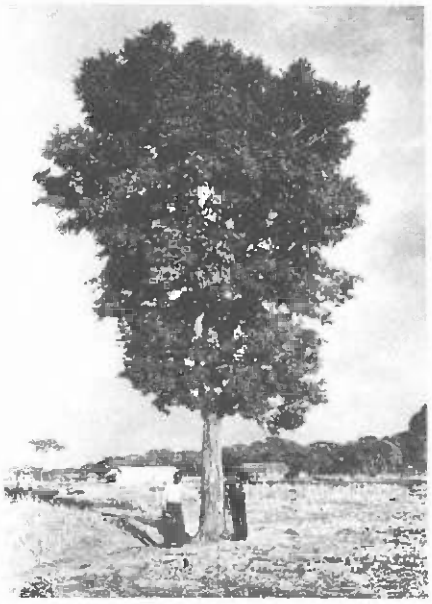


Plate XI_1 - tree at Rungwa, Manyoni, May, 1982

Plate XI_2 - branchlet bearing mature fruits, Rungwa, Manyoni, May, 1982

12. FLACOURTIA INDICA

1.0 NAMES:

Family	Flacourtiaceae
Botanical	Flacourtia indica (Burm.f.) Merrill
Syn.	Gmelina indica Burm. f. Flacourtia ramontchii L Herit. F. hirtiuscula Oliv. F. elliptica (Tul.) Warb F. kirkii Burtt Davy F. kirkiana Gardner F. afra Pichi-Serm. Xylosma ellipticum Tul
Vernacular	msingila, mpunguswa (Kinyamwezi); mtundukarya (Kirangi), mgola (Kizigua); mgora (Kiluguru); msanbachi (Kichagga); msunga (Kibende); msungusu (Kizinza); mtaswa (Kimwera); mchongoma, mkingili, ngovigovi (Kiswahili).
Commen English Name	Indian Plum

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that F. indica is never common but is distributed throughout Tanzania. Sleumer (1975) reports that F. indica grows naturally in Ukerewe Island, on the Rondo Plateau, in the Lindi area, Zanzibar Island and Kibondo District. A survey of the botanical specimens in Lushoto herbarium shows that F. indica grows naturally from coastal areas, i.e. Kisarawe, Kongowe, Rufiji to inland areas, e.g. Morogoro at Mtibwa and Turiani; Iringa at Njombe; Rukwa and Mpanda; Tabora in Simbo Forest Reserve; Singida; Kilimanjaro at Marangu and Tanga at Mombo and Soni.

2.2 Altitude: Sleumer (1975) observed that the species grows naturally from sea level to about 2400 m above sea level.

2.3 Climate: F. indica grows naturally in areas with varying climatic regimes. According to Morgan (1972) it appears that the species grows in areas receiving between 508 and over 1270 mm annual rainfall in four years out of five. However, it appears to be absent in semi-arid areas of central Tanzania receiving between 254 and 508 mm annual rainfall in four years out of five. The mean minimum and mean maximum temperatures are 13° C and 29° C, respectively (United Republic of Tanzania, 1967).

2.4 Geology and soils: F. indica grows naturally on a variety of soils of varying rock origin. Field observations show that in the Brachystegia woodland the species prefers mostly sandy soils near water courses and red clay soils.

2.5 Vegetation types: Brenan and Greenway (1949) observed that F. indica grows naturally in Brachystegia and Combretum woodland. Sleumer (1975) observed that F. indica grows naturally in woodland, wooded grassland and bushland, often riparian. The common associate tree species have already been given under Diospyros mespiliformis. In addition there areAcacia polyacantha, Afzelia quanzensis, Brachystegia spiciformis, Friesodielsia obovata, Oldfieldia dactylophylla, Swartzia madagascariensis, Vitex mombassae, V. doniana, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The inventory taken in Tabora (Schultz & Company, Ltd., 1973) showed that the distribution of trees in diameter (DBH) classes 15-29 cm and 30-44 cm were 1.62 and 1.58 stems per ha. The stocking on 7 992 ha was 25 574 stems, i.e. 3.2 stems/ha. Field observations show that the species is more abundant in Brachystegia and Combretum woodland on sandy soils with high watertable than in wooded grassland or bushland.

4.0 DESCRIPTION:

F. indica is a small, many-branched and spiny deciduous shrub or small tree up to 10 m high with rough pale yellow bark and light yellow slash. Branches usually glabrous or covered with yellowish powder, young branchlets usually smooth and lenticellate. Leaves variable in shape and size, alternate, ovate, elliptic, suborbicular or obovate, 2.5-12 cm long (or more), 2-8 cm wide, membraneous to almost coriaceous, rounded, obtuse or rarely obtuse-acuminate at the apex, cuneate or rounded at base, crenate-serrate or rarely sub-entire with 4-7 lateral nerves which are slightly prominent on both surfaces. Leaf stalks short, 0.3-2 cm long. Flowers dioecious or sometimes bisexual, small, cream or pale yellow, fragrant, borne on short axillary cymes. Fruits globose berries up to 2.5 cm in diameter, reddish or reddish-black and fleshy when ripe, marked with persistent style scars on one end, containing up to 10 seeds. Seeds small, 0.8-1 cm long, 0.4-0.7 cm broad, tick-shaped, ridged and hard. Illustrations are shown in Figure 12 and Plate XII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

F. indica fruits are persistent, thus on ripening are picked from the tree. Ripe fruits are often dried and stored as a future food source.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that F. indica flowers in January and February. White (1962) observed that in Zambia F. indica flowers between October and December; while fruit ripening occurs between May and July. A survey of the botanical specimens in Lushoto herbarium shows that flowering occurs between November and July, implying that it starts at the onset of the rainy season, continues through the rainy season and extends into the dry season. Fruit ripening occurs between December and July. This is supported by the results obtained during the field survey carried out during the course of this study.

The above observations show that flowering and fruit ripening times vary from locality to locality, and that it takes about five to eight months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: F. indica regenerates naturally from seed and coppice. The germination behaviour of the seed is not known. However, its hard seed coat may result in poor germination. Coppice shoots are produced on felling of the trees and shrubs. In general, natural regeneration on sandy soils is average; often trees of all stages can be seen in the field. However, most young trees succumb to annual forest fires. Protection of its natural habitat from fires and crop refining could improve the stocking and consequently result in high fruit yields.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, through improving the germination capacity of the seed by pre-treatment, the species could be raised in the nursery and planted out in the field. It is important that the planting site be partially cleared as the species is a light demander. Moreover, the young crop should receive slashing and spot weeding until it is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Fruits are edible and sold on the market; root bark and leaves are used a great deal in local medicines, i.e. cough medicine and treatment for asthma; and as fuel.

PLATE XII. Flacourtia indica (Burm.f.) Merril

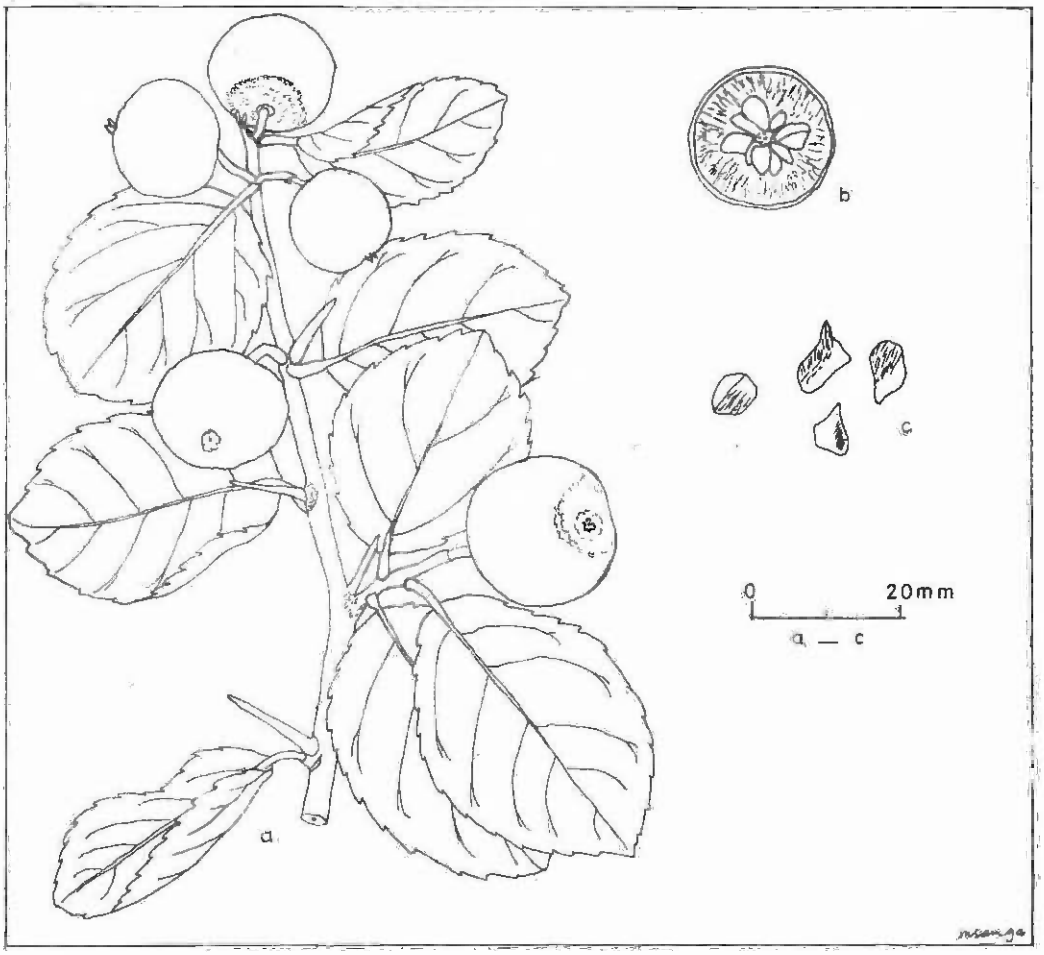


Plate XII. Flacourtia indica (Burm.f.) Merril

a - fruiting branchlet
b - cross section of fruit
c - seeds

Plate XII$_1$ - branchlet bearing mature and ripe fruits, at Beekeeping School, Tabora, May, 1982

13. FRIESODIELSIA OBOVATA

1.0 NAMES:

Family	Annonaceae
Botanical	Friesodielsia obovata (Benth.) Verdc.
Syn.	Unona obovata Benth
	Popowia obovata (Benth.) Engl. & Diels
	P. stormsii De Wild
Vernacular	msalasi (Kinyamwezi)

2.0 DISTRIBUTION:

2.1 Locality: Verdcourt (1971) observed that the species occurs naturally in Shinyanga, Tabora (i.e. Ugalla and Isimbila areas) Dodoma (i.e. Bankolo area), Manyoni (i.e. near Mkwesi) and Lindi Districts. A survey of the botanical specimens in Lushoto herbarium shows that in Tabora the species is also found at Beekeeping School Forest Reserve, Simbo Forest Reserve, Ichemba, Kiwele, Sikonge, Utimule, Urumwa and Kigwa. It is also found in Nzega at Idudumo. The species is known to occur in Kigoma at Gombe River Forest Reserve.

2.2 Altitude: According to Verdcourt (1971), F. obovata occurs naturally from 780 to 1500 m above sea level. This is in agreement with the data available in Lushoto herbarium.

2.3 Climate: Climatic data for Tabora and Manyoni are covered under Canthium burttii and Parinari curatellifolia and that of Dodoma is covered under Bussea massaiensis. Morgan (1972) observed that Lindi and Gombe River Forest Reserve in Kigoma receive between 762 and 1270 mm annual rainfall in four years out of five. United Republic of Tanzania (1967) observed that the mean maximum and mean minimum annual temperatures for Lindi are 29° C and 19° C, respectively; for Gombe River Forest Reserve, 28° C and 17° C, respectively.

2.4 Geology and soils: The geology and soils of Tabora and Manyoni are described under Bussea massaiensis. The soils of Lindi and Gombe River Forest Reserve in Kigoma, where F. obovata grows naturally, are brown clay loams to clay. At Lindi these soils are derived from rocks of Mozambique belt, while those of Gombe River Forest Reserve are derived from Bukoban rocks (Morgan, 1972).

2.5 Vegetation types: Verdcourt (1971) observed that F. obovata grows naturally in wooded grassland and grassland with scattered trees, often on termite mounds or rocky outcrops. F. obovata occurs in association with Afzelia quanzensis, Albizia petersiana, Berchemia discolor, Brachystegia spiciformis, Commiphora africana, Dalbergia melanoxylon, D. nitidula, Grewia bicolor, G. conocarpoides, G. platyclada, Pterocarpus angolensis, P. tinctorius, Terminalia mollis, T. sericea, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

Inventory data for F. obovata are not available. However, a field survey carried out during the course of the study showed that the species is dominant on termite mounds in the Brachystegia woodland.

4.0 DESCRIPTION:

F. obovata is a scandent deciduous shrub or small tree, 1-8 m high, with pendulous and spreading branches, smooth, grey fibrous bark and yellow slash. Leaves alternate, obovate, oblong-ovate, 4-14 cm long, 2-9 cm wide, obtuse, rounded or somewhat emarginate at the apex, rounded to cordate or, less often, broadly cuneate at the base, greenish above, paler and glaucous beneath, velvety when young, later sparsely to densely pubescent on both sides. Leaf stalks from 0.5 cm to 1.0 cm long. Flowers hermaphrodite, solitary, terminal or more usually extra-axillary. Pedicels slender, 1-5 cm long, bearing large leafy bracteole 1-2.9 cm long, 0.5-2.8 cm wide. Sepals broadly triangular to orbicular or rarely oblong, 4-6 cm long and wide. Petals yellow or greenish-yellow, thick, the outer being broadly ovate, round or reniform, 0.6-1.3 cm long, 0.8-1.6 cm wide. Stamens numerous, oblong or cuneiform, 0.75-1.0 cm long. Fruits usually contain from 1 to 3 segments, each containing one seed and constricted between seeds. The fruits are reddish when ripe. Seeds yellow, 1.2-1.7 cm long, 0.6-0.8 cm in diameter, cylindric-ellipsoid. Illustrations are shown in Figure 13 and Plate XIII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

F. obovata ripe fruits are picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

It is reported that F. obovata flowers in June (Brenan and Greenway, 1949). A survey of the botanical specimens shows that the species flowers between November and January, while fruit ripening is from April to June. This implies that flowering takes place in the rainy season, while fruit ripening takes place at the end of the rainy season, extending to the onset of the dry season.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates from seed, coppice and root suckers. The regeneration is adequate. During the field survey it was noted that there were seedlings, saplings, poles and mature trees. Natural regeneration and growth of naturally regenerated stock could be improved by carrying out partial refining.

F. obovata is very common on termite mounds. This might be due to the fact that the species requires a fertile site for optimum growth, or it is termite resistant. It is also possible that birds and animals which feed on the ripe fruits go and rest on these termite mounds where they give out faeces with viable seeds which germinate readily on termite mounds.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, because of the easy germination of the seed, it is possible that the species could be raised in pots and planted in the field where partial clearing of vegetation has been carried out as the species appears to be shade tolerant.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

F. obovata ripe fruits are suitable for eating, thus planting it on a large scale could help in boosting the income of fruit collectors; it is also used for withes, making bows, carriage beams, walking sticks and tool handles and as fuelwood.

PLATE XIII. Friesodielsia obovata (Benth.) Verdc.

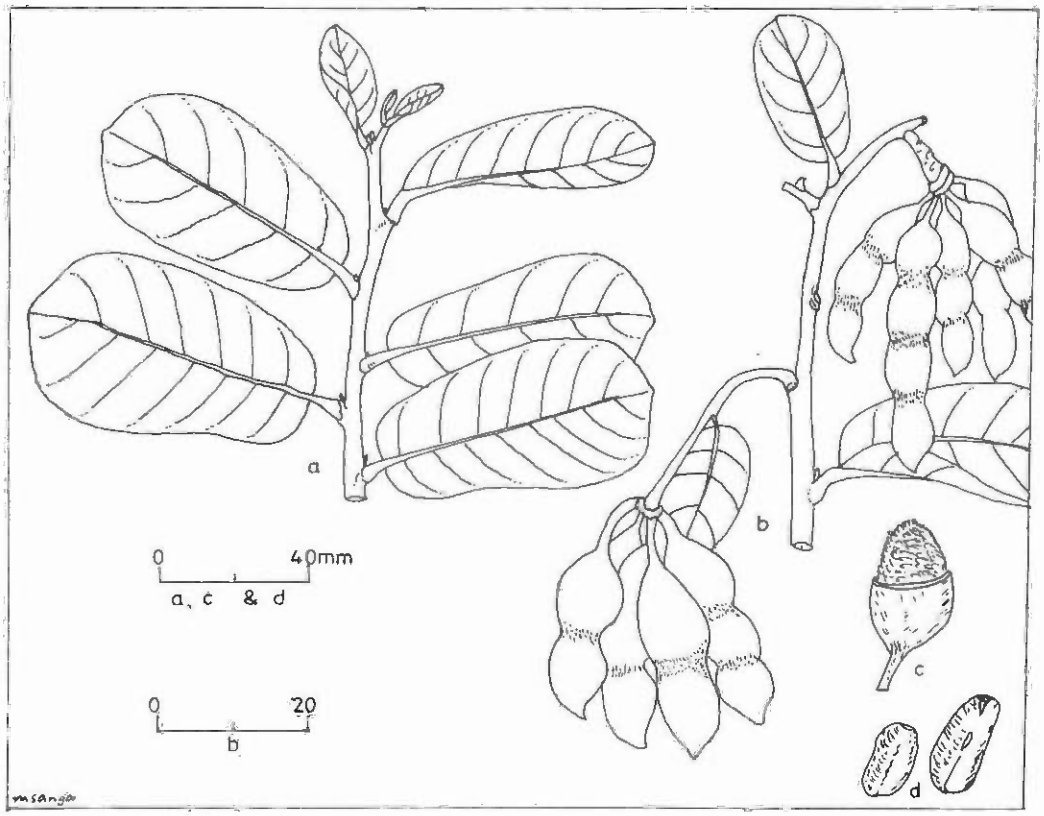


Plate XIII. Friesodielsia obovata (Benth.) Verdc.

a - branchlet
b - fruiting branchlet
c - fruit-part of skin removed to show pulp
d - seeds

Plate XIII$_1$ - multistemmed shrub, at Beekeeping School, Tabora in May, 1982

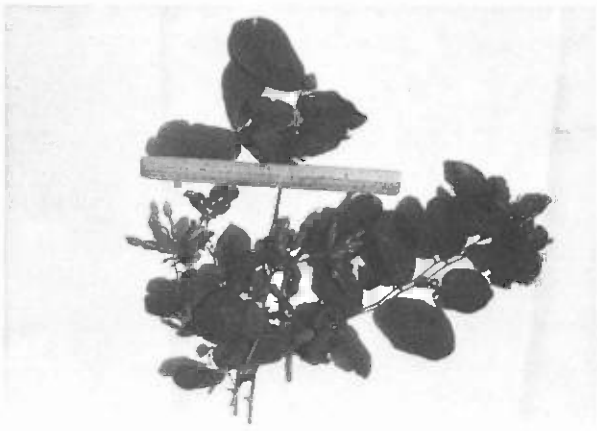


Plate XIII$_2$ - branchlets bearing mature and ripe fruits, Beekeeping School, Tabora in May, 1982

14. HEXALOBUS MONOPETALUS

1.0 NAMES:

Family	Annonaceae
Botanical	Hexalobus monopetalus (A. Rich.) Engl. & Diels Var. obovatus Brenan
Syn.	H. monopetalus non (A. Rich.) Engl. & Diels
Vernacular	mkuwa (Kinyamwezi)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that H. monopetalus var obovatus grows naturally in Simbo Forest Reserve in Tabora and Lindi Districts. According to Verdcourt (1971), the species also occurs naturally in Uzinza in Geita and Uvinza in Kigoma District. A survey of the botanical specimens confirmed the above facts. It was also noted that the species grows at Lupa in Chunya District. It is also known to occur naturally at Urumwa, Kigwa, Ichemba, Sikonge Kiwele and Rungwa in Tabora and Iringa (Mapinduzi and Kitapilimwa) Districts.

2.2 Altitude: Verdcourt (1971) observed that the species grows naturally between 1110 m and 1500 m above sea level. A survey of botanical specimens in Lushoto herbarium revealed that H. monopetalus var. obovatus grows down to 910 m above sea level at Lupa in Chunya District. Thus, the altitudinal range is between 910 m to 1500 m above sea level.

2.3 Climate: The climatic data for Geita and Tabora are described under Canthium burttii; that of Chunya under Canthium crassum, and of Lindi under Friesodielsia obovata. According to Morgan (1972), Uvinza in Kigoma District receives between 762 mm and 1270 mm annual rainfall in four years out of five. The mean minimum and mean maximum annual temperatures are 17° C and 28° C, respectively (United Republic of Tanzania, 1976).

2.4 Geology and soils: The geology and soils of Geita and Tabora Districts are described under Canthium burttii and Parinari curatellifolia; those of Chunya are described under Canthium crassum; and those of Lindi under Friesodielsia obovata. According to Morgan (1972), Uvinza is dominated by Bukoban rocks on which are formed light yellowish-brown to reddish-yellow, gritty, sandy clay loams.

2.5 Vegetation types: According to Verdcourt (1971) H. monopetalus var obovatus grows naturally in Brachystegia-Julbernardia woodland and Combretum-Terminalia scrub, sometimes among large boulders. The common associate tree species include Afzelia quanzensis, Brachystegia spiciformis, Combretum collinum, C. zeyheri, Flacourtia indica, Julbernardia globiflora, Monotes adenophyllus, Vitex mombassae, V. ferruginea, Terminalia sericea, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

H. monopetalus var obovatus is more abundant in Brachystegia-Julbernardia woodland and decreases in abundance in Terminalia-Combretum woodland.

A preliminary survey carried out at Simbo Forest Reserve in Tabora revealed that most of the seedlings and saplings are found in the vicinity of mother trees. It was found that within a plot of about 26 m^2 there were 8 plants, the seed tree being central. The frequency of H. monopetalus var obovatus in Lindi/Mtwara Region was worked out by C.D. Schultz & Company, Ltd (1973). The number of trees per hectare on 52 331 hectares in successive DBH classes of 14 cm, starting with 15-29 cm were 6.82, 0.95, 0.12, 0.05 trees, making a total of 7.94 stems/ha. The total number of trees on 52 331 ha was 415 667 stems.

4.0 DESCRIPTION:

H. monopetalus var obovatus is a deciduous shrub or small tree, up to 8 m high, with dense and compact crown and smooth, grey flaking and fibrous bark. Leaves alternate, obovate to obovate-oblong, usually relatively broad, 2-10 cm long, 1-6.5 cm wide, glabrescent or persistently adpressed pubescent near the midrib beneath with prominent venation above; obtuse, rounded or emarginate at the apex, cuneate to subcordate at the base, coriaceous, olive-green above, yellow-green beneath. Leaf stalks very short and pubescent, about 1-4 cm long. Flowers subsessile, axillary or in axils of fallen leaves, solitary or in 2-3 clusters, opening after the leaves have fallen, yellowish, greenish or cream. Fruit subsessile, obovoid or ellipsoid-cylindric, containing one to three segments, 1.5-5 cm long, 1-2.5 cm wide, scarlet, 2-8-seeded with reddish soft pulp when ripe. Seeds brown, compressed-ovoid, shaped like a spider's body, 1.2-1.5 cm long, 6-9 mm wide, 7-8 mm thick with raised rounded triangular terminal hilum produced into lateral rugose ridges at either side. Illustrations are shown in Figure 14 and Plate XIV.

5.0 MAIN USES:

The ripe fruit pulp is edible and has a pleasant acid flavour.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are picked from the tree while fruits may also be picked unripe and stored for ripening. It has been noted that ripe fruits falling on the ground are, in most cases, unsuitable for eating. This is because they are readily attacked by insects.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

A survey of the botanical specimens in Lushoto herbarium reveals that the species flowers in June and July. A field survey carried out during the course of this study showed that flowering takes place between August and September, while fruit ripening occurs between January and April. This implies that flowering takes place during the dry season, while fruit ripening occurs during the rainy season. The above data also reveal that it takes about six months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: H. monopetalus var. obovatus regenerates naturally from seed, coppice and probably by root suckers. A field survey carried out at Simbo and Urumwa Forest Reserves in Tabora District showed that all crop development stages are present, i.e. seedlings, saplings, poles and mature trees. The species natural regeneration is interrupted by annual forest fires which cause the death of most of the young seedlings. Thus, partial protection of the woodland where the species grows naturally could help in promoting natural regeneration. Although during early stages of development the species is a shade demander, at later stages it is a light demander. This implies that crop refining at a later stage could help in improving tree growth.

9.2 Artificial regeneration: Artificial regeneration has not been tried. Because the seed germinates readily, it is possible to raise potted seedlings in nurseries. On sites destined for planting, some trees should be left for the provision of shade to young trees, and the tending of young trees requires the slashing of herbaceous vegetation.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Because its fruits are edible, planting it on a large scale could help boost the economy of fruit collectors. Its timber is suitable for making tool handles, wooden spoons, carriage beams, bows, gun stocks and butts. It is also suitable for construction poles and fuelwood.

PLATE XIV. Hexalobus monopetalus var. monopetalus Brenan (A. Rich.) Engl. & Diels

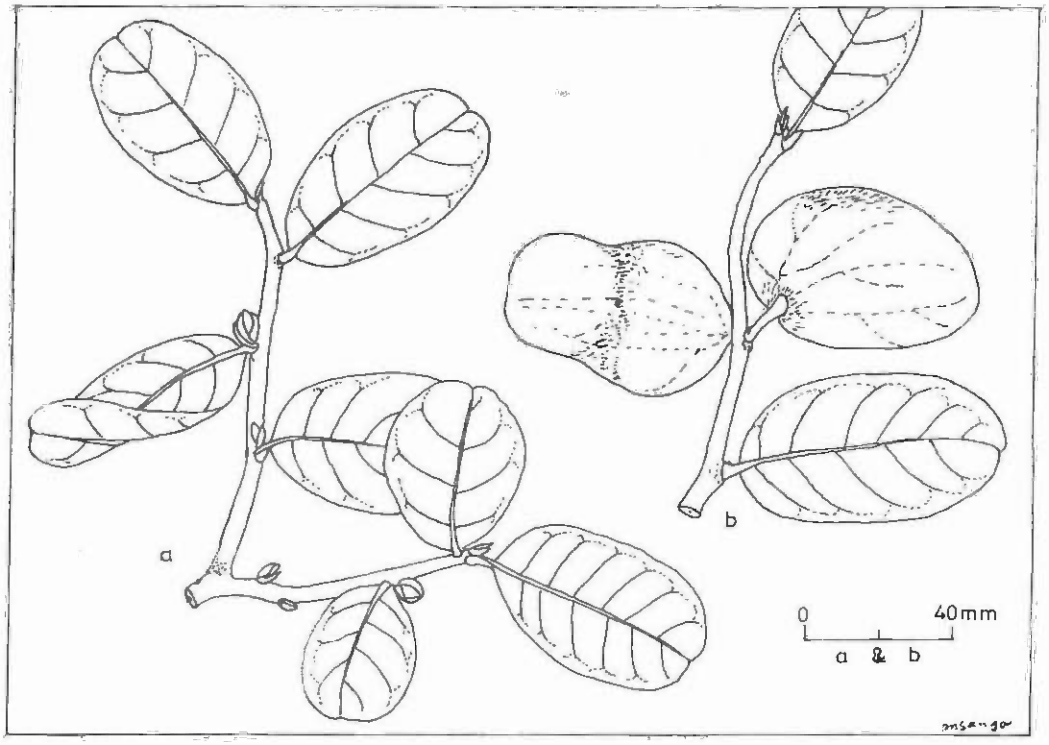


Plate XIV. Hexalobus monopetalus var. monopetalus Brenan (A.Rich.) Engl. & Diels

a - branchlet with flower buds
b - fruiting branchlet

Plate XIV_1 - tree at Simbo Forest Reserve Tabora in May 1982

15. MANILKARA MOCHISIA

1.0 NAMES:

Family	Sapotaceae
Botanical	Manilkara mochisia (Baker) Dubard
Syn.	Mimusops mochisia Baker
	M. densiflora Engl. var paolii Chiov.
	M. densiflora Engl.
	Manilkara densiflora Dale
Vernacular	mkonze (Kigogo, Kinyamwezi); mukonje (Kisukuma); msapa, mnago (Kiswahili)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that M. mochisia is common throughout central Tanzania and Pangani. Hemsley (1968) reports that the species grows naturally in Mwanza, Tabora, Mpwapwa, Tanga, Morogoro, Singida and Lindi. A survey of botanical specimens in Lushoto herbarium shows that the species grows naturally in Mwanza, Tabora and coastal regions. During the field survey carried out recently, M. mochisia was found growing naturally at Mpwapwa, Manyoni, Singida, Tabora and at Mikumi in Morogoro.

2.2 Altitude: Hemsley (1968) observed that M. mochisia grows naturally from sea level to about 2100 m above sea level.

2.3 Climate: M. mochisia grows in areas with varying climatic regimes as it grows from the coast to western Tanzania. According to Morgan (1972), areas where M. mochisia grows naturally receive between 508 mm and 1270 mm annual rainfall. The relative humidity and mean annual temperature data for a few selected meteorological stations where the species grows naturally are given in Table 6.

Table 6 Relative humidity and mean annual maximum and minimum temperatures for selected meteorological stations in Tanzania where M. mochisia grows naturally

Station	Mean Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Lindi	30.5	21.7	8.8	93	82	67
Dar-es-Salaam	29.7	21.9	7.8	-	85	69
Mwanza	27.5	17.7	9.8	85	73	59
Tabora	29.4	16.7	12.7	83	72	44
Tanga	30.4	22.1	8.2	93	80	67

Source: E.A. Met. Dept., 1975.

2.4 Geology and soils: M. mochisia grows on a great variety of soils derived from a variety of rocks. The species appears to prefer coarse sandy soils, riverain soils and vertisols. It is typically found growing on termite mounds.

2.5 Vegetation types: Brenan and Greenway (1949) observed that M. mochisia is common throughout central thornbush area, especially in riverain forests and thickets near ponds. Hemsley (1968) reports that the species grows naturally in deciduous bushland, thickets and dry scrub with trees. The common associate tree species include Afzelia quanzensis, Albizia anthelmintica, A. harveyi, Azanza garckeana, Balanites aegyptiaca, Berchemia discolor, Boscia mossambicensis, Cassia abbreviata, C. singueana, Combretum apiculatum, C. molle, C. zeyheri, Commiphora africana, Dalbergia melanoxylon, Diospyros kirkii, Grewia platyclada, Mystroxylon aethiopicum, Strychnos potatorum, Sterculia rhynchocarpa, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

There are no records of inventory data of M. mochisia. A field observation carried out recently showed that its stocking is very low. Moreover, the species is most abundant in riverain forests, decreasing in abundance through bushland to thickets and scrub.

4.0 DESCRIPTION:

M. mochisia is a small or medium-sized termitarian tree with low branching habit and spreading crown up to 20 m high. Bark brownish grey or black with close and deep fissures, browish-red slash and white latex. Branching usually very irregular with leaves clustered mainly at the end of twigs. Branchlets glabrescent or pubescent with evanescent ferruginous indumentum. Leaves usually coriaceous and glabrous, 1.5-6.5 cm long, 0.8-3 cm wide, elliptic-obovate to obovate, rounded, usually emarginate at the apex, broadly to narrowly cuneate at base; the lower surface minutely pubescent, especially in young leaves, lateral nerves, 10-14 on each side and not prominent on both surfaces; midrib impressed above, slightly prominent beneath. Leaf stalks short, 1.5-12 mm long, pubescent when young, glabrescent when mature. Flowers white or pale yellow, pedicellate and clustered in leaf axils. Pedicels short, 6-13 mm long, glabrous or pubescent. Fruits small, greenish when young, yellowish when ripe, up to 2.5 cm long, 1.3 cm in diameter, subglobose to ellipsoid, glabrous, containing 1-3 seeds and a soft edible pulp. Seeds are dark brown, ellipsoid and compressed, up to 1.3 cm long, 8 mm wide. Illustrations are shown in Figure 15 and Plate XV.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are picked from the tree or collected from the ground.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that M. mochisia flowers in November. White (1962) reported that in Zambia the species flowers in October and November, while fruit ripening takes place between March and June. A survey of the specimens in Lushoto herbarium shows that the species flowers in December, while fruiting is between December and March. A field survey carried out recently shows that flowering occurs between October and December, while fruit ripening takes place between March and June. The above observations show that flowering takes place during the rainy season, while fruit ripening occurs towards the end of the rainy season, extending into the dry season. Moreover, it takes about five to six months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: M. mochisia regenerates naturally from seed and coppice. The seed germination behaviour has not been studied. Field observation revealed that in natural forests seedlings are rare and mature trees are very few. This implies that the seeds do not germinate readily. This might be due to its water repellant seed coat or other forms of seed dormancy. Coppice shoots are produced on felling of the trees.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, with seed germination improved by pretreatment, it may be possible to raise potted seedlings and to plant them out in the field. The planting site should be partly cleared and intensive weeding is essential during the first few years, as the tree is a light demander.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruit is edible, while the wood can be used as fuel.

PLATE XV. Manilkara mochisia (Baker) Dubard

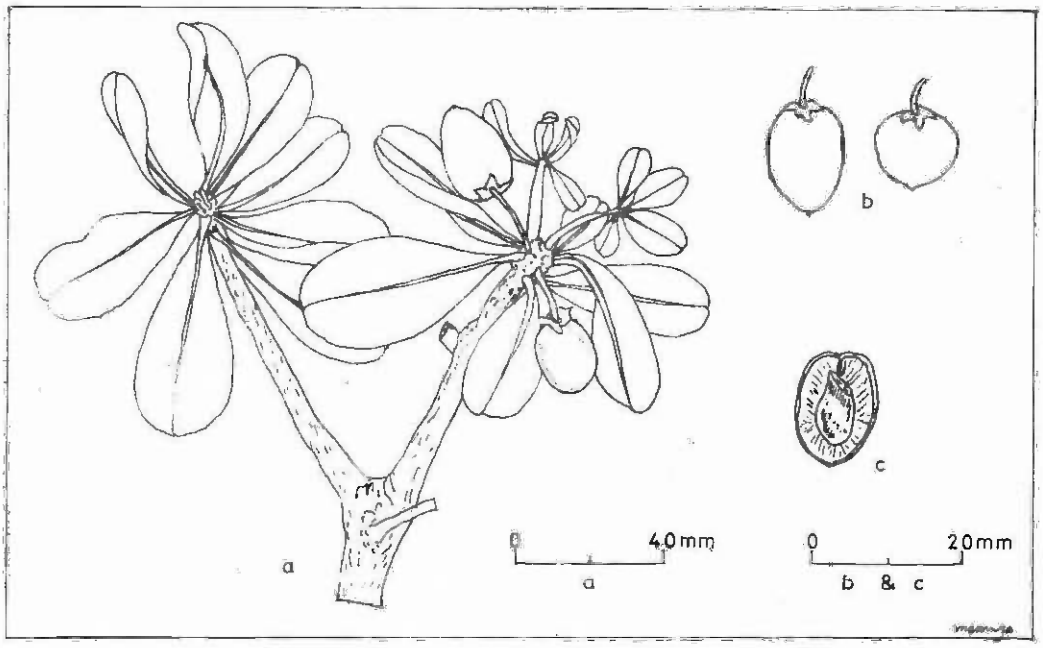


Plate XV. Manilkara mochisia (Baker) Dubard

a - branchlet
b - fruit
c - fruit part section showing seed

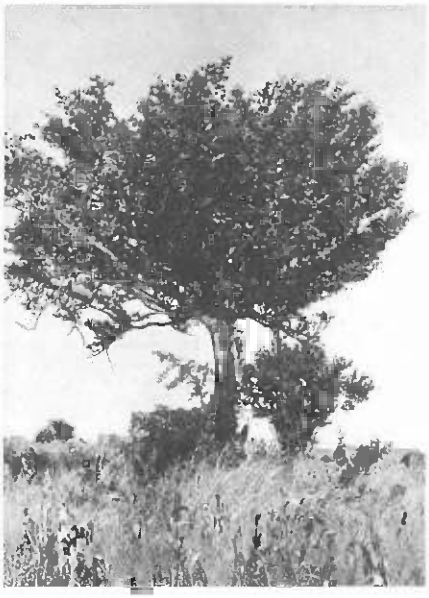


Plate XV$_1$ - tree at Rungwa, Manyoni, May 1982. Note that it is on termite mound in the maize farm

Plate XV$_2$ - branchlet, and ripe fruits, at Rungwa, Manyoni, May, 1982

16. MANILKARA OBOVATA

1.0 NAMES:

Family	Sapotaceae
Botanical	Manilkara obovata (Sabine & G. Don) J.H. Hemsl.
Syn.	Chrysophyllum obovatum Sabine & G. Don
	Mimusops cuneifolia Baker
	M. lacera Baker
	M. welwitschii Engl
	M. propinqua S. Moore
	Chrysophyllum holtzii Engl
	Manilkara cuneifolia (Baker) Dubard
	M. lacera (Baker) Dubard
	M. propinqua (S. Moore) H.J. Lam
Vernacular	mumbulu, mmumbulu (Kigogo); mukuaya (Kihaya); mmenge, mumenge (Kinyamwezi)

2.0 DISTRIBUTION:

2.1 Locality: M. obovata occurs naturally in Dodoma (i.e. Illangali south-west of Dodoma, along the Kizigo river); Bukoba (i.e. Minziro Forest Reserve); Tabora (i.e. Kiwere, along the Mkombizi river); Manyoni (along the Rungwa and Musa rivers) Districts.

2.2 Altitude: Hemsley (1968) observed that the species occurs between 1100 and 1300 m above sea level. However, during the recent field survey it was noted that the species grows naturally at about 1000 m above sea level at Ilangali along the Kizigo river. Thus, the species' altitudinal range may be taken to vary from 1000 m to 1300 m above sea level.

2.3 Climate: The rainfall data for Ilangali have been covered under Cordyla densiflora. There is no meteorological station in Minziro forest (Bukoba). However, the rainfall data for Kabwoba rainfall station (near Minziro forest) show that the mean annual rainfall is 952 mm with 67 rain days per year (Nshubemuki, et. al., 1978). According to Morgan (1972), Rungwa and Kiwere areas receive between 508 mm and 762 mm mean annual rainfall in four years out of five. The mean minimum and mean maximum annual temperatures where M. obovata occurs naturally are 17° C and 28° C, respectively. However, the exception is Minziro Forest Reserve with a mean annual temperature of 25° C (United Republic of Tanzania, 1967).

2.4 Geology and soils: The geology and soils of Ilangali are described under Cordyla densiflora. Rungwa and Kiwere areas are dominated by light yellowish-brown to reddish-yellow, gritty, sandy clay loam soils derived from acid gneisses, migmatites and associated granites and granodiorite rocks. Minziro is dominated by Bukoban rocks (Morgan, 1972). The soils in Minziro are mainly poorly drained swampy soils.

2.5 Vegetation type: The vegetation of Ilangali area has been described under Cordyla densiflora. In Rungwa and Kiwere areas, M. obovata occurs naturally in riverain forest occurring within Brachystegia woodland (Morgan, 1972). Minziro forest is composed of lowland rain forest, swampy and riverain forests (Hemsley, 1968). The dominant tree species in the riverain forest within Brachystegia woodland are Acacia tanganyikensis, Adansonia digitata, Albizia amara, A. harveyi, Azanza garckeana, Brackenridgea zanguebarica, Cordia ovalis, Diospyros mespiliformis, Grewia bicolor, G. platyclada, Lonchocarpus capassa, Manilkara mochisia, etc. In Minziro forest the dominant tree species are Baikiaea insignis, Cassipourea ruwenzorensis, Citropsis schweinfurthii, Heywoodia lucens, Mussaenda erythrophylla, Phoenix reclinata, Podocarpus usambarensis var dawei, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

M. obovata seems to grow on the banks of rivers and on ridges of swampy forests. The stocking is extremely low.

4.0 DESCRIPTION:

M. obovata is a small, many-branched evergreen tree up to 15 m high with dense crown, dark brown to brownish-grey, fissured and rough bark which is reddish with white latex when slashed. Leaves alternate, 4.5-13 cm long, 1.5-4 cm wide, glabrous, obovate or obovate-oblong, olive-green above, paler on the lower surface, rounded, emarginate or shortly acuminate at the apex, cuneate at the base. Leaf stalks slender, 1-3 cm long. Flowers white or cream, solitary or axillary. Fruits globose or subglobose, 2.5-3 cm long, 1.5-2 cm in diameter, glabrous, greenish with milky pulp when young, yellowish when ripe. Seeds hard, shiny brown, smooth and somewhat flattened, 1.5-2 cm long, 0.7-1.2 cm wide. Illustrations are shown in Figure 16 and Plate XVI.

5.0 MAIN USES:

M. obovata ripe fruit pulp is edible and it has a sweet taste and pleasant aroma.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

M. obovata ripe fruits are picked from the tree or from the ground, while unripe fruits may be picked and stored for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Hemsley (1968) observed that at Minziro Forest Reserve, M. obovata was flowering in February, and that in August there were young fruits. It was observed that in Malabigambo Forest near Katera in Masaka District (Uganda) the species was flowering in August. Brenan and Greenway (1949) observed that M. obovata was fruiting in July in the evergreen forest of Minziro Forest. A survey of the botanical specimens at Lushoto herbarium shows that M. obovata flowers in August and September, while fruiting is in April in Minziro Forest. At Kiwere (Tabora) flowering is in November, while fruiting is in February and March. During the recent field survey it was noted that flowering is between November and December, while fruit ripening is from March to June. From the above observation it can be concluded that flowering takes about six months, starting towards the end of the dry season, and extending to the rainy season, while fruit ripening takes about five months, starting during the rainy season and extending into the onset of the dry season.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally by seed and coppice. The seed can be dispersed by water. Natural regeneration is inadequate; in most cases only pole sized and mature trees can be seen. This is probably because most of the seeds and young seedlings are washed away by water when rivers are in flood. The hard seed coat may also reduce the germination capacity.

9.2 Artificial regeneration: Artificial regeneration has not been tried. But it is possible to raise the species from seed in the nursery. Owing to the hard seed coat, it is imperative that the seed should be pretreated before sowing. Being a light demander, M. obovata is one of the dominant tree species in the forests where it occurs naturally. The species prefers sites with high ground water table. Thus, it should be planted on alluvial riverine sites where the woody vegetation has been partially cleared and tending should include slashing of the herbaceous vegetation until the trees are well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The species seeds profusely in most years; the seed is sweet and has a pleasant aroma; the wood can be used as fuel, tool handles, bows, and carriage beams; being evergreen, the tree is suitable for shade.

PLATE XVI. Manilkara obovata (Sabine & G. Don.) J.H. Hemsl

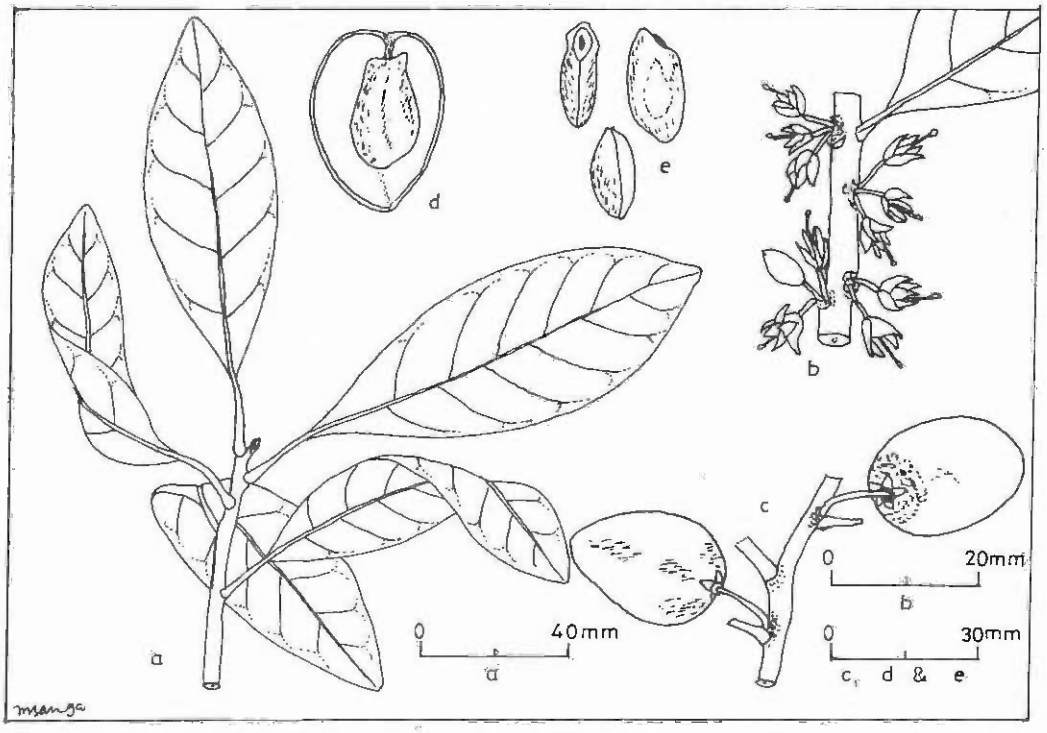


Plate XVI. Manilkara obovata (Sabine & G. Don.) J.H. Hemsl

a - branchlet
b - portion of branch bearing flowers
c - branchlet bearing fruits
d - fruit part section showing seeds
e - seeds

Plate XVI$_1$ - tree - at Ilangali, Dadoma, April, 1982

Plate XVI$_2$ - branchlet bearing mature fruits at Ilangali, Dodoma, April, 1982

17. MYRIANTHUS ARBOREUS

1.0 NAMES:

Family	Moraceae (Urticaceae)
Botanical	Myrianthus arboreus P. Beauv.
Common English Names	Giant Yellow Mulberry
Vernacular	mkonde (Kishambaa, Kibondei, Kizigua); mhunsa (Kimatengo), mkwayaga, mdewerere, mlowelowe (Kiluguru); mfuza (Kisagara)

2.0 DISTRIBUTION:

2.1 Locality: M. arboreus occurs naturally in east Usambara and on the eastern parts of west Usambara, Uluguru and Nguru Mountains, Southern Highlands (Iringa and Tukuyu), Songea (Liwili-Kiteza Forest Reserve).

2.2 Altitude: The species grows naturally between 600 m above sea level on the south-east Nguru Mountains to about 1530 m above sea level in Shikurufuni Forest Reserve in Morogoro. Dale and Greenway (1961) observed that in Kenya it grows from 1220 m to 1830 m above sea level.

2.3 Climate: The species is known to grow in areas of high annual rainfall, ranging from 1250 mm to 2340 mm for Liwili-Kiteza Forest Reserves and Tukuyu district office, respectively (Nshubemuki, et. al., 1978). The temperature and relative humidity data are available for Amani Meteorological stations. The mean maximum and mean minimum temperatures are 24.9° C and 16.3° C, respectively; the mean range is 8.6° C. The mean relative humidity is reported to be 87 percent at 0600 GMT and 75 percent at 1200 GMT (E.A. Met. Dept., 1975).

2.4 Geology and soils: The geology and soils of east Usambara and south-east parts of west Usambara, Nguru and Uluguru Mountains have been described above (see A. stuhlmannii). In Tukuyu Mountains, soils are derived from tertiary and recent volcanic rocks while in Songea soils are delivered from tertiary sediments (Morgan, 1972).

2.5 Forest type: Brenan and Greenway (1949) observed that M. arboreus is a rain forest species. Dale and Greenway (1961) report that in Kenya the species occurs naturally on the edge of montane rain forest and in damp localities. The common associate species include Allanblackia stuhlmannii, Caloncoba welwitsohii, Cephalosphaera usambarensis, Macaranga kilimandscharica, Myrianthus holstii, Newtonia buchananii, Ochma holstii, Strombosia scheffleri. M. arboreus is a shade-tolerant species.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

M. arboreus is of relatively low abundance in natural forests. It is usually a riverain species.

4.0 DESCRIPTION:

M. arboreus is a small or large evergreen tree, 15 to 25 m (rarely up to 30 m) high with smooth, light or reddish-grey bark. Leaves large and digitate, obovate or obovate-elliptic with long leaf stalks. The length of leaf stalks varies from 7 to 30 cm. The number of leaflets is usually 5 to 7, being smooth, dark green or greenish on upper surface and densely grey, tomentose with somewhat parallel and prominent venation beneath. Their sizes vary from 15 to 35 cm long and 6 to 13 cm wide. Leaf margins serrate, leaf tips acute or acuminate and leaf bases attenuate. M. arboreus is dioecious,

male and female flowers usually paired and borne in axils of the leaves. Male inflorescences of yellowish catkins borne on panicle cymes. Female inflorescences small, globose, light and yellowish. Fruit compound and yellowish after ripening. It resembles a small pineapple and is sweet and edible. Illustrations are given in Figure 17 and Plate XVII.

5.0 MAIN USES:

The fruit pulp is slightly acid and edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

M. arboreus ripe fruits are picked from the tree and eaten. Alternatively, green mature fruit can be picked from the tree and stored for ripening. Usually, fruits fallen on the ground are rotten and therefore unsuitable for eating.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

A survey of botanical specimens in Lushoto herbarium revealed that the species flowers from October to November, while fruit maturing is in April. During the field survey carried out recently, it was noted that flowering takes place from November to December and fruit matures from January to March. From the above it can be concluded that flowering is from October to December, and fruit maturing is from January to April.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge, but see Appendix 2 for constituents.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: On the basis of its low abundance in natural forests, and the absence of smaller size classes, it can be concluded that M. arboreus is not regenerating adequately. For the seed to germinate, the fruit should fall on damp places where it decomposes, releasing the seed. However, it appears that the seed has low germination capacity.

9.2 Artificial regeneration: Artificial regeneration has not been tried.

10.0 POTENTIAL ECONOMIC VALUE:

M. arboreus fruits may play an important role as a source of edible fruit if it is planted on a large scale; where there is a shortage of other tree species, M. arboreus could be a source of fuel wood; the wood is used for making wooden pots.

PLATE XVII. Myrianthus arboreus P. Beauv.

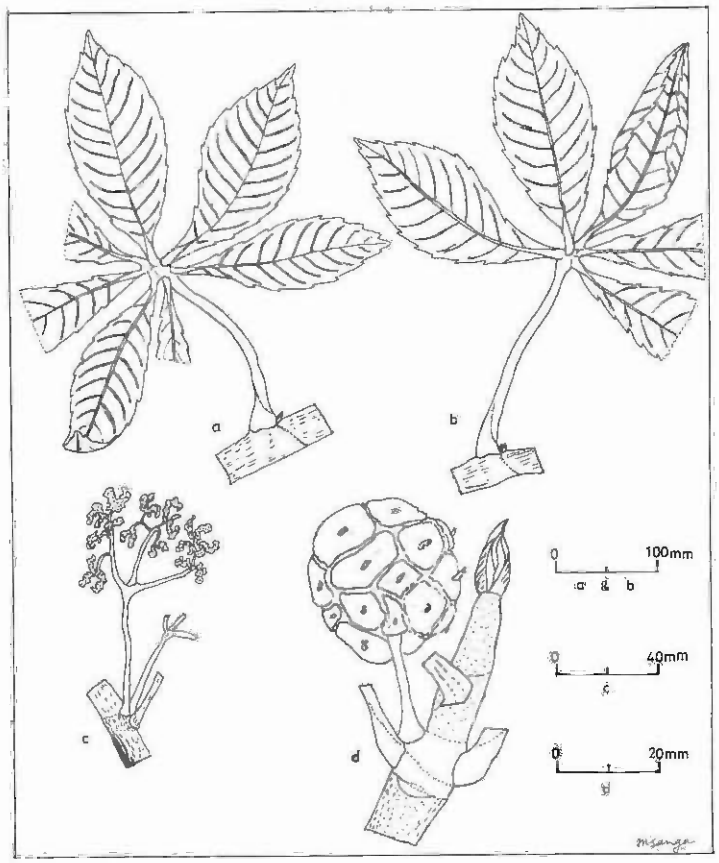


Plate XVII. Myrianthus arboreus P. Beauv.
a - leaf with seven leaflets
b - leaf with five leaflets
c - male inflorescence
d - branchlet bearing young fruit, leaves removed

Plate XVII$_1$ - tree at the left side of Amani stream Amani Montane forest January, 1982

Plate XVII$_2$ - branchlet bearing leaves and young fruits at Amani, Tanga, January 1982

18. OLDFIELDIA DACTYLOPHYLLA

1.0 NAMES:

Family	Euphorbiaceae
Botanical	Oldifieldia dactylophylla J. Leonard.
Syn.	Paivaeusa dactylophylla Welw. ex Oliv.
Vernacular	muliwanfwengi, mliwanfwengi, mkalanga (Kinyamwezi)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that the species grows naturally in Mwanza on the shores of Lake Victoria. A survey of the botanical specimens in Lushoto herbarium shows that the species grows naturally at Kipili (Manyoni District); Kipembawe (Chunya District), Simbo, Tabora Beekeeping School (Tabora District). These observations show that the species is restricted to Singida, Tabora and Mwanza regions.

2.2 Altitude: O. dactylophylla's altitudinal range is about 1100 to 1500 m above sea level.

2.3 Climate: Climatic data for Tabora and Mwanza, where O. dactylophylla grows naturally, are given under Manilkara mochysia. However, it should be noted that its water requirement is supplemented by ground water as it prefers areas with high ground watertable.

2.4 Geology and soils: O. dactylophylla grows naturally on light yellow friable clays with laterite horizon. The soils of Tabora and Singida are derived from acid gneisses, magmatites and associated granites and granodiorites; while the soils of Mwanza region are derived from granites and granodiorites (Morgan, 1972).

2.5 Vegetation types: O. dactylophylla grows naturally in Brachystegia-Julbernardia woodland. The common associated tree species are Afzelia quanzensis, Albizia antunesiana, Brachystegia boehmii, B. spiciformis, Combretum collinum, C. zeyheri, Flacourtia indica, Hexalobus monopetalus, Julbernardia globiflora, Lannea schimperi, Parinari curatellifolia, Strychnos pungens, S. spinosa, Terminalia sericae, Vangueriopsis lanciflora, Vitex mombassae, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

There are no records of inventory data for O. dactylophylla. However, it occurs in isolated patches in the Brachystegia-Julbernardia woodland, especially on sandy soils with high watertable. A rough sampling made near the Beekeeping School at Tabora showed that two plots measuring 52 m^2 and 11 m^2 each had 10 plants, i.e. seedlings or saplings.

4.0 DESCRIPTION:

O. dactylophylla is a small to medium-sized deciduous tree up to 17 m high with compact and rounded crown. Bark rough, black with deep longitudinal fissures, transverse cracks, brownish and resinous when slashed. Branchlets stout, short, ferrugineous-tomentose when young, rough with prominent leaf-scars and dormant buds when old. Leaves alternate or in fascicles, digitate, usually with 3-5 leaflets, sometimes up to 7 leaflets, leaf stalks 0.5-4 cm long, leaflets subsessile or shortly stalked, elliptic or oblanceolate-elliptic, 7-16 cm long, 3-6 cm wide, obtuse at apex, cuneate at base, margin entire, glabrous and shiny above, grey tomentose with prominent midrib beneath. Flowers dioecious, yellowish or rusty-yellow, dense, produced in leaf axils. Male flowers very shortly stalked. Female flowers have longer and branched peduncles, 1-2 cm long. Fruits subglobose, fulvous-tomentose, about 2.5 cm in diameter, greenish when young, yellowish when ripe, tardily dehiscent, containing 3 seeds. Seeds are flattish, up to 1.3 x 0.9 cm, cone-shaped, yellowish with edible pulp. Illustrations are shown in Figure 18 and Plate XVIII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

O. dactylophylla fruits are persistent; they are picked on ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

A survey of the botanical specimens in Lushoto herbarium shows that flowering takes place between September and October, while fruit ripening occurs in September and October. White (1962) observed that in Zambia the species flowers in May, while fruiting occurs in March and September. During the course of this study the species was noted flowering and ripening fruit in May. The above observations show that the species flowers and fruits twice per year. Flowering and fruit ripening occurs concurrently at the onset and towards the end of long rains. Moreover, it takes about five to seven months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: O. dactylophylla regenerates naturally from seed, coppice and suckers. The seed appears to be germinating well because during the field observation we noted profuse natural regeneration around mother trees. These seedlings rapidly develop a deep root system which helps to sustain the plant during the long dry season. Coppice shoots are produced on felling of trees. Root suckers are produced after wounding of roots by any means already mentioned in preceding chapters. In general, this species regenerates adequately in natural forests where it grows naturally.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, owing to the observed good germination capacity, there is a possibility of raising the species in the nursery and planting it in the field where there has been partial clearing of vegetation.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Fruits are edible; wood for fuel.

PLATE XVIII. Oldfieldia dactylophylla J. Leonard

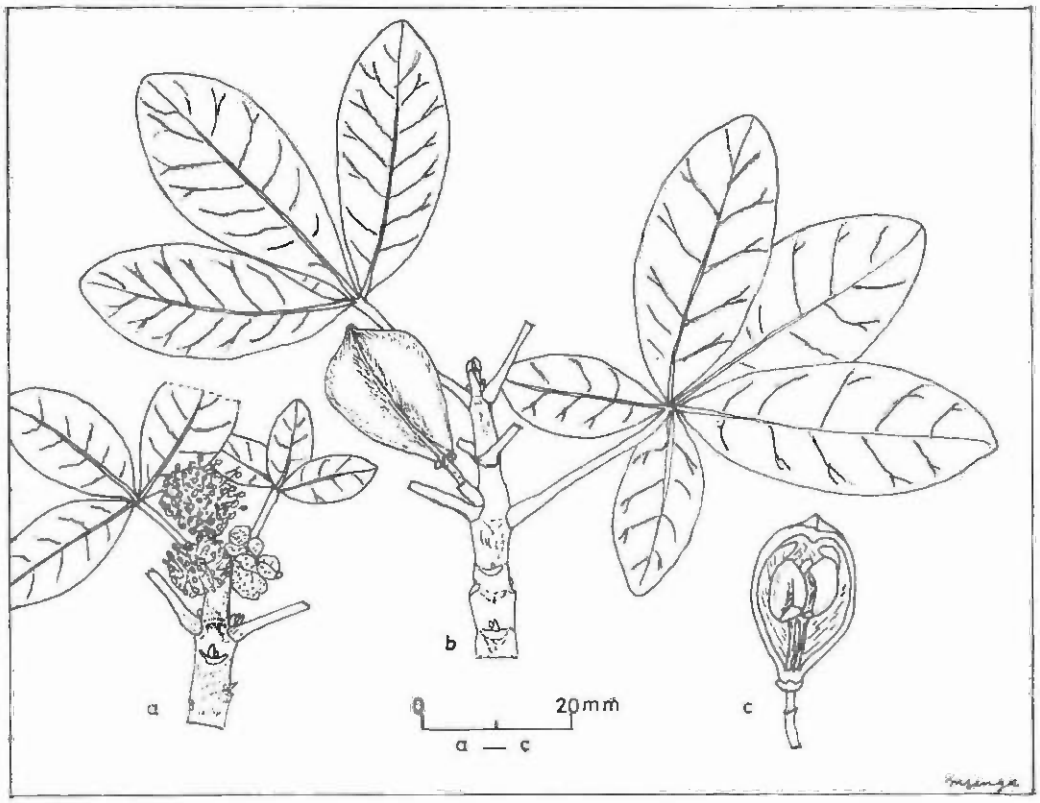


Plate XVIII. Oldfieldia dactylophylla J. Leonard
a - branchlet bearing flower buds c - fruit part section showing seeds
b - fruiting branchlet

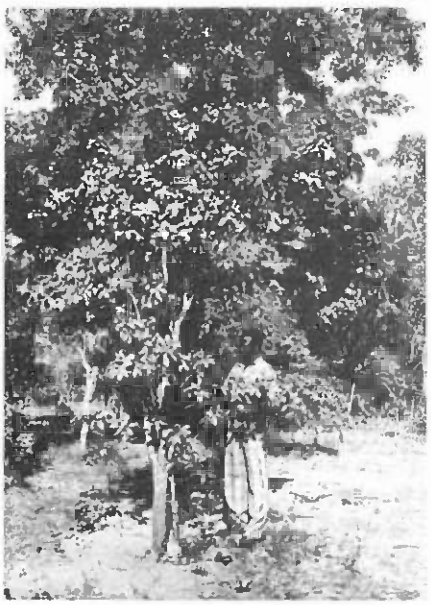


Plate XVIII$_1$ - tree, at Beekeeping School, Tabora, May, 1982

Plate XVIII$_2$ - branchlet bearing flowers, at Beekeeping School, Tabora, May, 1982

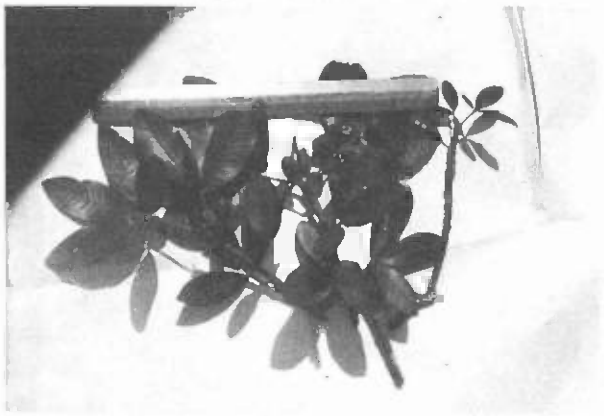


Plate XVIII$_3$ - branchlet bearing ripe fruits at Beekeeping School, Tabora, May, 1982

19. PACHYSTELA BREVIPES

1.0 NAMES:

Family	Sapotaceae
Botanical	Pachystela brevipes (Baker) Engl.
Syn.	Sideroxylon brevipes Baker
	Sideroxylon sacleuxii Baill.
	Pachystela sacleuxii (Baill.) Baill.
	Sersalisia brevipes (Baker) Baill.
	Pachystela brevipes (Baker) Baill.
	Chrysophyllum stuhlmannii Engl.
	Pachystela cinerea (Engl.) Engl.
	Bakeriella brevipes (Baker) Dubard
	Buteria brevipes (Baker) Baehni
Vernacular	msavia, mchocho, mchanvya, msamvia (Kiswahili); mgelezi (Kizaramo); msambia (Kipare, Kinguru); mkarati (Kizinza); ndobilobe (Kinyakyusa); msambwa (Kiluguru); mdu (Kipare)

2.0 DISTRIBUTION:

2.1 Locality: P. brevipes occurs naturally in lowland rain forests of Zanzibar (Mchocha), Pemba (Ngezi Forest Reserve) and Mafia Islands. The species is also known to occur in Kibaha (Bana); Korogwe (Rwengera River); Muheza Morogoro (Mtibwa), and Kilosa (Kidodi). It is also found in Iringa (Vigola Forest Reserve) and Tujuyu (Karoro Forest Reserve). It is also known to occur around Lake Victoria. It is found on Kome Island (Chigara Forest Reserve), Bukoba (Rubare Forest Reserve and Myakato) and Mgara (Muwendo Ferry).

2.2 Altitude: Hemsley (1968) reported that P. brevipes occurs from 0-1500 m above sea level. However, botanical specimens found in Lushoto herbarium revealed that the species occurs up to 1600 m above sea level at Muwendo Ferry (Ngara).

2.3 Climate: P. brevipes appears to occur naturally in areas with varying rainfall regimes. The minimum and maximum annual rainfall figures are 978 mm and 2029 mm for Ruvu near Dar-es-Salaam and Mkoani meteorological station on Zanzibar Island, respectively (Nshubemuki, et. al., 1978; E.A. Met. Dept., 1975). The temperature and relative humidity for selected areas where P. brevipes occurs naturally are given in Table 7.

Table 7 Annual temperature and relative humidity for the selected stations in Tanzania where Pachystela brevipes Engl. occurs naturally

Station (Period)	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Bukoba Met. Station (1936-70)	26.0	16.0	10.0	89	82	69
Miingano (1947-70)	30.1	20.4	9.7	-	80	66
Morogoro Met. Station (1940-60)	30.0	18.6	11.4	90	84	50
Zanzibar-Kisauni Airport (1952-70)	30.3	21.6	8.7	93	81	64
Zanzibar-Wete (1939-70)	29.9	21.1	8.8	-	78	-

Source: E.A. Meteorological Dept., 1975

2.4 Geology and soil: P. brevipes grows naturally on dark red to red loamy sands, red to yellow-red, gritty sandy clay loams (latosolic soils) and yellow-red loamy sands. On Lake Victoria Island the species grows on coastal sands and soils derived from granites and granodiorite rocks. Soils in Bukoba are derived frum Bukoban rocks; those in Ngara are derived from Karagwe-Ankolean rocks. Along Tanzanian coast and on Zanzibar, Pemba and Mafia Islands, soils are derived from quaternary sediments. In Morogoro and some parts of Tanga, soils are of Mozambican belt rock origin (Morgan, 1972).

2.5 Forest type: The species occurs naturally in moist lowland rain forests and riverain forests, and between moist lowland and montane rain forests. Its common associate tree species include Afrosersalisia cerasifera, Antiaris usambarensis, Bequaertiodendron magalismontanum, Malacantha alnifolia, Bombax rhodognaphalon, Chlorophora excelsa, Chrysophyllum albidum, Khaya nyasica, Pachystela msolo, Sorindeia madagascariensis, Sterculia appendiculata, Trema orientalis. P. brevipes is commonly found on river banks and margins or other such sites with a permanent watertable.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

There have been no inventory data taken. However, from field observations, the species is scattered in natural forests.

4.0 DESCRIPTION:

P. brevipes is a small or large evergreen tree up to 35 m high with dense crown and much fluted or ribbed bole. Leaves dark green, alternate, obovate, acuminate, obtuse or emarginate at apex, cuneate at base; glabrous and shining on the upper surfaces, while the lower surfaces are slightly pubescent and greyish. Primary lateral nerves prominent and 8 to 14 on each side, secondary nerves absent, ultimate veins oblique and inconspicuous. The sizes of the leaves vary from 9 to 20 cm long and 3.5 to 8 cm wide (or rarely more). The length of the stalks varies from 0.5 to 1 cm. Hemsley (1968) observed that flowers are either yellowish green, yellowish white or cream, and fragrant. Pedicels up to 2 mm long. Sepals connate at base, ovate to elliptic-oblong, up to 4 mm long, 3 mm wide, pubescent externally. Corolla yellowish green or cream; tube up to 2 mm long; lobes about elliptic to narrowly ovate, up to 4.5 mm long, 2.5 mm wide. Free part of filament up to 5 mm long; anthers narrowly obcordate, dehiscence. Small membraneous ovate-lanceolate or minute triangular staminodes sometimes present. Ovary subconical, up to 2 mm long; style up to 5 mm long.

The flowers are crowded in thick clusters below the leaves on young branchlets and also on older branches. The fruits are small, rusty-green, hairy berries about 3 cm long and 2.4 cm wide, ellipsoid or oblong-ellipsoid, prominently beaked at one end and yellowish after ripening. The fruit has a soft, milky pulp with an acid-sweet taste and edible. Illustrations are shown in Figure 19 and Plate XIX.

5.0 MAIN USES:

The fruit contains a milky juice and a white mucilaginous acid-sweet edible pulp (Dale and Greenway, 1961).

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are collected from standing trees. Fruits falling on the ground are normally unripe or overmature and thus unsuitable for eating.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) report that flowering takes place in May, August and December, and trees are fruiting in October. Recent field observations at Muheza (Tanga) and Kalundwa Morogoro revealed that flowering is in June and December, while fruit ripening is from October to February. This implies that there are long flowering and fruiting periods.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: P. brevipes regenerates naturally by seed and coppice. The species seeds heavily in most years. On overmaturing, the fruit falls to the ground. During the rainy season, or towards the end of the rainy season, there is profuse natural regeneration of the species. However, few seedlings advance to sapling or pole sized trees. This is mainly because most of the seeds which germinate towards the beginning of the dry season die. Moreover, a few pole sized or mature stocks which survive are frequently cut because the tree is reputed to produce good quality poles for construction.

9.2 Artificial regeneration: No efforts have been made to regenerate the species artificially. However, owing to good germination capacity, it would be possible to raise it in pots in the nursery or by direct sowing on cultivated soils. Field observations carried out in Morogoro revealed that pollarding could increase the quantity of fruits produced by trees.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Although the species seems to be slow growing, it has high potential for its edible fruits, construction poles, firewood and pestles.

PLATE XIX. Pachystela brevipes (Baker) Engl.

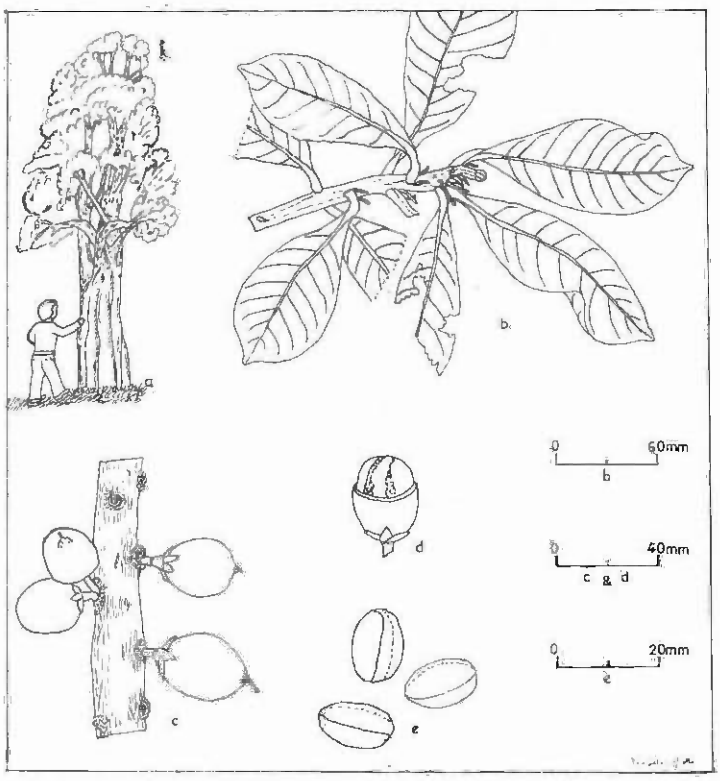


Plate XIX. Pachystela brevipes (Baker) Engl.

a - tree
b - branchlet
c - cluster of fruits on an old branch
d - fruit in part section showing pulp and seed
e - seed

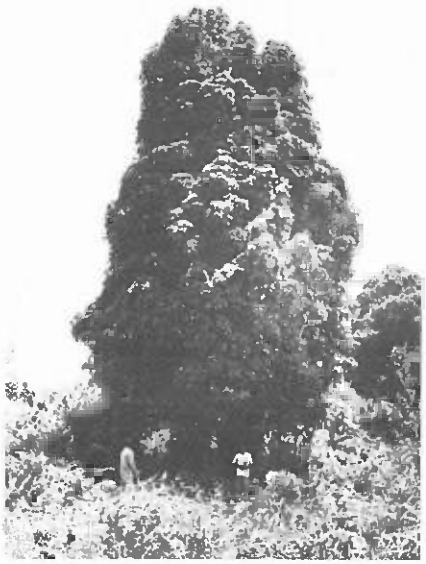


Plate XIX$_1$ - tree at Kalundwa Morogoro, February, 1982

Plate XIX$_2$ - branchlets showing leaves and ripe fruits

20. PACHYSTELA MSOLO

1.0 NAMES:

Family	Sapotaceae
Botanical	Pachystela msolo (Engl.) Engl.
Syn.	Chrysophyllum msolo Engl.
	Pachystela ulugurensis Engl.
	Pouteria msolo (Engl.) Mceuse
	Amorphospermum msolo (Engl.) Baehni
Vernacular	msavia, mohocho, mchanvya, msambia (Kiswahili); mgelezi (Kizaramo); msambia (Kinguru, Kizigua); mkarati (Kizinza); ndobilobe (Kinyakyusa); msambwa (Kiluguru); mdu, msambia (Kipare); mnyohoyo (Kizigua).

2.0 DISTRIBUTION:

2.1 Locality: The species occurs naturally at Korogwe (Mombo and Mashewa); Muheza (Amani, Kwamkoro); Morogoro (east Uluguru and south-east Mguru(at Manyangu Forest Reserve); Handeni (along the Msiri River); eastern South Pare Mountains and Bukoba (Rubare Forest Reserve). Hemsley (1968) reported that the species is also found in the southern highlands.

2.2 Altitude: The species occurs between 80 m and 1400 m above sea level (Hemsley, 1968). According to the botanical specimens found in Lushoto herbarium, the species is found up to 1524 m above sea level at Maskati in the south-east Nguru Mountains.

2.3 Climate: P. msolo is found to grow in areas with great variations in rainfall regimes. The minimum annual rainfall is 642 mm (Mombo) and the maximum annual rainfall is 1753 mm (Amani) (Nshubemuki, et. al., 1978). It should be borne in mind that the low rainfall at Mombo is supplemented by the permanent high ground watertable. The temperature and relative humidity for selected areas where P. msolo occurs naturally are given in Table 8.

Table 8 Annual temperature and relative humidity for the selected stations in Tanzania where P. msolo occurs naturally

Station (period)	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Amani (1931-73)	24.9	16.3	8.6	-	87	75
Mombo (1959-70)	31.0	18.9	12.1	92	78	50
Morogoro (1946-60)	30.0	18.6	11.4	90	84	50
Bukoba (1936-70)	26.0	16.0	10.0	89	82	69

Source: E.A. Met. Dept., 1975.

2.4 Geology and soils: P. msolo occurs naturally on laterized red earths with a shallow organic topsoil derived from gneisses with varying amounts of pyroxene, hornblende and biotite rocks in the east Usambara. In Korogwe, Muheza, Handeni and Morogoro, the species grows naturally on red to yellow-red, gritty sandy clay loams (latosolic soils) and yellow-red loam soils derived from rocks of the Mozambican belt. In the Uluguru and Nguru Mountains, these soils are derived from coarse grained siliceous rocks and usually associated with "Inselbergs" at lower altitudes. The soils in Bukoba District are highly leached (dark greyish to brown) with low humus. The "A" horizon overlies yellow-red loamy sands on quartz-rich Bukoban sandstone (Mørberg, 1972; Morgan, 1972).

2.5 Forest type: The species occurs naturally in lowland rain forests extending into the lower fringes of upland rain forests, and in riverain forests. At lower altitudes the species occurs in association with Afrosersalisia cerasifera, Antiaris usambarensis, Bombax rhodognaphalon, Chlorophora excelsa, Chrysophyllum albidum, Sorindeia madagascariensis, Sterculia appendiculata and Trema orientalis. At higher altitudes, the species occurs in association with Allanblackia stuhlmannii, A. ulugurensis, Cephalosphaera usambarensis, Isoberlinia scheffleri, Myrianthus arboreus, Newtonia buchananii, Parinari excelsa, P. goetzeniana, Strombosia scheffleri, Syzygium guineense, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The species is abundant in forests at lower altitudes, but its frequency in occurence decreases with rise in altitude.

4.0 DESCRIPTION:

P. msolo is a medium or tall evergreen and many-branched tree, 20 to 50 m high, with dense crown and deeply fluted and pillared bole to about 3 m. Leaves alternate, medium to large, 8 to 35 cm long, 3 to 14 cm wide (or rarely larger than this), dark green, coriaceous, glabrous and shining on upper surfaces, while the lower surfaces are slightly silvery, hairy or glaucous with prominent venation. Their shapes vary from obovate-oblong to oblanceolate with rounded or shortly acuminate tips and cuneate, obtuse or subauriculate leaf bases. Lateral nerves 10 to 16 on each side of the leaf. Leaf stalks short, 0.3 to 1.0 cm long. Flowers small, greenish-white and fragrant, clustered below the leaves on young branchlets and older branches. Pedicels short, usually from 0.3 to 0.6 cm long. Fruits small, green, subglobose berries about 3 cm long, 2.5 cm wide and beaked. The fruits become yellowish after ripening and have a juicy pulp. Illustrations are shown in Figure 20 and Plate XX.

5.0 MAIN USES:

The fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are collected from standing trees. Fruits falling on the ground are usually not ripe or overmature and unsuitable for eating.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that P. msolo flowers in July, October and December, while fruits mature in July. A survey of the specimens in the Lushoto herbarium revealed that the species flowers in October and December. During recent field survey, it was noted that the species flowers in October, while fruit ripens in December, February, March and April. This suggests that it takes about six months from flowering to fruit maturing.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: P. msolo regenerates naturally by seed and coppice. The species seeds heavily every year. On overmaturing, the fruit falls to the ground. During the rainy season or towards the end of the rainy season, there is profuse natural regeneration of the species. However, few seedlings advance to sapling or pole sized stages. The species suffers a fate similar to that suffered by P. brevipes (see previous species).

9.2 Artificial regeneration: No efforts have been made to regenerate the species artificially. However, owing to observed good germination capacity in natural forests, it would be possible to raise it in pots in the nursery or by direct sowing on well-prepared ground. Pollarding seems to increase the quantity of fruit produced by trees.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Despite the fact that the species is very slow growing, it has high potential for its edible fruit pulp, construction poles, fire wood and pestles.

PLATE XX. Pachystela msolo (Engl.) Engl.

Plate XX_1 - heavily fluted bole at Mombo arboretum- Tanga, February, 1982

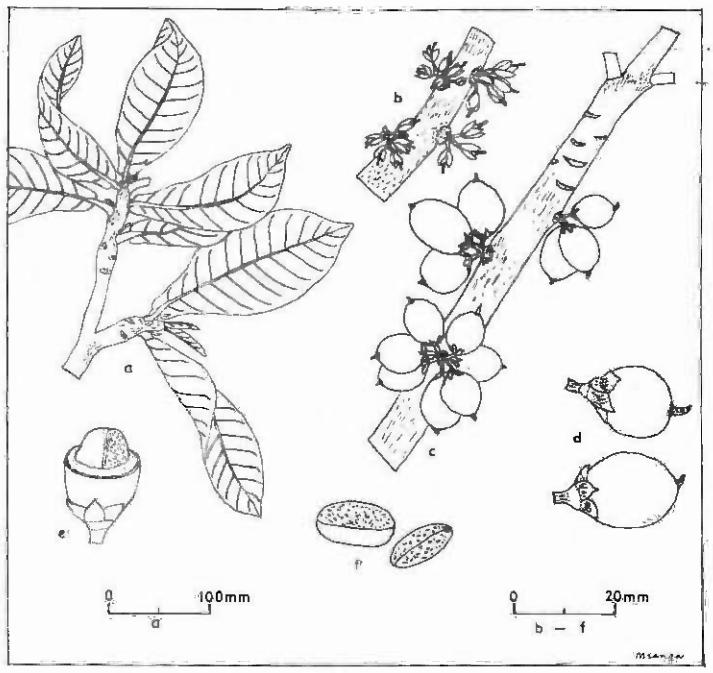


Plate XX. Pachystela msolo (Engl.) Engl.
a - branchlet bearing leaves and terminal buds
b - cluster of flowers on a branchlet
c - cluster of young fruits on a branchlet
d - mature fruits
e - fruit in part section showing
f - seeds

Plate XX_2 - tree at Longuza - Tanga, February 1982

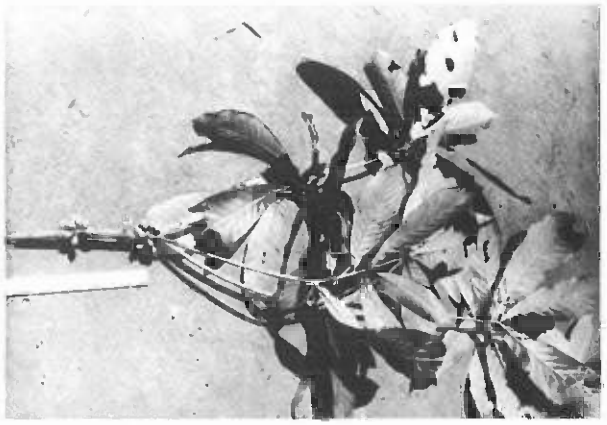


Plate XX_3 - branchlet bearing leaves and fruits

21. PARINARI CURATELLIFOLIA

1.0 NAMES:

Family	Rosaceae
Botanical	Parinari curatellifolia (Planch.ex) Benth
Sub-species	curatellifolia
Syn.	P. curatellifolia Benth; sensu stricto
Sub-species	mobola (Oliv.) R. Grah.
Syn.	P. mobola Olive
Vernacular	mumura (Kirangi); mbula muvula (Kinyamwezi); mbula (Kizaramo); munazi (Kihaya, Kikerewe); mnazi (Kisukuma, Kilongo); msaula (Kihehe); umbula (Kinyakyusa); ikusu, ibula (Kinyiha); mbura (Kiswahili).

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that P. curatellifolia is rare in central Tanzania regions but abundant in the great west Brachystegia forest from Uvinza to Ufipa. Graham (1960) reports that the species grows naturally in Mwanza Region (i.e. Geita, Karumo, Chamabanda), Mpanda and Kisarawe (i.e. Mongo Forest Reserve) Districts. A survey of the botanical specimens in Lushoto herbarium shows that the species occurs naturally in Kagera (Bukoba-Rubya); Mwanza (i.e. Geita, Kome and Ukerewe), Tabora (i.e. Urumwa, Kigwa, Simbo, Sikonge, Kiwere); Singida (i.e. Manyoni, Kipiri, Mwamagembe, Rungwa); Dodoma (i.e. Massawi, Chenene, Kola); Iringa (i.e. Iringa and Mufindi Districts) Mbeya (i.e. Mbeya, Tukuyu and Mbozi Districts); Rukwa (i.e. Mpanda); Kigoma (Kibondo); Coast (i.e. Kongowe, Fungoni, Odongo, Mogo) Regions and Zanzibar and Pemba Islands. Generally, it can be concluded that P. curatellifolia is widely distributed in Tanzania.

2.2 Altitude: Graham (1960) observed that the species grows naturally from sea level to about 1800 m above sea level. During the course of this study the species was found growing naturally at about 1880 m at Sao Hill, in Mufindi District. This shows that the species' altitudinal range is between 0 and 1900 m above sea level.

2.3 Climate: P. curatellifolia grows naturally in areas with varying climatic regimes. The rainfall, temperature and relative humidity statistics for selected stations where P. curatellifolia grows naturally are shown in Table 9.

Table 9 Rainfall, temperature and relative humidity for selected stations in Tanzania where P. curatellifolia grows naturally

Station (Period)	Rainfall mm			Mean temperature °C			Relative humidity %		
	Mean	Highest	Lowest	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Iringa (1919-59)	743	1100	401	24.7	13.5	11.2	88	72	52
Mbeya (1932-70	905	1287	564	23.9	10.1	13.2	91	73	56
Njombe (1951-70	1151	1438	758	21.9	10.2	11.7	-	93	63
Ukiriguru (1963-70)	1025	1343	854	28.5	17.1	11.4	-	71	49
Zanzibar (1952-70)	1565	2373	807	30.3	21.6	8.7	93	81	64

Source: E.A. Met. Dept., 1975

The data in Table 9 show that maximum and minimum annual rainfall is 2373 mm and 401 mm, respectively, while the highest mean maximum temperature is 30° C and the lowest mean minimum is 10° C.

2.4 Geology and soils: P. curatellifolia grows naturally on a variety of soils derived from different parent materials. It grows on light yellowish-brown to reddish-yellow, gritty, sandy clay loams and red to dark red, friable clays with laterite horizon. In Mwanza these soils are derived from granites and granodiorites. In Tabora, Singida and Iringa Regions, these soils are derived from acid gneisses, migmatites and associated granites and granodiorites. In Coast and Kagera it grows on yellow-red loamy sands derived from tertiary sediments and Bukoban rocks, respectively (Morgan, 1972).

2.5 Vegetation types: Graham (1960) observed that P. curatellifolia grows naturally in deciduous woodland, especially Brachystegia woodland, extending to its upper limits, and then scattered in upland grassland; often persisting in cultivated land and present in secondary bushland. The common associate tree species are Albizia antunesiana, A. versicolor, Antidesma venosum, Apodytes dimidiata, Brachystegia longifolia, B. spiciformis, Combretum collinum, C. molle, Faurea saligna, Julbernardia globiflora, Piliostigma thonningii, Psorospermum febrifugum, Pericopsis angolensis, Rhus natalensis, Securidaca longipedunculata, Syzygium guineense, Uapaca kirkiana, Vitex doniana, V. mombassae, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

P. curatellifolia is often one of the dominant species in the Brachystegia forests of Kibondo, Iringa and Mbeya. A rough sampling carried out at Nyololo (Mufindi) and Urumwa (Tabora) shows that plots measuring 144 m^2 and 296 m^2 had 20 and 27 stems, respectively.

4.0 DESCRIPTION:

P. curatellifolia is an evergreen tree, up to 15 m high, with rounded crown. Bark corky, grey-black, longitudinally fissured with red to pink slash. Leaves alternate, petiolate, variable in shape, usually oblong or oblong-elliptic, 6.5-12 cm or sometimes up to 17 cm long, 3.5-6 cm or rarely up to 9 cm wide, round or obtuse, sometimes emarginate at the apex, cuneate or cordate at base, coriaceous, green and glabrous above or with tomentose midrib, silvery-grey to fulvous-brown-tomentose beneath, sometimes very thickly so, with prominent midrib and close subparallel primary nerves. Flowers pale mauve, produced in open or dense terminal or axillary panicles with dense silvery to fulvous hairs; cymes 2-3 flowered and sweet scented. Calyx rather asymmetrically cup-shaped. Fruits ellipsoid-ovoid up to 3-5 cm long, 2.5-4 cm in diameter, glabrous, greenish with paler specks when mature, becoming yellowish when ripe and dark brown when dry. Seed hard and woody, 2.1-4 cm long, 1.1-2.5 cm in diameter containing two fatty kernels. Illustrations are shown in Figure 21 and Plate XXI.

5.0 MAIN USES:

The ripe fruit pulp is edible. Moreover, the seed is pounded and used for making soup.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

P. curatellifolia fruits on ripening fall onto the ground from where they are collected.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that P. curatellifolia flowers between August and November. White (1962) observed that in Zambia flowering and fruit ripening occur concurrently in July and August. Chingaipe (Pers Comm.) observed that in Zambia, P. curatellifolia fruit ripening occurs between September and November. A survey of the botanical specimens in Lushoto herbarium shows that flowering takes place between June and January, while fruit ripening occurs between August and May. The field survey carried out during the course of this study showed that P. curatellifolia flowers from October to December, while fruit ripening occurs between October and May. The above observations show that P. curatellifolia has long flowering and fruit ripening periods. The species' flowering and fruit ripening often occur concurrently during the rainy and dry seasons. It takes about nine to ten months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

The kernel has a high oil content. See Appendix 2 for main constituents.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally from seed, coppice and suckers. The behaviour of the seed as regards its germination has not been studied. However, owing to its hard seed coat, it is considered likely that its germination is poor. Coppice shoots are produced on felling of trees. Root suckers are produced after root wounding. It is important to note that most of the trees and young regeneration seen in the field originated from root suckers. The species has been seen to be growing naturally in almost pure dense stands in most parts of Iringa and Mbeya Regions. This implies that the species regenerates adequately there.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, there is a possibility of regenerating it naturally. Seed germination capacity could be improved by pretreatment. Potted stock raised in the nursery could be planted in the field where partial clearing has been carried out.

However, it is suggested that regeneration inducement from root suckers could be a feasible technique in areas where the species is semi-cultivated on farm land.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruit pulp is edible and sold on the market; seed kernel has a high oil content which is edible and it could be extracted; its wood is reddish, hard and heavy and is very hard on saws - used for making railway sleepers, mining timber, and canoes.

PLATE XXI. Parinari curatellifolia (Planch.ex) Benth

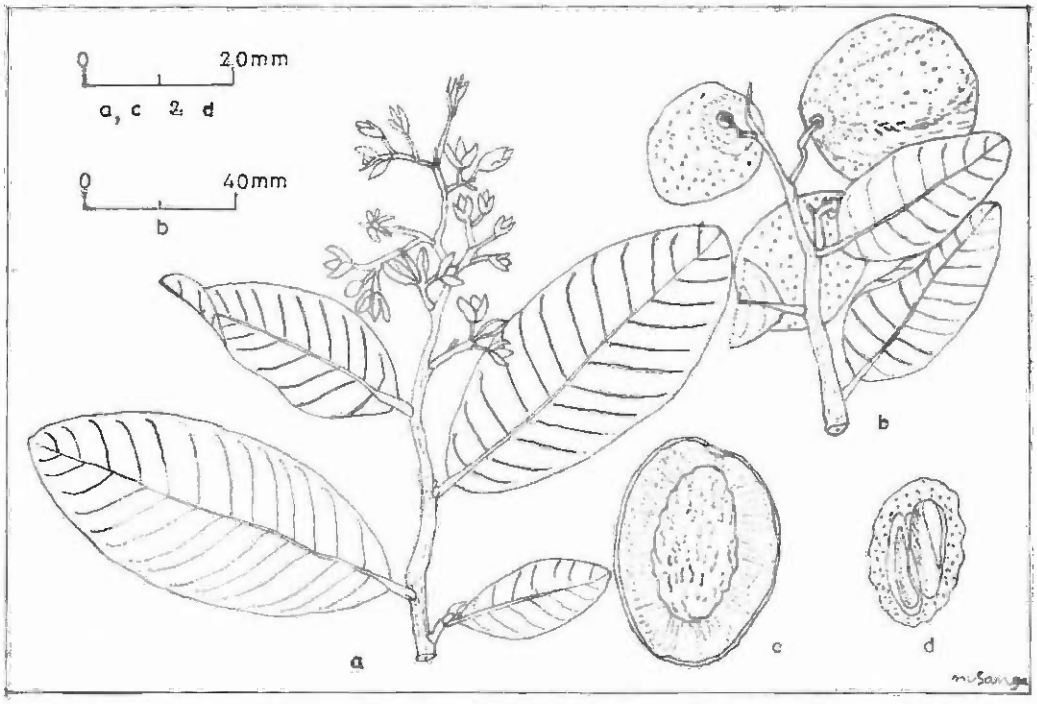


Plate XXI. Parinari curatellifolia (Planch.ex) Benth

a - branch bearing inflorescence
b - fruiting branchlet
c - fruit part section showing seed
d - longitudinal section through seed

Plate XXI_1 - Tree, at Isangu Village, Mbozi District, Mbeya, June, 1982. Note that it is a shade tree in Coffee & banana plantations

Plate XXI_2 - Young regeneration at Nyololo, Mufindi District, Iringa, June, 1982

22. PARINARI EXCELSA

1.0 NAMES:

Family	Rosaceae
Botanical	Parinari excelsa Sabine
Sub-species	holstii (Engl.) R. Grah.
Syn.	P. holstii Engl.
	P. salicifolia Engl.
	P. mildbraedii Engl.
	P. excelsa Sabine var fulvescens Engl.
Vernacular	mbura (Kiswahili); mhula , mbula, muuwa, muula (Kishambaa); mula (Kizigua); msaula (Kihehe); muganda (Kipare)

2.0 DISTRIBUTION:

2.1 Locality: The species occurs naturally in Bukoba (Rubare); it is widely distributed in the montane rain forest of west Usambara (e.g. Baga-Bumbuli road, in Kitivo, Shagayu Forest Reserves); east Usambara Mountains (Amani and Kwamkoro), Southern Highlands (Njombe, Mufindi and Rungwe Districts) and South Pare Mountains. According to Graham (1960) the species is also said to occur in Morogoro Region. The specimens in Lushoto herbarium show that the species is also found along the Mukula River near Sanje in Mahenge District.

2.2 Altitude: The species occurs naturally between 1000 m and 2100 m above sea level (Graham, 1960).

2.3 Climate: P. excelsa grows naturally in areas receiving an annual rainfall of about 955 mm (Bukoba Meteorological Station) to 1992 mm (Mufindi Meteorological Station) (Nshubemuki, et. al., 1978). The temperature and relative humidity for selected areas where P. excelsa occurs naturally are given in Table 10.

Table 10 Annual temperature and relative humidity for the selected stations where P. excelsa occurs naturally

Station (Period)	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Amani (1941-70)	24.9	16.3	8.6	-	87	75
Bukoba (1936-70)	26.0	16.0	10.0	89	82	69
Njombe (1951-70)	21.9	10.2	11.7	-	93	63

Source: E.A. Met. Dept. 1975.

2.4 Geology and soils: P. excelsa grows naturally on dark red to red loamy sands (latosolic soils) derived from rocks of Mozambican belt origin. The species is also known to occur on yellow-red sandy clay loams (latosolic soils) and dark greyish-brown calcareous clay loams (rendzinic soils) derived from acid gneisses, migmatites and associated granites and granodiorites (Morgan, 1972). The geology and soils in Bukoba are described by Mørberg (1972), see under Pachystela msolo.

2.5 Forest type: P. excelsa is known to occur in montane rain forests and riverain forests in Brachystegia woodland (Graham, 1960). However, Brenan and Greenway (1949) observed that P. excelsa occurs naturally in rain forest, fringing and mountain forests. Fanshawe (1968) reported that in Zambia, P. excelsa is the characteristic species of montane forests and dry evergreen forests on the copper belt. Dominant or at least characteristic of riparian forest fringing small streams or the upper reaches of large streams and occasionally found on the fringes of swamp forests. Its common associate species include Albizia adianthifolia, A. gummifera, Entandrophragma excelsum, Isoberlinia scheffleri, Newtonia buchananii, Ochna holstii, Ocotea usambarensis, Olea hochstetteri, Podocarpus ensiculus, P. usambarensis, Prunus africana and Syzygium guineense.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The frequency of P. excelsa in forest reserves of the montane rain forest of west Usambara was assessed by the Inventory Section of the Forest Division and reported by Maagi, et. al. (1979). The number of trees per hectare on 27 642 ha in successive DBH classes of 10 cm, starting with 25-34 cm were: 0.52, 0.65, 0.43, 0.47, 0.10, 0.19, 0.16, 0.09, 0.06, 0.21, 0.05, 0.07, 0.04, 0.01, 0.03, 0.01, 0, 0, 0.03 trees, making a total of 3.1 stems/ha.

4.0 DESCRIPTION:

P. excelsa is a large evergreen tree, 20 to 45 m high, with dense spreading crown and buttressed or unbuttressed bole up to 1 m DBH. The buttresses reach up to 3 m high. Its bark is greyish-brown, rough and flaking longitudinally. Leaves alternate lanceolate, elliptic, ovate-elliptic, 3.5 to 15 cm long, 1.3 to 3.5 wide. On coppice shoots up to 17 cm long. They are dark-green, shiny and glabrous above; dull whitish, hairy with paralleled and prominent venation beneath. Leaft stalks 0.3 to 1.0 cm long. Leaf margins entire, leaf tips acuminate, acute or obtuse and leaf bases rounded or cuneate. Flowers white or yellowish-white, borne in thick terminal or axillary panicles. Fruits are egg-shaped drupes, 3 to 5 cm long and 2.5 to 3.2 cm wide, brown with small whitish spots, with fleshy pulp surrounding hard seed. Illustrations are shown in Figure 22 and Plate XXII.

5.0 MAIN USES:

The fruit pulp and kernel are edible. Fanshawe (1968) observed that the fruit pulp is used in making beer and the kernels are oily and edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

On ripening, the fruits fall to the ground from where they can be collected. The perishability of the fruit depends very much on the weather. In dry conditions, the fruit may remain in good condition on the ground for about a week. But it perishes quickly under moist conditions.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Phenological observations carried out in Lushoto over four years, 1978 to 1981, revealed that P. excelsa flowers from August to March, while fruit ripening is from August to February. Heavy fruit falling is from November to December.

8.0 NUTRITIONAL VALUE:

Indications of range of constituents in Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: From field observations in Lushoto, the species seems to be regenerating naturally by root suckers. P. excelsa has a spreading shallow root system which becomes exposed very easily. On exposure and wounding by any means, roots produce profuse root suckers. Some of these root suckers, if not eliminated by natural means or human beings, advance to sapling and pole sized trees and finally form part of the mature crop. The species also regenerates naturally by coppice.

9.2 Artificial regeneration: Very little has been done to regenerate this species artificially. However, seed research carried out in Lushoto showed that of the seeds produced annually, only a few are sound. Moreover, as most of the seed is eaten by man and animals, regeneration by seed is not as promising as root wounding.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Timber is suitable for heavy duty work such as flooring and railway sleepers. The fruit and bark are used in the preparation of traditional medicine (Fanshawe, 1968). The ash of the bark and wood yields tannin, while the shell and pulp of the fruit yields a dye. In West Africa these products are used in tanning and dyeing hides (Watt and Brayer-Brandwijk, 1962).

PLATE XXII. Parinari excelsa Sabine subsp holstii (Engl) R. Grah

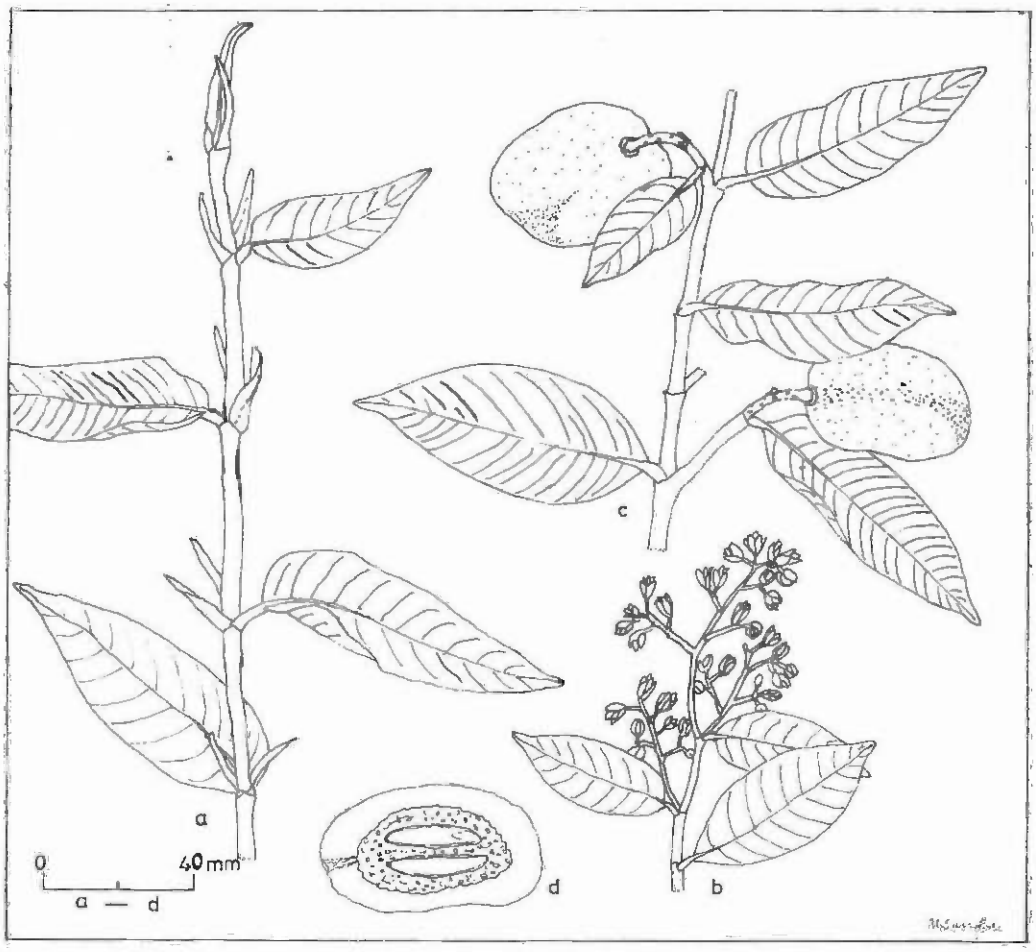


Plate XXII. Parinari excelsa Sabine subsp holstii (Engl) R. Grah

a - coppice shoot
b - inflorescence
c - branchlet bearing fruits
d - fruit in longitudinal section

Plate XXII$_1$ - tree at Lushoto silviculture nursery, January, 1982

23. SABA FLORIDA

1.0 NAMES:

Family	Apocynaceae
Botanical	Saba florida (Benth.) Bullock
Syn.	Landolphia comorensis (Boj.) K. Schum L. comorensis (Boj.) K. Schum. var florida (Benth.) K. Schum. L. florida Benth.
Common English Name	Rubber vine
Vernacular	mbungo, mpira (Kiswahili) mbungo (Kishambaa); mubungu (Kizinza); mgombe (Kimbunga); omubungo (Kirongo, Kizinza); ngombe (Kirufiji); mtegeti (Mara)

2.0 DISTRIBUTION:

2.1 Locality: The species occurs on lowland rain forest areas. It is mainly found along the coast, extending from Tanga to Mtwara and up to Korogwe (Kwamdorwa) and Morogoro areas. It also occurs in districts around Lake Victoria, i.e. Bukoba, Biharamulo, Geita, Mwanza and Mara and on Lake Victoria Islands. The species is also abundant around Lake Nyasa and Lake Tanganyika. It has also been observed to be growing naturally at Tengeru (Arusha) and Rau Forest (Moshi). The species is also widely distributed on Pemba (e.g. at Ngezi Forest Reserve) and Zanzibar Island (Jozani Forest Reserve).

2.2 Altitude: The species occurs naturally from sea level to about 1250 m above sea level.

2.3 Climate: S. florida flourishes on a variety of sites receiving varying amounts of rainfall. The minimum recorded mean annual rainfall is 885 mm (Moshi Meteorological Station) and the maximum recorded mean annual rainfall is 2029 mm (Mkoani Meteorological Station on Zanzibar Island). The temperature, evaporation and relative humidity for selected areas where S. florida occurs naturally are given in Table 11.

Table 11 Annual temperature, evaporation and relative humidity for the selected stations in Tanzania where Saba florida occurs naturally

Station (period)	Temperature °C			Relative humidity %			Annual evaporation mm		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT	Mean	Highest	Low
Mlingano (1947-70)	30.1	20.4	9.7	-	80	66	-	-	-
Morogoro Met. (1940-60)	30.0	18.6	11.4	90	84	50	-	-	-
Moshi Met. (1932-70)	29.6	17.3	12.3	87	78	49	2604	3003	2039
Zanzibar-Kisauni Airp. (1952-70)	30.3	21.6	8.7	93	81	64	-	-	-
Zanzibar-Wete (1939-70)	29.9	21.1	8.8	-	78	-	-	-	-

Source: E.A. Met. Dept., 1975

2.4 Geology and soil: S. florida grows on a variety of soils of different origin. The species grows naturally on red to yellow-red, gritty sandy clay loams (latosolic soils) and yellow-red loamy sands. The species is also known to occur naturally on dark grey to greyish-brown compacted loamy sands (solodized solonetzic soils). On Lake Victoria Islands, the species grows on coastal sands and coral rag derived from granites and granodiorite rocks. Soils around the north-eastern part of Lake Tanganyika and on the western parts of Lake Victoria are derived from Bukoban rocks. Along Tanzania coast and on Zanzibar and Pemba Islands, soils are derived from quaternary sediments. In Morogoro and some parts of Tanga, soils are of Mozambican belt rock origin (Morgan, 1972).

2.5 FOREST TYPE: S. florida is a lowland rain forest species. Its common associate tree species are Antiaris usambarensis, Chlorophora excelsa, Khaya nyasica, Pachystela brevipes, P. msolo, Sterculia appendiculata, Sorindeia madagascarientis, Trema orientalis, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The species is very abundant in undisturbed forests and very rare in open areas.

4.0 DESCRIPTION:

S. florida is a strong forest liane up to 20 m on other trees with lenticellate stem containing white, sticky latex. It has opposite, dark green, thick and glabrous leaves, 9 to 18 cm long, 4 to 9 cm wide, of variable shapes; ovate elliptic or oblong with prominent venation beneath. Leaf stalks from 1 to 1.5 cm long, leaf margins entire, leaf apex obtuse, acute or shortly acuminate and leaf bases rounded. Flowers five-petalled, white, tubular,sweet scented borne in many shortly stalked terminal or axillary corymbs. Fruits greenish when young, turning to orange-yellow after ripening. Their sizes vary from 4 to 8 cm long and 3.5 to 6 cm wide. The pulp obtained from ripe fruit is yellow. Illustrations are shown in Figure 23 and Plate XXIII.

5.0 MAIN USES:

The ripe fruit pulp is edible. The pulp is mixed with water and sugar to make a refreshing drink.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

On maturing, the fruits turn yellow and it is at this time that fruits are collected from the climber. Mature fruits never fall to the ground; they dry and disintegrate with time-releasing seeds.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

S. florida does not fruit every year. Moreover, field observations show that S. florida climbers do not flower or fruit at the same time. There is a lot of variation from place to place and from climber to climber. The species flowers between February and November. Fruit maturing is from December to May. From these observations it can be deduced that it takes about one year from flowering to fruit maturing.

8.0 NUTRITIONAL VALUE:

Not known.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally by seed and coppice. For establishment the seed needs fertile moist soils under partial or full shade. The seed is easily spread by birds and monkeys. Coppices are produced after cutting the main stem.

9.2 Artificial regeneration: Little effort has been made to regenerate S. florida artificially. For easy and quick germination, the seed needs squashing by hand and cleaning in water to remove the pulp. The germination capacity of freshly collected seed is over 90 percent. Germination starts usually 12 days after sowing and is completed after one month; it is uniform and hypogeal. The species can also be regenerated by using cuttings.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Currently, very little importance is attached to S. florida as a potential income source. In Dar-es-Salaam an average fruit is selling at T Shs 4, while in Zanzibar and Pemba it sells at an average price of T Sh. 2. If large quantities of fruits could be collected, there is an export potential as the fruit does not rot easily. The stem yields latex which is used as an inferior rubber.

PLATE XXIII. Saba florida (Benth.0 Bullock

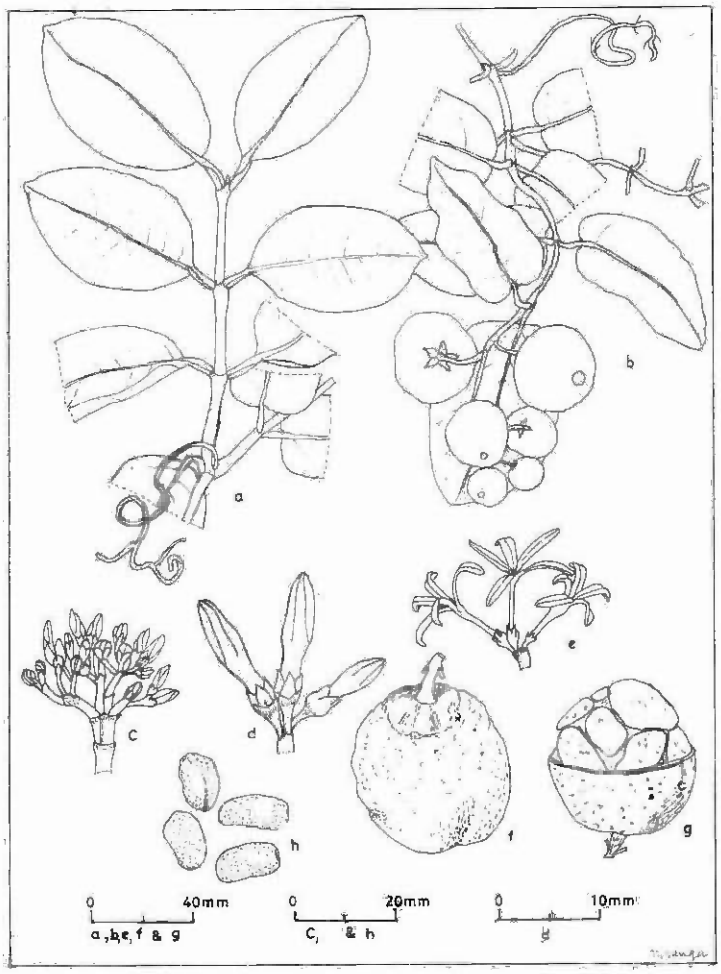


Plate XXIII. Saba florida (Benth.) Bullock

a - branchlet
b - branchlet bearing young fruit
c - cluster of flower buds
d - flower buds
e - flowers
f - fruit
g - fruit in part section showing seeds in situ
h - cleaned seeds

Plate XXIII$_1$ - Investigators pulling climbers at Longuza Forest Reserve - Tanga, February, 1982

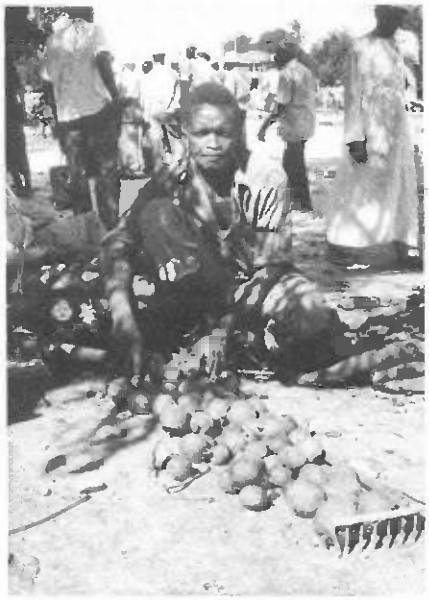


Plate XXIII$_2$ - Fruit vending in a street in Wete - Pemba Island, May, 1981

24. SORINDEIA MADAGASCARIENSIS

1.0 NAMES:

Family	Anacardiaceae
Botanical	Sorindeia madagascariensis Thon
Syn.	S. obtusifoliolata Engl
Vernacular	Msugwe (Kigoro); mpilipili (Kihehe); mgoda, mgweda (Kichagga); mhirihiri, mhilihili, mkungwina, mkunguina (Kiluguru) mkwingwina (Kizigua, Kibondei); mkunguma (Kipare, Kiswahili); msurupi (Kividunda); mpilipili (Kizaramo, Kimbunga); mpiripiri (Kiswahili); luhagalanguku (Kishambaa); msungwi (Kizigua).

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that the species grows naturally near Dar-es-Salaam, the Uluguru Mountains, Usambara Mountains, Kilimanjaro, Masai Highland and Tukuyu. A field survey carried out during the course of this study confirmed that the species grows naturally in the above-mentioned areas. Also, it is known to grow naturally on Zanzibar Island.

2.2 Altitude: 0-1500 m.

2.3 Climate: S. madagascariensis grows naturally in humid areas. Climatic statistics for selected meteorological stations where the species grows naturally are given in Table 12.

Table 12 Selected meteorological stations where S. madagascariensis grows naturally

Station (period)	Rainfall mm			Temperature °C			Relative humidity %		
	Mean	High	Low	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Arusha (1960-70)	927	1543	514	25.2	13.9	11.3	94	85	59
Dar-es-Salaam (1938-53)	1075	1361	553	29.7	21.9	7.8	-	85	69
Miingano (1936-70)	1170	1827	590	30.1	20.4	9.7	-	80	86
Mombo (1958-70)	675	1010	462	31.0	18.9	12.1	92	78	50
Morogoro (1906-70)	908	1536	564	30.0	18.6	11.4	90	84	55
Moshi (1898-1970)	856	1677	468	29.6	17.3	12.3	87	78	49
Zanzibar (1952-70)	1565	2373	807	30.3	21.6	8.7	93	81	64

Source: E.A. Met. Dept., 1975.

It can be inferred from the above table that the lowest and highest recorded annual rainfalls are 462mm and 2375 mm, respectively; while the lowest mean minimum temperature is 14° C and the highest mean maximum is 31° C.

2.4 Geology and soils: In Kilimanjaro, Meru and Tukuyu, S. madagascariensis grows naturally on volcanic soils. In the Usambara and the rest of Tanga and Morogoro regions, the species grows on red to yellow-red, gritty sandy clay loams (latosolic soils). On Zanzibar Island it grows on yellow-red loamy sands. The soils in Kilimanjaro and Meru and Tukuyu are derived from tertiary-recent volcanics. Those of Morogoro are derived from rocks of the Mozambique belt. On Zanzibar Island soils are derived from tertiary sediments (Morgan, 1972).

2.5 Vegetation types: S. madagascariensis grows naturally in lowland rain forests and riverain forests. The common associate tree species are given under Diospyros mespiliformis. The common associate tree species in riverain forests are Albizia gummifera, A. glaberrima, A. versicolor, Khaya nyasica, K. grandifoliola, Parinari curatellifolia, Parkia filicoidea, Syzygium cordatum, S. guineense, Tamarindus indica, Trema orientalis, Trichilia roka, Voacanga lutescens, etc.

3.0 ABUNDANCE AND DISTRIBUTION:

Field observations carried out during the course of this study show that the species is more abundant in lowland rain forests than in riverain forests. The inventory of the species was studied by Schultz, C. D. & Company, Ltd. (1973). It was found that in the Kilombero the number of trees per hectare on 23 086 ha in DBH classes of 15-29 cm and 30-44 cm were 4.43 and 0.25 trees, respectively, making a total of 4.68 stems/ha. In Tanga, on 203 ha, the number of trees per ha in 15-29 cm and 30-44 cm were 16.23 and 2.9 trees, respectively, making a total of 19.13 stems/ha.

4.0 DESCRIPTION:

S. madagascariensis is a small or medium-sized evergreen tree, 7-20 m high, with dense rounded crown, rough dark grey bark which gives off small longitudinal flakes and pink slash. Branchlets smooth or slightly pubescent and marked with leaf scars. Leaves large, alternate, imparipinnate, petiole and rhachis, 10-45 cm long, terete, striate, the petiole being rather swollen at the base. Leaflets 7-13 in number, light green, up to 34 cm long, 13 cm wide, glabrous on both surfaces, alternate or subopposite, oblong, elliptic or obovate-oblong, asymmetric, rounded or cuneate at the base, rounded or obtuse to acuminate at the apex. Venation parallel and curved towards the leaf margin, alternate or subopposite, prominent beneath. Flower buds globose, not apiculate. Flowers dull yellow, fragrant, produced in pendulous panicles which are borne on older branches below the leafy region. Fruits drupaceous, up to 2.5 cm long, 1.5 cm in diameter, smooth, greenish when young, yellowish after ripening, ellipsoid and apiculate. Illustrations are shown in Figure 24 and Plate XXIV.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION:

Fruits are picked from the tree or collected from the ground.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that the species flowers between July and October on the coast, and in the Uluguru and east Usambaras. A survey of the botanical specimens in Lushoto herbarium shows that S. madagascariensis flowers between July and January, while fruit ripening occurs between October and January. Field survey carried out in Kilimanjaro revealed that the species flowers in August, while fruit ripening is in October. The above observations show that flowering takes place during the dry season extending into the rainy season, while fruit ripening occurs during the rainy season. Furthermore, it takes about three to four months from flower fertilization to fruit ripening. It is also most likely that flowers formed in December and January are abortive.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: S. madagascariensis regenerates naturally from seed and coppice. The seed germinates readily in natural forests. Coppice shoots are produced on felling of the tree. The tree regenerates adequately in natural forests, where all development stages can be seen. The species is a shade bearer when young but becomes a light demander at later stages. Thus, crop refining could help in promoting growth of old trees, thus increasing fruit yield.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, owing to its excellent seed germination capacity, it should be possible to raise it in the nursery and plant it in the field. Because it is a shade bearer when young, it is suggested that it should be planted along strips or "lanes" in natural forests.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Fruits are edible and sold on the market; fruits are used in making intoxicating liquor; wood is white, heavy and hard, and is used for various purposes.

PLATE XXIV. Sorindeia madagascariensis Thon

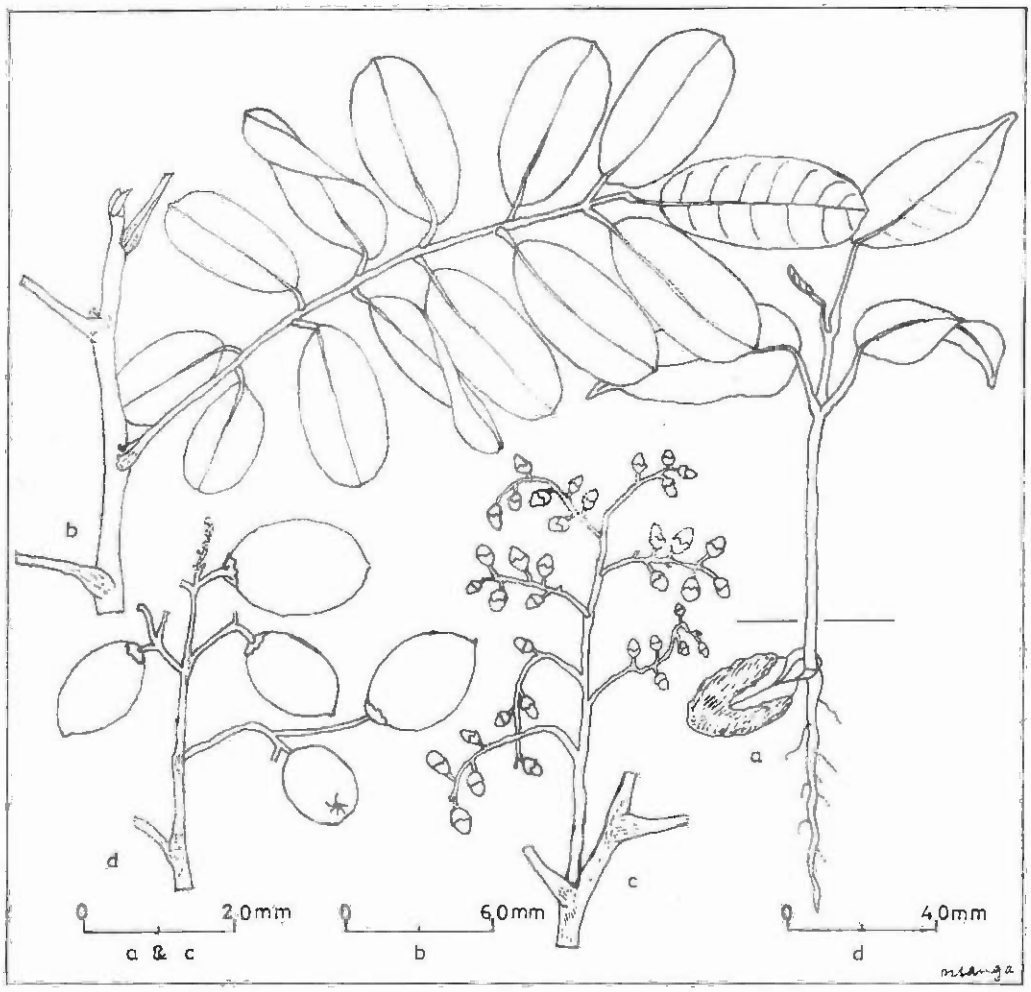


Plate XXIV. Sorindeia madagascariensis Thon

a - four-month old seedling
b - branchlet
c - inflorescence bearing flower buds
d - cluster of fruits

Plate XXIV$_1$ - tree at Korogwe, Tanga, February 1982

Plate XXIV$_2$ - Branchlet bearing flower buds at Mombo, Korogwe, August 1982

25. STRYCHNOS COCCULOIDES

1.0 NAMES:

Family	Loganiaceae
Botanical	Strychos cocculoides Baker
Syn.	S. goetzei Gilg
	S. suberifera Gilg & Busse
	S. schumanniana sensu Brenan
Vernacular	m'milwa, mtonga, mumilwa (Kinyamwezi); mpera-mwitu, mtonga (Kiswahili); mnywewa (Kihehe)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that S. cocculoides grows naturally in the Uzungwa Mountains, Iringa and Songea Districts. According to Bruce and Lewis (1960), S. cocculoides grows naturally at Manyanga near Lindi, Kazikazi in Manyoni, at Tanangozi in Iringa and in Mbozi. During the course of this study, the species was found to be growing naturally in Tabora (Simbo, Urumwa and Tabora Beekeeping Forest Reserves), Iringa (Mkimbizi, Kitapilimwa, Kalenga, Kitelewasi) and Mbozi Districts. The species is also known to occur naturally at Kigwa, Ulyankulu, Goweko, Sikonge, Kiwele, Rungwa and Kipili in Tabora District and Rondo plateau in Lindi District.

2.2 Altitude: Bruce and Lewis (1960) observed that S. cocculoides occurs naturally between 400 m and 2000 m above sea level. The survey carried out recently in some regions shows that the species grows naturally between 760 m and 1700 m above sea level.

2.3 Climate: The climatic data for some meteorological stations in Tabora and Manyoni are given under Canthium burtii. The climatic statistics for Iringa meteorological station (about 20 km from Tanangozi) shows that the mean annual rainfall for the period 1931 to 1975 was 674 $\pm$ 163 mm and the mean number of raindays was 84 $\pm$ 20 per year (Nshubemuki, et. al, 1978). The mean maximum and mean minimum annual temperatures are 25° C and 14° C, respectively. The range in mean temperature is 11° C. The relative humidity was 88 percent at 0300 GMT, 72 percent at 0600 GMT and 52 percent at 1200 GMT (E.A. Met. Dept., 1975). Mbozi District receives between 1250 and 1500 mm annual rainfall. The mean maximum and mean minimum annual temperatures are 25° C and 14° C, respectively (United Rep. of Tanzania, 1967). According to Mugasha (1980) Rondo receives 1020-1190 mm mean annual rainfall.

2.4 Geology and soils: The geology and soils of Tabora and Manyoni have already been described under Parinari curatellifolia and Bussea massaiensis. In Iringa, S. cocculoides grows in black to dark-grey clays (grumosolic soils) derived from rocks of acid gneisses, magmatites and associated granites and granodiorites. In Mbozi the species grows on dark red to red loamy sands (latosolic soils) derived from Ubendian rocks. On the Rondo plateau the species grows on yellow-red loamy sands derived from tertiary sediments (Morgan, 1972).

2.5 Vegetation types: Brenan and Greenway (1949) observed that S. cocculoides grows naturally in Brachystegia-Isoberlinia woodland and Brachystegia mixed forests. Bruce and Lewis (1960) report that S. cocculoides grows naturally in deciduous woodland. The common associated species include Afzelia quanzensis, Brachystegia boehmii, B. spiciformis, Combretum collinum, C. molle, C. zeyheri, Julbernardia globiflora, Pericopsis angolensis, Strychnos innocua, S. spinosa, Terminalia sericea, Vitex ferruginea, V. mombassae, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The inventory of S. cocculoides in Mtwara was carried out by Schultz and Company Ltd. (1973). It was found that there was an average of 4.28 stems per hectare in diameter classes of 15-29 cm. The total number of stems on 40 128 ha was 171 563. However, it should be borne in mind that most of S. cocculoides trees are below 15 cm in breast height diameter. Thus, inclusion of smaller trees could raise the stocking to about 15 to 20 stems per hectare.

4.0 DESCRIPTION:

S. cocculoides is a shrub or small tree, 3-8 m high, with thick, longitudinally ridged, brown and corky bark. Young branchlets reddish or blackish purple, densely spreading-pubescent or rarely glabrous, usually longitudinally fissured. Spines stout, sharp, curved downwards, axillary and paired. Leaves opposite, coriaceous, oblong-elliptic to broadly ovate, usually broadest below the middle, 1.8-8 cm long, 1.4-6 cm wide, pubescent on both sides, rounded, acute or rarely emarginate at the apex and sometimes apiculate, rounded, subcordate or rarely cuneate at the base, 3-7 nerved at, or just above, the base and matt or shining above. Venation compressed above, prominent and conspicuous beneath. Flowers greenish-white borne in dense terminal cymes. Fruits globose, 1.6-7 cm in diameter with a smooth woody shell which is dark green with paler mottlings when young, turning to yellow after ripening. Seeds numerous, compressed, up to 2 cm in diameter and embedded in a fleshy pulp which is juicy and yellow when ripe. Illustrations are shown in Figure 25 and Plate XXV.

5.0 MAIN USES:

Ripe fruit pulp is edible and has a pleasant taste.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits may be picked from the tree or collected from the ground. Alternatively, green fruits can be picked from the tree and stored for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that between May and February, S. cocculoides bears young fruits. Bruce and Lewis (1960) observed that S. cocculoides was bearing young fruits at Manyoni in November. A field survey carried out shows that the fruit ripening period is between July and December. An interview carried out in Tabora during the course of this study revealed that the species flowers between October to February. It appears therefore that S. cocculoides flowers during the rainy season, while fruit ripening takes place during the dry season. Moreover, it takes about eight to nine months from the flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Watt and Breyer-Brandwijk (1962) observed that S. cocculoides yields 0.85 percent of a reddish fixed oil.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates by seed, coppice and root suckers. The seed has a hard seed coat. Thus, it does not germinate readily. However, annual forest fires help to soften the seed coat, thus promoting germination. Coppices are produced on felling young or mature trees. Root suckers are produced after wounding of the root by any means, e.g. fire or trampling by grazing animals.

In its natural habitat, S. cocculoides prefers open growing conditions. Thus, crop refining in natural forests could help to promote growth of S. cocculoides trees.

9.2 Artificial regeneration: Artificial regeneration has not been tried. However, the species is semi-cultivated. On clearing agricultural land, S. cocculoides is spared for provision of fruits.

With suitable seed pretreatment, the species could be raised in pots in the nursery and planted in the field. The site should preferably be cleared of all herbaceous vegetation before planting, and tending should include slashing of weeds and climbers until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The wood is suitable for tool handles. Its timber is suitable for building construction. Watt and Breyer-Brandwijk (1962) observed that S. cocculoides root is chewed in the treatment of eczema. It is an alleged cure for gonorrhea.

PLATE XXV. Strychnos cocculoides Baker

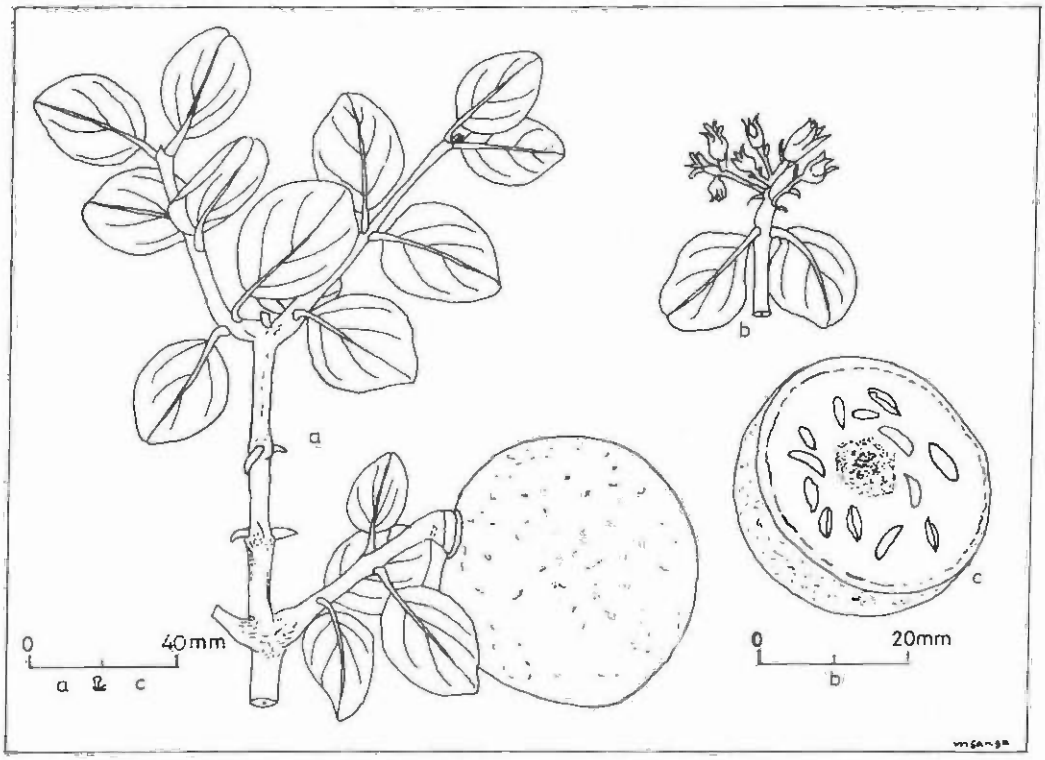


Plate XXV. Strychnos cocculoides Baker

a - branchlet bearing a fruit
b - flowering branchlet
c - sectioned fruit

Plate XXV$_1$ - tree at Goweko, Tabora, December 1981

Plate XXV$_2$ - fruit vending in Tabora Town, December 1981. Note the price per fruit is TSh.0.5.

26. STRYCHNOS INNOCUA

1.0 NAMES:

Family	Loganiaceae
Botanical	Strychnos innocua Del.
Vernacular	munhulwa (Kigogo); bunkundu (Kibende); mtonga (Kibondei, Kizigua, Kiswahili); mkome, mkwata (Kizinza); mpundu, mumundu, mkulwa (Kinyamwezi); mgulungungulu(Kimwera, Kiswahili); msungwe (Kizanaki); msege (Kikuria); mumirwa (Kisumbwe); mbaya (Kihehe); g e'kegheke (Kisandawe); mukomu (Kirangi); mkwakwa (Kibondei, Kizigua)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that S. innocua is widespread throughout Tanzania in Brachystegia woodland, in Combretum zeyheri - Xeroderris stuhlmanni - Terminalia sericea woodland and in the coastal belt. Bruce and Lewis (1960) report that the species grows naturally in Geita, Kigoma, Shinyanga, Tabora, Singida, Kondoa, Lindi and Tanga Districts, and on Zanzibar Island.

2.2 Altitude: Bruce and Lewis (1960) observed that the species' altitudinal range is 0 to 1400 m above sea level. A survey of the botanical specimens in Lushoto herbarium showed that the species grows up to 1520 m above sea level at Lupa in Chunya.

2.3 Climate: The climatic statistics for the areas where the species grows naturally have been presented under Bussea massaiensis, Canthium burttii, C. crassum and Friesodielsia obovata.

2.4 Geology and soils: The geology and soils of the areas where S. innocua grows naturally have been described under the species mentioned in paragraph 2.3 above.

2.5 Vegetation types: S. innocua grows naturally in dry lowland forests and in Brachystegia-Combretum woodland. The common associate tree species in the dry lowland forests are Albizia petersiana, A. versicolor, Antiaris usambarensis, Brachylaena hutchinsii, Chlorophora excelsa, Combretum molle, C. zeyheri, Dombeya spp., Harrisonia abyssinica, Lannea stuhlmannii, Manilkara sulcata, Margaritaria discoidea, Pteleopsis myrtifolia, Sclerocarya caffra and Sterculia appendiculata, etc. In Brachystegia-Combretum woodland the common associate tree species are Albizia antunesiana, A. anthelmintica, A. harveyi, Brachystegia spiciformis, Cassia abbreviata, Combretum collinum, C. molle, C. zeyheri, Dalbergia melanoxylon, D. nitidula, Manilkara mochisia, Pterocarpus angolensis, P. tinctorius, Sclerocarya birrea, Strychnos potatorum, etc.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

A field survey carried out during the course of this study showed that S. innocua is relatively more abundant in the dry lowland forests than in the Brachystegia-Combretum woodland. An inventory of S. innocua was carried out at Kilombero by C.D. Schultz and Company, Ltd. (1973). It was found that the number of trees per hectare on 18 190 ha in successive DBH classes of 14 cm, starting with 15-29 cm were 12.91, 3.52, 0.92, 0.19 and 0.03 trees, making a total of 17-54 stems/ha.

4.0 DESCRIPTION:

S. innocua is a small or medium-sized tree, up to 13 m high, with smooth green or yellowish-white and powdery bark. Branchlets stout, smooth and powdery. Leaves simple, alternate, subsessile or shortly petiolate, obovate, elliptic or oblong-elliptic, 3-15 cm long, 2-9 cm wide, coriaceous, rounded-emarginate or subacute at the apex, widely to very narrowly cuneate or rarely rounded at the base, glabrous to pubescent beneath. Venation finely reticulate on both surfaces with 3-7 nerves arising from leaf base, prominent beneath. Flowers greenish-white or yellowish, produced in axillary cymes. Fruits

globose, 6-10 cm in diameter, with hard rind, glabrous, bluish-green when young, yellowish or orange when ripe, containing many seeds embedded in a yellowish pulp. Seeds yellowish-white, tetrahedral, stony hard, 1.5-1.8 cm in diameter. Illustrations are given in Figure 26 and Plate XXVI.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION:

Fruits are persistent, thus are picked on ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that S. innocua flowers in October, while fruit ripening occurs in January. White (1962) observed that in Zambia S. innocua flowering and fruit ripening occur concurrently in September. A survey of the botanical specimens in Lushoto herbarium revealed that flowering takes place between August and January, while fruit ripening occurs from May to November. A field survey carried out during the course of this study revealed that flowering occurs between August and January, while fruit ripening takes place from July to December. The above observations show that flowering and fruiting occur concurrently, starting in the dry season, extending into the rainy season. Moreover, it takes about a year from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

S. innocua pulp and seed contain a reddish oil, the percentage in the pulp being 3.8 percent. The seed also yields a bitter principle and a heteroside loganosic acid, caffeic and cyasuric and all have been isolated from the plant (Watt and Breyer-Brandwijk, 1962). See also Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: S. innocua regenerates naturally from seed, coppice and root suckers. The seed does not germinate readily owing to its hard seed coat. Coppice shoots are produced on felling of trees. Root suckers are produced after root wounding by any means. Although the species is sparse in the forest, it can be concluded that the regeneration is moderate; trees in different stages of development can be seen. The tree is fire tender, thus protection of its natural habitat from forest fires could help in promoting natural regeneration.

9.2 Artificial regeneration: There have been no efforts to regenerate S. innocus artificially. However, with improvement of seed germination capacity by pretreatment, the species could be raised in the nursery and planted in the field. The species is a light demander, thus it should be planted in areas where there has been partial clearing of herbaceous vegetation.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruit is edible and sold on the market. The wood is used for tool handles and fuel.

PLATE XXVI. Strychnos innocua Del.

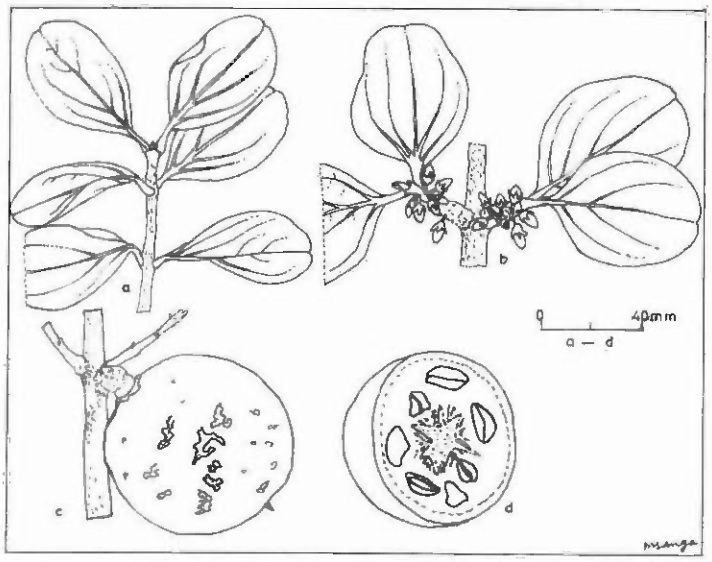


Plate XXVI. Strychnos innocua Del.
a - branchlet
b - flowering branchlet
c - fruit
d - cross section through fruit

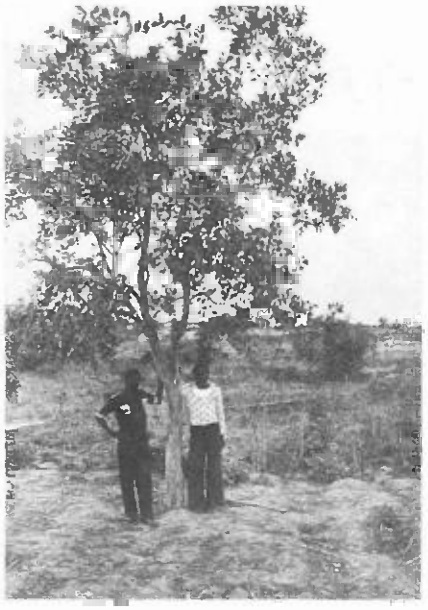


Plate XXVI$_1$ - tree at Rungwa, Manyoni, December 1981

Plate XXVI$_2$ - branchlet bearing young fruits at Urumwa, Tabora May, 1982

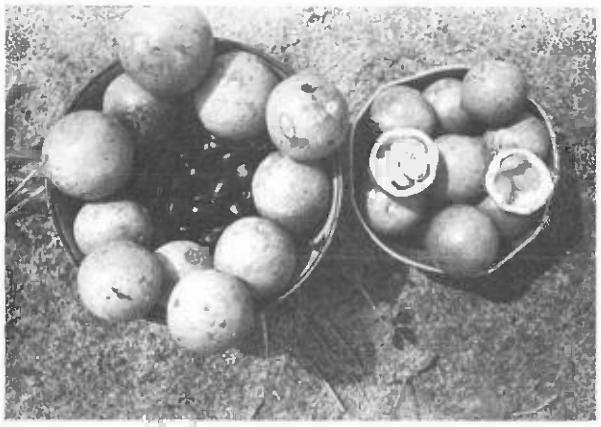


Plate XXVI$_3$ - ripe fruits at Goweko, Tabora, December, 1981

27. SYZYGIUM GUINEENSE

1.0 NAMES:

Family	Myrtaceae
Botanical	Syzygium guineense (Willd.) DC
Vernacular	mzuari, mzambarau mwitu (Kiswahili); muvengi (Kikeho); muhula, mshiwi (Kishambaa); mulambo, mulalambo (Kifipa, Kibende); musu (Kifipa, Kirungu); mmasai (Chagga); mgege (Zinza); mbogonte (Kiha); msangura (Kizinza, Kiromgo); muhulo, muhuu (Kigogo); msabasaba (Kitongwe); muchwesi (Kihaya); mbajiru, musuaru, mkomati (Kirangi); mzambalawe, kashamongo (Kinyamwesi); irgatu (Kiiraqw); nguluka (Kigakonde); msarabo (Kirufiji); isasa (Kikerewe)
Common English Name	Waterberry or waterboom or waterpear

2.0 DISTRIBUTION:

2.1 Locality: S. guineense is widespread throughout Tanzania's mainland with the exception of the dry mountain forests and the dry thicket belt of central Tanzania.

2.2 Altitude: The species occurs naturally from coastal areas to about 1350 m above sea level in Mbeya, Mjombe, Mpanda and Sumbawanga.

2.3 Climate: S. guineense grows naturally in areas receiving varying amounts of annual rainfall. The minimum and maximum annual rainfall figures are 743 mm and 2340 mm for Iringa Town meteorological station and Tukuyu District Office, respectively (Nshubemuki, et. al., 1978). In areas receiving low annual rainfall, the species is being supplemented by permanent high underground water as the species prefers water courses and swampy areas. The temperature and relative humidity for selected areas where S. guineense occurs naturally are given in Table 13.

Table 13 Mean annual temperature and mean relative humidity for the selected stations in Tanzania where Syzygium guineense occurs naturally

Station (period)	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Bukoba (1936-70)	26.0	16.0	10.0	89	82	69
Iringa (1935-55)	30.3	21.7	8.8	93	82	67
Morogoro (1965-60)	30.0	18.6	11.4	90	84	55
Mjombe (1951-70)	21.9	10.1	11.7	-	93	63
Tabora Airport (1952-70)	29.4	16.7	12.7	83	72	44

Source: E.A. Met. Dept., 1975

2.4 Geology and soils: S. guineense is known to occur on a variety of soils of varying origin. The species seems to prefer permanently fresh moist soils. It does not occur in the dry belt of Dodoma thickets and Masailand.

2.5 Forest type: The species usually occurs in lowland rain forests, mountain rain forests, fringing and riverain and swampy forests. It is also known to grow in open Brachystegia-Faurea woodland. Its common associated species include Albizia gummifera,

A. adiathifolia, Aningeria adolfi-friedericii, Entandrophragma excelsum, Isoberlinia scheffleri, Macaranga kilimandscharica, Ocotea usambarensis, Ochna holstii, Olea hochstetteri, Newtonia buchananii, Parinari excelsa, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The species is most abundant in montane rain forests, along river courses, on alluvial and swampy soils and there is a decrease in abundance on dry localities. The frequency distribution of S. guineense in the forest reserves of the montane rain forests of west Usambara was studied by Maagi, et. al. (1979). It is reported that the number of trees per hectare on 33 810 ha in successive DBH classes of 10 cm, starting from 25-34 cm were 1.50, 2.68, 1.89, 1.02, 0.56, 0.29, 0.32, 0.08, 0.10, 0.10, 0.06, 0.08, 0, 0, 0.01 trees, making a total of 8.5 stems/ha.

4.0 DESCRIPTION:

S. guineense is a medium-sized or tall evergreen tree 15 to 30 m high, with rough greyish-white flaking bark. Leaves simple, opposite, glabrous, shiny with entire margins. The length and width vary from 5.0 to 16.0 cm and 1.3 to 7.0 cm, respectively, while the length of leaf stalks varies from 0.5 to 1.0 cm. Leaf shape also variable, either elliptic, lanceolate or ovate with acuminate or rounded apex and cuneate base. Flowers white and fragrant, usually profusely borne in terminal panicles. The calyx is 4-toothed and persistent, petals are 4 and there are numerous stamens. Fruits are ovoid or ellipsoid drupes, 2 to 3 cm long, 1.5 to 2.3 cm wide, whitish-green when unripe, turning to purplish-black and juicy after ripening. Seeds yellowish to brownish, rounded, 1.3 to 1.4 cm in diameter. Illustrations are given in Figure 27 and Plate XXVII.

5.0 MAIN USES:

The ripe fruits are sweet tasting and edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

The ripe fruits are picked from the tree. However, freshly fallen fruits may be collected from the ground. The collection of the ripe fruit from the ground should be carried out soon after fruit falls since it is perishable.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that S. guineense flowers in April and August. Analysis of botanical specimens in Lushoto herbarium showed that in north-east and north-west Tanzania, where there are two rainy seasons, the species flowers twice, i.e. during the short dry season (January to February) and towards the end of the long rains (May), extending to the dry season (June to September) and up to the onset of the short rains (October to December). In the rest of Tanzania, i.e. areas with one rainy season, the species flowers only once, starting towards the end of the dry season and extending into the rainy season, i.e. September to December. The species' fruit maturing was noted to be concentrated from February to May.

8.0 NUTRITIONAL VALUE:

Not known, but apparently ascorbic acid is present (See Appendix 2).

9.0 CULTIVATION AND PROPAGATION OF THE SPECIES:

9.1 Natural regeneration: The species regenerates adequately in natural forests. This is because all tree development stages can be seen, i.e. seedlings, saplings, poles and mature trees. The species regenerates naturally by seed and coppice. For successful germination and seedling establishment, the seed should come in contact with mineral soil

and moisture. The species is sensitive to crown competition and a strong light demander. Thus, crop refining in natural forests could be necessary in order to distribute growth potential to S. guineense trees.

9.2 Artificial regeneration: S. guineense seed requires no pretreatment. The germination is very good and uniform, attaining 80 to 90 percent germination after 25 to 30 days respectively. Thus, direct sowing into pots is recommended. Potted planting stock could be raised and planted on cleared sites.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Poles are used for building, timber used for construction of local bridges and wood (smoke used for smoking milk containers (Brenan and Greenway, 1949)). The fruit is used as a remedy for dysentry and a decoction of the bark is used as an anti-diarrhoeic drug Breyer-Brandwijk, 1962).

PLATE XXVII. Syzygium guineense (Willd) D.C.

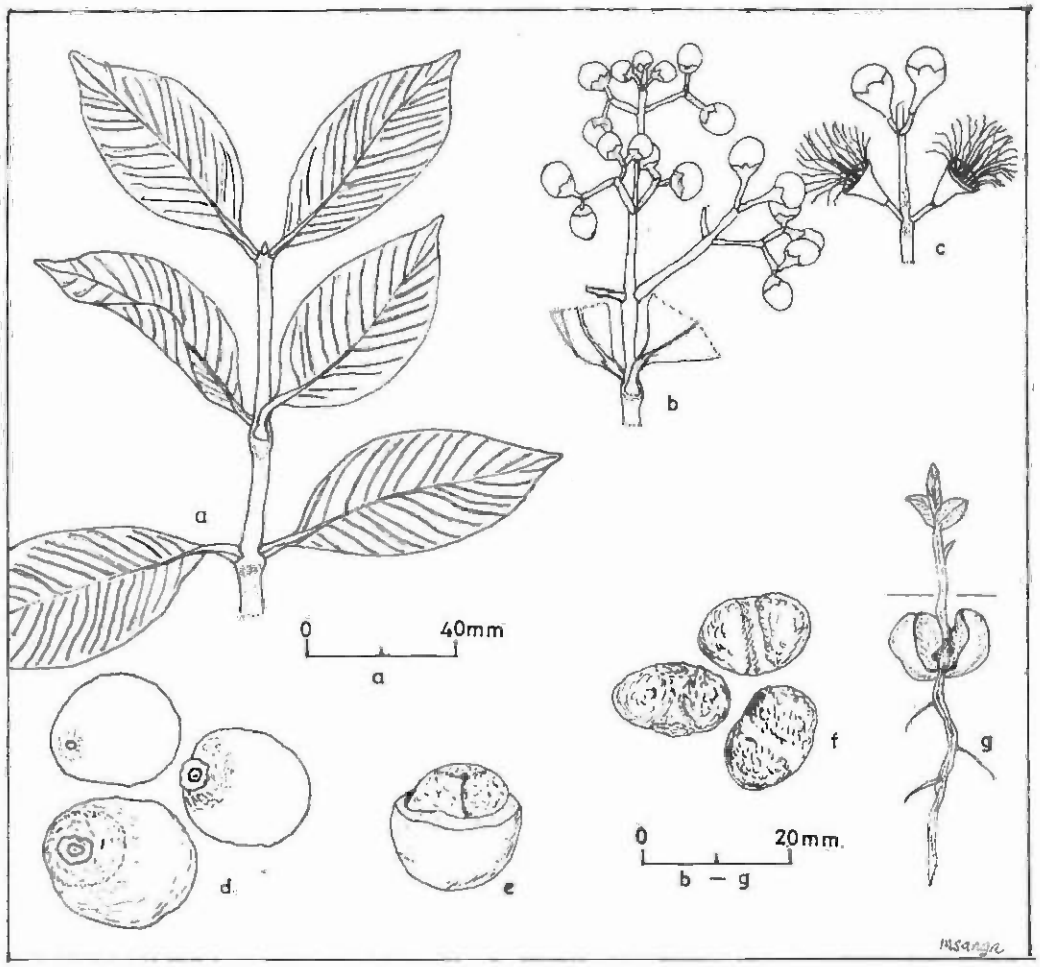


Plate XXVII. Syzygium guineense (Willd) D.C.

a – branchlet bearing leaves
b – inflorescence with flower buds
c – portion of inflorescence with flower buds and flowers
d – fruits
e – fruit in part section, showing seed
f – seeds
g – seedling - forty days after sowing

Plate XXVII$_1$ – tree at Dule – Lushoto, Tanga, January, 1982

Plate XXVII$_2$ – branchlets bearing leaves, flower buds and flowers

28. TRICHILIA ROKA

1.0 NAMES:

Family	Meliaceae
Botanical	Trichilia roka (Forsk.) Chiov.
Syn.	Trichilia emetica Vahl
Vernacular	mkungwina, mtimaji, mtimai (Kiswahili); mgolimazi (Kizigua); mgolemazi (Kinguru, Kishambaa); myembemwitu (Kigogo); mkongoni (Kichaga); mtengotengo, mjagengo (Kiluguru); mbangwe, mbwewe (Kishambaa); mgolemazi, msukulilo (Kisagara); msanguti (Kinyakyusa); mtandaruka (Kisubi), monko-ya-nyika (Kizigua, Kishambaa)

2.0 DISTRIBUTION:

2.1 Locality: The species is widespread in Tanzania with the exception of miombo woodland and dry thicket belts. It is most abundant in Tukuyu, Kyela, Ifakara, Muheza, Korogwe and Morogoro Districts.

2.2 Altitude: Brenan and Greenway (1949) observed that the species occurs below 1800 m above sea level. Wimbush (1950) observed that in Kenya it occurs from sea level to 1676 m above sea level. But it generally occurs up to 1830 m above sea level (Dale and Greenway, 1961).

2.3 Climate: T. roka appears to be growing on different sites with varying rainfall regimes. According to Nshubemuki, et. al. (1978) the maximum and minimum mean annual rainfall are 2340 mm for Tukuyu and 643 mm for Mombo meteorological stations. For Mombo meteorological station the mean maximum and mean minimum temperatures are 31° C and 19° C, respectively; the range is 12° C. Relative humidity varies between 92 percent and 50 percent. For Morogoro meteorological station the mean maximum and mean minimum temperatures are 30° C and 19° C, respectively; the range is 11.4° C. The mean relative humidity varies between 55 percent and 90 percent.

2.4 Geology and soils: T. roka grows best on deep moist heavy soils, although it will also grow on many other soils, provided they are not infertile or too dry. According to Morgan (1972) most of these soils are derived from Mozambican belt rock formations, tertiary or recent volcanics, quaternary sediments and Bukoban rocks.

2.5 Forest type: The species is frequently found in open riverain or alluvial lowland rain forests with high ground watertable. Its common associates include Acacia polyacantha, A. albida, Albizia glabrescens, A. versicolor, Antiaris usambarensis, Chlorophora excelsa, Ficus sycomorus, Khaya nyasica, Parkia filicoidea, Sorindeia madagascariensis, Trema orientalis, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

T. roka is relatively more abundant on riverain-alluvial soils in lowland rain forests, and it decreases in abundance at the upper limits of lowland rain forests. The frequency in various forest types has not been studied to date.

4.0 DESCRIPTION:

T. roka is a medium-sized or tall and many-branched tree, up to 20 m high, with dense rounded crown. Bark pale or dark grey, smooth and flaking. Leaves are imparipinnate, villous-pubescent or sub-glabrous, varying in length from 10 to 40 cm. The

number of leaflets varies from 3 to 13. They are oblong-elliptic or oblanceolate, 4 to 23 cm long, 2 to 10 cm wide with prominent venation on the lower surfaces. Flowers yellowish-green, yellowish-white or cream, produced on short, congested axillary panicles. Fruits are pear-shaped capsules of four valves containing dark brown seeds with a scarlet or orange-red aril. The aril contains a fatty white pulp which produces edible oil. Illustrations are given in Figure 28 and Plate XXVIII.

5.0 MAIN USES:

The seed aril is squashed into a fatty milky suspension which is used for cooking. The cotyledons are crushed into powdery form and thereafter oil is extracted. The oil is used for manufacturing soap and cosmetics.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Mature T. roka fruits on ripening split open and the seed falls to the ground where it may be collected. Alternatively, mature fruits may be picked from the tree, and on drying, they split open and the seed is extracted by shaking the open capsules. On storage, the nut is attacked by mould and seed borers (not yet identified) and no efforts have been made to alleviate the situation.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that T. roka flowers from July to December, while fruits mature in February. An examination of botanical specimens at Lushoto herbarium revealed that the species flowers from July to November, and fruit maturing is from February to April - and sometimes in December and January. It should, however, be borne in mind that there are some years when little seed is produced and in some years there is abundant production of seed. The actual seeding cycle has not been studied.

8.0 NUTRITIONAL VALUE:

It is reported that commercially pressed oil from the small factory in Mbeya had a very high acid value equivalent to 23.3 percent of oleic acid. It is also reported that samples of press cake from Tukuyu had a nitrogen content of 2.6 to 2.8 percent, so had a limited manurial value. Laboratory samples of the extracted arils, fat-free and dry, had N 2.4 percent; kernels, fat-free dry residue 4.79 percent (Child, 1961). It is also reported that the yield of oil from the whole seed is 58.3 to 68 percent, and the seed coat contains 14 to 51.2 percent and the kernel 68 percent oil (Watt and Breyer-Brandwijk, 1962). See also Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally by root suckers, coppice and seed. Root suckers are produced after wounding of the root by any means, e.g. accidental wounding during land preparation, burrowing animals and fire. T. roka seed falls to the ground by gravity and thereafter it is probably dispersed by water, as it is too heavy to be spread by wind, and no animal or bird is known to spread it. Seed germination in natural forests takes place on wet soils - alluvial and riverain soils. Although all crop development stages can be seen in natural forests, regeneration cannot be considered adequate. This is because only a few seed trees remain and it is only under these trees that natural regeneration takes place.

9.2 Artificial regeneration: Owing to rapid loss in viability of T. roka seed (Shehaghilo, 1978), it is advised that the seed should be sown soon after collection. Direct sowing into pots is an economically viable technique, although it has not been tested. Seeds showing signs of germination are transplanted into polythene pots before the tap root goes deep into seed bed soils. After transplanting, the potted stock needs to be lightly shaded and watered at least twice per day. After staying in the nursery for 6 to 8 months the stock is ready for planting out (Mugasha, et. al., 1980).

The planting site should be cleared of all herbaceous vegetation, leaving 30 stems/ha as shade trees. T. roka is sensitive to weeds. Observations carried out in the field revealed that unweeded trees tend to be stunted. Thus, weeding is essential, especially during the first few years after planting.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The Government of Tanzania is putting much emphasis on the planting of T. roka as a source of oil used for soap manufacturing and cooking. Githens (1948) and Palgrave (1956) report that T. roka is of medicinal value.

PLATE XXVIII. Trichilia roka (Forsk.) Chiov.

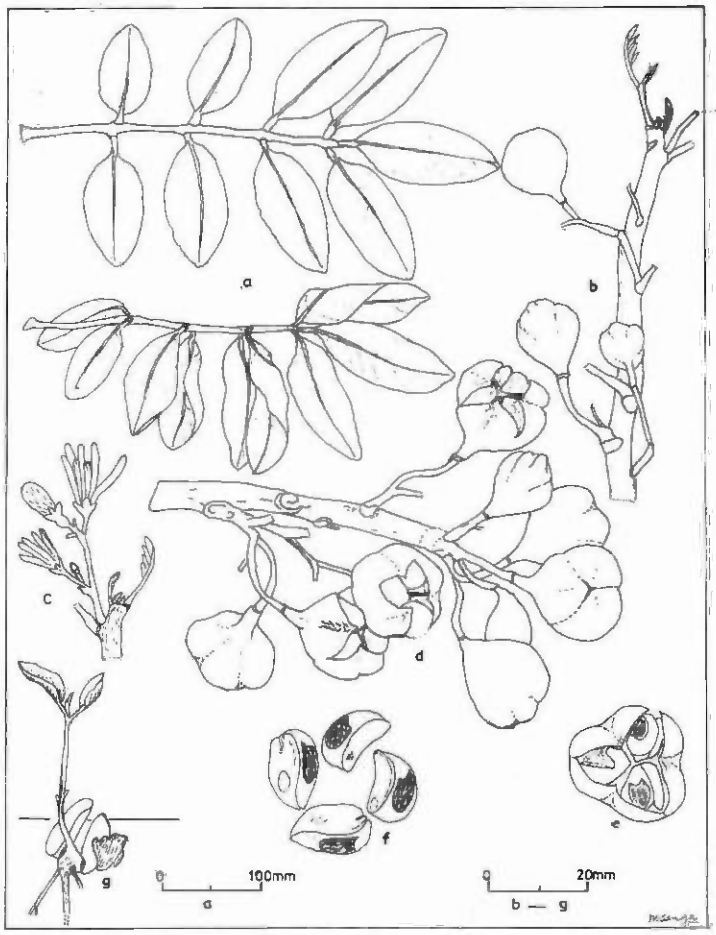


Plate XXVIII. Trichilia roka (Forsk.) Chiov.

a - Leaves, showing all the leaflets
b - branchlet with leaves removed, bearing young fruits
c - flowering branchlet
d - fruiting branchlet
e - ripened fruit (capsule) showing seeds in situ
f - seeds
g - seedling at fourty days after sowing

Plate XXVIII$_1$ - tree at Morogwe, Tanga, February, 1982

Plate XXVIII$_2$ - branchlet bearing fruits and partly burnt leaves

29. UAPACA KIRKIANA

1.0 NAMES:

Family	Euphorbiaceae
Botanical	Uapaca kirkiana Mull Arg.
Syn.	U. goetzei Pax.
Vernacular	mkuhu (Kinyakyusa); mguhu (Kihehe, Kibena); mkusu (Kiswahili, Kihehe, Kinyamwezi, Kibena, Kibende, Kilongo)

2.0 DISTRIBUTION:

2.1 Locality: A survey of the botanical specimens in Lushoto herbarium shows that the species grows naturally in Mpanda, Kasulu, Kibondo, Geita and Njombe. A field survey carried out during the course of this study shows that the species also grows naturally at Kiboliani Mountain and Mwanaota in Mpwapwa, Kipiri in Tabora; Mbozi, Tukuyu and Chunya in Mbeya; Mafinga, Sao Hill, Nyororo and Mugororo in Iringa.

2.2 Altitude: U. Kirkiana grows naturally between 800 m and 1900 m above sea level.

2.3 Climate: The climatic data for Tabora are given under Canthium burttii and that of Chunya are given under Canthium crassum. In general, the species grows naturally in areas receiving between 508 and 1270 mm annual rainfall in four years out of five (Morgan, 1972). Relative humidity and temperature for Tabora and Iringa are given under Azanza garckeana.

2.4 Geology and soils: The geology of the areas where U. kirkiana grows naturally have been given under preceding species, e.g. Canthium burttii , C. crassum Cordyla densiflora. The species prefers sandy loamy soils overlying murram.

2.5 Vegetation types: Brenan and Greenway (1949) observed that the species is co-dominant and dominant in Isoberlinia-Brachystegia-Parinari open to closed woodland in mountainous areas. The common associate tree species are Annona senegalensis, Brachystegia longifolia, B. spiciformis, Combretum molle, Faurea saligna, Flacourtia indica, Harungana madagascariensis, Isoberlinia angolensis, Parinari curatellifolia, Pericopsis angolensis, Protea rubrobracteata, Psorospermum febrifugum, Uapaca nitida, U. sansibarica, etc.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

There are no records of inventory data on U. kirkiana. However, field observations carried out during the course of this study show that almost pure stands of U. kirkiana covering several hundred hectares exist in Iringa and Mbeya Regions. Moreover, it is one of the dominant species where it grows in association with Parinari curatellifolia, other Uapaca spp., Brachystegia and Faurea saligna. A rough count carried out at Idetelo (Iringa) showed that over 256 m^2 there were 49 young trees up to 2 m in height and two old trees up to 7 m in height.

4.0 DESCRIPTION:

U. kirkiana is a small to medium-sized evergreen or deciduous tree, up to 13 m high, with many branches and a dense rounded crown. Its stem is short and stout with rough dark grey or blackish, thick, deeply and closely reticulately fissured bark. Branchlets short, thick with prominent leaf scars. Leaves alternate, large concentrated at the ends of branchlets, obovate or obovate-elliptic, 7-27 cm long, 4-16 cm wide, rounded at the apex, cuneate at base, leathery; secondary nerves parallel and quite prominent beneath, in 12-16 pairs; floccose-pubescent with short curly hairs all over

beneath when young, later becoming almost glabrescent; petioles short, 1-3 cm long. Flower buds globose, flowers yellow, borne in short, slender fascicular and axillary peduncles. Fruits subglobose, fleshy, up to 3.3 cm in diameter, dull-yellow when ripe, containing up to 3 seeds. Seeds white, up to 2 cm long, 1.3 cm thick. Illustrations are shown in Figure 29 and Plate XXIX.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

U. kirkiana ripe fruits are picked or collected from the ground.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

White (1962) reports that in Zambia the species flowers in January, while fruit ripening occurs between July and September. Chingaipe (Pers.Comm.) observed that U. kirkiana fruit ripens between October and December. A survey of the botanical specimens shows that the species was found flowering in February, while fruiting occurred between May and October. A field survey revealed that the species flowers between December and February, while fruit ripening occurs between September and December. This implies that both flowering and fruit ripening occur during the rainy season and it takes about nine to eleven months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Watt and Breyer-Brandwijk (1962) observed that the ripe edible part of the fruit contains 1.8 mg/gm of ascorbic acid.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: U. kirkiana regenerates naturally from seed, coppice and root suckers. The seed has good germination capacity but it loses viability very quickly. Coppice shoots are produced on felling of trees. Root suckers are produced after wounding of roots by any means, e.g. burrowing and trampling animals, cultivators, mild fires, etc. It should be stressed here that most of the natural generation seen in natural forests originated from root suckers. In general, it can be concluded that U. kirkiana natural regeneration is adequate. Thus, this might be the most reliable method for propagation of U. kirkiana.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, owing to good germination capacity, it is possible to raise the species in the nursery and to plant potted stock in the field. However, there might be no need to raise the species as natural regeneration is reliable.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Ripe fruits are edible and sold on the market. Moreover, it is an important famine food. It is also used in making sweet beer. The wood is often a source of sawn timber and fuel, as well as wooden spoons. It is also a shade provider.

PLATE XXIX. Uapaca Kirkiana Mull. Arg.

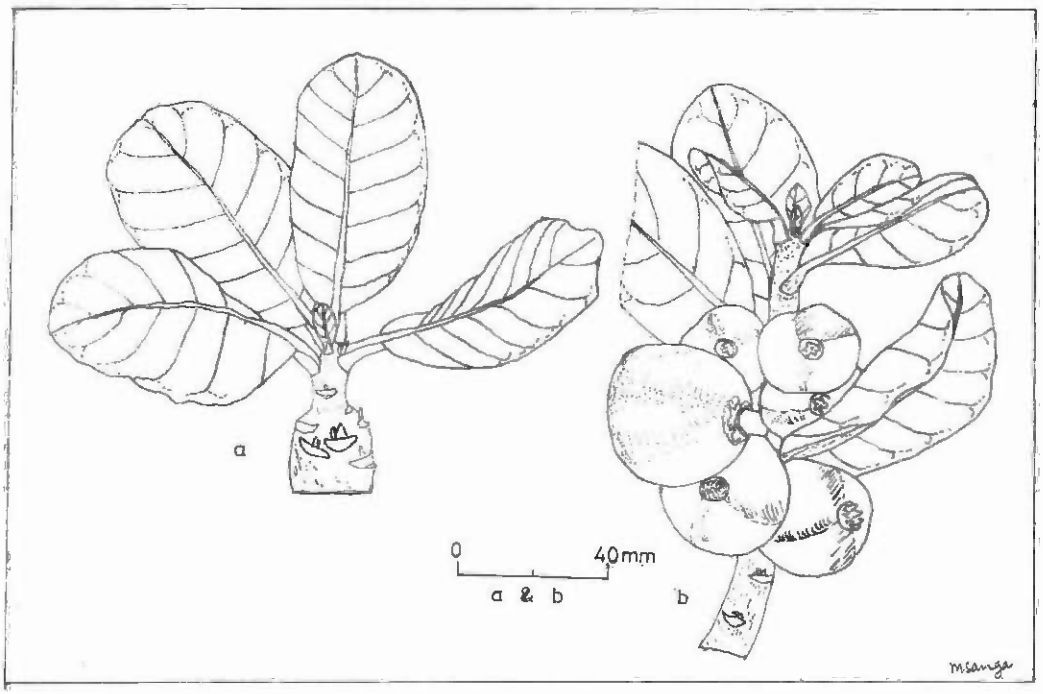


Plate XXIX. Uapaca kirkiana Mull. Arg.

a - branchlet
b - fruiting branchlet

Plate XXIX$_1$ - tree at Luingulo Village, Iringa, June, 1982

Plate XXIX$_2$ - young fruits, Luingulo Village, Iringa, June, 1982

30. VANGUERIA LINEARISEPALA

1.0 NAMES:

Family	Rubiaceae
Botanical	Vangueria linearisepala K. Schum.
Vernacular	mviru (Kiswahili); msada (Kinyamwezi, Kiluguru, Kihehe, Kividunda); mvilu, mviu (Kishambaa); mdaria (Kipare); msambarawe (Kihehe)

2.0 DISTRIBUTION:

2.1 Locality: The species occurs naturally in Lushoto (Kwemadaa on Lushoto-Mombo road, Kitivo, Shume-Magamba Forest Reserves), Mufindi (Irundi Sao Hill), south and north Pare Mountains (Changweni and Chome Forest Reserves and Usangi), Tabora (Kiwere), Kilosa (Vigude, Kidodi).

2.2 Altitude: V. linearisepala grows naturally from 850 m (Kwemadaa) to about 1920 m above sea level (near Viti-Lushoto).

2.3 Climate: V. linearisepala grows on sites receiving varying amounts of annual rainfall. The minimum and maximum annual rainfall is 749 mm (Sao Hill) and 1038 mm (Lushoto Agriculture Meteorological Station) (Nshubemuki, et. al., 1978). Mykvist (1976) reports that for Irunda Hill West, the mean annual temperature is 19° C, and the mean maximum and mean minimum annual temperatures are 24° C and 12° C, respectively. Borota (1971) observed that the mean annual temperature for Lushoto is 18° C.

2.4 Geology and soils: The hillsides of west Usambara Mountains are dominated by non-laterized red earths. These soils are normally deep and fertile. In general, these mountains, except for valley bottoms (of mainly colluvial origin, although alluvial soils may locally dominate in some valleys) and lithosols of escarpment, are latosols which include humic ferrallitic soils and humic ferrisols. These soils are derived from gneisses with varying amounts of pyroxene, hornblende and biotite. They are of late Precambrian rocks of the Mozambican belt formation. Tabora is dominated by light yellowish-brown to reddish-yellow, gritty, sandy clay loams derived from acid gneisses, migmatites and associated granites and granodiorite rocks. In Iringa (e.g. at Irunda-Sao Hill) V. linearisepala grows on fine-grained sandy, lateritic soils overlying peneplains and pink to light red soils overlying granites (Mykvist, 1976; Morgan, 1972; Lundgreen, 1978).

2.5 Forest type: V. linearisepala is widely distributed in Sclerocarya-Combretum and and miombo woodlands. The species also occurs on the margins of the mountain forests. In the former two types of forests the species occurs in association with Acacia polyacantha, Brachystegia spiciformis, Combretum zeyheri, Cordia africana, Cussonia holstii, C. spicata, Diospyros mespiliformis, Euclea divinorum, Sclerocarya caffra, etc. In the mountain forests the species occurs in association with Albizia gummifera, Bridelia micrantha, Cussonia spicata, Ficus vallis-choudae, Ocotea usambarensis, Olea hochstetteri, Ochna holstii, Parinari excelsa.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

V. linearisepala is more abundant in Sclerocaryna-Combretum and miombo woodlands than in mountain forests. This species decreases in abundance with increase in altitude. During recent field survey it was estimated the stocking varies from 3 to 150
The frequency in various forest types has not been worked out.

4.0 DESCRIPTION:

V. linearisepala is a deciduous shrub or small tree, 3 to 6 m high, with many spreading branches. Bark brownish or dark grey. Leaves large, opposite, ovate-oblong, elliptic or elliptic-oblong, 6 to 18 cm long, 3 to 9 cm wide, softly tomentose, especially on lower surfaces, acuminate at the apex and cuneate or rounded at the base. Lateral veins visible on both sides but more prominent beneath. Flowers greenish yellow or greenish white, borne on axillary panicles. Fruits globose or sub-globose, 3 to 6 cm wide, greenish when young, changing to brownish green when ripe. The fruits contain a soft, chocolate-tasting edible pulp. Seeds are hard coated, 2.9 to 3.5 cm long, and 1.3 to 1.7 cm wide. Illustrations are given in Figure 30 and Plate XXX.

5.0 MAIN USES:

The fruit pulp has a sweet, slightly sour taste and is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are picked from the tree. Alternatively, mature green fruits are picked from the tree and stored for ripening.

7.0 SEASON (TIME) OF COLLECTION OF THE EDIBLE PART:

V. linearisepala has long flowering and fruiting periods. Moreover, these events vary from one locality to another. For example, in the west Usambaras, flowering is from December to March and often extends into June, while fruit maturing takes place from August to January. In the Pare Mountains, flowering peak is from December to January, and fruit maturing peak is from August to September. In Tabora, flowering takes place in November and December, while fruit maturing takes place from June to July. From the above observations it can be concluded that flowering takes place at the onset of the rainy season and fruit maturing occurs during the dry season. It takes about seven to eight months from flowering to fruit maturing.

8.0 NUTRITIONAL VALUE:

Not known. Small amounts of ascorbic acid, see Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates in natural forests by suckers, coppice and rarely by seed. Root suckers are produced when roots are wounded by any means, e.g. cultivators, burrowing animals and fire. Natural regeneration from seed is uncommon because the seed coat is very hard, requiring pretreatment, e.g. cracking by slight hammering.

Natural regeneration has been noted to be induced by cultivation. This is because cultivation reduces competition for light and also stimulates root sucker production.

9.2 Artificial regeneration: There have been no efforts to regenerate the species by artificial means. However, there are possibilities that with pretreatment of the seed, the species could be raised in the nursery and planted on cleared sites. Moreover, stake planting has some potential.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruits have a high demand on local markets and the stem is used for making handles and digging tools.

PLATE XXX. Vangueria linearisepala M. Schum.

Plate XXX$_1$ - tree at Kwemadaa, Lushoto, Tanga, February, 1982

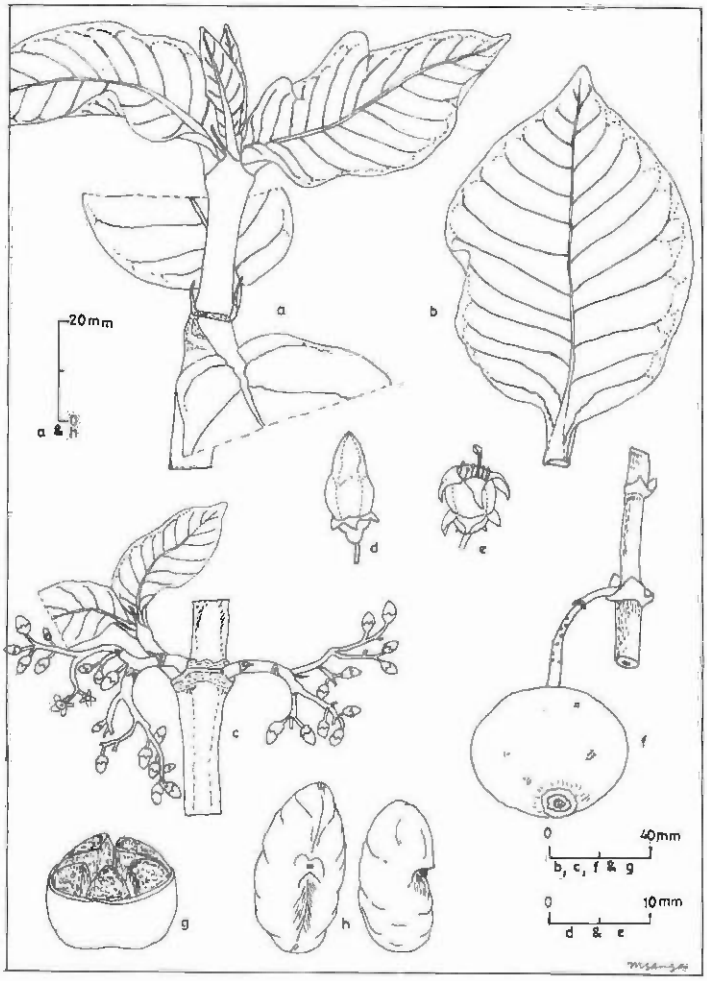


Plate XXX. Vangueria linearisepala M. Schum.

a - young branchlet
b - leaf
c - branchlet bearing flower-buds
d - flower - bud
e - flower
f - fruit
g - part section of fruit showing seeds in situ
h - seeds

Plate XXX$_2$ - branchlet bearing leaves, flower buds and flowers

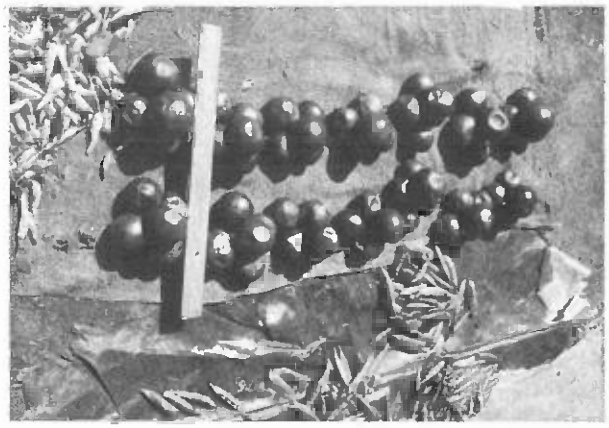


Plate XXX$_3$ - fruit vending at Lushoto Market, Tanga

31. VANGUERIA MADAGASCARIENSIS

1.0 NAMES:

Family	Rubiaceae
Botanical	Vangueria madagascariensis Gmel
Syn.	V. acutiloba Robyns
Vernacular	engumi, olmadanyi (Kiarusha, Kimasai); loshoro (Kiarusha), imumua (Kimeru); erakwtu (Iraqw); karowo, kiworo, ndawiro, ndowo (Kichaga); mbiro, mdaria (Kipare); mubilu (Kinyiramba); mulade (Kinyaturu); mviru (Kirangi); msada (Kinyamwezi, Kigogo); mviru (Kiwahili)

2.0 DISTRIBUTION:

2.1 Locality: V. madagascariensis is widespread in Tanzania. The species has been found growing naturally in Kilimanjaro, Arusha, Dodoma, Singida and Tabora Regions.

2.2 Altitude: Brenan and Greenway (1949) report that the species was found growing naturally at Kilema, Kilimanjaro at about 1500 m above sea level. A survey of the botanical specimens in Lushoto herbarium revealed that the species grows between 600 m and 2040 m above sea level at Kahe and Rongai, respectively. However, there is a possibility of the species growing at a much lower altitude and at higher altitudes than those shown.

2.3 Climate: The climatic statistics for Dodoma, Singida and Tabora have already been described under Canthium burttii. The rainfall data for selected meteorological stations in Arusha and Kilimanjaro Regions where the species occurs naturally are shown in Table 14.

Table 14 Selected meteorological stations in Arusha and Kilimanjaro Regions where the species occurs naturally

Region	Station (period)	Rainfall mean (mm)	Raindays
Arusha	Olmotonyi (1931-73)	930 ± 214	91 ± 21
	Tengeru Coffee (1931-73)	1235 ± 382	94 ± 24
Kilimanjaro	Kilema (1931-73)	1919 ± 427	113 ± 28
	Moshi (1931-75)	855 ± 273	83 ± 18

Source: Mshubemuki, et. al., 1978.

The mean maximum and mean minimum annual temperatures for Moshi meteorological station are 29° C and 17° C, respectively. The range is 12° C. The relative humidity is 87 percent at 0300 GMT, 78 percent at 0600 GMT and 49 percent at 1200 GMT (E.A. Met. Dept., 1975).

2.4 Geology and soils: The geology and soils of Dodoma, Tabora and Singida where V. madagascariensis occurs naturally have been described under Parinari curatellifolia and Bussea massaiensis. In Kilimanjaro and Arusha, V. madagascariensis grows naturally on volcanic ash soils derived from tertiary-recent volcanics (Morgan, 1972).

2.5 Vegetation types: The species grows naturally in riverine-lowland forests and Brachystegia-Combretum woodland. The common associate tree species in riverine-lowland forests include Albizia schimperana, Cordia africana, Croton macrostachys, Diospyros abyssinica, D. mespiliformis, Kigelia africana, Newtonia buchananii, Olea africana, O. welwitschii, Trema orientalis and Trichilia roka. In the Brachystegia-Combretum woodland the common associate species are Acacia tanganyikensis, Afzelia quanzensis, Albizia harveyi, Brachystegia spiciformis, Combretum collinum, C. molle, C. zeyheri, Commiphora africana, Terminalia sericea, Vitex ferruginea and V. mombassae.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

A detailed inventory on V. madagascariensis has not been taken. However, a field survey shows that the species is more abundant in open areas (where original vegetation has been cleared) than in closed forests. A rough count at Mtipa in Singida revealed a stocking of about 150 stems per ha.

4.0 DESCRIPTION:

V. madagascariensis is a profusely-branched shrub or small tree, up to 5 m high, with smooth grey bark and whitish or cream slash. Leaves opposite, elliptic-ovate or rotundate, dark green above, paler beneath, glabrous or rarely slightly pubescent, with acuminate or rarely obtuse or acute apex and prominent venation below. Their sizes vary from 7 to 20 cm long and 2 to 11 cm wide. Leaf stalks vary from 0.5 to 1 cm long. Flowers greenish, fulvous-pubescent, borne in dense axillary cymes. Fruits globose, 3 to 4.5 cm long by 2.5 to 4.2 cm wide, containing hard-coated seeds. Illustrations are given in Figure 31 and Plate XXXI.

5.0 MAIN USE:

The ripe fruit pulp is edible and has a pleasant chocolate-like taste.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

The ripe fruits are persistent, thus they are necessarily picked from the tree. Unripe fruits may be picked and stored for several days for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that the species flowers between October and January. This observation is in agreement with the specimens in Lushoto herbarium, except that the flowering period extends into February. A field survey carried out during the course of this study showed that in Arusha and Kilimanjaro the flowering period continues until March and April.

Fruit ripening varies according to locality. A survey of the specimens in Lushoto herbarium and data collected during the course of this study show that fruit ripening in Dodoma, Singida and Tabora regions is between April and July. In Kilimanjaro and Arusha it takes place between August and December.

The above observations show that flowering takes place in the rainy season, while fruit ripening occurs during the dry season. Moreover, it appears that it takes about six to eight months from flower fertilization to fruit ripening, depending on the locality.

8.0 NUTRITIONAL VALUE:

Not known. See Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: V. madagascariensis regenerates naturally by seed and coppice. Seed germination is difficult owing to its hard seed coat. However, the longer the seed stays on the ground, the softer the seed coat becomes. Coppices are produced on felling of young or old trees.

A survey of the species in natural forests revealed that the species is not regenerating adequately. Mostly only mature trees were seen.

As it is usually found in open areas, it is anticipated that crop refining could help in promoting regeneration and growth. Protection of the forest bearing V. madagascariensis from late forest fires could be of benefit as the species appears to be fire tender.

9.2 Artificial regeneration: Artificial regeneration has not been tried. However, with scarification of the seed, the species could be raised in pots in the nursery. Because it is a light demander, the planting site should be cleared of most vegetation. Weeding of the crop until it is well established is essential.

The crop is, however, semi-cultivated on farms. During the clearing of the farm land, V. madagascariensis is left as a future source of edible fruits.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Ripe fruits are sold on the market, thus its cultivation on a large scale could help boost the income of fruit collectors, if the marketing of fruits can be organized. Its wood is used in building construction and as fuel.

PLATE XXXI. Vangueria madagascariensis Gmel

Plate $XXXI_1$ - tree - near Roman Catholic Mission in Tabora - December, 1981

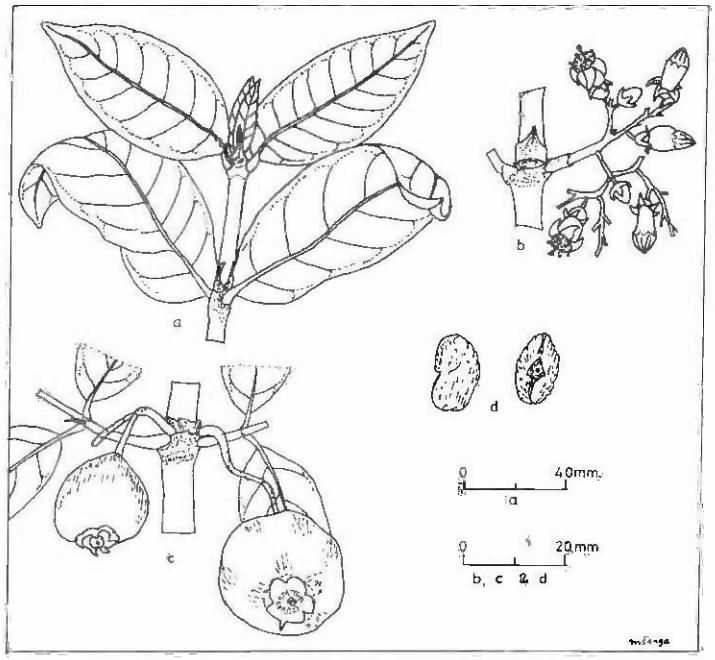


Plate XXXI. Vangueria madagascariensis Gmel

a - branchlet
b - part of inflorescence bearing flower buds and flowers
c - fruiting branchlet
d - seeds

Plate $XXXI_2$ - branchlets bearing flower buds and flowers, at Karanga in Moshi - April, 1982

Plate $XXXI_3$ - branchlets bearing flowers and young fruits - near Roman Catholic Mission in Tabora - December, 1981

32. VANGUERIA ROTUNDATA

1.0 NAMES:

Family	Rubiaceae
Botanical	Vangueria rotundata Robyns
Vernacular	engumi, olmadanyi (Kiarusha, Kimasai); loshoro (Kiarusha); imumua (Kimeru); karowo, kiworo, ndawiro, ndowo, mbowe (Kichaga); msada (Kizaramo, Kirufiji); mviru (Kiswahili)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) observed that the species occurs naturally in Tukuyu (Kyimbila) mountains. During the course of this study it was noted that the species is also widely distributed in Arusha and Kilimanjaro Regions. A survey of the botanical specimens in Lushoto herbarium revealed that the species also grows naturally in Rufiji (Kibiti) and Kisarawe (Banda Forest Reserve).

2.2 Altitude: Brenan and Greenway (1949) observed that the species grows naturally between 1000 m and 1400 m above sea level. The specimens in Lushoto herbarium show that V. rotundata grows naturally at about 100 m above sea level at Kibiti and a field survey carried out revealed that it grows at about 1830 m above sea level at Kibongoto (Kilimanjaro). Thus, the altitudinal range for V. rotundata varies between 100 m and 1830 m above sea level.

2.3 Climate: The climatic statistics for Arusha and Kilimanjaro have been described under Vangueria madagascariensis. According to Morgan (1972), Kibiti and Banda Forest Reserves receive between 762 and 1270 mm annual rainfall in four years out of five. The mean minimum and maximum annual temperatures are 19° C and over 29° C, respectively (United Republic of Tanzania, 1967).

2.4 Geology and soils: The geology and soils of Arusha and Kilimanjaro where V. rotundata grows naturally are described under Vangueria madagascariensis. Rufiji (Kibiti) and Kisarawe (Banda Forest Reserve) where the species is known to occur naturally have yellow-red loamy sands derived from quaternary and tertiary sediments (Morgan, 1972).

2.5 Vegetation types: V. rotundata grows naturally in lowland rain forests and riverine forests. Brenan and Greenway (1949) observed that the species grows naturally along streams in mountain grassland. Its common associate tree species in Rufiji are Afzelia quanzensis, Albizia versicolor, Antiaris usambarensis, Baphia kirkii, Brachystegia spiciformis, Cassia petersiana, Chlorophora excelsa, Pteleopsis myrtifolia, Pterocarpus angolensis, Trachylobium verrucosum and Trema orientalis. Its common associate tree species in Arusha and Kilimanjaro Regions are given under Vangueria madagascariensis.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

There are no records of inventory data on V. rotundata in indigenous forests. However, a field survey carried out during the course of this study revealed that the species is more abundant in mountain forests and riverine forests than in lowland rain forests. Moreover, the species is more abundant in open areas than in closed forests, thus implying that it is a light demander.

4.0 DESCRIPTION:

V. rotundata is a profusely branched shrub up to 3 m high, with smooth greyish bark and cream slash. Leaves opposite, 7 to 17 cm long, 4 to 11 cm wide, elliptic, elliptic-ovate or rotundate, hairy on both surfaces. Leaf stalks 0.5 cm to 1 cm long. Leaf bases cuneate or rounded and leaf tips acuminate, acute or obtuse. Flowers greenish with pubescence at throats, borne in dense axillary cymes. Sepals up to 0.5 cm long, petals ovate, up to 0.4 cm long. Fruits globose, greenish when unripe, chocolate when ripe, containing 5 hard-coated seeds. Illustrations are given in Figure 32 and Plate XXXII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

As for V. madagascariensis.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that V. rotundata flowering and fruiting takes place in November. The results obtained from the survey carried out during the course of this study and from the specimens in Lushoto herbarium show that V. rotundata flowering takes place between November and April. Fruit ripening takes place between July and December.

It is inferred that flowering takes place during the rainy season, while fruiting takes place in the dry season, although it extends into the rainy season. Moreover, it takes about seven to eight months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known. See Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: V. rotundata regenerates naturally by seed and coppice. Natural regeneration from seed is rare because the seed coat is hard. However, the longer the seed stays on the ground the softer the seed coat becomes. Thus, it takes a long time for the seed to germinate under closed forest conditions. Coppice shoots are produced on felling of trees.

It has been noted that V. rotundata prefers open areas. This implies that crop refining could improve growth of the trees.

9.2 Artificial regeneration: No efforts have been made to regenerate V. rotundata artificially. However, with suitable seed pretreatment, e.g. scarification, potted stock could be raised in the nursery and planted out. The planting site should be partly cleared of the vegetation in order to open up space. Weeding until the crop is well established is essential.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruits are edible and sold on the market, thus its culitvation on a large scale could ensure higher yields and consequently boost the income of fruit collections. Its wood is also suitable as fuel and withes.

PLATE XXXII. Vangueria rotundata Robyn

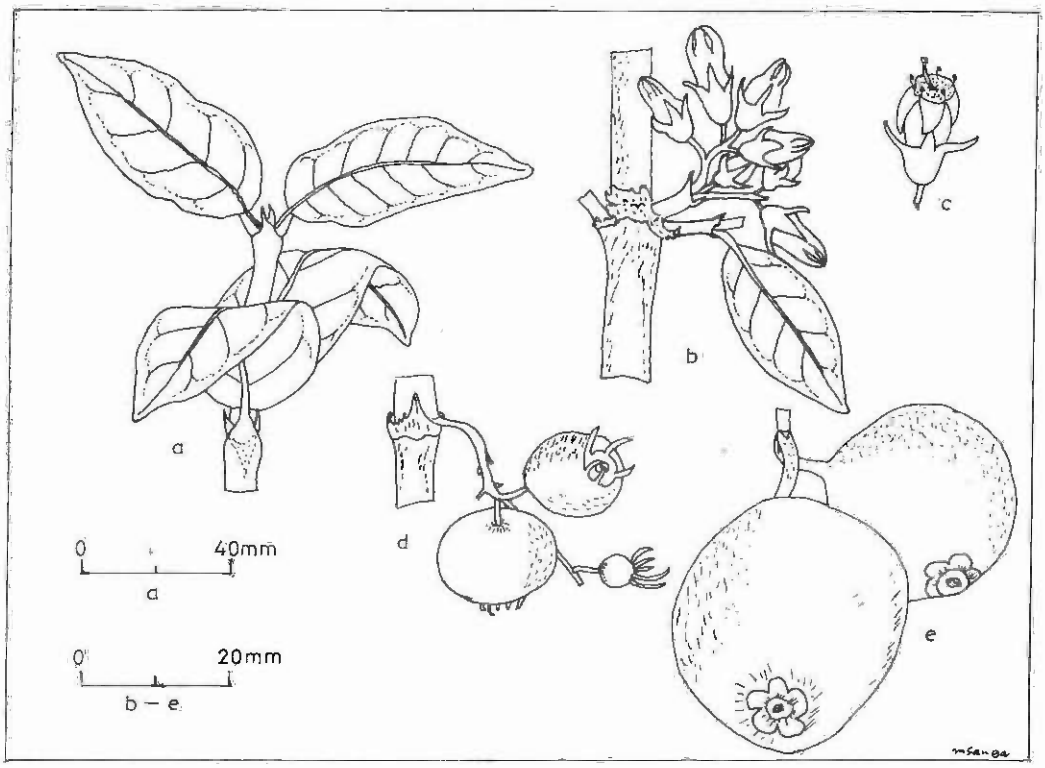


Plate XXXII. Vangueria rotundata Robyn

a - branchlet
b - branchlet bearing flower buds
c - flower
d - young fruits
e - mature fruits

Plate XXXII$_1$ - Shrub - at Ngaramutoni Arusha, April, 1982

Plate XXXII$_2$ - branchlet bearing flowers and young fruits, at Ngaramutoni, Arusha April, 1982

33. VANGUERIA TOMENTOSA

1.0 NAMES:

Family	Rubiaceae
Botanical	Vangueria tomentosa Hochst.
Vernacular	mviru muiru (Kiswahili), msada (Kinyamwezi, Kihehe, Kividunda); mvilu, mviu (Kishambaa, Kibondei, Kizigua); msambalawe (Kihehe); mnyabwita (Kizinza); mufitanda (Kikerewe)

2.0 DISTRIBUTION:

2.1 Locality: According to the available botanical specimens in Lushoto herbarium, V. tomentosa occurs naturally on shores (Pasiasi and Geita) and the islands of Lake Victoria (Ukerewe) and Tanga Region (Handeni and Korogwe). However, Brenan and Greenway (1949) report that the species occurs naturally in Kondoa and Manyoni Districts and that it is probably generally widespread in Tanzania.

2.2 Altitude: V. tomentosa grows naturally from about 350 m (Korogwe) to about 1220 m above sea level (Geita).

2.3 Climate: The climatic elements of Kwamdulu Sisal Estate near Kwamarukanga in Korogwe are given by Mushi (1978). The mean annual rainfall over a 10-year period is about 1063 mm, but it varies between 730 and 1380 mm. The mean annual temperature is about 16° C, with the range from 23° C in July to 28° C in March. Woodhead (1968) estimated that the mean annual potential evaporation varies between 1400 and 1600 mm. According to the E.A. Met. Dept. (1975), Mwanza Airport Meteorological Station has a mean annual rainfall of 1083 mm, but it varies between 699 and 1543 mm. The mean maximum and mean minimum temperatures are 27.5° C and 17.7° C, respectively, with a range of 9.8° C. The mean relative humidity figures are as follows: 85 percent at 0300 GMT; 73 percent at 0600 GMT and 59 percent at 1200 GMT.

2.4 Geology and soils: In Tanga Region (i.e. Korogwe and Handeni), V. tomentosa grows naturally on red or yellow-red, gritty sandy clay loams (latosolic soils) and on brown clay loams to clays, derived from Mozambican belt rocks. On the shores of Lake Victoria the species grows on red to dark red friable clays with laterite horizon and on Ukerewe Island, it grows on coral rag soils derived from granites and granodiorite rocks (Morgan, 1972).

2.5 Forest type: Brenan and Greenway (1949) observed that V. tomentosa grows naturally in Isoberlinia woodland. On Ukerewe Island and areas on the shores of Lake Victoria, the vegetation is dominated by savanna-like communities derived from forest (including forest remnants) (Morgan, 1972). Korogwe-Handeni areas are dominated by Brachystegia-Combretum type vegetation. V. tomentosa associate species include Acacia polyacantha, Afzelia quanzensis, Albizia versicolor, Brachystegia spiciformis, Combretum schumannii, C. zeyheri, Dalbergia melanoxylon, Markhamia obtusifolia, Pterocarpus angolensis, Stereospermum kunthianum.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

The species is more abundant on the margins of disturbed woodlands and decreases in abundance as one goes deeper into undisturbed woodlands. The frequency in various forest types has not been worked out.

4.0 DESCRIPTION:

V. tomentosa is a deciduous, many-branched shrub or small tree, 2 to 6 m high. The branches are usually opposite with reddish tomentose young branchlets. Leaves opposite, rusty tomentose, medium to large, usually from 5 to 30 cm long and 3 to 18 cm wide. Their shapes vary from ovate or obovate to lanceolate or rounded. Their venation is more prominent beneath. Leaf apexes either obtuse or subacuminate, leaf bases usually rounded. Leaf stalks short, 0.5 to 1.0 cm long. Flowers greenish white, 5-petalled, small and hairy, profusely borne on opposite and axillary cymes. Fruits subglobose, 3 to 6.5 cm long and 3.5 to 6 cm wide, greenish when unripe, turning brownish after ripening and with a soft fleshy pulp. They contain 3-5 hard-coated seeds, 2.3 to 3 cm long, 1 to 1.5 cm wide. Illustrations are given in Figure 33 and Plate XXXIII.

5.0 MAIN USES:

The fruit pulp has a sweet, slightly sour taste and is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

The ripe fruits are picked from the tree. Alternatively, mature green fruits are picked from the tree and stored for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that V. tomentosa flowers in October, December, and February, while fruits mature in February. A survey of the botanical specimens in Lushoto herbarium revealed that flowering takes place from September to April, while fruit maturing is from August to January. During a recent field survey at Korogwe in January, trees were flowering and fruits maturing simultaneously. Moreover, it was noted that flowering and fruiting is influenced by availability of soil moisture. This is because during the dry season, trees far away from river courses were shedding leaves and fruits were ripening, while those near river courses were green and bearing flowers. From the above it can be concluded that flowering takes place during the rainy season, while fruit maturing occurs in the dry season. It should also be borne in mind that the phenological behaviour of the species is influenced by the availability of soil moisture, local fruiting and flowering differences being caused by differences in the availability of soil moisture.

8.0 NUTRITIONAL VALUE:

Not known. See Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally in natural forests by suckers, coppice and, rarely, by seed. Root suckers are produced when roots are wounded by any means, e.g. cultivators, burrowing animals and fire. Field observations revealed that in addition to inducement of sucker production, cultivation reduces competition for light. The species is a light demander. Natural regeneration from seed is uncertain because the seed coat is very hard, requiring pretreatment, e.g. cracking by hammering.

9.2 Artificial regeneration: There have been no efforts to regenerate the species by artificial means. However, there are speculations that with pretreatment of the seed, the species could be raised in the nursery and propagated, especially in view of the fact that stake planting also has some potential.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

A decoction of the root is used as an anthelmintic, especially for ascaris, and is a snake-bite remedy (Watt and Breyer-Brandwijk, 1962).

PLATE XXXIII. Vangueria tomentosa Hochst.

Plate XXXIII$_1$ - multistemed tree with leaves partly shaded, at Korogwe, January, 1982

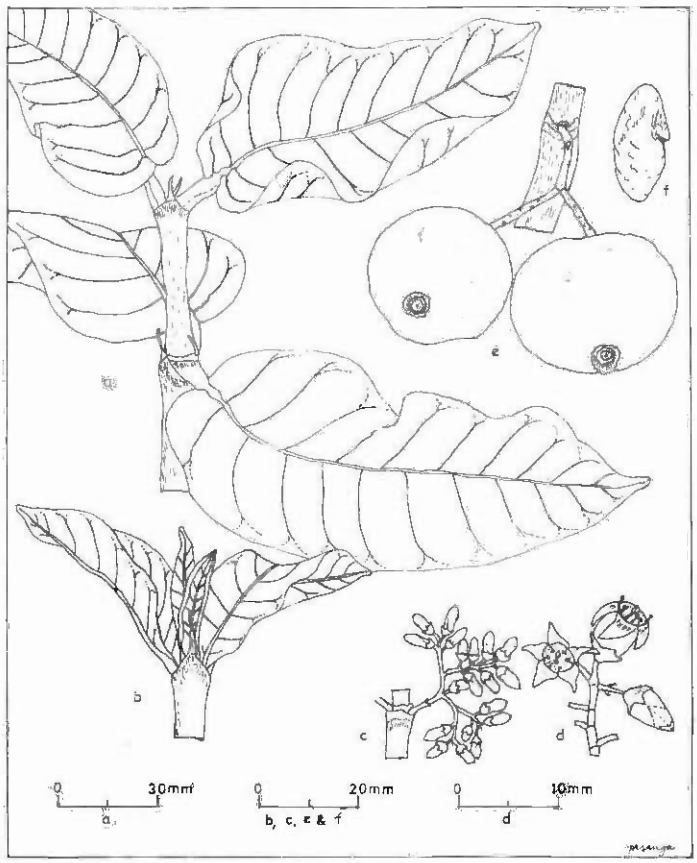


Plate XXXIII. Vangueria tomentosa Hochst

a - branchlet bearing leaves
b - terminal bud
c - branchlet bearing inflorescence
d - branchlet bearing flower buds and flowers
e - branchlet bearing fruits
f - seeds

Plate XXXIII$_2$ - branchlet bearing leaves and mature fruits

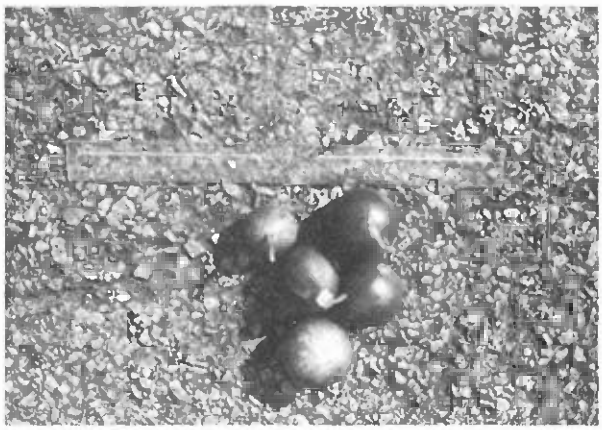


Plate XXXIII$_3$ - mature fruits

34. VANGUERIOPSIS LANCIFLORA

1.0 NAMES:

	Family	Rubiaceae
	Botanical	Vangueriopsis lanciflora (Hiern) Robyns.
	Vernacular	mungelelya (Kinyamwezi); msambalawe-lulenga (Kihehe)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) show that V. lanciflora grows naturally at Kakoma in Tabora. A survey of botanical specimens shows that the species grows naturally at Simbo in Tabora and at Masasi in Mtwara. During the survey carried out, it was found to be growing naturally at Ichemba, Kiwere, Urumwa, Kigwa and Sikonge in Tabora; Rungwa, Mwamagambe, Kipili and Kiyombo in Manyoni,; Lupa in Chunya; and Mkimbizi and Kiwere in Iringa.

2.2 Altitude: V. lanciflora grows naturally from 250 m above sea level to about 1250 m above sea level.

2.3 Climate: The climatic data for Tabora is given under Canthium burttii, and that of Iringa is given under Strychnos cocculoides. According to Morgan (1972) Chunya, Masasi and Rungwa (Manyoni) receive between 508 and 762 mm annual rainfall in four years out of five. The mean minimum and mean maximum temperatures are 16° C and over 29° C, respectively (United Republic of Tanzania, 1967).

2.4 Geology and soils: The geology and soils of Tabora are described under Ximenia americana. Chunya and Rungwa are dominated by red to dark red friable clays with laterite horizon. The soils in Chunya are derived from granites and granodiorites, while in Rungwa they are derived from Dodoman rocks. The soils in Masasi are brown clay loams to clays derived ffom rocks of the Mozambique belt (Morgan, 1972).

2.5 Vegetation types: V. lanciflora grows naturally in Brachystegia-Julbernardia woodland. The species prefers sandy soils with high watertable, The common associate tree species are Afzelia quanzensis, Brachystegia spiciformis, Combretum collinum, C. molle, C. zeyheri, Erythrophloeum africanum, Flacourtia indica, Hexalobus monopetalus, Julbernardia globiflora, Oldfieldia dactylophylla, Pericopsis angolensis, Psorospermum febrifugum, Pterocarpus angolensis, Schrebera trichoclada, Securidaca longipedunculata, Strychnos cocculoides, Terminalia sericea, Vitex mombassae, etc.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

V. lanciflora is a deciduous shrub or small, erect tree, up to 13 m high, 18 cm DBH, with smooth, reddish, powdery bark, rounded crown and brownish slash. Branchlets short, thick, with prominent leaf scars, and covered with reddish, powdery bark. Leaves opposite, variable in shape and size, medium to large, 3-13 cm long, 5-9 cm wide, oblong, oblong-elliptic or oblanceolate, rounded or subacuminate at the apex, rounded or cuneate at the base, bluish-green and hispidulous above, densely greyish pubescent with prominent venation beneath. Flower buds elongate-lanceolate, up to 3 cm long, densely tomentose outside. Flowers greenish, tubular, sweet scented, borne in leaf axils towards the ends of branchlets. Fruits globose when two-seeded or asymmetric when only one-seeded, up to 3 cm long, 2.5 cm in diameter, greenish when young, brownish to reddish and juicy when ripe. Illustrations are given in Figure 34 and Plate XXXIV.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

The ripe fruits are collected from the ground or picked from the tree. Alternatively, mature green fruits can be picked and stored for ripening.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that V. lanciflora flowers in September and October. White (1962) observed that in Zambia the species flowers between June and September, while fruit maturing occurs in September. A survey of the botanical specimens in Lushoto herbarium shows that the species flowers in November. Field observation carried out during the course of this study revealed that the species flowers between July and October, while fruit ripening takes place in November and December. The above observations show that the species flowers during the dry season and that flowering sometimes extends into the rainy season, while fruit ripening occurs during the rainy season. Furthermore, it takes about four or five months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates from seed, coppice and root suckers. The germination behaviour of the seed is not known. However, germination may be poor owing to the hard seed coat. Moreover, the seed is attacked by insects. Coppice shoots are produced on felling of trees. Root suckers are produced after wounding of roots by any means. Although regeneration from coppice and root suckers is often profuse, most coppice shoots and suckers succumb to drought and forest fires. In general, natural regeneration is not adequate.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, there are possibilities of raising it in the nursery provided there is suitable seed pre-treatment. The species is a light demander, thus it should be planted where partial clearing of vegetation has been carried out.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The ripe fruit pulp is edible and the wood is used in making wooden spoons and for fuel.

PLATE XXXIV. Vangueriopsis lanciflora (Hiern) Robyns.

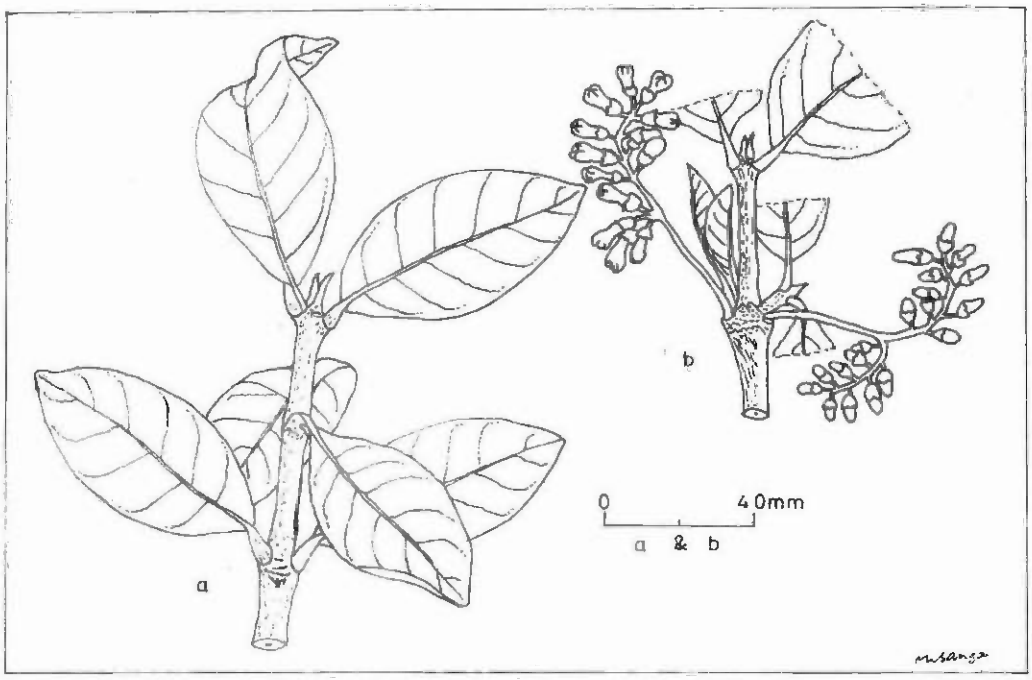


Plate XXXIV. Vangueriopsis lanciflora (Hiern) Robyns.
a - branchlet
b - branchlet bearing flower buds

Plate XXXIV$_1$ - tree at Mwitikio, Kiwere, Tabora, December, 1981

Plate XXXIV$_2$ - ripe fruits at Mwitikio, Kiwere, Tabora, December 1981.

35. VITEX DONIANA

1.0 NAMES:

Family	Verbenaceae
Botanical	Vitex doniana Sweet
Syn.	Vitex cuneata Thonn.
	V. cienkowskii kotschy & Peyr.
Vernacular	mfuu, mfudu (Kiswahili); mgobe (Kisambaa, Kibondei, Kizigua); mkoga (Kividunda); mfuru (Kizaramo, Kiluguru, Kimbunga); mfulu, mfuzu, mpuru (Kinyamwezi); kiputu (Kilungu); mufita (Kifipa); mukoronto (Kikerewe); mpindimbi (Kimwera); mpuru (Kirangi); mfulu (Kigogo)
Common English Name	Black Plum

2.0 DISTRIBUTION:

2.1 Locality: V. doniana is found locally throughout Tanzania with the exception of the montane rain forests and the Dodoma thicket belt. The species also occurs naturally on Zanzibar and Pemba Islands.

2.2 Altitude: The species occurs naturally from sea level to about 1829 m above sea level.

2.3 Climate: V. doniana occurs naturally in areas receiving varying amounts of annual rainfall. The minimum and maximum recorded mean annual rainfall figures are 743 mm and 2029 mm for Iringa Town meteorological station and Mkoani meteorological station on Zanzibar Island (Nshubemuki, et. al., 1978; E.A. Met. Dept. 1975). The temperatures and relative humidity for selected areas where V. doniana occurs naturally are given in Table 15.

Table 15 Annual temperature and relative humidity for the selected stations in Tanzania where Vitex doniana is found

Station (period) (yrs inclusive)	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Zanzibar Kisauni (1952-70)	30.3	21.6	8.7	93	81	64
Morogoro (1946-70)	30.0	18.6	11.4	90	84	55
Iringa	24.7	13.5	11.2	88	72	52
Njombe	21.9	10.2	11.7	-	93	63
Tabora	29.4	16.7	12.7	83	72	44

2.4 Geology and soils: V. doniana occurs on a variety of soils of varying origins, as can be seen from the soil map of the world (FAO/Unesco, 1973).

2.5 Forest type: V. doniana occurs naturally in coastal woodland, riverain and lowland rain forests, deciduous woodland, especially Brachystegia woodland, extending to its upper limits in upland grasslands. Brenan and Greenway (1949) observed that V. doniana occurs naturally in bush and savanna, usually on alluvial soils. Common associate species include Afzelia quanzensis, Baphia kirkii, Brachystegia spiciformis, Erythrophleum suaveolens, Parinari curatellifolia, Pteleopsis myrtifolia, Trema orientalis, Syzygium guineense and S. cordatum.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

V. doniana is more abundant on alluvial soils and near or along stream courses. However, in some other parts where it is known to occur naturally its abundance is relatively low.

4.0 DESCRIPTION:

V. doniana is a small or large tree, 8 to 18 m high, with heavy rounded crown and a clear bole up to 5 m. Bark rough, pale brown or greyish white. Leaves opposite, dark green glabrous, 14 to 34 cm long, usually with 5 leaflets on long leaf stalks. Leaf stalks 6 to 14 cm long. Leaflets distinctly stalked, ovate, obovate-elliptic or oblong, entire, 8 to 22 cm long, 2 to 9 cm wide. Leaf tips rounded or emarginate, leaf bases cuneate. Flowers white-petalled except one largest lobe which is purple, densely borne on opposite and axillary cymes. Fruits glabrous, oblong-ellipsoid drupes, 1.8 to 3.4 cm long, 1.4 to 2.4 cm wide. Greenish when young, turning to blackish after ripening and have a starchy black pulp. Seeds hard, conic, 1.5 to 2.0 cm long, 1.0 to 1.2 cm wide. Illustrations are given in Figure 35 and Plate XXXV.

5.0 MAIN USES:

The ripe fruit is black, edible, sweet, mealy, somewhat resembling a prune in taste.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

There are two methods by which fruits can be collected. Ripe fruits fall to the ground from where they can be collected; alternatively, ripe fruits can be collected from the tree by picking.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

White (1962) observed that in Zambia, V. doniana flowers from August to September, while fruit ripening occurs in April. A survey of botanical specimens in Lushoto herbarium revealed that in Tanzania the species flowers from August to November, while fruit ripening is from January to April.

8.0 NUTRITIONAL VALUE:

Details of nutritional constituents in Appendix 2.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: The species regenerates naturally by seed, coppice and root suckers. The seed germinates after a very long time in natural forests. However, it is thought that forest fires help in inducing germination because they help break the hard testa. The species coppices. Root suckers are produced after wounding of surface roots by cultivators, burrowing animals or mild forest fires. It is, however, of importance to note that trees in different development stages are found under or in the vicinity of mother trees, although animals, such as monkeys, help spread the seed.

9.2 Artificial regeneration: To date very little has been done to regenerate V. doniana artificially. However, it could be regenerated by seed. Potted seedlings could be raised in the nursery. The seed should first be pretreated by breaking the hard seed coat.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The species yields a useful timber which has some resemblance to teak and can be used for building, furniture and, in West Africa, for boat making. Watt and Breyer-Brandwijk (1962) report that the species is used as a remedy for anaemia and the root is used for gonorrhoea. In a well-organized market, V. doniana fruits could be a good source of income to fruit collectors.

PLATE XXXV. Vitex doniana Sweet

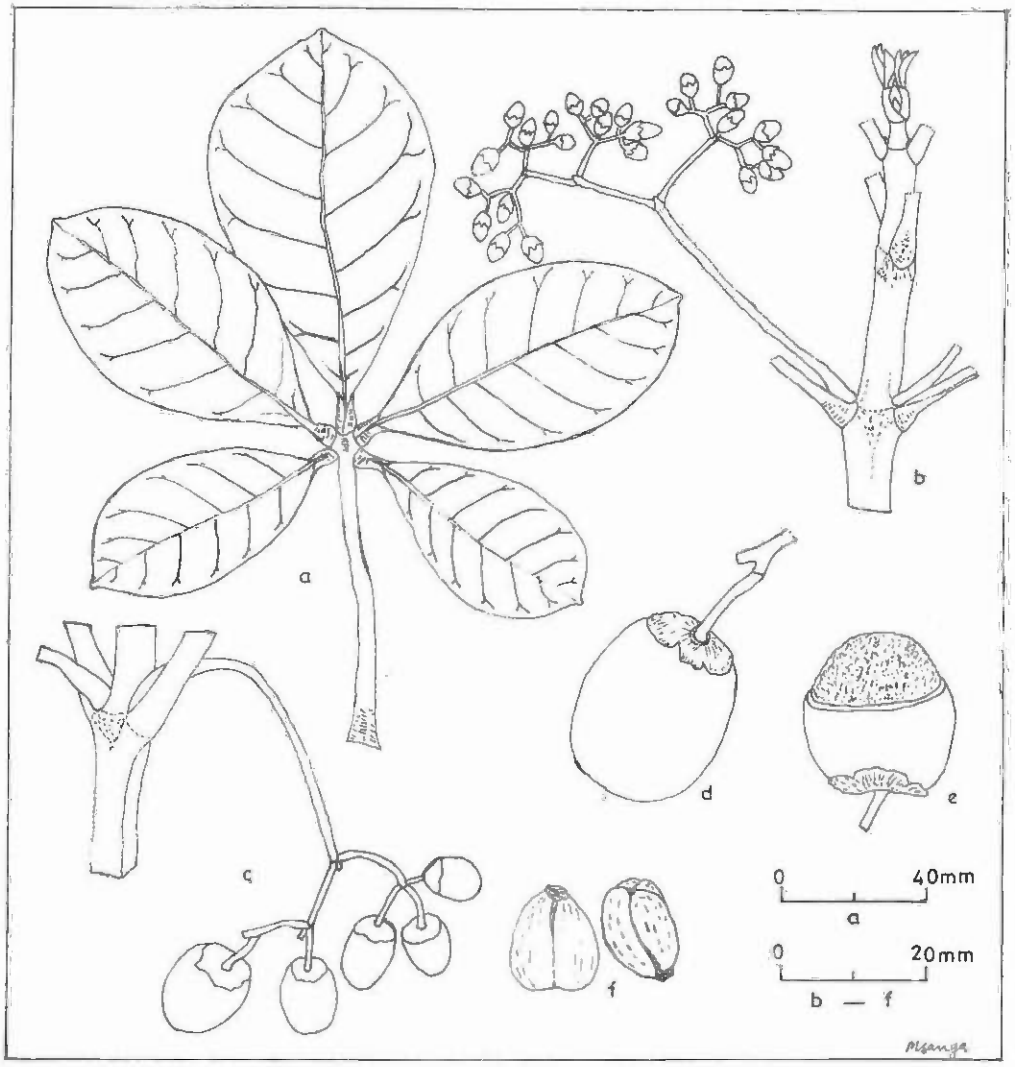


Plate XXXV. Vitex doniana Sweet

a - leaf
b - branchlet with leaves removed, bearing young inflorescence
c - cluster of young fruits
d - mature fruit
e - part of skin removed to show fruit pulp
f - seed

Plate XXXV$_1$ - tree at Kibaha Dar es Salaam, February, 1982

Plate XXXV$_2$ - branchlet bearing leaves and fruits

36. VITEX FERRUGINEA

1.0 NAMES:

Family	Verbenaceae
Botanical	Vitex ferruginea Schum. & Thonn.
Syn.	V. amboniensis Gurke
Vernacular	mfulu, mfulugenge (Kinyamwezi); mugobe (Kizigua, Kibondei), mfulu (Kigogo, Kihehe); mupulu (Kinyiramba); mufuu (Kinyaturu); mtalali (Kiswahili)

2.0 DISTRIBUTION:

2.1 Locality: V. ferruginea is widespread in Tanzania. The species is known to occur from Tanga to Lindi, Dodoma, Singida, Tabora, Rukwa, Iringa and parts of Shinyanga and Mwanza regions.

2.2 Altitude: During the course of this study it was noted that the species occurs from about 140 m above sea level at Kibaha to about 1500 m above sea level in Iringa.

2.3 Climate: The climatic statistics for some localities where V. ferruginea occurs naturally have been described elsewhere: e.g. Dodoma under Bussea massaiensis; Mwanza Singida and Tabora under Canthium burttii; Mpwapwa under Cordyla densiflora; Lindi under Friesodielsia obovata and Iringa under Strychnos cocculoides. According to Morgan (1972) Tanga and coastal areas receive about 762 to 1270 mm annual rainfall in four years out of five. The mean minimum and mean maximum temperatures for these areas are 19° C and 29° C, respectively (United Republic of Tanzania, 1976). V. ferruginea grows in areas receiving varying rainfall. It grows in semi-arid areas of central Tanzania and areas receiving moderate rainfall in Tabora, Iringa and the coastal belt.

2.4 Geology and soils: V. ferruginea grows on different soils of varying origins. It grows naturally on sandy soils of the coastal belt of Tanzania to sandy loam soils in Tabora, Iringa and Singida. Details of the geology and soils for the localities where the species grows naturally have already been described under the species listed in paragraph 2.3 above.

2.5 Vegetation: V. ferruginea grows naturally in different forest vegetation. It grows in dry lowland evergreen forests and Brachystegia woodland. The species is also abundant in the thickets and bushland from Manyoni-Itigi to Singida. The common associate tree species are as follows: In dry lowland evergreen forests they are Annona senegalensis, Albizia glaberrima, A. petersiana, Baphia kirkii, Chlorophora excelsa, Lannea stuhlmannii, Pteleopsis myrtifolia, Sclerocarya caffra, Strychnos innocua, Vitex doniana, etc. In Brachystegia woodland they are Afzelia quanzensis, Albizia petersiana, Azanza garckeana, Brachystegia spiciformis, Burkea africana, Combretum collinum, C. molle, C. zeyheri, Ozoroa reticulata, Pterocarpus angolensis, P. tinctorius, Strychnos cocculoides, S. innocua, Terminalia sericea, etc. In thickets and bushland: Adansonia digitata, Afzelia quanzensis, Albizia anthelmintica, Burttia prunoides, Bussea massaiensis, Combretum apiculatum, C. molle, C. zeyheri, Commiphora ugogensis, Dalbergia arbutifolia, Entandrophragma bussei, Grewia burttii, G. platyclada, etc.

3.0 ABUNDANCE AND FREQUENCY IN FOREST TYPES:

There has been no inventory of V. ferruginea in its natural habitat. However, during field observations made during the course of this study, it was found that V. ferruginea is abundant in open areas in the thickets and bushland, extending from

Manyoni-Itigi to Singida. It decreases in abundance in the Brachystegia woodlands. V. ferruginea's abundance in the dry lowland evergreen forests is relatively low.

4.0 DESCRIPTION:

V. ferruginea is a many-branched, small tree, 4-12 m high, with rough, grey fissured bark and dense crown. Young branchlets fulvous-tomentose with raised leaf scars. Leaves opposite, digitate with 3-5 leaflets. Leaf stalks long and pubescent, 6-18 cm long. Leaflets lanceolate-elliptic to oblong-lanceolate, the terminal one being largest, 4.5-16 cm long, 2.5-8 cm wide, petiolulate or sessile, glabrous or pubescent above, densely pubescent or tomentose beneath, rounded, acute or acuminate at the apex, cuneate at the base. Flowers white, except one largest lobe which is violet, in dense, axillary and pubescent cymes. Fruits somewhat globose, 2-3 cm long, 1.5-2.4 cm in diameter, greenish when young, then black when ripe. Seeds globose or conic and hard, 1.8-2 cm long, 1-1.5 cm in diameter. Illustrations are shown in Figure 36 and Plate XXXVI.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

On ripening, the fruits fall to the ground from where they are collected, or ripe fruits may be picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

V. ferruginea flowering varies from locality to locality. During the course of this study, at Kibaha, V. ferruginea was found flowering towards the end of February, i.e. at the onset of the long rains. On the other hand, in the Brachystegia woodland, thickets and bushland in Singida, Tabora and Dodoma, the species flowers from September to December, i.e. during the rainy season. Fruit ripening also varies from locality to locality. In eastern Tanzania, i.e. Tanga, the coast and Lindi Regions, fruit ripening takes place between July and September. In Dodoma, Singida and Tabora, it takes place between April and July. This implies that fruit ripening takes place during the dry season, and that it takes about 6 to 8 months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: V. ferruginea regenerates naturally from seed and coppice. Natural regeneration is often adequate. However, this depends on the type of vegetation where the species grows naturally. In the thickets and bushland, the species' development stages are all present in reasonable stockings. The regeneration in Brachystegia woodland and dry lowland evergreen forest is relatively rare; only mature trees can be seen, while seedlings and saplings are missing.

V. ferruginea seed germination is difficult and it takes place after a long time. This is because of its hard seed coat. Annual forest fires help in softening the seed coat.

The growth of the species in natural forests could be improved by refining. This is because trees seen growing in open areas in the thickets and bushland of Itigi-Manyoni were healthier than those growing as understorey trees in the Brachystegia woodland and dry lowland evergreen forests.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, there is a possibility of raising it in the nursery and planting it in the field. The planting site should be of sandy loam soils.

The seed germination capacity could be improved by scarification. Potted seedlings could be planted in the field. The planting site should have the natural vegetation reduced in order to open up space as the species prefers open spaces. Tending should include spot weeding and slashing until canopy closure.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The fruit is sold. The ash obtained from burning V. ferruginea wood is suspended in water which dissolves some salts and is then filtered. The filtrate is used in cooking vegetables. It is believed that this filtrate helps in hastening the cooking process. The filtrate is also used in the preparation of tobacco snuff. The wood is suitable for fuel.

PLATE XXXVI. Vitex ferruginea Schum. & Thonn

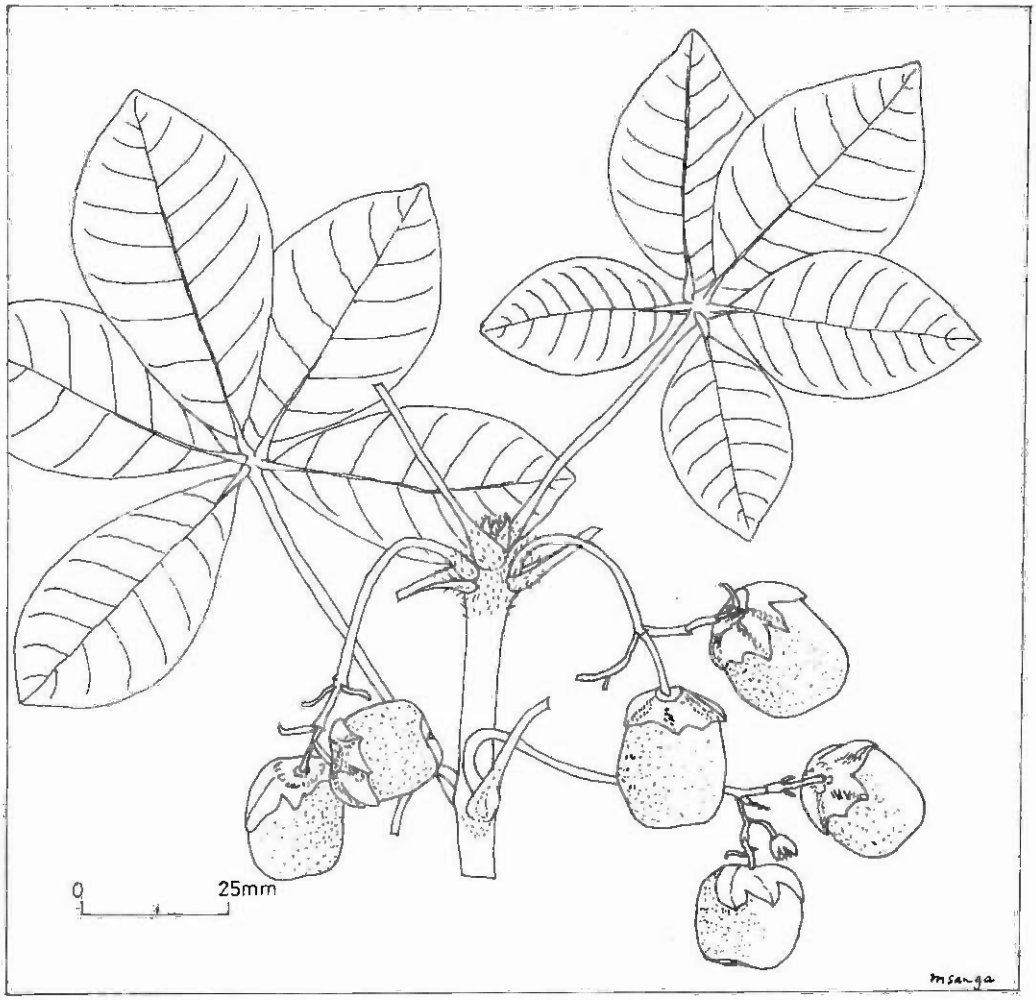


Plate XXXVI. Vitex ferruginea Schum. & Thonn.
a - fruit branchlet

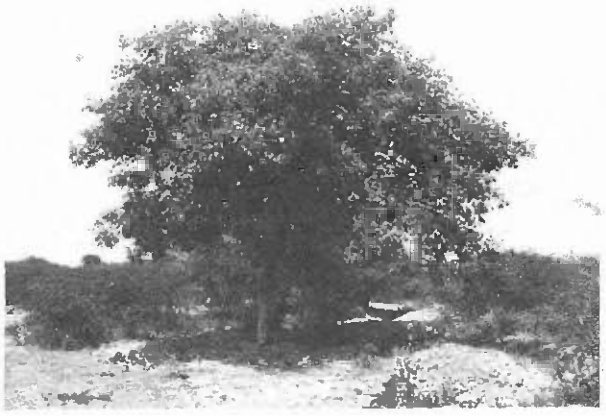


Plate XXXVI$_1$ - tree at Vikonje, Dodoma, April 1982

Plate XXXVI$_2$ - branchlets bearing fruits at Vikonje, Dodoma, April 1982

37. VITEX MOMBASSAE

1.0 NAMES:

Family	Verbenaceae
Botanical	Vitex mombassae Vatke
Vernacular	mtalali (Kinyamwezi, Kiswahili); mfundumaji (Kiswahili); mgukubi, msungwi (Kinyamwezi, Kisukuma); msungwa (Kikerewe, Kizinza); mkinka (Kifipa); mgobe (Kizigua); mfudululenga (Kihehe); mchumbau, mjumbau (Kirangi); msassi (Kinyiramba); msasati (Kihehe, Kibena); mtaai, irwana (Kinyaturu); msuungwi (Kikimbu)

2.0 DISTRIBUTION:

2.1 Locality: V. mombassae is widespread in Tanzania with the exception of Kilimanjaro and Arusha Regions and Zanzibar Island. The species grows naturally from coast region to Kigoma and from Ruvuma River to Biharamulo in Kagera Region.

2.2 Altitude: V. mombassae's altitudinal range varies between 500 m above sea level in Handeni to about 1520 m above sea level in Iringa and Singida.

2.3 Climate: The climatic data for some stations where V. mombassae grows naturally have already been described elsewhere, e.g. Mwanza, Tabora and Singida under Canthium burttii; Dodoma under Bussea massaiensis; Iringa under Strychnos cocculoides; Lindi and Kigoma under Friesodielsia obovata. According to Nshubemuki, et. al. (1978) the mean annual rainfall for Biharamulo is about 955 $\pm$ 143 mm with 106 $\pm$ 15 rain days; Geita receives about 994 mm with 81 rain days and Newala receives about 1051 $\pm$ 249 mm and 72 $\pm$ 21 rain days. The United Republic of Tanzania (1967) observed that the mean maximum and mean minimum temperatures for most of the areas where it grows naturally are 28° C and 17° C, respectively.

2.4 Geology and soils: The geology and soils for some regions where V. mombassae grows naturally have already been discussed elsewhere (see species listed in paragraph 2.3). In general, the species prefers well-drained sandy soils.

2.5 Vegetation types: The species grows naturally in Brachystegia woodland. Its common associate tree species are Afzelia quanzensis, Brachystegia spiciformis, Combretum collinum, C. psidioides, C. zeyheri, Ekebergia benguellensis, Flacourtia indica, Hexalobus monopetalus, Julbernardia globiflora, Parinari curatellifolia, Pericopsis angolensis, Pterocarpus angolensis, Strychnos cocculoides, S. pungensis, Swartzia madagascariensis, Terminalia sericea, etc.

3.0 ABUNDANCE AND FREQUENCY IN VARIOUS FOREST TYPES:

V. mombassae is most abundant in Brachystegia woodland on sandy soils with high ground watertable. The species is also abundant in open areas where the natural vegetation has been partly cleared.

4.0 DESCRIPTION:

V. mombassae is a shrub or many branched small tree up to 8 m high with grey, rough and fissured bark. Young branchlets usually fulvous-tomentellous. Leaf stalks pubescent, 4-8 cm or rarely up to 10 cm long. Leaflets 3-5 obovate, elliptic or oblong-elliptic, 2-12 cm long, 1.5-7 cm wide, sessile or shortly petiolulate, pubescent on both sides when

young, then becoming coriaceous and glabrous above, pubescent beneath after ripening, rounded, acute or apiculate at the apex, cuneate or rounded at base with reticulate and prominent venation beneath. Flowers white, mauve, or white with one mauve corolla lobe, borne in axillary cymes. Fruits almost globose, 1.8-3 cm long, 1.6-2.5 cm in diameter, greenish with small dots when young, then becoming greenish white after ripening, never black. Seeds are hard, hairy, ellipsoid or ovoid, 1.5-2.5 cm long, 1-15 cm in diameter. Illustrations are shown in Figure 37 and Plate XXXVII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

On maturing and ripening, fruits drop on the ground from where they are collected. Alternatively, ripe fruits are picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that V. mombassae flowers between September and January. A survey of the botanical specimens in Lushoto herbarium revealed that flowering occurs between August and January, while fruit ripening occurs between April and June. The above observation shows that flowering takes place during the rainy season, while fruit ripening takes place towards the end of the rainy season and extends to the dry season.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULITVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: V. mombassae regenerates naturally from seed and coppice. The germination from seed is difficult and takes place after a long time from seed fall because of the hard seed coat. Annual forest fires help in seed scarification. Coppices are produced after felling of young or mature trees.

Field observations carried out during the course of this study revealed that natural regeneration is more abundant in Brachystegia woodland sandy soils with high watertable than on alluvial soils. Forest refining may help in the natural regeneration because the species is a light demander and prefers open areas.

9.2 Artificial regeneration: There has been no effort to regenerate V. mombassae artificially. However, with improved seed germination capacity induced by scarification, there are possibilities of raising it in the nursery and planting it out in the field.

In the selection of planting sites, preference should be given to Brachystegia woodlands on sandy soils. There should be partial clearing of the vegetation. Tending should include spot weeding and slashing until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

The ripe fruits are edible and sold at the market. The ash obtained from burning the wood is suspended in water which dissolves some salts and is then filtered. The filtrate is used to hasten cooking of vegetables. The wood is suitable for firewood.

PLATE XXXVII. Vitex mombassae Vatke

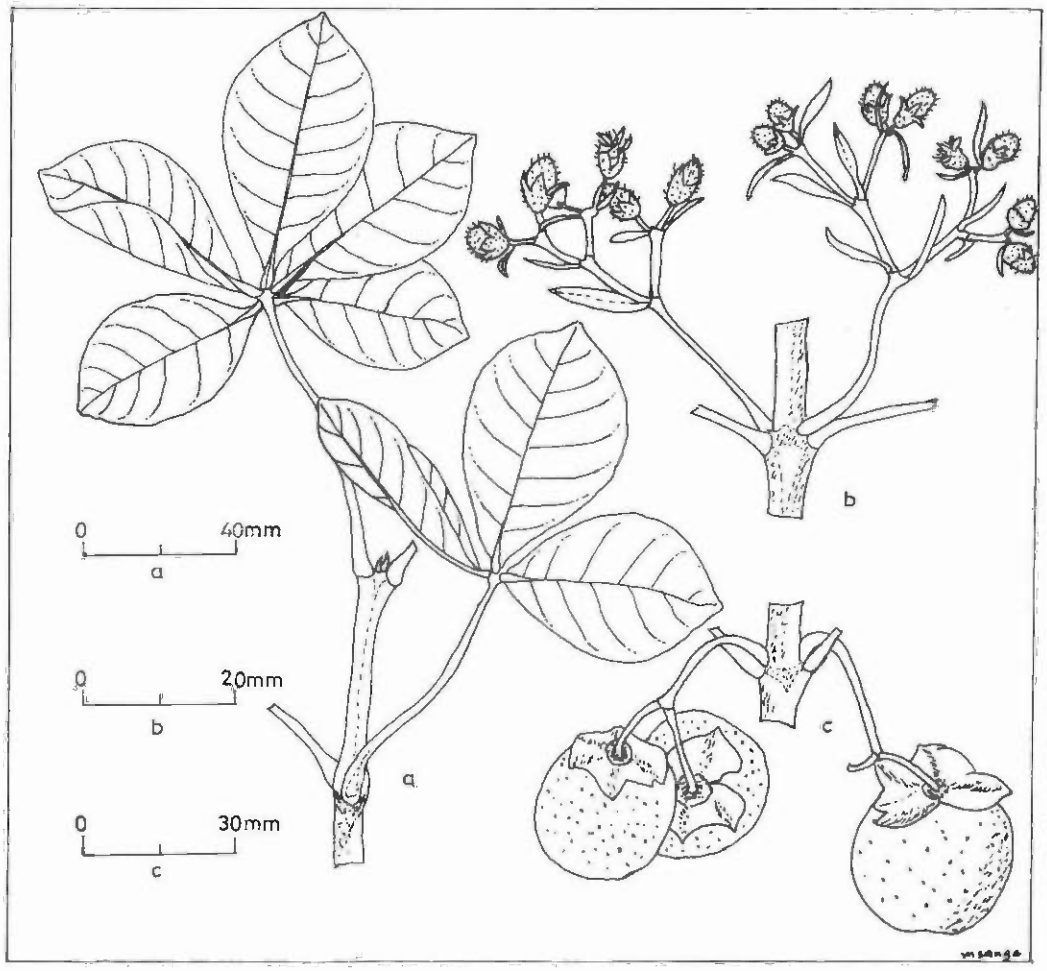


Plate XXXVII. Vitex mombassae Vatke

a - branchlet
b - branchlet bearing flower buds
c - branchlet bearing fruits

Plate XXXVII$_1$ - tree at Iduguta, Nzega May, 1982. Note a sorghum farm in the background

Plate XXXVII$_2$ - branchlets bearing fruits, at Iduguta, Nzega, May, 1982

38. VITEX PAYOS

1.0 NAMES:

Family	Verbenaceae
Botanical	Vitex payos (Lour.) Merr.
Syn.	V. hildebrandtii Vatke
Vernacular	mfulu (Kinyamwezi); mtombofa (Kizinza); mgobe (Kizigua); mfuu, mfufu (Kiswahili); naaso (Sandawi)

2.0 DISTRIBUTION:

2.1 Locality: V. payos grows naturally in Tabora (e.g. Urumwa, Beekeeping School, Kigwa, Ichemba, Kipalapala); Mwanza (e.g. Mwanza Township, Bukindu Forest Reserve in Geita) and Tanga (e.g. Kangata and Kwamarukanga in Handeni). Brenan and Greenway (1949) observed that the species also occurs in the Coast, Morogoro, Singida (Manyoni) and Shinyanga Regions.

2.2 Altitude: The altitudinal range for V. payos varies between 150 m above sea level at Kibaha and about 1250 m above sea level in Tabora and Mwanza.

2.3 Climate: The climatic data for Tabora, Coast, Morogoro, Singida and Mwanza areas where V. payos grows naturally are given under Parinari curatellifolia, Annona senegalensis, Canthium burttii and Sorindeia madagascariensis. Mushi (1978) gives the climate of Kwamdulu Sisal Estate which is within the vicinity of Kwamarukanga (Handeni District). It was found that over a 10-year period (1964 to 1974), the mean annual rainfall is about 1063 mm, but it varies between 730 and 1380 mm. Mean monthly temperature is 25° C, with the range from 23° C in July to 28° C in March. Woodhead (1968) estimated that the mean annual potential evaporation varies between 1400 and 1600 mm.

2.4 Geology and soils: The geology and soils of Coast, Morogoro, Singida, Tabora and Mwanza have already been described under the species listed in paragraph 2.3 above. In general, the species grows naturally on sandy soils, the exception being Kwamarukanga where the species grows naturally on clay red soils. According to Morgan (1972), these clay red soils are derived from rocks of the Mozambique belt.

2.5 Vegetation types: The vegetation type is similar to that mentioned under Vitex mombassae. However, there are soil variations at Kwamarukanga within short distances. The tree species commonly associated with V. payos at Kwamarukanga are Acacia polyacantha, Dalbergia melanoxylon, Brachystegia spiciformis, Combretum schumannii, Markhamia obtusifolia, Pterocarpus angolensis, Stereospermum kunthianum, etc.

3.0 ABUNDANCE AND FREQUENCY IN FOREST TYPES:

V. payos is more abundant on sandy soils with high watertable in Brachystegia woodland than on clay red soils.

4.0 DESCRIPTION:

V. payos is a small spreading tree up to 9 m high with dark grey fissured bark. Young branchlets densely lanate-tomentose. Leaf stalks densely pubescent when young and only slightly so when mature. Leaflets usually 5, soft and pubescent on both sides when young, later becoming coriaceous and glabrous or sub-glabrous on both sides, 3-12 cm long, 1.5-7 cm wide, obovate, sessile or shortly petiolulate, rounded or acute at the apex, rounded or cuneate at base with reticulate and prominent venation beneath. Flowers white or purple, borne in sparse or dense axillary cymes. Fruits ellipsoid, 3-3.5 cm long, 2.5-3 cm in diameter, dark brown to dark purple, juicy. Seeds hairy, hard, ellipsoid or globose, 2.2-5 cm long, 1.5-2 cm in diameter. Illustrations are shown in Figure 38 and Plate XXXVIII.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Fruits are collected from the ground or picked from the tree.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

The flowering and fruit ripening periods vary from locality to locality depending on the prevailing environmental factors. Brenan and Greenway (1949) observed that V. payos flowers in November. A survey of the botanical specimens in Lushoto herbarium revealed that at Kwamarukanga, V. payos flowers between April and June, while fruit ripening occurs between November and January. It was also noted that in other parts, e.g. Tabora and Singida, V. payos flowers from September to December, while fruit ripening occurs between April and June. The above observations show that flowering takes place during the rainy season, while fruit ripening occurs during the dry season. Moreover, it takes about seven to eight months from the fertilization of the flower to fruit ripening.

8.0 NUTRITIONAL VALUE:

Not known to the best of our knowledge.

9.0 CULITVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: V. payos regenerates naturally by seed and by suckers. The germination of the seed is difficult and takes place after a long time from seed fall. This is because of its hard seed coat. Annual forest fires help in breaking seed coat hardness. Coppices are produced when trees are felled.

Natural regeneration is rare; often only mature trees could be seen in the Brachystegia woodland. There were no traces of saplings or pole sized trees. It is, however, possible to encourage natural regeneration by protecting the woodland from annual late fires. Moreover, refining of Brachystegia woodland could help in promoting natural regeneration. This is because the species prefers open areas.

9.2 Artificial regeneation: There have been no efforts to regenerate V. payos seed, e.g. scarification could improve germination capacity. Thus it could be raised in the nursery and planted out in the field.

The species does best on sandy sites. Before planting out, there should be partial clearing of the vegetation in order to open up space. Tending should include spot weeding and slashing until the crop is well established.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Fruits are edible and are sold at the local markets. Its wood is suitable for fuel.

PLATE XXXVIII. Vitex payos (Lour.) Merr

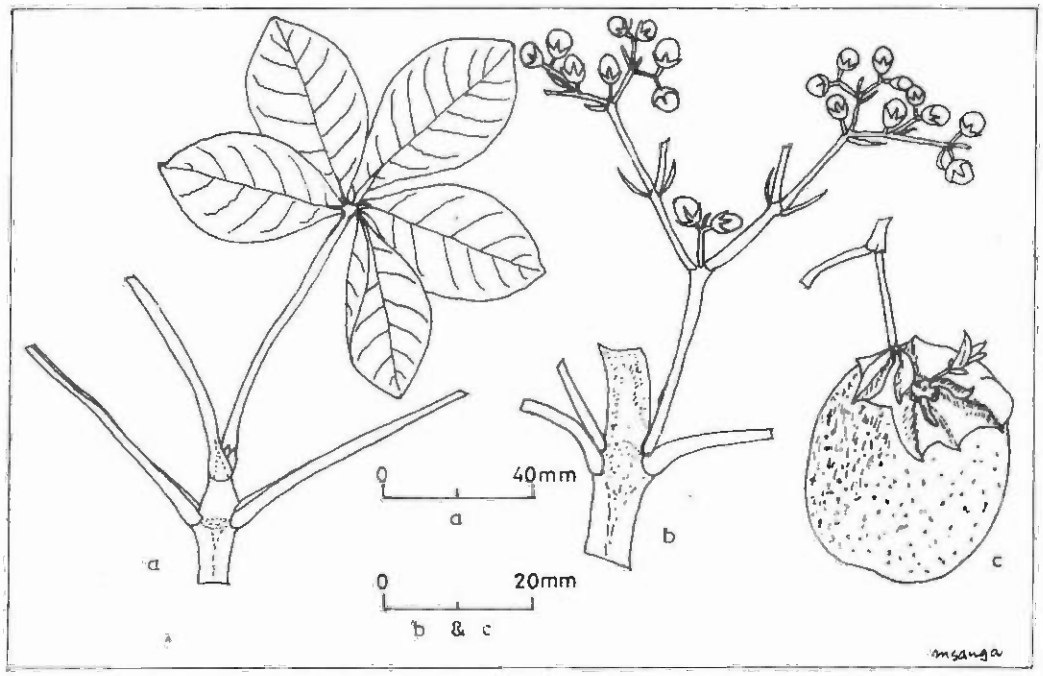


Plate XXXVIII. Vitex payos (Lour.) Merr

a - branchlet with one leaf and leaf stalks

b - branchlet bearing a portion of inflorescence with flower buds

c - mature fruit

Plate XXXVIII$_1$ - tree, at Urumwa, Tabora, May 1982

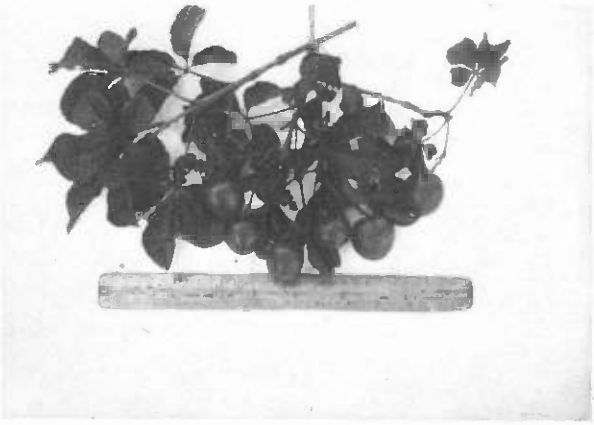


Plate XXXVIII$_2$ - branchlets bearing fruits, at Urumwa, Tabora, May, 1982

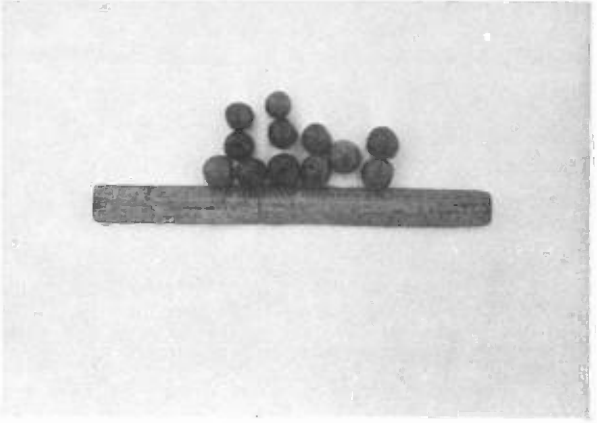


Plate XXXVIII$_3$ - ripe fruits at Urumwa, Tabora, May, 1982

39. XIMENIA AMERICANA

1.0 NAMES:

Family	Olacaceae
Botanical	Ximenia americana L.
Syn.	X. lauriana Del.
	X. americana L. var microphylla Oliv.
	X. rogersii Burtt Davy
	X. americana var. sphaerica Chiov.
	X. americana L. var. oxyprena Chiov.
Vernacular	mtundwa, mnembwa (Kinyamwezi); mtundwe (Kigogo); msantu (Kibende); Muhingi (Kizaramo); mtundwi (Kizigua); mtundakula, mpingi (Kiswahili); Wild Plum (Common English Name); mpingipingi (Kibena); mtundwahai (Kihehe)

2.0 DISTRIBUTION:

2.1 Locality: Brenan and Greenway (1949) report that the species grows naturally in the region around Lake Victoria and in central Tanzania. Lucas (1968) observed that X. americana grows naturally in areas mentioned above and in Arusha, Tanga, Tabora, Dodoma, Singida, Morogoro and Coast Regions. A survey of the botanical specimens shows that the species also grows naturally in Iringa, Mbeya and Rukwa Regions. A field survey carried out during the course of this study revealed that the species grows in Tabora, Singida and Iringa. It can be concluded that the species is widespread throughout Tanzania with the exception of Mtwara, Lindi and Ruvuma Regions.

2.2 Altitude: Lucas (1968) observed that X. americana grows naturally between 50 m and 1950 m above sea level.

2.3 Climate: X. americana grows naturally in areas receiving between 254 mm and 1270 mm annual rainfall in four years out of five (Morgan, 1972). Relative humidity and mean temperatures for selected areas where the species grows naturally are given in Table 16.

Table 16 Relative humidity and mean maximum and minimum temperatures for selected meteorological stations in Tanzania where X. americana grows naturally

Station	Temperature °C			Relative humidity %		
	Max	Min	Range	0300 GMT	0600 GMT	1200 GMT
Dar-es-Salaam	29.7	21.9	7.8	-	85	69
Dodoma	28.9	16.4	12.5	89	75	44
Iringa	26.2	14.0	12.2	85	68	51
Mbarali	29.6	16.2	13.4	-	65	45
Morogoro	30.0	18.6	11.4	90	84	55
Mwanza	27.5	17.7	9.8	85	73	59

Source: E.A. Met. Dept., 1975.

The above table shows that the lowest mean and highest mean maximum temperatures are 14° C and 30° C, respectively.

2.4 Geology and soils: X. americana grows on brown clay loams to clays and dark reddish-brown to dark brown clay loams derived from rocks of the Mozambique belt. In the coastal belt it grows on dark grey to greyish-brown compacted loamy sand (solodized solonetzic soils) derived from tertiary sediments. In Dodoma, Singida, Tabora, Iringa, and Mbeya it grows on light yellowish-brown to reddish-yellow, gritty, sandy clay loams and red to dark red friable clays with laterite horizon derived from acid gneisses, migmatites and associated granites and granodiorites. In Mwanza these soils are derived from granites and granodiorites (Morgan, 1972).

2.5 Vegetation types: Brenan and Greenway (1949) observed that X. americana grows naturally in riverain thickets and clump thickets on hard-pan soils of central Tanzania and around Lake Victoria. Lucas (1968) reported that the species grows naturally in wooded grassland, deciduous and coastal bushland. The common associate tree species are Acacia burttii, A. sieberiana, A. tanganyikensis, A. tortilis, Adansonia digitata, Albizia anthelmintica, A. harveyi, Combretum apiculatum, C. molle, C. obovatum, C. zeyheri, Entandrophragma bussei, Grewia burttii, G. bicolor, G. mollis, G. platyclada, Manilkara mochisia, Tamarindus indica, etc.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

There are no records of inventory data of X. americana in its natural habitat. However, a field survey carried out during the course of this study revealed that the species is more abundant in bushland of semi-arid areas than wooded grassland and coastal bushland. It is, however, important to note that species' abundance is relatively low in all vegetation types where it grows naturally.

4.0 DESCRIPTION:

X. americana is a semi-scandent, bush-forming shrub or small tree 2-7 m high, with pale grey and smooth bark. Branchlets smooth, armed with stout, axillary spines, purple red, covered with waxy blooms. Leaves alternate, coriaceous, glabrous, elliptic, lanceolate, ovate-elliptic or oblong-lanceolate, 3-8 cm long, 1.5-4 cm wide, obtuse or emarginate at the apex, cuneate at base, midrib impressed above, prominent beneath; lateral veins 3-7 pairs, inconspicuous. Petioles short, slender, up to 6 mm long, canaliculate. Flowers yellowish green or whitish, fragrant, borne on shortly pedunculate, axillary racemes or umbels; pedicels 3-7 mm long, sub-equal to, or shorter than, the newly opened flowers; both peduncles and pedicels glabrous. Fruits globose to ellipsoidal drupes about 3 cm long, 2.5 cm thick, glabrous, greenish when young, becoming yellowish (or rarely organge-red) when ripe, containing a juicy pulp and one seed. Seed woody, light yellow, up to 1.5 cm long, 1.2 cm thick with a fatty kernel. Illustrations are shown in Figure 39 and Plate XXXIX.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

The ripe fruits are picked from the tree. Owing to its high perishability rate, those collected from the ground are unsuitable for eating.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that X. americana flowers in January, March and October to December, while fruit ripening takes place in April and December. White (1962) reports that in Zambia the species flowers in Feburary, May, July and September, while fruit ripening occurs in September. Chingaipe (Pers. Comm.) observed that X. americana fruit ripening occurs between September and December. A survey of the botanical specimens shows that the species flowers in January, May, September, and November, while trees fruit in January, May, June and November to December. A field survey carried out during the course of this study shows that X. americana flowers in January and June, while fruit ripening takes place from March to May and from October to November. The above observations show that flowering and fruiting periods vary from locality to locality and from tree to tree. However, it is important to note that the species flowers and ripens fruit throughout the year, and that flowering and fruiting periods do not seem to be governed by climatic regimes.

8.0 NUTRITIONAL VALUE:

The kernel yields 40 to 50 percent oil (Galpin, 1926: in Watt and Breyer-Brandwijk, 1962). Wehmer (1929-31) in Watt and Breyer-Brandwijk (1962) reports that the yield is 60 to 70 percent oil. South African material has yielded 67.4 percent calculated on the moisture-free kernel (Union of South Africa, 1925: in Watt and Breyer-Brandwijk, 1962). The kernel is said to contain 0.1 percent of a caoutchouc but no saponin, alkaloid nor cyanogenetic glucoside (Schroder 1912: in Watt and Breyer-Brandwijk 1962). The shell, which represents 32.3 percent of the nut, yields 5.9 percent fat (Watt and Breyer-Brandwijk, 1962).

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: There have been no efforts to study the natural regeneration of X. americana. However, it is possible that the species regenerates from seed and coppices. The regeneration in natural forests is very sparse, probably because most seedlings and saplings succumb to forest fires and droughts. Thus, partial protection of its natural habitat could help promote natural regeneration.

9.2 Artificial regeneration: Artificial regeneration has not been tried. However, there are possibilities of raising it from seed in the nursery and planting it out in the field.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

Fruits are edible and wood can be used for fuel.

PLATE XXXIX. Ximenia americana L.

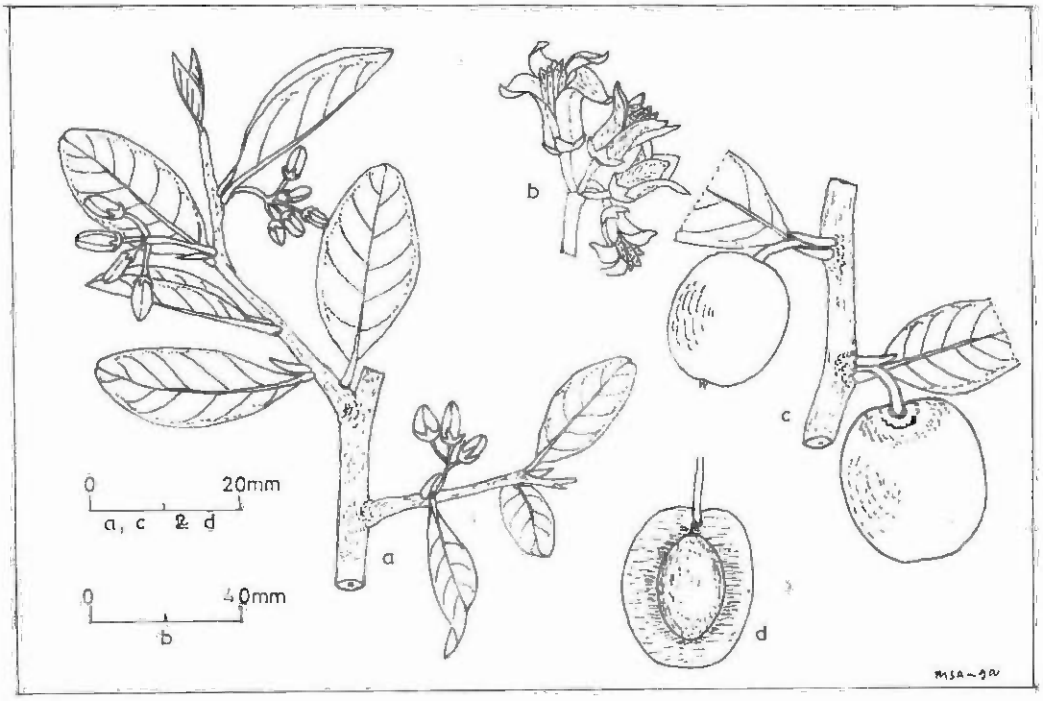


Plate XXXIX. Ximenia americana L.

a - branchlet bearing flower buds
b - cluster of flowers
c - fruiting branchlet
d - part of fruit pulp removed to show seed

Plate XXXIX$_1$ - shrub at Mshome Village, Iringa, June, 1982

Plate XXXIX$_2$ - branchlet bearing ripe fruit at Mshome Village Iringa, June, 1982

40. XIMENIA CAFFRA

1.0 NAMES:

Family	Olacaceae
Botanical	Ximenia caffra Sond. var caffra Sond.
Syn.	X. americana L. var caffra (Sond.) Engl.
	X. americana L. var. tomentosa Engl.
	Ximenia caffra Sond. var natalensis Sond.
Vernacular	mtundwa (Kihehe); mtundwe (Kigogo); mseaka (Kikerewe); mtundwa, mnembwa (Kinyamwezi);

2.0 DISTRIBUTION:

2.1 Locality: Lucas (1968) reported that X. caffra Sond. var. caffra Sond. grows naturally around Lake Victoria, Arusha, Tabora, Dodoma, Singida, Morogoro, Coast, Iringa and Mbeya Regions. On the other hand, X. caffra Sond. var natalensis Sond. grows naturally in all the above-mentioned areas with the exception of areas around Lake Victoria. It also grows naturally in Lindi, Mtwara and Ruvuma Regions. This implies that the species is widespread throughout Tanzania.

2.2 Altitude: Lucas (1968) reported that X. caffra Sond. var. caffra Sond. grows naturally between 15 m to 2000 m above sea level, while X. caffra Sond. var natalensis Sond. grows naturally from sea level to about 1800 above sea level.

2.3 Climate: The climate for areas where both varieties grow naturally are given under Ximenia americana.

2.4 Geology and soils: The geology and soils for areas where both varieties grow naturally are described under Ximenia americana.

2.5 Vegetation types: Lucas (1968) observed that X. caffra Sond. var. caffra Sond. grows naturally in dry woodland and wooded grassland, while X. caffra Sond. var natalensis Sond. grows naturally in dry wooded bushland and wooded grassland. The common associate tree species are Acacia tortilis, Afzelia quanzensis, Albizia versicolor, Azanza garckeana, Boscia salicifolia, Brachystegia spiciformis, Combretum collinum, C. molle, C. zeyheri, Dalbergia melanoxylon, Grewia bicolor, G. mollis, G. platyclada, Julbernardia globiflora, Lannea schimperi, Maytenus senegalensis, Ozoroa reticulata, Terminalia sericea, etc.

3.0 ABUNDANCE AND DISTRIBUTION IN VARIOUS FOREST TYPES:

The inventory carried out by C.D. Schultz & Company, Ltd. (1973) in Kilombero showed that in diameter classes of 15-29 cm and 45-59 cm, there were 15.03 and 1.73 stems per hectare, respectively. Thus, on 1096 ha covered there was a total of 18 369 stems of X. caffra.

A field survey carried out during the course of this study revealed that at Rungwa (about 22 km from Rungwa on the Rungwa-Itigi road), there were 6 mature trees on 64 m^2. Moreover, X. caffra is relatively higher in abundance in coastal and lowland dry woodland areas than in bushland and wooded grassland.

4.0 DESCRIPTION:

X. caffra is a small tree or shrub, up to 8 m high, with greyish-brown to black, longitudinally fissured bark and red slash. Branches and twigs are armed with stout axillary spines and are glabrous or densely tomentose. Leaves alternate, coriaceous, glabrous or tomentose, elliptic to lanceolate, 2.5-9 cm long, 1.2-5 cm wide, obtuse or emarginate at the apex, cuneate at base, midrib impressed above, prominent beneath, lateral veins 4-5 pairs and inconspicuous. Leaf stalks short, slender, 5-6 mm long and canaliculate. Flowers whitish green, sometimes tinged pink to red, axillary, solitary or fasciculate; pedicels 3-6 cm long. Fruits ellipsoidal or ovoid drupes up to 3.5 cm long, 2.5 cm in diameter, greenish when young, orange to red when ripe, with juicy pulp and woody seeds. The seed is ellipsoid, reddish, up to 2.5 cm long, 1 cm thick with a fatty kernel. Illustrations are shown in Figure 40 and Plate XL.

5.0 MAIN USES:

The ripe fruit pulp is edible.

6.0 METHOD OF COLLECTION OF THE EDIBLE PART:

Ripe fruits are picked from the tree. Fruits collected from the ground are mostly unsuitable for eating as the fruit perishes quickly.

7.0 TIME (SEASON) OF COLLECTION OF THE EDIBLE PART:

Brenan and Greenway (1949) observed that X. caffra flowers in May, July and October, while it fruits in October. X. caffra var. natalensis flowers in January and October. Chingaipe (Pers. Comm.) observed that in Zambia, X. caffra fruit ripens in January. White (1962) reported that in Zambia X. caffra flowers between August and September. A survey of the botanical specimens in Lushoto herbarium shows that the species flowers in April, September and October. A field survey carried out revealed that at Banda Forest Reserve (Coast Region), X. caffra fruits were ripening in November. The above observations show that flowering takes place during the dry season and sometimes towards the onset of the rains, while fruit ripening takes place during the rains. Moreover, it takes about four to five months from flower fertilization to fruit ripening.

8.0 NUTRITIONAL VALUE:

The Vitamin C content of the fresh fruit is 27 percent (Okazaki, et. al., 1972). The kernel contains a yellow viscous non-drying oil. The yield is about 65 percent (Miller, 1952; Anon. 1917).

9.0 CULTIVATION AND PROPAGATION METHODS OF THE SPECIES:

9.1 Natural regeneration: X. caffra regenerates naturally from seed, coppice and root suckers. X. caffra seed germination capacity is good. This is revealed by the fact that during field survey a profuse natural regeneration was noted at Rungwa. Coppice shoots are produced on felling of trees. Root suckers are produced after root wounding by any means.

Although there was profuse natural regeneration at Rungwa, it was noted with concern that there were no saplings or pole sized trees. This might be because regeneration, which comes up after the rains, succumbs to prolonged drought or to forest fires. Thus, partial protection of natural woodland where the species grows naturally could help in promoting natural regeneration.

9.2 Artificial regeneration: There have been no efforts to regenerate the species artificially. However, because of its good seed germination capacity, there are possibilities of raising it in the nursery and planting it in the field.

10.0 POTENTIAL ECONOMIC IMPORTANCE:

X. caffra fruits are edible. Its timber is suitable for making tool handles and wooden spoons. It is used for construction poles and as fuel.

PLATE XL. Ximenia caffra Sond. var natalensis Sonds

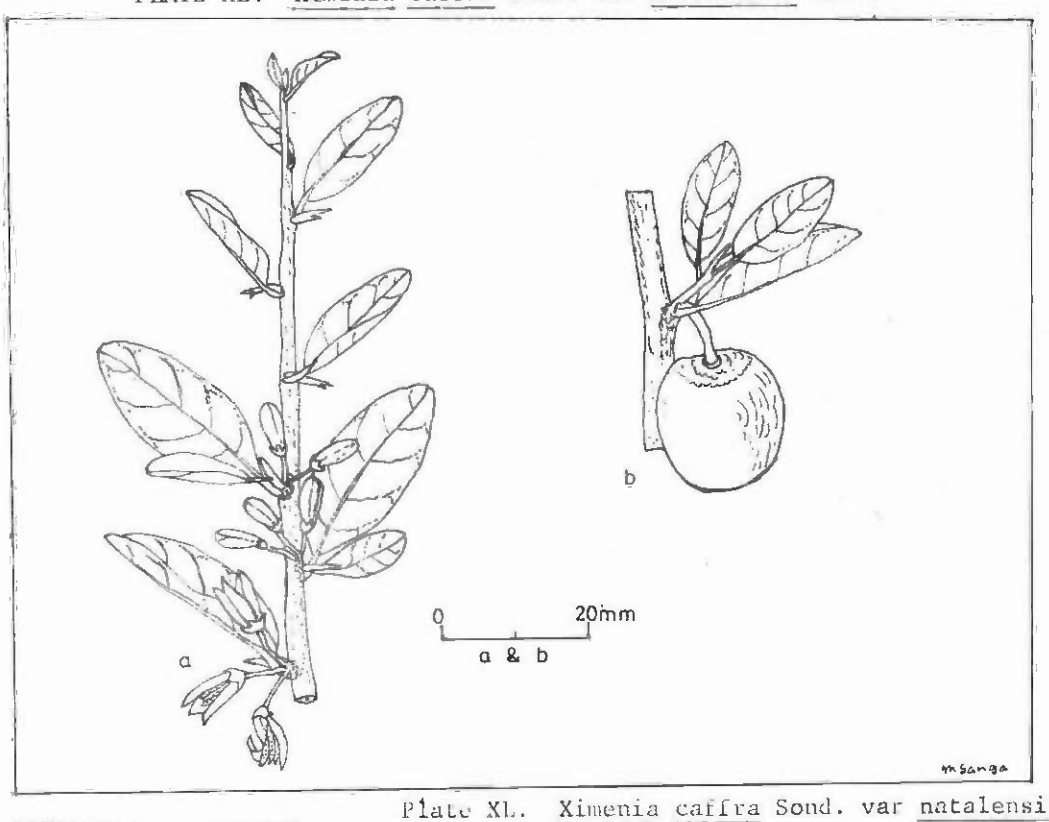


Plate XL. Ximenia caffra Sond. var natalensis Sonds
a - branchlet bearing flower-buds and flowers
b - fruiting branchlet

Plate XL_1 - trees at Rungwa, Manyoni, May 1982

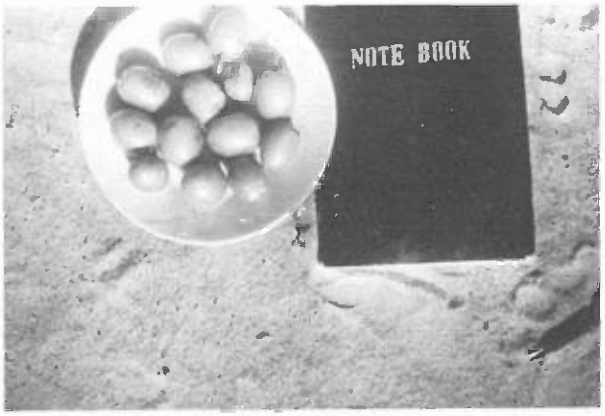


Plate XL_3 - ripe fruits

Plate XL_2 - branchlet bearing ripe fruits

APPENDIX 1

ALTITUDINAL RANGE OF SPECIES

Information for the altitudinal range is quoted under paragraph 2.2 for each species and is based on information derived from one or more of the following:

1. Brenan and Greenway, 1949.
2. The appropriate part of the Flora of Tropical East Africa, if published.
3. Herbarium specimens in the Lushoto herbarium.
4. Observations made during a recent field survey.

These can be summarized as follows:

Category	Altitude
	0 m ± 2000 m
Annona senegalensis	0 - 1800
Azanza garckeana	0 - 1900
Berchemia discolor	0 - 2000
Flacourtia indica	0 - 2400
Manilkara mochisia	0 - 2100
Pachystela brevipes	0 - 1600
Pachystela msolo	80 - 1520
Parinari curatellifolia	0 - 1900
Saba florida	0 - 1250
Sorindeia madagascariensis	0 - 1830
Sorindeia innocua	0 - 1520
Syzygium guineense	0 - 1820
Trichilia roka	0 - 1830
Vangueria rotundata	100 - 1830
Vitex doniana	0 - 1820
Vitex ferruginea	140 - 1500
Vitex payos	150 - 1250
Ximenia americana	50 - 1950
Ximenia caffra	0 - 2000

Category	Altitude
	± 500 m ± 1500 m
Allanblackia stuhlmannii	850 - 1200 (-1600)
Bussea massaiensis	960 - 1370
canthium burttii	1000 - 1500
Cordyla densiflora	850 - 1220
Diospyros kirkii	400 - 1250
Diospyros mespiliformis	350 - 1250
Friesodielsia obovata	780 - 1500
Hexalobus monopetalus	910 - 1500
Manilkara obovata	1000 - 1300
Myrianthus arboreus	600 - 1530 (-1830)
Oldfieldia dactylophylla	1100 - 1500
Vangueria tomentosa	350 - 1220
Vangueriopsis lanciflora	250 - 1250
Vitex mombassae	500 - 1520
	± 500 m - ± 2500 m
Allanblackia ulugurensis	700 - 2050
Canthium crassum	1150 - 1820
Parinari excelsa	1000 - 2100
Strychnos cocculoides	400 - 2000
Uapaca kirkiana	800 - 1960
Vangueria linearisepala	850 - 1920
Vangueria madagascariensis	600 - 2040

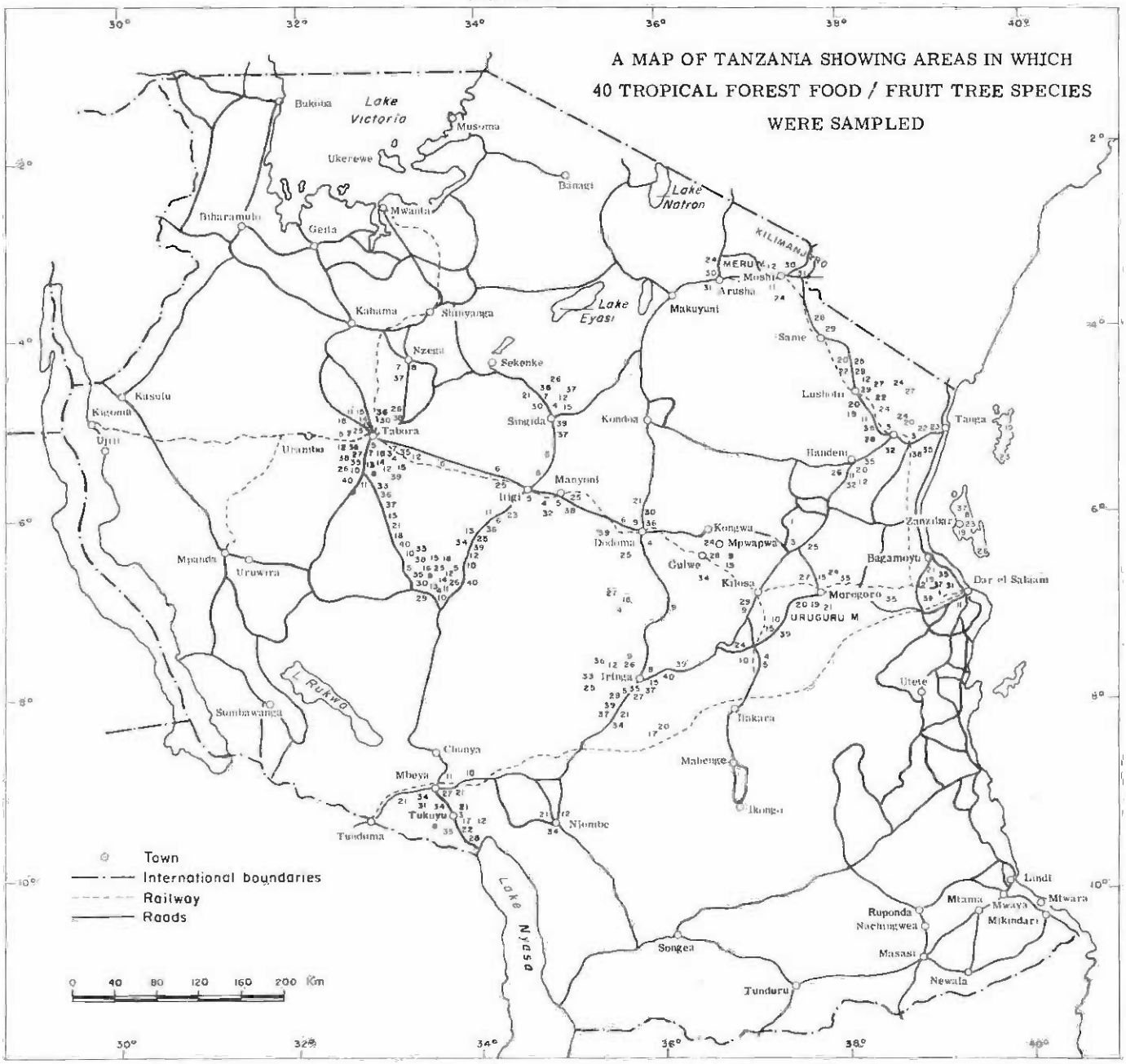
APPENDIX 2 Food Composition Table[1/] : Information Available for 7 of the Food and Fruit Tree Species Covered

Food and Description	French Name	Composition in Terms of 100 Grams Edible Portion: Food Energy	Moisture	Protein	Fat	Carbohydrate, total (incl. fibre	Fibre	Ash	Calcium	Phosphorus	Iron	Retinol	B-carotene Equivalent	Thiamine	Riboflavin	Niacin	Tryptophan	Ascorbic Acid	Refuse in as purchased
4. NUTS AND SEEDS		Calories	Percent	Grams	Grams	Grams	Grams	Grams	Milligrams	Milligrams	Milligram	Micrograms	Micrograms	Milligrams	Milligrams	Milligrams	Milligrams	Milligrams	Percent
Myrianthus, spp. (Myrianthus spp.), kernel, dried	Myrianthus	471	13.5 (3) 12.3-14.2	23.6 (3) 22.4-25.9	33.4 (3) 27.3-39.5	27.0	3.5 (3) 3.4-3.5	2.5 (3) 1.7-2.9	132 (3) 97-171	371 (3) 334-394	6.6 (3) 5.3-8.6								
Myrianthus, sp. (Myrianthus spp.), fruit, dried	Myrianthus	49	85.5 (1)	1.9 (1)		11.8		.8 (1)	44 (1)	70 (1)	1.1 (1)								
Parinarium, sp; rough-skinned-plum; grey-plum; guinea-plum (Parinari excelsa), fruit, raw	Parinari	117	66.8 (3) 66.4-67.0	1.3 (1) 1.2- 1.5	.2 (3)	30.9	1.5 (3) 1.4-1.6	.8 (3) .6- .9	38 (3) 37- 41	27 (3) 24- 28	1.7 (3) ---		290 (2) ---					31 (2) ---	
Water-berry; muKute-rusumbudzi (Syzgium guineense; Eugenia guineensis), fruit raw	Syzgium		88.1 (1)															0 (1)	50 (1)
Bitterwood, sp. (Trichilia spp.): Seed, dried	Trichilia	518	6.0 (1)	10.4 (1)	36.3 (1)	43.9	18.8 (1)	3.4 (1)	272 (1)	294 (1)	1.3 (1)			.05 (1)	.42 (1)			13 (1)	
Press-cake		335	12.3 (1)	17.0 (1)	3.6 (1)	60.5	14.1 (1)	6.6 (1)	586 (1)	433 (1)	6.1? (1)			.17 (1)	1.12 (1)			25 (1)	
Aril, dried		514	10.3 (1)	5,8 (1)	38.9 (1)	41.3	13.1 (1)	3.7 (1)	259 (1)	121 (1)	7.8 (1)			.21 (1)	1.23 (1)			40 (1)	
Small-medlar, wild; umViyo (Vangueria tomentosa), fruit	Vangueria		53.1 (1)															0 (1)	0 (1)
Blackplum (Vitex doniana; V. cienkowskii), fruit, raw	"Prune noire"	104	70.6 (7) 59.5-73.6	.7 (7) .6- .8	.4 (7) .1- 1.3	27.4	1.3 (5) ---	.9 (7) .3-1.2	34 (7) 20- 47	47 (4) ----	2.7 (6) 2.0-4.5			.02 (4) ---				9 (6) 6-16	
Kaffir-orange; muTamba (Strychnos cocculoides), fruit, raw	Strychnos		79.7 (2)															1 (2) ---	58 (2) ---

Terms and Symbols used: 1. Figures in parentheses denote approximate number of analyses, and the values below indicate the range values. When no range values are reported, a dash is used.
2. An asterisk used in the ascorbic acid column designates reduced ascorbic acid; otherwise, values refer to total ascorbic acid.
3. Trace denotes that the amount present is small.
4. Blank means no values reported, or data are questionable and omitted.

1/ SOURCE: Food Composition Table for Use in Africa (1968); A research project sponsored jointly by the US Department of Health, Education and Welfare; Public Health Service; Health Services and Mental Health Administration; National Center for Chronic Disease Control; Nutrition Program; Bethesda, Maryland 20014 and Food Consumption and Planning Branch; Nutrition Division; FAO, Rome, Italy

APPENDIX 3


A MAP OF TANZANIA SHOWING AREAS IN WHICH
40 TROPICAL FOREST FOOD / FRUIT TREE SPECIES
WERE SAMPLED
Lake Victoria
Lake Natron
Lake Eyasi
Lake Nyasa
L. Rukwa
KILIMANJARO
MERU
Bukoba
Musoma
Ukerewe
Biharamulo
Geita
Mwanza
Bunagi
Kahama
Shinyanga
Nzega
Sekenke
Kasulu
Kigoma
Ujiji
Tabora
Urambo
Singida
Kondoa
Manyoni
Itigi
Mpanda
Uruwira
Sumbawanga
Chunya
Mbeya
Tukuyu
Tunduma
Njombe
Makuyuni
Arusha
Moshi
Same
Lushoto
Handeni
Tanga
Zanzibar
Kongwa
Mpwapwa
Dodoma
Gulwe
Kilosa
Bagamoyo
Dar el Salaam
Morogoro
URUGURU M
Iringa
Ilakara
Mahenge
Ilonga
Utete
Songea
Tunduru
Masasi
Newala
Ruponda
Nachingwea
Mtama
Mtwara
Mikindani
Lindi
Town
International boundaries
Railway
Roads
0 40 80 120 160 200 Km

APPENDIX 4

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