

Agroforestry Extension Manual for Eastern Zambia

The Technical Handbook Series of the Regional Land Management Unit

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REPUBLIC



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Ministry of Agriculture, Food and Fisheries

Agroforestry Extension Manual for Eastern Zambia

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C. L. Phiri
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Forestry Department
Ministry of Environment and Natural Resources



Regional Land Management Unit, RELMA
Nairobi

1998

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Foreword

The first edition of this manual was published in 1992 by the then Regional Soil Conservation Unit (RSCU), Nairobi.

However, many developments have taken place since then. In many cases these developments have brought new knowledge and experience in agroforestry technologies which must be taken into account for the benefit of the farmer, especially small-scale farmers in Eastern Province. The importance of this knowledge and experience cannot be over-emphasized. Agroforestry technologies are dynamic and constantly changing and it is therefore imperative that these experiences are shared in order to enhance our understanding and use of these technologies.

This is the main reason that a revised version of this manual has been produced. I believe that it will continue to benefit all concerned and that it will provide the keen researcher with a springboard for further research.

I wish to pay tribute to Bo Tengnäs for spearheading the production of the manual and to take this opportunity to thank RELMA and Sida for providing the necessary financial support. I would also like to thank all those who have contributed in other ways to the final product.

Lastly, I wish to sincerely thank Samuel Simute, the main author, for a job well done.

P. C. Manda

*Acting Deputy Chief Conservator of Forests
Head of the Technical Committee*

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Mr Saiton Gondwe, retired Forest Officer, provided Senga names, while Mr George Zimba of National Parks and Wildlife Services helped with Kunda names of the tree and shrub species.

Many of the illustrations in Part I were taken from *Agroforestry Extension Training Source Book* by Louise E. Buck, and from *Agroforestry in Dryland Africa* by D. Rocheleau, F. Weber and A. Field-Juma. Most illustrations of the plants described in the species Fact Sheets in Part II are taken from the other manuals in RELMA's Technical Handbook series (where sources or artists are indicated), but Ann Birnie drew new ones for *Kirkia acuminata*, *Hyphaene petersiana* and *Uapaca nitida* for this volume.

We are very grateful to Mrs Yasmin Kalyan for typing services and to Mrs Caroline Agola for editing and typesetting the final book.

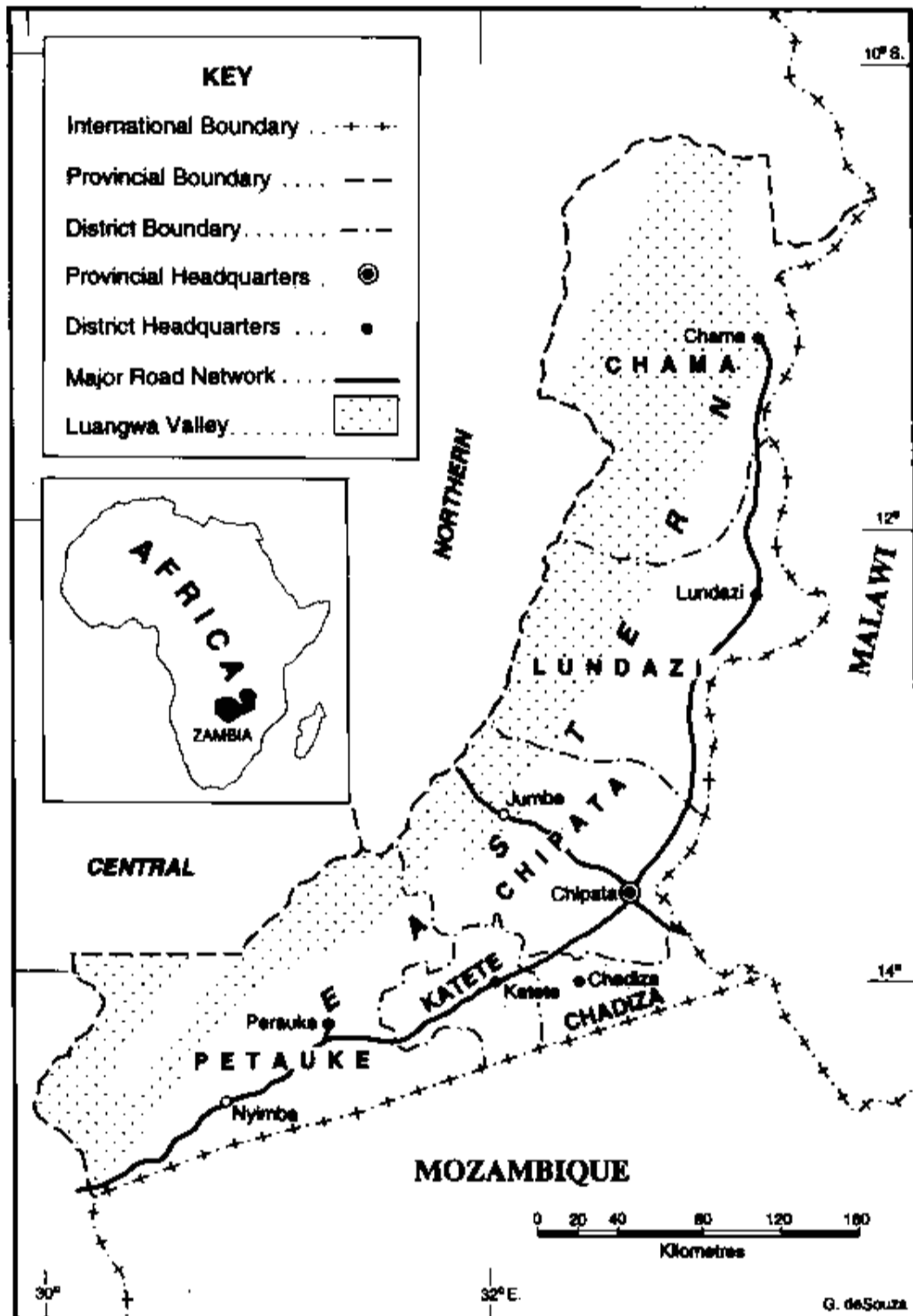
We thank the Chief Conservator of Forests and the Director of Agriculture for their support.

We are aware that no publication of this nature can be correct in every detail; therefore, we take responsibility for any errors or omissions.

S. Simute
C. L. Phiri
Bo Tengnäs

Part I

Agroforestry



Map 1. The Eastern Province of Zambia

1

INTRODUCTION

Agroforestry is a form of natural-resource management that plays a key role in a wide range of situations from providing important income-generating tree products and crops for land users in areas with developed markets to reclaiming degraded lands.

According to the definition currently used by ICRAF, agroforestry “refers to a dynamic, ecologically based, natural resources management system that, through the integration of trees in farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels” (ICRAF 1996).

Two missionaries, Danforth and Noren (1994), suggested another definition of agroforestry: “Agroforestry is an ancient farming system established by God when he created the Garden of Eden (Genesis 1 and 2). In Eden, God had every kind of plant and animal in association with trees for the benefit of people’s survival and pleasure.”



Figure 1.1 Agroforestry may sometimes have different meanings for different people

1.1 The need for agroforestry in Eastern Zambia

Much deforestation has occurred in the last 40 years. This has been due to the rapid population increase which has not been coupled with parallel economic and technological development. The following activities have contributed to deforestation:

- Clearing forests for agriculture and settlement
- Cutting of trees for charcoal production

- Collection of firewood for domestic as well as commercial purposes
- Late burning of forests
- Overgrazing by livestock in some areas, e.g. Kagoro, Chief Kawaza's area, Chief Saili's area.

Some of the consequences of these activities are:

- Shortage of construction poles and timber
- Fuelwood problems in some areas
- Shortage of fodder during the dry season
- Silting and flooding of rivers and streams
- Declining soil fertility leading to low crop yields
- Increased soil erosion.

1.2 Benefits of agroforestry

Some of the main benefits of agroforestry are:

- Provision of fruits and other food, e.g. honey
- Provision of poles and timber
- Improvement of soil fertility
- Provision of material for traditional medicine
- Provision of fodder
- Provision of fuelwood
- Control of soil erosion
- Stabilization of stream and river banks.

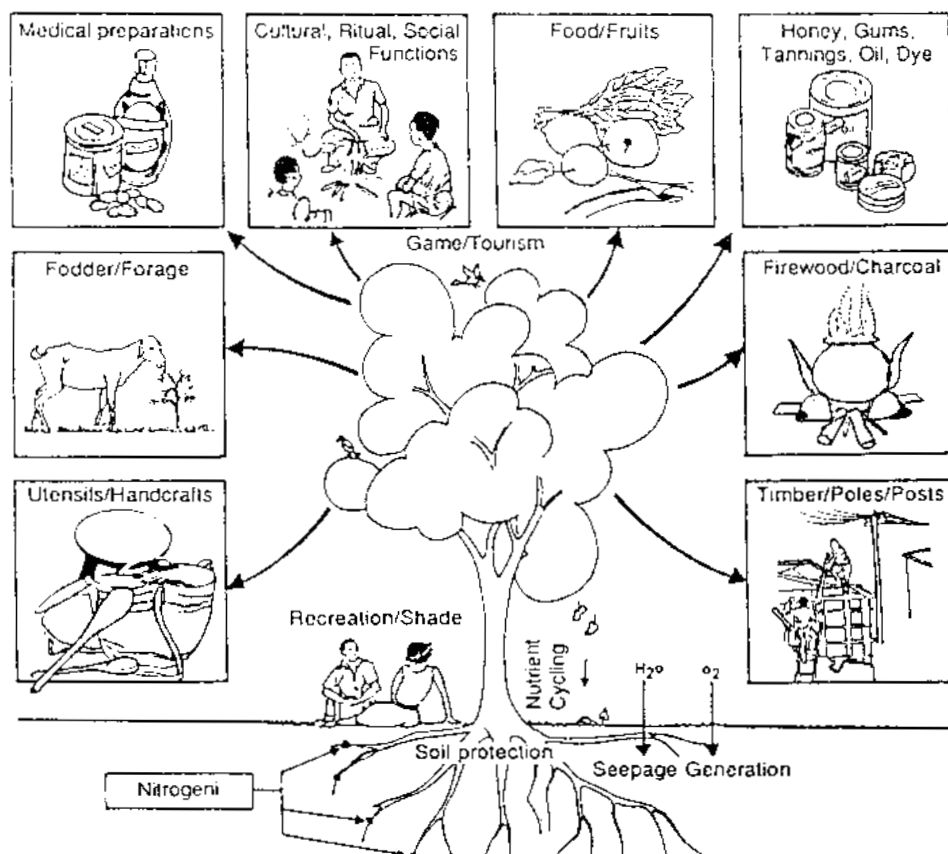


Figure 1.2 Benefits of agroforestry

Fruits and other food

Fruits are important in the diet even in small quantities since they are rich in vitamins and minerals. Fruits are a seasonal food supply and are often eaten as snack food or to provide tasty “additions” to the staple foods, increasing appetite and thus general food intake. Wild leaves, either fresh or dried, still frequently accompany staple grain dishes. Some leaves have a high protein content. Seeds and nuts are also used in side dishes and sauces. Roots and tubers provide energy, carbohydrates and minerals. They are especially valuable as dry-season and famine-period foods. Although some may be eaten raw as snacks, others require complicated processing and these are only used in times of food scarcity. All these types of food provide essential elements in the human diet.

Among the important food-producing trees in Eastern Province are *Hibiscus* (leaves), *Cordyla africana* (fruit, seeds are cooked), *Tamarindus indica* (fruit), *Moringa oleifera* (leaves and flowers) and cashew nut (fruit, nuts are roasted). Increased cultivation or protection of such species and use in agroforestry systems would ensure continued good access to food and many other products.

Poles and timber

There are many pit-sawyers in the Province who mainly exploit *Pterocarpus angolensis* (Mlombe), *Pericopsis angolensis* (Muwanga), and *Afzelia quanzensis* (Mpapa, Mupapa). The pit-sawyers are mainly concentrated in Mambwe sub-boma and Petauke District. A number of carpentry workshops have been established in towns throughout the Province and construction is a major consumer of timber and poles. The Minga Timber Company is the major private company involved in the exploitation of forestry resources in the Province, mainly using indigenous trees.

Soil fertility

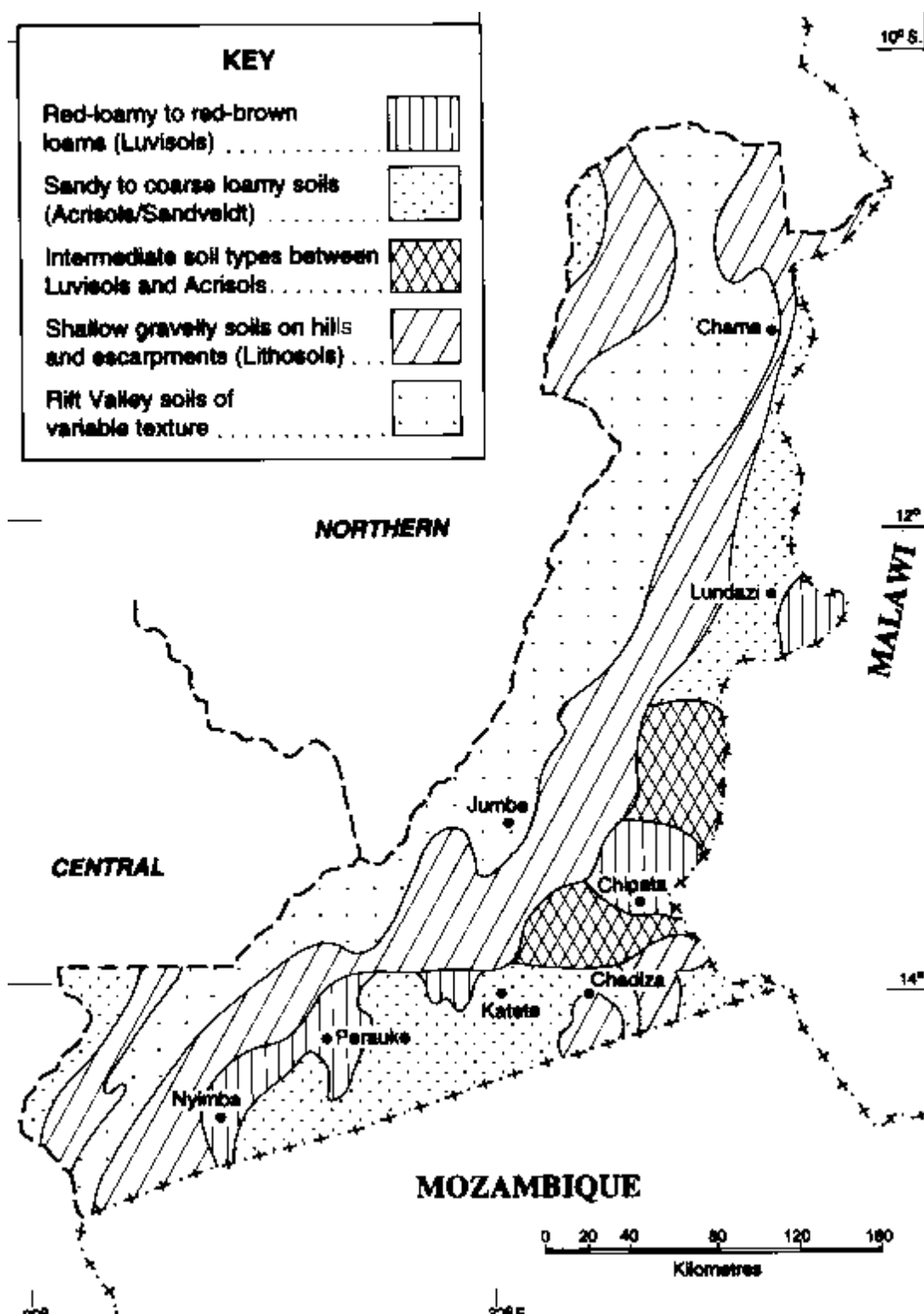
Apart from providing various products, trees also have service functions. Many species have the ability to fix nitrogen from the atmosphere and can play an important part in sustaining or improving soil fertility. This is becoming increasingly important as fallow periods become shorter, and larger and larger areas are devoted to agriculture.

Research results from Msekera in Eastern Province have confirmed that soil fertility can be improved by trees, an opinion that is also widespread among farmers. Researchers have systematically been working on development of agroforestry technologies for soil-fertility improvement, e.g. improved fallows with *Sesbania sesban*.

Fuelwood

The main source of domestic fuel is firewood, and demand increases as the population increases. Charcoal production is a commercial activity and demand is also rising rapidly. The National Breweries in Chipata is a major user of fuelwood, and so are education institutions and hotels and restaurants scattered throughout the Province.

Increased efforts at tree growing near settlements would, in the long run, reduce this pressure on woodlands and forests.



Map 2. The major soil types of Eastern Zambia

1.3 Profile of Eastern Province

Location

The Province lies between latitudes 10° and 15° S and longitudes 30° and 33° E and has a land area of approximately 69,000 km². It is bordered by Lusaka Province to the south-west and Central and Northern Provinces to the west, and has international boundaries with Malawi to the east and Mozambique to the south (see Map 1).

Topography

The landscape is generally one of gentle to moderate slopes. There are two distinct zones, namely:

- The plateau which lies at an altitude of 900–1,200 m above sea level. The lower parts of the plateau (dambos) have a reliable supply of water even during the dry season. They become flooded during the rainy season
- The Luangwa Valley is 300–600 m above sea level.

Climate

There are three distinct seasons: the warm rainy season from November to April, the cool dry season from May to August, and the hot dry season from September to October. Annual rainfall ranges from 800 to 1,000 mm. Approximately 85% of this rainfall falls during the four wettest months, i.e. December to March. In the valley areas, the rainy season tends to begin and end earlier than elsewhere.

The mean temperatures vary between 15° and 18°C during the coldest months (June and July) whilst the hottest months have a mean temperature of between 21° and 26°C (September and October).

Soils

The arable soils of the Eastern Province fall into three main categories (see Map 2):

- Yellowish sandy soils (Sandveldt or Acrisols), which are the most common in the Province. These soils are light and easy to till but are low in nutrients and water-holding capacity. They tend to form a hard pan at certain depths.
- Red clays or red brown loams (Luvisols) found near Chipata (within 50 km), between Petauke and Nyimba, and in smaller areas near Seya and Vulamukuko in Katete District. These soils are heavy, difficult to till by hand, but rich in nutrients and have a good water-holding capacity.
- Valley sedimentary soils, a complex of pale sands, grey-brown alluvial soils and dark grey clays, found in the Luangwa Valley. These soils have developed through deposition of soil by the rivers. They are often poorly drained and in the valley/escarpment zone only about 3% of the land area, mostly bordering tributary streams, is suitable for upland crops. A further 2% may be suitable for swamp rice production, taking the Lupande Game Management Area as an example.

Another type of soil that occurs in the Province is the shallow gravel (Lithosol) that is found on hills and in the escarpment zone between the Luangwa Valley and the plateau areas. These soils are not suitable for cultivation.

Nitrogen is deficient throughout the Province. On the poorer sandy soils good yields of maize cannot be obtained without nitrogenous fertilizers. With good management, a profitable response by hybrid maize can be expected with an application of 100–120 kg nitrogen per hectare on most soils.

Severe sulphur deficiency occurs in parts of the Eastern Province on the sands and the heavier soils, on the plateau and in the valleys (Jumbe, Chama). However, even the most severe deficiency can be corrected by application of about 20 kg sulphur per hectare. Current compound fertilizers contain about 10 kg sulphur in 100 kg. Application rates over 10 kg per ha give only marginal increases in yield and the use of sulphur should be limited as much as possible since it increases acidity and therefore leads to depletion of other nutrients in the soil.

Phosphate is generally not deficient, nor is potash, although when continuous cropping is practised application of maintenance rates of phosphate and potash is recommended. The Petauke red clays may be deficient in phosphate. In such areas, the use of R compound instead of X on cotton (and maize) may be preferable.

Eucalypts are sensitive to soils which are deficient in boron, nitrogen, phosphorus and potassium. They tend to show stunted growth, chlorosis and severe die-back. Application of NPK and borate fertilizers can improve the growth in such instances.

Soil acidity is measured as pH—the lower the pH the more acid the soil. Groundnuts, soy beans and sunflower all thrive better in soils of pH 4.8 or higher. In most of the Province soils are not very acidic (pH usually in the range of 5.0 to 5.5) but more acidic soils do occur, for example in some sandy areas in Chipata south, Chadiza and Katete Districts.

When pH falls below 4.6, groundnuts are likely to yield many “pops” or empty shells. In this case an economic response can be expected from the application of lime or “L” mixture. The benefits of lime are likely to last for at least three seasons. Some leguminous shrubs, e.g. *Leucaena leucocephala*, do not grow well in acidic soils.

Demography

According to the 1990 population census, there were 973,818 people in Eastern Province, or 12.5% of Zambia's total population. In the same year, it was estimated that 90% of the people of the Province lived in rural areas and depended on subsistence agriculture for their livelihood.

The average population density of 14.1 per km² is higher than the national average of 10.4 per km². Katete is the most densely populated District in the Province. The Province also has a higher population growth rate (4%) than the rest of the nation (3.2 %).

Table 1.1 Population density by District, 1969, 1980, 1990 (persons per km²)

District	1969	1980	1990
Chadiza	12.5	17.4	24.7
Chama	1.8	1.8	3.0
Chipata	12.4	17.1	24.5
Katete	20.2	23.6	35.0
Lundazi	6.6	8.2	12.3
Petauke	6.6	9.3	13.4

Vegetation

Much of Eastern Province is covered by woodlands. Different types of woodlands are recognized depending on the species composition:

- Miombo (*Brachystegia*) woodland is the major vegetation type in the Province. This is a two-storeyed woodland with an open and semi-evergreen canopy 10–20 m high. The predominant tree genera are *Brachystegia*, *Julbernardia* and *Isobertinia*. The predominant grass species are *Themeda triandra*, *Hyparrhenia* spp. and *Heteropogon contortus*.

- Munga (*Acacia* spp.) woodland is dominated by acacias, often *A. polyacantha*, which form a park-like woodland with trees scattered or in groups. *Combretum* spp. and *Terminalia* spp. are other trees found in this type of woodland. Munga woodland is usually found on rich clayey soils.
- Mopane (*Colophospermum mopane*) woodland is usually a one-storeyed woodland dominated by that species. *Colophospermum mopane* is, however, also found mixed with miombo and munga woodland at dambo edges.
- Riparian woodland occurs in narrow strips on stream banks and along rivers. The common species are *Syzygium* spp., *Khaya nyasica* and *Trichilia emetica*. Orchids and ferns are common.
- Termitaria (anthill) woodland. Anthills are common in miombo, mopane and munga woodlands, and due to the termite activities certain species thrive there. Such species are *Strychnos* spp., *Diospyros* spp. and *Sterculia* spp.

In addition to the vast woodlands, there are grasslands which occur mainly in dambos and on plains where the water-table is high and where trees are uncommon. Common grasses are *Panicum maximum* and *Echinochloa* spp.

The growing stock of wood in woodlands has been estimated at around 85 m³ per hectare. Total forest cover in Eastern Province has been estimated at approximately 6 million ha, with a total standing volume of 344 million m³ (Alajärvi 1996). This figure includes the growing tree stock in Forest Reserves, forests in open areas, in Game Management Areas, National Parks and trees outside forests. Since the woodland areas are extensive, the tree resources in Eastern Province are still substantial. As noted earlier, apart from wood, many other important products can also be obtained from the woodlands, e.g. food, honey, fodder and raw material for medicine. But in order to sustain supplies of tree products in the Province, good management of these woodlands is important.

The total area of forest reserves is approximately 847,297 ha, equivalent to 12.3% of the land area. There is also a substantial area of ungazetted forest in traditional (trust) lands. Some 600 ha of *Eucalyptus* plantation and a smaller area of pines have been established by the Forest Department.

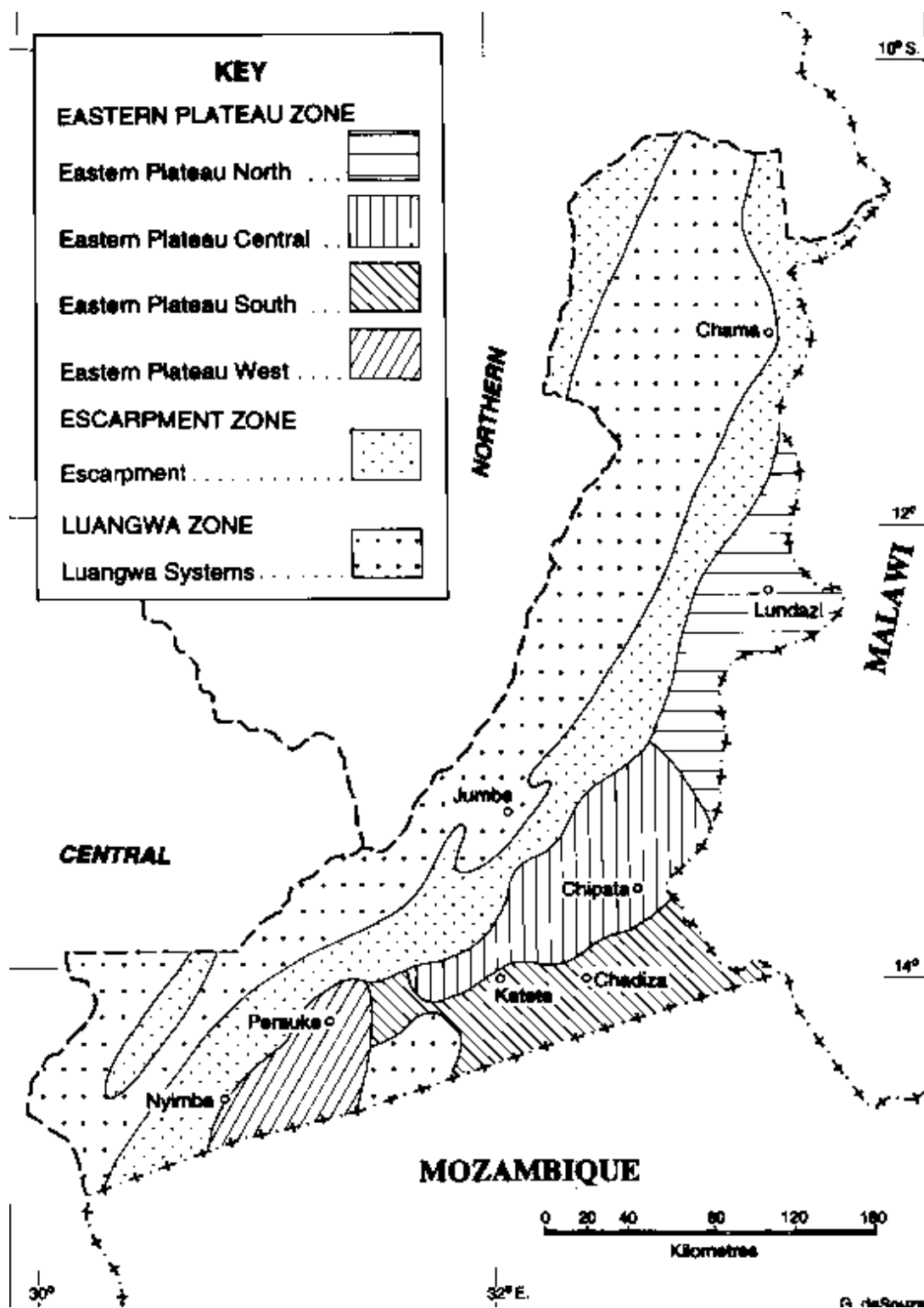
Land tenure

During the colonial era land was divided into two distinct tenure classes: Tribal Trust land and Crown land. What was designated Crown land then is now called State land and Tribal Trust land is now called Traditional land.

Out of the total available land in the Province, 96% is classified as Traditional land. This land may be used or occupied according to customary law without leasing it or having any formal right assigned and it is controlled by Chiefs with their Headmen in charge of villages. Utilization depends on both right and ownership of the community. An individual can, however, acquire a certificate of title depending on how the Chief perceives the request, though normally Chiefs do not accept such requests because they fear it might lead to a loss in popularity among their subjects.

Only 4% of the total land in the Province, about 280,000 hectares, is designated State land. This land is directly under the control of the President of the Republic of Zambia who makes grants and arranges leases of 14–99 years through the Commissioner of Lands. An individual or a group of people can be title holder.

The tenurial arrangements have a bearing on the farming systems in the Province. In many areas tree felling, grazing and overall management of natural resources are regarded as free for all, resulting in over-use and degradation.



Map 3. Agro-ecological zones

Traditional economic activities

Agriculture, hunting (mainly in the Valley), gathering/collecting wild fruits and vegetables and trading, mostly through the barter system, have been the main traditional economic activities of the people of Eastern Province.

Agriculture

The type of soils and vegetation influence the kind of agriculture practised in the Province. Most of the inhabitants practise mixed farming, combining both pastoral and arable activities. Pastoral farmers concentrate on cattle keeping and other smallstock, e.g. goats. Crop production involves growing of staple crops like millet (both bulrush and finger millet), sorghum and maize.

Hunting

Traditionally many societies in the Province were hunters, especially those in the Valley areas (Kunda). This was either to supply meat for their own consumption or for bartering. Hunting became important in the area and it created a society with well-respected specialist hunters. Even though fishing brought in some income and was a source of protein, the occupation was never accorded the same status as hunting. Nowadays hunting is confined to Game Management Areas due to excessive deforestation around villages and open areas, and the number of traditional hunters has declined because hunting in Game Management Areas requires a licence.

Gathering

Products from the miombo woodlands such as roots, tubers, fruits, mushrooms, honey and caterpillars were very important in the past and are still gathered on a small scale. In addition, certain species of trees such as *Albizia* spp., *Brachystegia* spp. and *Pseudolachnostylis maprouneifolia* provided medicines for traditional healing. Nowadays people walk long distances to collect some of these forest products.

Farming systems

Eastern Province is the third most important cattle-rearing area in the country after Southern and Western Provinces. Close to 30% of the farmers in the Province keep cattle but this is mainly on the plateau rather than in the Luangwa Valley because of the prevalence of tsetse fly in the Valley (see Map 3). The amount of cultivated land varies from one area to another: the majority of farm families cultivate 2 ha. Ox-cultivation is practised by some 50% and the other 50% use hoe.

There are three major farming systems found in Eastern Province:

- **Hand-hoe cultivation:** In this farming system the area under cultivation is usually small (i.e. 1–2 ha). Some hoe cultivators, however, are able to hire oxen for cultivation from their friends/relatives when resources permit. This kind of farming system is prevalent in the traditional land that is controlled by the Chiefs and their Headmen.
- **Valley hand-hoe cultivation:** This system is practised in the Luangwa Valley where there are no work oxen because of the presence of the tsetse flies. In this system, millet, sorghum and groundnuts are the main crops with cotton being grown as a cash crop. Rice is also important both as a food and cash crop. A very limited amount of land is cultivated by each family unless tractors are hired. The growing season ranges from 125 to 140 days and the average annual rainfall ranges from 700 to 900 mm. The conditions are such that weeds grow faster than the crops and a farmer has to weed his field many times before the crop reaches maturity. Soils are alluvial, medium to heavy textured and fairly fertile.

- **Ox-cultivation:** On the plateau many families have cleared fairly large tracts of land for crop production (5 ha or more per family). Oxen are used to cultivate the land and the crops generally grown under this system are maize, groundnuts, cotton, sunflower, tobacco and soya beans. The growing season ranges from 125 to 145 days with an annual rainfall of 800–1,000 mm. Soils are well to moderately drained sands and sandy loams of medium acidity. This system is found both on Traditional and State land.

Because of pressure on land from both livestock and people, and earlier policies on agricultural marketing, most people practise monocropping of maize and this crop takes up about 70% of the cultivated land. Poor marketing arrangements are recognized as being constraints in all the farming systems, especially in remote areas.

In the areas cultivated by hand-hoe, the main constraints are lack of labour early in the season, drought, limited cash to purchase inputs, seasonal food shortages in the period from January to March, and declining soil fertility. Where fallow periods are allowed, they are too short to allow restoration of soil fertility and in the long run people abandon such fields in search of fresh ones.

People start working in their fields as early as July and work continues through to October. This work is known as *galauza* in Nyanja. In this system, trash and stalks are buried by piling soil between two old ridges to make a new ridge. This ridging, if done systematically along the contours, results in controlling run-off, but if done along the slope, both soil and trash are swept away. The people involved in *galauza* are mainly women and children. Men normally attend to the large fields which are used for the production of cash crops and where oxen are used after the onset of the rains.

In all farming systems, harvesting is done between June and July. Many farmers, especially in Chipata, Katete, Chadiza and Petauke, leave their cattle free during the dry season without anybody to herd them so they often damage other people's fields. Bush fires in these four Districts are very common because people burn grass and maize stalks to clear the fields in search of mice which are a delicacy among the Ngoni, Chewa and Senga. Such fires clear the ground of any vegetation, leaving the soil unprotected and vulnerable to erosion. Vegetative soil cover is important in controlling erosion, and also acts as a mulch which maintains soil moisture thus providing a better environment for microbial activity.

People on the plateau are usually busy with the field crops up until about March when they start to utilize dambos to grow vegetables to generate extra income. The main crops in these dambos are vegetables, sugarcane and fruit trees. To keep livestock away from the gardens, people use live fences and also make wooden fences. When wooden fences are used, the poles have to be replaced every three years. The extension service discourages people from using poles for fencing and has put the emphasis on live fences using *Agave sisalana* (Sisal E) and shrubs like *Caesalpinia decapetala* (Chatata N).

In the valley hand-hoe cultivation system, there are some people who cultivate two distinct areas on their farms, one during the rainy season and another area during the dry season. During the planting season they plant their field crops such as maize in the silt-fertilized river valleys from May to August: this system is referred to as *nyata* and it allows people to have two crops a year which helps to overcome poverty and hunger.

2

TREE AND CROP INTERACTION

2.1 Introduction

The capacity of trees and other plants to restore soil fertility was utilized in African traditional agricultural systems that were based on shifting cultivation. Farmers still grow or leave trees on their land, often noting that this has beneficial effects for the soil and crop yields. It is well known that the topsoil in forests is usually rich in nutrients with a good structure, and scientists have concluded that nutrient cycling under natural vegetation is relatively efficient; that is, there is little leakage of nutrients out of the system. Agroforestry systems are more similar to natural ecosystems than monocropping systems since both trees and herbaceous plants are present, and a well-functioning agroforestry system has the potential for decreasing leakage of nutrients out of the system.

Soil status is one of the important factors that determine how a crop will perform on a certain site. It is, however, not the only one. Moisture content is another important factor, and trees growing with the crops will also have an impact on the moisture content of the soil. Roots from some tree species compete significantly with crops for moisture whereas, on the other hand, the presence of trees reduces wind and thus evaporation. Due to litter fall and decomposition, trees also contribute to the organic-matter content of the soil, which increases the capacity of the soil to retain moisture.

Above the ground a tree will provide shade, which will have some effect on crop performance. Occasionally trees may harbour organisms that are harmful to crops, e.g. a tree may attract grain-eating birds to nest in its crown.

These and other factors affect the nature of the tree's interaction with crops surrounding it. The area where this interaction takes place is sometimes called the tree/crop interface. Agroforestry is only beneficial to the farmer if the net effect of all the factors involved in this interaction is positive. The trees planted with crops certainly do not always contribute to a higher output or to more sustainable land use. The benefits will only be obtained through a combination of the right tree species with the right crops in the right spatial arrangements with the right management practices. It is important to understand these factors and their effects on the trees and crops before agroforestry interventions are discussed and planned with farmers.

2.2 How trees improve soils

The processes through which trees improve soils can be grouped into four different categories, as follows (adapted from Young 1989):

- | Increasing inputs (organic matter, nitrogen fixation, nutrient uptake)
- | Reducing losses (organic matter, nutrients) by promoting recycling and checking erosion
- | Improving soil physical properties, including water-holding capacity
- | Beneficial effects on soil biological processes.

The processes by which trees maintain or improve soils

Processes which augment additions to the soil

- | Maintenance or increase of soil organic matter through carbon fixation in photosynthesis and its transfer via litter and root decay.
- | Nitrogen fixation by some leguminous and a few non-leguminous trees.
- | Nutrient uptake: the taking up of nutrients released by weathering of rocks in deeper layers of the soil.
- | Atmospheric input: the provision by trees of favourable conditions for input of nutrients by rainfall and dust, including via throughfall and stemflow.
- | Exudation of growth-promoting substances by the rhizosphere.
- | Reduction of acidity through addition of bases in tree litter.

Processes which reduce losses from the soil

- | Protection from erosion and thereby from loss of organic matter and nutrients.
- | Nutrient retrieval: trapping and recycling nutrients which would otherwise be lost by leaching, including through the action of mycorrhizal systems associated with tree roots and through root exudation.
- | Reduction in the rate of organic-matter decomposition by shading.

Processes which affect soil physical conditions

- | Maintenance or improvement of soil physical properties (structure, porosity, moisture-retention capacity and permeability) through a combination of maintenance of organic matter and the effects of roots.
- | Breaking up of compact or indurated layers by roots.
- | Modification of extremes of soil temperature through a combination of shading by canopy and litter cover.

Soil biological processes and effects

- | Production of a range of different qualities of plant litter through supply of a mixture of woody and herbaceous material, including root residues.
- | Timing of nutrient release: the potential to control litter decay through selection of tree species and management of pruning and thereby to synchronize nutrient release from litter decay with the plants' requirements for nutrient uptake.
- | Effects upon soil fauna.
- | Transfer of assimilate between root systems.

Litter and mulch

During the lifetime of a tree, leaves, twigs and branches die and fall to the ground as litter. In agroforestry, trees are often managed and the biomass from the tree may be cut and used as mulch. The roles played by mulch and litter are similar.

Litter or mulch lying on the ground provides cover for the soil and this reduces erosion rates. In general, tree canopies only reduce the erosive effect of rainfall by about 10%, and in certain situations the canopy may make the rainfall even more erosive than if there were no tree. If the soil is covered with litter or mulch, on the other hand, erosion will often be reduced to low levels.

Another characteristic of litter is its contribution to the organic-matter content of the soil after it decomposes. A soil that is rich in organic matter has a better capacity to absorb and retain water, and thus is also more resistant to erosion. A good cover of litter or mulch can also be very effective in suppressing weeds.

In general, trees do not necessarily lead to control of erosion. What matters is their spatial arrangement and the way they are managed.

Nitrogen fixation

Many leguminous trees and a few non-leguminous ones have the ability to fix atmospheric nitrogen through symbiosis with bacteria or fungi in root nodules. The fixation of nitrogen has been proven and found to be a significant factor in soil fertility. Tree species that have the ability to fix nitrogen may not always be efficient in doing so, however. One of the preconditions for efficient fixation of nitrogen is a minimum level of phosphorus in the soil. In exhausted soils which are low in phosphorus, therefore, nitrogen fixation may be insignificant even if nitrogen-fixing species are planted.

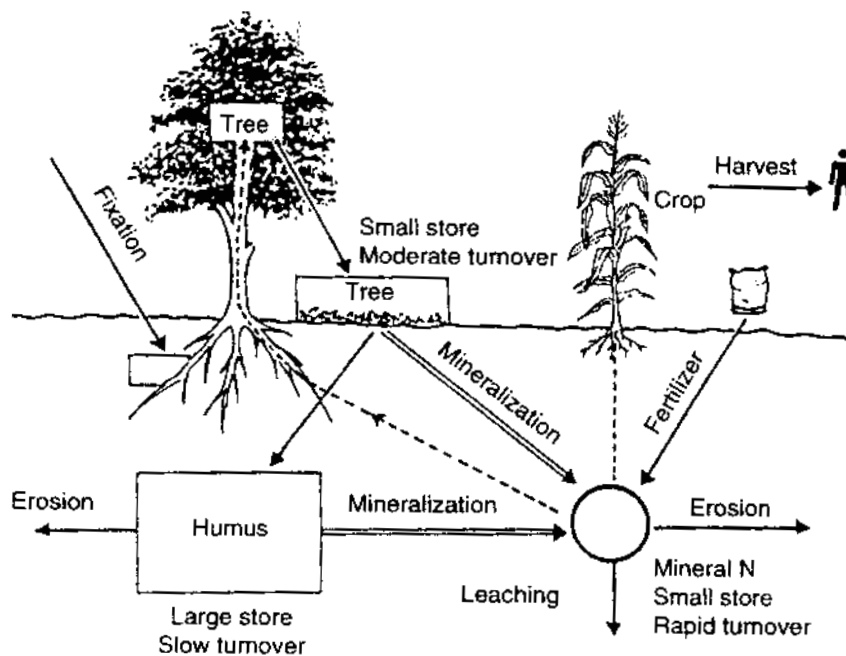


Figure 2.1 The nitrogen cycle under agroforestry simplified to show major stores and flows

The roots of a plant constitute 20–30% of its biomass. But the roots often contribute more to net primary production than the above-ground biomass. This is because the fine roots only have a short lifespan and therefore there is rapid turnover of them. Hence,

root decay is a significant process, and it is probable that cutting back the biomass above ground (coppicing, pollarding, etc.) results in a temporary increase in root die-back. When the roots die, nitrogen is released and can be used by other plants, e.g. crops. So far, these processes that release nitrogen from roots are not very well understood but they are being studied. Besides release of nitrogen, the death of the fine roots also contributes to organic-matter build-up.

A major part of the nitrogen which is fixed by the roots is used by the nitrogen-fixing plant for its own growth, so the litter from nitrogen-fixing plants is often rich in nitrogen and this is added to the soil when the litter or mulch decomposes.

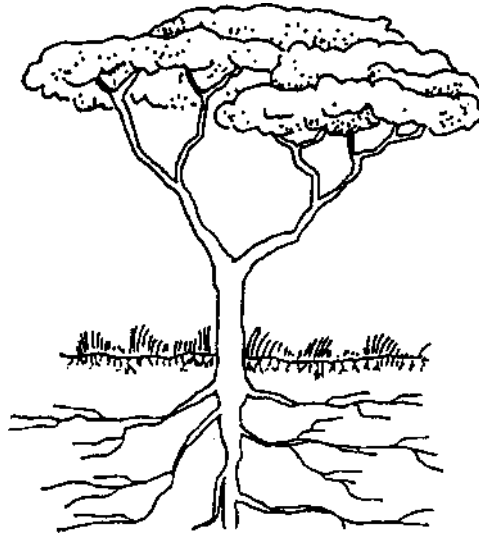


Figure 2.2 Spatial distribution of the roots of trees and crops in the soil

Nutrient uptake

Tree roots normally penetrate deeper into the soil than the roots of crops. It has, therefore, been assumed that trees are more efficient than crops in taking up nutrients released by weathering deep in the soil. Potassium, phosphorus and micronutrients are essential for plant growth and these elements are often released through such weathering. The nutrient uptake from deep layers of the soil, sometimes called nutrient pumping, has still not been experimentally verified.

Nutrients from the atmosphere

The presence of a tree reduces wind speed and creates good conditions for the deposition of dust. Nutrients in the atmosphere are conveyed to the soil when they are dissolved in rain or settle with dust. Rain water dripping from leaves and flowing along the branches carries the nutrients to the ground, together with those released from the tree itself and associated plants growing on it. It is known that the amounts of nutrients reaching the ground in this way are substantial.

Protection from erosion

Soil erosion can be controlled by checking the flow of water down a slope with runoff barriers—the barrier approach—or through maintaining a cover of living plants and litter

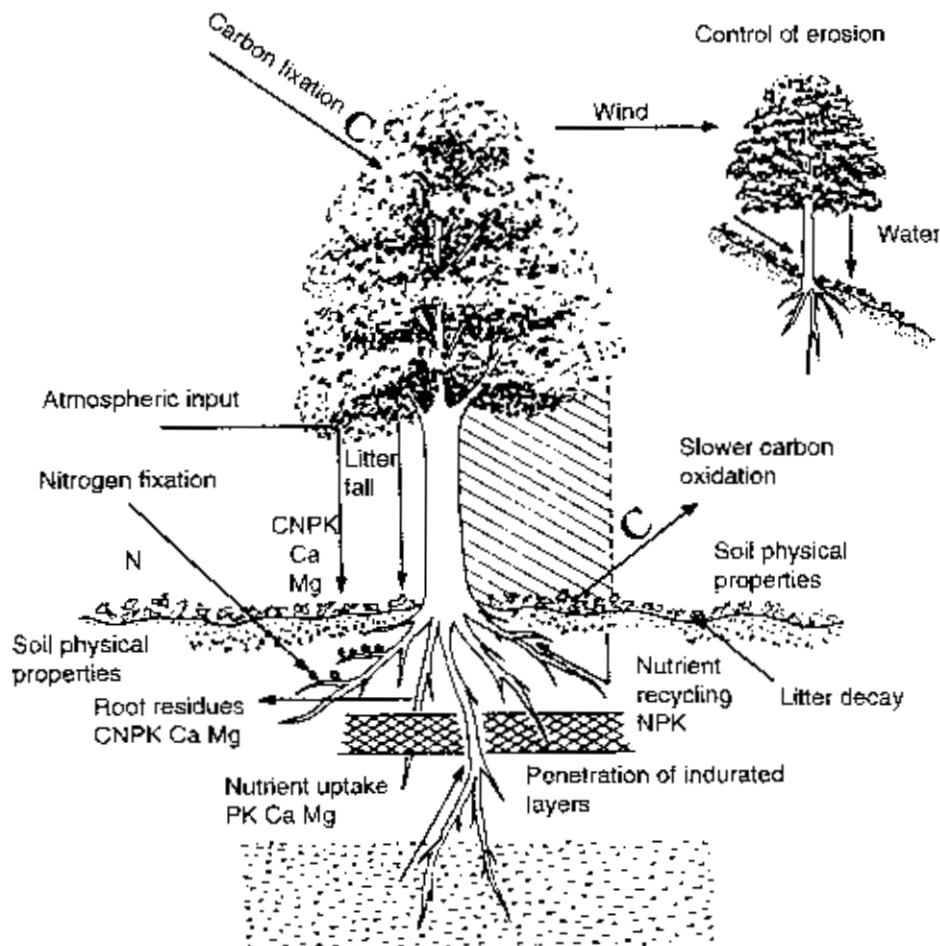


Figure 2.3 Processes by which trees maintain or improve soil

on the ground—the cover approach. A cover of mulch or litter on the soil reduces the impact of rain drops and provides dispersed micro-barriers to runoff (Young 1989). Soil erosion involves loss of topsoil, including loss of both organic matter and nutrients. Trees play an important role in erosion control, both through the barrier and cover effects. Formerly the barrier effect was thought to be the most important, but in recent years the cover effect has received increasing attention.

In the barrier approach, trees and shrubs play a direct role in reducing erosion if they are grown in rows on contours. Another effective control method is to combine trees and grass in strips along contours. Combining trees and grass is a means of making optimal use of the strips of land which are taken out of direct crop production. If productive use is made of the strips, the soil-conservation measures are more likely to be regarded as beneficial by the farmer and therefore to be adopted on a permanent basis.

If physical soil conservation structures are constructed, trees or shrubs that are planted on or near them can help to strengthen and stabilize the structures. Another example of the use of trees in the barrier approach is the growing of trees as a windbreak.

The benefits of trees in the cover approach have been discussed earlier in connection with litter and organic-matter maintenance.

Reduction of the rate of organic-matter decomposition by shading

Trees influence the microclimate. The shade resulting from tree canopies and litter reduces temperatures during the heat of the day and this cooling effect slows down the decomposition of organic matter.

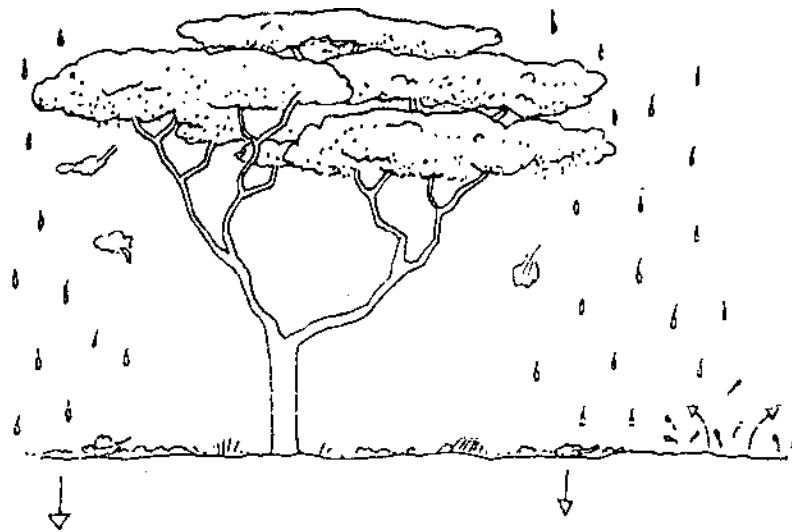


Figure 2.4 The effect of leaf mulch in reducing splash erosion and increasing infiltration

2.3 The crop component

Some of the more important crop-related factors that determine how the crop will perform with trees are:

- | Light demand
- | Demand for moisture and nutrients (or the “aggressiveness” of the crop)
- | Potential for bird damage
- | The distribution of roots in the soil profile
- | The potential for wind damage.

Characteristics of some common crops grown in Eastern Province are summarized in Table 2.1.

Table 2.1 Characteristics of some important crops in relation to agroforestry

Crop	Demand for light	Demand for moisture	Risk of bird damage	Root distribution/ nematode risk	Risk for wind damage
Maize (Chinangwa)	Moderately demanding	Demanding	No risk	Shallow	No risk
Sorghum (Mapila)	Demanding	Low demand	High risk	Shallow	Moderate risk
Finger millet (Mawele)	Demanding	Low demand	High risk	Shallow	No risk
Rice (Mupunga)	Demanding	Very demanding	Moderate risk	Shallow	No risk
Bananas (Nthochi)	Shade tolerant	Very demanding	No risk	Rather deep, nematode risk	High risk
Sweet potatoes (Kachamba)	Demanding	Low demand	No risk	Shallow	No risk
Irish potatoes (Mbwasi)	Shade tolerant	Demanding	No risk	Rather shallow, nematode risk	No risk
Tobacco (Fodya)	Demanding	Low demand	No risk	Shallow	No risk
Sugar cane (Nzimbe)	Very demanding	Very demanding	No risk	Shallow	No risk
Sunflower (Mchinga-zuwa)	Moderately demanding	Low demand	Some risk	Shallow	Some risk
Groundnuts (Nshawwa)	Demanding	Moderately demanding	No risk	Deep	No risk

2.4 The tree component

A good agroforestry species should have at least some of the following characteristics:

- | Fast growth, e.g. *Senna siamea* (Makechi N)
- | A light, open crown, e.g. *Faidherbia albida* (Musangu N) to reduce shade if grown with crops
- | Ability to coppice or respond to pollarding, e.g. *Piliostigma thonningi* (Msekese N)
- | Provide products like poles, food, fodder and medicine, e.g. *Parinari curatellifolia* (Mpundu N)
- | Nitrogen fixation, e.g. *Sesbania sesban* (Jejejele N)
- | Deep rooted, e.g. *Pterocarpus angolensis* (Mulombe N) to reduce competition if grown with crops
- | Should not harbour pests and diseases
- | Be easy to propagate and manage, e.g. *Tephrosia vogelii* (Buwa N).

In short, the tree should be compatible with crops or livestock.

A farmer is likely to appreciate a tree that gives him or her higher yields. The farmer's perceived value of the direct benefits, e.g. poles and timber, and the indirect benefits, e.g. erosion control and nitrogen fixation, should be high. Which product or service is seen as being most important may vary from one area to another and from one farmer to another according to his needs. In fact, the values attached to various products or services may often vary even within the family, e.g. the wife's preferences may sometimes be quite different from those of her husband. Thus it is desirable to involve both wife and husband in discussions on tree species.

Where land holdings are small, very competitive trees (e.g. *Eucalyptus* spp., *Acacia mearnsii*) may not be accepted by the farmers even if they are fast growing and have valuable production. Trees with a deep root system are usually less competitive with crops than those with many shallow roots. A shallow root system may be desired if the trees are intended to stabilize soil and competition with crops is less important. Examples of trees with shallow roots are *Casuarina* spp., *Cupressus lusitanica* and *Sesbania sesban*, although the latter does not compete much with crops since this species fixes its own nitrogen.

3

SOCIO-ECONOMIC ISSUES IN AGROFORESTRY

3.1 Cultural background

The major ethnic groups in Eastern Province are Ngoni, Chewa, Senga, Nsenga, Tumbuka and Kunda.

The Ngoni are predominant in Chipata, while the Chewa are found in Chadiza and Katete Districts and the Nsenga in Nyimba and Petauke. The Tumbuka and Senga live in Lundazi and Chama, respectively. Apart from the Ngoni and Tumbuka who follow patrilinear lines, the other ethnic groups have a matrilinear line of inheritance.

Traditions and customs vary between different ethnic groups, and the work of an extension worker becomes easier if he or she familiarizes him or herself with such traditions and customs.

3.2 Traditional power structure and local governance

In Eastern Province, the local communities fall under the authority of the traditional leaders such as the Chiefs, Indunas, Headmen and household heads (in the case of married couples).

At household level, the man is the decision maker in a house and his views must be respected by his wife/wives.

The traditional leader's role in a society is to maintain law and order in the manner that is socially and culturally accepted by everyone in that society. Apart from the maintenance of law and order in their communities the Chiefs in Zambia are the custodians of traditional land and have the responsibility of land distribution in their areas of jurisdiction.

Thus local leaders play a major role in enhancing development in their areas. Chiefs and Headmen take initiatives in organizing their people and also mobilizing resources

for active participation of local communities in development. This is a positive aspect of the local leadership. Even if there may occasionally be negative aspects of local leadership, avoiding or ignoring the leaders altogether can prove to be detrimental to any extension or community development work. Chiefs and Headmen have extensive powers over their subjects and over land, and thus it is of vital importance to recognize their authority and work with them and through them to achieve results.

3.3 Tenure issues in relation to agroforestry

Land tenure refers to the possession or holding of the many rights associated with each parcel of land. Ownership or user rights are not static because such rights can be subdivided or transferred by the holder. Also the different kinds of right to a certain piece of land may not be held by the same person.

An example of such a situation is a field or a plot that is privately owned when a crop is growing on it but after the harvest animals from different villages, or those belonging to different people in the same village, may be allowed to graze through the same field. In such cases, communal grazing may be regarded as a right that the neighbours have to the land in spite of formal individual ownership. In such a situation, planting or protecting trees in a farmer's field would require a change of tenure, i.e. the practice of uncontrolled grazing after the harvest would have to be discontinued if trees are to survive and grow. Therefore, such an initiative would have to involve the whole village or community reaching an agreement on where and how animals should be herded, and such agreement may be difficult to achieve.

Communal tenure also often involves restrictions on land use, e.g. cutting of trees, which are recognized and observed by all members of the community.

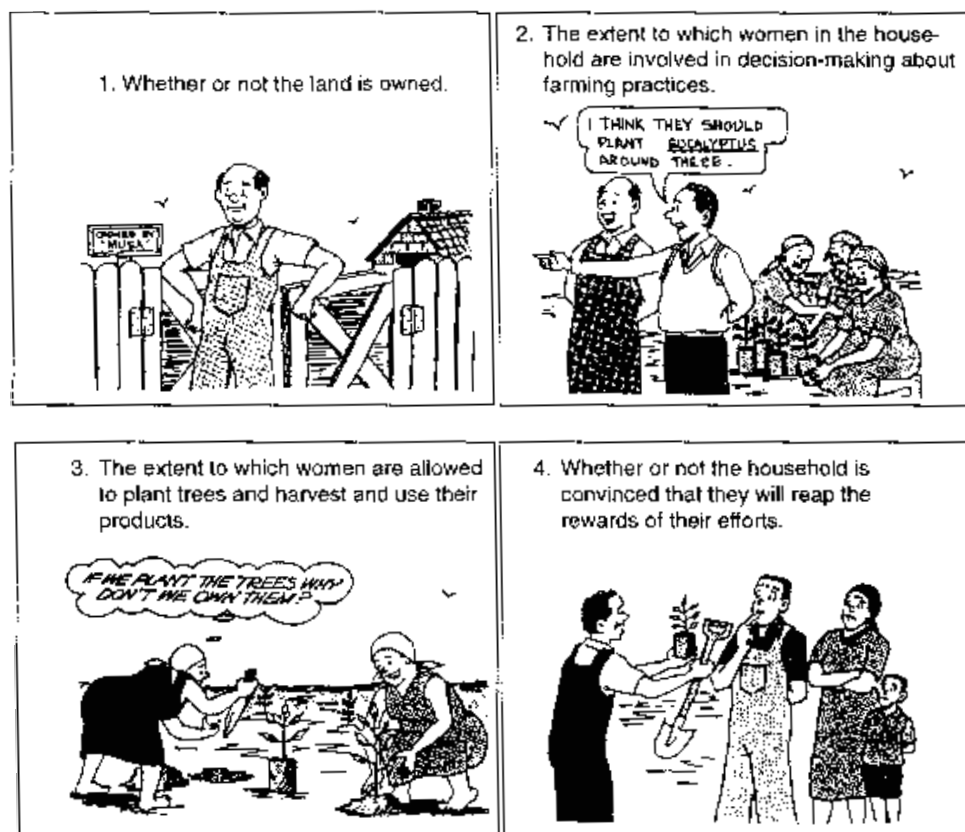


Figure 3.1 Land- and tree-tenure issues

3.4 Gender

In different societies there are differences between men and women with regard to their responsibilities, user rights, legal status, division of labour, decision-making powers, and so on.

Much research is being focused on the role of women in agriculture and resource management. Studies on the role of women have revealed that women in Eastern Province (and Zambia as a whole) do a large share of farm work in addition to all the other duties that are traditionally their responsibility. In fact, on a national average women spend more than three times as much time in the fields as do men. This division of labour implies any effective agroforestry intervention must be such that it reduces rather than increases the workload of women.

Some of the gender-related issues to be taken into account in agroforestry extension programmes are:

- | The different roles played by men and women in agricultural production and how these are recognized, valued and rewarded
- | The different needs of men and women and how they are catered for in the extension programme
- | The extent to which men and women become involved at different levels in the extension programmes.

Gender analysis is an essential tool in planning and implementing agroforestry extension programmes for a number of reasons:

- | The relationship between men and women is part of the social organization of the community and therefore dynamic rather than static
- | Universally, women are less privileged than men in the same social group
- | Focusing on one sex only, e.g. the women, ignores the fact that both men and women interact and are interdependent.



Figure 3.2 A woman carrying firewood home

Gender-related constraints that affect women in most communities are:

- | Limited access to formal education
- | Limitations caused by socio-cultural taboos

- | Limited access to land
- | Women seldom have control over the benefits derived from development programmes
- | Unfavourable credit facilities
- | Most work done by women is unrecognized, unappreciated and undervalued
- | Absence of appropriate technology
- | Women have a heavy workload.

As a general conclusion, it is important to get the whole family involved in discussion on agroforestry. All family members have ideas and knowledge to contribute and their individual needs and priorities should be taken into account. Planning and implementing agroforestry extension programmes can be treated as opportunities for involving both men and women and reducing any conflicts between them. The analysis should also consider the different roles, functions and workloads of women and men and how these affect the implementation of the extension programme. Particular attention should be paid to households headed by women.

4

AGROFORESTRY TECHNOLOGIES AND PRACTICES

The guidelines provided in this chapter should not be treated as inflexible rules, but rather as a basis for consultations with farmers. Farm conditions and farmers' priorities vary from place to place and therefore flexibility is a must. Thus, farmers need to be active partners in adapting and evaluating new technologies, and their technical knowledge should be valued. Still, much remains to be learnt about the interaction between trees, crops and livestock in existing and new agroforestry technologies under different conditions.

4.1 Trees in homesteads and around institutions

Trees can be planted around the homestead for shade, beauty, as a windbreak, and for medicine, fruits, timber, poles, fuelwood and fodder. Trees can also improve the micro-climate of the area around homes.

There are advantages and disadvantages to planting trees in homesteads and around institutions. The major advantage is that it is easy to look after trees and the products (e.g. fruits) are easily accessible to the user.

There are, however, several disadvantages too. The trees need protection not only from livestock but also from children and sometimes even adults. Sometimes trees can damage buildings, e.g. by branches or a whole tree falling during rain storms, or roots of trees like *Ficus* spp. growing into and cracking walls and foundations. Trees can also cause too much shade and dampness and can attract insects and snakes.

Criteria for selection of species

Trees that would be suitable for planting in homesteads and around institutions should:

- Provide valuable products or services (shade, fruit, beauty, etc.)
- Not shed too much litter
- Be deep rooted
- Be resistant to wind damage.

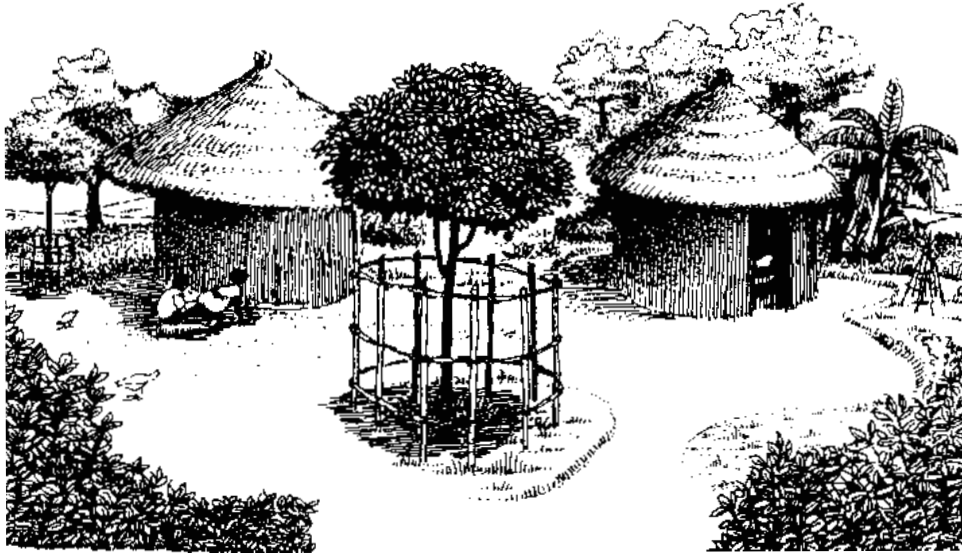


Figure 4.1 A fenced fruit tree in a homestead

Recommended species

Suitable trees for shade

- *Ficus brachylepis* (Kachele N)
- *Ficus sycomorus* (Mkuyu, Mukuyu N)
- *Khaya nyasica* (Mubawa, Mlulu N)
- *Mangifera indica* (Manga N)
- *Senna siamea* (Makeche N)
- *Senna spectabilis* (Golden cassia E)
- *Tamarindus indica* (Bwemba N)
- *Trichilia emetica* (Msikizi N)

Fruit trees

- *Mangifera indica* (Manga N)
- *Citrus* spp. (Lalanje, Ndimu N)
- *Morus nigra* (Malubeni N)
- *Prunus americana* (Avocado E)
- *Anacardium occidentale* (Kashunati N, Cashew nut E)

Ornamental trees

- *Delonix regia* (Flamboyant E)
- *Jacaranda mimosifolia* (Jacaranda E)
- *Senna siamea* (Makeche N)
- *Senna spectabilis* (Golden Cassia E).

Establishment

By cutting, direct seeding and seedlings. Fruit trees must be spaced according to the recommendations for that species (in the Fact Sheets in Part II of this book). Ensure that the trees are planted at least 5 m away from houses. (For further details, see Chapter 8 on planting, tending and management of trees in the field.)

Management

Trees around homesteads need to be protected against livestock. They can be pollarded, pruned, fertilized and watered to improve the performance and growth. Simple water-management techniques such as basins, bunds or half-moon-shaped depressions are useful during dry seasons. However, the best type of management to be used depends largely on the species and the purpose of planting.

4.2 Trees on boundaries and as windbreaks

Trees and shrubs can be planted along boundaries of fields and structures for demarcation purposes. Traditionally, field boundaries were planted with trees for permanent demarcation. Trees can also be planted along roadsides for beautification and to provide shade for pedestrians.

Windbreaks are lines of trees or shrubs planted for the purpose of protecting crop fields, institutions, houses, etc., from wind damage. In Eastern Province planting around field boundaries and on soil-conservation structures should, in most cases, offer sufficient wind protection since the area does not experience strong winds.

Benefits of boundary planting

- Production of fuelwood, poles, fruits, fodder and timber.
- Marking of field or farm boundaries.
- Protection of crops and soil against wind (yields are known to increase when windbreaks are established in areas with strong winds).

Criteria for selection of species

Trees that would be suitable for windbreaks should be:

- Easy to establish
- Easy to manage
- Not harbour pests and diseases
- Deep rooted
- Resistant to wind
- Provide minimum competition for light, water and nutrients to adjacent crops
- Not spread on their own.

Recommended species

Suitable species for boundary planting:

- *Azadirachta indica* (Neem E)
- *Casuarina* spp. (Whistling pine E)
- *Eucalyptus camaldulensis* (Bulugamu N; Red river gum E)
- *Eucalyptus tereticornis* (Bulugamu N; Forest red gum E)
- *Senna siamea* (Makeche E)
- *Senna spectabilis* (Golden cassia E)
- *Tamarindus indica* (Bwemba N; Tamarind E).

Establishment

Trees on boundaries

The main method of establishment is by seedlings. Seedlings of the desired species are first raised in the nursery and planted out at the beginning of the rainy season when they are 25–30 cm high. However, direct seeding and cuttings may also be used depending on species. (See species Fact Sheets for further details.)

The spacing for smaller and medium sized fruit trees is normally 3 m. Other multi-purpose tree species can be spaced between 2 and 4 m depending on species.

Windbreaks

The main method of establishing windbreaks is by seedlings. Planting a single line of trees is sufficient to mark a boundary and to serve as a windbreak. A windbreak should be established at a right angle to the prevailing wind direction. The spacing between trees is normally 2 m, but this may vary with species.

The efficacy of a windbreak can be improved by planting tall trees in the first line and shorter trees in a parallel line. If the boundary separates two fields, the first line of trees should be placed one or two metres inside the boundary. If both farmers are interested, each can plant a line of trees inside their boundary.

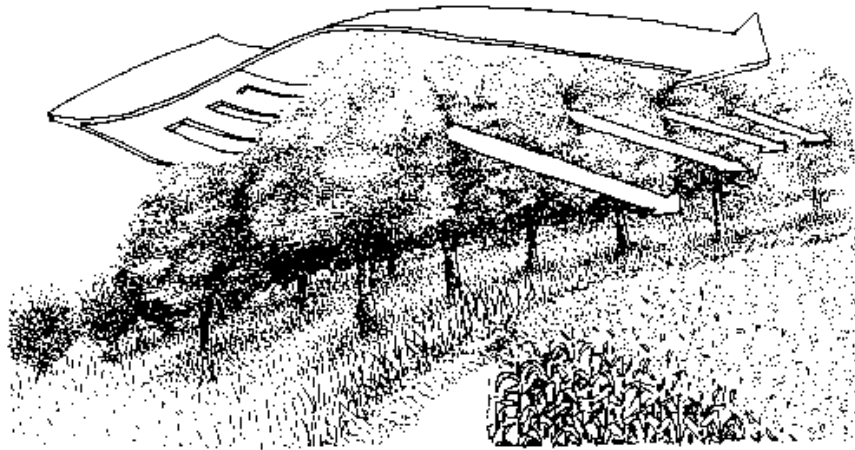
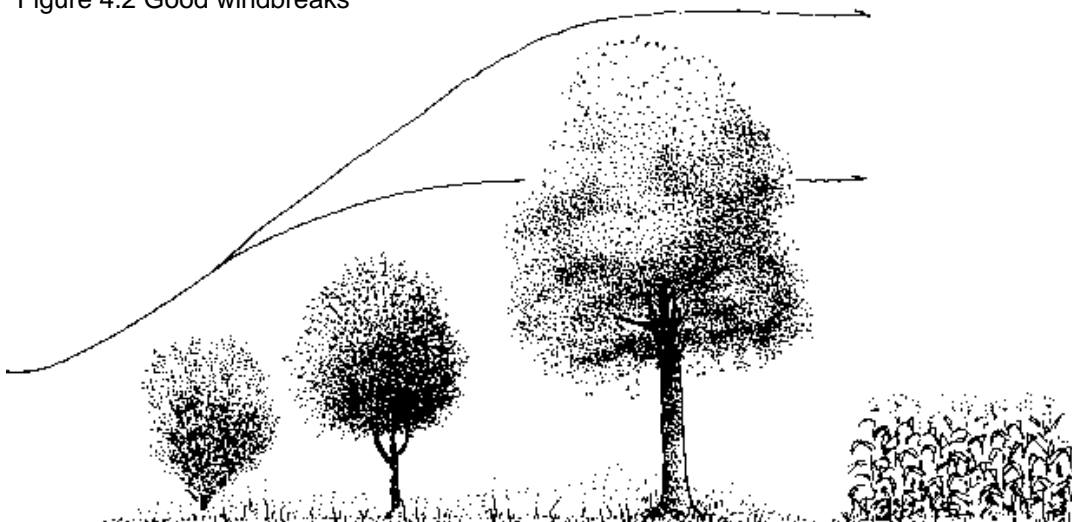


Figure 4.2 Good windbreaks



Management

Trees on boundaries

Protect young trees against livestock and fires. Tend the trees by pruning and pollarding to reduce shade on the adjacent crops. The prunings and pollarded branches can be used as construction materials or firewood.

Windbreaks

Protect young trees against livestock and fires. Termite control is necessary for trees such as eucalyptus which are susceptible to termite attack. Mature trees can be selectively pruned or pollarded to reduce the shading effect on the adjacent agricultural crops.

4.3 Natural shelterbelts

Natural shelterbelts are strips of trees which are left when establishing new fields. The main functions of natural shelterbelts are to protect fields from runoff and wind damage. They also provide tree products like fuelwood, timber, fruits and medicine. In Eastern Province natural shelterbelts are mainly found in settlement schemes.

Establishment

Natural shelterbelts should be aligned across the slope for them to be effective in soil conservation. The width of a shelterbelt can range from 30 to 50 m and the length will depend on the area of the piece of land under cultivation. Spacing between shelterbelts can be 50 m or more depending on conditions.

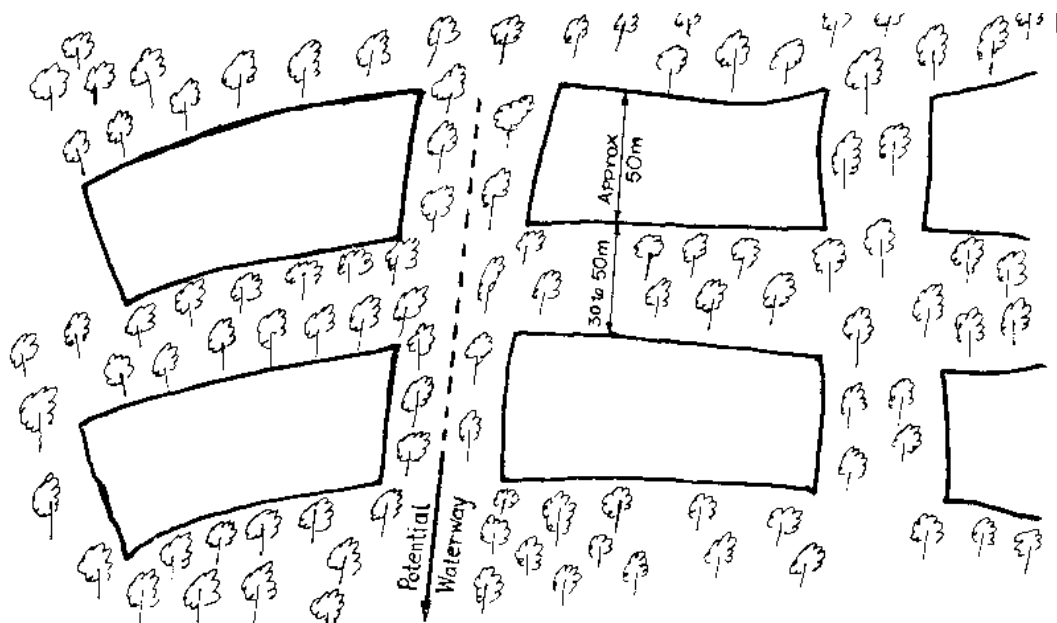


Figure 4.3 Natural shelterbelts

Management

Natural shelterbelts require sound silvicultural management practices to sustain their productivity. Fires have generally been one of the biggest problems in management of forests in Eastern Province. Early burning of shelterbelts from May to June is recommended. Controlled grazing should be practised in order to avoid overgrazing.

Trees can be pollarded or coppiced. This will ensure sustainable use of forest products. Natural regeneration should be well protected.

The following species tolerate pollarding: *Albizia* spp., *Balanites aegyptiaca*, *Bauhinia* spp., *Bridelia micrantha*, *Commiphora* spp., *Cordia* spp., *Ficus* spp., *Piliostigma thonningii*, *Syzygium* spp. and *Terminalia* spp.

4.4 Woodlots

Woodlots are plots of planted or naturally growing trees. They provide multiple products and services such as timber, poles, fuelwood, medicine, soil-erosion control and shelter. Poles, fuelwood and timber may be used by the farmer or sold to supplement cash income for the household or community.

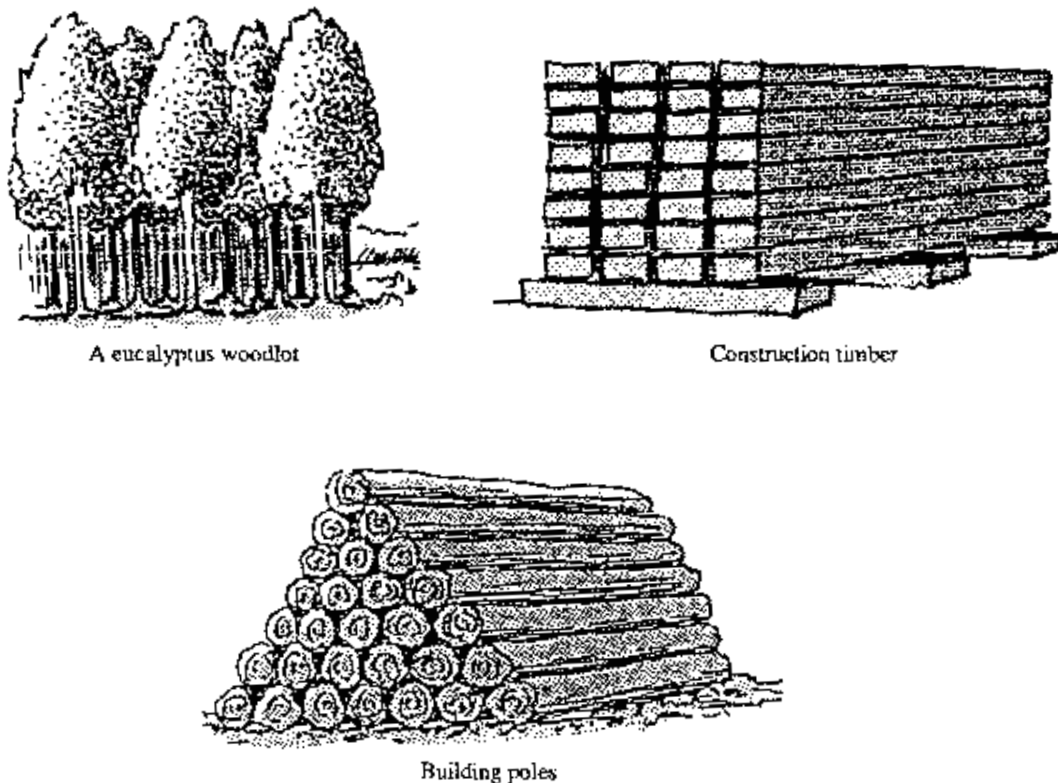


Figure 4.4 A woodlot and some of its products

Siting of woodlots

A woodlot should be sited where it can be easily protected from livestock and fires and this is easier if it is sited close to a village. It may also serve as a demonstration plot.

Like crops, most trees grow better on fertile, deep soils. Most farmers will give priority to the crops and choose to plant trees on poorer soils. Thus, if the farmer expects the trees to grow fast on such soils, fertilizer or manure may have to be used. Shallow soils where termites are common should be avoided.

Recommended species

- *Eucalyptus camaldulensis* (Bulugamu N; Red river gum E)
- *Eucalyptus tereticornis* (Bulugamu N; Forest red gum E)
- *Gmelina arborea* (Malaina N)
- *Khaya nyasica* (Mubawa, Mlulu N)
- *Melia azedarach* (Bead tree E)
- *Pinus kesiya* (Pine E)
- *Pinus oocarpa* (Pine E)
- *Senna siamea* (Makeche N)
- *Tamarindus indica* (Bwemba N).

Establishment

The spacing of trees in woodlots varies depending on the management objective and the tree species. The common spacing for most woodlots is 2 m x 2 m which is later thinned to allow bigger diameter trees for production of timber. Other spacings such as 3 m x 3 m, or even 4 m x 4 m, may also be used and the trees may be intercropped with low crops, e.g. beans or groundnuts, in the first few years. Where land is scarce and small-diameter wood is needed, planting at a dense spacing, e.g. 1 m x 1 m, is also feasible.

Woodlots can also easily be established if indigenous trees are simply allowed to regenerate.

Management

- Weed around young trees and shrubs to reduce competition for moisture, light and nutrients.
- Protect the young seedlings against livestock, termites and fires.
- Apply manure or fertilizer to trees and shrubs which show signs of nutrient deficiency, e.g. die-back on eucalyptus, yellowing of leaves and poor growth.
- Mature trees could be pruned, thinned and later coppiced depending on the species.

Management options for woodlots of indigenous trees are similar to management of woodlands (see section 4.11).

4.5 Fodder banks

Fodder banks are plots of fast-growing and high-yielding trees, grasses and shrubs managed for fodder production. The animals are given supplements of protein-rich feedstuffs during the dry season when other good-quality fodder is scarce. The fodder may be cut, carried and fed to livestock in their enclosure (kraal). The kraal manure can be applied to crops, and the amount of manure increases with good feeding of the animals. Alternatively, livestock can be allowed to graze on the fodder bank, although not all fodder species tolerate this well.

Criteria for selection of fodder species

Trees that would be suitable for fodder should be:

- Palatable to livestock and rich in protein
- Easy to manage
- Drought tolerant

- Tolerant of trampling if to be grazed
- Able to resprout easily.

Recommended species

Leaves

- *Leucaena leucocephala* (in recent years, attack by the leucaena psyllid has reduced production in some areas)
- *Cajanus cajan*
- *Pennisetum purpureum* (Napier grass E)
- *Panicum maximum* (Kanjala, Ntende N)
- Siratro, *Desmodium* and other fodder legumes
- *Leucaena diversifolia* (research still being carried out).

Pods

- *Acacia tortilis* (Mzungu, Nyoswa N)
- *Faidherbia albida* (Msangu N)
- *Dicrostachys cinerea* (Kalumphangala N)

Pods and young leaves

- *Piliostigma thonningii* (Msekese N)
- *Acacia polyacantha* (Ngowe N).

Establishment

Direct seeding, cuttings or seedlings depending on species. Shrubs may be planted in pure stands or intercropped with grasses.

In pure stands, plant shrubs at 1 m x 1 m. When shrubs are mixed with grasses, space the shrubs 1 m apart in 4-m-wide alleys with three rows of Napier grass in between the shrub rows. A spacing of 45 cm between the Napier cuttings is suitable. Fencing is usually required for good establishment.

Management

- Weed around the plants.
- Protect the plants against livestock and fires during establishment.
- Cut back when the plants (hedges) attain a height of more than 1 m.
- Cut back *Leucaena* and *Gliricidia* to 30 cm with a slanting cut.
- Cut back at least three times a year for optimum quantity and quality, e.g. December, February and early June.

4.6 Improved fallows

An improved fallow is a piece of land planted with, preferably fast-growing, nitrogen-fixing species of trees/shrubs for the purpose of enhancing soil fertility.

Benefits

- Protect the soil from erosion.
- Reduction of nuisance weeds (e.g. *Striga asiatica*).
- Increase the nutrient and organic-matter content of the soil thereby improving its fertility and structure, including aeration, water-holding capacity and tilth.
- Production of fuelwood.

In Eastern Province, interest in this technology is very high because of the high cost of fertilizers and the promising results that have been obtained in on-station and on-farm trials. Maize yields have been reported to have increased from about 0.15 tonnes per ha to 4.0 t per ha after only two years of *Sesbania sesban* improved fallows on farms with depleted soils (Kwesiga *et al.* 1995). After three years of *Sesbania sesban* fallow, there is a potential to produce maize yields of up to 6 tonnes per ha, but such long fallow periods have been found to be less profitable than shorter ones.

The technology may, however, not be applicable to farmers with very small land-holdings since it requires land to be taken out of crop production for fallowing.

Recommended species

Fast-growing nitrogen-fixing species recommended for improved fallows are:

- *Sesbania sesban* (Msalasese, chigoma, jelejele N)
- *Sesbania macrantha* (Chizonga N)
- *Tephrosia vogelii* (Ububa N)
- *Cajanus cajan* (Pigeon pea E, Nyamundolo N)
- *Crotalaria* spp. (Sunhemp E, Kalongonda, Sanyembe N).

Establishment

Plant short-lived shrubs such as *Sesbania sesban* at 1 m x 1 m or 90 cm x 90 cm. Use of seedlings is expensive, however, since many are required, and direct sowing of *Sesbania* can also be tried. *Sesbania macrantha* normally nodulates well even without inoculation and is thus more suitable for direct sowing than *S. sesban*. Improved fallows can be sown with a mix of species to obtain more benefits, e.g. *S. sesban* with *Cajanus cajan*.

Management

Weed during establishment to improve growth of the shrubs and protect the shrubs against livestock and fires. Cut short-lived shrubs after 2–3 years and thereafter let the crops grow. A limiting factor for use of *Sesbania sesban* in improved fallows is its susceptibility to pests, e.g. root-knot nematodes, beetles (*Mesoplatys ochroptera*) and termites.

4.7 Live fences and hedges

These are barriers of closely spaced trees or shrubs to protect crops or structures against livestock and human interference. Live fences may be semi-permanent or permanent. Land-use patterns throughout the year should be considered before introducing a live fence. Live fences can be combined with other trees for production of wood and fruits.

Benefits

Fencing of fields, dimba (gardens), fodder banks, woodlots, paddocks and around home-steads makes improved management practices possible. With a fenced field, the farmer can improve his management of crop residues, pastures, trees, fallows, etc., by regulating access of livestock and people. Fencing and controlled grazing are the only ways that he and his cattle can benefit from such improved farming practices.

The use of live fences is a cheap method of fencing large areas because once the live fences become established they are permanent. Their establishment requires no expensive materials to be purchased and they are easy to maintain. Living fences may also give produce, e.g. fruits.

Criteria for selection of species

The species which are to be used for live fencing should be:

- Able to keep off livestock (thorny and /or densely branched)
- Easy to establish and maintain
- Able to withstand temporary waterlogging when planted in dimba
- Resistant to fire
- Able to provide useful by-products.

Recommended species

The following species are suitable for live fencing. Some of them are already being used by farmers for fencing their gardens and homesteads:

- *Agave sisalana* (Khonje, Gavi N)
- *Bougainvillea* sp.
- *Caesalpinia decapetala* (Chatata N)
- *Commiphora africana* (Chitonto, Mchovwe N)
- *Commiphora mollis* (Chololo, Chitonto N)
- *Cupressus lusitanica* (Cypress E)
- *Dovyalis caffra* (Kei apple E)
- *Euphorbia tirucalli* (Nkhadzi N)
- *Opuntia* spp. (Dorofiya N; Prickly pear E)
- *Ricinus communis* (Nsatsi, Tsatsi, Mono N)
- *Thevetia peruviana* (Yellow oleander E)
- *Ziziphus abyssinica* (Kankande, Mlashawantu N)
- *Ziziphus mauritiana* (Masau, Msau N)
- *Acacia polyacantha* (Ngowe N)
- *Lannea discolor* (Shaumbu N)
- *Solanum aculeastrum* (Katuntula, Ntuntula N).

There are other potential live fencing species which can be tested, for example:

- *Balanites aegyptiaca* (Nkuyu N)
- *Jatropha curcas* (Nyamukumanga, Chivumulu N)
- *Ricinodendron rautanenii* (Mkusu N)
- *Thyrsacantha* spp.

Establishment

The establishment method for live fencing must be simple and cheap. Direct seed sowing or use of cuttings (depending on the species) is primarily recommended, e.g. direct sowing of *Caesalpinia decapetala* (Chatata N) and use of cuttings for *Euphorbia tirucalli* (Nkhadze N). When direct seeding, sow more than one seed per station, the number depending on seed viability. The sowing depth should not be more than twice the diameter of the seed.

It is better to raise seedlings in nurseries for *Dovyalis caffra* and cypress since they have small seeds and are relatively slow in growth in the initial stage.

In dimba and other waterlogged areas seedlings or cuttings should be planted on ridges.

It is better to sow seeds and plant seedlings or cuttings in two staggered rows to make the fence or hedge impenetrable. The distance between the rows should be 15–30 cm. Spacing within the row varies between 15 and 50 cm depending on the species.

Management

- Protect the young seedlings against livestock and fires.
- Weed young seedlings.
- Replant (gap) the dead seedlings as quickly as possible to minimize gaps in the fence.
- Trim or prune to make a dense fence. Most species, e.g. Kei apple, make a better fence if trimmed to a pyramidal shape so that even the lowest branches can get some light.
- Apply manure/fertilizer if seedlings do not grow well or show other signs of nutrient deficiency.

4.8 Trees, shrubs and grasses on conservation structures

Trees, shrubs and grasses can be planted as biological soil conservation measures. Since trees alone can only be effective on slopes less than about 6%, it is important to combine trees with grasses for effective soil-erosion control, especially on steeper slopes. These trees, shrubs and grasses can be planted along or on marker ridges, level bunds, graded bunds, storm drains and buffer strips.

Benefits of trees on conservation structures

The main benefits are:

- Stabilization and preservation of soil-conservation structures
- Marking of the contour lines
- In the case of shrubs, acting as barriers to water run-off
- Provision of ground cover and fertility improvement through litter fall
- Provision of poles, fuelwood, timber, fruit and/or fodder.

Recommended species

- *Cajanus cajan* (Nyamundolo N; Pigeon peas E)
- *Carica papaya* (Papayi N; Pawpaw E)
- *Faidherbia albida* (Msangu N)
- *Leucaena leucocephala* (Lusina, Lukina N)
- *Psidium guajava* (Gwawa N; Guava E)
- *Senna siamea* (Makeche N)
- *Senna spectabilis* (Golden Cassia E).

Establishment

A single line of trees/shrubs should be planted along the pegged (marked) contour line or on existing physical structure.

Trees/shrubs may be established by direct seeding, cuttings or seedlings. The latter method is the commonest in Eastern Province.

Some of the recommended species and spacings for planting on soil conservation structures are listed in Table 4.1.

Table 4.1 Species and recommended spacing for planting on soil-conservation structures

Botanical name	Local name	Spacing	Comments
<i>Faidherbia albida</i>	Msangu	10–12 m	Can be combined with grasses, e.g. Vetiver grass at 15 cm apart between the trees
<i>Cajanus cajan</i>	Nyamundolo	50–90 cm	For barrier hedges. For food production, space widely
<i>Carica papaya</i>	Papayi	3 m 2 m	Combined with grass Without grasses
<i>Senna siamea</i>	Makeche	50 cm 2 m	For barrier hedges For production of poles/firewood
<i>Senna spectabilis</i>	Makeche	50 cm 2 m	For barrier hedges For production of poles/firewood
<i>Leucaena leucocephala</i>	Lukina	30–50 cm	For hedges
<i>Pennisetum purpureum</i>	Senjele (Napier grass)	20–25 cm	Can be cut and fed to livestock
<i>Psidium guajava</i>	Gwawa	4 m	For fruit production. Wider spacing when combined with grasses (6–8 m)
<i>Vetiveria zizanioides</i>	Kaluvela, Vuluvela	15 cm	Forms a good hedge for control of soil erosion
<i>Mangifera indica</i>	Manga	4–6 m	Dwarf variety can be closely spaced. Giant variety 10–12 m
<i>Anacardium occidentale</i>	Kashunati	4 m	Dwarf variety can be closely spaced. Giant variety 10–12 m

Management

The main management practices are side pruning, pollarding and coppicing. These practices aim at reducing the shading effect on crops as well as harvesting of tree products. The prunings from nitrogen-fixing trees may be incorporated into the soil for soil improvement or used as fodder. Others may be used as fuelwood or poles and timber. Shrubs can be pruned as hedges when they are more than 1 m high.

4.9 Trees in cropland

Some farmers in Eastern Province retain and sometimes plant trees in their cultivated fields for a variety of reasons, e.g. production of fruits, fuelwood or medicine, or other functions such as soil improvement, shade and various cultural uses. *Faidherbia albida* is suitable for intercropping with food crops and can grow to a large size.

Unlike other trees, it has leaves in the dry season and drops them gradually in the rainy season. Thus, there is limited shading of the crops during the rainy season, and it provides both fodder and shade for livestock in the dry season.

The leaves which fall at the start of the rainy season are a rich source of nutrients that improve soils and crops. Cattle also benefit from the pods which ripen and drop in October (up to 150 kg per tree). Cattle eat the fruit, enjoy the shade and drop their manure under the tree, which helps to add nutrients and humus to the soil. Because of the nutrients supplied by the leaves and the cattle manure, it has been reported that crops grown adjacent to these trees can give up to 60% increase in yields as compared with crops grown further away from the tree.

Benefits of trees in cropland

The benefits that may be obtained by having trees in the fields are:

- Improved soil fertility by converting atmospheric nitrogen to a form usable by plants and the decomposition of leaves and other residues to organic matter
- Reduction of soil erosion because leaf litter acts as mulch, conserves soil moisture, improves water infiltration and suppresses weeds
- Provision of fodder for livestock
- Provision of poles and timber
- Provision of fuelwood and medicine
- Improvement of the microclimate on cropped land.

Recommended species

Some of the common species found on cropped lands are:

Plateau area

- *Azela quanzensis* (Mpapa N) Timber
- *Pericopsis angolensis* (Muwanga N) Improves soil fertility, timber
- *Dicrostachys cinerea* (Kalumpangala N) Fodder
- *Diospyros mespiliformis* (Mchenja N) Timber, fruit
- *Mangifera indica* (Manga N) Fruit, shade
- *Piliostigma thonningii* (Msekese N) Improves soil fertility, fodder
- *Flacourtia indica* (Ntudza N) Fruit
- *Parinari curatellifolia* (Mpundu N) Fruit
- *Parkia filicoidea* (Mpeza, msenya N) Fruit
- *Pterocarpus angolensis* (Mlombe, mlombwa N) Soil fertility, timber
- *Strychnos cocculoides* (Mzai N) Fruit
- *Uapaca kirkiana* (Msuku N) Fruit
- *Ximenia americana* (Ntengele, matundulukwa N) Fruit.

Valley area

- *Acacia polyacantha* (Ngowe N) Improves soil fertility, fodder
- *Adansonia digitata* (Mlambe, mkulukumba N) Fruit, traditional value
- *Borassum aethiopum* (Chipamba, kakoma N) Fruit, fibre products
- *Faidherbia albida* (Msangu N) Improves soil fertility, fodder
- *Mangifera indica* (Manga N) Fruit, shade, shelter at night
- *Ziziphus mauritiana* (Masau N) Fruit, beer making
- *Sclerocarya birrea* (Mgamu, msewe N) Fruit, medicine.

Establishment

Trees can be established in cropland by direct seeding, wildings, seedlings and cutting, depending on the species. However, the most convenient method is to leave desirable trees when clearing land for agriculture, or if they are too few, to protect naturally growing seedlings, suckers or coppice shoots.

Spacing is determined by the size of the trees when they are mature in order to fit them into cropland with minimum negative interference with crop cultivation and production. Preferably, trees growing in cropland should be beneficial to crop growth.

Spacing

The trees may be scattered or spaced systematically. In the maize–sorghum-based crop-

ping system in the Valley, the tree density ranges from 2 to 40 trees per hectare for *Faidherbia albida*. For *Borassus aethiopum* some 10 palms per hectare are common.

Young seedlings should be established at the following spacings:

- 10 x 10 m or 12 x 12 m for *Faidherbia albida* and other species with a large tree canopy.
- 6 x 10 m or 6 x 12 m for other species with small canopies like *Parkia filicoidea* and *Uapaca kirkiana*.

On sloping ground, the tree lines should follow the contour so that crop ridges are aligned along the tree lines and thus on the contour.

Tall crops like maize should be planted at least 1 m away from the seedlings to reduce competition while the trees are young and to reduce damage during harvesting. When trees with dense shade, like mango for example, mature they will compete with light-demanding crops, and it is better not to plant crops under these tree canopies.

Management

Tree management will depend on the tree and crop species cultivated, but generally there is need to protect the young seedlings from livestock and fires, especially during dry seasons.

Trees intercropped with light-demanding crops like maize should be pollarded or pruned. Trees for timber and poles should be coppiced, e.g. *Pterocarpus angolensis*.

4.10 Beekeeping (apiculture)

Beekeeping is the art of keeping bees for production of honey and beeswax. Bees feed on nectar in flowers and since they carry pollen on their hairy legs when collecting nectar they pollinate crops like sunflower, mangoes, legumes, pawpaws and avocados. Good pollination increases crop yields of many crops. It has been reported that four well-managed beehives per hectare in a field of sunflower increase the yield of sunflower seeds by 15–20% (Paulick 1989).

The obvious advantage of beekeeping is that it does not require a big piece of valuable land and the labour requirement is low as bees do not need daily attention in order to produce well. Honey produced by bees is good food, good medicine and can also be sold.

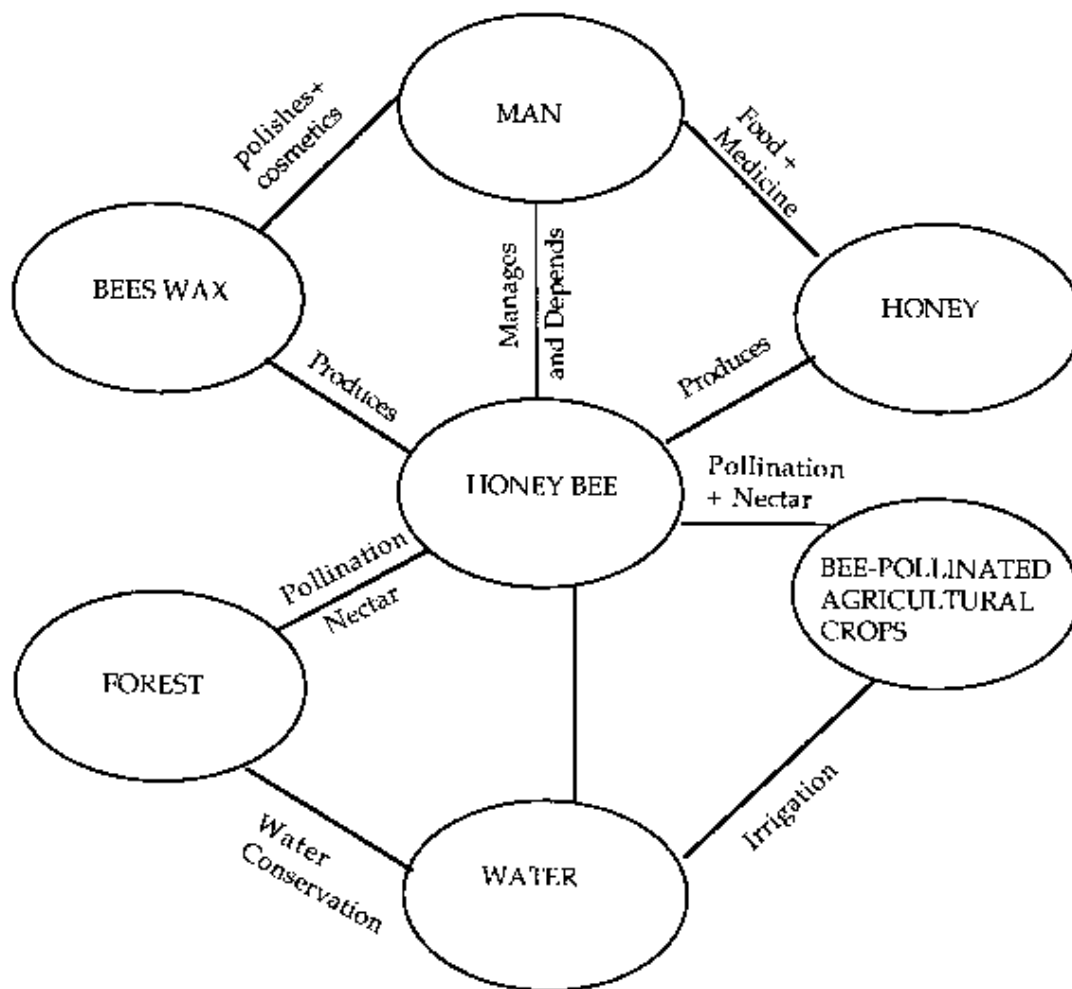
Bees play an important role in the ecosystem as illustrated in the diagram on the next page.

Benefits of beekeeping

- Provision of valuable food.
- Provision of income to the farmer.
- Improvement of crop yields through pollination and subsequently better development of seeds and fruits.
- Provision of incentives for protection of nectar-producing trees.

Uses of beeswax

- Cosmetics (perfumes, hair creams).
- Polishes.
- Candles.



The role of bees in the ecosystem

Uses of honey

- Food, sweetener, beverages.
- Cookery.
- Preservative.
- Medicinal uses:
 - For colds and sore throats, honey in lemon juice is soothing
 - Insomnia—drink honey with hot milk.
 - Fatigue—take a dessertspoon of honey when you are tired.
 - Germicidal—for dressing burns, cuts, abscesses, boils, etc.
 - Hangovers—honey combined with lemon juice is a good cure for hangover; 2 tablespoons in as much lemon juice as you like. It also acts as a preventive measure if taken before drinking alcohol.
- Cosmetics.
- Shampoo—2 tablespoons in a litre of warm water for the final rinse is said to preserve the colour of the hair.
- Skin cleanser—honey and warm water can be used to wash the face and neck. Rinse off with warm water.

Management of bees

Modern beekeeping is based on sound management techniques which can result in higher yields than the traditional methods.

Traditional beekeeping is based on bark hives, but trees are ring-barked when making bark hives and this leads to destruction of species such as *Julbernardia paniculata* (Mtondo N) and *Brachystegia* spp. (Muombo, mputi N) which are good nectar producers. The following are some of the hive types which are not destructive to the trees: calabashes, oil drums, baskets and frame hives. Frame hives produce more honey than bark hives. The average yield of comb honey per bark hive is only 8 kg, whereas frame hives can yield up to 20 kg per season. Modern methods of beekeeping should be encouraged.

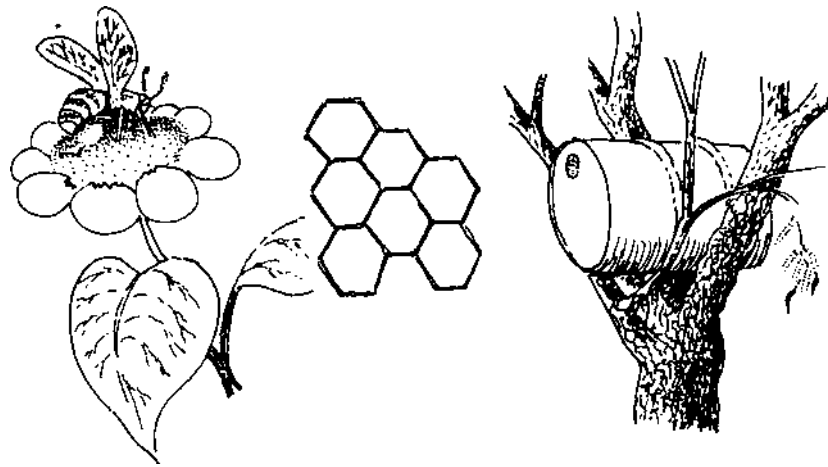


Figure 4.5 A foraging bee and a beehive made from an old oil drum

The apiary

For effective management hives should be located at a clearly designated area, with one or more hives, called an apiary. The number of hives in the apiary will depend on the capacity of the individual to handle the task.

Siting an apiary

- Should be sited within 2 km of nectar-producing plants.
- For safety reasons, the distance between the apiary and public places like markets, villages and schools should be at least 100 m and at least 50 m from homesteads.
- The site should be protected from adverse weather conditions such as excessive humidity, cold, strong winds and heat.
- Water should be available within a 500 m radius.
- Hive stands (bushes or trees) should be available for hanging the bee hives.

Baiting hives

New hives must be baited in order to attract bee swarms to occupy them. Beeswax is the most suitable baiting material. Smoke or heat the hive and hold a block of beeswax close to the flames and rub the molten surface of the block all over the inside of the hive. Heat the hive further to ensure that the wax penetrates into the hive walls.

“Bee glue” (propolis) can also be used for baiting.

Hanging the hives and occupation by swarms

Hives should be hung shortly before the swarming season. The swarming season in Zambia is between August and October and February and April. The hives should be hung above 4 metres in the forest or woodlands where you get good occupation.

Important species for honey production are listed in Table 4.2. If hives are located where these trees occur the chances of a good harvest are high.

Table 4.2 Important tree species for honey production

Botanical name	Local names
<i>Acacia</i> spp.	Ngowe, mtubetube, nyafungu
<i>Albizia antunesiana</i>	Msase, chisale
<i>Brachystegia</i> spp.	Mufundanzizi, muombo, msamba, muputi
<i>Burkea africana</i>	Kawidzi, mkoso
<i>Citrus</i> spp.	Lalanje, ndimu
<i>Eucalyptus</i> spp.	Bulungamu
<i>Julbernardia globiflora</i>	Kamponi
<i>Julbernardia paniculata</i>	Mtondo
<i>Kigelia africana</i>	Chizutu, mvungala, mvunguti
<i>Parinari curatellifolia</i>	Mpundu
<i>Syzygium cordatum</i>	Mchisu, msombo
<i>Tamarindus indica</i>	Bwemba
<i>Ziziphus mauritiana</i>	Masau

In low and sparse woodland, cultivated and fallow areas the occupancy rate will be good at any time. Cylindrical hives may be placed in the fork of a branch, or on top of large branches, and tied with bark fibre or suspended from a bark rope or wire attached to a strong forked stick which is hooked over a branch.

Table 4.3 Beekeeping calendar

Month	Floral activity	Bee activity	Beekeeper's activity
June	Few flowers	Little activity	Feed bees with sugar syrup under extreme conditions
July	<i>Parinari curatellifolia</i> <i>Syzygium cordatum</i> and <i>Uapaca kirkiana</i> start flowering	Breeding starts and builds up during the month	Start preparing new hives; supply water near occupied hives
August	<i>Brachystegia</i> spp. start flowering together with other species	Breeding continues rapidly and swarming occurs	Hang and bait new hives for occupation
September–mid-October	<i>Brachystegia</i> in full flower	Breeding slows and surplus honey stored	Protect hives against termites and honey badgers
Mid-October–November	Few trees in flower	Breeding stops and then starts again at low level	Cropping of honey and processing of beeswax
December–February	Few trees but rather more herbs in flower	Breeding still slow	Cropping continues on small scale
February–March	<i>Julbernardia</i> starts flowering	Rapid build up and swarming	Maintenance of old hives. Hang and bait new hives and re-bate old hives
March–April	<i>Julbernardia</i> in full flower	Breeding slows and honey surplus stored	Cropping can be done depending on the availability of honey in the hive
May–June	Little flowering	Little hive activity	Clean the apiary early. Inspect hive for diseases and pests. Repair and maintain beekeeping equipment

Note: For more information on beekeeping, contact the nearest Forest Officer.

Cropping

The honey should be cropped at the end of the flowering season, which varies from one area to another depending on the tree species. Generally, however, cropping takes place in October and November in *Brachystegia*-dominant forest areas and in May and June in *Julbernardia*-dominated woodlands.

Cropping should be done early in the morning or in the late afternoon when it is cool and the bees are confined to their hives. The beekeeper should prepare the following equipment for cropping traditional hives:

- A container in which to put the honey
- A piece of rope for lowering and mounting the hive
- A smoker to subdue the bees (the traditional type made of a core of dry twigs wrapped around with a layer of fresh leafy branches is sufficient)
- A cropping knife
- A brush for removing bees from the honeycomb
- Protective clothing (veils, overalls, gloves, safety boots)
- At least one helper.

After the equipment has been organized, prepare the smoke and blow a moderate amount through the flight entrance of the hive. The bees will be driven to one side of the hive. Remove the grass door and start removing honeycomb while continuing to blow in small puffs of smoke. Continue cropping until you reach the brood area. Leave enough honey for the bees themselves to feed on, otherwise they will abscond to a new home. After cropping, replace the hive door and mount the hive in its usual position.

Honey processing

Honey processing starts with grading. During this process, all impurities such as pollen, dead bees and other debris should be removed so that only sealed combs (also known as ripe honey) remain. After grading, the honey is extracted as follows:

- Break up or crush the combs and put the pieces into a container
- Put the crushed combs into a honey press with a clean cloth or mesh wire inside
- Apply pressure on the combs to extract the liquid (home-made sieves and strainers can also be used)
- Heat the pressed honey to liquify, strain, settle and then bottle it. (Do not place the honey directly on the heat, place it in another container filled with water.) The honey is ready for sale.

Ungraded honey can be consumed at home or made into honey beer (*imbote B*) for sale. How much processing is carried out on the honey depends on the type of market and demand.

Processing of beeswax

After extracting the honey, the combs are processed into beeswax, another valuable bee product. The process involves heating and filtering. The following are the basic equipment and materials required:

- Two containers to heat the combs and half-cleaned wax
- Two straining containers
- Two pieces of sacking or calico material for straining
- A piece of rope for squeezing out the wax
- A piece of soap or detergent.

The process is as follows:

- Put the combs into a container
- Fill the container with an amount of cold water equivalent to the amount of comb
- Heat the mixture to just below boiling point and stir continuously until the mixture is like soup
- When all the wax is melted, pour it onto the straining material held over a container by two helpers
- The third person ties rope around the lump of beeswax, twists and squeezes out the molten wax
- Leave the mixture to cool and a solid layer of wax will float to the top of the water
- Break the cake of wax into a clean container and add a few drops of water. Repeat the heating process until you get a clean cake of beeswax.

Marketing of honey and beeswax

Honey and beeswax are valuable commodities with ready local and export markets. In addition to honey, eaten as a food and for making beer, brood (the bee larvae) is also eaten by some people and said to be very nutritious. The value of honey and beeswax can be increased through processing. Beeswax can be used to make polishes and candles, which can be sold locally.

4.11 Sustainable management of miombo woodlands

Miombo woodlands cover most parts of the plateau of Eastern Province. Currently they are being extensively exploited for agricultural production, fuelwood, food and timber without any proper management system.

In this chapter sustainable management means wise utilization of the woodlands for the benefit of present and future generations. The woodlands have to be managed in such a way that the needs of different people in the community are met.

Traditional leaders have an important role to play in mobilizing the local people. The forests can only be effectively managed if the local people are fully involved in the planning and management process. In Chipata, Paramount Chief Mpezeni has made rules to protect the hill catchment areas at Indaba and Luangeni villages, while in Lundazi, Senior Chief Mwasa has protected the forest at Nthakalavu. These examples demonstrate how effective traditional leaders can be in conservation of natural resources.

The following guidelines are meant to assist extension officers in encouraging farmers and the local community in managing the woodlands sustainably.

Harvesting techniques

The trees can be cut selectively or clear felled.

Selective felling

This is the common form of harvesting selected tree species for a specific use, e.g. poles, timber and firewood. However, selective cutting creates uneven gaps in the tree canopy and natural regeneration is irregular. Selective felling may also endanger certain valuable species, e.g. *Pterocarpus angolensis* (Miombe N), since such species tend to be cut more often than other species.

Adjacent trees should be cut to create gaps with little shade on the stumps and young seedlings. This will ensure good regeneration either from stumps (coppices), roots or seeds.

Clearfelling

This harvesting technique involves the removal (felling) of all the trees in a given area. This is the best method of encouraging coppicing of stumps and sprouting of seedlings.

Clear felling should be designed in such a way that huge areas are not cut at once. Instead, strips alternating with shelterbelts should be cut. The strips and shelterbelts should be at least 30 m wide. The shelterbelts will serve as seed sources for regeneration in the cleared areas.

Cutting/felling height for stumps

In order to encourage good shoots from the stumps, trees should be cut 30 cm above ground. The stump should be trimmed at an angle to prevent water collection and rotting.

The best time for coppicing miombo species in Zambia is between September and October (Chidumayo 1996).

Rotation

Table 4.4 shows the rotation periods (time between clear felling) in miombo woodlands based on Chidumayo's recommendation. Cutting of small poles may have the same effect as thinning. The dense stands of trees should be thinned to promote good growth of the remaining trees.

Table 4.4 Types of forest product / size

	gbh (cm)	Rotation period (years)
Small poles	12–25	10–20
Medium-sized poles	26–38	21–30
Large poles	39–63	31–50
Sawn timber	> 62	> 50
Firewood (pole size)	12–63	10–50
Charcoal (large pole)	39–63	31–50

Note: gbh (girth at breast height) is girth 1.3 m above the ground

Harvesting roots

This is mainly done to obtain material for medicinal purposes or dyes. Lateral roots should only be harvested from one side of the tree or shrub to ensure that the plant does not die. The remaining roots should be buried and not left exposed to the sun. The taproot should not be removed.

Harvesting bark

Bark should be harvested in long vertical strips; ring-barking should always be avoided as ring-barked trees usually die.

Grazing and browsing by livestock

Grazing areas should be well managed to ensure that they are not overgrazed. Rotational grazing should be encouraged in order to prevent mortality of preferred browse species.

The following trees could occasionally be coppiced at about 1 m height so that the animals can browse the fodder easily:

- *Baphia bequaerti* (Mbuwu N)
- *Brachystegia floribunda* (Mvukwe, Msamba N)
- *Brachystegia spiciformis* (Mputi N)
- *Diplorhynchus condylocarpon* (Mtowa N)
- *Isoberlinia angolensis* (Kapane, Msanganza N)
- *Julbernardia globiflora* (Kamponi N)
- *Julbernardia paniculata* (Mtongo N)
- *Parinari curatellifolia* (Mpundu N).

Conservation of catchment areas, streams banks, hill slopes

Trees need to be well protected for water- and soil-erosion control in these areas. No cultivation should be allowed near stream or river banks. Where cultivation is done near streams, only perennial crops should be cultivated.

The conserved woodlands can be utilized economically by exploiting non-woody products like honey, mushrooms and fruits. All these products are in high demand in Eastern Province.

Management of fires

Fire is the most important management issue in the miombo woodlands of Eastern Province. The major cause of the late fires is mice hunting. Young seedlings and shoots are killed by late fires.

In order to encourage natural regeneration of trees, controlled burning should be encouraged in villages. The forests should be burnt during May and June when the vegetation is partially dry. The slash from the felled trees should be collected and stacked at least 2 m away from live stumps before burning the forests.

5

EXPERIENCES IN AGRICULTURAL AND FORESTRY EXTENSION IN EASTERN PROVINCE

5.1 Historical background

In 1925, the colonial Government in Zambia set up the Department of Agriculture in order to address growing problems related to land use. Investigation of erosion, both in the Native Reserves and on Crown Lands, was high on the agenda. The methods used at the time to combat erosion were taken from the United States and the emphasis was on physical measures and very little on agronomic measures. The strategy was applied in a harsh manner and, as a result, was not successful because it was seen as an imposition on the people. Failure to adopt the measures ordered resulted in punishment, and very few people understood the benefits of soil conservation.

The Forestry Department was established in 1947. The major function of the Department was to protect and manage the forests for supply of timber to the mines and the local industries. After Independence, very limited changes were made to the Forest Act in order to involve the local community in the management of the forests. The community looked upon the forest estates as belonging to the Government and foresters as policemen who prevented them from collecting forest produce.

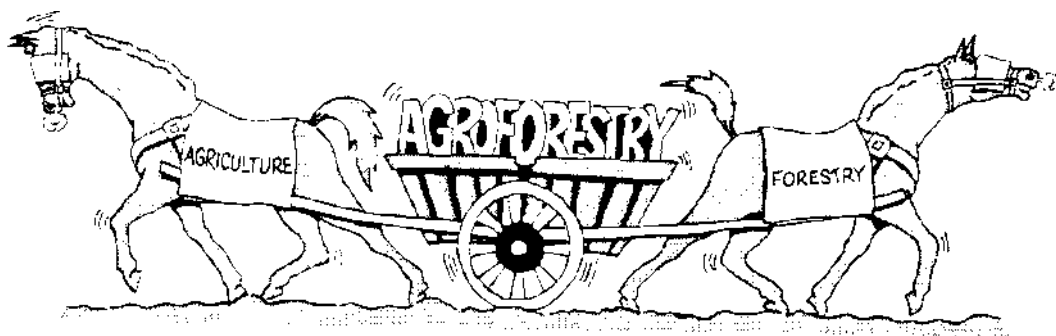


Figure 5.1 Agroforestry does not have to be a tug of war

5.2 The extension challenge

Extension is a term that has long been used to describe a non-formal education system aimed at improving the livelihood of farmers and their communities. Although various incentives, e.g. free tree seedlings or subsidized inputs, may be part of an extension system, the core activities in extension are education and training.

Sim and Hilmi (1987) used the term “forestry extension” to cover any situation in which local people are directly and willingly involved in forestry activities and from which they will derive some recognizable benefit within a reasonable period of time. These authors felt that too often in the past extension has been regarded as a means of passing down to farmers techniques which, it was believed, would be beneficial to them without taking into account sufficiently the particular social or environmental conditions of the area concerned. In particular, too often, the indigenous skills, social structure and detailed local knowledge of the people have been ignored in trying to transfer new skills or techniques to them.

Fortunately, extension is now being regarded as a much wider task of integrating indigenous with new skills and techniques through discussion and co-operation between the people and the extension organization.

The challenge for agricultural and forestry extension, therefore, is to address issues related to land management so that people can realize higher yields and higher income in both the short and long run. Farmers should not be regarded as targets for dissemination of technologies, but rather as partners to be involved in identifying their own problems and developing appropriate technologies for addressing those problems.



Figure 5.2 Farmers can be reliable sources of information provided you have gained their trust and understanding

5.3 Actors in extension

Farmers

The beneficiaries of an extension system should be the farmers in a given area. Indigenous technical knowledge is very important for both extension workers and researchers. Ideally, farmers should interact with researchers in on-farm research; thus farmers are a resource for extension and research, and vice versa.

Chiefs

Chiefs are hereditary tribal leaders in charge of specific tribes and they are very influential in their communities. Under the Chiefs are the Village Headmen who look after certain sections of their communities and advise the Chiefs in matters relating to land allocation and settling of disputes. Thus the Village Headmen also command respect and all such local leaders must be taken into account in the provision of extension services to their subjects. Before an extension worker goes to the people in a locality these leaders must be consulted and the proposed interventions explained and discussed. In this way, the extension worker will be treated as a friend and not a foreigner by the Chief, Headman and community.

A good example is in Chief Mwase's area in Lundazi where improved land-use technologies are being adopted because the Chief himself is actively taking part in the identification of problems and in technology development. Chief Mwase is convinced that extension efforts are important because he has travelled widely in Zambia and Malawi and has seen the effects of soil erosion and uncontrolled cutting of trees there.



Figure 5.3 An enlightened Chief asking his people for their views on local land-use problems

Extension officers

Agricultural extension has many roles to play in agricultural production and these roles may vary among the individuals performing such duties. Extension work is a dynamic process and, therefore, there is no single role for an extension worker. The list below gives some of the tasks that should be performed by extension officers:

Provision of information

Information is a vital resource which an extension worker provides to an individual or group of farmers. This information can either be appropriate or inappropriate depending on how the client perceives it.

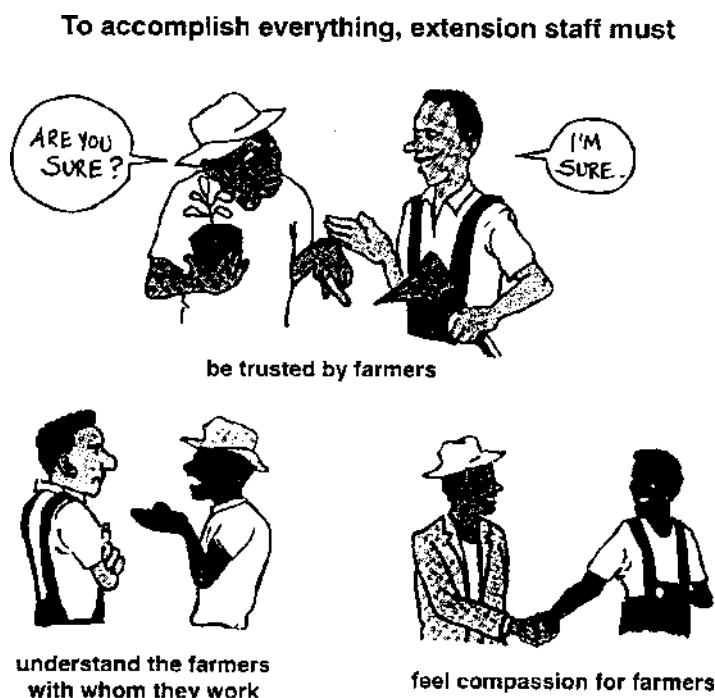
Identifying and solving problems

Extension officers identify and solve problems with farmers. If an extension system does not make provision for farmer participation, then very little can be achieved by way of identifying problems and solving them.

Training of farmers

Improved technologies that have been developed must be passed on to farmers in ways that encourage them to adopt them. At the same time, extension officers must recognize that farmers also have their own prior knowledge and skills which must be taken into account in any training efforts.

Figure 5.5 Extension workers should have a good relationship with farmers



Non-governmental organizations

Non-governmental organizations (NGOs) are important as their operations are often aimed at raising the standard of living of the rural poor. Several NGOs have personnel operating in remote and rural areas. In Eastern Province the NGOs do not operate in isolation but co-ordinate with research and with the Extension Branch of the Department of Field Services. NGOs that work with the farmers, sometimes in the absence of adequate Government extension personnel, play an important role in bridging gaps between farmers and researchers.



Figure 5.5 A village meeting with a woman extension worker

Researchers

Researchers develop technology for farmers to adopt. A farmer is a rational human being who is always searching for useful innovations and new knowledge. Research which is not farmer driven may not yield appropriate results. Research should, therefore, allow farmers to participate in identification of problems to be researched on. Farmers are also researchers on their own.

5.4 Recent extension strategies in Eastern Province

Extension planning

A basic fault in the conventional approach to development is that the rural poor are rarely consulted in development planning. Many technologies that are developed without the participation of the people turn out to be inappropriate, or fail to be adopted.

In any community, individuals and groups interact through dialogue and this also applies to outsiders. Each time a previously unknown person approaches a community, initially that individual is treated with suspicion. In order to remove this suspicion, extension workers should first carry out a participatory rural appraisal (PRA) in order to identify farmers' problems. Extension workers should allow the farmers to prepare maps, seasonal calendars, charts and trend lines.

Through PRAs, people's preferences can be identified. As far as tree growing is concerned, the community will indicate what tree species are useful for them both economically and socially. There has been growing interest in planting *Gmelina arborea*, *Senna* spp., *Melia azedarach*, indigenous species like *Khaya nyasica* and fruit trees like *Ziziphus mauritiana*.

A problem which may be identified as a result of PRA may be poor soil fertility. In this case, people should be guided as to how to increase fertility in soils. Here research would play a major role in screening tree species that can improve soil fertility.

In some parts of Eastern Province crop production is based on ox cultivation. It may be that the system is being limited by a lack of fodder during the dry season and, if so, extension and research should focus on tree species for fodder. Improved fallows using *Sesbania sesban* have become very popular because they have demonstrated the potential for improving soil fertility in degraded areas.

Communities have different beliefs about the trees that grow around them, and if they do not participate in problem identification and technology generation there may be conflicts with their customs. If that happens the technology will become a non-starter.

Gender sensitivity is of paramount importance. For example, only women go out looking for firewood for cooking. In an area where firewood is a constraint, a priority should be helping women to avoid having to walk long distances in search of fuelwood.



Figure 5.6 An extension worker acquainting himself with community needs

The approach that has been used in Eastern Province in the promotion of technologies is a liberal one where people are not forced to take up certain technologies but are given a choice. An adventurous farmer will always want to be updated on the latest information. When people are exposed to new ideas or techniques they become curious to know why there are differences between what they do and what others do.

Some hints for good communication

- Tell farmers why you are there.
- Do not write a lot while discussing.
- Do not act as an officer—you are now a learner.
- Accept local names of trees. Find out later which are the corresponding botanical names if needed.
- Stay longer with those people showing interest.
- Follow local customs and try to make people feel comfortable.
- Give positive feedback during the interview.
- Be flexible and allow the discussion to go beyond the questions that you had intended to ask.
- Avoid challenging or too personal questions.
- Do not ask questions when the answer is obvious: 'Do you have Napier grass?' when you are standing beside it. If you can see do not ask.
- Concentrate on the discussion. Do not look around admiring cows or whatever. Such behaviour gives an impression that you are not serious.
- Do not start lecturing. Remember, you are a learner.
- Observe whether the farmer has time or not. Minimize disturbance.
- Eye contact is important, but if you are too direct, the farmer may feel uneasy.

Extension organization

Extension is not static but dynamic. This calls for the extension service to use more than one method to attract the interest of farming communities. The Training and Visit (T&V) system, in which an extension worker dealt with contact farmers and the contact farmer would pass on a technology to a non-contact farmer, was, on the whole, a failure. One factor which may have been overlooked in the T&V system was the rural structure of the community. Often Chiefs, Village Headmen and other leaders were not consulted or kept informed. This failure has led to a modification of the approach.

In the hope that this will make the extension service more effective, extension workers are now addressing farmer's groups instead of contact farmers. The individual farmers chosen to disseminate information are not selected by the extension workers themselves but are elected by the community and therefore they do not discriminate against individuals on grounds of gender or status. Groups or villages have come together because they have a common goal. These groups have proved to be more effective in the diffusion of agricultural and forestry information. This approach that has been developed because of the unsatisfactory results from T&V is called the Zambia Structured Extension and Training system (ZASET).

In ZASET, field extension workers have divided their areas into eight zones which they visit on a fortnightly basis. During the visits, farmers' problems are identified and those that can be solved by the field extension worker are attended to there and then, whereas those that are difficult are referred to the Block Extension Officer. Sometimes the Block Extension Officer may not have the answers. If so, the problem is referred to a District subject-matter specialist in that field. If such problems are common and persist, a course, which can be either mobile or residential, may be conducted.

By definition, communication is a two-way process requiring feedback. To achieve this two-way communication, monthly or quarterly training workshops are conducted at District level. In these workshops field staff report on their experiences in the field and the problems they face. These can be dealt with at length and answers are provided by the specialists. These meetings and workshops are held together with the Farming Systems Research Team, commodity research teams and extension officers. Researchable problems are identified and included in the research protocols.

During the planning process, and later in the implementation of various activities in the community, the stakeholders have roles to play. It is imperative that institutions related to extension co-ordinate effectively.

Linkages

With the introduction of District Agricultural Committees in every District, co-ordination has become a little easier than before. Each committee is composed of farmers, representatives of farmers' associations, the private sector, NGOs, researchers and extension workers.

Each Province hosts consultative workshops for promotion of agroforestry technologies twice a year, in March and September. In these workshops, the participants assess performance in promotion of agroforestry technologies in all areas of the Province. For example, improved fallows and any increase in the number of people establishing woodlots is assessed. In addition, other research extension meetings are held with farmers and NGOs also participating.

In Eastern Province a dissemination network has been set up which includes World Vision International (WVI), Lutheran World Federation (LWF), the Reformed Church in Zambia (RCZ), Farming Systems Research (FSRT), farmers' groups and Government departments, i.e. Field Services, Forestry and Natural Resources. These organizations are working together to set up demonstrations in the training centres and on farmers' fields. A multi-disciplinary approach involving the Departments of Forestry, Agriculture and Natural Resources has been used since 1986. This has reduced conflicts in information dissemination to the farmers and has harmonized planning.

Some constraints and remedies in extension

The extension services may not benefit many people in the community because at the moment the extension worker–farmer ratio is about 1:800. This simply means that there are too few extension staff compared to the number of farmers they serve. The presence of the NGOs in the field mitigates the shortfall to some extent.

To have a sound and reliable extension service, there must be strong links between research, extension, NGOs and farmers. Farmers must not be passive but active participants in finding solutions to the problems affecting them. Political and traditional leaders must participate in the dissemination of information to the community to which they belong. Participatory methods are effective in identification of problems people face. It is during these participatory meetings with farmers that they must be helped to realize the reasons for encouraging tree growing.

Many agricultural extension workers lack knowledge in forestry, and there is, therefore, a need for additional training. Training on topics such as nursery management, pest and disease control and general tree management is useful.

5.5 Extension methods in Eastern Province

Popularization campaigns

There is an assumption that the various communities are knowledgeable about the use of trees. This assumption can be true to a certain extent, but not many people have detailed knowledge about tree growing. It is, therefore, imperative that extension services, in liaison with other interested parties such as NGOs and other departments, take deliberate steps to carry out campaigns on tree growing. Campaigns are most important in areas which have been depleted of trees. Leaflets, video shows, drama performances, songs and

other methods can be used to popularize tree growing. Under the Soil Conservation and Agroforestry Extension Programme, such methods have been used extensively.

Training of farmers

After the community has been sensitized about tree growing, and enthusiasm and interest have been generated, training follows. Leaders such as Chiefs, Village Headmen and local politicians play an important role in this, and for extension to be effective these people need to be trained and sensitized.

The Extension Branch of the Department of Field Services has at least one Training Centre in each District and a Farm Institute in Chipata. These centres are used to train farmers by conducting one- or two-week specialized courses in various technologies. Farmers are selected for the courses on the basis of identified priorities or problems. For example, nursery management could be a subject to be tackled if farmers in an area wish to establish woodlots. Such recruitment ensures that people are trained to adopt technologies that are appropriate to their farming systems.

Farmers who may not benefit from the residential courses can instead attend three-day mobile courses that are conducted in the Districts. These mobile courses have proved popular and attract a lot of people.

The group approach

Since there are many farm families to be covered by one extension worker (e.g. in Chipata South the ratio is 1:1,020 per camp), substantial resources would be required to serve all farmers. Addressing a group rather than individual families reduces costs, increases coverage and encourages the formation of local groups, which in turn empower farmers to stand on their own feet.



Figure 5.7 A group meeting

The school approach

Schools have taken an active role in the establishment of school nurseries and woodlots. If young boys and girls are convinced of the benefits, they may be able to persuade their parents to adopt new technologies. In Eastern Province, agricultural extension workers, with assistance from the Department of Forestry, are providing agroforestry training in

schools. The Soil Conservation and Agroforestry Extension Programme is promoting the establishment of nurseries and woodlots in schools, and these can act as demonstration plots for the surrounding villages, thus creating awareness and interest in the community. A school tree-planting competition organized by the World Life Conservation Society, Chipata Branch, in conjunction with the Departments of Agriculture, Forestry, National Parks and Wildlife Services, has raised interest in tree planting in schools. The prizes range from a three-day game-viewing trip to South Luangwa National Park to ballpoint pens and exercise books. Survival rates of trees in schools have gone up as a result of this improved management.

Study tours

These provide opportunities for dissemination of information from farmer to farmer where individuals and groups learn from each other. Through study tours, farmers are exposed to new ideas in practice, e.g. through visits to research stations where they see on the ground what type of research is being undertaken.

Demonstrations, farm visits, field days

Schools, individuals and groups of people have set up woodlots, nurseries and improved fallows with the help of NGOs, extensionists and researchers. These can act as demonstrations.



Figure 5.8 An extension officer demonstrating how to plant trees

Drama

Drama is also used in extension to sensitize farmers to the latest agricultural technologies. Voluntary drama groups are encouraged where members participate in problem identification in a community. The identified problem is dramatized in the same community so that people can see for themselves. This is an approach which people like and it has become popular in many communities.

Posters, newsletters and bulletins

Posters, newsletters and bulletins are also used and distributed to the farming community. This, however, has only worked when funds are available for the production of

such materials and the language level and layout used make them suitable for the target groups concerned.

Radio programmes

Radio programmes may also play a role in technology dissemination, but of course are only relevant where people own radios or have access to them in public places.

6

SEED COLLECTION AND HANDLING

The following activities are involved in seed collection and handling:

- Selection of seed provenance
- Selection of mother trees
- Seed collection
- Seed extraction
- Seed storage
- Record keeping
- Pre-sowing treatment
- Inoculation.

6.1 Selection of seed provenance (seed origin)

Provenance means the place or site from which seed is collected. A good provenance is just as important as the choice of species. Seed should be collected from trees that are growing under similar agro-ecological conditions to those where the seeds will be eventually sown. This will ensure that the trees are adapted to the physical conditions of the new environment. It is therefore advisable to collect seeds from an area with similar altitude, temperature range, rainfall, humidity and soils. Often the best option is to collect seed in the locality where the seedlings are to be planted.

6.2 Selection of mother trees

A mother tree is a tree from which seeds and other planting material are collected. In a natural or man-made stand, some trees are of superior quality to others. Seed should be collected from the best individual trees which have good-quality disease-free seeds.

Seeds from straight and vigorous trees will most likely produce straight and vigorous trees, while twisted or stunted trees may produce trees with those same poor characteristics.

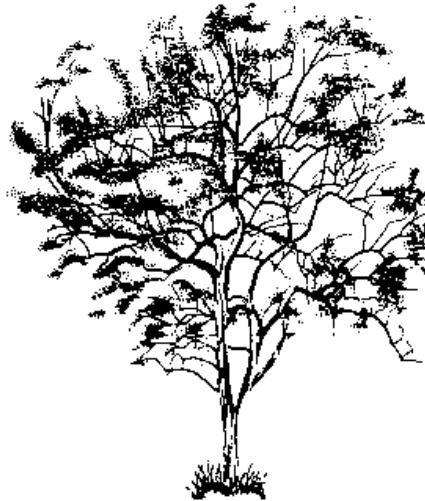
Selection of mother trees will depend on the end use:

- For live fencing: shrubs or trees with dense or thorny branches.
- For timber: very straight trees with few branches
- For fodder: trees with palatable, dense foliage and /or pods
- For fruit: trees with good quantities of sweet, healthy fruits of marketable size.

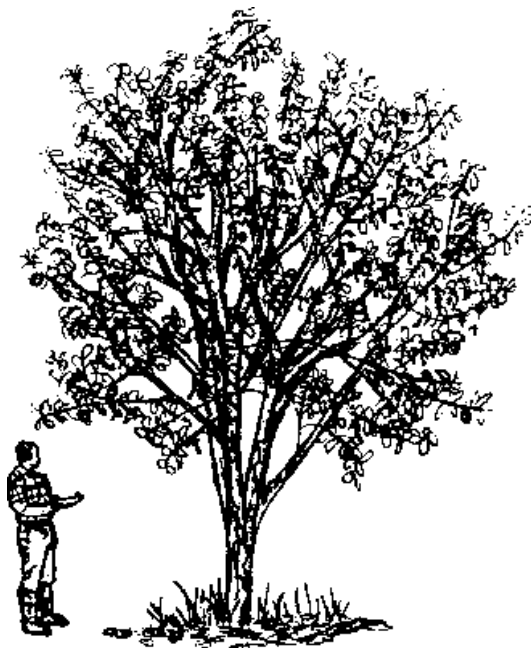
Trees with early branching are preferable since it is easy to pick fruits from low branches. Fruit trees like oranges, should be budded or grafted in order to obtain better yields. In that case, buds or grafting material should be collected from good mother trees.



A good timber mother tree
A good timber mother tree



A bad timber mother tree
A bad timber mother tree



A healthy fruit mother tree



A good fodder mother tree

Figure 6.1 Selection of the right kind of mother tree

6.3 Seed collection

Seeds should be collected from ripe or mature fruits, cones or pods which are disease free. In order to provide genetic variation, a seed sample should consist of seeds collected from as many trees as possible. For commercial nurseries, for example, seed should be collected from at least 25 trees.

Different tree species require different seed-collection techniques depending on the nature of the seed. The best way of collecting most seeds is to harvest the pods or fruits when they are ripe but before they open and fall to the ground. Some large or hard-coated seeds and fruits can, however, be collected after they have fallen to the ground. Some ripe seeds remain on the tree for some time which allows for collection from the crown. Others are dispersed by wind so they can only be collected on the trees before they are blown away. Yet others fall to the ground while still fresh and sound, allowing collection from the ground. Each of these ways of collection has advantages and disadvantages.

Collection from the ground is cheap and easy but there is competition from seed eaters. Clear the ground below the tree of bushes and weeds. Newspapers or sacks can be spread around the base of the tree so that the seeds fall on them and can be collected easily. Seeds and fruits should be collected immediately they have fallen to reduce insect or animal damage. In some cases, pods, fruit or seeds may be dislodged by shaking or beating the branches, as with *Faidherbia albida* (Msangu).



Sacks spread around the tree to collect falling seed



A farmer shaking a tree to knock down the seed



Farmers beating branches to dislodge the seed



Collecting seed from the ground

Figure 6.2 Methods of collecting seeds from a tree

6.4 Seed extraction

Once the pods, cones or fruits have been collected, the seeds should be extracted. Various extraction methods can be employed depending on the species, amounts of seed required and the resources at hand:

- Threshing
- Depulping by soaking in water
- Hand extraction

Threshing

Threshing is an operation to extract seeds from pods or cones. A common procedure is as follows:

- Dry the pods or cones in the sun until they begin to open
- Put the pods and cones into a sack immediately they begin to open
- Beat the sack to extract the seed from the pods or cones
- Remove the seed from the sack and clean it by winnowing.

Examples of seed that can be extracted in this way are:

- *Sesbania sesban*
- *Acacia* spp.
- *Faidherbia albida*
- *Senna* spp.



Figure 6.3 Extracting seed by threshing

Depulping by soaking in water

Depulping is the removal of the fleshy part of the fruit (pulp) from the seed. Depulping enhances the germination capacity of seeds since the pulp contains inhibiting chemicals that induce dormancy. Depulping and extraction of seeds (both pulpy and non-pulpy) also makes it easier to dry, sort and clean, store, distribute and sow the seed. The recommended procedure is as follows:

- Soak the pulpy fruits in a container of water in a proportion of about 1 part of fruit to 3 parts of water to ensure that there is an adequate amount of water remaining after absorption has taken place
- Leave the pulpy fruits in water for a day or two. Change the water daily if the fruits are left in water longer than a day
- Remove the pulp by hand
- Remove and throw out any floating seeds (this means they are empty)
- Dry the remaining seed in the sun.



Figure 6.4 Removing the pulp

Examples of seed that can be extracted in this way are:

- *Azadirachta indica* (Neem E)
- *Dovyalis caffra* (Kei apple E)
- *Gmelina arborea* (Malaina N)
- *Syzygium guineense* (Katope N)
- *Melia azedarach* (Persian lilac E).

Some pulpy seeds should not be stored, e.g. *Azadirachta indica* (Neem E), *Bridelia micrantha* and *Syzygium* spp., because they lose viability very fast.

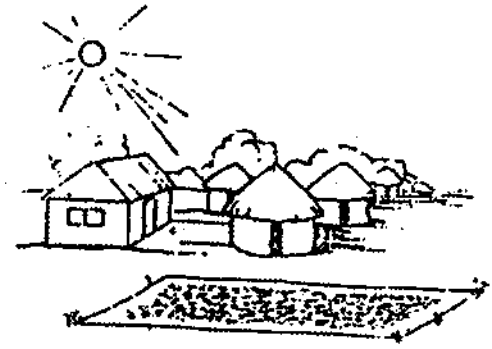


Figure 6.5 Drying seed in the sun

Hand extraction

Seeds can also be extracted manually:

- Dry the fruit in the sun
- Use your fingers to open the pod or fruit and remove the seed.

This is an alternative method to threshing, which can be applied to the same species but, of course, is time consuming if large amounts of seeds are to be dealt with.

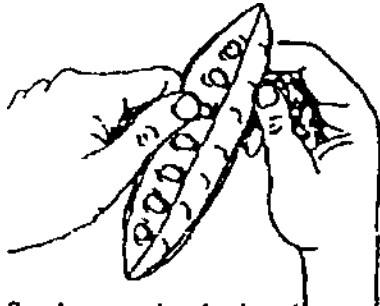


Figure 6.6 Extracting seeds by hand

6.5 Seed storage

Whenever it is not possible to use the seeds immediately, store them in containers such as tins, bottles, plastic packets or boxes which are rodent proof. Stored seeds should be thoroughly dry. The best place to store the seeds is in a refrigerator. If no refrigerator is available, hang the seed containers from the ceiling or roof using a rope or string so they cannot be reached by rodents. The lower the temperature at which the seed is stored the better. Label the container with the species name, date and site of collection.



Figure 6.7 Containers for storing seed

6.6 Record keeping

Camp, Block and District Officers are advised to keep simple records indicating the species name, location of the species, name of collector and date when seed was collected.

6.7 Pre-sowing treatment

Seeds with hard seed coats, i.e. many leguminous as well as other kinds of trees, require treatment to break the resting stage (seed dormancy) and to speed up germination.

The following methods are often used to break this seed dormancy:

- Hot-water treatment
- Cold-water treatment
- Mechanical treatment.

Hot-water treatment

Hot-water treatment is suitable for hard-coated seeds such as *Faidherbia albida* (Msangu N) and *Leucaena leucocephala* (Lusina N). The recommended procedure is as follows:

- Boil some water in a pot. Use 3–4 parts of water to 1 part of seed
- Remove the pot from the fire and pour the hot water into the container with the seed
- Leave the seed to soak for a day or two
- Remove the swollen seed from the container and sow them immediately
- Leave unswollen seed in the container for one more day and then sow them.

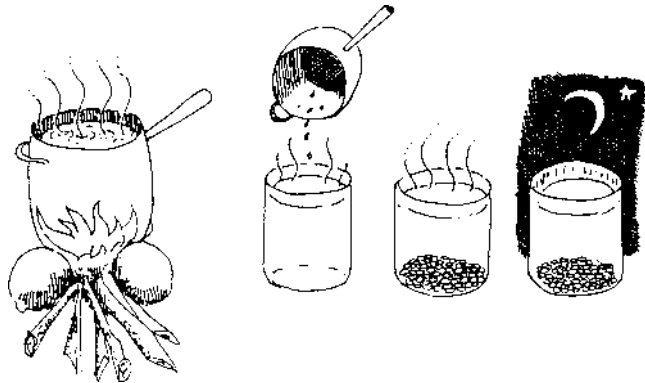


Figure 6.8 Hot-water treatment

Cold-water treatment

This treatment can be used on most types of seed, for example *Anacardium occidentale* (Cashew nut E) and *Senna siamea* (Makeche N), to accelerate germination. The recommended procedure is as follows:

- Pour 3–4 parts of cold water into the container with seed and leave to soak for a day
- Remove the swollen seed from the container and sow them immediately
- Leave unswollen seed in the container for one more day and then sow them.

Mechanical treatment

For large seeds with a very hard and thick shell, the best treatment is to break the shell and extract the kernel using a hammer or stone. Among the species needing this type of treatment are *Parinari curatellifolia* (Mpundu N), *Uapaca kirkiana* (Msuku N) and *Ricinodendron rautanenii* (Mkusu N).

Recommended procedure:

- Place the seed on a hard surface
- Use a hammer or stone to carefully break the seed coat and remove the seed
- Sow the seed immediately.

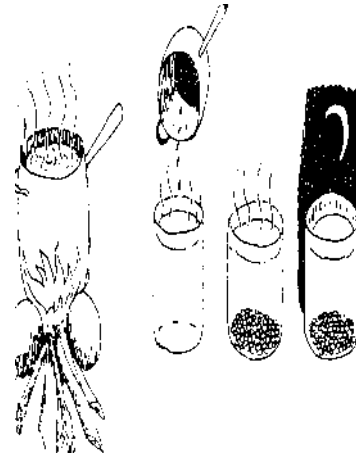


Figure 6.9 Breaking the seed coat with a hammer

6.8 Inoculation

Inoculation is the introduction of a beneficial micro-organism (usually a fungus or bacterium) into the soil. Such micro-organisms grow symbiotically with certain tree species and without the micro-organism the tree growth is hampered. Both trees and micro-organisms benefit from the presence of the other. Pines, *Casuarina* and most leguminous trees grow in such association with micro-organisms and for those species inoculation is required. Soil for inoculation can be collected from the ground under mature trees of the same species.

Recommended procedure:

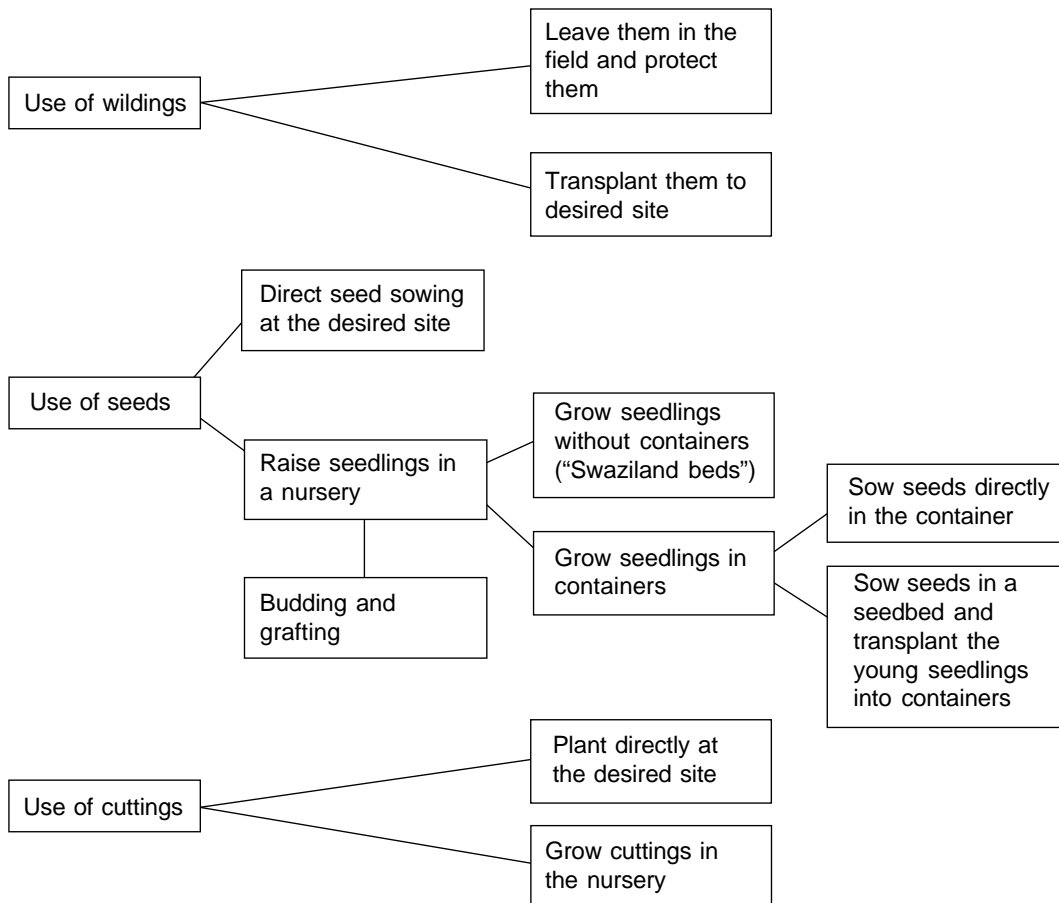
- Mix 3 parts of ordinary soil and 1 part of inoculum soil
- Fill the soil mixture into the containers or spread onto the nursery beds
- Sow the seeds into the containers or nursery beds.

6.9 Further reading

For further details on seeds of different species of trees and shrubs and their treatment and storage, see the Facts Sheets at the end of this book and Table 9.2, Seed collection, handling and number of seeds per kg.

TREE PROPAGATION

Trees can be propagated in a number of ways, as shown in the figure below and described in the following sections.



Methods of tree propagation

7.1 Collection of wildings

A wilding is a seedling that regenerates naturally from dispersed seed. Wildings can easily be collected and replanted during the rainy season. The wildings of desired species can be collected while they are still young and transplanted to the farm where they can be protected. They should be carefully uprooted, leaving some soil around the roots, and planted in the same way as seedlings taken from a nursery. Young trees should be kept weed free.

For easy collection, the area under the seeding trees may be cleared of weeds and stones and the soil loosened to help the seedlings to grow. When the rains start, the seeds will germinate and the wildings can be collected soon after. The current year's wildings are recommended for transplanting because they survive better than older ones. Some examples of trees that can be propagated through collection of wildings are:

- *Delonix regia* (Flamboyant E)
- *Gmelina arborea* (Malaina N)
- *Khaya nyasica* (Mbawa N)
- *Mangifera indica* (Manga N)
- *Psidium guajava* (Gwawa N).

7.2 Direct seed sowing in the field

This is an easy and cheap way of establishing trees since the seeds are sown directly in the field. It eliminates the nursery stage and later planting out the seedlings. Many trees can be established much more quickly this way than if the seedlings are raised in a nursery. Direct seeding in the field is recommended for most indigenous tree species because they develop very deep taproots before there is any significant shoot growth.

Although this method has several advantages there are also some disadvantages:

- Large quantities of seed are needed
- The survival rate of the seed is lower than if they are sown in a nursery because both seed and seedlings may be exposed to sun, periods of drought or too much rain, pests, diseases and browsing animals
- Direct seeding can only be done at the onset of the rains, and therefore when the dry season approaches the seedlings will usually be smaller than those raised in a nursery with consequent effects on the seedlings
- More intense weeding is required.

Tree and shrub species suitable for direct seed sowing are:

- *Acacia polyacantha* (Ngowe N)
- *Cajanus cajan* (Ngolyolyo B, nyamundolo N)
- *Carica papaya* (Papayi N)
- *Faidherbia albida* (Msangu N)
- *Gmelina arborea* (Malaina N)
- *Khaya nyasica* (Mubawa N)
- *Leucaena leucocephala* (Lukina N)
- *Mangifera indica* (Manga N)
- *Melia azedarach*
- *Psidium guajava* (Gwawa N)
- *Senna siamea* (Makeche, msalasase, chigoma N)
- *Tamarindus indica* (Bwemba N).

Direct seeding

Open a shallow furrow along the contour, sow the seed, cover with soil lightly, and firm.



Figure 7.1 Direct seed sowing in a field

Establishment procedure:

- Till the site deep enough to facilitate quick and deep penetration of roots
- Mark planting holes
- When there has been sufficient rainfall, place at least three seeds in each hole and cover with soil. Ensure that the sowing depth is not more than twice the seed diameter. Remember to pre-treat seeds with a hard seed coat to enhance germination.
- Water daily if there is a dry spell during or after germination.
- Weed thoroughly around the seedlings, especially during the first year, to reduce competition for moisture and nutrients. This also reduces damage by fire.
- Protect the seedlings from livestock
- Thin out to one seedling per station where there are more than one. Leave the most healthy and vigorous seedlings.

7.3 Raising seedlings

Use of seedlings is the most common propagation method in Eastern Province. Tree seedlings can either be raised in containers or bare rooted. It is generally easiest to sow tree seeds directly in the field, but this is not always feasible. In that case, seedlings may have to be raised in a nursery where special care and protection can be given. This is especially recommended in the following situations:

- The species has very small seeds, e.g. eucalyptus
- The germination rate is low or uncertain
- The seeds are scarce
- Certain varieties are desired and seedlings require budding or grafting
- The seedlings are intended for an area where harsh conditions prevail (open land, poor soils, etc.)
- The seedlings are meant for very fertile sites where weed growth is vigorous (tall seedlings are recommended).

Seedlings in containers

Polythene pots and other containers are the most commonly used for raising seedlings. The main advantages of raising seedlings in containers are:

- The seedlings are easier to handle and transport
- Survival rate and growth are enhanced.

The main disadvantages are:

- The method is more expensive than direct seeding
- If the seedlings grow too big, root coiling occurs and the root-to-shoot ratio may be poor
- Good-quality soil must be used, which may mean collecting it from long distances
- They are heavy to carry if other means of transport are not available.

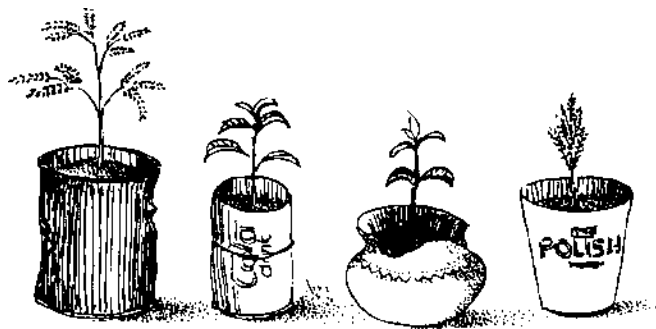


Figure 7.2 Containers for raising seedlings

Locally available materials are also used to raise seedlings. These include empty milk packets, used plastic containers, clay pots, old tins and large leaves such as those of banana. However, banana-leaf containers attract termites and are not very durable.

Soil collection

The ideal soil for raising seedlings in containers is light clay loam or sandy loam. These types of soils are somewhat sticky and therefore the soil does not fall out even if the containers are open ended. Besides this they allow aeration and are often rich in nutrients.

The sources of soil for the nursery can be:

- Forest or woodland
- Under individual trees such as acacia
- Dambo margins (black soil)
- Old livestock enclosures (with rotten manure).

Some miombo trees have a beneficial relationship (symbiosis) with bacteria or fungi (mycorrhiza). Root nodules are indicators of such partnerships. Therefore, if possible, miombo woodland soils should be used for raising seedlings of miombo species.

Preparation of a suitable soil mixture

If the soil contains too much clay and is too sticky, add sand from river or stream banks in a proportion of 2 parts of river sand to 2–3 parts of forest, woodland or garden soil.

The exact proportions of the different components depend very much on the quality of the soil available and no standard recommendation can be made. Nevertheless, the following mixture would be suitable in most situations:

- Three wheelbarrows of forest or garden soil
- One wheelbarrow of river sand
- One wheelbarrow of rotten manure or compost.

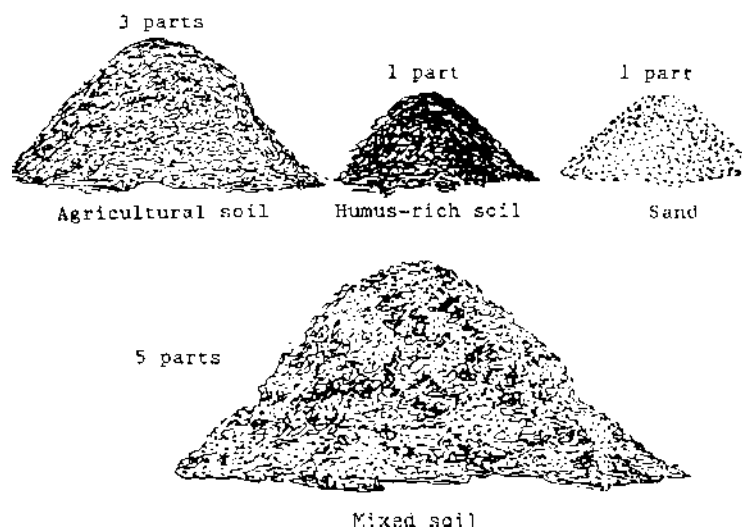


Figure 7.3 Prepare a suitable soil mixture

Good-quality soil, e.g. clay loam or sandy loam does not need to be mixed with any other soil. If the right type of soil cannot be obtained, then various types of soils must be mixed to obtain the right composition. Nursery soils should be sieved to remove unwanted debris (clumps, stones, small roots, etc.).

If seedlings which require an inoculant (addition of an essential micro-organism, e.g. mycorrhiza) for their development are being raised, e.g. pines and leguminous trees, the inoculant should be added to the soil. This may be obtained by collecting one part of soil

under the mature leguminous mother trees or pines and mixing it with five parts of other good soil (see Section 6.8).

Filling the containers

- Place the container on flat ground or on a piece of wood.
- Fill a bit more than a third of the container with soil.
- Compact the soil firmly so that it does not fall out easily.
- Fill the rest of the container evenly with soil. Do not compact the soil so much that it will not be aerated or leave it so loose that there will be air pockets as both of these things hamper root development. Press the soil down gently but firmly.
- After filling them, place the pots upright in rows on the beds. The width of the bed should not be more than 1 m with a space of 60 cm in between each for ease of movement.
- Use long containers for species which develop taproots, e.g. acacias, and for *Moringa* which is sensitive to root pruning.

Sowing

Sowing in containers

Species which have big seeds and a high germination rate may be sown directly into containers. Hard-coated seeds should be pre-treated before sowing. A dibble (small sharpened stick) should be used for making the hole in which the seed is to be sown. Two or three seeds may be sown per container, depending on the viability of the seed.

Seeds should be sown at the correct depth. As a general rule, this is a depth one or two times the diameter of the seed. Seeds sown too deeply will not germinate as the shoots will fail to push through the thick soil layer, while those sown too near the surface risk being dried out, destroyed by rodents and other pests, or being washed away during watering or by heavy rain.

The seeds should be covered with soil and gently pressed down to ensure contact with the soil. The containers should then be watered with a fine spray using watering cans or tins with small holes in the base and left in the shade until the seeds germinate. The soil surface on which the containers are placed should not be allowed to dry, and neither should it be too wet.

Sowing in seedbeds

Seeds of unknown viability, that are difficult or expensive to obtain, or too small to be counted (e.g. eucalyptus) should be sown in seedbeds. The seedbed soil should be well drained.

The two most common sowing methods are broadcasting and drilling. In the broadcast method, the seed are spread on the seedbed. The disadvantage of this method is that it is difficult to distribute the seed evenly over the seedbed. Very small seeds, such as those of eucalyptus, should be mixed with sand before sowing to make even distribution easier. In the drilling method, lines are made 5–8 cm apart. The seeds are then sown in the rows, covered with soil, watered thoroughly and shaded.

Time of seed sowing

Slow-growing seedlings, like pines, cypress and *Pterocarpus angolensis*, may be sown from June to August, and fast-growing species, like eucalyptus and leucaena, from September to October, i.e. 2 months before the tree-planting season. Other species which take only a few weeks to attain planting size, like *Sesbania* spp., can be sown in mid-October or later.

Most indigenous tree seeds are sown a year before the actual planting in the field since they are slow growing as seedlings. Exotic species like *Toona ciliata* whose seeds mature during the rains and have short viability periods can also be sown a year before the planned planting time.

Germination

Germination may take place in as little as three days or only several months after sowing, depending on species and treatment, but most species take between 12 and 24 days.

Shading/mulching

Shading is necessary to protect seedlings from direct sunlight. After sowing, the pots or seedbeds should be covered with mulch made of dry grass, reeds or other material. After germination, shading should be erected 50 cm above the pots or bed.

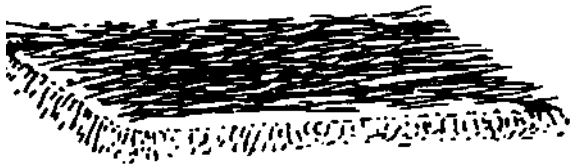


Figure 7.4 Grass mulch on a seedbed

Shading should be reduced gradually from being all day at the beginning to none at a later stage. For the last few months in the nursery, seedlings should be exposed to full sunlight. Shading mats can still be used at any stage to protect the seedlings against damage by heavy rain storms or when the sun is too strong.

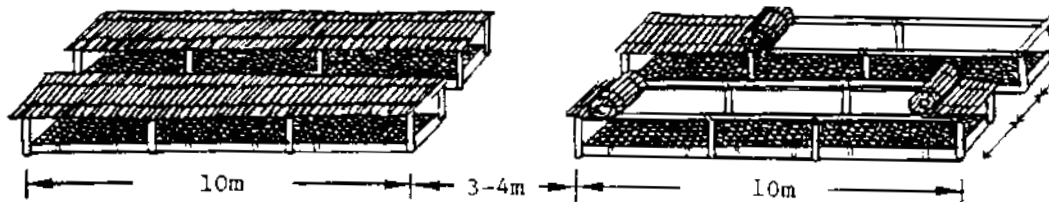


Figure 7.5 Raised shade over a seedbed

Watering

It is imperative that the seedbed should never dry out during the germination and early growth period. The watering regime described below will avoid moisture stress on seedlings.

- Remove the shading material / mulch before watering if it hinders the watering and replace it after watering. Mulch on newly sown seeds or on very young seedlings needs not to be removed.
- Before germination, and for the first few weeks thereafter, water twice a day, i.e. in the early morning and in the late afternoon.
- When the seedlings are established, reduce watering to only once a day, ensuring that the bottom of the container and the seedling bed are soaked.
- Occasionally check some seedlings in the bed by pushing a finger into the soil to see if it is still moist. If it is, do not water.
- Watering cans with fine nozzles, or tins with small holes, should be used so as not to wash the soil and seeds out of the pots or seedbeds.
- Ensure that the bed is watered evenly.

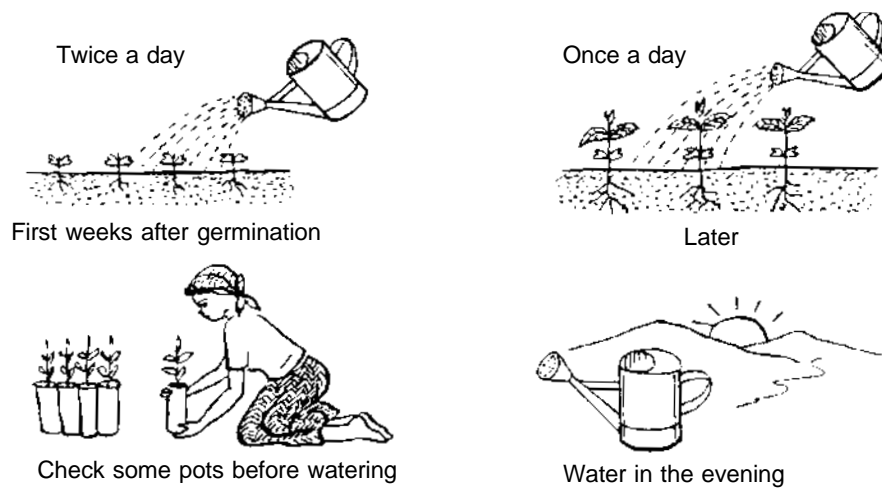


Figure 7.6 Watering seedlings

Avoid over-watering since it retards root growth, encourages fungal diseases and makes the shoot soft. Yellowing of leaves (despite application of fertilizers or organic manure) and a cover of moss on top of the container are signs of over-watering.

Pricking out (transplanting)

Seedlings in seedbeds need to be transferred to containers some time after germination. This is known as pricking out. Pricking out should be done when the seedlings have the first two or three leaves. Transplanting larger seedlings results in higher mortality.

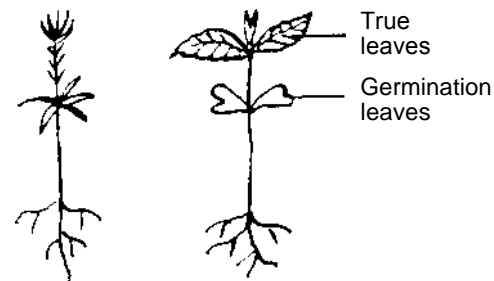


Figure 7.7 The right size for transplanting seedlings

The following procedure is recommended:

- Water the seedbeds and pots thoroughly the day before pricking out to avoid damaging the roots of the seedlings.
- Work in the shade in the early morning or late afternoon to avoid exposure of the roots to sunlight or wind. Pricking out may be done during the day if the weather is cloudy.
- Prick out only healthy well-developed seedlings.
- Lift the seedlings together with the soil using a trowel or a flat piece of wood to avoid damaging the roots or exposing them to the sun.

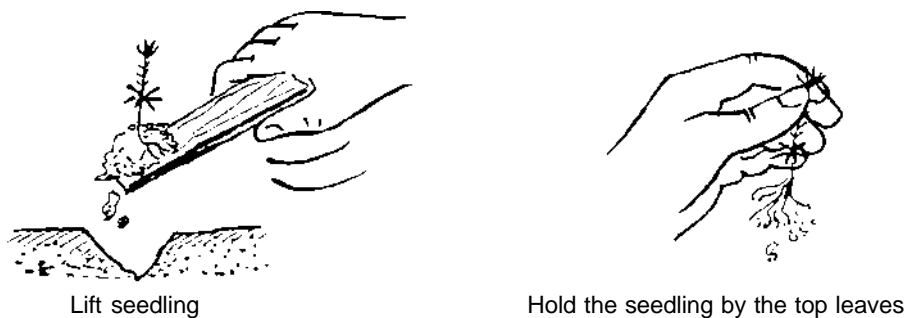


Figure 7.8 Handle seedlings gently

- Lift only a small number of seedlings at a time so that they can be transplanted within an hour to avoid drying out in the sun. Keep the roots covered at all times or put the small seedlings in a container with cool water.
- Make a hole in the container or pot—it should be deep and wide enough to accommodate the roots of the seedlings.



Figure 7.9 Transplanting a seedling

- Pick one seedling at a time; hold it by its leaves but not its stem to avoid damaging the soft tissues of the stem. Damaged stem tissues can attract damping-off fungi.
- If necessary, cut the long taproot with a sharp knife to about a third of its length to avoid the root coiling or bending into a U-shape when the seedling is transplanted into the pot.
- Place the seedling in the hole ensuring that the roots are not bent or pointing upwards. Bent or U-shaped roots result in deformed roots and high seedling mortality.
- Using your fingers and perhaps a piece of wood (dibble), gently press down the soil around the seedling to close the hole. Make sure that the hole is well closed and the soil pressed down around the seedling's roots to avoid air pockets which lead to high plant mortality. Be careful not to damage the root or stem.
- Water and shade the seedlings immediately after pricking out.

Containers in which direct sowing was done may contain more than one seedling. Such seedlings should be singled out when they are 2–5 cm high leaving only one strong seedling per pot. When singling out, the extra seedlings can be transferred to empty pots using the same procedure as for pricking out.

Weeding

Weeds compete with seedlings for light, nutrients and water and increase the risk of pests, diseases and fungal infection. Weeds should be uprooted by hand using a pointed stick or blunt knife. Never allow weeds to flower and fruit in a nursery or its surroundings. Do not damage the roots or shoots of the seedlings when weeding.

Fertilizer application

This may be necessary if the plants do not grow vigorously or if the leaves turn yellow. Do not use too much fertilizer otherwise the plants will become too tall before transplanting. Mix half a matchbox full of compound "D" fertilizer in 1 litre of water and apply the mixture to 100 plants. Subsequent applications, using the same concentration, may be made at fortnightly intervals. Approximately four such applications should be sufficient unless the soil in the pots is very poor. Be careful not to apply too much fertilizer.

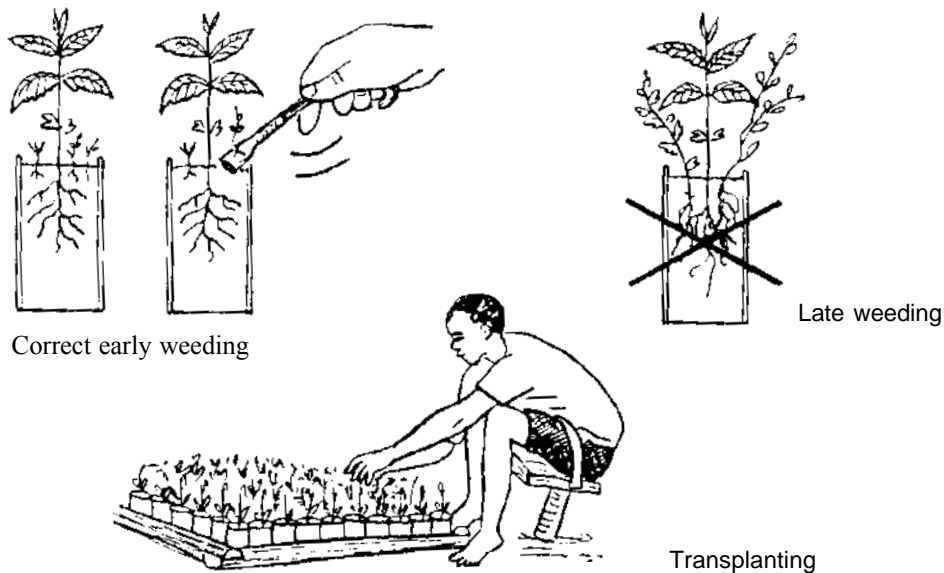


Figure 7.10 Weeding

Root pruning

Roots should be pruned to stop them growing through the open-ended containers into the ground underneath. The easiest method is to lift the container and prune the roots from underneath it. This must be done not later than when the seedlings have reached about 12 cm high and the roots start to penetrate the ground. As soon as the seedlings are more than 5 cm, the roots should be checked. If they have already grown too big, they should be cut with pruning shears or a sharp knife. Root pruning should be done repeatedly to prevent the roots growing too deep into the ground. Before root pruning, the seedlings should be well watered and then watered lightly again immediately afterwards.

Another method to control the root development is simply to shift the pots from one place in the bed to another (wrenching) as this detaches the roots from the ground.

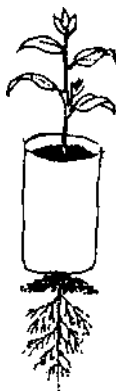


Figure 7.11 Overgrown roots

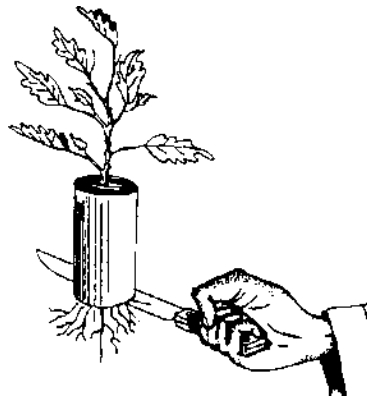


Figure 7.12 Pruning the roots with a sharp knife

Shoot pruning

When the shoot is more than twice the height of the pot or container, it may be necessary to trim it, but trimming the shoot is only possible for some broad-leaved species which sprout readily, e.g. eucalyptus, leucaena. It should not be done with conifers or species that become bushy rather than developing one leading shoot soon after pruning. Consult the nearest forester in case of any doubt.

Hardening off

Hardening off means conditioning or adapting seedlings to the harsher conditions that prevail in the field. This adaptation is achieved by gradual exposure to full sunlight through reduction of shade and a gradual reduction of watering frequency. The process of hardening should start one or two months prior to planting out.

The hardening process will make the stems hard and woody but vigorous, and the root system compact and well developed. Seedlings should be watched during the process. If signs of wilting appear, the plants must be watered and the hardening-off process slowed down.

Bare-rooted seedlings

Seedlings that are to be transplanted within the farm need not be raised in containers. In Eastern Zambia, experience of raising seedlings without polythene pots is limited, but some recommendations can be made:

- Clear the ground and remove the top 5 cm layer of the topsoil from the site where you want to establish your bed. Compact the soil thoroughly.
- Construct a frame, approximately 60 x 100 cm and 20–30 cm high, from bricks, planks or any other suitable material and secure it with wooden pegs, stones or soil. Fill this frame with good fertile topsoil, which should be not too clayey nor too sandy. Firm the soil lightly. Sow 2–3 seeds per planting station in rows, 10 cm between rows and 10 cm between stations. When the seedlings are about 5 cm high they should be thinned to one per station.
- You can also make a raised bed without a frame (similar to that for vegetables).

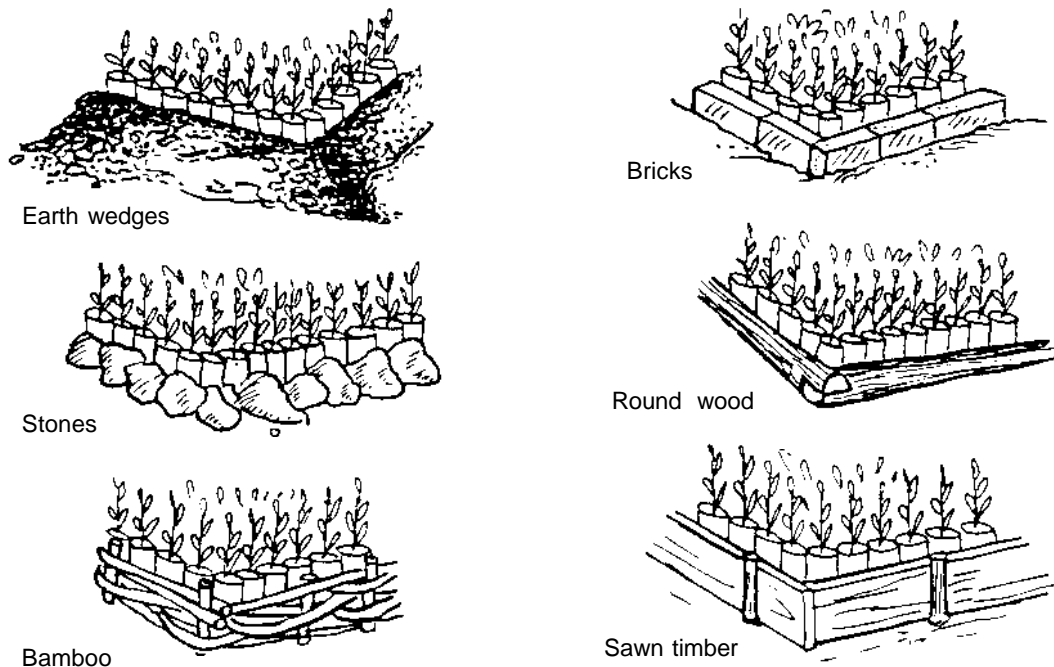


Figure 7.13 Different types of frames

Root pruning

Prune roots as soon as seedlings are about 10 cm high and the roots start to penetrate into the compacted soil layer.

Recommended procedure:

- Water the seedlings before pruning them
- Using a long sharp knife, panga, spade or a piece of wire, cut horizontally underneath the nursery bed to prune the taproots

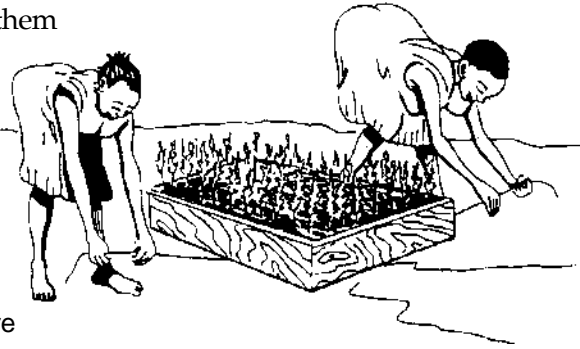


Figure 7.14 Root pruning using a thin wire

- Prune the side roots by cutting between the rows of seedlings using a sharp knife
- Water the seedlings again and shade them for at least a week to allow them to overcome the stress of root pruning
- Continue to root prune every four to five weeks.

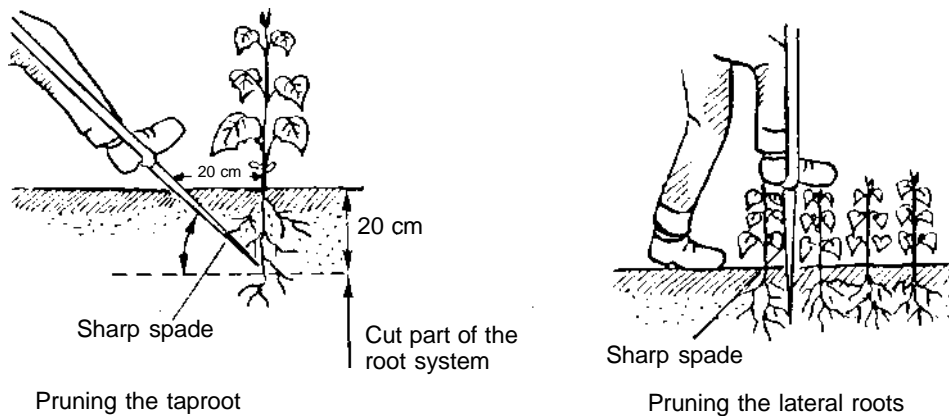


Figure 7.15 Root pruning

The other tending operations such as weeding, watering, shading and hardening off are the same as when seedlings are raised in containers.

Planting out

When planting out, seedlings should be dug up with a knife or spade, ensuring that all the soil around the roots is not removed. Avoid exposing the roots to direct sunlight when transporting seedlings and plant them as quickly as possible in holes that have been prepared in advance. The success rate will much depend on species and on how carefully the transport and planting was done.

7.4 Cuttings

A cutting is a piece or section of a stem, branch, root or twig which is taken from the mother (parent) tree and which will develop into a new plant with similar characteristics as the parent tree. The mother tree from which the cuttings are obtained should be healthy and disease free. If the cuttings are not planted right away, they should be wrapped in a wet sack and stored in a cool, dark place. Alternatively, they may be buried in wet ground for a few days. There are many species that grow well from cuttings, e.g. *Morus alba*, *Euphorbia* spp. and *Lannea discolor*.

Cuttings between 1 and 2 cm in diameter and 30–50 cm in length are ideal for planting directly in the field. In certain species such as *Kirkia acuminata* (Mzumba N), *Pterocarpus angolensis* (Mlombe N) and *Lannea* spp., larger cuttings more than 50 cm long and 2 cm in diameter can also be planted directly. The planting site must be well protected. A cutting must be placed in the soil with the buds in the upright position (not upside down), with two-thirds of its length in the ground (at least two nodes being in the ground) and at a slanting angle to speed up the development of roots and shoots.

Cuttings can also be raised in the nursery before transplanting into the field. For this purpose cuttings can be cut from branches. The recommended size of cuttings for this purpose is 1–2 cm diameter and 20–30 cm long.

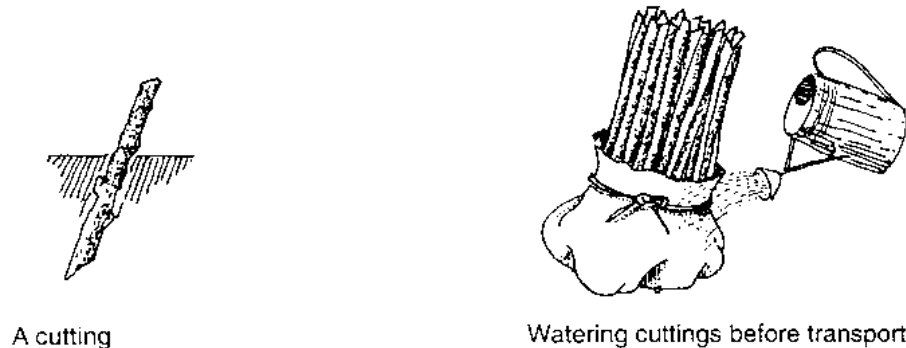


Figure 7.16 Management of cuttings before planting in the field

7.5 Budding and grafting

Budding and grafting are common methods of propagating fruit trees and have been widely used, especially for *Citrus* spp. The advantages of budding and grafting using good parent material are:

- Earlier production and higher yields
- Greater resistance to diseases
- Budded or grafted trees will show the true characteristics of the mother tree.

The part of the new plant that will grow to become the stem and branches is called the scion. The part that will grow to become the root is called the rootstock

Budding

Budding is the propagation method in which a lateral bud is used to produce a new plant by inserting the bud from a desired variety into another plant rootstock.

Seedlings, e.g. *Citrus*, are ready for budding after 8–12 months when the shoots are pencil-size. Bud-wood material should be obtained from high-yielding, disease-free mother trees and must be cut just before the budding is to be done. A good bud stick could be about 25–30 cm long and have 8–10 buds. Use the buds from the bottom and middle part of the bud stick. It is generally recommended not to use the bud nearest the top end of the bud stick. All leaves and thorns should be removed before the actual budding work starts

Budding methods

There are two basic methods of budding: the “T” or shield-budding method and the inverted “T” method.

"T" or shield budding

- Take the rootstock plant and trim off all the leaves below the point where you intend to bud the seedlings. This should be at least 25 cm above the ground.
- Using a sharp knife, make a vertical cut about 3 cm long (the cut should not penetrate the wood).
- Then make a horizontal cut about 1 cm long at the upper end of the vertical cut to form a "T".
- Using a blunt part of the budding knife, open out the cuts.
- Take the bud stock and remove a shield-shaped piece of bark including the bud—the piece should be approximately 2 cm long.
- Hold the shield-shaped piece you have removed and insert it into the "T"-shaped cut on the rootstock plant, pushing it downward.
- Using polythene sheeting or tape, wrap around the insertion firmly from the bottom moving upwards and avoid covering the bud completely.
- Unwrap the bud after 15–20 days.
- Two weeks later inspect the bud to check if it is still green. If so, the bud has taken and the seedling can be cut 15–20 cm above the bud to stimulate the bud to grow. If the bud is brown, then it is dead and the seedling must be budded again.
- Remove the old seedling stub close to the bud (2 cm above the bud) after the bud has grown 20–30 cm long.

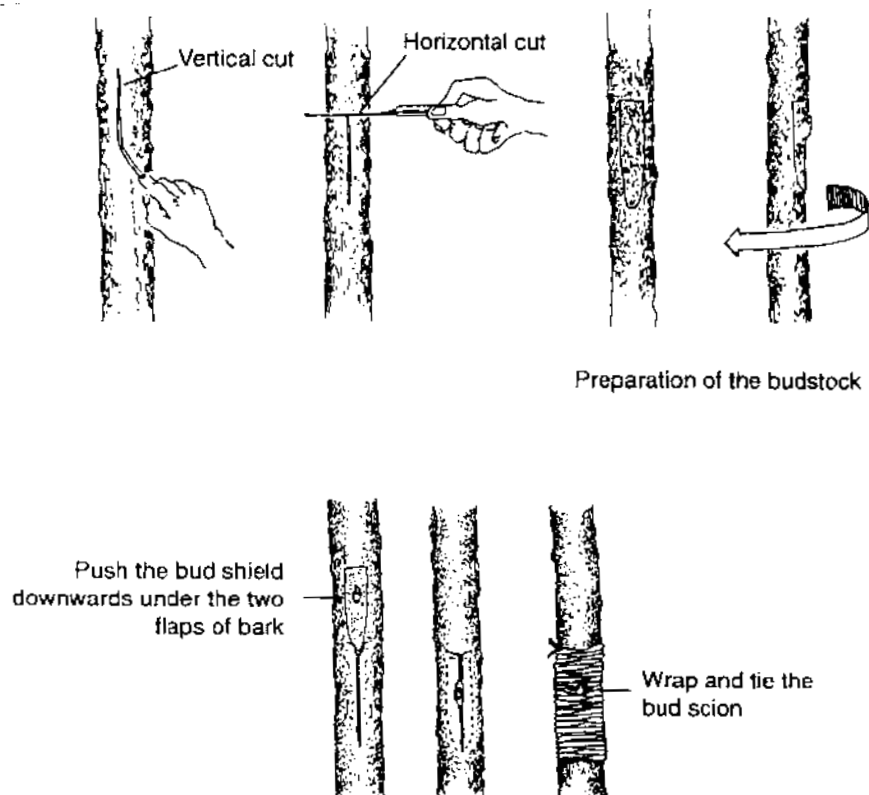


Figure 7.17 "T" or shield budding

Inverted "T" budding

The procedure is the same as in the "T" budding method except that the horizontal cut is made below the vertical cut. The "Inverted T" is good and it is the most common method in Zambia.

For more details on budding contact your nearest horticultural or forest officer.

Grafting

Grafting is joining together the scion and the rootstock so that they grow as one plant. There are several methods of grafting fruit trees. The two common ones are described below.

Splice (whip) grafting

- Using a sharp knife make a slanting cut at the basal end of the scion.
- Make a similar cut at the end of the rootstock.
- Place the cut surfaces together ensuring that the cambial regions are in contact.
- Tie the rootstock and scion together with a strip of polythene sheeting, tape or string.
- Protect the grafted plant against sunlight and water it regularly until the graft has united.

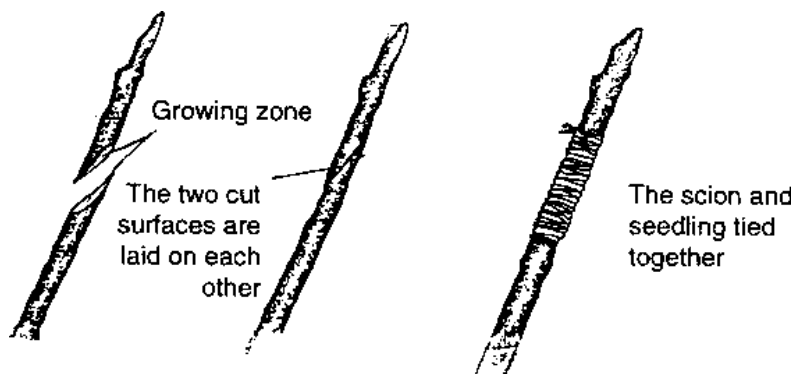


Figure 7.18 Splice grafting

Wedge or cleft graft

A wedge or cleft graft is made by inserting a scion into a split in the stock. This method is suitable for grafting young materials which are in the growing stage.

Grafting procedure

- Prepare the scion by making two sloping cuts (4–5 cm in length) slightly below the level of the leaves using a sharp knife almost parallel to the twig.
- Cut the rootstock across at a succulent (soft) point.
- Split the rootstock.
- Insert the scion into the split.
- Tie the union with a polythene strip or tape.
- Protect the seedling against sunlight and water it regularly until the scion and the rootstock have united.

Open a shallow furrow along the contour, sow the seed, cover with soil lightly, and firm.



Figure 7.19 Wedge grafting

8

MANAGEMENT OF TREES IN THE FIELD

The planting site must be well prepared in order for trees to become well established. All shrubs and bushes should be cut, piled up and burnt. Deep hoeing or ploughing must be done to get rid of weeds for a radius of at least 50 cm around the planting stations.

8.1 Planting

Planting should be done when the rains are well established, i.e. any time from mid-November to January. It is best to start planting after the top 30 cm of the soil are moist and the rains seem to be reliably established. The amount of moisture can be determined by simply digging a hole in the ground and feeling if the soil is moist. Seedlings must be well watered a day before planting.

At planting time, the seedlings should be between 15 and 30 cm tall. Overgrown seedlings should be avoided because they are more susceptible to mechanical damage and stress. Spacing will vary depending on the purpose and the desired products. Planting at high density is advantageous if small-sized poles or firewood are in high demand. For each seedling a big hole should be dug (30 cm x 30 cm x 30 cm) so that the roots can establish easily. Remove the polythene pots when planting, though this can be somewhat time-consuming. This ensures that the roots can grow sideways and quickly get access to water and nutrients from a larger volume of soil. The polythene pots can be reused.



Figure 8.1 A seedling planted without a polythene pot

All dead or dying plants should be replaced 3–4 weeks after planting. This operation is known as beating up, making good or blanking.

8.2 Fertilizer application

This may be necessary when the trees show signs of nutrient deficiency such as stunted growth, yellowing of leaves and serious die-back. Organic manure and compost can be used instead of expensive inorganic fertilizers which farmers may not be able to afford. Some species can grow reasonably well without fertilizers, however, provided the soil is not too poor. Tree species which are susceptible to boron deficiency, e.g. eucalyptus and grevillea, do not do well or may even die without application of borate. The symptoms of boron deficiency are leaf deformity, serious die-back and high mortality rates.

8.3 Weeding

Weeding is an important tending operation for the following reasons:

- It reduces the competition for moisture and nutrients thereby boosting early growth of the tree seedlings
- It reduces the risk of fire to the seedlings
- Proper weeding combined with loosening of the soil surface facilitates percolation of water and reduces evaporation from the soil surface thus contributing to good plant development.

Young trees should begin the dry season completely weed-free. The number of times weeding will be required annually will depend on the amount of weeds in the locality and how vigorous they are.

Farmers should be encouraged to intercrop trees with crops, at least during the first two years. The labour invested in weeding is repaid by the value of the crops harvested in the short term. Further, farmers find it more natural to weed crops than trees, and therefore the trees will benefit indirectly from the crop management.

Weeding may be carried out by hand, hoe or oxen and should be continued until the seedlings are well established.

Weeding techniques

Spot weeding

This is a type of weeding in which an area of 50-cm radius around each plant is weeded with a hoe.

Clean weeding

This is when the entire plot of trees is completely weeded. It may be done by hand, hoe or with oxen. Oxen are ideal if the area to be weeded is very large.

Line or strip weeding

This is when the rows of trees are weeded. It is also known as line screening. Hand weeding or the use of oxen are both suitable for this type of weeding.

8.4 Protection of young trees

Newly planted seedlings and young trees are very sensitive and need to be protected against livestock, fire, termites, wind and people.

Livestock

Trees need protection from livestock until they are sufficiently high for at least part of the crown to be out of reach of browsing livestock, which normally takes at least 2–3 years. In Eastern Province livestock are left on free range during the dry season after the crops have been harvested. It is during this period, when there is a shortage of fodder in communal grazing areas, that newly planted tree seedlings are likely to be browsed or trampled if they are not protected.

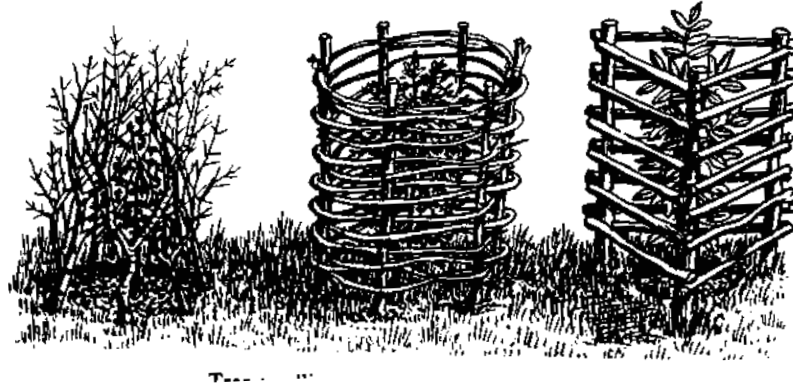


Figure 8.2 Tree seedlings protected against livestock

The most common way of protecting young trees from livestock is by fencing. Various materials can be used for fencing such as thorny branches, sticks and poles. Poles may be required for spot fencing (around individual young seedlings) or for fencing around a woodlot.

The other method of fencing is to use a living plant. Trees or shrubs, e.g. *Euphorbia tirucalli*, are planted around the young trees to form a live fence. To be effective, the live fence needs to be established 3–4 years earlier than the trees. If planted later it will need to be reinforced with dry thorny branches until it is sufficiently high and well established. This method is more permanent and requires little labour for repair. However, goats may find their way through a live fence of euphorbia, especially when the fence is still young. When the fence is older, it can be made quite impenetrable if well managed.

Yet another method of protecting trees against livestock is to use the animal's dung or urine. Fresh dung is mixed with water and soap to make a solution which is then allowed to stand for three days. The mixture is then painted or spread around the trees. An example is use of a solution of goat dung smeared on stems of *Gmelina arborea*.

Planting tree species which are not favoured for browsing by livestock, e.g. *Senna siamea*, is an alternative in areas with a lot of livestock.

General control of grazing animals after the harvest would reduce tree mortality due to trampling and browsing. However, post-harvest grazing is an accepted practice and a strong tradition and presently in many places there is no mechanism to control it. In Eastern Province controlled grazing is practised throughout the year in Paramount Chief Mpezeni's area, Chief Saili's area and Senior Chief Mwase's area. These Chiefs passed legislation on herding of livestock. Any animals which are not being herded are impounded and forfeited to the Chief. In the case of livestock grazing on or damaging somebody's crops, the livestock owner is required to compensate the victim. In addition, he/she has to pay a fine to the Chief. This kind of legislation has helped to reduce post-harvest grazing problems in these areas. Rotational grazing and introduction of fodder banks under a zero-grazing system (stall feeding) could also help alleviate these problems. Most of these techniques require fencing of relatively large areas if the technology is to work effectively. Sweet dambos are commonly used for grazing livestock during the dry season. With proper management they could sustain a certain number of animals throughout the dry season.

Fire

If young trees are weed free there is no grass to fuel a fire. Therefore, weeding is very important. Construction of a firebreak also helps to protect trees against fire. A firebreak should be 4–6 m wide and must be free of grass and dead wood. Firebreaks should be constructed between April and June before the beginning of the fire season.

Early burning of the surrounding bushes and forest should be carried out between April and June rather than later when it is very difficult to control a fire.

Control of pests and diseases in plants

There are several pests and diseases which affect plants, especially during the development stage.

Termites are among the most serious pests which damage growing trees. Termites eat practically any plant material containing cellulose. Growing of termite-resistant species is recommended in areas with a serious termite problem.

Tree mortality caused by termites represents a tremendous economic loss in terms of direct establishment costs and potential yields. Farmers incur equally heavy crop losses from other plant pests and diseases. A cheap method of controlling termites is to use natural pesticides. Some farmers use local plants to control pests and diseases in this way, though only on a small scale.

Application of wood ash in a planting hole and around the base of a tree has also been reported to be effective against termites. Dry tobacco leaves crushed and soaked in water and then applied around the plant have been tried in some parts of the Province. A more difficult method has been used in Kenya: the queen termite is located and killed and this leads to dispersal of the rest of the colony.

Some of the plants which can be used to control pests and diseases are listed in Table 8.1.

Wind

Young trees should also be protected against strong winds. A windbreak or hedge is effective against wind. Sticks can also be used to support the young trees against strong winds.

People

Trees should also be protected against people, particularly children, who may break, uproot or trample the seedlings. Thorny fences are effective against children.

8.5 Management of trees

The most important management techniques are coppicing, pollarding, pruning, lopping and thinning. These management practices are described below.

Coppice management

Coppicing is the cutting back of a tree to stimulate production of new shoots. When carrying out coppicing the following are the steps:

- The cut should be clean and slanting and at 10–30 cm above ground level.
- The bark of the stump should not be damaged.

Table 8.1 Natural pesticides

Botanical name	Local name	Part of plant used	Preparation	Pests/diseases controlled
<i>Capsicum frutescens</i> (Chillies)	Sabola Mphilipili	Fruits, seeds	<ul style="list-style-type: none"> ● Grind (crush) one handful (about 100 g) of dry chillies ● Put the ground chillies in 1 litre of water in a bucket ● Stir the mixture and allow to stand overnight ● Add 5 litres of soapy water so that the mixture sticks to the crop leaves when applied ● Apply on a small spot first to test the concentration (if it is too strong, leaves can easily be scorched). ● Dilute with more water if the mixture is too concentrated ● Spray (apply) on the crops in the evening. 	Ants Aphids Beetles Cucumber mosaic virus Weevils Ring spot virus Tobacco mosaic virus
<i>Allium</i> spp.	Galiki	Garlic bulbs	<ul style="list-style-type: none"> ● Grind 3–4 garlic bulbs ● Soak the garlic powder in 500 ml of paraffin for 24 hours (one day) ● Filter the mixture ● Add 10 litres of water to the mixture ● Dissolve a bar of soap in warm water and add to the mixture ● Spray in the evening 	Aphids Fungal diseases Cabbage worm
<i>Swartzia madagascariensis</i>	Mcheleket	Leaves, pods	<ul style="list-style-type: none"> ● Pound fresh leaves and pods ● Soak the mixture in hot water for 24 hours (there should be enough water to cover the pounded mash) ● Dilute 1 part of the mixture to 1 part water ● Sieve and spray the affected plants. 	Termites
<i>Carica papaya</i> (Pawpaw)	Papayi	Leaves	<ul style="list-style-type: none"> ● Chop and pound 1 kg of pawpaw leaves ● Add 1 litre of water ● Squeeze (sieve) the mixture through a cloth ● Add half a litre of soapy water ● Dilute 1 part of the mixture to 4 parts of water ● Apply early in the morning or late evening. 	Rust

Botanical name	Local name	Part of plant used	Preparation	Pests/diseases
<i>Tephrosia vogelii</i>	Ububa	Leaves	<ul style="list-style-type: none"> ● Pound one bucket full (15 litres in volume) of fresh leaves ● Soak in water for 2–3 hours ● Sieve the mixture using a cloth or sieve ● Dilute 1 part of the mixture to 4 parts of water ● Apply (spray) once a week. 	Aphids Cutworms Termites
<i>Nicotiana tobacum</i>	Fodya (Tobacco)	Leaves	<ul style="list-style-type: none"> ● Boil a mixture 250 g tobacco leaves and 30 g soft soap in 4 litres of water for 30 minutes ● Dilute 1 part of the mixture to 5 litres of water ● Spray the tobacco tea on the affected plants 	Aphids Termites Caterpillars Fungal, viral diseases.
		Cigarette butts	<ul style="list-style-type: none"> ● Boil one cupfull of cigarette ends in one litre of water ● Dilute the mixture with 5 parts of water ● Add some soap to make the tobacco tea stick to the leaves 	
<i>Azadirachta indica</i> (Neem)	Nimu	Seeds	<ul style="list-style-type: none"> ● Prepare 500 g of crushed seed kernels ● Mix the crushed seed with 10 litres of water ● Stir the mixture ● Leave to stand for at least 5 hours ● Spray the neem water directly on the crop to be protected ● The effect lasts for 3–6 days ● It has been estimated that 20–30 kg of neem seed (an average yield from 2 trees) can normally treat one hectare. 	Grain borers, beetles.
<i>Tagetes erecta</i> African/Aztec marigold		Plant	<ul style="list-style-type: none"> ● It is advisable to intercrop marigold in gardens where there are nematodes and other pests. It is a good repellent. 	Aphids Nematodes

- Preferably coppicing should not be done during the rainy season. This may increase fungal infection, and many timber trees, e.g. *Eucalyptus tereticornis* (Bulugamu N) sprout prolifically if cut during the hot dry season just before the onset of the rains.
- When the shoots are about a metre tall, all except the best one should be removed to reduce competition.
- Slash the grass to avoid uncontrolled fire in the area under coppice management.
- Carry out early burning (May–June) outside the area under coppice management.



Figure 8.3 Coppiced trees

Not all trees coppice. For instance pine and cypress trees do not. Some trees that can be coppiced are:

- *Eucalyptus* spp. (Bulugamu N)
- *Gmelina arborea* (Malaina N)
- *Isobertlinia angolensis* (Kapane, Msanganza, Mtowo N)
- *Leucaena leucocephala* (Lukina, lusina N)
- *Pterocarpus angolensis* (Mlombe, Mlombwa N)
- *Senna siamea* (Macheche N)
- *Senna spectabilis*
- *Syzygium guineense* (Katope, Katubwi, Mfowo N).

Pollarding

Pollarding is the cutting back of the crown of the tree at a height of 2 m or more from the ground. The main purpose of pollarding is to harvest the branches or leaves and to stimulate the growth of a new, well-formed productive crown at a height where livestock cannot reach the new shoots.

The entire crown of the tree is cut. The branches and twigs can be laid on the ground and left for one week. They can then be shaken to remove the leaves and small twigs and used as fuelwood or poles.

Not all species can withstand pollarding. Some commonly pollarded species are:

- *Balanites aegyptiaca* (Nkuyu N)
- *Brachystegia* spp. (Muombo N)
- *Erythrina abyssinica* (Mlunguti N)
- *Faidherbia albida* (Msangu N)
- *Ficus sycomorus* (Mkuyu N)
- *Grevillea robusta*
- *Jacaranda mimosifolia*
- *Julbernardia paniculata* (Mtondo N)

- *Manihot glaziovii* (Chinangwa, katapa, mtambula N)
- *Morus alba* (Malubeni N)
- *Piliostigma thonningi* (Msekese N).

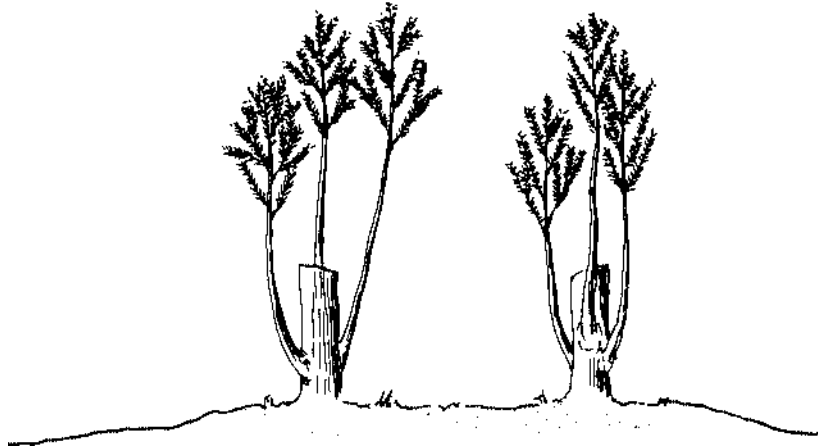


Figure 8.4 Pollarding

Pruning

Pruning is the removal of the lower branches of a tree. It is mainly done to:

- Reduce shade on the agricultural crop
- Harvest the branches for fodder, fuelwood, etc.
- Produce knot-free poles or sawn timber
- Allow passage through a woodlot.

Pruning should be done before planting the crop or during the cropping season when the trees have a shading effect on the crops. When pruning a branch, make the cut at an angle in order to allow rain water to drain away from the cut surface and therefore reduce the possibility of fungal attack. Trees for timber and pole production should be pruned close to the stem.

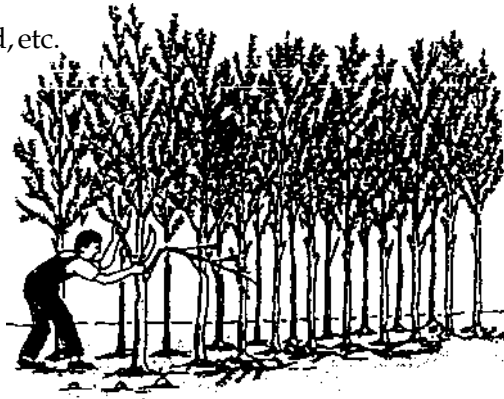


Figure 8.5 Pruning

Lopping

This technique involves cutting one or more branches from the trunk or stem of the tree, usually for fuel and/or fodder.

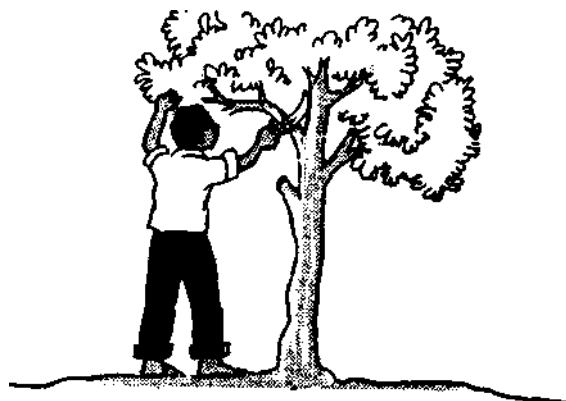


Figure 8.6 Lopping

Thinning

Thinning is a planned operation where closely planted trees are selectively cut. This requires the removal of about one-third of the trees leaving the best ones evenly spaced. In stands where trees are densely planted, thinning will occur naturally, but if active thinning is done the growth of the remaining trees will be promoted. The thinned stems can be used on the farm or sold, therefore thinning can be a profitable operation. Thinning can also be carried out for silvicultural reasons, for instance to salvage dying or diseased trees. Thinning out diseased trees reduces the risk of disease spreading to the rest of the stand.

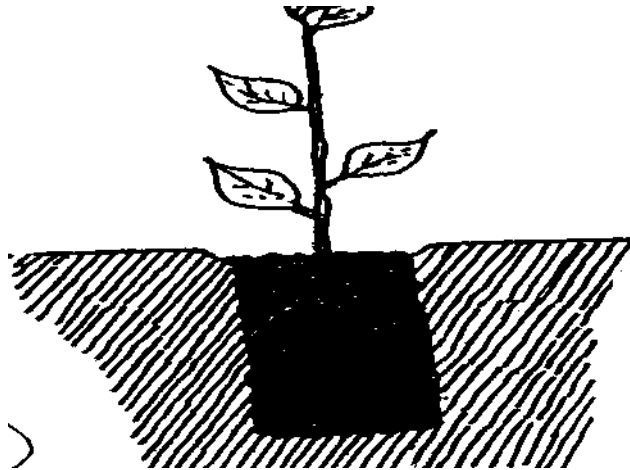


Figure 8.5 Thinning



MONTHLY PLANS FOR EXTENSION ACTIVITIES



9.1 Monthly plans

Table 9.1 gives details of extension activities to be carried out each month. The following subjects are covered:

- Practical topics in central nurseries (mainly Forest Department nurseries and, where applicable, horticultural nurseries in the Department of Agriculture). The areas covered under this topic range from propagation to sale of seedlings. The work in central nurseries should be co-ordinated by the District Forest Extension Officer.
- Topics for extension to individual farmers including nursery techniques, protection and management of trees and marketing of fruits.
 - This work should be done by Camp and Block Officers and co-ordinated by District Officers.
 - The District Forestry (Extension) Officer should make regular visits to supervise the programmes and help Block and Camp Officers with technical issues.
- Topics for extension based on group approach.
 - These include topics which need the active participation of the community, e.g. controlled burning, protection and management of indigenous forests and group nurseries. This work can best be done using a co-ordinated





Monthly plan for extension activities

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Issues (what is to be done in nurseries)											
Seedlings for extension purposes	X										X
Work at the nursery	X	X		X	X			X	X		X
Seedling distribution	X										
Procurement of nursery inputs	X	X	X								
Prevention of fire breaks			X	X	X						
Maintenance			X	X							
Procurement of nursery inputs				X	X	X	X				
Pruning				X	X	X					
Maintenance of shade mats					X	X					
					X	X	X	X			
Propagation of slow-growing species						X	X	X			
Propagation of seedlings						X	X	X	X	X	X
Propagation of slow-growing species							X	X	X		
Propagation of fast-growing species									X	X	
Propagation of cuttings								X	X	X	X
Propagation of citrus								X	X	X	X
Pruning									X	X	X
Pruning off										X	X
										X	X
Propagation of seedlings	X	X	X								X
Pruning			X	X				X	X	X	
Pruning (see Table 9.2)	X	X	X	X	X	X	X	X	X	X	X
Propagation of fast-growing species								X	X	X	X





	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov
extension work geared to families											
of wildlings	X	X									
f seedlings	X										
ling of live fences and woodlots	X										
f cuttings	X									X	X
ing of food crops, leguminous shrubs	X										
of seedlings from being s weeds when fields are weeded	X	X	X								
against insect damage and termites	X	X	X	X	X						
nd tending young seedlings		X	X	X	X						X
esting and marketing					X	X	X	X	X	X	X
against livestock damage					X	X	X	X	X	X	X
ent of on-farm nurseries						X	X	X	X	X	X
						X	X	X	X	X	
slow-growing species, including ment							X	X	X		
fast-growing species, including ment									X	X	X
against fire							X	X	X	X	X
g of woodlots									X	X	X
nd grafting							X	X	X	X	
clearing of land/management t in fields								X	X	X	X





	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov
Preparation prior to planting or direct										X	X
Assessment and importance of wind breaks	X										X
Planting out/singling of slow-growing species							X	X	X		
Planting out/singling of fast-growing species									X	X	X
Extension based on the group											
Protection of seedlings from being removed when fields are weeded	X	X	X								
Protection against insect damage (termites)	X	X	X	X	X						
Protection against fire						X	X	X	X	X	X
Monitoring and tending young seedlings		X	X	X	X						X
Monitoring and marketing				X	X	X	X	X	X	X	X
Organization					X	X	X				
Protection against livestock damage				X	X	X	X	X	X	X	X
Management of village/group nurseries					X	X	X	X	X	X	
Field burning				X	X	X					
Use of indigenous bushland for establishment								X	X	X	X
Management of school nurseries when possible							X	X			X
Use of indigenous trees							X	X	X		
Clearing of land/management of land in the field							X	X	X	X	X
Assessment and importance of windbreaks	X										X
Planting out/singling of fast-growing species related to boundary planting										X	X





as there may be certain tree species which farmers need but that do not appear on the list. These may be added on your local collection programmes.

Seed collection should be spearheaded by the Forest Extension Officers if the demand for good-quality tree seeds and seedlings in the Province is to be met. Farmers with adequate knowledge and skills in collecting and handling seeds should be encouraged to collect for their own use.





Seed collection, handling and number of seeds per kilogram

Collection method

Ground: collecting the fallen fruits and seeds from the ground.

Climbing: collection from the crown by climbing the tree with or without tools.

Access: collection from the crown with access from the ground with or without tools.

Drying period

The period depends mainly on weather conditions. The period given in the tables applies under good drying weather conditions.

Scientific name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment	Time of sowing
					Method	Period (days)					
<i>Acacia senaria</i>	Ngowe	June–Sept.	Picking Ground	Threshing	Sun	3–5	Winnowing	14,000–16,000	Airtight container	Soak in hot water	January
<i>Acacia drepanolobium</i>	Mzunga Nsangu	May–Oct.	Climbing	Threshing	Sun	3–5	Winnowing	12,000–31,000	Airtight container	Soak in hot water	January
<i>Acacia gerrardii</i>	Mlambe	April–Oct.	Shaking Climbing Ground	Crushing Soaking	Sun	3–5	Washing	1,500–3,000	Airtight container	Soak in hot water	January
<i>Acacia robusta</i>	Mupapa	June–Oct.	Climbing Picking	Sun drying	Sun	3–5		450	Airtight container	Not necessary	January
<i>Acacia robusta</i>	Mkalanga Msengwa Mnye	Dec.–April	Climbing	Drying	Sun	3–5	Hand	10,000–13,000	Airtight container	Soak in hot water	January
<i>Acacia robusta</i>	Mlilanzenze Mtanga Msasempanga	Aug.–Nov.	Climbing Ground	Threshing Drying	Sun	3–7	Hand	6,000–8,000	Airtight container	Soak in cold water	January





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds /kg	Storage treatment	Pre-sowing	T
					Method	Period (days)					
	Chikuni Chashaba Buwa	March–June	Picking Ground	–	Sun	3–5	Hand	150–200	Container	Soak in	S
alensis	Mpovya	Dec.–April	Picking Ground	Crushing Squeezing	Sun	3–5	Washing	2,500–3,000	Airtight container	Not necessary Loses viability within 6 months	Ju
us	Jackfruit	Oct.–Feb.	Climbing Ground	Soaking	Sun	3–5	Hand washing	45–90	Not recommended	Not necessary	O
ndica	Nimu	Feb.–May	Picking	Soaking	Not recommended	–	Washing	5,000	Not recommended	Not necessary	A
eanana	Mkole	Aug.–Sept.	Climbing Ground	Drying	Sun	3–5	Washing	±4,000	Looses viability within 6 months	Not necessary	F
pytiaca	Nkuyu	April–Sept.	Picking Ground	Mortar Pestle	Sun	3–7	Washing	350	Airtight container	Soak in cold water	Ju
rsiana	Mpondo Katondotodo	May–Sept.	Climbing Ground	Drying	Sun	3–7	Washing	±1,500	Airtight container	Soak in water	Ju
color	Mtacha Mziyi	Feb.–May	Picking	Squeezing	Sun	3–5	Washing	3,000–3,500	Airtight container	Not recommended	Ju
tiopum	Mlaza Chipamba Kakoma	Aug.–Dec.	Climbing Ground	Soaking	Sun	4–7	Washing	2–3	Airtight container	Not necessary	M





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment	T s
					Method	Period (days)					
bussei	Mkongolo Mwanza Masaka	July–Aug.	Climbing Ground	Drying	Sun	3–7	Washing	1,500	Airtight container	Soak in water	
	Mputi	June–Nov.	Climbing	Sun drying	Sun	5–7		1,500–2,600	Airtight container	Nicking	
antha	Mpasa Mlebezi Msongamino	Nov.–Jan. Ground	Climbing	Soaking Sieving	Sun 19,500	3–5 well	Winnowing necessary	19,000–	Does not store	Not	
na	Kawidzi Mkoso Ngalati Kapanga	April–Oct.	Climbing Ground	Threshing Drying	Sun	3–5	Hand	12,500–14,000	Airtight container	Soak in hot water	
decapetala	Chatata	June–Aug.	Picking Ground	Drying	Su	3–5	Winnowing Hand		Airtight container	Soak in hot water	
clothysrus	Kalyandula	Aug.–Sept.	Picking	Threshing	Sun	3–5	Winnowing	19,000	Airtight container	Soak in hot water	
a	Papayi	Feb.–Nov.	Climbing Picking	Soaking	Sun	2–4	Washing	±20,000	Airtight container	Not necessary	
viata	Mkoswe Mtantany-elele Mnyoka	June–Aug.	Climbing Picking Ground	Drying	Sun	3–7	Winnowing Sieving	±15,000	Airtight container	Soak in cold water	
n	Nyamundolo	April–July	Picking	Drying	Sun	3–5	Washing		Airtight container	Soak in cold water	





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage treatment	Pre-sowing	Treatments
					Method	Period (days)					
M. africana	Kajwalina	July–Sept.	Climbing	Sun drying	Sun	2–5	Sieving	600,000–900,000	Airtight container	Not necessary	None
	Ndimu	April–Aug.	Picking Ground	Soaking Squeezing	Sun	2–4	Washing		Airtight	Not necessary	None
	Kalamamba Tsanya Mpane’e Mkwelambulu	May–Oct.	Climbing Ground	Drying	Sun	3–7	Hand		Airtight container	Not necessary	None
M. holle	Kalama Mkute Kailunguni	June–Sept.	Climbing Ground	Drying Threshing	Sun	3–5	Hand Floatation	10,000–15,000	Airtight container	Remove seed wings	None
M. zozonica	Saipuresi	May–July	Climbing Ground	Drying	Sun	3–5	Sieving	88,000–200,000	Airtight container	Not necessary	None
M. bitanica	Saipulasi	May–Aug.	Climbing	Sun drying	Sun	3–5	Sieving	160,000–290,000	Airtight container	Not necessary	None
M. cinerea	Flamboyant	April–June	Climbing Ground	Drying Shaking	Sun	2–5	Winnowing	±2,000	Airtight container	Soak in hot water	None
	Kalum-pangala	May–Oct.	Climbing Ground	Drying	Sun	3–7	Winnowing		Airtight container	Soak in hot water	None
M. nana	Mchenja, Mchenja-musumu	April–Sept.	Picking	Trampling Mortar Pestle	Sun	2–4	Hand/ Washing	2,700–3,200	Airtight container	Not recommended	None





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment
					Method	Period (days)				
<i>...s</i> <i>...pon</i>	Mtowa, Mtombozi	June–Aug.	Climbing Ground	Drying	Sun	3–7	Floatation		Airtight container	Not necessary
<i>...undifolia</i>	Matowo Mchiu	Oct.–Nov.	Climbing Ground	Drying Threshing	Sun	3–5	Hand Winnowing	35,000–40,000	Not recommended	Not necessary
<i>...yssinica</i>	Mulunguti Mwale	Dec.–March	Climbing Ground	Drying Threshing	Sun	3–7	Hand Winnowing	6,800	Airtight container	Not necessary
<i>...itriodora</i>	Bulugamu	May–Sept.	Climbing Shaking	Drying	Sun	1–3	Sieving	140,000–220,000	Airtight container	Not necessary
<i>...randis</i>	Bulugamu	May–Sept.	Climbing Shaking	Drying	Sun	1–2	Sieving	900,000–3 million	Airtight container	Not necessary
<i>...s</i>	Bulugamu	April–July	Climbing Shaking	Drying	Sun	1–2	Sieving	300,000–800,000	Airtight container	Not necessary
<i>...bida</i>	Msangu	July–Oct.	Climbing	Mortar Pestle	Sun	3–4	Winnowing	±13,000	Airtight container	Soak in hot water
<i>...a</i>	Chiyele Chinsense	Oct.–April	Climbing Ground	—	Sun	3–7	Winnowing	165,000	Not recommended	Not necessary
<i>...dica</i>	Ntudza	May–Sept.	Climbing Picking	Drying Mortar Pestle	Sun	3–7	Winnowing	±200,000	Airtight container	Soak in hot water
<i>...hananii</i>	Matatane Msamusa Msongwa	Jan.–April	Climbing Ground	Soaking	Sun	3–7	Winnowing	–	Not recommended	Soak in cold water





Name	Local name	Time for seed collection	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment
					Method	Period				
<i>Quercus</i>	Quick stick	Aug.–Oct.	Ground Picking	Drying	Sun	3–5	Winnowing	6,500–8,000	Airtight container	Soak in hot water
<i>Albizia</i>	Malaina	Oct.–Dec.	Ground	Soaking Pounding	Sun	3–5	Floating	1,400–2,500	Airtight container	Not necessary
<i>Acacia</i>		May–July	Climbing	Threshing	Shade	3–5	Winnowing	±83,000	Airtight container	Not necessary
<i>Commersonia</i>		March–June	Climbing Picking	Drying	Sun	2–5	Hand	63,000–80,000	Airtight container	Not necessary
<i>Antigonon</i>	Mtondo	Aug.–Dec.	Climbing	Drying Ground	Sun	3–7	Hand		Airtight container	Soak in cold water
<i>Ipomoea</i>	Kamponi	July–Nov.	Climbing Ground	Drying	Sun	3–7	Hand	1,500–2,000	Airtight container	Soak in cold water
<i>Passiflora</i>	Mubawa Mlulu	June–Oct.	Climbing Ground	Drying	Sun	3–7	Hand	2,000–3,800	Airtight container	Not necessary
<i>Conocarpus</i>	Mvunguti Mvungula Chizutu	Jan.–March	Climbing Ground	Soaking Mortar Pestle	Sun	3–7	Washing	3,400–6,000	Seed does not store well	Not necessary
<i>Eleusine</i>	Mtumbwi Mzumba	April–August	Ground Climbing	Drying Shaking	Sun	3–5	Floatation	3,000	Airtight container	Not necessary
<i>Eleusine</i>	Chaumbu	Nov.–Feb.	Climbing	Soaking	Sun	3–5	Hand	40,000–	Not recom-	Not
<i>Eleusine</i>	Kombwanyika Msambandola		Ground Picking				Floatation	45,000	mended	necessary
<i>Eleusine</i>	Lusina Lukina	June–Sept.	Picking	Threshing	Sun	3–4	Winnowing	13,000–34,000	Airtight container	Soak in hot water





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Name	Local name	Time for seed collection	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment
					Method	Period				
<i>s capassa</i>	Chimpakasa Mswaswa Chiwala-wala	May–Oct.	Climbing Ground	Drying	Sun	3–5	Winnowing Floatation	5,000	Airtight container	Soak in cold water
<i>dica</i>	Manga	Nov.–April	Climbing Ground	Drying	Sun	3–5	Washing	±50	Airtight container	Remove seed coat
	Kasanika Msusankwale	May–Sept.	Climbing Ground	Drying Threshing	Sun	3–5	Hand Floatation	±32,000	Airtight container	Not necessary
<i>ach</i>	Chinkondi	April–Aug.	Ground	Mortar Pestle	Sun	4–7	Washing	2,100–3,000	Airtight container	Not necessary
<i>fera</i>		July–Oct.	Picking	Threshing	Sun	2–5	Winnowing	4,000–5,000	Airtight container	Not necessary
<i>atellifolia</i>	Mupundu Mubula	May–Nov.	Climbing Ground Pestle	Soaking Mortar	Sun/ Shade	3–7	Washing	250–350	Airtight container	Not necessary
<i>golensis</i>	Muwanga	July–Oct.	Climbing Ground	Drying	Sun	3–7	Hand	3,000–3,500	Airtight container	Not Necessary
<i>cana</i>	Kotapela	Picking March–June	Climbing Ground	Soaking	Shade	3–5	Washing	±15	Seed does not store well	Not necessary
t	Msekese	May–Sept.	Picking	Mortar Pestle	Sun	3–5	Winnowing	±7,200	Airtight container	Not necessary
	Paini	May–Aug. Tumbling	Climbing	Sun drying	Sun	1–4		143,000	Airtight container	Not necessary





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment	Remarks
					Method	Period (days)					
Panicum stylis folia	Paini	April–July	Climbing	Sun drying Tumbling	Sun	2–5	De-winging	55,000–62,000	Airtight container	Not necessary	1
	Paini	May–Aug.	Climbing	Sun drying Tumbling	Sun	3–5	De-winging Hand	±36,000	Airtight container	Not necessary	1
	Msolo	June–Oct.	Climbing	Soaking	Sun	3–7	Hand Washing		Airtight container 24 hours	Soak in hot water for	1
Passiflora	Gwawa	April–July	Picking	Soaking	Sun Ground	2–5	Washing	±500,000	Airtight		1
Panicum unguis	Mlombe	April–July	Climbing	Sun drying Mortar Pestle	Sun	3–7	Hand	3,400–5,000	Airtight container	Remove seed coat, soak in cold water	1
	Mkusu	April–Sept.	Climbing Ground	Drying	Sun	4–7	Hand Winnowing	–	Airtight container	Soak in hot water	1
	Tsatsi Mono	Aug.–Oct.	Picking	Drying	Sun	3–7	Hand Winnowing	1,300	Airtight container	Not necessary	1
Passiflora	Mgamu Msewe	March–June	Climbing	Soaking Ground	Sun	2–5	Washing	400–450	Airtight container. Can store for months at room temperature	Soak in cold water	1
	Makeche	June–Sept.	Climbing Ground	Drying	Sun	3–7	Floating	30,000–45,000	Airtight container	Soak in cold water	1





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment
					Method	Period (days)				
<i>bilis</i>		Aug.–Oct.	Climbing Ground Picking	Drying	Sun	3–7	Washing	31,000–45,000	Airtight container	Soak in hot water
<i>erantha</i>	Chizonga	July–Oct.	Picking	Threshing Winnowing	Sun	3–5	Hand	85,000–130,000	Airtight container	Soak in cold water
<i>an</i>	Chigoma Msalasese Jelejele	May–Oct.	Picking	Threshing	Sun	2–3	Floatation	±100,000	Airtight container	Soak in hot water
<i>ata</i>	Nandi flame	April–July	Climbing Ground	Drying Shaking	Sun	3–5	Floatation	±150,000	Not recommended	Not necessary
<i>cana</i>	Mgoza Mulele	April–July	Climbing Ground	Drying	Sun	3–7	Hand	15,000–17,000	Airtight container. Viable for 2 months only	Not necessary
<i>inqueloba</i>	Mgoza Mgozga Msambamfumu Mlelezombo	June–Oct.	Climbing Ground	Drying	Sun	3–7	Hand	24,000–	Airtight 28,000 Viable for 2 months at room temp.	Not container.
<i>cculoides</i>	Mzimbili Mzai Mtemya	Oct.–Dec.	Climbing Ground	Crushing Soaking	Sun	3–7	Washing	1,800	Airtight container	Soak in cold water
<i>nocua</i>	Mteme Mtulutulu Kabulukulu	Nov.–Feb.	Climbing Picking Ground	Breaking Soaking	Sun	3–5	Floatation Hand	1,800	Not recommended	Soak in cold water





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment	T
					Method	Period (days)					
<i>mosa</i>	Mzimbili Mzai Msongolo	Sept.–Dec.	Climbing Picking Ground	Breaking Soaking	Sun	3–7	Floatation Hand	1,800	Airtight container	Soak in cold water	6
<i>riensis</i>	Mchelekete	May–Sept.	Climbing	Drying Mortar Pestle	Sun	3–7	Washing Floating	±2,500	Airtight container	Soak in hot water	1
<i>datum</i>	Mchisu Msombo Msinyika	Nov.– March	Climbing Ground	Soaking	Sun	2–5	Washing	400– 500	Seed does not store well	Not necessary	1
<i>neense</i>	Katope Msombo	Oct.–Jan.	Ground			2–4	Winnowing	2,400– 3,700	Storage in open moist container possible for a few days	Not necessary	6
<i>adica</i>	Bwemba	July–Nov.	Climbing Ground	Soaking Wire mesh	Sun	3–7	Winnowing	1,400– 2,600	Airtight container for 24 hours	Soak in hot water	1
<i>is</i>	Bamatiki	June–Aug.	Climbing Ground	Soaking	Sun	3–7	Floating	100	Airtight container	Not necessary	1
<i>elii</i>	Wombo Mtetezya Buba	June–Oct.	Picking	Drying Threshing	Sun	3–5	Hand Winnowing	17,000– 33,000	Airtight container	Soak in hot water	9
<i>ricea</i>	Gonondo	May–Aug.	Ground		Sun	3–7	De-winging	1,200	Airtight container	Soak in cold water	1





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment	T s
					Method	Period (days)					
uviana	Savesha	May–Aug.	Picking Ground	Soaking	Sun	3–7	Washing	±300	Airtight container	Not necessary	
	Sendeleda	Nov.–Dec.	Climbing	Drying	Sun	2–5	Winnowing Sieving	300,000–380,000	Airtight container	Not necessary	
tica	Msikizi	Dec.–April	Climbing	Shade Drying Shaking	Shade	3–5	Winnowing	300	Moist storage possible in open containers for a few days	Not necessary	
ana	Msuku	Aug.–Dec.	Climbing Picking	Soaking Squeezing Ground	Sun	3–5	Washing	±2,500	Does not store well	Removal of seed coat	
a	Kasokolowe	Sept.–Nov.	Climbing Ground	Soaking	Drying	3–5	Winnowing	–	Not recommended	Not necessary	
barica	Kasokolowe Katoto	Sept.–Dec.	Climbing Ground	Soaking	Drying	3–5	Winnowing	–	Not recommended	Not necessary	
a	Mfimfya Mfifya Mfutu	April–Aug.	Climbing Ground	Soaking	Sun	3–5	Washing	900–1,300	Airtight container	Soak nut in cold water for 24 hours	
ricana	Ntengele Mtundulukwa	April–Aug.	Ground Picking	Soaking Squeezing	Sun	3–5	Washing	660–1,400	Airtight container	Not necessary Seed only viable for three months	





Name	Local name	Time for seed collection (months)	Collection method	Extraction method	Drying		Separation (cleaning)	Seeds per kg	Storage	Pre-sowing treatment
					Method	Period (days)				
<i>sinica</i>	Kankande Mlashawantu	April–Nov.	Picking Ground	Soaking Squeezing	Sun	3–5	Washing	430– 2,000	Airtight container Remove fruit pulp	Soaking in water.
<i>ritiana</i>	Msau Masau	May–Oct.	Ground Picking	Soaking Squeezing	Sun	3–5	Washing	650– 3,500	Airtight container	Soaking seed in cold water for 24 hours



Species Fact Sheets

Introduction

The 116 tree species in this section have been selected on the basis of their usefulness from the farmer's point of view. Some of the species can easily be propagated artificially, whilst others need to be protected and managed to allow natural regeneration. Each fact sheet covers the following:

- **Botanical name:** Name of plant, and, if applicable, subspecies and common synonyms (in brackets).
- **Family name:** Useful for identification purposes for researchers and extension workers who are not familiar with local names.
- **Local names:** English, Kunda, Nyanja, Senga and Tumbuka names have been included as far as possible.
- **Ecology:** A brief description of the distribution of the species as well as other ecological characteristics. For most species an altitudinal range is indicated. These figures refer to Africa in general, not specifically Zambia.
- **Uses:** The listed uses are those reported by farmers in eastern and southern Africa, the most important ones being marked in bold.
- **Description:** A brief description of the tree—size, shape of leaves, fruits, flowers and other characteristics—is included for identification purposes. Significant identifying features for a particular species are in bold type.
- **Propagation:** Where available, information on the most suitable method of establishment is included for each species.
- **Seed:** Where information is available, information on the number of seeds per kilogram, germination rates, etc., is also included.
- **Treatment:** Indicated for those species which require some pre-treatment to enhance germination.
- **Storage:** Information on the possible storage period is provided on some species.
- **Management:** Information on the recommended management practices for each species.
- **Remarks:** Any additional information of interest is given under this heading. It must also be noted that information is unavailable for some species, particularly on propagation, storage and management, and further research work is needed in these areas.

Acacia polyacantha ssp. *campylacantha*

Mimosoideae

Indigenous

English: Falcon's-claw acacia, hook thorn

Kunda: Ngowe

Nyanja: Ngowe

Senga: Ngobe

Tumbuka: Ngobe

Ecology: Widespread throughout Africa and found all over Zambia except on the nyika plateau, usually on dambo margins, in woodlands by rivers; sometimes as pure stands but often with other *Acacia*.

Uses: Firewood, **timber** (farm tools), posts, gum (edible), medicine (leaves and roots), fodder (pods, leaves, seeds), ornamental, **nitrogen fixation**, **soil improvement**, dyes, tannin (gum), live fence.

Description: A deciduous tree to 20 m, the **feathery foliage** giving an open, light canopy. **BARK:** grey-brown, scales or knots, old trees deeply grooved. **THORNS:** small and hooked, tips black. **LEAVES:** feathery, with numerous leaflets, each one small and narrow, leaf stalk hairy. **FLOWERS:** in large **cream-white spikes**, 2–3 together, each to 12 cm, fragrant, August–December. **FRUIT:** dark brown pods, tip pointed, flat and smooth, to 18 cm long, explode to set free 6–8 flat round seeds, June–September.

Propagation: Seedlings, wildings, direct seeding.

Seed: Seeds prolifically. No. of seeds per kg: 14,000–16,000. Good seed germinate in 10–20 days. Germination rate 60–90%.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Seed can be stored if kept cool, dry and insect-free.

Management: Pollarding, coppicing.

Remarks: A useful and widely available tree which should be planted more often. The wood is termite-resistant. The heartwood is red-brown but difficult to work. Moderately fast growing. It is an indicator of fertile soil and a high groundwater-table. Roots are used for treatment of gonorrhoea and snakebite. The bark is used for treatment of sore-throats and diarrhoea.



Adansonia digitata

reBombacaceae

Indigenous

English: Baobab
Kunda: Muuyu
Nyanja: Mlambe, mkulukumba
Senga: Mubuyu
Tumbuka: Mubuyu

Ecology: A distinctive tree of tropical Africa south of the Sahara, limited to 0–1,000 m. Found all over Zambia except northern areas; common in Luangwa Valley and occasionally also found on the plateau, mainly in woodlands and valleys but also in miombo thickets. It can grow where the water-table is high but is also drought-resistant. Despite its soft inner wood, it can live up to 3,000 years.

Uses: **Food** (shoots, leaves, fruit), drink (seed pulp), medicine (roots, bark), fodder (leaves, fruits), bee forage, **string**, rope (fibres), gum, resin, dye (roots).

Description: A massive deciduous tree to 20 m high, bare for up to 7 months. The circumference around the base can also measure up to 20 m. The **large bare branches**, thin at the tip, look like upturned roots. **BARK:** pink-grey, shiny, later rough and wrinkled. **LEAVES:** found at ends of branchlets, up to 9 **leaflets arranged like fingers of a hand**. **FLOWERS:** **large and white**, opening at night, the unpleasant-smelling nectar attracting pollinating fruit bats, etc. **FRUIT:** large, **hairy grey-green to yellow-brown capsules hang on long stalks all over the bare tree**. They contain about 100 seeds in pink-white floury acid pulp which is edible.

Propagation: Seedlings, cuttings.

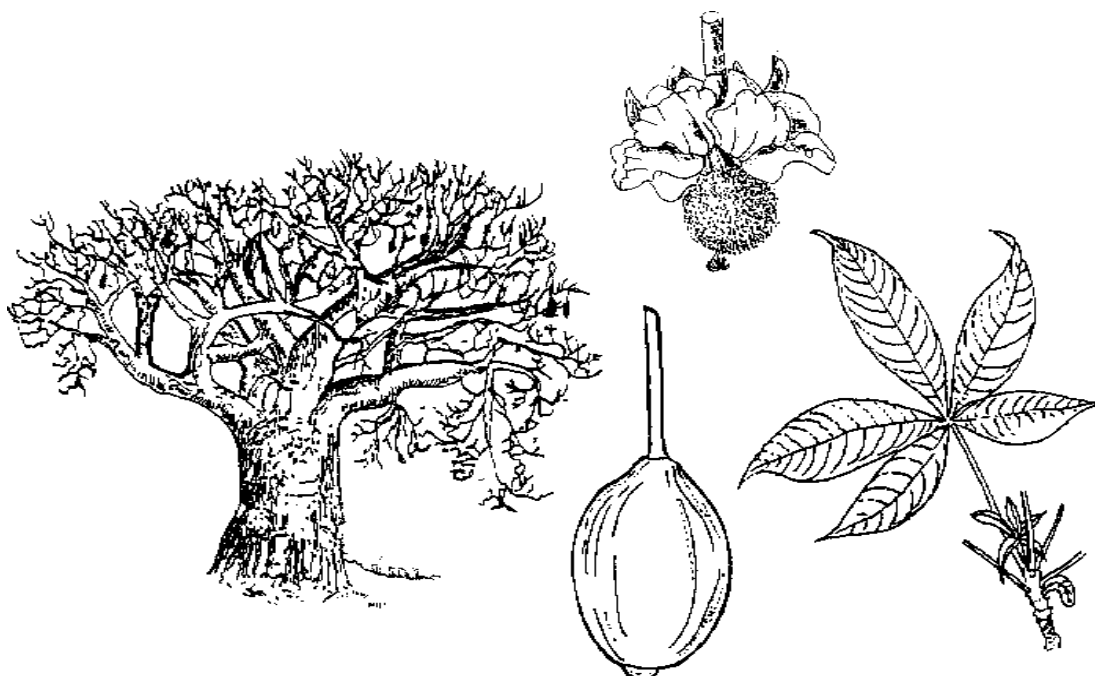
Seed: Seed collection is done in April–October. No. of seeds per kg: 1,500–2,500. Good, treated seed can germinate in 30–50 days but the germination rate is usually low.

treatment: Immerse the seed in hot water and allow to cool for 24 hours.

storage: Seed can be stored for a long time if kept cool and dry.

Management: Lopping, pollarding, coppicing when young.

Remarks: The spongy inner tissues of the trunk can hold much water which is used by elephants and even people in the driest areas. Old trees are often hollow. The tree is fire-resistant. Considered a sacred tree by many African people. Young leaves can be cooked and eaten as a vegetable. The seed and flower are high in proteins and the kernel contains edible oil.



Azelia quanzensis

Caesalpinioideae

Indigenous

English: Mahogany bean, lucky bean

Kunda: Mpapa

Nyanja: Mpapa, mupapa

Senga: Mpapa

Tumbuka: Mpapa

Ecology: Found in lowland thicket from northern South Africa to Kenya, 0–1,200 m and all over Zambia except the nyika plateau. It is deep rooted and prefers well-drained soils.

Uses: **Timber** (furniture, carving), medicine (roots, bark), fodder (leaves), shade, ornamental.

Description: A large semi-deciduous tree up to 24 m with short main trunk and thick spreading branches (providing timber). The flat-to-rounded crown is spreading and shady. **BARK:** grey-brown, flaking in large pieces leaving pale patches underneath. **LEAVES:** compound, leaf stalk to 30 cm, few leaflets, each one to 9 cm, **oblong, tip rounded**. **FLOWERS:** a distinctive **single petal**, green outside, pink-red inside, 2–3 cm wide, sweet scented in small groups on erect heads. **FRUIT:** dark brown, **flat, woody pods**, 20 x 10 cm with 6–10 shiny brown to black seeds in a soft orange-red “cup”.

Propagation: Seedlings, wildings, direct seeding.

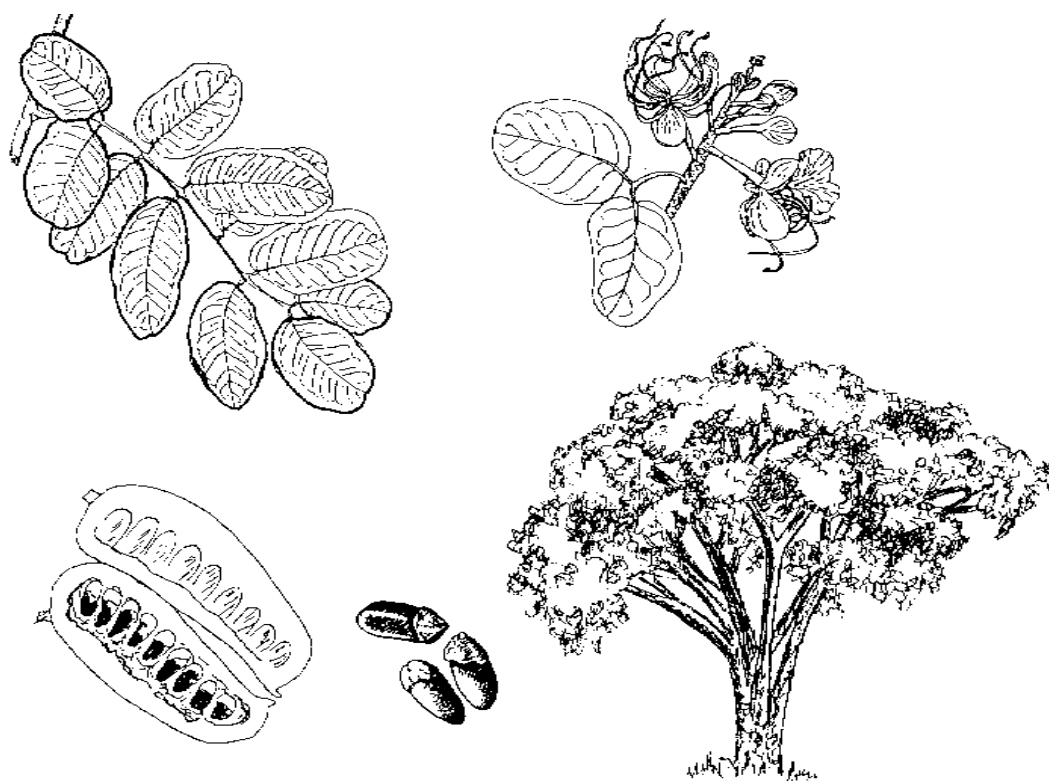
Seed: Produces abundant seed. Good germination reaching up to 90% after 4 weeks. No. of seeds per kg: ±480.

treatment: Not necessary for fresh seed, but soak stored seed in cold water for 24 hours to enhance germination.

storage: Can be stored for up to a year.

Management: Grows fast in the early stages. Lopping, pollarding, prune to clear bole.

Remarks: Termite- and fire-resistant. Slow growing. A tree with potential for plantation in miombo woodlands and a good avenue/shade tree. The bark is used as a hunting charm. It is reported that in Tanzania people have been killed by eating the roots for medicinal purposes.



Agave sisalana

Agavaceae

Mexico

English: Sisal
Kunda: Khonje
Nyanja: Khonje, gavi
Senga: Khonje

Ecology: Introduced to Africa as a plantation crop for the fibres extracted from sun-dried leaves. Widely cultivated around homesteads and dimba (vegetable gardens) on the plateau of Eastern Province. It grows on a wide range of soils from sandy loam to clay, withstands waterlogging and is drought-hardy.

Uses: **String,** ropes, sacking, mats (fibres), **live fence.**

Description: A woody herb with whorls of spiny leaves at ground level. The flowering stem reaches up to 6 m. **LEAVES:** **sword-shaped, to 2 m long,** edges spiny, with a **sharp dark brown tip.** **FLOWERS:** a flowering "pole" after 7 years has small **green-yellow flowers** on side branches. **FRUIT:** dry capsules with seed but little is viable. Some flower buds become thick and hard and will root when planted. They are called **bulbils** and may **develop among the flowers.** Suckers are produced at the base of the leaves.

Propagation: Suckers and bulbils.

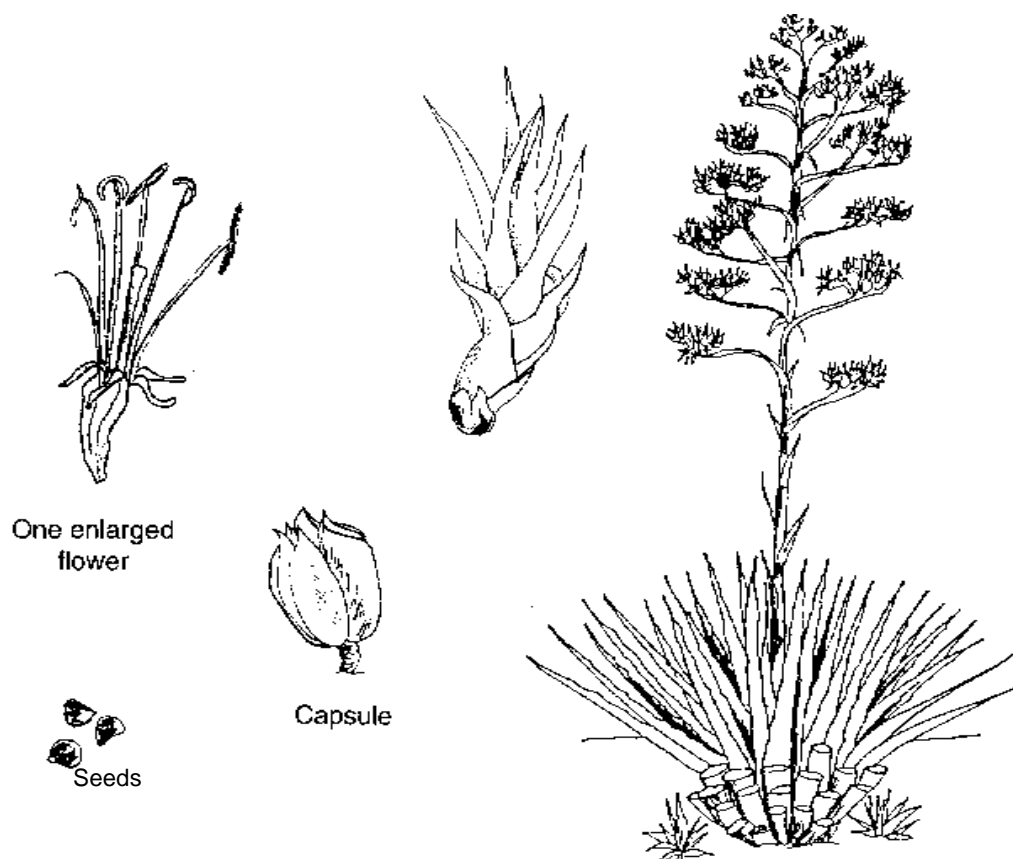
Seed: Little viable seed.

treatment: –

storage: –

Management: Remove mature leaves that start to die in order to allow young leaves to grow and for the plant to stay healthy. For a good fence, plant one row of sisal on a raised bund with 30 cm between the plants. The fence needs to be maintained by replacing dead plants.

Remarks: The whole plant dies after flowering. Leaves for fibres can be cut after about 2 years.



Albizia adianthifolia

Mimosoideae

Indigenous

Nyanja: Mtanga

Ecology: Widespread in tropical Africa in Zimbabwe, Mozambique, South Africa, west to the Gambia and north to Kenya. In Zambia it grows in *chipya* woodlands in Eastern Zambia along the valleys and on the plateau.

Uses: Firewood, charcoal, timber (furniture, tool handles), **medicine** (bark, roots), fodder (leaves), **nitrogen fixation**.

Description: A semi-deciduous tree to 27 m with erect, **spreading branches to a light, feathery crown**. Branchlets hairy. **BARK:** red when young, becoming dark brown-black, ridged, cracking into small square scales. **LEAVES:** bipinnate, the **5–8 pairs pinnae** each with 5–17 pairs of leaflets, each leaflet rectangular, 2 cm long with yellow hairs below, leaf tip usually blunt. **FLOWERS:** **white-green in hemispherical heads**, the stamen tubes red-pink-green, **hanging out of each flower**. **FRUIT:** **flat pods, softly hairy, dull yellow-brown**, 9–19 cm and 3 cm across, containing dark green seeds, oval and flat.

Propagation: Seedlings, wildings.

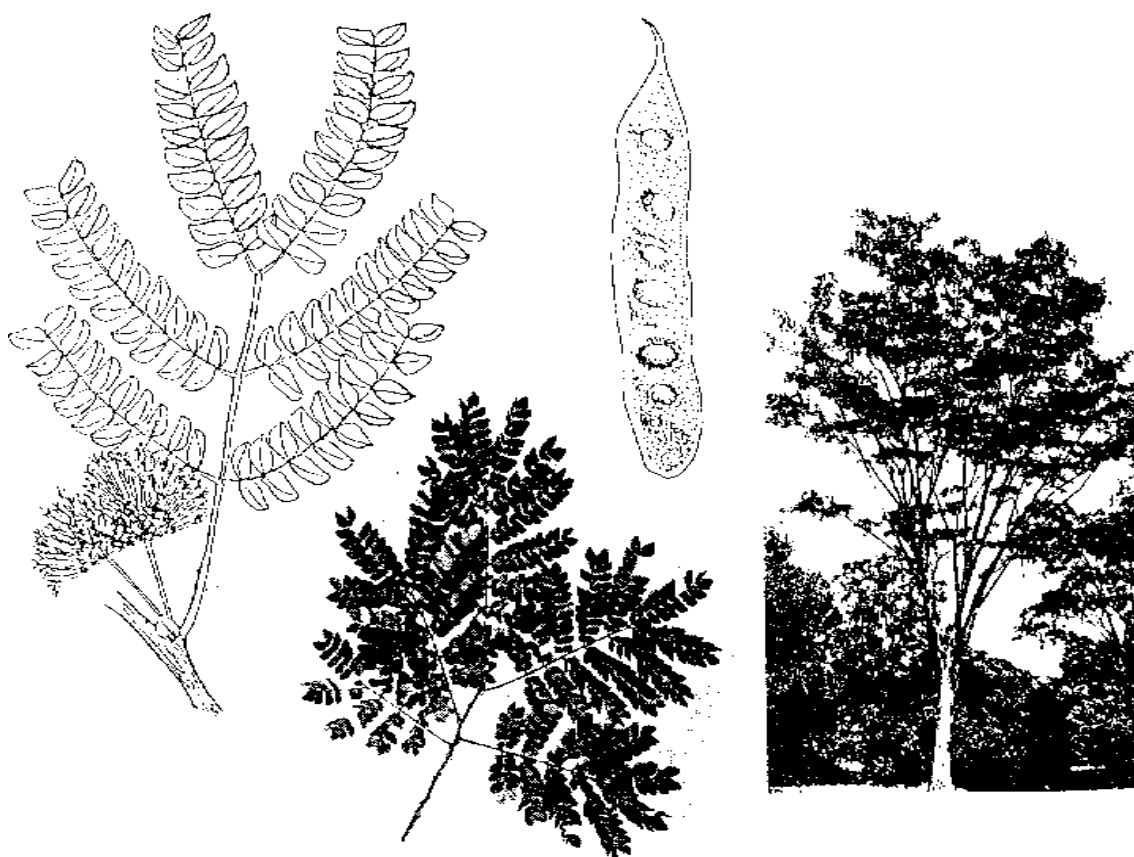
Seed: The pods split open and are carried some distance with the seeds still attached. This makes collection difficult. Seed are often damaged by insects.

treatment: Not necessary.

storage: Not more than 3 months. Add ash to reduce insect damage.

Management: Fairly slow growing.

Remarks: The bark is used to treat scabies and other skin diseases as well as bronchitis. Roots are used to treat eye inflammation, snakebite and stomach-ache. Plant on hilly ground and for intercropping with food crops.



*Albizia amara***Mimosoideae**

Indigenous

Kunda: Mnjelenjete

Nyanja: Mkalanga, msengwa, nyele

Ecology: A common tree found from South Africa north to Ethiopia and throughout Zambia. It can be found on anthills and at margins of dambos in the miombo woodlands, 400–1,200 m.

Uses: Firewood, timber, poles, **medicine** (bark, seed oil, leaves, fruit, roots), fodder (leaves), **ornamental**, soil conservation, **nitrogen fixation**, resin.

Description: A semi-deciduous tree growing up to 18 m but often smaller, trunk short, soon branching, crown flat to rounded, fairly dense. **BARK:** pale then dark brown and cracked with age, a brown gum when cut. **LEAVES:** appear pale and **feathery**, with very many leaflets, each one straight. Leaf stalks, **twigs and leaves are soft due to yellow-orange hairs**. **FLOWERS:** many in cream-pink heads, 2–3 cm across in October–December. **FRUIT:** large pods, 20 x 3 cm, straight, thin like paper, bulging over 4–8 seeds. Collect seed June–September.

Propagation: Seedlings, direct seeding, cuttings.

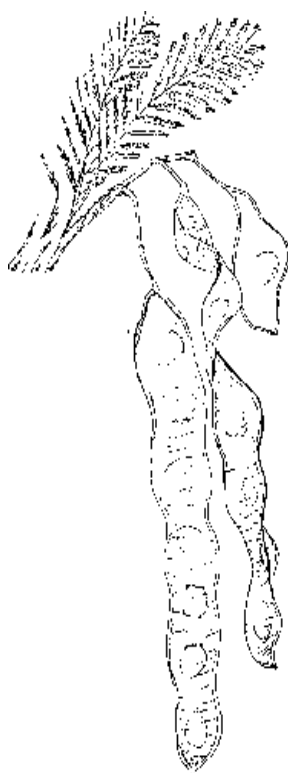
Seed: No. of seed per kg: 10,000–13,000.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Seeds can be stored for a long period if kept dry and insect-free.

Management: Coppicing, pollarding, lopping.

Remarks: The bark and roots can be used for washing clothes since they contain a saponin which produces a soapy lather in water. The pods are used as an emetic and as a remedy for cough and malaria. The seed oil has been used for treating leprosy, and the leaves for treating inflammation and abscesses. Can be planted in urban areas as an ornamental and avenue tree and also along roads in rural areas.



Albizia antunesiana

Mimosoideae

Indigenous

English: Purple-leaved albizia, winter thorn

Kunda: Chingologolo, musase

Nyanja: Musase, msase

Senga: Mzanga

Tumbuka: Mzanga

Ecology: A tree which occurs in a belt across central Africa from Angola to Tanzania. It grows throughout Zambia and is found frequently in *chipya* and Kalahari woodland and occasionally in most other woodland types. In Eastern Zambia it is common on the plateau areas and also in some parts of the valley areas.

Uses: Firewood, **timber** (furniture), medicine (roots, bark, leaves, fodder (leaves), **bee forage**, tannin.

Description: A semi-evergreen tree, to 25 m, with a **light umbrella-shaped crown**. BARK: red brown, then dark grey-brown, fissured with raised scales. When cut a **crimson gum** exudes. LEAVES: compound, 2–3 pairs of pinnae each with 5–9 papery leaflets, **grey-blue-green below**, 3–5 cm long, young leaves often purple. FLOWERS: fragrant **yellow-white-green in feathery clusters** just before new leaves in September–October, **stamen tube not hanging out and green-yellow-white**. FRUIT: **oblong pods, pale brown, 12–23 cm, 3–4 cm across**, ripening July–September in the following year. Pods split to release 4–10 pale yellow-green flat seeds.

Propagation: Seedlings, wildings.

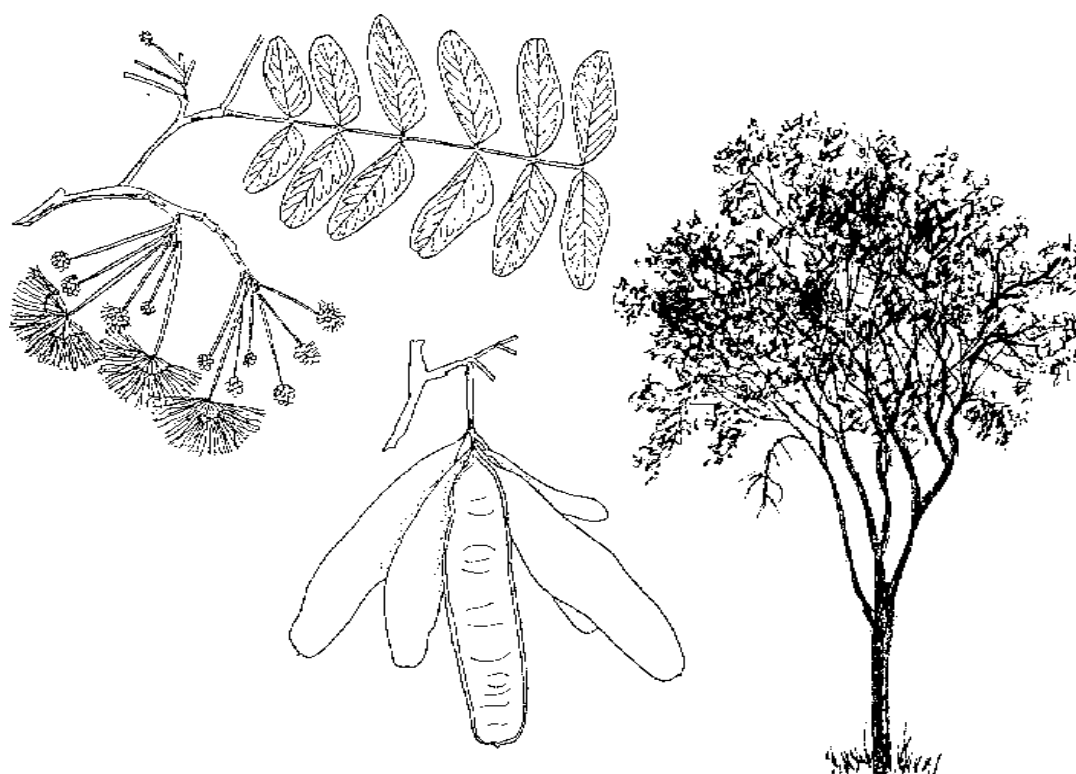
Seed: Upon being released from the pods, seeds will be scattered and blown away by wind.

treatment: Not necessary.

storage: –

Management: Pollarding, lopping.

Remarks: The tree is known to harbour edible caterpillars. The timber is good for furniture making, moderately heavy and strong. Roots are used to treat colds, stomach-ache, gonorrhoea and internal bleeding and the sap to wash cuts and wounds.



Albizia versicolor

Mimosoideae

Indigenous

Kunda: Msasengoma
Nyanja: Mlilanzeze, mtanga
Senga: Msasempanga
Tumbuka: Buwa

Ecology: Grows from Kenya and Uganda in the north to South Africa. Common in deciduous woodlands, bushland and wooded grassland throughout the miombo. Prefers well-drained soils and a high water-table, 150–1,700 m. It is found both on the plateau and in the valley.

Uses: **Timber** (small boats, tool handles, utensils, mortars), **beehives**, **medicine** (roots, bark), nitrogen fixation.

Description: A medium to large deciduous tree with a short trunk to a **light spreading crown**, usually 5–15 m. **Young branchlets and leaf stalks have rust-brown hairs**. **BARK:** rough grey-brown-black, deep wide fissures. **LEAVES:** compound, only 2–4 pairs of stalks with **3–6 pairs large stiff leaflets**, each 2–6 cm long, 1–4 cm across, wider at the tip, usually flattened with a small, sharp point; hairs above, **densely hairy below**, veins raised. **FLOWERS:** large half-spherical heads, red stamens on **green-yellow stalks**. **FRUIT:** large pods at the top of the tree, red at first, later **shiny red-brown**, flat and straight up to 27 x 6.5 cm, with 4–6 flat seeds about 1 cm across.

Propagation Seedlings, rootsuckers.

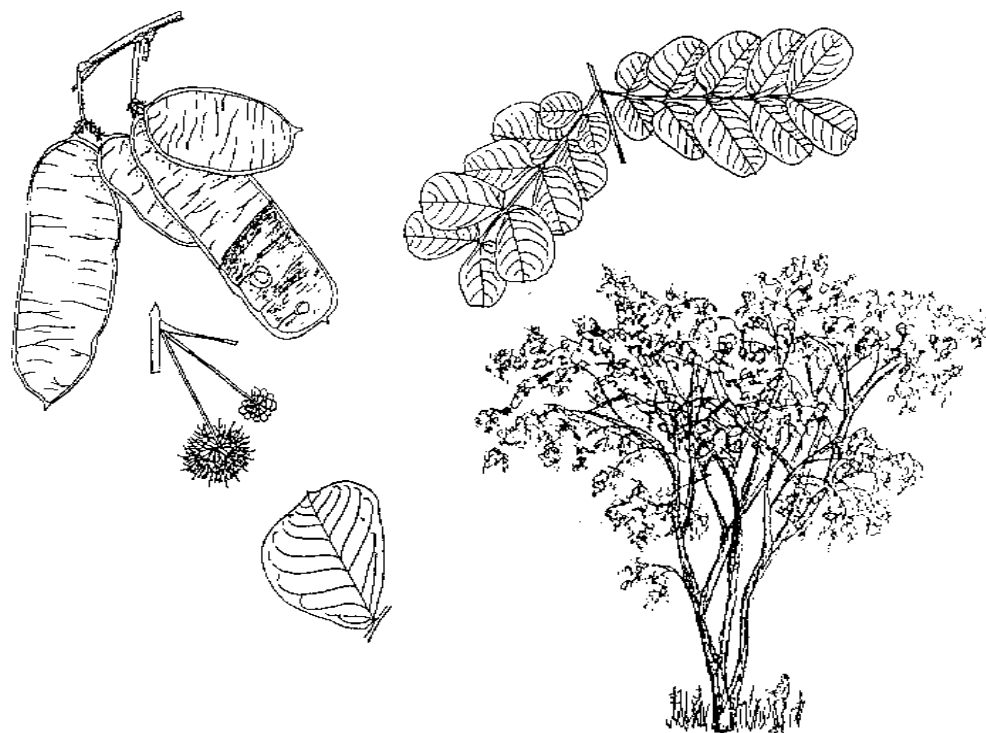
Seed: No. of seeds per kg: 6,000–8,000. Germination is good, in 30 days.

treatment: None for fresh seed; soak stored seed in cold water for 6 hours.

storage: Can be stored for long periods if kept dry and insect-free.

Management: Fairly fast growing; lopping, pollarding.

Remarks: Seeds and pods are poisonous to livestock. The wood is light to moderately heavy but not durable. It is easy to work for household utensils such as mortars. An infusion of roots is used to treat headache, and a decoction of roots boiled for 3 minutes is used to treat syphilis, gonorrhoea, sore eyes, night blindness and skin rash.



Anacardium occidentale

Anacardiaceae

Brazil, Caribbean

English: Cashew nut

Senga: Chikunichashaba

Ecology: One of the oldest cash crops, widely planted all over the tropics. Prefers sandy, deep soils but not saline ones, and can produce a crop when planted in between widely spaced trees. Ideal for valley areas of Eastern Province, does well in Western Province as a cash crop (Zambia Cashew Nut Company); and is tolerant of drought.

Uses: Firewood, charcoal, posts, **food** (cashew apple, cashew nut), shade, soil conservation, windbreak, varnish (nutshell oil), gum.

Description: An evergreen tree about 5 m, crown rounded and shady. **BARK:** rough, dark brown. **LEAVES:** leathery, dark green and **broadly oval to 15 cm long, tip rounded**, wavy. **FLOWERS:** clusters, small and star-like, pink-cream, few becoming fruit. **FRUIT:** hard, **kidney-shaped nuts grow below a shiny orange-yellow "cashew apple"** (a swollen stalk). Nuts fall to the ground when ripe.

Propagation: Seedlings.

Seed: No. of seeds per kg: 150–200.

treatment: Soak old seeds in cold water for 24 hours.

storage: Plant fresh seed. Do not store more than 9 months.

Management: Coppicing, pruning.

Remarks: The nuts have a thin skin containing a poisonous oil which must be removed by hand or by roasting. These nuts are one of the world's best edible nuts and command a good price on the world market. The cashew can suffer from an insect which attacks the shoots and from fungal diseases, but so far these problems have not been serious in Eastern Province. There are several varieties: Brazilian Dwarf is recommended since it fruits early and does not grow tall, hence it is easy to pick the fruit. This variety can be spaced 3–4 m, whereas the giant variety requires 10–12 m between the trees.



Annona senegalensis (*A. chrysophylla*)

Annonaceae

Indigenous

English: Wild custard apple
Kunda: Mpovya
Nyanja: Mpovya
Senga: Mkonokono, mthopa
Tumbuka: Mkonokono, mthopa

Ecology: A wild fruit tree found all over Africa from semi-arid scrub to humid, lowland woodland. It is usually seen as a shrub under taller trees; and grows throughout the Eastern Province, particularly in the valleys. It can be grown in a wide variety of soils.

Uses: **Food** (fruit), **medicine** (root, gum, fruit), fodder (leaves), dye (bark).

Description: A shrubby, deciduous tree usually 2–6 m. **BARK:** smooth and grey, later rough, thick; young branches hairy, grey-orange. **LEAVES:** **oval and rounded**, to 18 cm, hairy below; a **peculiar smell** when crushed. **FLOWERS:** 1–3 small flowers hang down below twigs, yellow-green, **parts in threes**. **FRUIT:** fleshy, rounded, to 4 cm across with overlapping “scales”, many seeds within the soft pulp.

Propagation: Seedlings, root suckers, wildings.

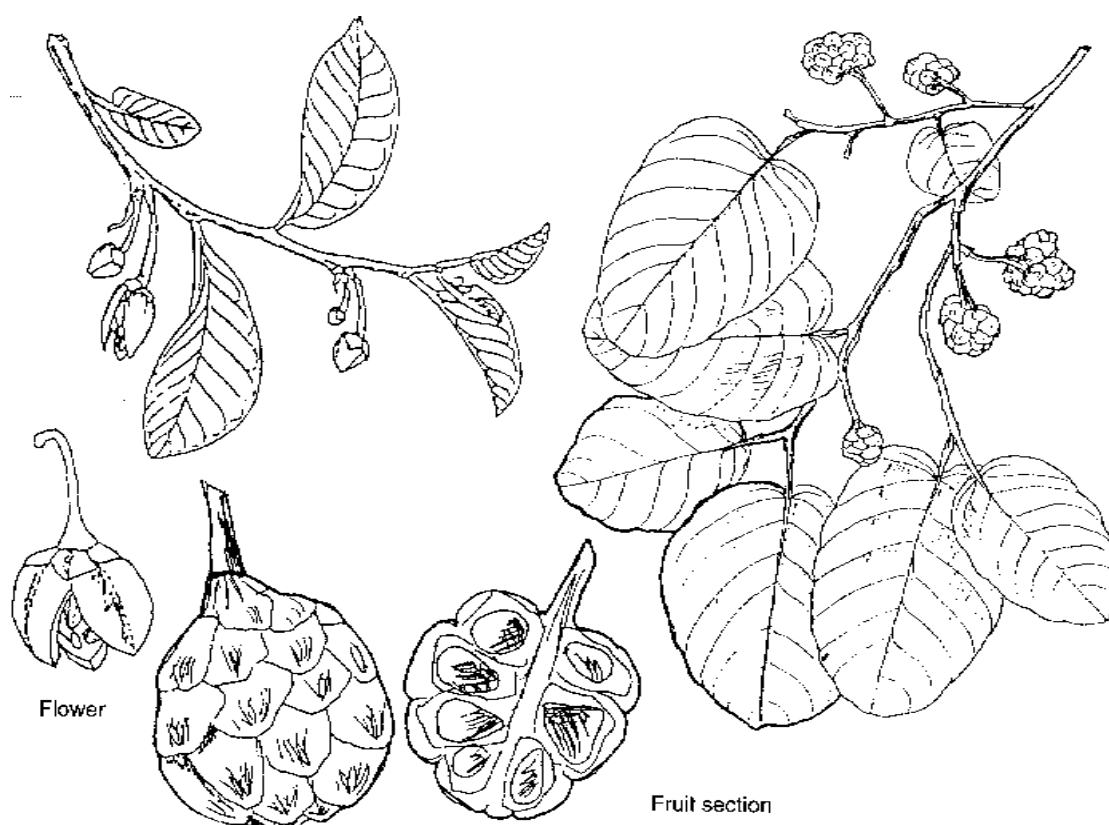
Seed: No. of seeds per kg 2,500–3,000.

treatment: Scarify seed with sand or soak in hot water and allow to cool for 24 hours.

storage: Seeds susceptible to insect damage and lose viability within 6 months.

Management: Coppicing, fire protection.

Remarks: The ripe fruit is orange-yellow, smells like pineapple and tastes sweet. The fruit should be picked while still green to avoid damage by birds, and then kept for ripening. Commonly used as an aphrodisiac, roots are used to treat skin rashes and leaves are used to treat snakebite. Regenerates on recently cultivated or burnt land. The leaf tips and bark are used to treat colds and pneumonia. The fruits are used for diarrhoea, dysentery and vomiting. The roots are also used for stomach problems. The bark is used to treat intestinal worms as well as dysentery and the gum is used to treat cuts.



Artocarpus heterophyllus (*A. integrifolius*)

Moraceae

Asia

English: Jackfruit

Ecology: Probably originates in the forests of the Western Ghats in India. Today it is widespread in other parts of the tropics and most popular in Sri Lanka, 0–1,200 m. It requires well-drained, deep and highly fertile soils. It can tolerate drought or waterlogged soils but will not fruit under these poorer conditions. In Chipata some trees have been planted by people of Asian origin.

Uses: Firewood, timber (furniture, carts, doors), **food** (fruit, seed), fodder (leaves), **shade**, gum.

Description: A medium-sized evergreen tree with thick branches, to 25 m. The **bole is short**, up to 1 m in diameter in old specimens with **branching beginning less than 2 m from the ground**. **BARK:** rough bark on the bole, grey but smooth on the branches. **LEAVES:** glossy, **oval to 15 cm long and 10 cm wide**. **FLOWERS:** separate male and female, all very small, grow on the trunk or large branches where the fruit—the largest known—develops. **FRUIT:** massive and irregular “cauliflowery”, **yellow-green compound fruit with a spiky thick skin, reaching a record 20 kg in weight and 1 m in length**. The flesh is sweet and edible but an acquired taste. Seeds, 2–5 cm, are edible when roasted.

Propagation: Seedlings, bud grafting, air layering; vegetative propagation to select desirable characteristics. Direct sowing on site preferable due to early growth of the taproot.

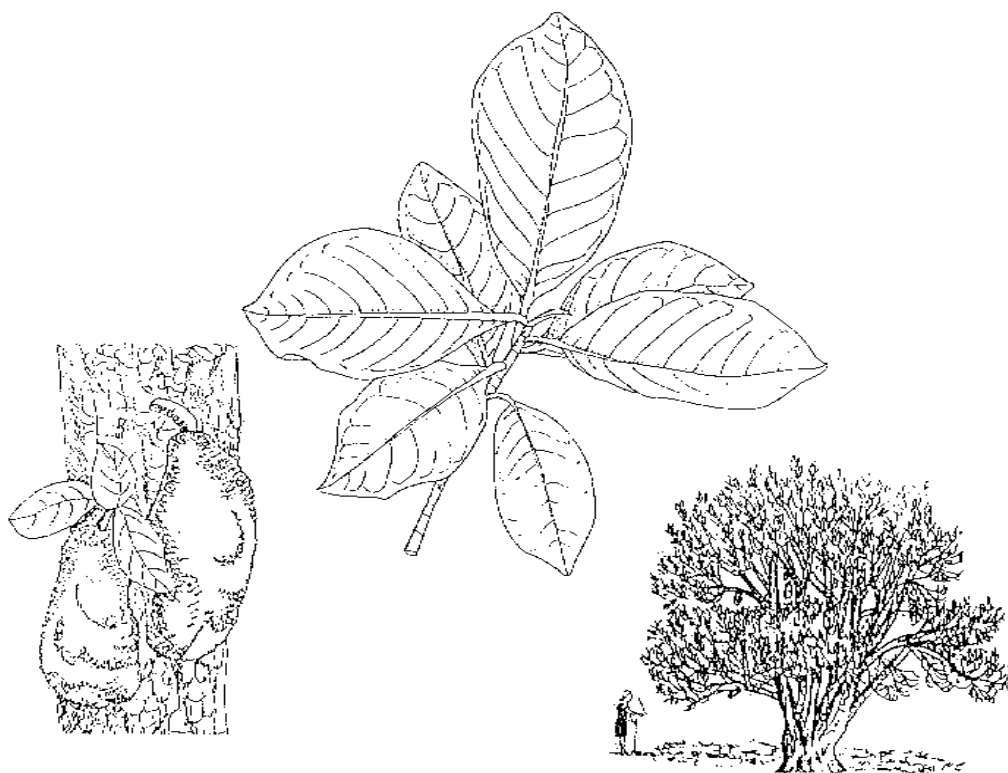
Seed: Seeds are hand picked from the fruit flesh after drying. No. of seeds per kg: 45–90.

treatment: no pre-sowing treatment needed.

storage: the seed is viable for only 1 month as it is very oily.

Management: For good fruit yields, space trees 10–12 m apart. Most cultivars fruit in about 8 years. Cut back fruiting twigs after harvesting.

Remarks: Unripe fruit can be used as a vegetable. This tree should be planted for its fruit and the good shade it provides. Ideal for homestead planting. Mostly appreciated by people of Asian origin.



Azadirachta indica

Meliaceae

N.E. India, Burma

English: Neem

Ecology: A tree well known in its native India and now one of the most widely planted trees in Africa and all over the tropics, in arid and semi-arid regions. It is very drought-resistant, does well on poor soils but does not withstand waterlogging. The roots grow deep and wide. This is a suitable tree for improving degraded soils. Does best in the Valley in Eastern Province.

Uses: Firewood, charcoal, timber (furniture), poles, **medicine** (leaves, bark, roots), fodder (foliage, oil seed cake), bee forage, **shade**, ornamental, soil conservation and improvement, windbreaks, **insecticide** (azadirachtin), oil (seeds), soap (seed oil).

Description: A **fast-growing**, medium-sized tree which may reach up to 20 m high, with a dense, leafy, oval-shaped canopy, evergreen except in the driest areas. **BARK:** pale grey-brown, grooved. **LEAVES:** glossy green, crowded at the ends of branches; compound, to 40 cm long; **each leaflet curved and long pointed, the edge roughly saw-toothed;** a smaller leaflet at the leaf tip. **FLOWERS:** small, fragrant cream-white, hanging in long graceful sprays. **FRUIT:** **oval yellow berries** when ripe; 2 cm long, thin-skinned with oily pulp around 1–2 seeds.

Propagation: Seedlings, wildlings, cuttings, direct seeding.

Seed: Number of seeds per kg: $\pm 5,000$.

treatment: Not necessary, sow seed immediately after collection and extraction.

storage: Avoid storage.

Management: Lopping, pollarding.

Remarks: Slow growing only the first year, then relatively fast. A most useful tree whose cultivation should be encouraged. It is called "mwarubaini" in East Africa, meaning it can be used as medicine for 40 different diseases (Swahili: *arubaini* = 40). Reported to be used to treat malaria, rheumatism, stomach-ache, cough, diarrhoea, etc. The wood is tough and resistant to decay and termites.



Azanza garckeana

Malvaceae

Indigenous

English: Tree hibiscus

Kunda: Ukole

Nyanja: Mkole

Senga: Mtowo

Tumbuka: Mtowo

Ecology: The only *Azanza* species found in Africa, from the Sudan south to South Africa, occurring in all types of woodlands, especially on termite mounds, 0–1700 m. Found in all parts of Zambia, except Western Province; only occasional in Eastern Province.

Uses: **Firewood, charcoal, timber** (tool handles, yokes), **food** (fruit), fodder (leaves), bee forage, shade, fibre (bark).

Description: A semi-deciduous shrubby tree, 3–10 m with a leafy rounded crown. **BARK:** dark brown, rough, branchlets with woolly hairs. **LEAVES:** distinctively **rounded up to 20 x 20 cm**, usually 8 x 12 cm, **on long stalks up to 13 cm**, **3–5 lobes**, rough brown hairs above, soft below. **FLOWERS:** showy, yellow with a purple-brown centre appear November–March; casual flowering up to August. **FRUIT:** rounded and woody 2–8 cm wide, yellow to brown-green when mature, opens into 4–5 sections. Sweet and edible, contains 15–30 light brown woolly seeds. Ripen August–September.

Propagation: Seedlings, direct seeding, rootsuckers.

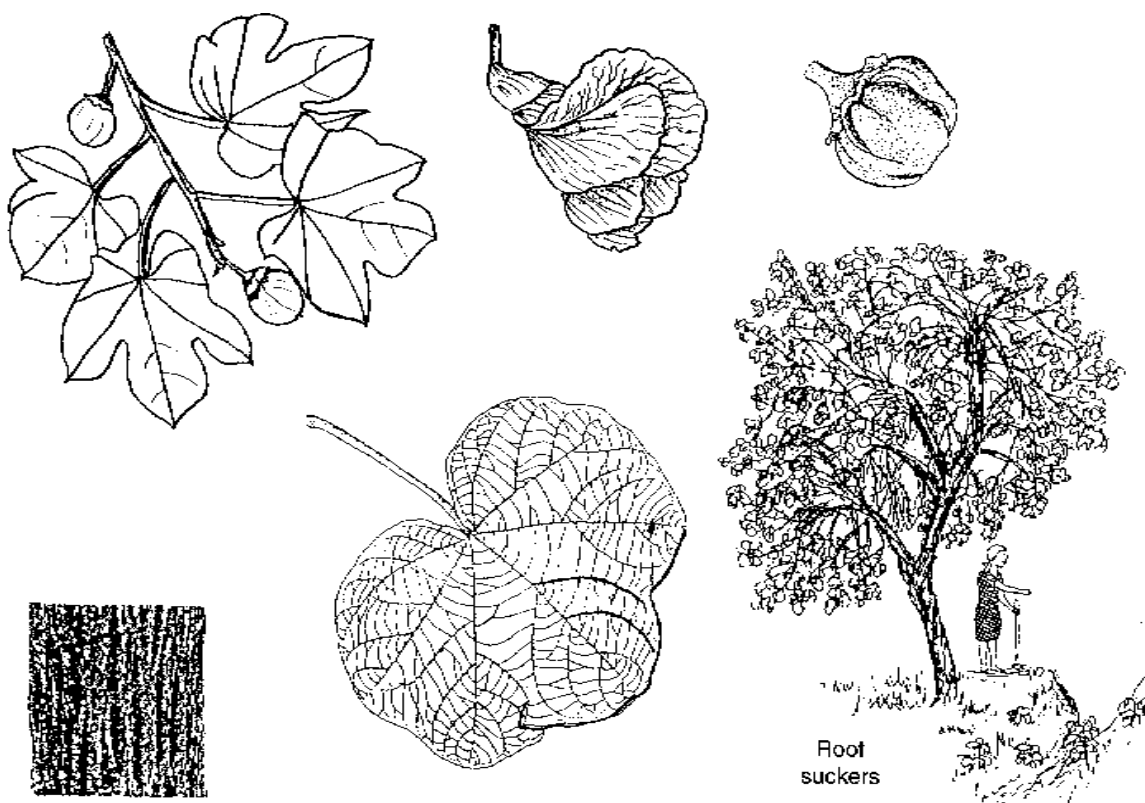
Seed: No. of seeds per kg: about 4,000.

treatment: Not necessary.

storage: Use fresh seed to get a good germination rate. Seeds lose viability within 6 months.

Management: Coppicing.

Remarks: The tree is a host of cotton stainers, therefore should not be grown in cotton-producing areas. The fruit is chewed like chewing gum and is very popular with children. Susceptible to bush fires. The leaves can be used as green manure and mulch.



*Balanites aegyptiaca***Balanitaceae (Simaroubaceae)**

Indigenous

English: Desert date
Kunda: Nkuyu
Senga: Mubambang'oma

Ecology: A very common and useful tree in arid to sub-humid areas of tropical Africa, even extending into India, 0–1,500 m. It is found in most parts of Zambia and in Eastern Province is common in the mopane woodlands of the Luangwa Valley. It can grow on almost any type of soil including clay pans and is very drought-resistant. Wild animals and goats eat the foliage and fruit despite the sharp thorns.

Uses: Firewood, timber (utensils), poles, **food** (fruit, drink), medicine (roots, bark, gum, fruit), **fodder** (leaves, fruit, young shoots), windbreak, oil (seeds), water purification (e.g. saponin in fruit kills snails which carry bilharzia), gum, live fence, fencing (dry branches).

Description: An evergreen spiny shrub, scrambler or tree to 6 m, crown rounded in a tangled mass of branches, often drooping. **BARK:** yellow then dark brown–black, cracked and scaling, producing gum if cut. **Spines** green and soft, becoming **sharp and woody, to 8 cm**. **LEAVES:** distinctive **pairs of grey-green leaflets**, ovate to 5 cm, fleshy to leathery. **FLOWERS:** fragrant yellow-green clusters; September–December. **FRUIT:** yellow-orange, **oblong to 5 cm, both ends rounded**, a hard pointed seed surrounded by yellow-brown bittersweet flesh, seed easily separated; April–August.

Propagation: Seedlings, direct seeding, cuttings, root suckers.

Seed: No. of seeds per kg: 500–1,500.
treatment: Soak the seeds in cold water for two days.
storage: Can be stored up to a year.

Management: Coppicing.

Remarks: An important tree with many uses in the Sahel and in India. The few mature trees that grow naturally on the plateau indicate that this useful species could be more widely planted in Eastern Province. It is already widely used in the Valley. As it tolerates seasonal waterlogging, it is useful for fencing dimba (vegetable gardens). Gum mixed with porridge has been used to treat chest trouble; bark has been used to treat syphilis and the oil from kernels to treat sleeping sickness. The timber is termite-resistant.



Bauhinia petersiana

Caesalpinioideae

Indigenous

English: White bauhinia
Nyanja: Mpondo, katondotondo
Senga: Mpondo
Tumbuka: Mpondo

Ecology: A small tree distributed from Tanzania south to Namibia, 150–1,830 m. Common all over Zambia except northern areas. Growing in most woodlands and on anthills.

Uses: Food (seeds), medicine (roots, leaves), fodder (leaves, pods), **ornamental**, shade, tannin (roots).

Description: Evergreen or semi-deciduous, shrubby scrambler to 2–8 m with spreading branches, branchlets with brown hairs. BARK: grey-brown. LEAVES: **blue-green, divided into 2 lobes**, lobes rounded, 3–9 cm across, feel hairy below. FLOWERS: **white with pink stamens**, petals wavy, to 8 cm long, September–January. FRUIT: **brown and smooth**, to 18 x 6 cm, explode to set free 5–8 flat, brown seeds, May–September; dry **spiral pods remain**.

Propagation: Seedlings, direct seeding.

Seed: No. of seeds per kg: 1,500.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Can be stored.

Management: Pruning, coppicing, pollarding.

Remarks: Elephant browse on leaves and pods. Seeds have been eaten raw or cooked as famine food. Ground seeds have been used as a substitute for coffee, “Zambezi coffee”.



Berchemia discolor

Rhamnaceae

Indigenous

English: Wild almond
Kunda: Mtacha
Nyanja: Mtacha, mziyi
Senga: Msindila

Ecology: Widespread in Africa from the Sudan to South Africa, scattered in open dry woodland along river valleys and frequent on termite mounds. It grows throughout Zambia in lowlands with medium rainfall.

Uses: Timber, poles, **food** (fruit), medicine (roots), fodder, bee forage, **black dye** (heartwood and roots), whitewash (ash).

Description: Usually a semi-deciduous shrub 4–5 m, but can be a big tree, the spreading branches make a shady rounded crown. **BARK:** grey-black or brown, cracking and scaly, **corky spots** on young greenish branches. **LEAVES:** shiny dark green, **sticky when young, oval to 11 cm, lateral veins making a clear pattern.** **FLOWERS:** small yellow-green, profuse in loose clusters, the nectar attracting bees; erratic flowering. **FRUIT:** **oblong, yellow, to 2 cm, 1–2 flat seeds in sweet edible flesh;** ripe February–May.

Propagation: Seedlings, rootsuckers.

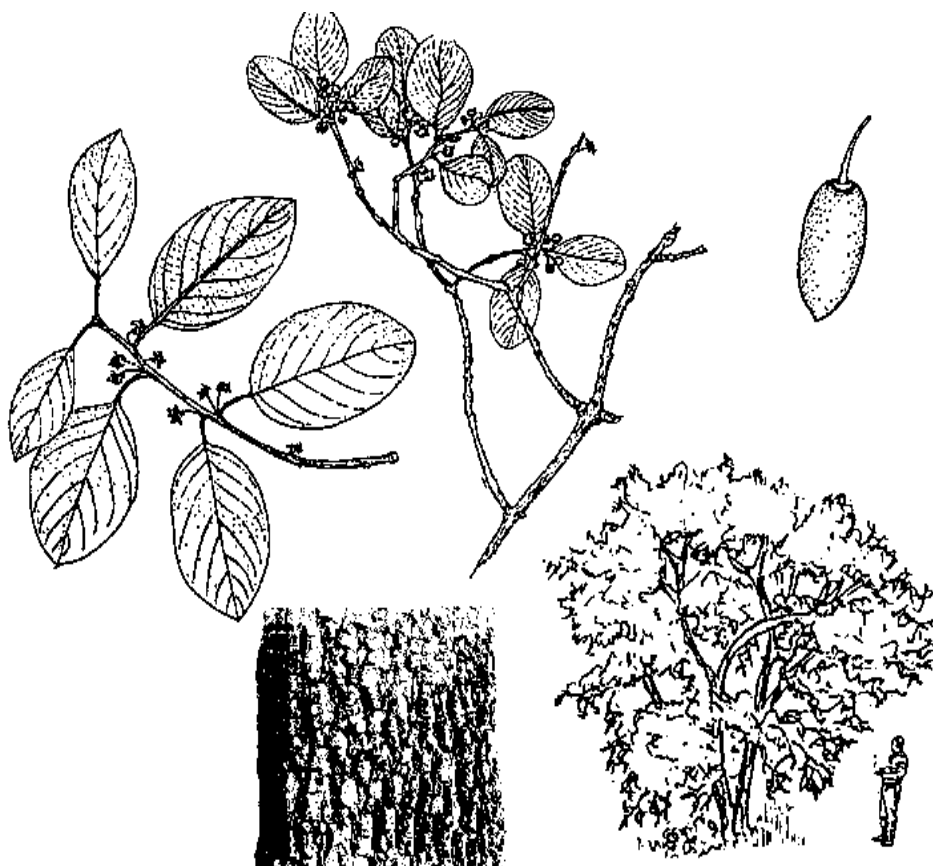
Seed: No. of seeds per kg: 3,000–3,500. Germination good and fast.

treatment: Immerse in hot water and allow to cool for 24 hours.

storage: Stores well at room temperature if kept dry.

Management: Coppicing, lopping, pollarding.

Remarks: The sapwood is light and yellow; the heartwood yellow-brown and resinous; perhaps one of the hardest timbers in East and Central Africa. It can bend nails but the wood planes well. The fruit is very rich in vitamin C and sugar and can be boiled with millet to make porridge. Whitewash for painting houses can be made from the ash.



Borassus aethiopum

Palmae

Indigenous

English: Borassus palm
Kunda: Kakoma
Nyanja: Chipamba, mlaza, kakoma
Senga: Mkama
Tumbuka: Mkama

Ecology: A tropical palm tree occurring from Senegal to Sudan, south to northern South Africa, 0–1,200 m. It requires a high water-table and therefore is found in dense stands along watercourses, tolerating seasonal floods. In Zambia, it is found in most Districts and is common in the Luangwa Valley of Eastern Province and more occasional in woodlands. As elephant eat the fruit, they have contributed to its distribution.

Uses: Timber (construction), **poles**, **food** (fruit, drink), medicine (roots, oil, fruit), **basketry**, **mats**, **thatching** (leaves, leaf stalks), fish traps, brushes (leaf stalk).

Description: A tall palm to 25 m with a characteristic **thickening above the middle** after about 25 years' growth. **BARK:** smooth, grey-green; dead leaves remain around the young palm trunks. **LEAVES:** **large, fan-shaped to 4 m long by 3 m across**, deeply divided into narrow leaflets; thorny along the leaf stalk. **FLOWERS:** male and female trees; males producing branched spikes to 2 m, September–October. **FRUIT:** **large, round** about 15 cm, fragrant and **orange-brown**, in a large calyx "cup", with soft fibrous pulp; fruit matures a year after flowering; around 1–3 seeds.

Propagation: Seedlings, direct seeding.

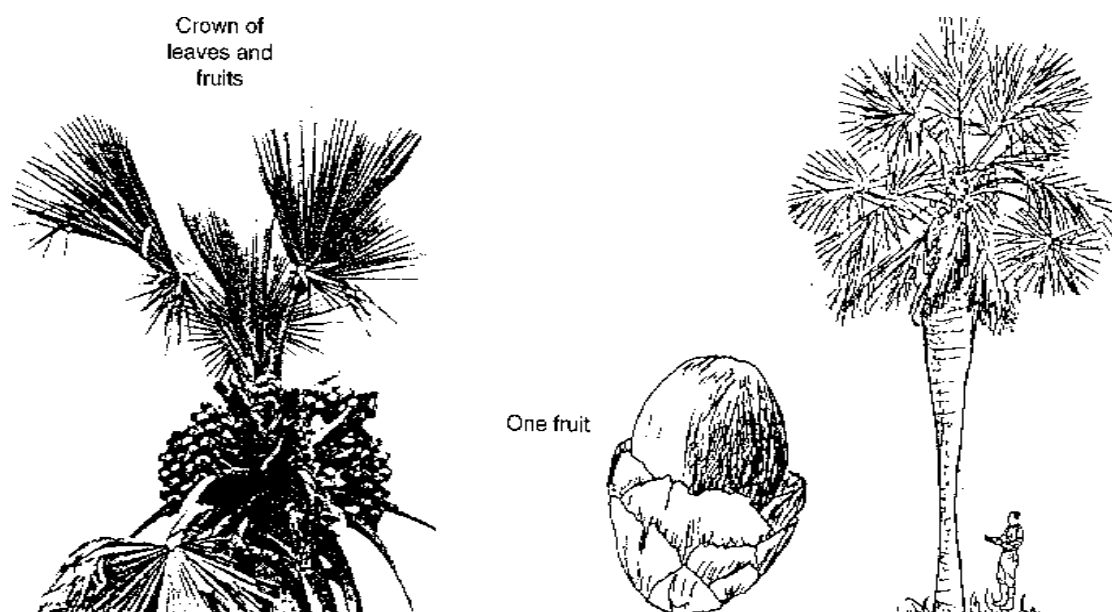
Seed: No. of seeds per kg: 2–3. Seeds should be dried in the shade to avoid scorching. Germination takes one month.

treatment: Not necessary.

storage: Sow fresh after removing seed from pulp. Seeds dried in the shade remain viable for up to 6 months.

Management: Rotation periods range between 60 and 140 years depending on site.

Remarks: Young leaves used for basketry and the wood is hard, heavy and resistant to both fungi and termites. The rich sap of the flowering shoots can be tapped to make a potent palm wine. The palm grows very slowly (flowering in about 30 years), and taking about 10 years to develop the main trunk. The poles are durable and now popular for building purposes at safari camps in the South Luangwa National Park.



Brachystegia bussei

Caesalpinioideae

Indigenous

English: Large-leaved brachystegia**Nyanja:** Mkongolo, msale**Senga:** Mkongolo

Ecology: A tree which often dominates Central African miombo woodlands, extending north to Tanzania and south to Mozambique, 240–1,700 m. Typically it is found on coarse soils but also on red soils, either in pure stands or with other *Brachystegia* spp. and *Julbernardia globiflora*. It grows in woodlands, plateaux, escarpments and valleys in Eastern Province where it often indicates shallow or eroded soils.

Uses: **Timber** (joinery, roof beams), medicine (roots, bark), gum (resin).

Description: A deciduous, slender tree to 20 m, crown rounded to flat, branches loose and drooping. **BARK:** looks **smooth, grey-purple**, but irregular thin pieces flake off. When cut, it exudes a brown sticky gum. **LEAVES:** compound, **3–4 pairs of leaflets**, widely spaced on a stalk to 8 cm long, **largest leaflets at tip**, each one to 6 cm, oval to lance-shaped. **FLOWERS:** in **small heads, 5 x 5 cm**, green-white, October–December. **FRUIT:** smooth **woody pods**, to 15 cm, with a sharp tip, covered with grey-white powder, ripe July–August. Each pod contains 1–3 flat brown seeds.

Propagation: Natural regeneration (wildings), seedlings, root suckers.

Seed: No. of seeds per kg: 1,500. Germination very good and uniform.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Can retain viability for up to a year if kept free from insects.

Management: Coppicing, pollarded.

Remarks: The timber is heavy with an attractively patterned light brown heartwood; saws easily but is not durable. This species has the largest leaflets among the indigenous species. In the past, the inner bark of *Brachystegia* was used to make barkcloth.



Last pair of leaflets

Brachystegia longifolia

Caesalpinioideae

Indigenous

Nyanja: Mbovu, mchenga, msamba

Ecology: Occurs over most of Tanzania, southern Zaire, eastern Angola, Malawi and northern Mozambique. It is found throughout Zambia in all types of miombo woodland and some other forests; often dominant in wetter areas, 950–1,700 m. Not a very common species in Eastern Province but found in miombo woodland on the plateau.

Uses: **Firewood, charcoal, timber** (tool handles), medicine, **bee forage**, shade, bark fibre.

Description: A semi-deciduous tree to 30 m with a **straight bole**, occasionally swollen at the base, with a flat to rounded, spreading crown, sometimes in two layers. Twigs usually hairless. **BARK:** **grey-black** or dark brown, grooved with deep vertical fissures and squarish flakes. **LEAVES:** alternate, **pinnate, mostly 9–12 pairs, leaflets long oval, thin, leathery**, paler below, middle leaflets longer, mostly 3–5 cm, **well spaced** on a stalk **9–18 cm**. **FLOWERS:** green-white in terminal bunches about 7 cm long, September–December. Casual flowering March–June. **FRUIT:** woody, flat, **8 cm long, somewhat shiny**, reddish brown pods, one edge thickened, ripen June–September, then open explosively to scatter **2–6 flat chestnut-brown seeds** (rarely seen above the crown).

Propagation: Seedlings, wildings.

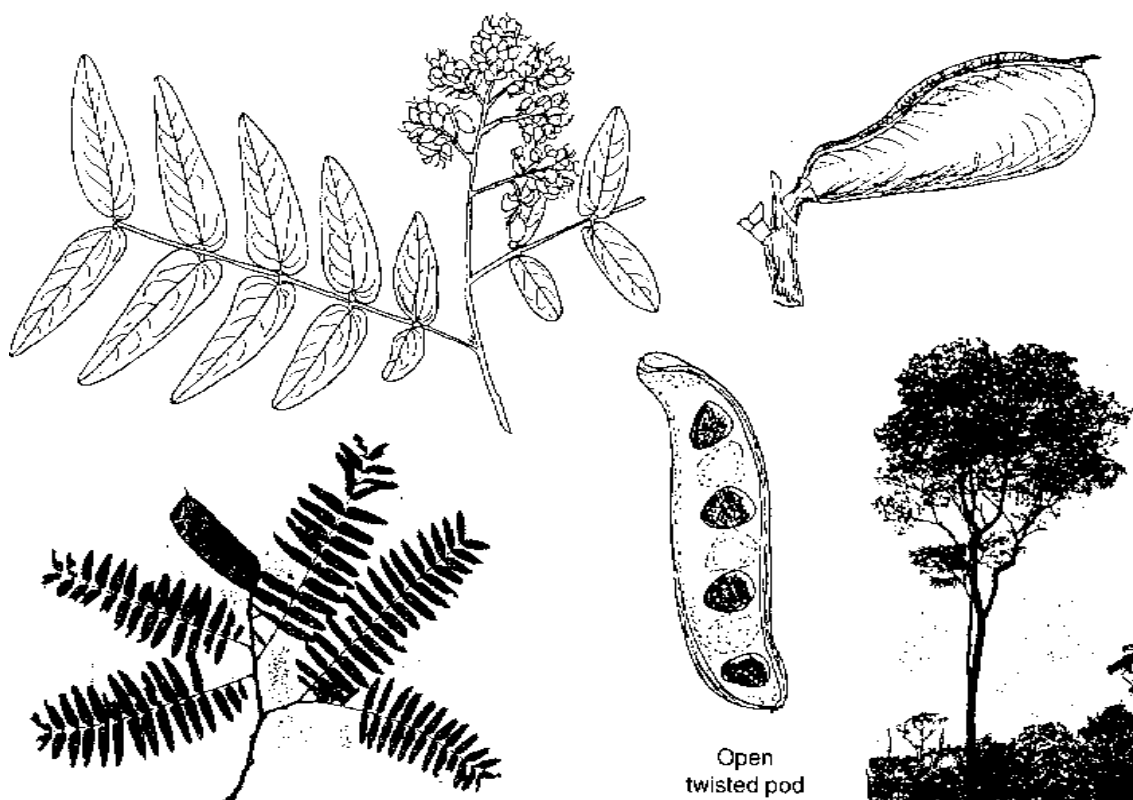
Seed: –

treatment: Soak in hot water and allow to cool for 24 hours.

storage: –

Management: Coppicing, pollarding, lopping.

Remarks: The timber is very susceptible to borers, moderately heavy and hard but not very durable. It readily absorbs preservatives. The timber is used as mine props and in temporary construction work. It is a good bee tree with heavy nectar flow between September and November.



Brachystegia spiciformis

Caesalpinioideae

Indigenous

English: Bean-pod tree
Nyanja: Kamponi, mputi, muputi
Senga: Mpapanyozi

Ecology: A dominant tree in large areas of Central Africa, north to coastal forests of Kenya and south to South Africa, 0–2,350 m. It is found throughout Zambia on most soils; often growing on rocky slopes, typical of miombo and chipya.

Uses: **Firewood**, charcoal, **timber**, beehives, medicine (bark, roots), **fodder**, bee forage, shade, soil improvement, fibre rope (bark), dye (bark).

Description: A semi-deciduous tree, usually 8–15 m, crown somewhat flattened; the main trunk dividing into **large branches**. **BARK:** smooth grey-brown, later rough and flaking. **LEAVES:** compound, 3–5 **pairs leaflets**, **largest at tip**, to 8 cm long. **Pink-red young leaves** conspicuous on the bare tree. **FLOWERS:** green, sweet scented, in **short unbranched heads to 6 cm**, August–November. **FRUIT:** flat, **red-brown pods**, to 14 cm, explode to scatter 4–6 seeds, June–November.

Propagation: Seedlings, wildings.

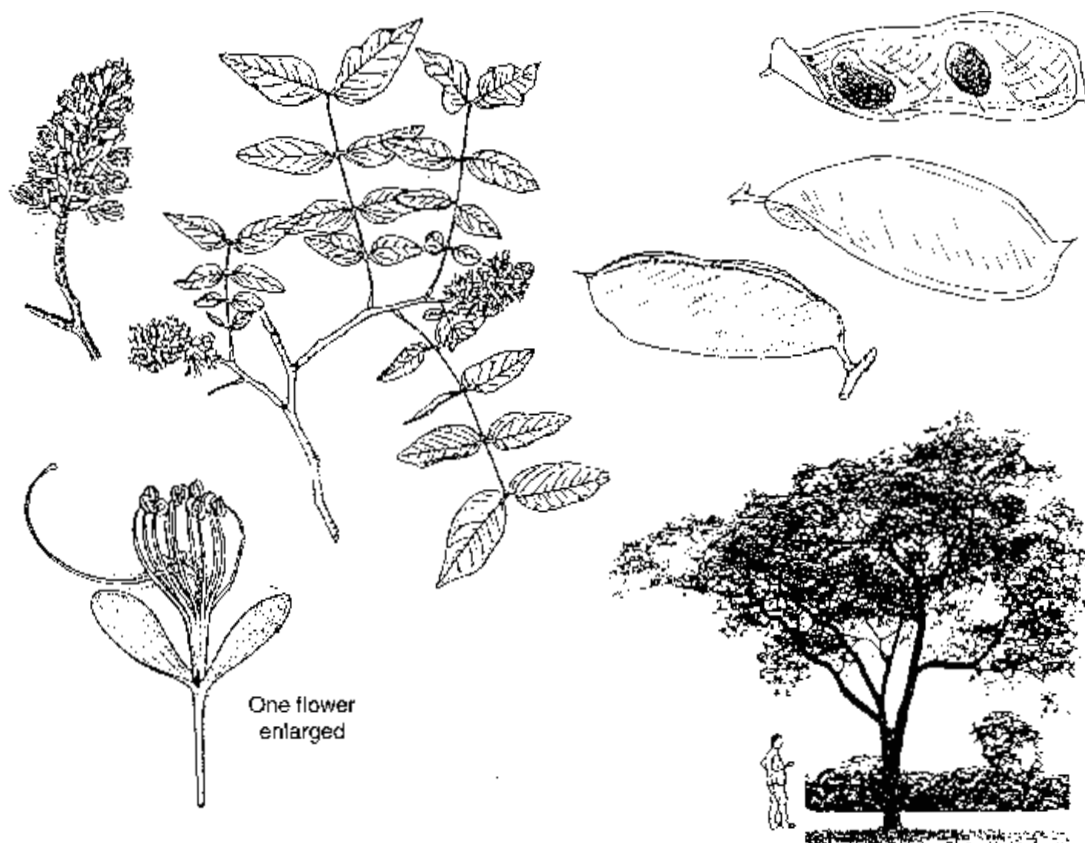
Seed: No. of seeds per kg: 1,500–2,600.

treatment: Not necessary, but germination is improved if the seed is soaked. Soak in hot water and allow to cool for 24 hours. Germinates in 21–30 days under ideal conditions; up to 80% with good seed.

storage: Can be stored up to 1 year.

Management: Coppicing, pollarding.

Remarks: Although seed germinates well, the tree is slow growing. Timber is used as mine props but posts are not durable. Wood is difficult to season. The bark is used for making hives. The tree is often used for charcoal production.



Bridelia micrantha

Euphorbiaceae

Indigenous

Nyanja: Mlebezi, mnazi, msongamino, mpasa

Senga: Msongamino

Ecology: A tree of the high-potential areas in East and Southern Africa. It is a riverine tree found at forest edges or in open woodland, 0–2,200 m. Only a few trees can be seen in Eastern Province, usually riverine. It does well in a variety of climatic zones.

Uses: **Firewood, timber** (tool handles), poles, **food** (fruit), medicine (leaves, root, bark), fodder (fruit, leaves), shade, dye (fruit, wood chips, bark).

Description: A leafy, evergreen tree to 15 m, with a dense spreading crown. **BARK:** grey-brown, flaking with age. **LEAVES:** appear compound but grow alternately, somewhat zigzag, along branches. Leaves shiny, to 12 cm, **veins parallel, each one extending along the leaf margin**. **FLOWERS:** small, cream, in clusters. **FRUIT:** very small, less than 1 cm, soft and purple, edible and sweet when ripe, November–January. Fruit only found on female trees.

Propagation: Seedlings, wildings.

Seed: A prolific seeder. No. of seeds per kg: 19,000–19,500. Germination is very good and uniform, up to 100%, after 20–25 days.

treatment: Use fresh seed. No pre-treatment.

storage: Avoid storage (the seeds are oily therefore have a short viability period).

Management: Coppicing, pollarding.

Remarks: Wood is resistant to termites and makes excellent firewood. The timber polishes well and makes fine furniture. The roots are crushed and used for treating stomach-ache, tapeworm, diarrhoea, headaches and painful joints. The leaf sap is used for sore eyes. The sweet fruits are readily eaten by children. Goats eat the bark and leaves. A paste made of pounded bark has been used to seal cracks in doors, baskets and pottery.



Burkea africana

Caesalpinoideae

Indigenous

English: Wild syringa
Nyanja: Kawidzi, mkoso, ngalati
Senga: Kapanga

Ecology: A common tree found throughout tropical Africa; north to Sudan and south to northern South Africa. Widespread in Zambia, occurring in various types of woodland and a wide range of other habitats and altitudes, but characteristic of sandy dambo margins and the lower slopes of rocky hills in the high-rainfall areas, occasionally in miombo woodland.

Uses: **Firewood, charcoal,** timber (furniture), medicine (bark, roots), fodder (leaves), **bee forage,** tannin (bark), gum (bark).

Description: A medium-sized deciduous tree, usually 8–10 m but may reach 20 m. The bole is straight and the **young branches are covered with rusty hairs**. BARK: dark grey becoming grey-brown, **rough and scaly** with age; exudes a red or yellow gum when damaged. LEAVES: compound, crowded at branch ends, **5 to 15 papery leaflets**, grey-green to dark green; **tip rounded and notched**. Leaf fall May–September, and new-leaf flush August–December. FLOWERS: fragrant, **cream-white** or pale green, 5 mm wide, hang in **long spikes to 24 cm**, crowded near ends of branchlets, August–November. Casual flowering May–June. Produce a lot of nectar. FRUIT: **thin flat pod about 8 cm long**, brown; ripen April–October the following year. Contain 1–2 flat brown or green-yellow seeds. Pods remain on the tree for a long time.

Propagation: Seedlings.

Seed: No. of seeds per kg: 12,500–14,000. Germination is good and fairly uniform, 20–70% after 10–25 days.

treatment: Soak seed in hot water and allow to cool for 24 hours.

storage: Can be stored if kept dry and free from insects.

Management: Pruning, lopping.

Remarks: The wood is moderately hard and durable. It saws, works and finishes well, but is difficult to nail. The tree is host to two kinds of edible caterpillars. In Eastern Province, the name *kawidzi* is also used for *Erythrophleum africanum* because it is somewhat similar to *Burkea africana*. It can be distinguished from *E. africanum* by its hairy buds and shoots, non-reticulate bark and more-or-less oval leaflets.



Caesalpinia decapetala

Caesalpinioideae

Tropical Asia

English: Mauritius thorn

Nyanja: Chatata, jatata

Ecology: This spiny shrub was introduced to Africa from Asia because it made a useful hedge, comparable to barbed wire. It has become naturalized in many wetter parts of Africa from Kenya to South Africa, 900–2,100 m. In Zambia it is common on the plateau, often used to fence in dimba in Eastern Province. Away from farms, it invades grasslands, bushland and forest clearings but does not do well on poor soil.

Uses: Medicine, bee forage, ornamental, soil improvement, **live fence**.

Description: A shrub or climber, rarely reaching 10 m. **LEAVES:** compound, to 50 cm long with **hooked prickles below the leaf stalk**. **FLOWERS:** showy, **pale yellow**, in spikes to 30 cm, each 2 cm across with **orange stamens hanging down**. **FRUIT:** clusters of brown **pointed pods held erect on woody stalks**, scattering many seeds as they open.

Propagation: Seedlings, direct seeding.

Seed: Germination rate > 60%. Germinates within 10 days or so if treated.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Seed can be stored for a long period if it is kept free from insects.

Management: Trim as a live fence, coppicing.

Remarks: It may become a serious weed if not checked. Burning of naturally regenerated growth in the dry season is an effective control measure. Fairly fast growing.



Cajanus cajan

Papilionoideae

S. E. Asia

English: Pigeon pea
Kunda: Nyamundolo
Nyanja: Nyamundolo
Senga: Pheni

Ecology: The genus *Cajanus* is recognized as containing 32 species. It was brought to West Africa early, then to the West Indies as a food crop. It is widely grown on a variety of soils, but not saline or waterlogged ones, 0–3,000 m. Researchers have developed varieties which are drought-resistant and give high yields in dry areas. Improved “tree-types” are also available (work done in India).

Uses: **Food** (seeds and leaves), **fodder** (leaves and pods), bee forage, windbreak, **nitrogen fixation**, **soil improvement**, soil conservation.

Description: A slender shrub growing up to 4 m high, annual or perennial, becoming woody with age. **LEAVES:** compound, the 3 leaflets ovate and pointed, **hairy white below**, to 8 cm long. **FLOWERS:** pale yellow, 2–3 cm in terminal groups, the large petal has red lines on the outside. **FRUIT:** **curved pods to 5 cm; hairy** with 4–5 green-grey seeds.

Propagation: Direct seeding, seedlings.

Seed: Seed highly susceptible to insect attack.

treatment: Soak old seeds in cold water for 24 hours. Fresh seeds do not require pre-treatment.

storage: Seed stores well if protected from insects.

Management: The tree types require pruning if they are to be intercropped.

Remarks: A useful high-yielding crop for dry areas but susceptible to many pests and diseases. In Eastern Province, the plant is often left to grow for 2 or more years. In Tanzania, a root extract is used for stomach-ache and as an aphrodisiac.



Carica papaya

Caricaceae

Tropical America

English: Pawpaw

Nyanja: Papayi

Ecology: A short-lived fruit tree grown in the tropics and in subtropical areas with a mild climate in Africa, Australia and North America. It is planted around homesteads throughout Zambia. Suitable soils are well drained and fertile. It has a shallow root system.

Uses: **Food** (fruit), **drink** (fruit), medicine (roots, leaves), meat tenderizing (leaves, fruit).

Description: A tree-like herb, 2–10 m, the soft fibrous trunk to 20 cm across, narrowing to a crown of leaves. **BARK:** pale grey, smooth, **well marked with leaf scars**. **LEAVES:** to 60 cm across, **deeply palmately lobed**, the **hollow stalks to 60 cm long**. **FLOWERS:** male trees, abundant **flowers on drooping stalks**, cream-yellow, about **2 cm long, tubular** and fragrant; female trees larger, few flowers beside leaves, **5 thick waxy petals, cream, about 5 cm long**, fragrant with prominent sticky stigma (sometimes male and female together on one tree). **FRUIT:** take about 3 months to mature, oblong to spherical, **7–50 cm long and 15 cm across, thin skin, green to orange**. The sweet edible flesh bears many black seeds on the inside leaving the centre hollow.

Propagation: Seedlings, direct sowing at site; grows easily from seed.

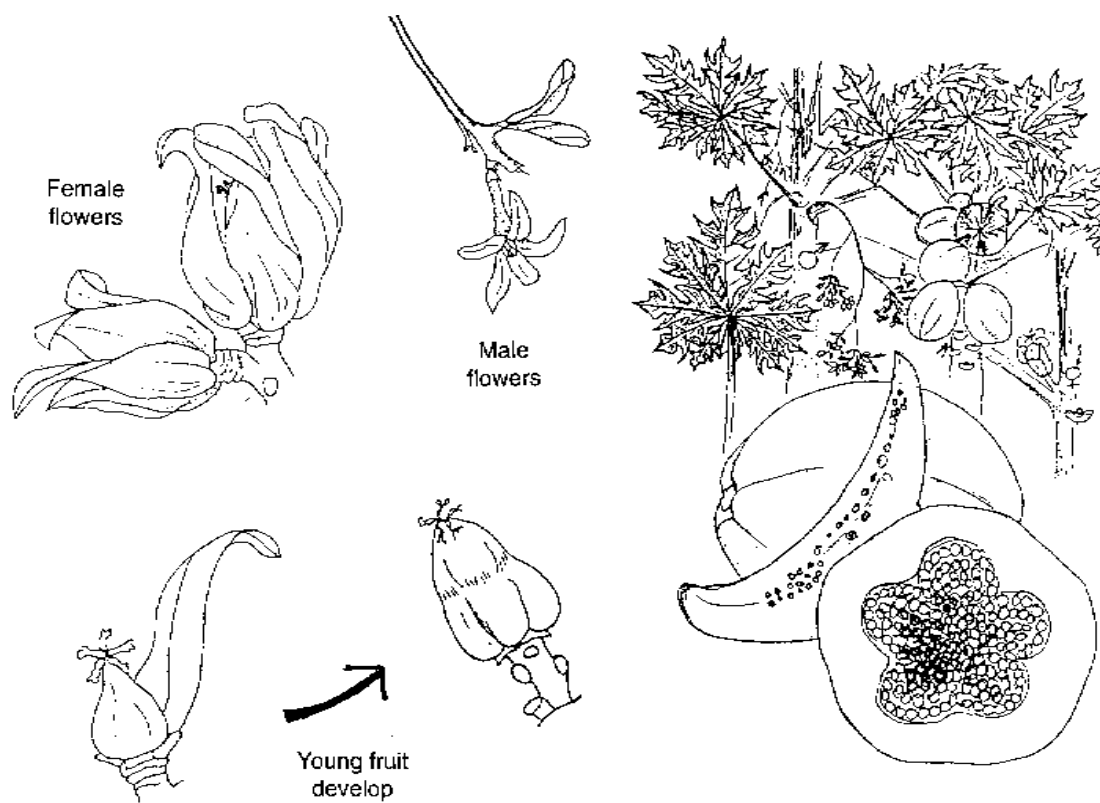
Seed: No. of seed per kg: 20,000. Collected from ripe fruit.

treatment: Dry in air.

storage: Store under cool and dry conditions. Viability is up to 3 years.

Management: Germination takes 1–4 weeks. Weeding is essential as pawpaw is sensitive to root damage. In plantations, space plants 2–4 m apart and have 1 male tree for every 25 female trees.

Remarks: Meat can be tenderized by wrapping it in pawpaw leaves. Trees do well for 3–4 years then yield falls, so plant every 4 years on a fresh site. The tree is attacked by several weevils, bugs, etc. Leaves are used to treat whooping cough and roots to treat sexually transmitted diseases.



Cassia abbreviata

Caesalpinioideae

Indigenous

English: Long-pod cassia
Kunda: Mleza
Nyanja: Mkhoswe, mleza, mnyoka
Senga: Mwanamayoka

Ecology: A small tree widespread in dry thornbush and woodlands from Somalia to South Africa, 220–1,520 m. There are two main subspecies. In Eastern Province, it is common on termite mounds in open woodlands and deciduous thicket. Easily recognized as the long pods hang on the tree for some time.

Uses: Firewood, timber (furniture, joinery), **medicine** (bark, roots).

Description: A deciduous shrub or well-branched tree up to 10 m with a light, open flat-to-rounded crown growing up to 10 m high (may reach 15 metres). **BARK:** rough, grey-brown, cracked. **LEAVES:** compound on a leaf stalk to 25 cm, up to **12 pairs stalked leaflets**, each one thin and oblong to 6 cm, **tip rounded or notched**. **FLOWERS:** **golden yellow** heads to 9 cm, fragrant, 5 petals to 3 cm. Flowers are seen on the bare tree in the dry season, March–November. **FRUIT:** dark brown **Pods, 30–90 cm**, thick cylindrical section containing many seeds in pulp. Pods ripen June–July of the following year and seeds are shaken out.

Propagation: Seedlings, wildings.

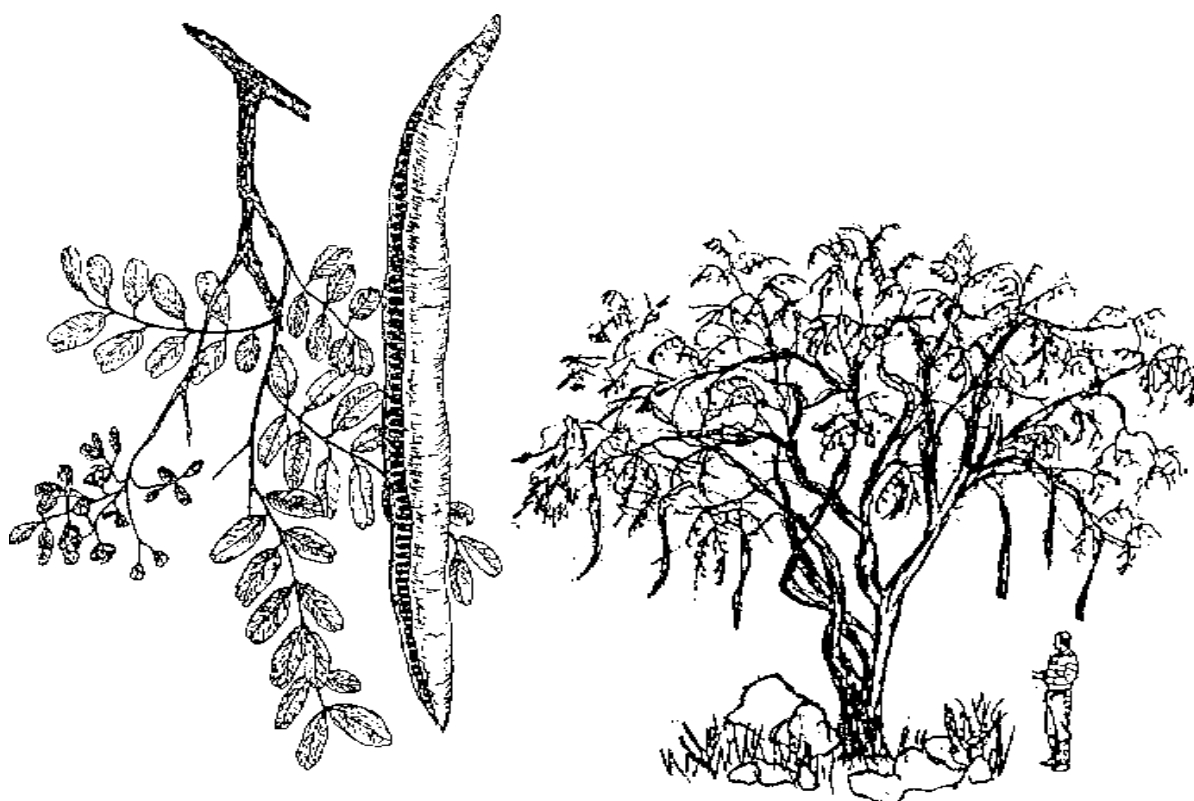
Seed: No. of seeds per kg: 15,000. Germination is good and fast with fresh seed.

treatment: Not necessary for fresh seeds. Soak stored seed in cold water for 24 hours.

storage: Can be stored for a long time if kept dry and free of insects.

Management: Pruning.

Remarks: A good medicinal tree for many ailments, e.g. sexually transmitted diseases and stomach-ache.



Cassia singueana

Caesalpinioideae

Indigenous

English: Winter cassia

Nyanja: Mtanthanyerere, kalusapwe

Ecology: Widespread in drier areas of tropical Africa. In Zambia, it occurs on termite mounds, in most types of woodland, wooded grassland and bushland all over the country. In Eastern Province, it is mainly found in open woodlands, frequently on termite mounds.

Uses: Firewood, **medicine** (leaves, bark, roots), tannin.

Description: A deciduous shrub or small tree, usually 4–5 m but occasionally up to 11 m, with a light open crown. **BARK:** red becoming grey-brown and rough. **LEAVES:** compound with **4–10 pairs oval leaflets**, fresh green, 2.5–5.0 cm long. **Between each leaflet pair there is a conspicuous gland on the stalk.** Leaflets are round at the tip and base and have a very **short stalk**. **FLOWERS:** striking **deep yellow**, fragrant, in large **loose sprays** to **15 cm**, on the bare tree (April–September). The coloured **sepals are rounded**; 3 different groups of stamens. There are **glands on the flower stalks**, stalks **2–4 cm long**. **FRUIT:** A **narrow cylindrical pod to 25 cm**, **sharply pointed and narrowed between seeds**. Pods hang in clusters and ripen the following year, yellow when ripe. **Seeds circular, flat, only 5–6 mm** with a **small mark** (the areole).

Propagation: Seedlings, wildings.

Seed: –

treatment: not necessary.

storage: –

Management: Coppicing.

Remarks: A good medicinal tree for many ailments (e.g. stomach pains, syphilis). The pods are said by some people to be edible either raw or boiled and made into a gruel, while others regard them as poisonous.



Casuarina equisetifolia

Casuarinaceae

Australia

English: Whistling pine

Ecology: The most widespread species of *Casuarina*, mainly found along tropical coastlines, including sandy shores of Africa both East and West, 0–1,500 m. It does well on loose sandy soils with adequate moisture, but cannot withstand waterlogging. The extensive root system and nitrogen-fixing root nodules enable the tree to grow in poor soils. In Chipata and Lundazi Districts the species has been planted around the townships.

Uses: Firewood, charcoal, **timber, poles, windbreak, ornamental, nitrogen fixation**, dye, tannin (bark).

Description: An evergreen tree with “weeping” foliage to 20 m. BARK: grey-black, cracked. BRANCHLETS: **hang down to 30 cm** in crowded tufts. FLOWERS: male flowers are seen as yellow pollen-bearing tips to branchlets, and female flowers are tiny heads with hairy red stigmas on woody branches. FRUIT: the prickly brown cone-like capsules are **2.5 cm long**, larger than those of *Casuarina cunninghamiana*.

Propagation: Seedlings.

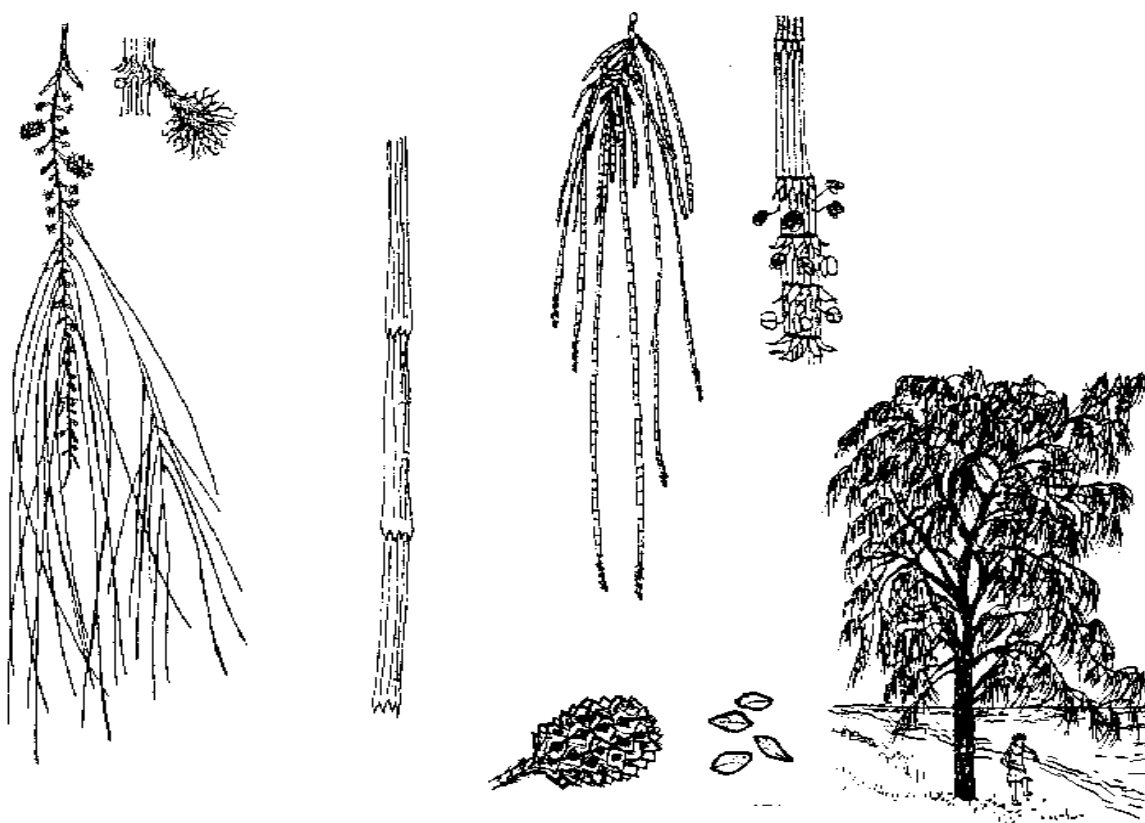
Seed: No. of seeds per kg: 600,000–900,000.

treatment: Not necessary.

storage: Seed can be stored for up to a year.

Management: Side pruning to get a clear bole.

Remarks: The timber is very hard, heavy and difficult to saw but attacked by termites. The charcoal produces high heat with little smoke or ash. The bark contains tannin and a red dye. An appropriate species for reclaiming and improving sandy soils. A good windbreak species. A tree with potential for growing in sandy areas of the Province.



Citrus limon

Rutaceae

India

English: Lemon
Kunda: Mandimu
Nyanja: Ndimu
Senga: Mandimu

Ecology: A tree originally from Assam in India and suited to sandy or loamy well-drained soils. Lemon trees will grow at higher altitudes than some other citrus but, like all citrus, they require a high temperature to fruit well and well-distributed rainfall. High humidity increases the risk of pests and diseases.

Uses: Firewood (twigs, dead branches), **food** (fruit, jam, pickle), **drink**, flavouring (peel), medicine (juice, peel, roots, leaves), ornamental.

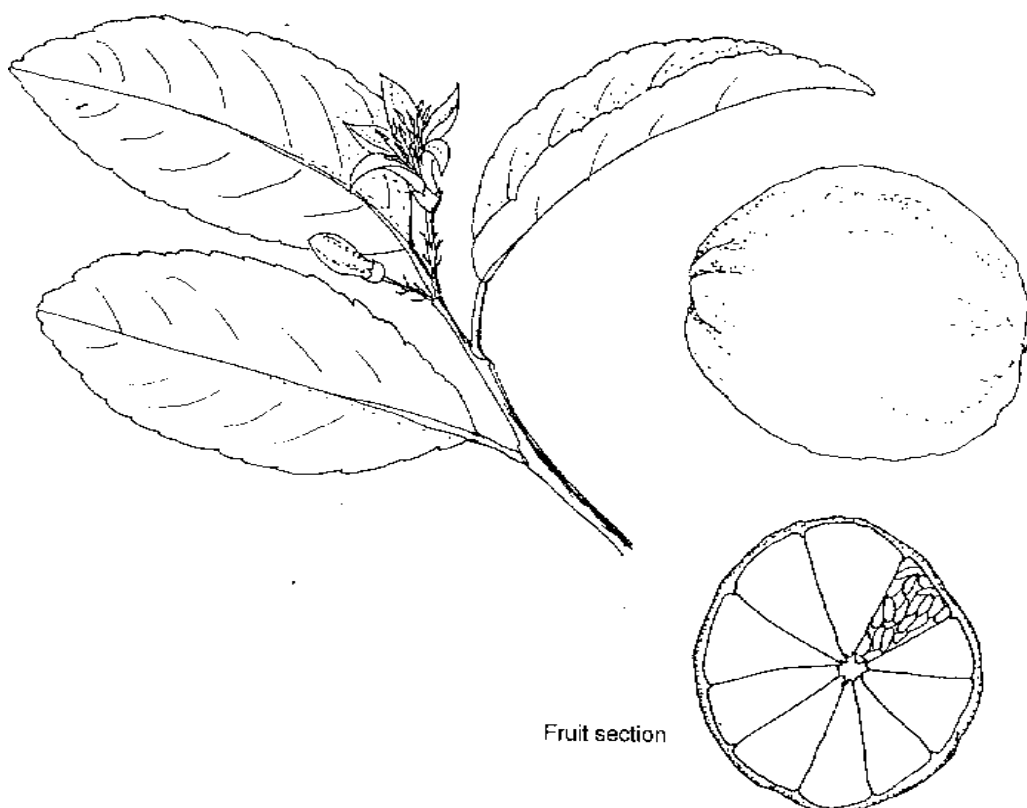
Description: A tree to 8 m, rather open, branches with stout, stiff thorns. Young plants are more thorny, especially near the centre of the tree. **LEAVES:** **paler green than most citrus**, sharp-tipped, quite large, **edge toothed**, leaf stalk very short, wing very narrow, clear joint to blade. **FLOWERS:** **white, solitary**, petals thick and fragrant, **back of petals purple-red so buds appear purple**. **FRUIT:** about 7–8 cm long, **ovoid, pointed both ends**, yellow or green when ripe, rough or smooth, **flesh pale yellow with much juice** which is acid to bitter. Few seeds.

Propagation: Seedlings, budding, grafting.

Seed: -
treatment: Not necessary.
storage: Can be stored.

Management: Mixed planting with other trees that could serve as a support.

Remarks: Lemons ripen during most of the year. They grow easily, bear fruit quite quickly and withstand drought. Rough lemon provides the best rootstock for budding and grafting lemons, limes, grapefruit and tangerines.



Citrus sinensis

Rutaceae

Southern China, Vietnam

English: Orange**Kunda:** Lalanje**Nyanja:** Lalanje

Ecology: Oranges are the most widely grown and important citrus fruit, no longer known in the wild. They are very widely grown both in the tropics and subtropics but do not do well in very wet areas nor at high altitudes. The tree is to be found in all districts planted either by individual farmers or institutions. They produce more fruit with irrigation.

Uses: **Food** (fruit), **juice** (fruit).

Description: A **well-shaped tree** 6–12 m with **dense foliage** and rather thin spines beside leaves. The twigs are angled when young. **LEAVES:** oval to 15 cm, 2–8 cm across, dark green, edge entire, the **stalk narrowly winged**, having a **line or joint with the leaf blade**. **FLOWERS:** flower buds white, in clusters of 1–6, sepals and petals thick, 5 recurved petals, 2–3 cm across. **FRUIT:** rather variable in colour and shape, **rounded**, smooth, green-orange-yellow, **4–12 cm across**, the relatively **thin skin hard to separate**, the pulp surrounding the seeds **sweet-sour but juicy**.

Propagation: Budding or grafting on rootstock of rough lemon.

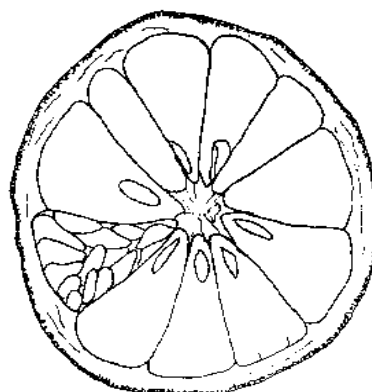
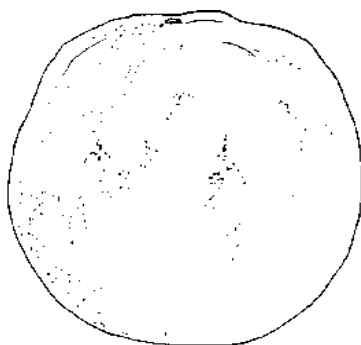
Seed: –

treatment: not necessary.

storage: –

Management: Pruning to encourage branching and to keep the fruit low for harvesting. Watering and mulching.

Remarks: There are many cultivars, and desirable ones are grafted onto rootstock trees grown from seed. Most citrus can be both self- and cross-pollinated. The strong fragrance attracts bees to the flowers which have much nectar and sticky pollen. The most common varieties in Eastern Province are Washington Navel and Valencia. Washington Navel has bigger fruit with less seed and is more juicy, but Valencia is sweeter. Oranges are eaten both fresh and for juice: a ripe orange or tangerine contains about 12% sugar. Essential oils can be extracted from flowers, leaves and peel. A glass of orange juice provides the daily requirement of vitamin C.



Colophospermum mopane

Caesalpinioideae

Indigenous

English: Mopane, turpentine tree

Nyanja: Mupane, tsanya, chanye

Senga: Lupani

Ecology: A tree restricted to the hot lowlands of Central Africa, 0–1,200 m. In Zambia, it is a dominant tree in the major river valleys, including Luangwa and in Chama District, often seen in pure stands, “mopane woodland”. It tolerates poorly drained clay and alkaline soils better than most trees.

Uses: **Firewood, charcoal, timber (construction), poles,** medicine (bark, roots).

Description: A tall deciduous tree to 20 m, with a tall and straight trunk; crown small and dense. **BARK:** grey-black, thick, ridged with deep cracks. When damaged it exudes gum. **LEAVES:** easily recognized, **2 leaflets** together, like butterfly wings, each leaflet up to 10 x 5 cm, stalk to 4 cm. Crushed leaves smell of turpentine. **FLOWERS:** pale green, in sprays, December–March. **FRUIT:** flat **leathery** pods, **golden-brown, kidney-shaped**. The single seed within is wrinkled and sticky. It can germinate inside the pod which does not break open.

Propagation: Seedlings, wildings.

Seed:

treatment: Not required.

storage: Can be stored.

Management: Coppicing.

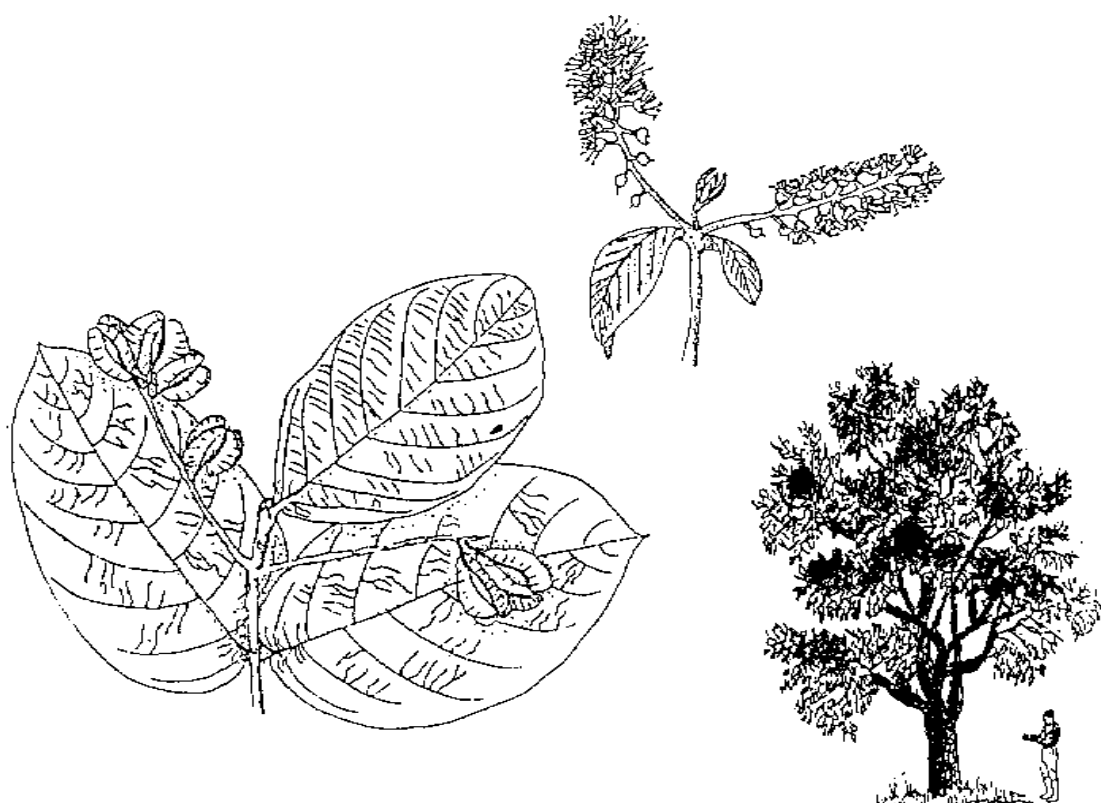
Remarks: The dark red-brown heartwood is heavy and termite-resistant. An edible caterpillar (*Gonimbrasia helina*) feeds on the leaves. These colourful “mopane worms” are eagerly collected and roasted. The tree remains bare in winter. The thick bark is fairly fire-resistant. Leaves characteristically hang down during the heat of day and so provide little shade. Mopane is an indicator of poorly drained shallow soil; unsuitable for crops. It makes excellent fuelwood (firewood and charcoal).



Combretum molle

Combretaceae

Indigenous

English: Bush willow, velvet-leaved combretum**Nyanja:** Kalama, mkute, kakunguni**Senga:** Kalama**Ecology:** A tree of dry woodlands; very widespread throughout tropical Africa and very variable in habit, 0–2,300 m. It is found all over Zambia but rare in the south and west. Can form pure stands on wooded hillsides and is common in all types of woodlands and in semi-evergreen thicket. Occurs in Eastern Province in all woodland types.**Uses:** **Firewood**, charcoal, **timber** (tool handles, construction), **poles**, fence posts, medicine (bark, leaves, roots), fodder (young leaves), dye (roots).**Description:** Usually a small tree 5–7 m, up to 13 m; the thin trunk often crooked or leaning, branches heavy, drooping. **BARK:** characteristic in older trunks, **brown-black, deeply grooved into small squares** like “crocodile skin”. **LEAVES:** large and opposite; soft to the touch, more **grey-white hairs below than above, to 17 cm long**, rounded at the base. **FLOWERS:** green-yellow in spikes to 9 cm, sweet heavy scent, before or with new leaves, July–October; the tree conspicuous in flower. **FRUIT:** dry **4-winged seeds**, to 2 cm, yellow-green becoming a bright **golden brown**; June–September.**Propagation:** Seedlings, rootsuckers.**Seed:** No. of seeds per kg: 10,000–15,000. Germinates easily if fresh.**treatment:** Remove seed wings before sowing.**storage:** Can be stored for a few weeks; sow fresh seeds for best results.**Management:** Lopping, coppicing.**Remarks:** The timber is hard and pale yellow, reasonably termite-proof. The seed germinates easily and the tree grows relatively fast initially. Roots can be used for treating hookworm, snakebite, stomach pains, fever, dysentery and leprosy. A concoction of roots is used to treat abdominal pains and sterility.

Commiphora africana

Burseraceae

Indigenous

Nyanja: Mchovwe, chitontho

Senga: Chitontho

Tumbuka: Chitontho

Ecology: A shrub found all over Africa in the driest areas. It will grow on sandy plains, clay soils to rocky slopes with minimal rainfall. In Zambia, it is widespread at low to medium altitudes in dry areas, e.g. Luangwa Valley.

Uses: Food (fruit), medicine (roots, bark, fruit), **fodder** (goats eat shoots), **live fence**.

Description: A deciduous, **thorny shrub** or tree to 5 m, **bare for many months**. BARK: **grey-green peeling to show green below; when cut a yellowish gum drips out, branchlets thorn-tipped**. LEAVES: soft, **hairy**, compound, **3 leaflets, the central leaflet largest**. FLOWERS: small, often clustered on the thorns, green to red. FRUIT: soft and pointed, **pink-red, to 1 cm**, containing 1 hard seed.

Propagation: Large cuttings.

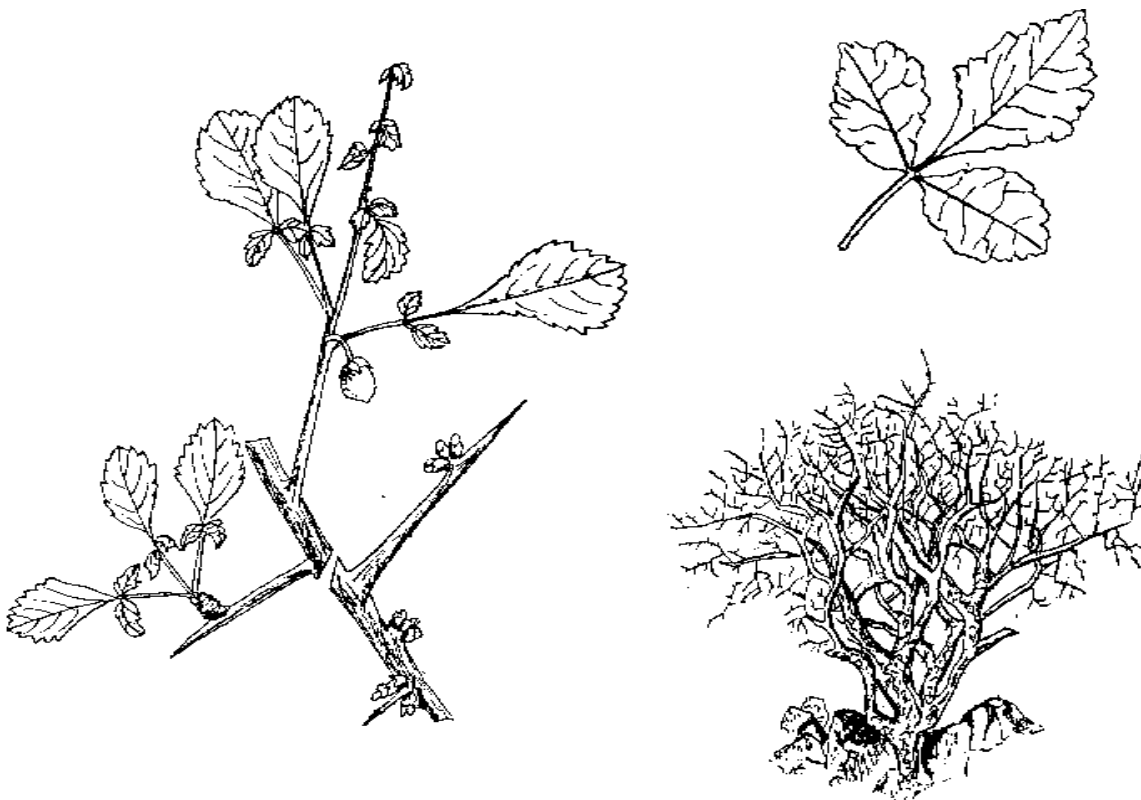
Seed: No. of seeds/kg 8,000.

treatment: –

storage: –

Management: Lopping. Slow growing.

Remarks: Leaves contain bitter tannin, so they are not browsed by cattle or wild game, but important fodder for goats. The leaves contain 8–14% crude protein. Widely used as a live fence for gardens. It does not compete with crops. Fruits are used for the treatment of typhoid fever and stomach problems. The powdered bark mixed with porridge is used to cure malaria. Burnt resin fumes are used as an insecticide. An edible oil can also be extracted from the seed.



Cordyla africana

Papilionoideae

Indigenous

English: Wild mango

Nyanja: Mtondo

Senga: Msika

Tumbuka: Msika

Ecology: Occurs at low altitudes in hot areas, often in riverine forest and swamps, from East Africa to South Africa. In Eastern Province, common in Luangwa Valley along rivers and streams.

Uses: **Timber** (construction, tool handles, carving, drums, stools, mortars), poles, beehives, **food** (fruit), shade.

Description: A large spreading deciduous tree 9–25 m tall with a rounded crown. **BARK:** greyish-brown and rough, thick and grooved. **LEAVES:** alternate compound, with 11–28 pairs of leaflets plus a terminal leaflet, each one oblong to 2.5 cm, dark green with a short **hairy stalk**. Held up to the light, unusual **clear dots and streaks can be seen**. **FLOWERS:** **semi-spherical heads of yellow-orange stamens** up to 2.5 cm, hang on branched stalks. They appear in axillary sprays or in axils, with the new leaves in July–October. No petals but sepals, ovary stalked. **FRUIT:** unusual pods, **yellow** when ripe, **oblong to spherical**, thin-walled, **about 6 cm long**. The 3 flat seeds are contained in fleshy pulp and appear in November–January. The sticky pulp smells like beans.

Propagation: Seedlings, suckers.

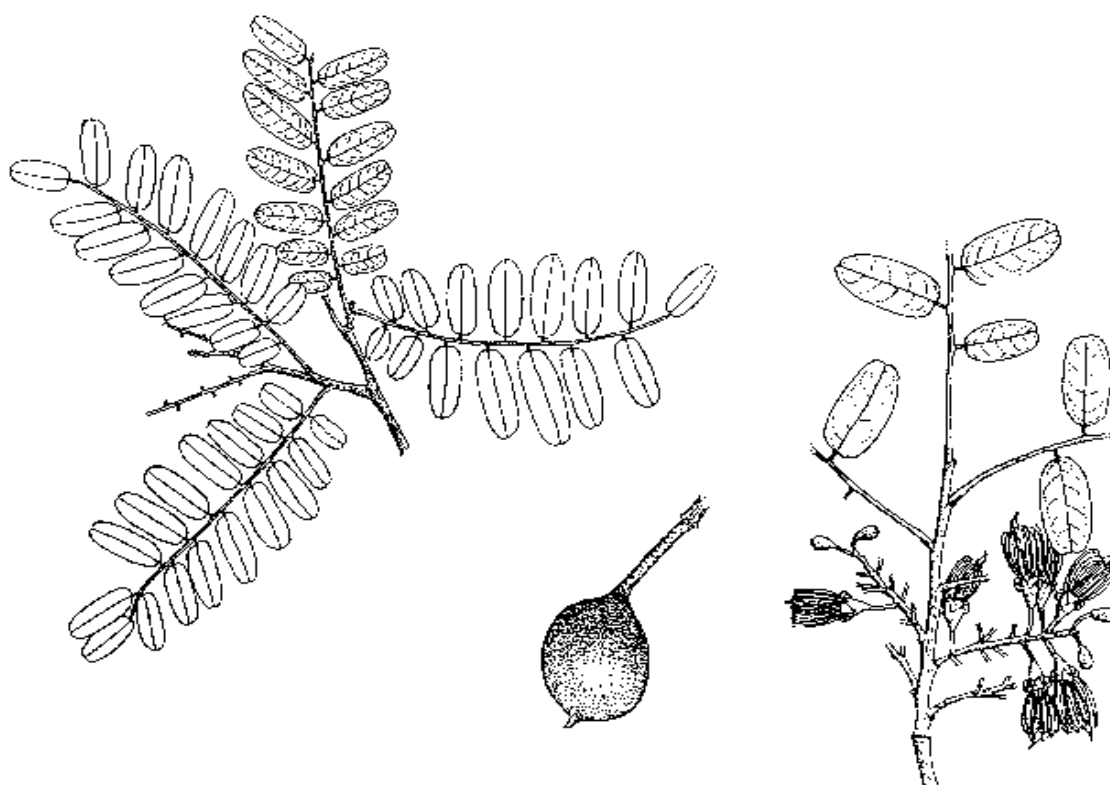
Seed: Fresh seed germinates easily.

Seed: Not necessary.

storage: Viability is short.

Management: Pollarding, lopping, coppicing.

Remarks: The fruit is very tasty and is eaten both raw and cooked. It has a very high vitamin C content. The heartwood has a rich brown colour and the timber is hard but susceptible to borers.



Cupressus arizonica

Cupressaceae

Mexico, Arizona

English: Arizona cypress

Nyanja: Saipuresi

Senga: Sapulesi

Ecology: This coniferous tree originates in the mountains of Arizona, and grows well with moderate rainfall in many parts of the world (1,000–2,800 m). It has been planted as an ornamental in Zambia in most urban areas and around institutions. It can be seen in Chipata and Katete Districts of Eastern Province. The tree will tolerate slightly saline soil.

Uses: Firewood, **timber**, poles, posts, **ornamental**, windbreak.

Description: An evergreen tree to 20 m, conical when young, the trunk straight, branches standing out. **BARK:** reddish–dark brown when mature; bark peeling off in thin plates. **LEAVES:** the tiny grey-green leaves cover the branchlets, each pointed. **CONES:** **shiny** and rounded, green to brown, 2.5 cm across with **few cone-scales**, each scale with a small “peg”; 90–120 seeds are set free from the cone as it dries. Cones remain several years on a tree.

Propagation: Seedlings.

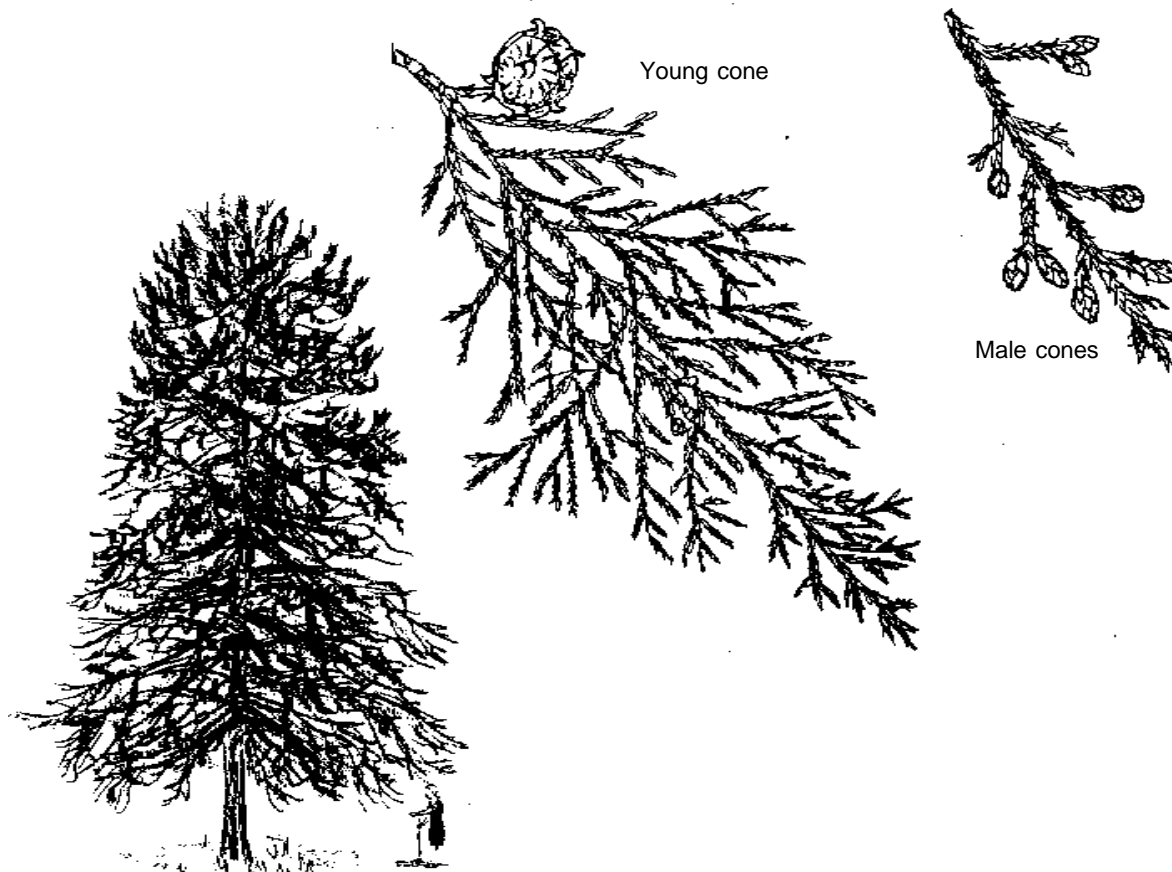
Seed: No. of seeds per kg: 88,000–200,000. Germinates in 13–30 days.

treatment: Not necessary.

storage: Stores up to 6 months.

Management: Pruning.

Remarks: During the dry season, this species is subject to severe aphid attack and therefore should be planted with caution. It is also susceptible to termites and catches fire easily. It will burn when still green. However, it is drought- and cold- resistant.



Cupressus lusitanica

Cupressaceae

Mexico, Guatemala

English: Mexican cypress

Nyanja: Saipuresi, lubani

Ecology: Widely planted in the tropics as a quick-growing softwood. It requires good rainfall and does best at high altitudes (1,300–3,300 m) in well-drained soils. Popular in Chipata.

Uses: Firewood, **timber** (furniture, construction), poles, **ornamental**, windbreak, **live fence**.

Description: An evergreen conifer to 35 m with a straight trunk and generally conical but **not regular**; branches wide spreading. The branchlets grow in many planes and hang down. **BARK:** red-brown with vertical grooves, grey with age. **LEAVES:** dull blue-green in 4 ranks, with **spreading pointed tips**. **CONES:** male cones, like fat tips on branchlets, produce clouds of yellow pollen dust; female **cones** round, 1.5 cm across, coloured **waxy grey** when young. Cones ripen in 2 years, becoming brown; scales open to release many winged seeds. Scales bear a slender peg.

Propagation: Seedlings.

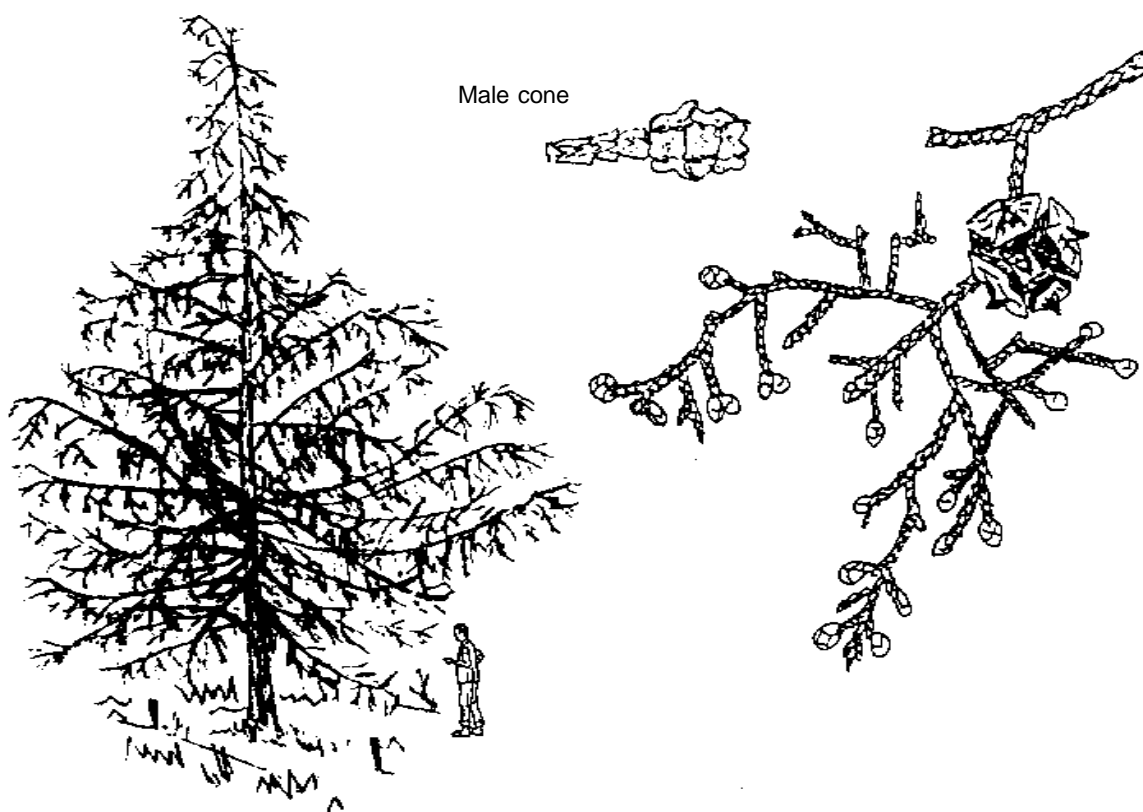
Seed: Germination rate about 40 % in 15–20 days. No. of seeds per kg: 160,000–290,000.

treatment: Not necessary.

storage: Seed can be stored for six months.

Management: Trimming as a hedge. Pruning and thinning of trees in woodlots.

Remarks: Can produce poles after 10 years, general purpose timber after 20 years. Not good for intercropping as leaf litter decomposes slowly and the shallow roots spread over a wide area. Commonly used as Christmas trees. The timber is pale brown, seasons well, making a very good lightweight wood that is widely used for furniture.



Cussonia kirkii (*Cussonia arboroea*)

Araliaceae

Indigenous

English: Cabbage tree, dead man's fingers
Nyanja: Mbwabwa, mpandanjovu, chipombo
Senga: Chipombola

Ecology: The commonest member of this family in Zambia. All have very soft wood and the leafy heads are a characteristic shape. They grow at forest edges of miombo woodland, widely distributed.

Uses: **Timber** (utensils, traditional musical instruments), medicine (bark, roots).

Description: A small deciduous tree about 10 m high with a **short bole**; the crown somewhat rounded. **BARK:** grey-brown, deeply grooved, thick and corky. **LEAVES:** compound, 7–9 leaflets, **each one toothed**, almost stalkless. The tree is bare between June and October and new leaves appear with the flowers. Leaves are crowded at the end of branches in very **large rounded clusters** ("cabbage-like"). **FLOWERS:** small and green, on long thin spikes, October–December. **FRUIT:** shiny, purple-black, rounded, **clustered along the spikes**, January–March.

Propagation: Strikes readily from cuttings.

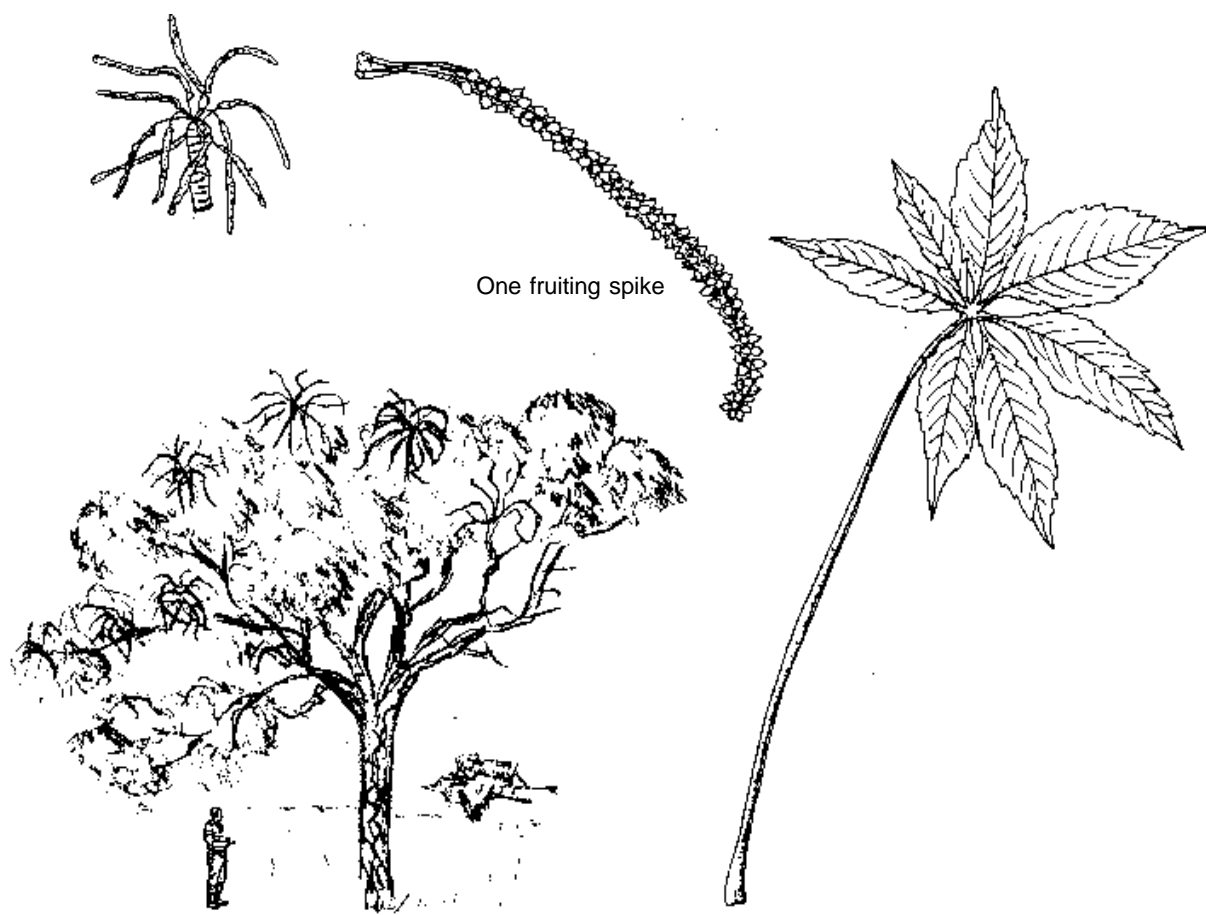
Seed: Propagated by cuttings.

treatment: –

storage: –

Management: Coppicing, pollarding.

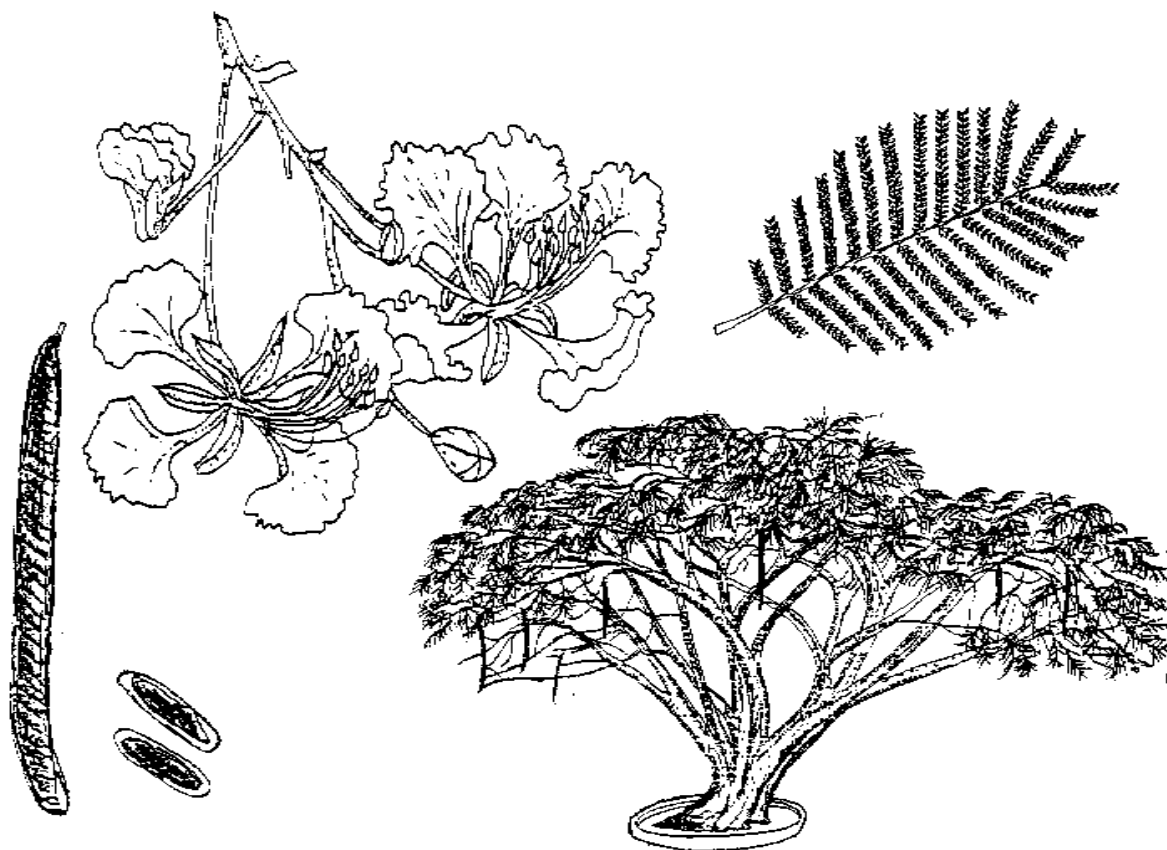
Remarks: The tree is a host to edible caterpillars. Burning wood gives off an unpleasant smell, therefore it is not commonly used for firewood.



Delonix regia

Caesalpinioideae

Madagascar

English: Flamboyant**Ecology:** A strikingly beautiful tree in flower, almost extinct in its native Madagascar, now cultivated throughout the tropics 0–2,000 m. It is found all over Zambia as an avenue tree and ornamental. It prefers sandy soil and moderate rainfall, but survives dry conditions.**Uses:** Medicine (bark), bee forage, shade, **ornamental**, beads (seed).**Description:** A **spreading deciduous** tree, usually to 10 m with a flattened or umbrella-shaped crown. **BARK:** grey and smooth. **LEAVES:** light green, **feathery, compound** on a stalk to 60 cm, leaflets less than 1 cm, folding at dusk and falling in the dry season. **FLOWERS:** brilliant **scarlet-red clusters**, often appearing on the bare tree, each flower to 10 cm across with 5 petals. **FRUIT:** **heavy flat pods, to 75 cm** long, remaining many months on the tree. When dry, they break open to release oblong seeds, April–June.**Propagation:** Direct seeding, seedlings.**Seed:** Seeds prolifically; high germination rate. No. of seeds per kg: $\pm 2,000$.**treatment:** Immerse seed in hot water and allow to cool for 24 hours.**storage:** Seed can be stored for up to 4 years.**Management:** Coppicing.**Remarks:** The species has a shallow root system making it unsuitable for growing near buildings and this feature, together with the dense canopy, also prevents its use for intercropping. Fast growing.

Dicrostachys cinerea

Mimosoideae

Indigenous

Nyanja: Kalumphangala

Senga: Lumphangala

Ecology: A thorny bush widespread all over Africa and beyond to India and Australia. It is very common throughout Zambia on all types of soil from open grassland to river banks, rocky hillsides and munga woodlands 0–2,000 m. Growing in low thicket, it is an indicator of overgrazing and poor soils.

Uses: **Firewood**, charcoal, timber (tool handles), poles, medicine (leaves, roots), **fodder** (leaves, pods), bee forage, **nitrogen fixation**, soil conservation, **fibres** (bark), basketry (debarked roots), **live fence**.

Description: A small shrubby tree, although it can reach 6 m. The feathery leaves show it is close to the genus *Acacia*. **BARK:** grey, thick and fibrous. The **thorns** are short and **single, alternate** and slightly hooked. **LEAVES:** compound, leaflets narrow, slightly hairy. **FLOWERS:** in two-coloured heads; upper half pink, lower half yellow. These hang on a thin stalk and so they have been called “Chinese lanterns”; October–December. **FRUIT:** A twisted cluster of thin, flattened pods. Each spiral pod contains about 4 seeds. Clusters fall to the ground and rot; May–September.

Propagation: Seedlings, direct seeding, rootsuckers.

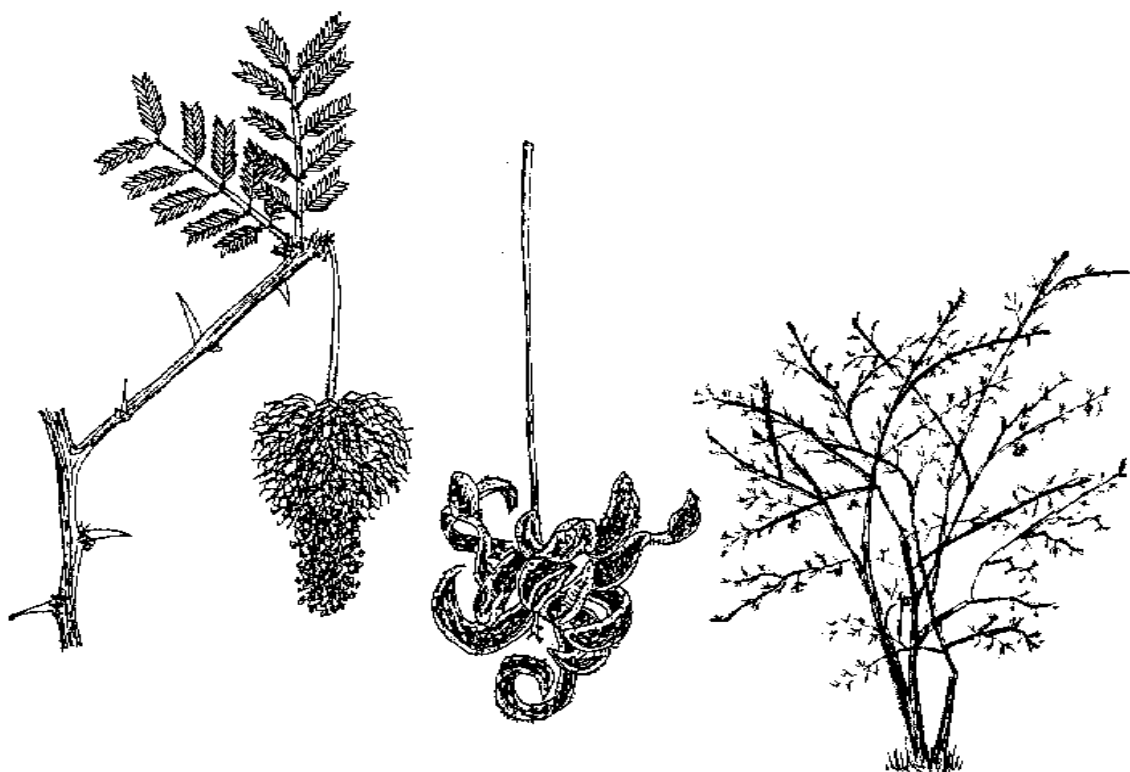
Seed: The tree seeds prolifically when in open land. No. of seeds per kg: 39,000.

treatment: Immerse seed in hot water and allow to cool for 24 hours.

storage: Can be stored up to 10 years at room temperature if kept dry and free from insects.

Management: Coppicing, lopping and pollarding.

Remarks: It has vigorous root suckers and can form a dense thicket. The timber is very heavy and hard but of small dimensions. The pods are very rich in protein and should therefore be given as supplementary feed to oxen. The bark is used to treat dysentery, toothache and elephantiasis. The leaves are a laxative and used to treat gonorrhoea and boils. They are also a remedy for stomach problems, snakebite and scorpion stings. It is also used as an aphrodisiac.



Diospyros mespiliformis

Ebenaceae

Indigenous

English: African ebony
Nyanja: Mchenja, mvimbe, mchenjamusumu
Senga: Mchenja
Tumbuka: Mnchenja

Ecology: A tree widespread in Africa from Senegal to Kenya and to South Africa. In Zambia, it is scattered throughout the country on termite mounds, along river banks and in most types of woodland at low to medium altitudes.

Uses: Firewood, **timber** (construction, carvings, furniture), **food** (fresh fruit, fermented drink), medicine (bark, roots, fruits), bee forage, shade, ornamental.

Description: A semi-evergreen tree, usually 10–15 m; the bole clear to a dense rounded crown. **BARK:** grey-black, rough and squared. **LEAVES:** shiny dark green, **alternate to 14 cm long, the midrib raised below, the edge wavy, tip rounded.** **FLOWERS:** fragrant; male clustered, female solitary cream-white; the stalk with woolly hairs. **FRUIT:** rounded to 2.5 cm in a calyx cup, the 5 segments curling back, yellow then purple, pulp soft and sweet containing 4–6 seeds.

Propagation: Seedlings.

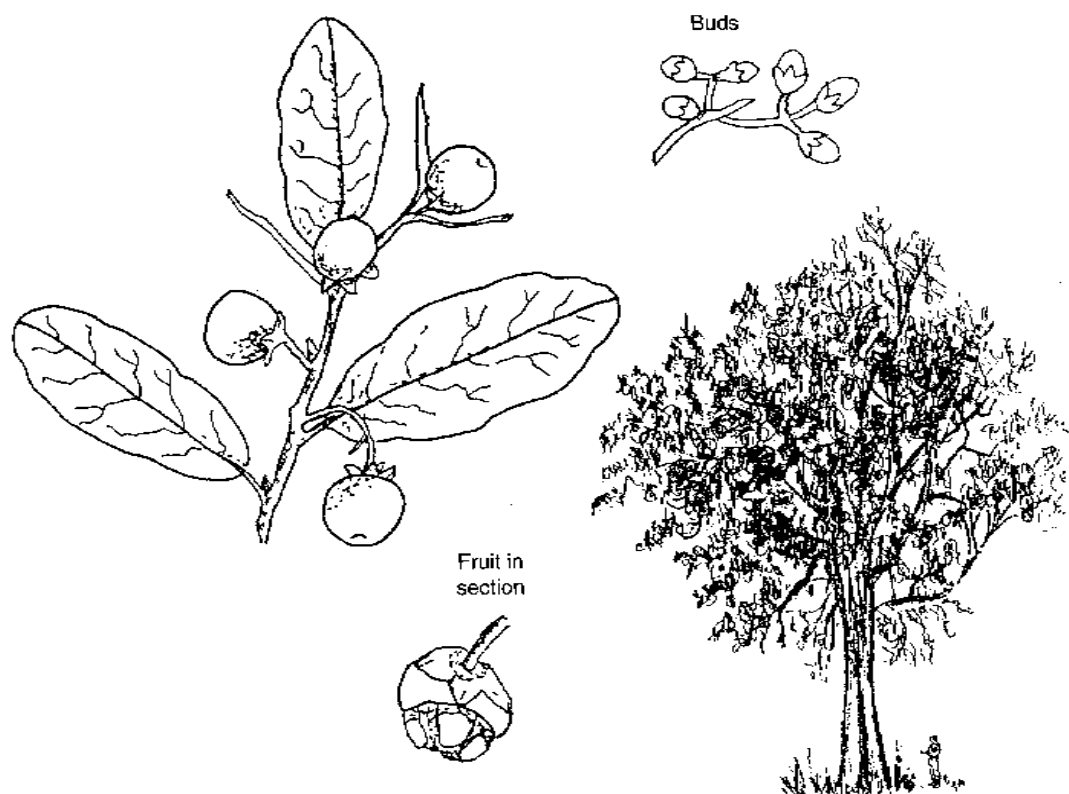
Seed: Good germination. No. of seeds per kg: 2,700–3,200.

treatment: Not necessary.

storage: Seed can be stored for many years.

Management: Coppicing, pruning.

Remarks: *Diospyros* spp. produce the valuable black heartwood “ebony”, very popular for wood carving. Only a few trees yield the black wood after felling; pale at first, the timber gradually becomes dark brown. The wood is hard, strong, with a fine grain and is fungus- and termite-resistant. Slow growing. The leaves are used to treat fever and for dressing wounds. Bark and roots are used for treating malaria, syphilis and leprosy. Different parts of the tree are used to treat headache, toothache and other body pains.



Diplorhynchus condylocarpon

Apocynaceae

Indigenous

English: Horn-pod tree, wild rubber tree

Nyanja: Mtowa, mtombozi

Senga: Mwenjendale

Ecology: Trees of this family grow as scattered individuals and not in stands. Many are good sources of drugs and latex. This species is found north to Tanzania, south to Namibia and throughout Zambia. It grows in all woodland types, especially plateau miombo, chipya, scrub woodlands but not in forest; preferring sandy well-drained soil at medium to low altitudes.

Uses: **Firewood, charcoal,** timber (furniture, utensils, carving), poles, **medicine** (bark, roots, leaves), **fodder** (leaves, fruit), gum (latex).

Description: A semi-deciduous shrub or small tree growing up to 4–10 m, often multi-stemmed; the **main branches erect** to a narrow crown. Young branches arch over with **drooping leaves**. **BARK:** thick grey to dark brown, evenly cracked into rectangular scales—resembling “crocodile skin”. **When damaged, it exudes a lot of white, sticky latex.** **LEAVES:** opposite, yellow-green and shiny, margin wavy, oval to 7 cm, on stalk about 2 cm. **FLOWERS:** small white and “star-like”; in loose branched heads near tips of branches, August–November. **FRUIT:** characteristic **brown fruits** about 4 cm long; hang on the tree a long time; brown, dotted with paler lenticels. The woody capsules split and curve back to release 2–4 **winged seeds**, June–August.

Propagation: Cuttings, seedlings.

Seed: –

treatment: Not necessary.

storage: –

Management: Coppicing, pollarding.

Remarks: The wood burns even if wet. The sticky latex is generally useful as a gum. The plant can survive bush fires.



Dombeya rotundifolia

Sterculiaceae

Indigenous

English: Wild pear**Nyanja:** Matowo

Ecology: A small tree occurring over a wide range of altitudes, usually in wooded or open grassland, often near termite mounds. Outside Zambia it is found in Namibia and Botswana, and in East and Central Africa from Kenya south to northern South Africa. In Eastern Province, it is common on the plateau area in the miombo woodland, often on termite mounds.

Uses: Timber (carving), **food** (fruit), medicine (roots), fodder (leaves), bee forage, ornamental, fibres, bows (strong but flexible branches).

Description: A shapely deciduous tree to 4 m. BARK: dark brown, deeply furrowed. LEAVES: **oval to almost circular, 6–18 cm across, rough**, often very hairy below, edge unevenly toothed, stalked. The **leaves dry, very crisp and hard**. FLOWERS: **white-pink in many-flowered heads**, buds woolly. Sweet-scented blossom attracts bees. FRUIT: small, round, hairy capsules.

Propagation: Seedlings.

Seed info.: No. of seeds per kg: 35,000–40,000. Germination is good and completed after 3 weeks.

treatment: Not necessary.

storage: Can retain viability only for 3 months at room temperature.

Management: Coppicing.

Remarks: The wood makes good fuel, is strong and tough but often twisted. An attractive tree when in flower.



Enlarged
flower

Dovyalis caffra

Flacourtiaceae

South Africa

English: Kei apple

Ecology: A spiny shrub of open bush and wooded grassland in the Cape and Natal Provinces of South Africa, but it has been widely planted from coast to highland in tropical and subtropical areas as an effective fruiting hedge. It prefers well-drained soils but tolerates loamy clay and is very drought-resistant once established; from coast to highlands. The spines make the hedge almost goat-proof. It has fairly recently been introduced to Eastern Province.

Uses: Food (fresh fruit or as jam), bee forage, ornamental, **live fence**.

Description: A thorny evergreen shrub 3–5 m. BARK: grey and smooth when young; **strong thorns, single and straight to 6 cm**. LEAVES: **shiny dark green** to 5 cm, often in tight clusters, tip rounded. FLOWERS: male and female plants—both required for fruit. Flowers cream-green in dense clusters, many stamens and no petals. FRUIT: **round, to 4 cm** when ripe, **orange-yellow**, soft sweet flesh; seeds up to 20 in a fruit.

Propagation: Seedlings, direct seeding.

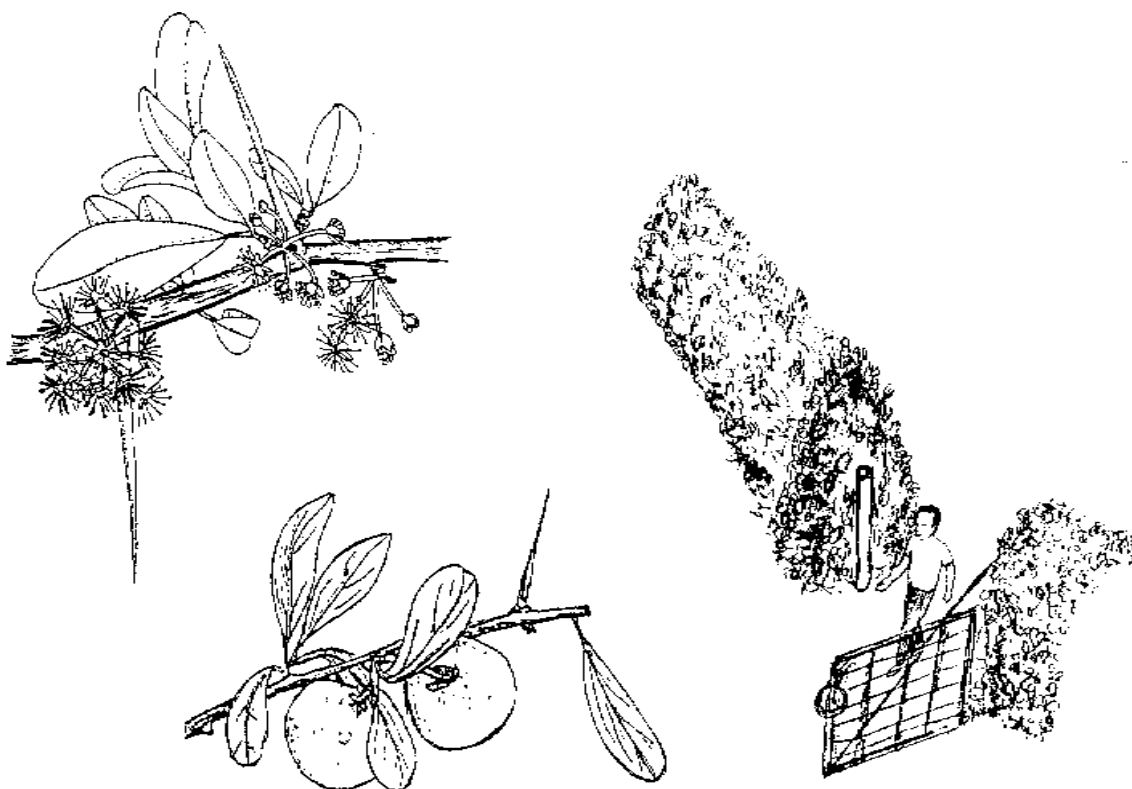
Seed: No. of seeds per kg: 27,000–47,000; 50 kg of fruit yield 1 kg of seed.

treatment: Not necessary.

storage: Seed loses viability within 3 months after picking.

Management: Trim regularly to maintain a good hedge. Best planted in two staggered rows with 20 cm between the plants and 30 cm between the rows to produce a good fence.

Remarks: The plant has shallow spreading roots which compete with crops. Hedges take time to grow. Seeds are best obtained from rotting fruit. Male and female plants cannot be distinguished at seedlings stage.



Erythrina abyssinica

Papilionoideae

Indigenous

English: Lucky bean, red-hot-poker tree

Nyanja: Mulunguti, mwale

Ecology: A small thorny tree, native to warm temperate and tropical areas of Africa, Central America, Australia, Southern Asia to Hawaii. Found throughout Eastern Province, especially on anthills in open wooded grasslands.

Uses: Firewood, timber (carving, beehives, mortars, drums), **medicine** (bark, roots), fodder (leaves), bee forage, mulch, **nitrogen fixation**, soil conservation, **ornamental** (necklaces and curios from seeds), ceremonial purposes.

Description: A deciduous tree with a short trunk, 6–12 m, and thick spreading branches, rounded crown. **BARK:** brown, **thick and corky**, often with woody spines. **LEAVES:** **trifoliate**, the largest leaflet rounded to 15 cm, branchlets and underside of leaves covered with **soft grey-brown hairs**, veins and stalks sometimes with sharp prickles. **FLOWERS:** **brilliant orange-red heads**, all over the bare tree, slender **calyx lobes and petals coloured**. **FRUIT:** small, hairy pods to 10 cm, **constricted between seeds**, **seeds shiny red** with a black patch.

Propagation: Seedlings, cuttings, direct sowing at site. Propagation from cuttings is successful if done immediately after the rainy season.

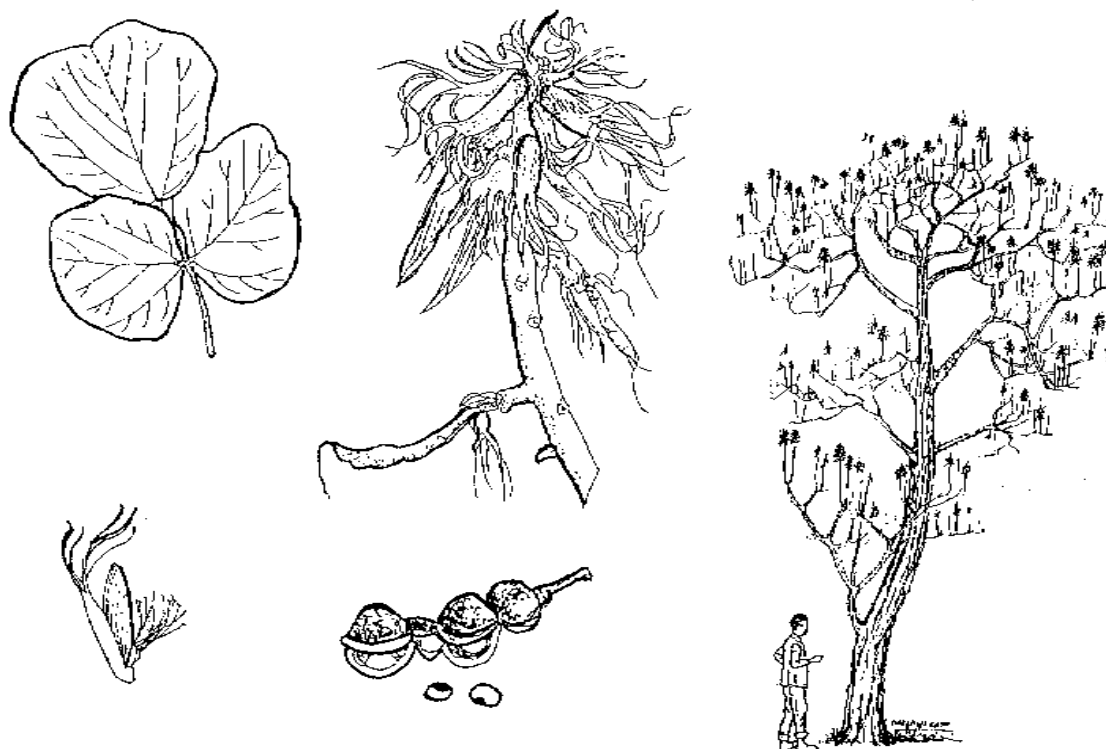
Seed: Low germination rate. No. of seeds per kg: $\pm 6,800$.

treatment: Not necessary.

storage: Seed stores for many years.

Management: Pollarding, coppicing.

Remarks: The tree is highly regarded for its medicinal properties (i.e. bark and roots). The seeds are used in children's games. Resistant to fire and termites as the young trees establish a deep root system before stem growth. Slow growing. The bark of young trees is used to treat trachoma. It is also roasted and applied to burns and swellings. Powdered root is used to cure syphilis, anthrax and snakebite.



Eucalyptus camaldulensis

Myrtaceae

Eastern Australia

English: Red River gum

Nyanja: Bulugamu

Senga: Bulugamu

Ecology: One of the world's most widely planted trees, especially in subtropical and arid areas with a dry season of 4–8 months. Gums were introduced to Zambia about 1900 by missionaries and traders and now some 10 species are widely planted by the Forest Department. All are quick growing and the flowers which have much nectar are attractive to bees. This species grows from 0 to 1,500 m and is unsuitable for planting near gardens and crops due to root competition. It tolerates some waterlogging and salinity.

Uses: Firewood, charcoal, timber, **poles, bee forage**, ornamental, **windbreak**.

Description: A tall well-branched tree, about 25 m but often rather crooked while young. **BARK:** white to brown, peeling in long strips; when cut it exudes red gum. **LEAVES:** grey-blue, **long and drooping to 30 cm**. Leaves on young trees different (wider) than the ones on older trees. **FLOWERS:** white clusters. Buds have **short conical caps**. **FRUIT:** **very small rounded capsules** on thin stalks, less than 1 cm.

Propagation: Seedlings.

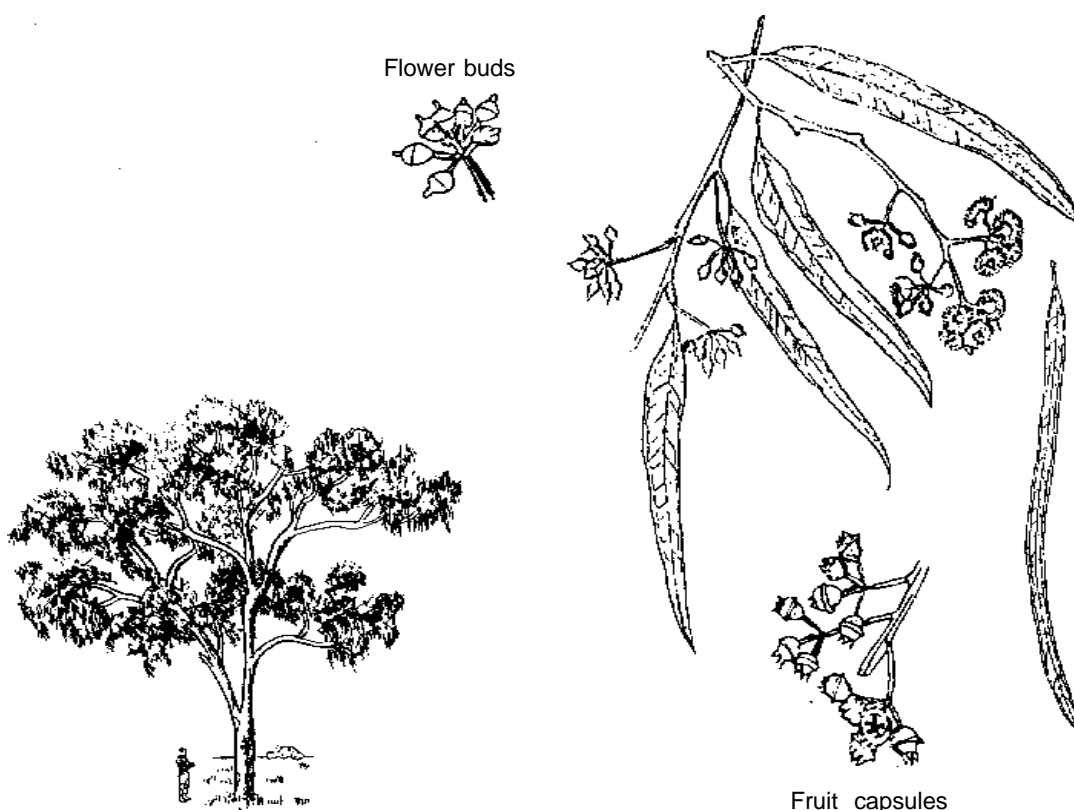
Seed: No. of seeds per kg: 70,000–2,000,000. Germinate uniformly after 7–10 days.

treatment: Not necessary.

storage: Seed can be stored for many years.

Management: Coppicing, normally every 5 years, in Zambia. Protect young trees against livestock and termites. Fast growing on good sites.

Remarks: In boron-deficient areas growth is not good unless borate or sulphur are added. A high-input crop which grows best on fertile soils. Its main use is for construction poles. The timber is red, heavy and hard, easy to work but can warp and split when being seasoned. Red river gum can be used to reclaim swampy sites. Woodlots of this species should not be planted near dambos to avoid drying up of wells.



Eucalyptus citriodora (*E. maculata* var. *citriodora*)

Myrtaceae

Eastern Queensland, Australia

English: Lemon gum, spotted gum

Nyanja: Bulugamu

Senga: Bulugamu

Ecology: A tall tree, in its native habitat 0–900 m, but widely planted from arid areas to tropical climates where it can grow at 1,800 m. In Brazil, it was a major source of charcoal for steel production and it is valued in Kenya as heavy construction timber. Planted in plantations in Zambia, so far it makes up only a small percentage of the total *Eucalyptus* planted. It prefers well-drained soils and can survive a long dry season.

Uses: Firewood, charcoal, timber, **poles**, medicine (leaves), bee forage, **windbreak**, essential oils (citronellal).

Description: An evergreen tree which may reach 40 m with a straight bole and rounded crown; foliage drooping. It is easily identified by the **strong lemon oil in the leaves** which perfumes the air, especially after rain. **BARK:** rounded patches flake off revealing grey-brown-yellow below. Old bark appears smooth grey-white. **LEAVES:** mature leaves **very long and narrow**. **FLOWERS:** smooth oval buds. **FRUIT:** rather large, about **1 cm, oblong cup-shaped**, in clusters.

Propagation: Seedlings.

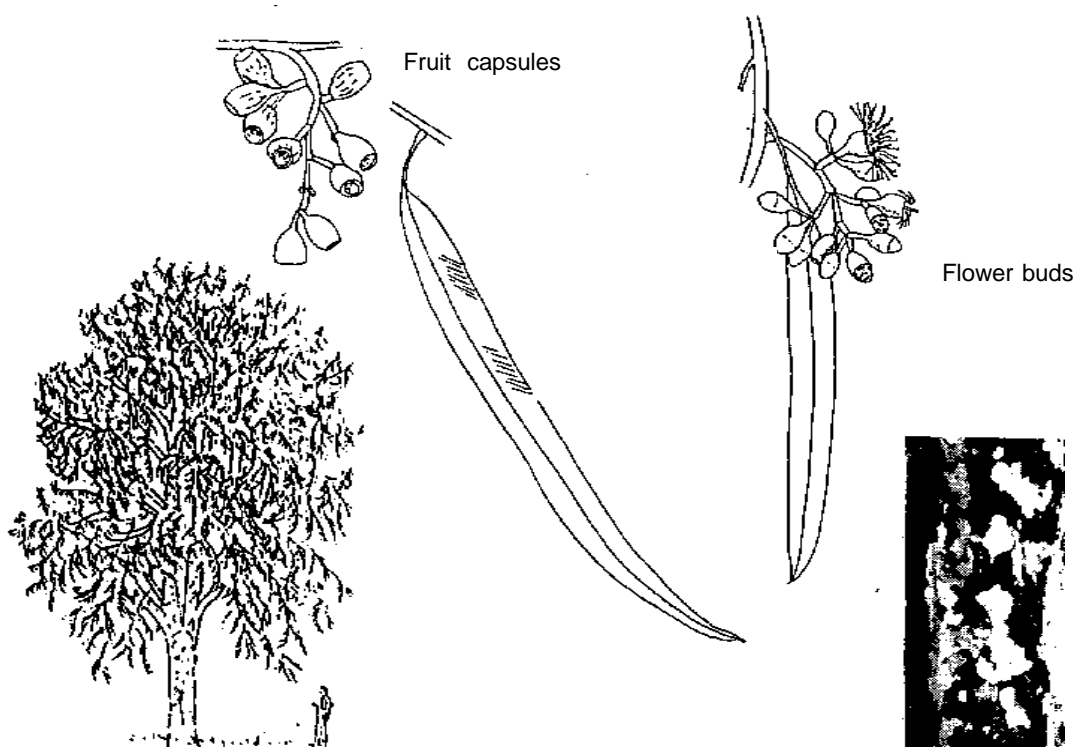
Seed: Not a prolific seeder like other *Eucalyptus* spp. Good germination rate: 60–90%. No. of seeds per kg: 140,000–220,000.

treatment: Not necessary.

storage: Seed can be stored.

Management: Coppicing.

Remarks: This species is not so frequently used in Eastern Province as *Eucalyptus tereticornis*, which is more termite-resistant, or *Eucalyptus camaldulensis*, which is more drought-resistant. However, its timber is superior and the species has a potential for the extraction of essential oils. Large branches are brittle and break off in strong winds. Susceptible to termite attack.



Eucalyptus tereticornis

Myrtaceae

Eastern Australia

English: Forest red gum, horn-cap eucalyptus

Nyanja: Bulugamu

Senga: Bulugamu

Ecology: A gum tree which can grow from hot wet lowlands to cool dry highlands and is the most widely planted, e.g. in Uganda and Malawi. In Zambia, it is now grown in village woodlots in order to replace *E. grandis* which dies in drought conditions and is prone to termite damage. It is grown in the valleys and plateau of Eastern Province where it prefers deep well-drained soils.

Uses: Firewood, timber (heavy and light construction, boxes, boat building), **poles**, transmission poles, fence posts, bee forage.

Description: An evergreen tree, up to 30 m, branching to an open crown. **BARK:** **smooth, later peeling** in irregular flakes leaving coloured patches; base dark grey. **LEAVES:** drooping to 21 cm long, often curved, both surfaces shiny green. Young leaves much wider. **FLOWERS:** have **distinctive bud caps**, long and conical (tereticornis = long round, horn), 12–17 mm. **FRUIT:** woody capsules half rounded, **less than 1 cm across**, a ring around the top; shiny dark seeds within.

Propagation: Seedlings.

Seed: No. of seeds per kg: 300,000–800,000. Seed germinates in 14–30 days.

treatment: Not necessary.

storage: Can store well if kept in cool airtight conditions.

Management: Coppicing after 5 years. Rotation 6–10 years.

Remarks: Drought-resistant and can be coppiced after five years. Tolerates occasional flooding and slightly saline soils. Normally used for electric transmission poles as the timber is strong and durable—but difficult to work. Less susceptible to termites than most other eucalyptus. Does best in fertile soils or with fertilizer application, but survives and grows slowly on poor sites. Susceptible to boron deficiency.



Fruit capsules



Pointed buds



Euphorbia tirucalli

Euphorbiaceae

Tropical Africa

English: Finger euphorbia, rubber hedge euphorbia**Kunda:** Nkhaze**Nyanja:** Nkhazi, mduze**Senga:** Nkhazu, nkhasi**Ecology:** A succulent shrub which may have come from India but is now widespread and naturalized throughout Africa. It is frequently planted in Zambia and used as a hedge in villages all over Eastern Province, even around graveyards. Occurring in a wide variety of habitats, it can survive in arid conditions.**Uses:** Medicine (young branches), **live fence**.**Description:** A dense succulent bush or straight-stemmed tree to 6 m. **Dense green branchlets**, finger sized, smooth and cylindrical, function as leaves. **LEAVES:** small, present on young shoots, soon fall. **FLOWERS:** yellow-cream and stalkless, in dense clusters. **FRUIT:** 3-part capsules, hard, purple-green, less than 1 cm across.**Propagation:** Cuttings strike readily.**Seed:** Not important.**treatment:** –**storage:** –**Management:** Coppicing; trim and top prune to make a hedge.**Remarks:** Medium to fast growing. Latex is very poisonous and dangerous to the eyes. If it does get in the eyes, human milk is said to be an antidote. Medicine from the plant must be used with extreme care due to its toxicity. It is believed that planting *E. tirucalli* on a termite mound will result in disappearance of termites from that mound. Planting *Euphorbia* cuttings next to *Eucalyptus* and other termite-prone species is said in Rwanda and Tanzania to keep away termites.

Faidherbia albida (*Acacia albida*)

Mimosoideae

Indigenous

English: Apple-ring acacia, winter thorn

Nyanja: Msangu

Senga: Msangu

Tumbuka: Msangu

Ecology: Widespread in semi-arid Africa on a wide range of soil types. Found in most of Zambia except North Western and Copperbelt Provinces and common in valleys of Eastern Province.

Uses: Firewood, charcoal, timber (construction, canoes, utensils), posts, medicine (bark), fodder (pods and leaves), shade, mulch, **nitrogen fixation, soil conservation and improvement**, windbreak, tannin, dye (bark, roots).

Description: A large deciduous tree to 30 m high, crown wide and rounded. **BARK:** grey-brown, cracked when old; young twigs shiny grey; **pairs of spines straight, to 2 cm.** **LEAVES:** compound, grey-green; shed leaves in the rainy season. **FLOWERS:** in dense **cream-yellow spikes about 10 cm**, fragrant; seen in May–June on the bare tree (hence, winter thorn). **FRUIT:** pods ripen in July–September, **conspicuous thick, orange-brown, twisted in odd shapes**, hard and shiny. Parts do not break open but rot to set free 10–20 flat round seeds which lie in soft tissue.

Propagation: Seedlings, direct seeding.

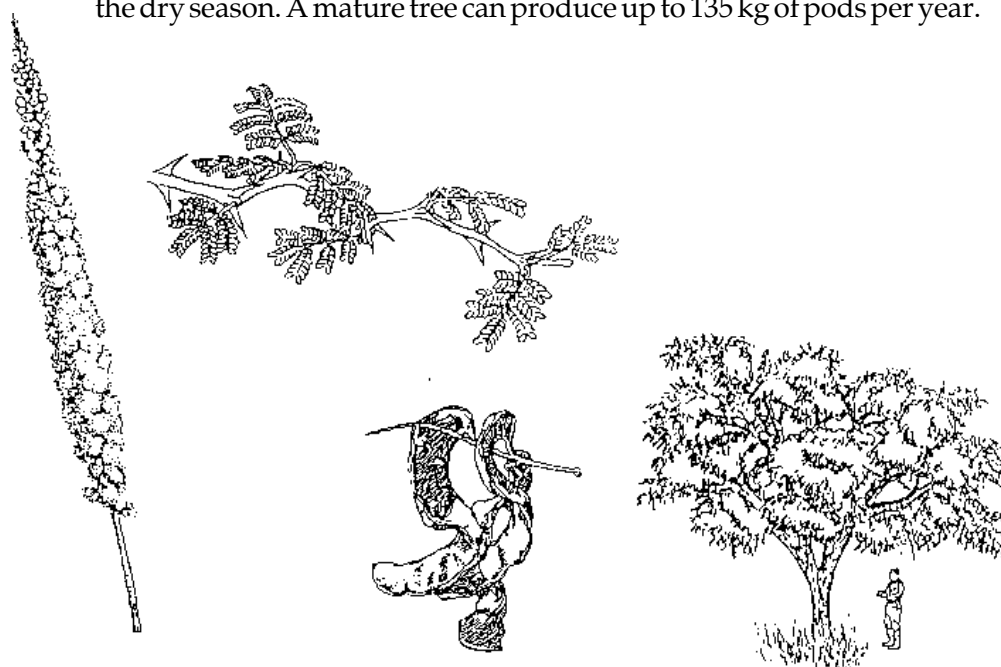
Seed: No. of seeds per kg: 7,500–15,000. Germination 45–96%.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Seed can be stored indefinitely if kept in a dry, cool place free from insects.

Management: Lopping, pollarding.

Remarks: Slow initial growth, later fairly fast growing on good sites. Unripe pods can be poisonous to cattle. It is deep-rooted and its peculiar leafing habits make it an ideal tree for intercropping. Cereals tend to do better underneath the trees—a sign of soil improvement. In Luangwa Valley sorghum is cultivated under *Faidherbia* trees and Chief Tembwe has observed that this tree indicates fertile soil. A good tree for planting on soil-conservation structures. A decoction of root bark is used to treat cough, fever and diarrhoea. Gum, bark and leaves are used to treat diarrhoea, haemorrhage and colds. Fruits are eaten to control diarrhoea. The bark is used to clean teeth and is believed to contain fluorine. Leaves and ripe pods are used as fodder during the dry season. A mature tree can produce up to 135 kg of pods per year.



Faurea saligna

Proteaceae

Indigenous

English: Beechwood
Kunda: Chiyele
Nyanja: Chiyele, chinsense
Senga: Chiyele
Tumbuka: Chiiyele

Ecology: A slender tree which grows north to Nigeria and Sudan, south to Natal, at medium to high altitudes. It grows in most parts of Zambia, excluding Western Province. In Eastern Province, it is mainly found scattered on the plateau in woodlands, on stony hillsides and beside streams.

Uses: Firewood, charcoal, **timber** (furniture, construction, utensils), poles, fenceposts, medicine (roots, bark), bee forage, windbreak, tannin (bark), dye (bark).

Description: A small- to medium-sized tree, usually 7–10 m but can reach 20 m, the bole often twisted. It resembles a gum tree. **BARK:** grey-black, rough, deeply grooved. **LEAVES:** leathery, shiny and drooping; **narrow, to 12 cm, tip pointed**, edge wavy; young leaves, pink and leaf stalk red. **FLOWERS:** characteristic, cream-purple spikes to 15 cm, honey scented, March–August. **FRUIT:** very small brown nutlets covered with **silky white hairs** in woolly spikes.

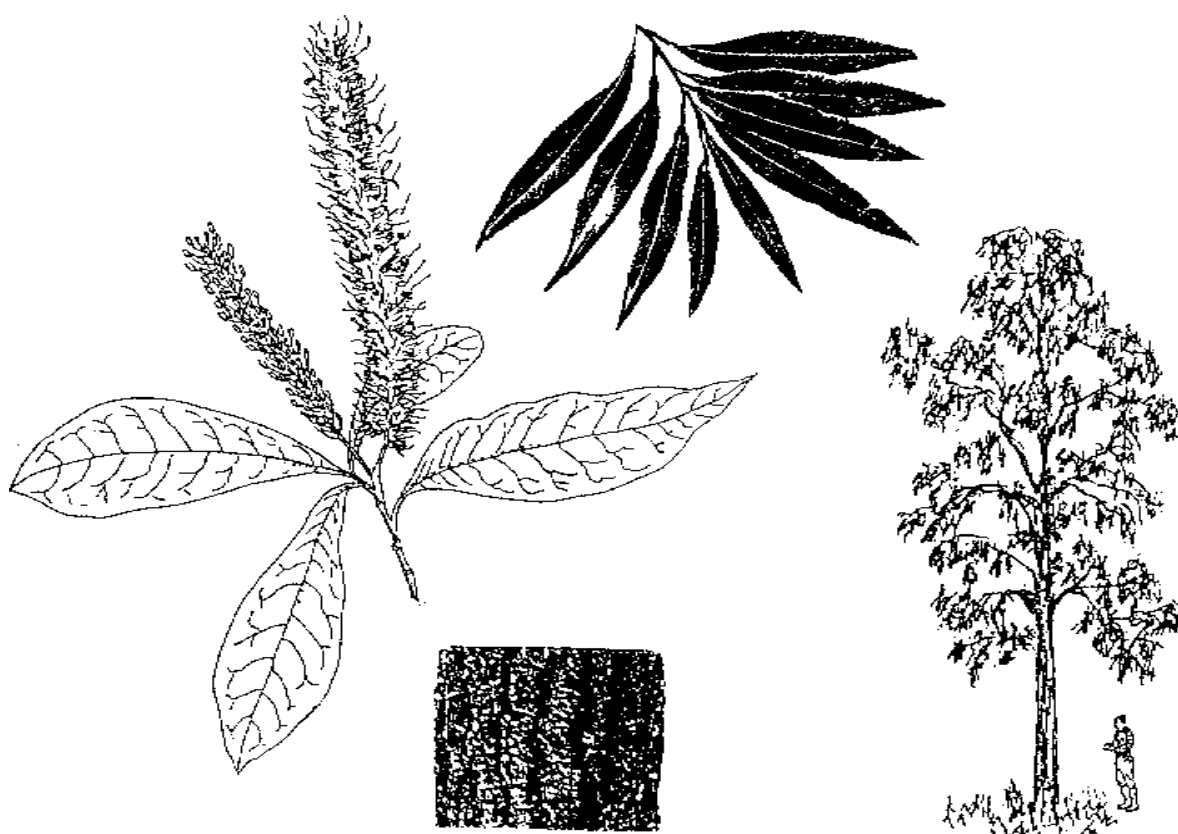
Propagation: Seedlings.

Seed: No. of seeds per kg: $\pm 165,000$. Poor germination.

treatment: –

storage: Use fresh seed.

Remarks: The wood is quite durable and resistant to termites and has an attractive grain. It is valued for furniture and panneling and for making wooden spoons, stools and tool handles..



Ficus sur (*F. capensis*)

Moraceae

Indigenous

English: Cape fig

Kunda: Kachele

Nyanja: Mukuyu

Senga: Chikuyu

Tumbuka: Chikuyu

Ecology: A large fig tree found all over Africa, 0–2,100 m. It prefers moist soils with a high water-table and grows in riverine forest and bush. It has been planted in villages even on the plateau.

Uses: Timber (carving), food (fruit), medicine (latex, leaves, roots, bark), **fodder** (leaves, fruit), soil improvement, dye (bark), gum (latex).

Description: A handsome semi-deciduous tree to 25 m with a heavy rounded crown, the base often buttressed. Sometimes fig seedlings on other trees grow up to strangle and replace that tree. **BARK:** smooth, pale grey, exudes latex if cut; rough with age. **LEAVES:** thin and shiny, broadly oval, to 20 cm long on a long stalk, veins very clear, edge often widely toothed. **FRUIT:** the figs grow in dense clusters from trunk and large branches. Each fig is rounded, orange-red when mature like a small “apple”, 3–5 cm. The soft fig is edible but not sweet, having many seeds and often full of insects.

Propagation: Cuttings strike readily.

Seed: –

treatment: –

storage: –

Management: Coppicing, pollarding.

Remarks: Leaves and fruits are reported to stimulate milk production in cattle. Moderately fast growing. Meetings are often held under this shady tree.



Ficus sycomorus**Moraceae**

Indigenous

English: Sycamore fig**Kunda:** Mtowe**Nyanja:** Mukuyu

Ecology: A large fig, often found near rivers but also in drier woodlands throughout Africa, 0–2,000 m. It is the biblical “sycamore” of Egypt and the Middle East. Common in Eastern Province where it provides fruit and shade in villages.

Uses: Firewood, timber (carving), bee-hives (bark), food (fruit), medicine (latex, bark), fodder (fruit, leaves), **shade, soil improvement.**

Description: A semi-deciduous tree to 20 m, soon branching to a large crown, often buttressed. **BARK:** distinctive **yellow-cream-brown**, smooth but irregular cracks with age. **LEAVES:** oval to almost circular; over 10 cm across; the **base heart-shaped**; edge wavy; **rough to the touch**, on a hairy stalk, to 3 cm across. **FRUIT:** in leaf axils or dense clusters on main branches and trunk; figs pear-shaped, hairy, yellow-red when ripe.

Propagation Cuttings strike readily.

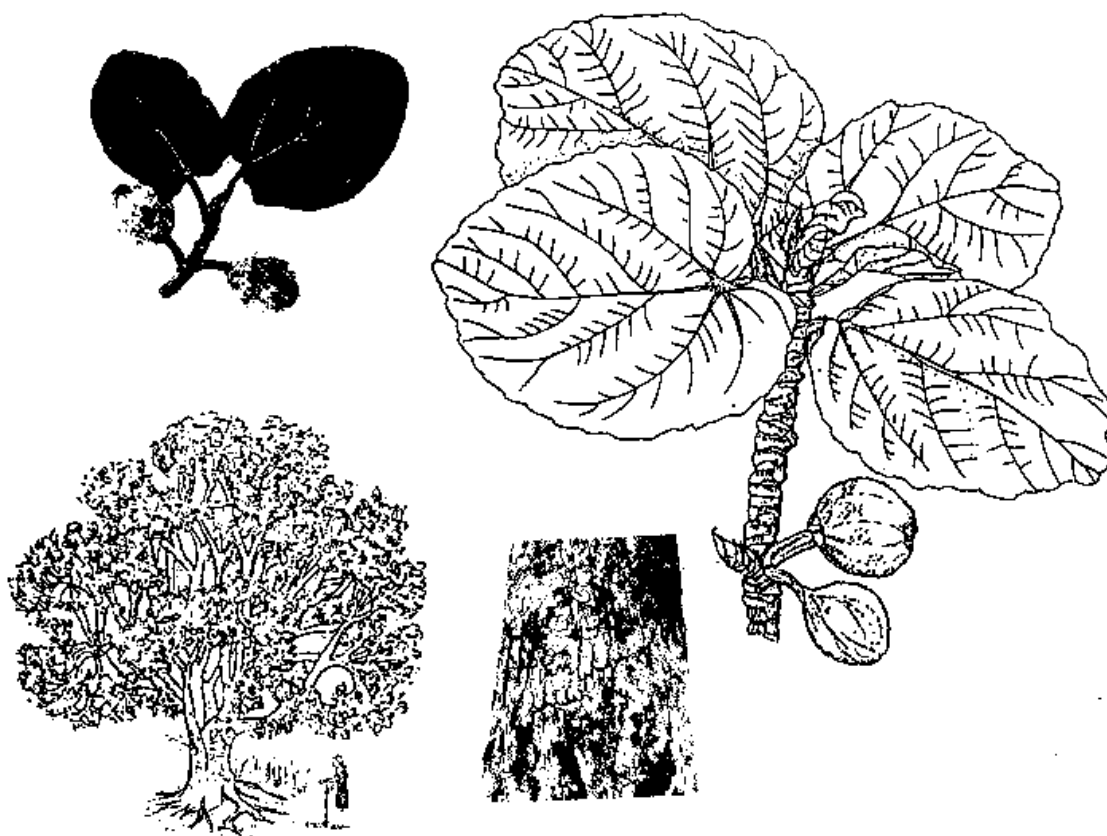
Seed: No. of seeds per kg: 800,000–1,000,000.

treatment: Not necessary.

storage: Seeds should not be stored.

Management: Pruning, lopping.

Remarks: Fast growing. Fruit eaten by birds, monkeys, baboons, hyrax, impala antelope. For humans these figs are only famine food. The leaves contain about 9% crude protein. The leaves are used to treat snakebite and jaundice. The latex is said to be effective for treating chest diseases, colds and dysentery.



Flacourtia indica

Flacourtiaceae

Indigenous

Nyanja: Nthudza
Senga: Thumbuzya
Tumbuka: Thumbuzga

Ecology: A small spiny tree widespread in tropical Africa, also in Asia, 0–2,400 m, always scattered, in wooded grassland and bushland; often riverine. It prefers sandy soil with a high water-table. Occasionally, it has been cultivated for its edible fruit. In Zambia, it grows in valleys and on the plateau.

Uses: **Firewood, timber** (tools), **food** (fruit), medicine (leaves, bark, roots), fodder (leaves), live fence.

Description: A deciduous **spiny shrub** usually 3–5 m; spines on the trunk sometimes branched, up to 12 cm long. **BARK:** **rough pale yellow-grey**, branches may have a **yellowish powder**, later dark grey. **LEAVES:** variable in size, oval to 12 cm, edge toothed, 4–7 pairs, **veins clear** on both surfaces, a stalk to 2 cm. **FLOWERS:** small, cream and fragrant; male flowers with very **many stamens**; female flowers with a divided, spreading style, October–December. **FRUIT:** **red-purple-black, round and** juicy but acid, to **2.5 cm across**, persisting on the tree. They contain up to 10 small hard seeds; ripen May–July.

Propagation: Seedlings.

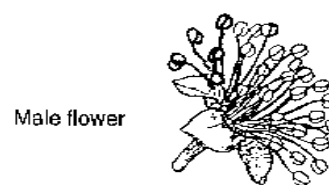
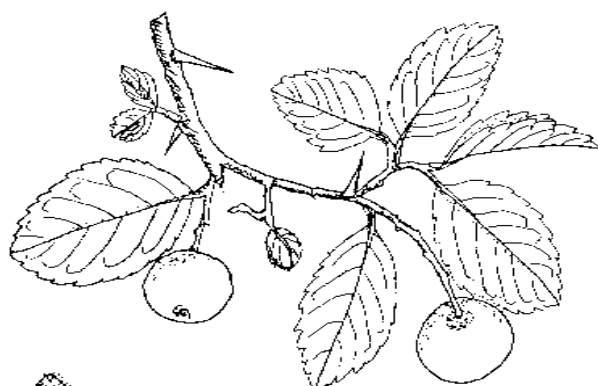
Seed: No. of seeds per kg: $\pm 200,000$. Germination is slow.

treatment: Soak seed in hot water and allow to cool for 24 hours.

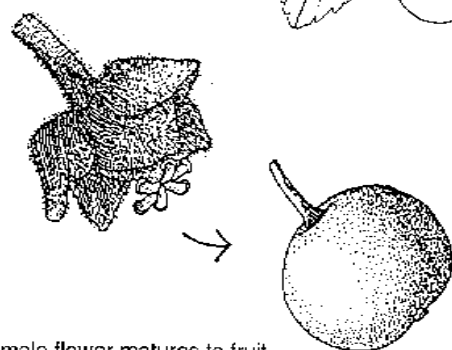
storage: Can be stored at room temperature for up to 6 months.

Management: Coppicing, trim for a hedge.

Remarks: A wild fruit which is well liked. It regenerates naturally from seed and coppice. It has been used in Zanzibar as a good hedge and windbreak. Not yet domesticated in Eastern Province. The fruits are used to treat jaundice and enlarged spleen. The leaves and roots are used to treat schistosomiasis, malaria and diarrhoea. The roots are used to treat laryngitis, pneumonia, intestinal worms and as an astringent, a diurectic and for pain relief.



Male flower



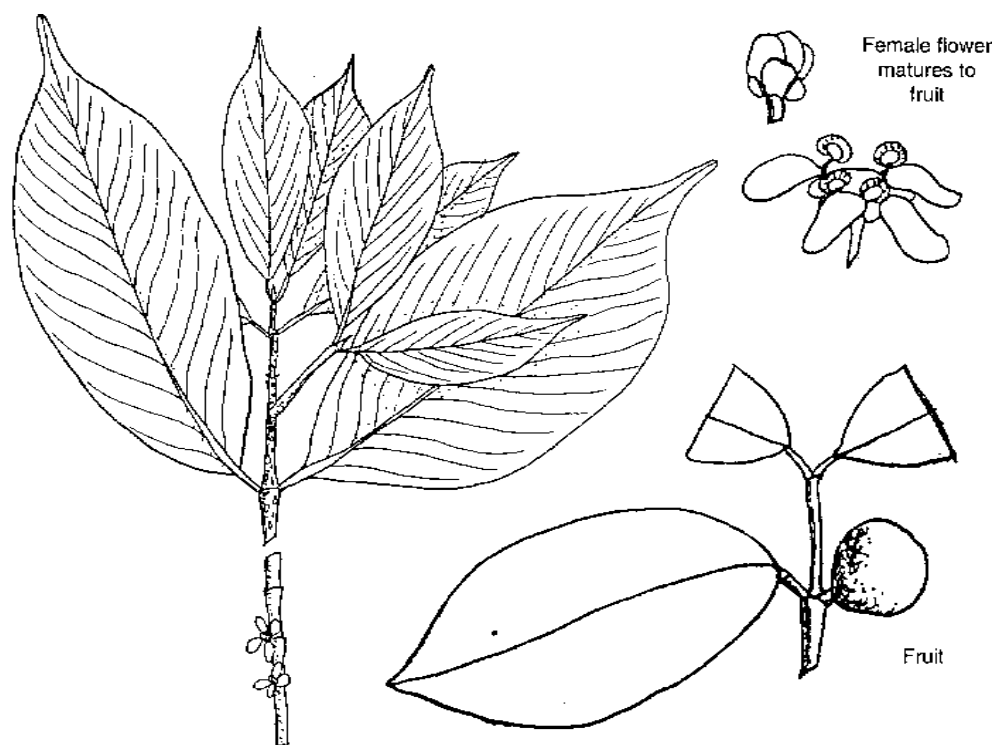
Female flower matures to fruit



Garcinia buchananii (*G. huillensis*)

Clusiaceae

Indigenous

Nyanja: Matatane, msamusa, msongwa**Ecology:** Occurs in a belt from the Sudan and Ethiopia south to Zimbabwe and Mozambique. It is found all over Zambia except for the Gwembe and Kalomo Districts and most of the Western Province. It is common in evergreen thicket and shrub (munga) but also in other types of woodland and forest. Common on the plateau in Eastern Province.**Uses:** Firewood, **timber**, poles, **food** (fruit), **medicine** (bark, roots, leaves), dye (bark, leaves), chewsticks, tannin.**Description:** An evergreen shrub or understorey tree with spreading or horizontal whorled branching forming a heavy ovoid or rounded crown. All parts contain a **sticky yellow sap**. **BARK:** yellow-brown becoming grey-brown or black, deeply fissured and scaly. **LEAVES:** **opposite, thick and leathery, shiny dark green above**, paler below, veins thin and fine on both sides, edge rolled under, wavy, usually 6–12 cm, **tip long-pointed**, base narrowed to a short stalk. **FLOWERS:** **white, yellow or orange, about 1 cm across**; female solitary, male in clusters of 2–3, July–September. **FRUIT:** **fleshy berries, yellow-orange when mature**, rounded to 2.5 cm across, edible but very acid pulp surrounds the 1–3 seeds.**Propagation:** Seedlings, wildings.**Seed:** Ripe fruit are collected and put in a cool place for the pulp to rot and fall away. Dry in the sun after which the seeds are separated.**treatment:** The seed coat needs brazing or overnight soaking before sowing to enhance germination.**storage:** Store in a cool dry place, spread out. If stored at room temperature, sow within two months.**Management:** Coppicing, pollarding.**Remarks:** The bark, roots and leaves contain alkaloids, saponins and tannin used for a wide variety of medicinal purposes from treatment of syphilis to expulsion of intestinal worms. The berries are rich in vitamin C. The hard yellow timber is also suitable for building, and the firewood is of high quality.

Gliricidia sepium

Papilionioideae

Central America, Mexico

English: Mother of cocoa, tree of iron, Mexican lilac, quick stick

Ecology: This tree has been widely grown in tropical lowlands all over the world, mainly below 500 m but up to 2,000 m. For many years, it has been interplanted with cocoa as a green manure and soil improver. In Zambia, trials for use in fallows and fodder banks continue in Eastern Province at Msekera Regional Agricultural Research Station. Some provenances are suitable for dry areas. It can grow in a wide variety of soils.

Uses: Firewood, charcoal, posts, fodder (leaves, shoots, pods), bee forage, ornamental, mulch, green manure, **nitrogen fixation**, soil conservation, live fence, live stakes.

Description: A small semi-evergreen tree to 8 m; the trunk very short with a spreading crown. BARK: grey–light brown, smooth, cracked with age. LEAVES: compound, the leaf stalk to 25 cm; many leaflets, oval and pointed, hang down. FLOWERS: **mauve-pink**, centre yellow, **grow out of woody stems**. FRUIT: thin, flat pods up to 15 cm long, yellow-grey, then black when dry; 3–8 seeds released when pod breaks open.

Propagation: Seedlings, cuttings, direct seeding.

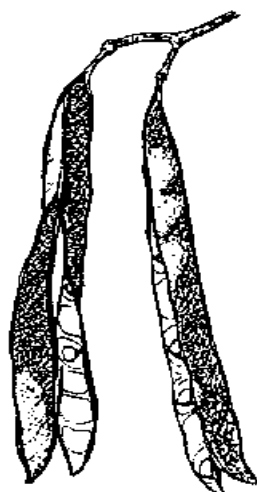
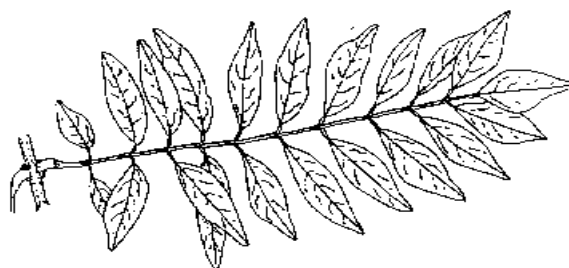
Seed: Germination > 90%. No. of seeds per kg: 6,500–8,000.

treatment: Soak seed in hot water and cool for 24 hours.

storage: It is best to use fresh seed; but it will store up to 1 year.

Management: Coppicing. Slow growing in Eastern Province.

Remarks: Although leaves are fodder for goats and cattle, they are toxic to non-ruminants like horses, donkeys and pigs. Livestock do not find these leaves very palatable; so they should be mixed with grass, straw or other roughage as a high-protein supplement. Allowing the leaves to wilt before feeding to livestock also improves palatability. A fence can be made from cuttings. Termite-resistant.



Gmelina arborea

Verbenaceae

Far East, South Asia

Nyanja: Malaina**Senga:** Melaina

Ecology: A tree of moist forests but now planted world wide in the tropics, 0–1,200 m. It grows throughout Zambia where it is popular as an avenue tree; also in plantations as a firebreak. In Eastern Province, it is a common shade tree in villages and around institutions. It grows best on deep well-drained soils but will also grow on most soil types and is moderately drought-resistant once established.

Uses: Firewood, charcoal, **timber** (furniture, tools), poles, **fodder** (leaves, fruit), bee forage, shade, ornamental, **windbreak**.

Description: A deciduous tree which may reach 18 m, but usually smaller; the crown fairly open. **BARK:** **pale cream** when young, **grey-yellow-brown** with age; corky and rough. **LEAVES:** **large and heart-shaped to 20 cm, tip pointed**, shiny above, pale and hairy below, the **stalk up to 12 cm**. **FLOWERS:** in clusters to 30 cm long, **orange-yellow**, each flower bell shaped. Abundant nectar attracts bees, August–October. **FRUIT:** **orange-yellow, egg shaped to 2.5 cm**, containing a stone with 1–4 seeds inside, October–December.

Propagation: Seedlings, wildings, direct seeding, cuttings.

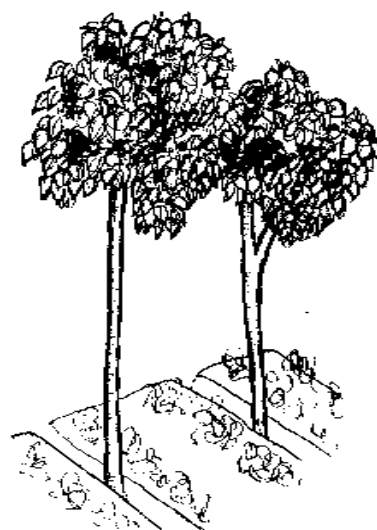
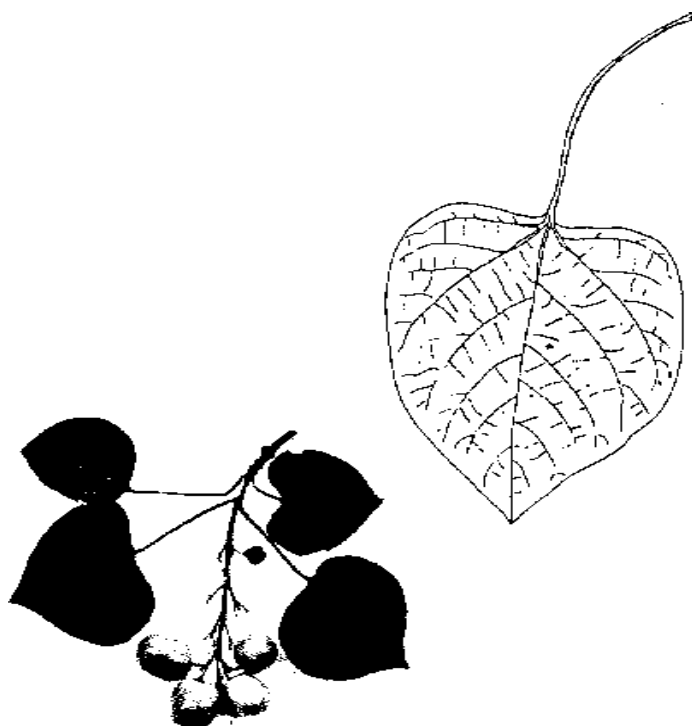
Seed: Germination 40–80% in 20–30 days. No. of seeds per kg: $\pm 2,500$ seeds when dry.

treatment: Soak in cold water for 48 hours.

storage: Seed can be stored for a year before it starts to lose viability.

Management: Pruning, lopping, coppicing. Protect young trees from goats by smearing goat dung around the stem. Weed young trees as they do not compete well.

Remarks: Established trees compete with crops for water and nutrients. The fruit contains a chemical which inhibits crop growth, so avoid planting these trees next to crops. The trees are resistant to termites and are fast growing. The timber is soft and has been used for matchsticks. In Eastern Province the timber is used to make simple furniture, boxes, etc.



Grevillea robusta

Proteaceae

Australia: New South Wales, Queensland

English: Silky oak

Nyanja: Gilevilia

Senga: Gilevilia

Ecology: A very successful Australian tree planted worldwide for shade and ornament, also in Africa, 0–3,000 m. It grows well on medium loam or light sandy soils, but not on heavy clays or waterlogged soils.

Uses: Firewood, charcoal, **timber** (furniture), **poles**, bee forage, **ornamental**, **windbreak**, soil conservation.

Description: A semi-evergreen tree usually to 15 m with a straight trunk and angular branches to an oval leafy crown. **BARK:** dark grey, rough and thick, vertically grooved. **LEAVES:** distinctive, compound, “**fern-like**”, **very divided**, pale green above, **silver-grey below**; stalk to 30 cm long. **FLOWERS:** many, in one-sided golden-orange spikes, much nectar which attracts bees and sunbirds, September–October. **FRUIT:** dark brown capsules, about 1 cm with a long beak containing 2 winged seeds.

Propagation: Seedlings.

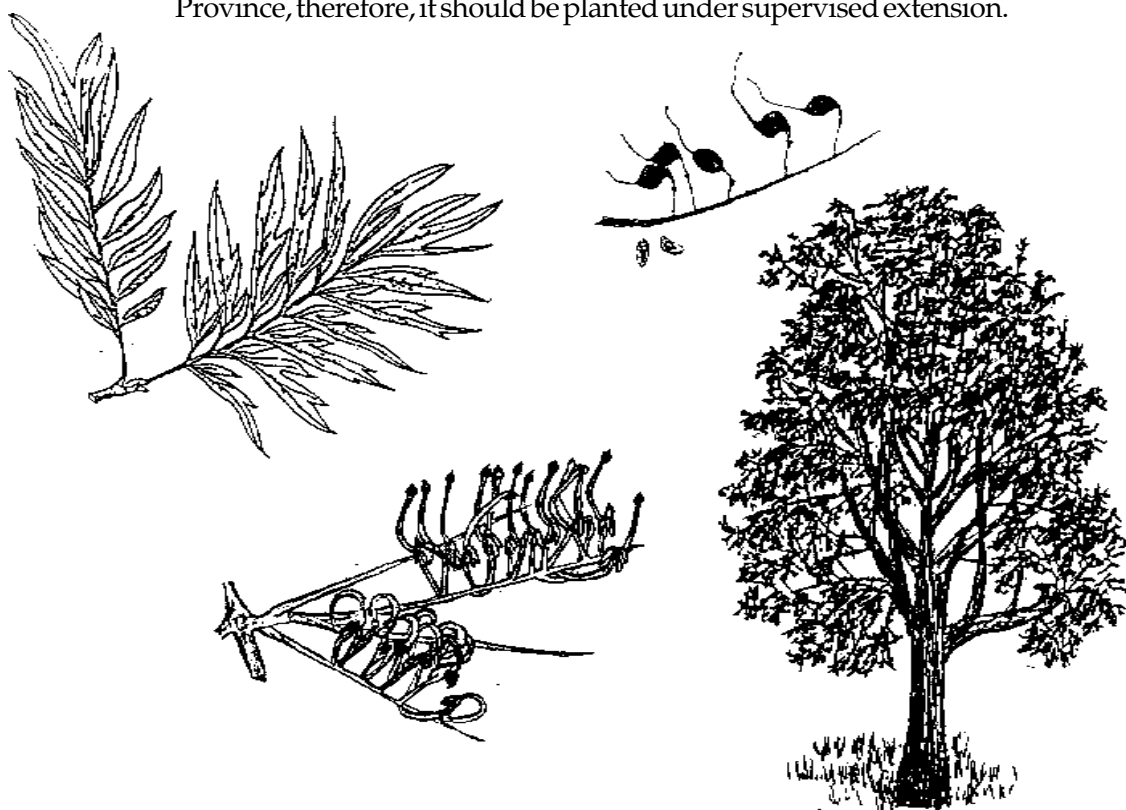
Seed: The species is a prolific seeder but seed is difficult to collect. Germination rate varies from 30 to 90%. No. of seeds per kg: 70,000–110,000.

treatment: Not necessary.

storage: Seed can only be stored for up to three months at room temperature. Storage period can be extended up to 2 years if refrigerated.

Management: Pollarding, lopping.

Remarks: Its introduction in Eastern Province is fairly recent and it seems to do well near dambo areas but not in waterlogged or upland areas. The tree grows well with food crops if managed to reduce shade, but the leaves do not rot easily. The timber is hard and has an attractive grain. Moderate to fast growing. The tree is drought-hardy and termite-resistant once established. In order to retain the winged seeds, they should be collected when the capsules begin to turn brown. Use of this tree is still at a trial stage in Eastern Province, therefore, it should be planted under supervised extension.



Hexalobus monopetalus

Annonaceae

Indigenous

Nyanja: Mkandanchembele, mkambendula

Ecology: A shrub or small tree, widespread in drier parts of tropical Africa from the Sudan to South Africa in woodlands, at forest edges and in rocky places. In Zambia, it occurs throughout the country, particularly in plateau and hill miombo but occasionally in other woodland types as well.

Uses: Firewood, timber (tool handles), poles, **food** (fruit), medicine (leaves, bark and roots).

Description: A semi-deciduous shrub or understorey tree, 4–8 m, branching horizontally to a rounded crown, often quite dense. **BARK:** grey-brown, smooth, becoming flaky with rectangular scales; characteristic short hard leaf bases where the leaves break off (higher than usual). **LEAVES:** simple, stiff, **long oval, 3–11 cm, tip broadly rounded**, base more or less rounded to a short stalk, dense hairs on the midrib below, **veins clear above**, olive green above, yellow green below. **FLOWERS:** solitary or in clusters beside leaves, **not stalked**, 6 cream-yellow petals, crinkly, spider-like, **joined at the base**, 2.5 cm long. Characteristic **red-brown buds** only open after leaf fall just before rains, April–August. **FRUIT:** 1–3 **cylindrical capsules** (like short fingers), to 3.5 cm, soft and fleshy, narrowed between seeds, **red-black when ripe**. Each section has several brown seeds in edible flesh, March–May.

Propagation: Seedlings, wildings.

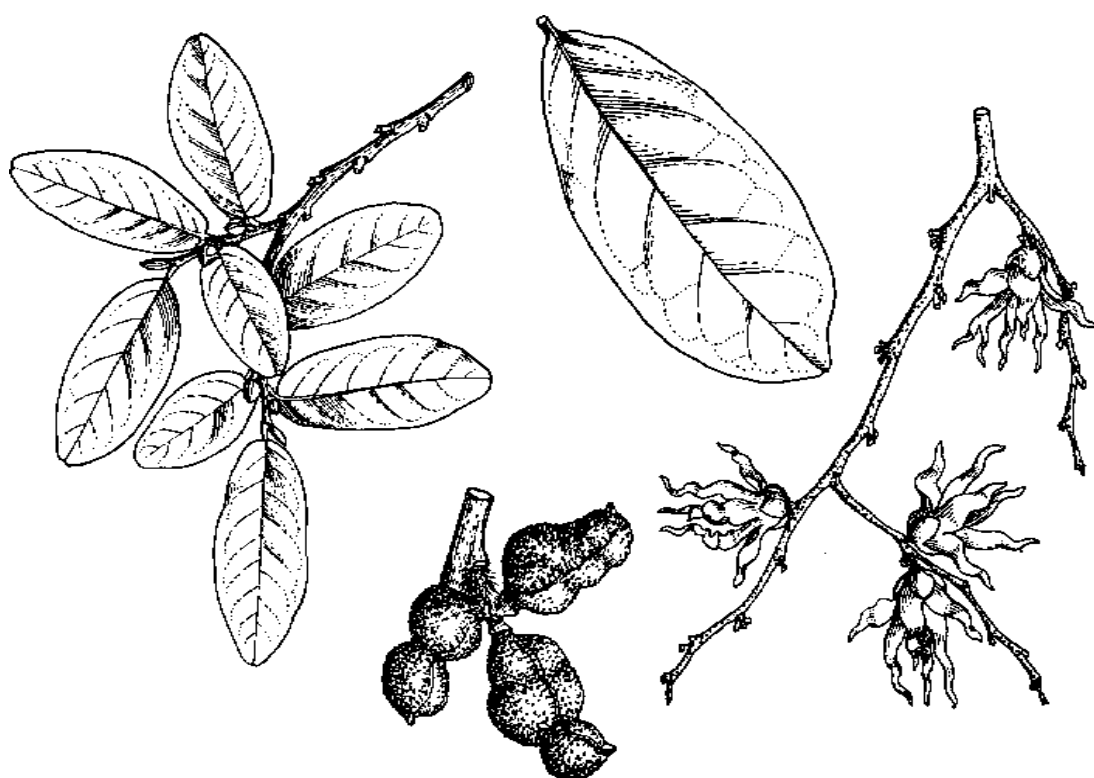
Seed: –

treatment: Not necessary

storage: –

Management: Coppicing.

Remarks: The reddish heartwood is moderately durable. The fruits are popular, especially with children, although they usually contain insects. A species to be managed in indigenous woodlots for its fruits and medicinal uses.



Hyphaene petersiana (*H. benguellensis* var. *ventricosa*)

Palmae

Indigenous

English: fan palm, Doum palm, vegetable ivory

Kunda: Nyamavumo

Nyanja: Mlaza

Senga: Kakoma

Tumbuka: Kakoma

Ecology: A fan palm which is usually solitary. Found throughout the Zambezi region through the Congo to Angola to West Africa, south to Mozambique and north to Tanzania. It is common on the alluvial flats of hot dry valleys, on termite mounds near dambo and plain margins. In Eastern Province, it is a common tree in Luangwa Valley.

Uses: **Rafters, poles, fruit, mats** (leaves), **baskets** (leaves), strings (fibres).

Description: A fan palm with an **unbranched trunk** to 20 m high, 25 cm diameter at breast height, sometimes with a swelling 1–2 m below the crown (like *Borassus*). The **trunk may be leaning or curved** and the **stem base is raised 15–30 cm on a mass of fibrous roots** (unlike *Borassus*). **BARK:** a thin grey-black bole, vertically cracked, clearly marked with **concentric rings of leaf scars**. **LEAVES:** a crown of **20–25 fan-shaped waxy grey-green leaves** on young trees; leaves persist a long time below the crown until they rot and fall. Leaf stalk 1–2 m, the base edged with black hooked spines. The fan has **20–50 folded segments** joined for only half their length. **FLOWERS:** yellowish green, borne on separate male and female trees, hang on hairy brown flower heads, mid-September to mid-November. **FRUIT:** ripe fruit variable but always **small**, 5–8 cm, **rounded or ovoid**, shiny and a rich red-brown colour, central stone 3.5 cm across. The white onion-shaped seed contains a little milk and an edible brown spongy layer surrounds it. Ripe fruit can remain on the tree for 2 years.

Propagation: Seed, wildings.

Seed: Stores for a very short time once extracted from the fruit.

treatment: –

storage: –

Management: Slow growing. Protection from fires.

Remarks: The wood is handsome and takes a beautiful polish; borer-proof. Seed germinates naturally when it passes through the intestines of elephants. Difficult to raise in nurseries. In Luangwa Valley used for making mats, and the trunks for rafters.



Isoberlinia angolensis

Caesalpiniaceae

Indigenous

Nyanja: Kapane, Msanganza.

Ecology: Occurs in Central and East Africa and throughout Zambia apart from Southern Province and the southern fringes of Central Province. It is found in all the plateau areas of the Eastern Province.

Uses: Firewood, charcoal, timber, bee forage, shade, poles, tannin (bark).

Description: A semi-deciduous tree reaching up to 20 m high with a cylindrical bole and erect branches spreading to a heavy rounded or slightly flattened crown. **BARK:** red-brown turning grey when older, cracked and scaly. **LEAVES:** even pinnate, with **3–4 pairs of dull grey-green leathery leaflets** on stalks about 10–20 cm, each leaflet 7–12 cm, smooth or hairy below, tip flat or notched. **FLOWERS:** **white**, in **much-branched terminal sprays with brown hairy stalks, green-brown leafy bracts around the flowers**, 1 large petal about 1 cm and 4 smaller petals. **FRUIT:** **large brown pods, 19–38 cm long x 6–8 cm wide, open explosively** to release 4–6 pale round seeds. The pods stand out on the tree like flags. They mature by August–October of the following year.

Propagation: Seed, wildings.

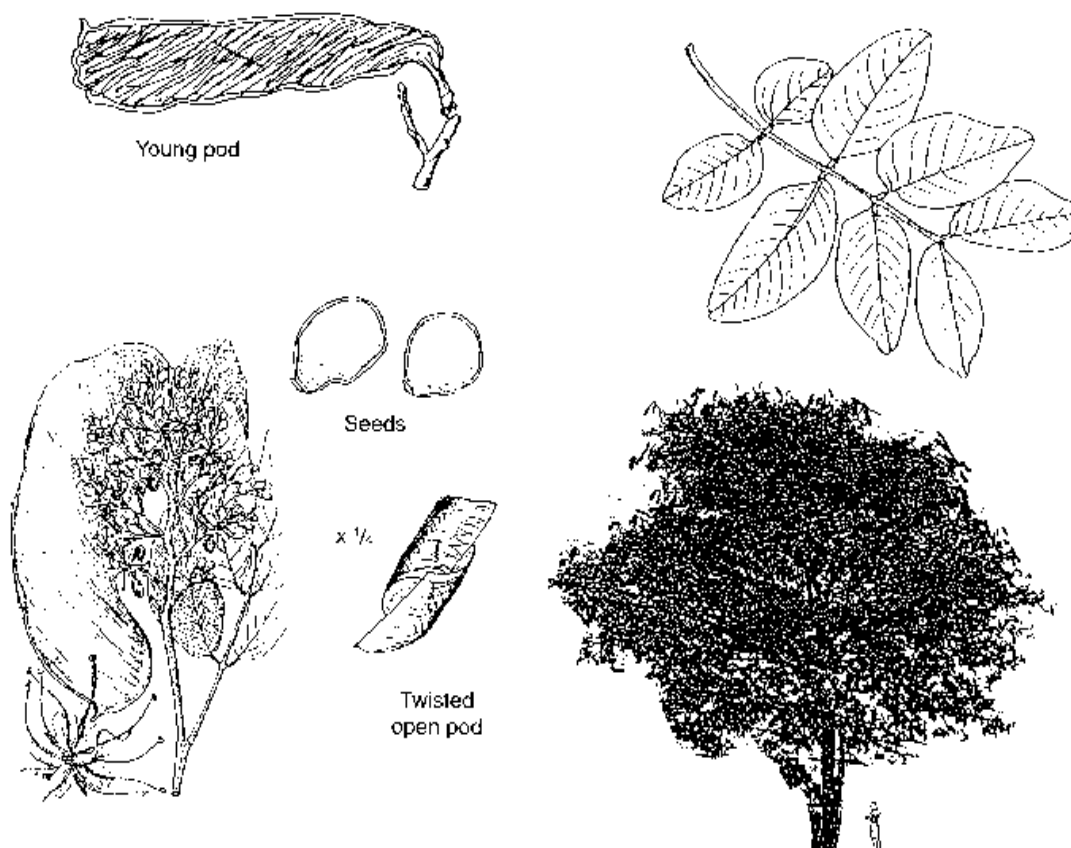
Seed: –

treatment: soak in hot water and allow to cool for 24 hours.

storage: –

Management: Coppicing, pollarding and lopping.

Remarks: The flowers have much honey and the tree is host to several types of edible caterpillar. The wood is extensively used in mines. The bark contains 9% tannin.



Jacaranda mimosifolia

Bignoniaceae

Brazil

English: Jacaranda, Brazilian rose wood

Nyanja: Jakaranda

Senga: Jakaranda

Ecology: A handsome tree widely grown as an ornamental throughout the tropics, 0–2,200 m. In Zambia, it is found frequently as an avenue tree and occasionally in parks and gardens; almost naturalized. A common tree in Eastern Province, it grows in most soils except waterlogged ones.

Uses: Timber, poles, bee forage, **ornamental**, **windbreak**.

Description: A deciduous or semi-deciduous tree growing up to 15 m with spreading branches forming a light crown. **BARK:** pale grey, smooth, becoming brown, rough and peeling with age. **LEAVES:** fern-like and **feathery up to 40 cm long; leaflets up to 30 pairs**, green when young, darker with age. Leaves fall in July–August and new ones appear in August–September. **FLOWERS:** striking **blue-violet clusters**; each flower bell shaped about 4 cm long; mostly in flower when not in leaf; July–October. **FRUIT:** **rounded, woody capsules with a wavy edge up to 7 cm diameter**, brown to almost black when mature; splitting on the tree to release numerous winged seeds. Capsules (pods) often persist on the tree for up to two years.

Propagation: Seedlings, wildings, cuttings.

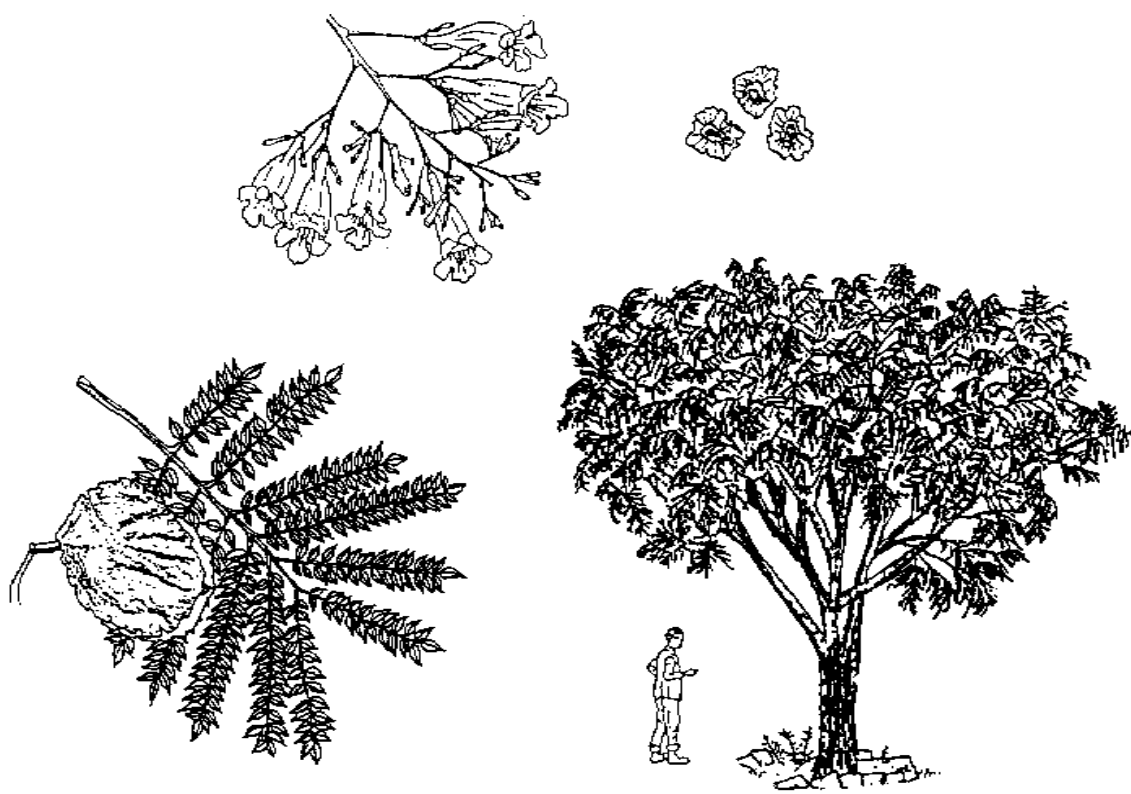
Seed: Seeds profusely. Germination rate 50–85%. No. of seeds per kg: 63,000–80,000.

treatment: Not necessary.

storage: Can be stored up to two years.

Management: Lopping, pollarding, coppicing, pruning (young trees).

Remarks: This tree is fast growing on good sites, termite-resistant and drought-hardy but not compatible with crops.



Julbernardia paniculata

Caesalpinioideae

Indigenous

Nyanja Mtondo

Senga: Mtondo

Tumbuka Mtondo

Ecology: A typical woodland tree north to Tanzania, south to Angola, 1,150–1,550 m. The commonest tree in Zambia. In Eastern Province commonly seen on the miombo plateau and most woodland types. Normally used as firewood.

Uses: **Firewood, charcoal**, timber, poles, medicine (bark), **fodder** (leaves, fruit), bee forage, rope (bark), dye (bark), tannin (bark).

Description: A big semi-evergreen tree to 23 m, crown flat to rounded. BARK: grey-brown–dark brown; later **round flakes make the trunk patchy**. LEAVES: compound, 2–4 pairs leaflets, smooth and shiny, **each to 13 cm long, tip rounded**, edge fringed with hairs when young. FLOWERS: green-white, in heads to 30 cm on **hairy brown stalks** which **stand erect above the leaves, March–June**. FRUIT: hairy pods to 10 cm long, beaked, dark brown, **explode** to scatter about 4 flat seeds, November–December.

Propagation: Natural regeneration, seedlings.

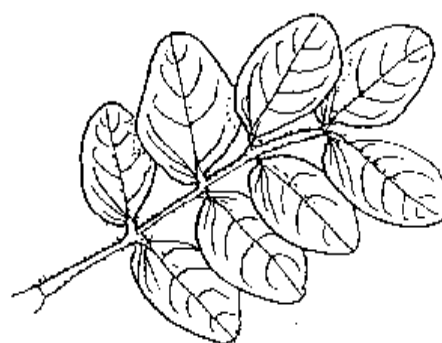
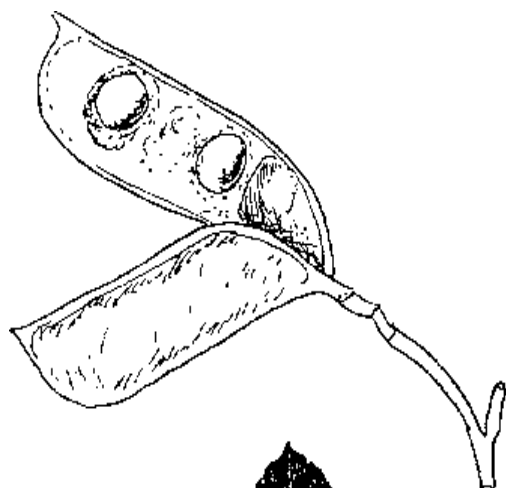
Seed: –

treatment: Soak in cold water for 24 hours.

storage: Can be stored for a few years.

Management: Coppicing.

Remarks: A favourite tree of the popular edible caterpillars, *matondo*. The timber is durable, hard and coarse-grained; widely used in the mines. It saws unevenly and tends to twist during seasoning. The flowering season is up to four months when few other flowers are available for bees. Beehives are often made from the bark. A tree worth planting on farms for its multiple uses.



***Khaya nyasica* (*K. anthotheca*)**

Meliaceae

Indigenous

English: Red mahogany

Nyanja: Mubaba, m'lulu

Senga: Mubaba

Tumbuka: Mubaba

Ecology: A tall forest tree which grows from Tanzania south to Mozambique. It is found throughout Zambia, at medium to low altitudes, normally beside rivers and it has been widely planted for timber around settlements in Eastern Province. It grows best in deep well-drained soils but can withstand seasonal flooding.

Uses: Firewood, **timber** (quality furniture), medicine (bark), bee forage, shade.

Description: A semi-evergreen tree with straight trunk up to 30 m before branching; buttressed at the base, the crown dense and rounded. **BARK:** grey-brown-black and thick, **later flaking**. **LEAVES:** compound, **2–7 pairs leaflets, each leaflet to 17 cm**. **FLOWERS:** small and white, in heads, often hidden by leaves, fragrant, September–November. **FRUIT:** a **dry capsule, to 5 cm across**, breaks into **4–5 sections** on the tree, scattering **30–60 pale flat winged seeds**, June–November.

Propagation: Seedlings, wildings, direct seeding.

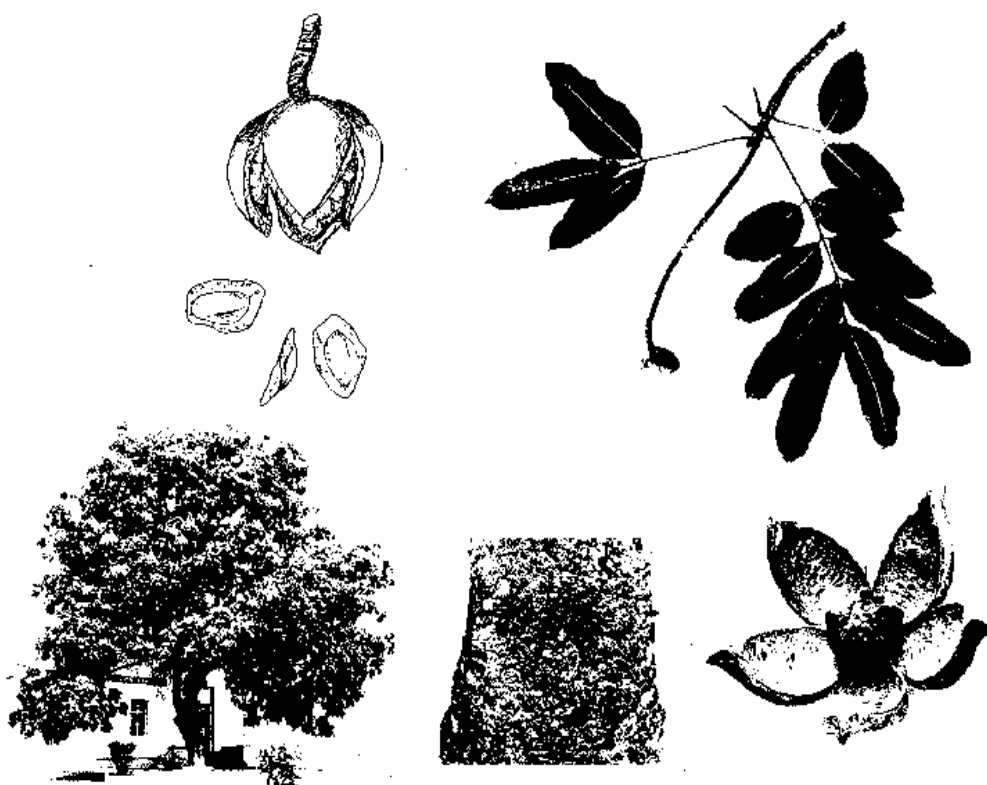
Seed: Produces 30–60 seeds per fruit. No. of seeds per kg: 2,000–3,800. Germination is very good and fast.

treatment: –

storage: Can store for some time.

Management: Coppicing, pruning.

Remarks: An indigenous fine hardwood that is easy to grow. Its present heavy exploitation by pitsawyers is worrying. Planting in school compounds and on farm should be encouraged. The timber is pale pink when fresh but red-brown on exposure. It is the most popular local timber for furniture as it is easy to work, polishes well and is also durable; resisting borers and termites. The bark is used to treat colds. Oil from seeds is rubbed on the scalp to kill lice.



Kigelia africana

Bignoniaceae

Indigenous

English: Sausage tree
Kunda: Mvungula
Nyanja: Chizutu, mvungula, mvunguti
Senga: Chizutu

Ecology: A distinctive African tree from north to south, of low to medium altitudes, 0–1,800 m; in open woodlands or beside rivers. In Zambia it is common in the valleys but occasionally occurs on the plateau.

Uses: Firewood, timber (dugout canoes, yokes), **medicine** (fruit, bark), fodder (flowers), dye (boiled fruit).

Description: A semi-deciduous tree with rounded crown about 9 m, the branches hanging low. **BARK:** grey-brown, smooth, flaking in round patches on mature trees. **LEAVES:** compound, arise in **threes**, crowded at the ends of branches, 3–5 leaflets, each to 10 cm, often with a sharp tip, **surface really rough and harsh** to the touch. **FLOWERS:** on long rope-like stalks, 2–3 m, about 12 **blood-red to liver-coloured flowers**, each an upturned trumpet with folded petals and yellow lines, August–November. **FRUIT:** look like long **grey-green sausages**. They are heavy, containing several kilos of fibrous pulp surrounding the seed—only released when the fruit rot on the ground, January–March. **Hanging stalks** remain on the tree.

Propagation: Seedlings.

Seed: Not a prolific seeder, poor germination rate and slow to germinate. No. of seeds per kg: 3,400–6,000.

treatment: Not necessary.

storage: Use fresh seeds.

Remarks: Unripe fruits are poisonous. Baked fruits are used to ferment beer. Slow growing.



Kirkia acuminata

Simaroubaceae

English: White syringa

Nyanja: Mtumbwi

Senga: Mzumba

Tumbuka: Mzumba

Ecology: Occurs in Africa from Zaire and Tanzania to Namibia and Northern Province of South Africa in various types of woodlands; medium to low altitudes. In Eastern Province, it is most frequent in the escarpment miombo, riverine woodlands and low-lying munga woodlands. This tree also occurs in the southern parts of Zambia.

Uses: Timber (utensils, furniture), medicine (roots), fodder (fallen leaves are eaten by cattle in times of drought), **live fence** (cattle enclosures), **stockade** (bathing shelters), barkcloth.

Description: A deciduous tree up to 21 m tall with a light open crown. Upper branches smooth and whitish. BARK: grey-brown when young, ridged and scaly with age. Branchlets marked with leaf scars. LEAVES: crowded at branch ends, **6–10 pairs leaflets, 2–8 cm, plus a single one at the end, narrow and pointed**, papery, on reddish stalks. Leaflets are dark green above, lighter below, **with toothed edges**. Leafless from May–June to September–November. FLOWERS: small, greenish cream-white appear in lax heads to 7 cm beside leaves from October to January. FRUIT: oblong, **brown thinly wooded capsule 1.5 cm long**, 4-sided, mature April–August, splitting into four 3-sided segments.

Propagation: Seedlings, cuttings.

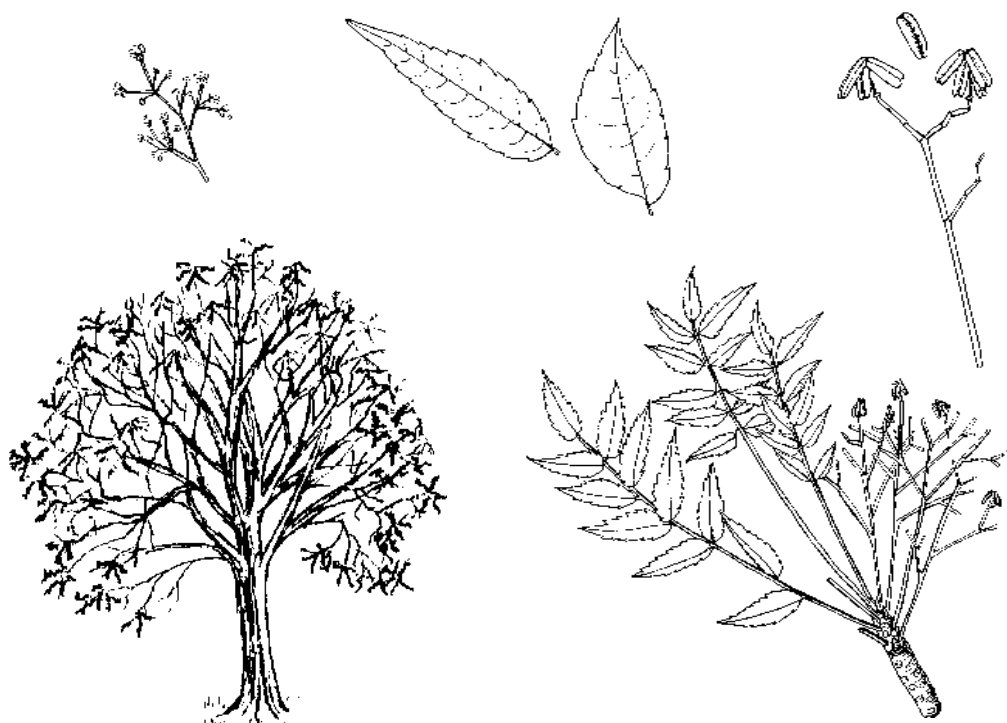
Seed: No. of seeds/kg: $\pm 3,000$.

treatment: Not necessary.

storage: Can be stored.

Management: Coppicing.

Remarks: This tree is often planted in graveyards in memory of the deceased by the Senga in Chama. The swollen roots of this tree act as water-storage organs and are dug up for water in drought periods. The burnt roots have been used to treat toothache. An ideal tree for planting as cuttings to grow live fences around homesteads and cattle kraals (enclosures).



Lannea discolor

Anacardiaceae

Indigenous

Nyanja Chaumbu, mbale

Senga Kabumbu

Tumbuka Kabumbu

Ecology: A small tree of lower altitudes from central to southern Africa. Common in open woodlands, thicket and scrub but not in evergreen forest in Zambia. It grows on a wide range of soils and is commonly used as a live fence protecting dimba in Eastern Province. One of several *Lannea* species in Zambia.

Uses: Timber (carvings, tool, handles), poles, **food** (fruit), medicine (bark, roots, leaves), live fence.

Description: A deciduous tree, usually 4–7 m but occasionally up to 15 m, the trunk straight with **thick erect branches** giving an open crown; bare 3–4 months. **BARK:** smooth, grey-black, later rough with scales. **LEAVES:** **crowded at tips of branchlets**, compound, 2–5 pairs leaflets, thin and leathery; the **lower surface very pale** due to grey-white hairs, contrasting with the **dark green upper surface** (discolor = different colours). **FLOWERS:** trees are male or female, in a cluster of spikes to 14 cm, cream and sweet scented, August–September. **FRUIT:** small and fleshy, **purple-red, to 1 cm long**, one-seeded, October–November. Fruit are relished by monkeys and birds.

Propagation: Cuttings, seedlings.

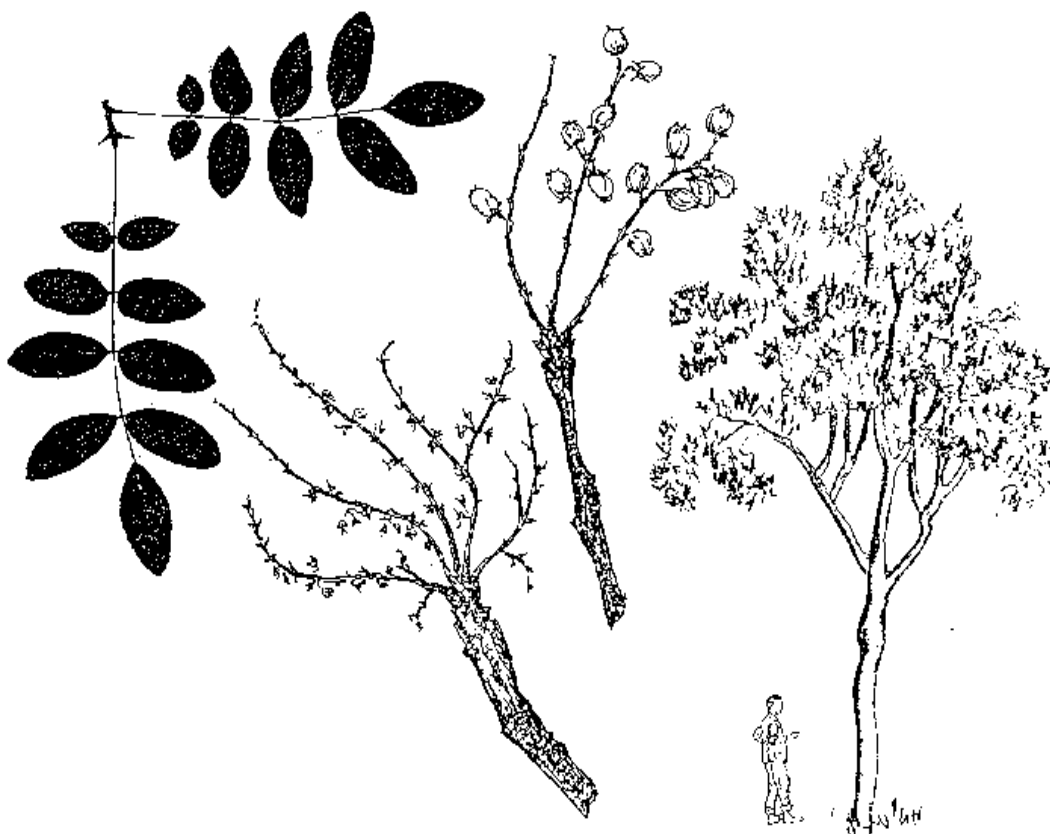
Seed: –

treatment: Not necessary.

storage: –

Management: Pruning, coppicing.

Remarks: The wood is soft but quite strong and durable and used for general carpentry. Large branches take readily to make a useful fence. The inner bark is used to treat diarrhoea. Roots are used to treat stomach-ache.



Lannea schweinfurthii subsp. *stuhlmannii*

Anacardiaceae

Indigenous

Nyanja: Chisula, msambandola, chaumbu, mbale

Senga: Kombwanyika

Ecology: A small tree widespread in Africa from Somalia to South Africa at a wide range of altitudes, 0–1,800 m. It is found throughout Zambia, but largely confined to riverine forest and termite mounds.

Uses: Timber (stools, utensils), **poles, food** (fruit, seed), medicine (leaves, roots, bark), purple dye (bark).

Description: A deciduous tree, usually 7–9 m, the crown rounded and branchlets drooping; young branchlets hairy. BARK: smooth grey-brown, later with large flakes. LEAVES: compound, clustered at branch tips, **2–4 pairs** of opposite leaflets, **not stalked** with a **central larger** leaflet to 9 cm. FLOWERS: male and female trees; small flowers in spikes, green-yellow, with new leaves, September–November. FRUIT: oblong, about 1 cm, **red-black, fleshy** and edible, November–February.

Propagation: Cuttings, root suckers, seedlings.

Seed: No. of seeds per kg: 40,000–45,000. Germination is good, completed after 45 days.

treatment: Not necessary.

storage: Very perishable. Viability only lasts for a few weeks.

Management: Pruning, coppicing.

Remarks: The tree withstands fires. Red-brown “wool” is obtained from the fibrous roots and was formerly used for stuffing pillows.



Leucaena leucocephala (L. glauca)

Mimosoideae

Central America

Nyanja: Lusina, lukina**Senga:** Lukina**Tumbuka:** Lukina

Ecology: Widely introduced throughout the tropics, including Africa, over the last 100 years. Today there are a great variety of *Leucaena* suitable for different habitats, 0–1,800 m. This species grows everywhere in Zambia in well-drained neutral soils with adequate rainfall. It does not tolerate highly acidic soil or dry sites.

Uses: Firewood, **fodder** (leaves, shoots), bee forage, ornamental, **soil improvement, nitrogen fixation**.

Description: An evergreen shrub or tree usually 3–5 m tall with a leafy canopy. **BARK:** grey-brown, smooth. **LEAVES:** compound, with many leaflets, on a stalk to 20 cm, **each leaflet thin and pointed, about 1 cm. Leaves and leaflets fold up** with heat, cold or lack of water. **FLOWERS:** round, white “balls”, to 2 cm, on a long stalk. **FRUIT:** bunches of thin, **brown pods, to 15 cm long**, persist on the tree; split to set free up to 25 hard shiny brown seeds.

Propagation: Seedlings, direct seeding.

Seed: The species is a prolific seeder. Germination rate 85–100%. No. of seeds per kg: 13,000–34,000.

treatment: Soak in hot water and allow to cool for 24–48 hours.

storage: Seed can be stored for long periods.

Management: Pollarding, lopping, coppicing.

Remarks: When used as fodder, *Leucaena* leaves should not exceed 20% of the feed intake because they contain mimosine. It may cause hair loss and stomach problems if fed in excess. Its deep roots bring up nutrients and root nodules are very active. It is fast growing. The *Leucaena* psyllid, *Heteropsylla cubana*, has recently appeared as a serious pest of *Leucaena leucocephala* and other leucaenas. After attack by the psyllid growth of the tree is retarded. Researchers are testing more psyllid-resistant varieties of *Leucaena*.



Lonchocarpus capassa

Papilionoideae

Indigenous

English: Lilac tree, rain tree
Nyanja: Chimpakasa, mswaswa
Senga: Chiwalawala

Ecology: A tree of central and southern Africa, north to Tanzania, with a useful timber. It grows near water in most parts of Zambia at low to medium altitudes, but not in evergreen forest, and prefers well-drained soils. Abundant nectar makes the flowers attractive to bees. The tree is a reliable indicator of groundwater.

Uses: **Timber** (utensils), food (seeds), **medicine** (roots), fodder (leaves), bee forage.

Description: A semi-deciduous tree about 10 m high with a rounded but open crown and drooping branches. **BARK:** light grey, smooth becoming rough. The sap is crimson-red. **LEAVES:** compound, 1–2 pairs of grey-green **leaflets** plus a central larger **leaflet to 15 cm**, leaf tip rounded. Leaf stalks are short and hairy. **FLOWERS:** **pink-purple**, in sweet sprays to 30 cm long, August–December. **FRUIT:** flat grey–cream pods, to 15 cm, with **one side wing-like** (May–October), 1–5 kidney-shaped seeds are set free when the pod rots on the ground.

Propagation: Seedlings.

Seed: No. of seeds per kg: $\pm 5,000$. Germination is good and fast.

treatment: Soak in cold water for 24 hours.

storage: Can retain viability for a long time at room temperature.

Management: –

Remarks: These trees are observed to drip water some weeks before the rainy season, between August and September. Froghoppers (*Ptyelus grossus*) invade the trees and the insect's nymphs suck the sap. Afterwards, they excrete almost pure water which falls on the ground below causing a patch of grass to grow; conspicuous in the dry landscape. They are sensitive to fire. Seeds are only eaten in time of famine. Rotenone, used in the insecticide "Derris", is extracted from the roots. The timber is strong, fairly hard and heavy. Root extracts are used to treat stomach-ache, hookworm and coughs.



Mangifera indica

Anacardiaceae

Northern India, Burma

English: Mango

Kunda: Mango

Nyanja: Manga

Senga: Mango

Tumbuka: Mango

Ecology: One of the most important fruit trees of the tropics, now almost naturalized in many places, including Zambia, 0–2,000 m. Hot areas with a pronounced dry season are best for regular fruiting. It prefers well-drained soil, does not tolerate flooding and survives in very dry areas. Roots grow deep.

Uses: Firewood, **food** (fruit), medicine (leaves), fodder (leaves), bee forage, **shade**, ornamental, windbreak.

Description: A dense leafy evergreen tree with a short trunk and **rounded crown**, 10–15 m. **BARK:** dark brown, cracked with age. **LEAVES:** **dark green**, crowded at ends of branches, to 30 cm long, young leaves soft, **copper-pink, hanging down**. **FLOWERS:** numerous and small, pink-brown in **big upright heads**; pollinated by flies and other small insects. **FRUIT:** large and heavy, **to 15 cm long**. Up to 1,000 fruit have been recorded on one tree. Each mango has a large seed surrounded by sweet, juicy flesh.

Propagation: Seedlings, direct seeding, grafting.

Seed: Germination rate 60–90%. No. of seeds per kg: ± 50 .

treatment: Not necessary, but remove pulp from seed.

storage: Dry seed can be stored. For best results, fresh seed should be used.

Management: Lopping.

Remarks: Fast growing. Scattered trees on farms provide shade and fruit. Both leaves and fruit skin can smell of turpentine. Trees for commercial fruit production are usually grafted specimens; selected varieties should have little fibre in the fruit and a skin free of the turpentine smell. However, in Eastern Province the mango production is not on a commercial scale and local varieties are used. The fruit is rich in vitamins A and C. The leaves are used to treat sore throats, coughs, bronchitis and diarrhoea.



Manihot glaziovii

Euphorbiaceae

Brazil

English: Tree cassava, ceara rubber tree, cearea

Kunda: Katapa

Nyanja: Mtambula, gwada

Ecology: A small tree related to the cassava plant and bearing similar leaves. It has been used as a source of rubber, obtained from the latex. In several African countries, it has become naturalized, including in Zambia where it grows in most soils both on the plateau and in valley areas. Many villagers grow the tree for shade and it does well even in dry areas.

Uses: Food (leaves), **fodder** (leaves), **shade**, ornamental.

Description: A semi-deciduous tree to 8 m, usually 4–5 m, the crown leafy and rounded. **BARK:** pale grey-brown, rough with age; with many **horizontal leaf scars**; copious **white latex** when cut. **LEAVES:** shiny green and soft, **palmate, compound, with up to 7 deeply cut lobes**, on stalks to 40 cm, crowded at the ends of branches. **FLOWERS:** small, yellow-green. **FRUIT:** **rounded**, green, in sections.

Propagation: Cuttings.

Seed:

treatment: –

storage: –

Management: Pollarding and coppicing.

Remarks: Fast growing. In Eastern Province, leaves are prepared and eaten like cassava (*Manihot esculenta*).



Markhamia obtusifolia

Bignoniaceae

Indigenous

English: Golden-bean tree
Kunda: Kasanika
Nyanja: Kasanika, msusankhwale
Senga: Kapandaziche

Ecology: A shrubby tree of medium to low altitudes; north to Kenya and just into South Africa. It is found on a wide range of soils scattered all over Zambia from open woodland to dune scrub; most common in *Baikiaea* forest. Although bare many months, it is an attractive tree in flower.

Uses: **Timber** (tools, furniture), **poles**, medicine (fruit, roots), fodder (leaves), bark rope, bird traps (twigs, bark).

Description: A bushy deciduous shrub, usually 1–2 m but can reach 13 m. **BARK:** light brown–grey, smooth at first. Long strips are pulled off older plants for bark rope. **LEAVES:** compound, 5 pairs of leaflets plus 1 central leaflet, on a stalk to 8 cm long; leaflets rounded to 14 cm long, lower surface yellow, hairy; leafy shoots covered with long golden hairs; tree bare June–November. **FLOWERS:** showy yellow, red-brown lines on 3 of the 5 lobes, buds and stalks also hairy; a long flowering period, November–March. **FRUIT:** long, flat capsules, yellow-brown, hairy, to 85 cm, with a central ridge, split to release winged seeds. Fruits hang on the tree all the year.

Propagation: Seedlings, wildings.

Seed: No. of seeds per kg: $\pm 70,000$. Germination is good and completed after 2–3 weeks.
treatment: Not necessary.
storage: Use fresh seeds. Can retain viability for a short period (3 months) at room temperature.

Management: Coppicing.

Remarks: An attractive tree when in flower. The Nyanja name *msusankhwale* means used for partridge (*nkhwale*) trapping. The wood is whitish, heavy and durable. *Markhamia acuminata*, with similar uses, is also found in Eastern Province. Its leaflets are pointed. Most *Markhamia* spp. can be grown with crops on farmland. The boiled root is used to treat backaches, body pains, and relieves stomach gas. Root powder is used to treat hookworm and snakebite.



Melia azedarach

Meliaceae

Western Asia, Himalayas

English: Persian lilac, bead tree

Senga: Paizoni

Tumbuka: Paizoni

Ecology: A common ornamental tree planted since early times in the tropics and subtropics, from coast to 2,000 m. It is planted throughout Zambia, including Eastern Province. It grows in most soils, including acidic and saline and is fairly drought-resistant.

Uses: Firewood, timber (furniture), **poles**, medicine (leaves), bee forage, shade, ornamental, **windbreak, insecticide** (leaves), essential oil.

Description: A semi-deciduous tree, usually 5–6 m, with a leafy rounded crown. **BARK:** grey and smooth, later rough and brown. **LEAVES:** **compound**, on branched stalks, to 40 cm long; leaflets bright shiny green, narrow to 8 cm, the edge **irregularly toothed**, the tip **pointed**. **FLOWERS:** small and fragrant but in striking rounded clusters; each flower with 5 **pale purple-to-white petals and a dark purple centre**. **FRUIT:** **fleshy yellow berries**, oval to 1.5 cm, persist on the bare tree. Each fruit has a stone containing 3–5 dark brown seeds.

Propagation: Seedlings, wildings, direct seeding.

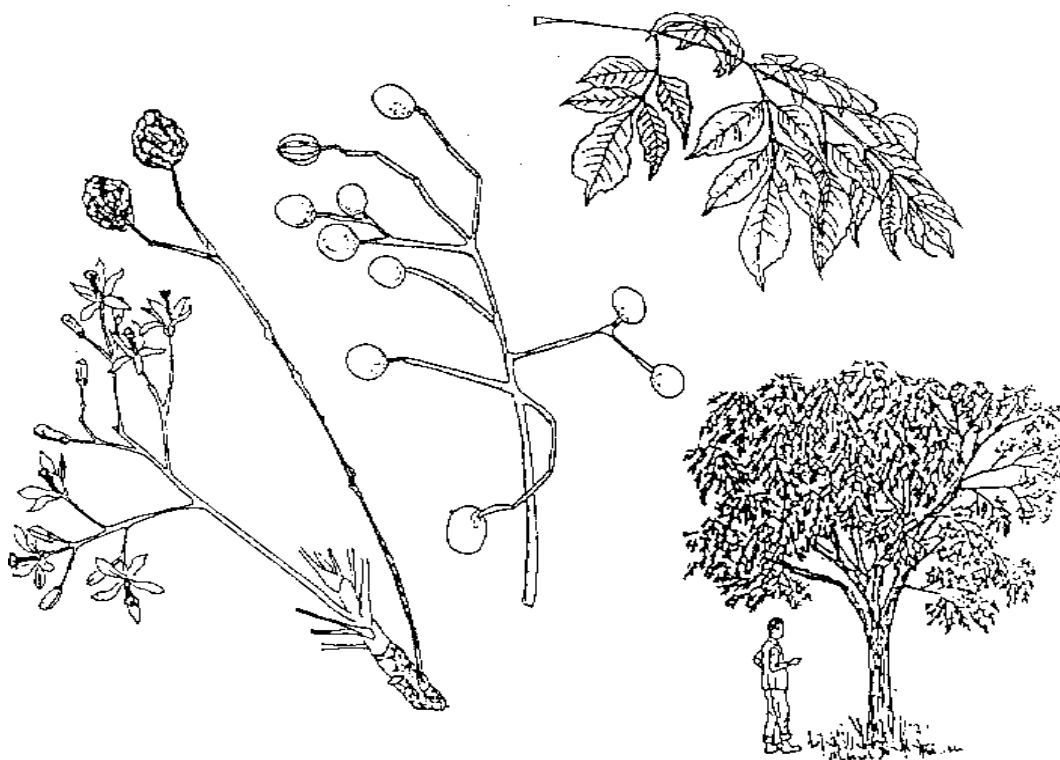
Seed: This species is a prolific seeder. High germination rate. No. of seeds per kg: 2,100–3,000. Germination is good but sporadic 85–100% in 4–10 weeks.

treatment: Not necessary.

storage: Seed can be kept up to 2 years if kept dry.

Management: Pollarding, lopping, coppicing, pruning.

Remarks: The berries are extremely poisonous to human beings and livestock. Leaves are not browsed by livestock. The tree is moderately termite-resistant and fast growing. The seeds have been used as beads. This tree is often confused with the related *Azadirachta indica*—both trees have medicinal uses. The leaves are boiled with water and the liquid used for stomach-ache. Stem borers attack the tree and make holes, approximately pencil size in diameter.



Monotes africana

Dipterocarpaceae

Indigenous

English: Yellow wood
Nyanja: Mkalakate, mtazya, mzaza
Senga: Mkalakate
Tumbuka: Mkalakate

Ecology: This tree is found in southern Tanzania, southern Zaire and Malawi. In Zambia it occurs in Eastern, Copperbelt and North-Western Provinces and through the northern region. It is a tree of poor miombo woodlands. It also occurs in hill, escarpment and normal plateau woodlands.

Uses: Firewood, **timber** (tool handles), poles, medicine (leaves, roots, bark), fodder, bee forage.

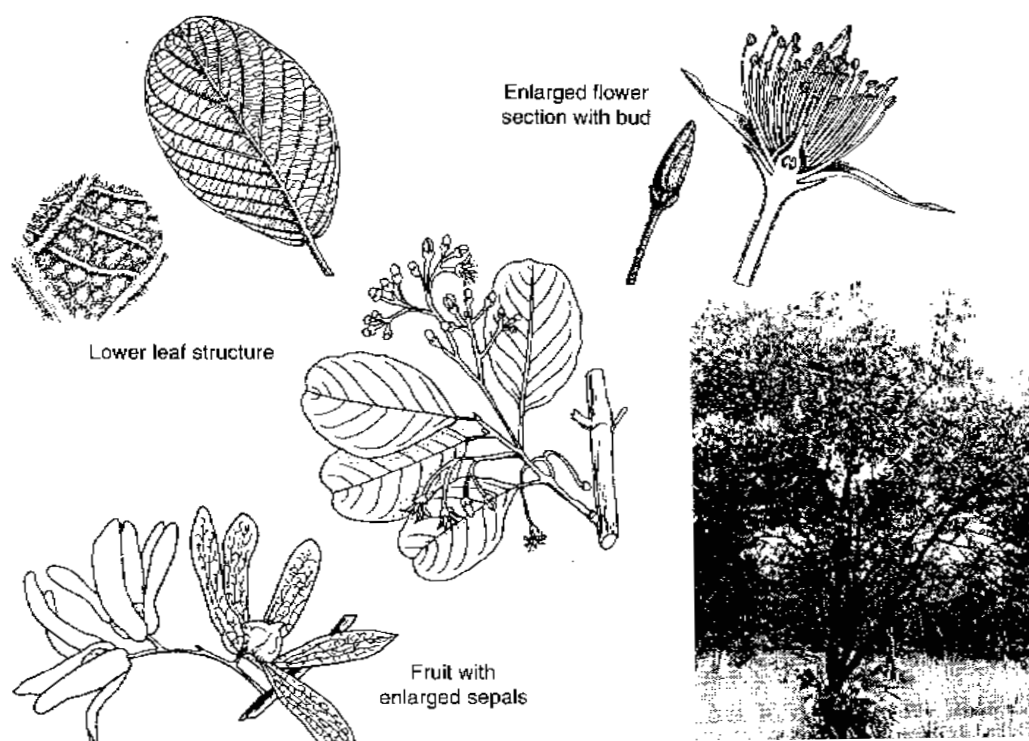
Description: A deciduous tree, usually 8–9 m (to 13 m), with an open crown. **BARK:** pale grey-brown, cracked and **broken into rectangles**, with small oblong scales. **LEAVES:** **alternate, oblong, about 6 cm**, tip blunt to rounded, curly hairs below and on the midrib above, both surfaces the same colour, stalked with **a clear glandular spot at the base of the midrib**. **FLOWERS:** in few-flowered clusters beside leaves, to 7 cm, parts in fives, pale cream and drooping, **the 5 sepals increase greatly in size** and look like membraneous petals. A central mass of stamens. Flowers covered in soft hairs, January–February. **FRUIT:** yellow-brown, **hard nut, conical to 1.5 cm, with 5 enlarged calyx "wings"**, about 3.5 cm, also yellow-brown, around the central nut which contains one seed.

Propagation: Seedlings, wildings.

Seed: –
treatment: Manual or mechanical scarification.
storage: –

Management: Coppicing.

Remarks: It is a good tree for bee forage. It is used as a constituent in an infusion which is said to drive away bad spirits.



Moringa oleifera

Moringaceae

India, Himalayas

English: Ben-oil tree, cabbage tree, horse-raddish tree, drum stick, mother's best friend.

Nyanja: Molinga

Senga: Molinga

Tumbuka: Molinga

Ecology: A tree native of India and the Western Himalayas but now widely grown throughout the tropics, 0–1,600 m. Naturalized in certain parts of Zambia such as Southern Province. In Eastern Province the tree has been planted around houses by people of Asian origin. Grows well on well-drained soils.

Uses: Food (young pods, young leaves, flowers) fodder (leaves, young fruit), bee forage, soil conservation, **water purification** (seeds), **ornamental**, live fence.

Description: A deciduous tree to 10 m, usually smaller, **pale feathery foliage**. BARK: grey, thick and corky, peeling in patches. LEAVES: pale green, **thrice compound**, the whole leaf 30–60 cm, leaflets **usually oval, tip rounded 1–2 cm long**. FLOWERS: **cream**, fading yellow in long sprays, each flower with 5 petals, 1 erect and 4 bent back, sweet-scented, attracting insects. FRUIT: long capsules, to 45 cm, **bluntly triangular in section**, splitting when dry to release 9 **dark brown 3-winged seeds** from the pith.

Propagation: Seedlings. Direct seed sowing, cuttings.

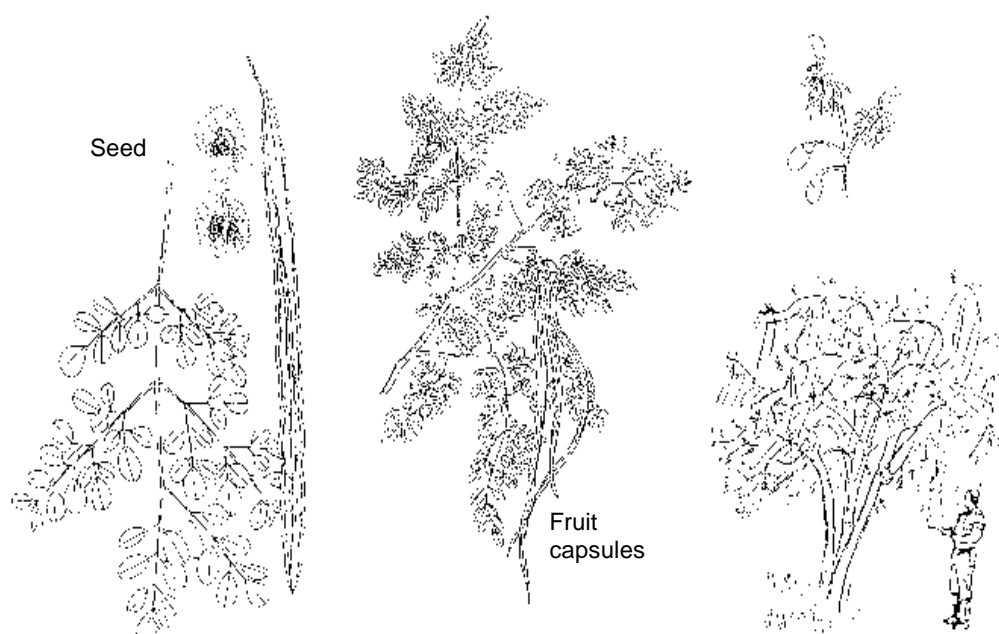
Seed: No. of seeds per kg: 4,000–9,000.

treatment: Not necessary.

storage: Can be stored for a year if kept dry.

Management: Pollarding, coppicing, lopping.

Remarks: An easy tree to propagate. The “Ben oil” from the seeds keeps its quality and so can lubricate precision machinery like watches. It is also used for salad oil, soap and cosmetics in India. The ground-up seeds have been used successfully in Kenya, Burundi and Sudan to clear muddy water—a very valuable property. In Eastern Province, people of Asian origin eat the leaves, young pods and flowers. The people of Southern Province have also started to eat them.



Morus nigra (*M. japonica*)

Moraceae

Western Asia, Iran

English: Black mulberry**Nyanja:** Malubeni**Senga:** Malubeni**Tumbuka:** Malubeni

Ecology: In Africa, *Morus nigra* and *Morus alba* have both been planted for some time, each species requiring slightly different conditions. Although their origin is temperate, *Morus* spp. do surprisingly well in dry areas from sea level to 2,000 m with little attention. Both species are grown in villages in Zambia as ornamental fruit trees. The common species in Eastern Province is *Morus nigra* which grows best at lower altitudes, but in the Northern Province experimental work is being done on *Morus alba* for silkworm production. This species has more general uses than *Morus nigra*.

Uses: Firewood, **food** (fruit), **fodder** (leaves, fruit), bee forage, ornamental, soil conservation, live fence.

Description: A small semi-deciduous **shrub usually 2–5 m**, with a spreading irregular crown. **BARK:** grey-brown, rough with age, resinous gum when cut. **LEAVES:** **large and heart-shaped, 10–15 cm; the edge with large teeth;** tip pointed, dull green and rough above, slightly hairy below. **FLOWERS:** sexes separate on the same tree. Small green flowers on short drooping spikes. **FRUIT:** red then **black when mature, to 2.5 cm long** (stains badly).

Propagation: Cuttings, seedlings.

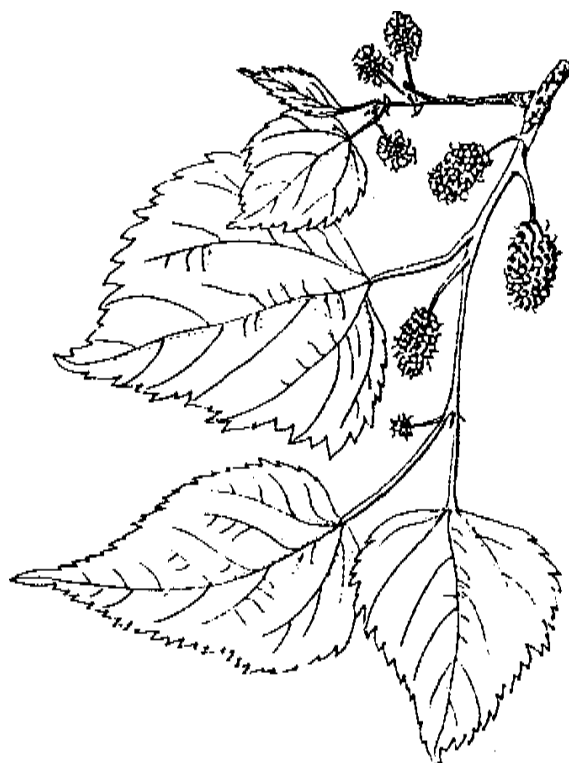
Seed: Poor germination. No. of seeds per kg: 325,000–700,000.

treatment: Soak in cold water for 48 hours.

storage: Can be stored for a long time.

Management: Lopping.

Remarks: The tree grows rapidly, especially from cuttings; bearing fruit in about 3 years. Fruiting is abundant and the fruit is a favourite with children, but at present it is not a commercial crop. Both goats and cattle browse leaves and shoots; so young saplings need protection.



Oxytenanthera abyssinica

Gramineae

Indigenous

English: Wild bamboo, lowland bamboo

Nyanja: Nthele, sungwi

Senga: Swaswe, sasu

Tumbuka: Saswe

Ecology: All bamboos belong to a subgroup of the huge grass family. Among the 250 species, there are 43 in Africa and 40 of these grow only in Madagascar. Most bamboo grow in the humid forests of South-East Asia where they are very important for rural people. They are perennials with woody stems, tough and hollow, growing up from swollen underground stems (rhizomes). Lowland bamboo ranges from Ethiopia, Uganda to Zimbabwe and grows throughout Zambia along river banks, on termite mounds and in dambos, particularly in the Copperbelt, 500–2,100 m. It is the most hardy of the three African species, often found on very poor soils, e.g. in Tanzania.

Uses: Poles (building, furniture, scaffolding), **ornamental**, **fences**, soil conservation, **basketry** (split stems).

Description: A tall grass to 7 m, in dense clumps, unusual as the stems are solid; reaching 10 cm diameter at the base. Stems arch over. **LEAVES:** there are **irritating dark brown hairs** on the leaf sheath. Leaves are blue-green, **base rounded, the tip long and spiny**, usually 15 cm long x 2.5 cm but up to 25 cm. **FLOWERS** and **FRUIT:** spikelets narrowed, pointed, 2.5 cm in **clusters** 6 cm across. Flowering takes place about every 7 years. Then the clumps die down but shoot one year later from the rhizomes.

Propagation: Rhizomes.

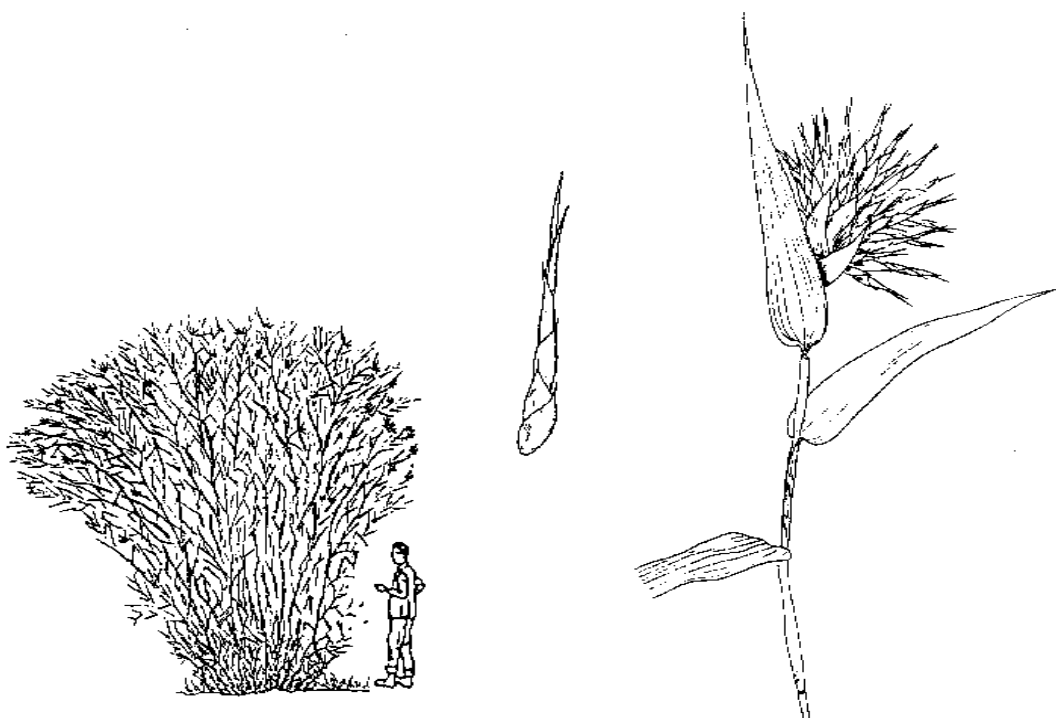
Seed: Seed is rare; cuttings, suckers.

treatment: –

storage: –

Management: Needs to be controlled by cutting.

Remarks: The yellow-stemmed bamboo commonly grown in and around Chipata belongs to another genus, *Bambusa vulgaris*. In most places bamboos are in demand for building purposes. Fences are susceptible to damage by termites and borers. It survives fires in its natural habitat. In Eastern Province, it is popular for basketry. The grain has been used as famine food.



Parinari curatellifolia subsp. *mobola*

Rosaceae/Chrysobalanaceae

Indigenous

English: Hissing tree, mobola plum**Nyanja:** Mumbula, mupundu**Senga:** Mbula

Ecology: A tall tree occurring north to Kenya and Senegal and south to the northern part of South Africa in all types of woodland and evergreen thicket, 0–1,900 m. Common in Zambia, especially in sandy soils and sandy loams. It is considered an indicator of a high water-table, and is often left in fields. It is scattered in distribution and it is fire-resistant.

Uses: Firewood, charcoal, timber (building, furniture, mortars), beehives (bark), **poles, food** (fruit), medicine (fruit, bark), edible oil (seed), fodder (leaves, fruit).

Description: An evergreen tree to 15 m, with a tall **straight trunk, erect branches and dense rounded crown**, occasionally buttressed at the base. **BARK:** rough, dark grey-brown, grooved, later flaking in large squares. **The sap is reddish.** Young shoots with yellow-brown hairs. **LEAVES:** **oval and alternate, with clear parallel veins**, shiny green above but hairy grey-white below, to 8 cm long. **FLOWERS:** small, white-pink in short **flat-topped heads**, to 6 cm across. Flower stalks and calyx have yellow-brown woolly hairs. **FRUIT:** **oval to 5 cm**, with grey scales over yellow-red-brown skin; ripen September–November. The fibrous yellow flesh is sweet but sharp and contains a hard stone with one edible seed kernel.

Propagation: Seedlings, rootsuckers.

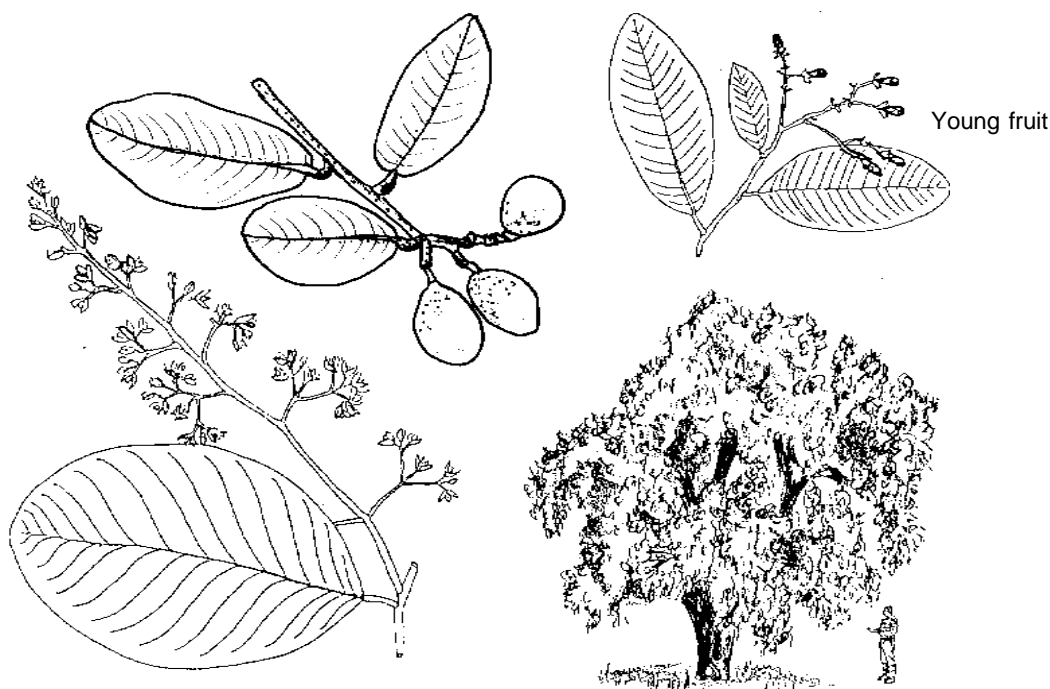
Seed: No. of seeds per kg: 250–350. Germination is poor and very slow.

treatment: Carefully break the seed coat with a hammer or a stone.

storage: Seed can be stored.

Management: Coppicing.

Remarks: The fruit is highly valued and collected to sell in local markets; usually eaten raw but also added to porridge and used for drinks. The flesh is high in vitamin C and the kernel rich in edible oil. The timber is very hard, heavy and durable but difficult to cut and plane. It is also borer-proof and fire-resistant but splits easily so can be used for fences as an alternative to bamboo. The bark is used to treat pneumonia and fever.



Pericopsis angolensis (*Afrormosia angolensis*)

Papilionoideae

Indigenous

Kunda: Muwanga

Nyanja: Muwanga

Senga: Mubanga

Tumbuka: Mubanga

Ecology: A medium-to-large tree typical of Central Africa, north to Tanzania and south to South Africa, and scattered all over Zambia. The timber is highly valued, hard and attractive; large trees are now rarely found. Trees are found in all the woodlands except mopane woodlands, preferring more fertile soils.

Uses: Firewood, charcoal, **timber** (construction, carving, quality furniture, floors), **poles, fence posts**, medicine (leaves, bark, roots), fodder (leaves, shoots), **nitrogen fixation**.

Description: A semi-deciduous tree usually 10 m, reaching 20 m; the bole rarely straight, branches spreading to an open crown. **BARK:** smooth and **pale grey-white** at first, darker later with irregular pieces **flaking off to show red-brown under bark**. **FLOWERS:** **pink-purple in sprays** to 15 cm; flower stalks and buds pale brown and hairy. **LEAVES:** **compound**, 4–10 pairs plus a central leaflet, each one to 6 cm, oval, the **tip rounded, blue-green**; September–November. **FRUIT:** Flat pods in distinctive heavy clusters, to 24 cm long, bright green then pale yellow-brown, with narrow wings on both edges. Inside are 1–3 flat orange-brown seeds, July–September.

Propagation: Seedlings, cuttings.

Seed: No. of seeds per kg: 3,000–3,500. Germination rate is very high and fast.

treatment: Not necessary.

storage: Can be kept viable for a long time if dry and free from insects.

Management: Pruning, coppicing.

Remarks: The strong wood has an attractive pattern, turns well and takes a high polish. Buried tool handles have been found and dated to about 100 years old, showing that this timber is extremely resistant to termites and borers. Leaves can be applied to wounds, including snake bites. This tree is often left in cultivated fields since it does not compete with crops.



Persea americana

Lauraceae

America

English: Avocado**Nyanja:** Kotapela**Senga:** Kotapela

Ecology: An attractive fruit tree which has been distributed all over the tropics and subtropics. It grows best in sandy loam with good drainage and has shallow roots, 0–2,200 m. The tree does not tolerate waterlogging but does well in the upper parts of dimba.

Uses: **Food** (fruit), shade, cosmetics, oil (fruit).

Description: A densely leafy evergreen tree to 10 m or more with a straight bole. **BARK:** grey–dark brown, rough and grooved with age. **LEAVES:** large and oval, to 20 cm, midrib and veins clear, shiny dark green above, young leaves pink. **FLOWERS:** small, **abundant, pale yellow in large heads**, only one in 5,000 becoming a fruit. **FRUIT:** on long stalks, large, **pear-shaped to 25 cm** with one large seed, enclosed by soft green–yellow flesh. The outer skin varies from green to purple.

Propagation: Grafted materials (improved varieties), seedlings.

Seed: No. of seeds per kg: ± 15 . Germination takes about 6 weeks.

treatment: Not necessary. Seed sown fresh for best results.

storage: Seed does not store well. Use fresh seed.

Management: Can be side-pruned to obtain the desired shape. Keep the area around the stem weed-free to reduce fire hazard.

Remarks: In Eastern Province, some farmers have raised trees from seed for marketable fruit. The fruit is very nutritious, rich in fat, protein and vitamins. The high demand for fruit in Eastern Province is currently met from outside the Province. Bark, leaves and seeds are toxic to browsing livestock. Difficult to intercrop since the tree produces dense shade and competes for nutrients through its dense superficial root system. Under good conditions trees may need inducement to form flowers. To promote flowers and fruit, cut roots in a trench, narrowly ring bark and even beat with a stick! There are some 300 varieties and grafting is necessary to maintain quality. An infusion of boiled leaves is said to be good for anaemia.



Phoenix reclinata

Palmae

Indigenous

English: Wild date palm, false date palm

Nyanja: Kanchinda

Ecology: A palm usually growing in dense clumps beside swamps and rivers. Found throughout tropical Africa, it grows in humid lowland woodlands, highland forests and on open rocky hillsides, 1,100–2,200 m. Common throughout Zambia. It is, however, essentially a swamp or riverine species but is also found around anthills, in dambos and in munga (acacia) woodlands. Occurs in Eastern Province near dambos and streams.

Uses: Wine, **basket/mat making, rope**, fibre, tannin, gum.

Description: The mature palm trunk may reach 10 m, slender and **often bent over** ("reclinata"), about 25 cm in diameter, covered in very rough leaf scars. **LEAVES:** To 2.7 m long, growing out from a fibrous leaf sheath, the crown of about 25 leaves arching over, leaflets **narrow, folded, bright shiny green, to 30 cm**, stiff and pointed. **FLOWERS:** Male and female on different trees. **FRUIT: Yellow-brown, about 2 cm, edible.**

Propagation: Seedlings, suckers.

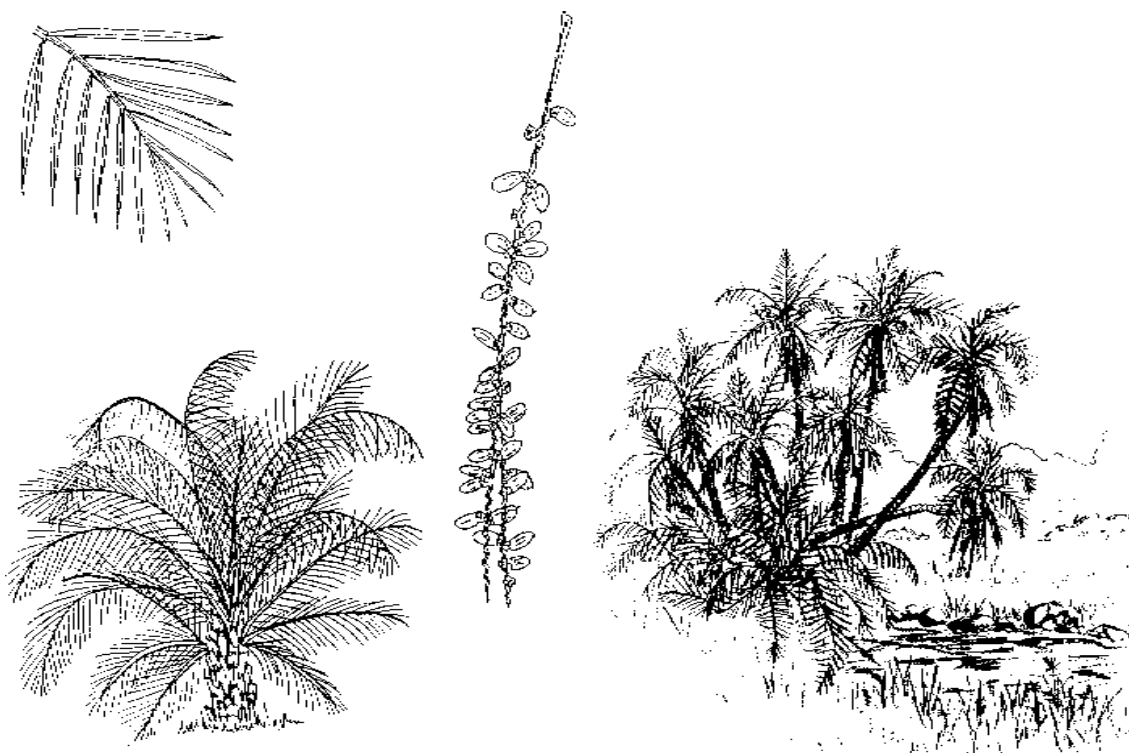
Seed: No. of seeds per kg: 900–5,000.

treatment: Not necessary.

storage: Seed stores well.

Management: Thinning if planted or growing in groups.

Remarks: Strong fibres from the leaves are used all over Africa for making baskets, mats, etc.



Piliostigma thonningii (*Bauhinia thonningii*)

Caesalpinioideae

Indigenous

English: Monkey bread**Kunda:** Chitimbe**Nyanja:** Msekese**Senga:** Chitimbe**Tumbuka:** Chitimbe

Ecology: A shrubby tree found all over Africa from West Africa to southern African grasslands, 0–1,850 m, growing in a variety of soils. It grows throughout Zambia except on the nyika plateau. When fields are left fallow these trees often emerge.

Uses: Firewood, charcoal, timber, poles, **food** (pods), **medicine** (leaves, bark, roots, pods), **fodder** (pods, shoots), bee forage, ornamental, rope (bark fibre), tannin, dye (pods, seeds, bark, roots).

Description: A semi-deciduous tree usually 3–5 m, the branches often twisted. **BARK:** thick, rough, fibrous underbark. **LEAVES:** distinctive **2-lobed**, rounded to 15 cm long; a small hair in the deep notch; leathery pale green, **lower surface brown hairy with raised veins**. **FLOWERS:** **white-pink**, fragrant in **drooping sprays** to 20 cm, November–March. Male and female trees. **FRUIT:** flat, **brown woody pods about 20 cm** long and 5 cm across, the surface hairy. Pods may decay on the ground to set free seed. Pulp surrounding seeds is edible, but seed is only used as famine food; May–September; remaining a long time on the tree.

Propagation: Seedlings.

Seed: The tree produces many seeds with good germination rate. No. of seeds per kg: $\pm 7,300$, difficult to extract.

treatment: Soak in cold water for 24–48 hours.

storage: Can be stored for several years.

Management: Coppicing, pollarding.

Remarks: This is a good tree for intercropping. Commercial farmers in Southern Province sometimes crush dried pods with molasses and minerals to make a cattle feed. Small-scale farmers could benefit from using pods as supplementary feed. The wood is termite-resistant. The leaves are used to treat cough and diarrhoea, the roots for severe menstrual bleeding and are also said to cure dysentery, coughs, sore throat and chest problems. Crushed leaves are used to treat malaria, snakebite and toothache.



Pinus kesiya (*P. insularis*)

Pinaceae

South East Asia

English: Pine
Kunda: Paini
Nyanja: Paini
Senga: Paini
Tumbuka: Paini

Ecology: A tree now widely planted in tropical and subtropical regions 1,000–2,000 m. Commonly planted in central and southern Africa. In Zambia, many pine species have been planted on a trial basis but the common ones in Eastern Province are *Pinus kesiya* and *Pinus oocarpa*. *P. kesiya* requires an annual rainfall of 700–1,800 mm and it grows well on deep well-drained soil.

Uses: Firewood, charcoal, **timber**, poles, resins (bark).

Description: An evergreen tree with a straight bole and spreading branches; growing up to 30 m high. **BARK:** thick brown-grey and rough. **LEAVES:** needles in **threes, erect, flexible, bright green, long, up to 25 cm and sharp pointed**. **FRUIT:** cones, **reddish brown to about 7 cm** on short stalks.

Propagation: Seedlings.

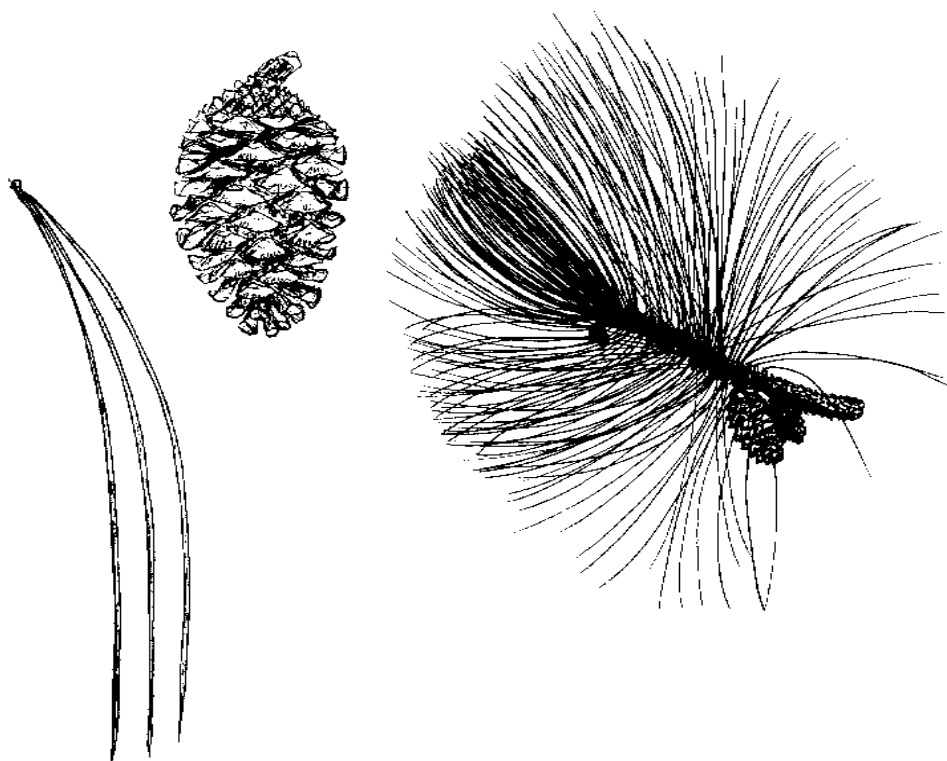
Seed: No. of seeds per kg: 55,000–62,000. Germinates after 10–14 days.

treatment: Not necessary.

storage: Can remain viable up to 2 years at room temperature.

Management: Pruning, thinning.

Remarks: The seedlings require inoculation with mycorrhiza in order to grow well. Mycorrhiza, which can be obtained by collecting soil from below mature pine trees, help the seedling to obtain nutrients from the soil. The tree takes 25–30 years before it can be harvested for timber. It is moderately resistant to termites but fire-sensitive. Pines have been planted on a large scale on the Copperbelt for timber production. The firewood and charcoal are not as good as those from most indigenous trees but are still used in the Copperbelt and in Malawi.



Pinus oocarpa

Pinaceae

Central America

English: Pine
Kunda: Paini
Nyanja: Paini
Senga: Paini
Tumbuka: Paini

Ecology: An exotic tree from Central America and now widely grown in tropical and subtropical Africa 1,000–2,400 m. Rainfall 750–1,500 mm. Common in regional supply plantations in the country. Grows on light, medium and heavy neutral to slightly acidic soils and tolerates shallow soils.

Uses: Firewood, charcoal, **timber** (construction), poles, resin (bark).

Description: An evergreen coniferous tree up to 25 m high and with a light crown. **BARK:** rough, grey-reddish brown. **LEAVES:** needles **in threes, fours or fives, drooping**, 15–25 cm long.

Propagation: Seedlings.

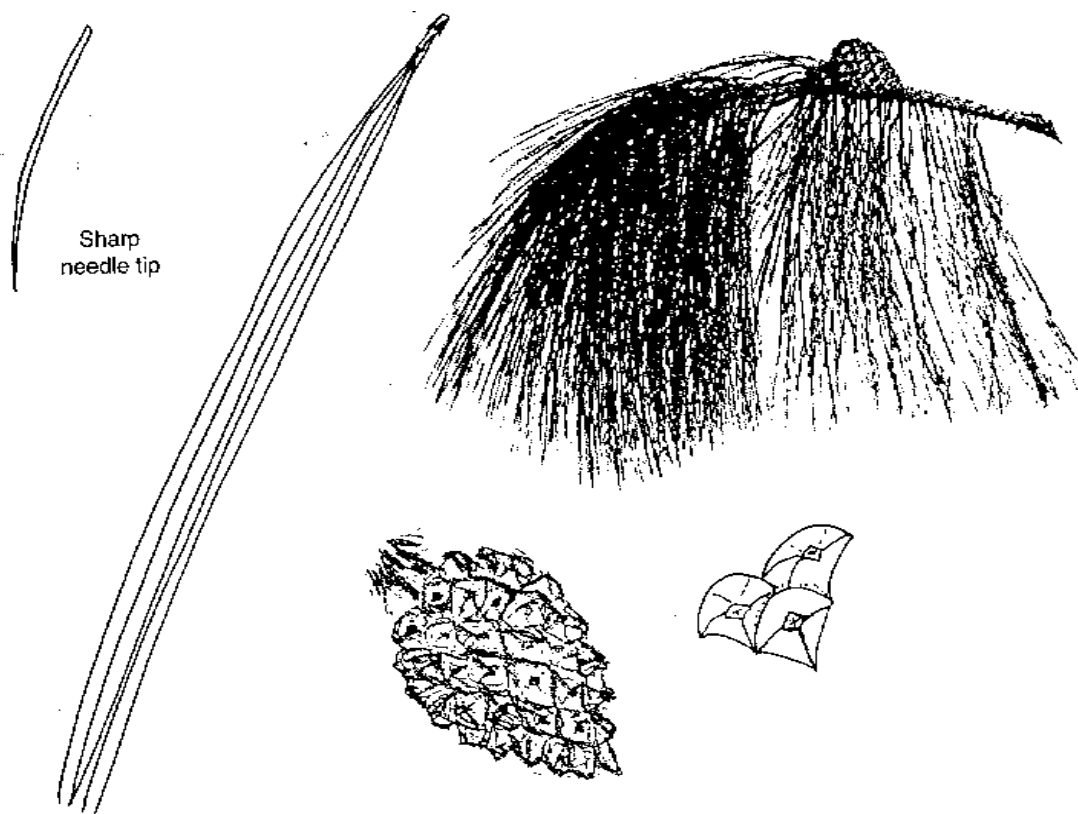
Seed: No. of seeds per kg: 41,000–55,000. Germinates after 14–21 days.

treatment: Not required

storage: Can retain viability for up to 2 years at room temperature if kept dry.

Management: Pruning, thinning

Remarks: The seedlings require inoculation with mycorrhiza for good establishment, as with *Pinus kesiya*. The firewood and charcoal are not as good as those from most indigenous trees but are still used in the Copperbelt and in Malawi. The species is moderately termite-resistant but fire-sensitive. Matures 25–30 years after planting.



Pseudolachnostylis maprouneifolia

Euphorbiaceae

Indigenous

English: Duiker berry

Kunda: Msolo

Nyanja: Msolo

Senga: Msolo

Tumbuka: Msolo

Ecology: A small tree of lower altitudes growing north to Tanzania and south to the Transvaal, on rocky or light soils in woodlands over a wide altitudinal range. Found all over Zambia, especially on the miombo plateau, and still held to be the home of ancestral spirits by villagers in Eastern Province so rarely cut down. The fruits are eaten by antelopes, hence the English name.

Uses: Firewood, charcoal, **timber** (joinery, rough carpentry), **medicine** (roots, bark, leaves), fodder (leaves, fruits), shade, dye (fruit).

Description: A semi-deciduous tree, about 6 m, varying in shape with the habitat, but it can have a straight bole and regular branches forming a light crown. **BARK:** smaller branches white and smooth but trunk rough and grey-brown with irregular scales. **LEAVES:** small and oval to 8 cm, alternate on the twigs, **thin and blue-green with yellow stalks**. **FLOWERS:** male and female trees; small, green-white, in clusters of a few flowers, July–December. **FRUIT:** green-yellow and rounded to 2 cm; **thin flesh with 3 seeds in 3 sections**, June–October.

Propagation: Seedlings, wildings.

Seed: –

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Can be stored.

Management: Pruning, weeding.

Remarks: These trees are very attractive when leaves turn orange-red before falling in winter. They are moderately fire-resistant. In the recent past, people placed food offerings to ancestral spirits at the foot of these trees. Roots are used to treat diarrhoea, sore eyes and syphilis, and to stop nosebleeds. A paste made from crushed leaves is used to treat footrot in hoofed animals.



Psidium guajava

Myrtaceae

South and Central America

English: Guava
Nyanja: Gwawa
Senga: Gwaba
Tumbuka: Gwawa

Ecology: A small fruit tree widely cultivated in the tropics, including Africa. It is grown at most altitudes, 0–2,700 m, in most soils but does not withstand waterlogging. It is drought-hardy and found all over Zambia in villages and gardens.

Uses: Firewood, timber (tool handles), fence posts, **food** (fruit, jam, jelly, juice), medicine (bark, leaves, roots), shade.

Description: A small evergreen tree to 8 m, branching irregularly. **BARK:** smooth pale brown, later peeling off, young shoots 4-sided. **LEAVES:** large and oval to 15 cm, **side veins prominent, hairy below**, in opposite pairs. **FLOWERS:** white, about 2 cm across, many stamens. **FRUIT:** rounded to 6 cm, tipped by remains of calyx. Colour white to pink depending on variety. Flesh sweet but containing many hard angular seeds.

Propagation: Seedlings, direct seeding.

Seed: No of seeds per kg: $\pm 500,000$.

treatment: Not necessary.

storage: Seed can be stored.

Management: Pollarding, lopping, pruning, coppicing.

Remarks: Common around homesteads. The tree may become a weed on good sites. Trees begin to bear fruit after 3 years and continue fruiting up to 30 years. The fruit is rich in vitamin C. Wood is termite-resistant. In Eastern Province there has been an increase in planting of this tree by small-scale farmers. It is best planted away from crops due to root competition. Boiled leaves are used to treat diarrhoea and bleeding wounds, while leaves boiled with sugar and salt are used to treat eczema and abscesses.



Pterocarpus angolensis

Papilionoideae

Indigenous

English: African teak, bloodwood, sealing-wax tree

Nyanja: Mlombe, mlombwa

Senga: Mlombe

Tumbuka: Mlombe

Ecology: One of the most useful and valuable of African timber trees, widespread in central and southern Africa north to Tanzania. It is found all over Zambia in the woodlands as well as in evergreen and deciduous forests. In Eastern Province, it is common between Nyimba and Sinda but also occurs in other areas on the plateau and in the Luangwa Valley, preferring well-drained soils.

Uses: Firewood, charcoal, **timber** (construction, quality furniture), poles, medicine (bark, roots, flowers, sap, seeds), **soil improvement**, tannin (bark), dye (sap).

Description: A deciduous tree about 16 m, up to 28 m, with a straight bole and leafy but open crown. **BARK:** grey-black, becoming ridged with deep cracks making rectangular sections. The thick red sap dries in a red mass, hence the English names. **LEAVES:** the tree remains bare June–October. Leaves compound, 5–9 **pairs leaflets plus a central leaflet thin and oval to 7 cm**; shortly stalked. **FLOWERS:** appear before new leaves, August–October; orange-yellow sprays to 20 cm long. **FRUIT:** **unusual round pods with only one seed and a distinctive papery wing**, 3 cm across. The seed case is covered with stiff brown hairs, April–June.

Propagation: Seedlings, cuttings, truncheons.

Seed: No. of seeds per kg: 3,400–5,000. Germination is usually 30–70%.

treatment: Crack the hard pod after removing the irritating hairs by light burning or expose the pods to termites. Soak the seed in cold water for 24–48 hours before sowing.

storage: Seed can be stored.

Management: Pruning, coppicing.

Remarks: The tree is fire-resistant. The wood seasons well, without shrinkage, and is termite-resistant. It is one of the most sought-after trees for its attractive and durable timber. The heartwood can be used for boat building. Good specimens of this species are becoming increasingly scarce. The root is believed to cure malaria, blackwater fever and gonorrhoea. The bark is used to treat headaches, mouth sores and rashes.



Ricinodendron rautanenii (*Schinzlophyton rautanenii*)

Euphorbiaceae

Indigenous

Nyanja: Mkusu

Senga: Mkusu

Ecology: A large tree of central and southern Africa. Found in most parts of Zambia, sometimes in pure stands, also in valley soils such as in the Luangwa Valley, up to 1,200 m. Fruit are eaten by wild game, and elephants like the bark of this tree.

Uses: **Timber** (handicrafts, floats, packing cases), food (nut), **oil** (nut), medicine (roots, seed), fodder, string (bark), **live fence**.

Description: A deciduous tree, 15–20 m, the main trunk soon dividing into several thick branches, crown heavy and rounded. **BARK: smooth, grey-green, marked with horizontal scars, later** cracked and scaly, yellow-brown, when cut white latex exudes. Branchlets, buds, leafy stalks covered with **red-brown hairs**. **LEAVES:** compound, **5–7 leaflets**, each oval to 10 cm, dark green above, woolly grey hairs below, shortly stalked. Leaves turn yellow before leaf fall from March. Lasting 6–8 months. **FLOWERS:** male and female trees; small cream flowers in sprays to 12 cm, female shorter; September–December, often on the bare tree. **FRUIT: oval to round, about 3 cm**, hairy green-brown. An edible flowery pulp surrounds a very hard nut, edible seed kernel is set free.

Propagation: Seedlings, cuttings, truncheons.

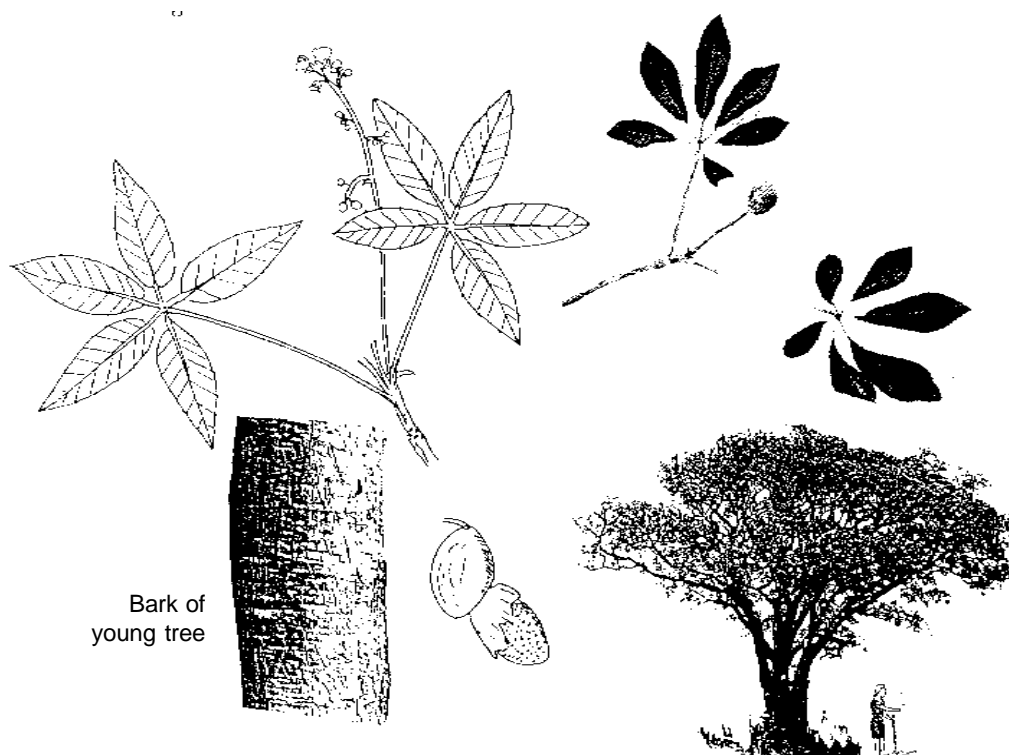
Seed: –

treatment: Crack the very hard nut, or soak in hot water and allow to cool for 48 hours.

storage: Can be stored.

Management: Coppicing, prune for a fence.

Remarks: The Lozi people of Western Province and the Senga of Chama in Eastern Province use both the flowery pulp and the yellow oil (extracted from seed) in their diet. The seed kernel contains 60% of an oil which is also suitable for paints or varnishes. The cake extract contains 50% protein, but if fed to cows colours the cream yellow. The soft light wood works easily but is not durable. The tree makes a quickly grown live fence.



Ricinus communis

Euphorbiaceae

Africa

English: Castor oil plant
Nyanja: Sasi, mono, tsatsi
Senga: Mono
Tumbuka: Mono

Ecology: First cultivated for its oil in ancient Egypt and now widely naturalized throughout the tropics. It is a weedy shrub or tree growing in dry country or on disturbed ground, 0–2,700 m. It can also be a commercial oil crop which is suited to all soils, even soil which may be seasonally waterlogged, including heavy clay. There are many forms and varieties, including attractive garden specimens, but only one species. In Katete District, it is commonly used for live fencing.

Uses: **Medicine** (seed oil), soil conservation, fertilizer (seed cake), **live fence**. The oil has many uses as a lubricant and in the chemical industry.

Description: An evergreen shrub or tree usually to 5 m. **LEAVES:** **compound palmate** to 50 cm across, on long stalks (5–11 lobes), the edge toothed, tips pointed. **FLOWERS:** crowded on an **upright spike** to 60 cm, male flowers with cream-yellow stamens at the base of the spike; female flowers with bright red stigmas, on the upper part of the spike. **FRUIT:** rounded to 2.5 cm across, covered with soft green spines; when mature, the **brown capsule** breaks into 3 sections to set free **3 large seeds**, coloured grey-purple-brown, spotted, depending on the variety.

Propagation: Seedlings, direct seeding, wildings, cuttings.

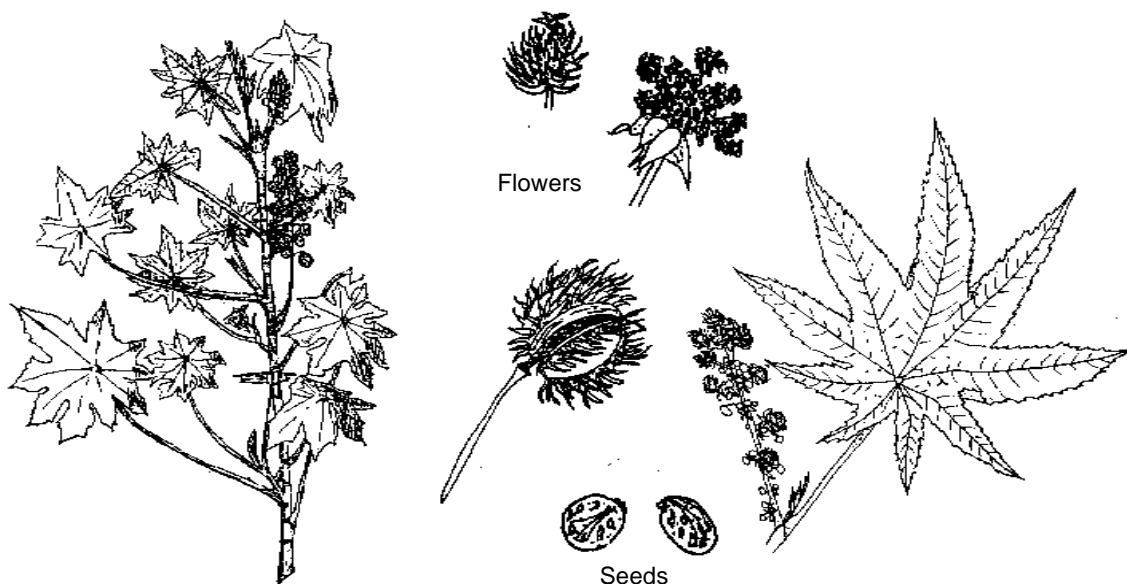
Seed: Susceptible to insect damage. No. of seeds per kg: 1,300. Germination is good; about 90% after 3 weeks.

treatment: Not necessary.

storage: Use fresh seeds. Can retain viability up to one year.

Management: Pruning.

Remarks: The plant is drought- and termite-resistant. The castor oil plant is promoted as a cash crop in Zambia. The oil is exported for use as a fine lubricant. The seed coat and leaves are poisonous to animals and poultry and even the oil residue can only be used as stock feed if specially treated. It can, however, be used as a fertilizer. The seeds yield up to 50% oil and this useful oil has even been used to lubricate aeroplanes. The oil extract is heated to neutralize the strong poison, ricin. Even a few seeds can kill if they are chewed—so take care with children. The oil is locally used as a body lotion.



Sclerocarya caffra (*S. birrea*)

Anacardiaceae

Indigenous

English: Marula
Kunda: Msewe
Nyanja: Mgamu, msewe
Senga: Msebe
Tumbuka: Msebe

Ecology: A fruit tree occurring from Ethiopia southwards to northern South Africa. Widespread at medium to low altitudes; scattered in most types of woodland. Although absent from parts of northern Zambia, it is found elsewhere, most frequent in munga woodland and chipya, on poor soils. In Eastern Province it is common in the Luangwa Valley.

Uses: Timber (general purpose), **food** (fruit, drink, jam), **medicine** (bark, roots, leaves), oil (seeds), fodder (leaves, fruit), bee forage.

Description: A deciduous tree about 10 m with a thick bole and wide branches forming a light rounded crown. **BARK:** grey becoming black, with irregular cracks and raised scales. Inner bark pink-red. **LEAVES:** **compound, crowded at branch tips**, shed April–May; new leaf growth October–December. **Leaflets in 7–13 pairs plus a central leaflet, each stalked**, oval to 10 cm long, tip pointed, darker above. **FLOWERS:** male and female flowers on the same tree or different trees. The flower spikes hang down and attract insects. **Female flowers are small, green-pink.** September–November. **FRUIT:** mature March–June; rounded and fleshy, skin cream but spotted, to 3.5 cm across; the skin peels away from the thin sweet flesh surrounding a large stone, tasting a bit like mango; 2–3 seeds inside the stone are oily and edible.

Propagation: Cuttings, seedlings.

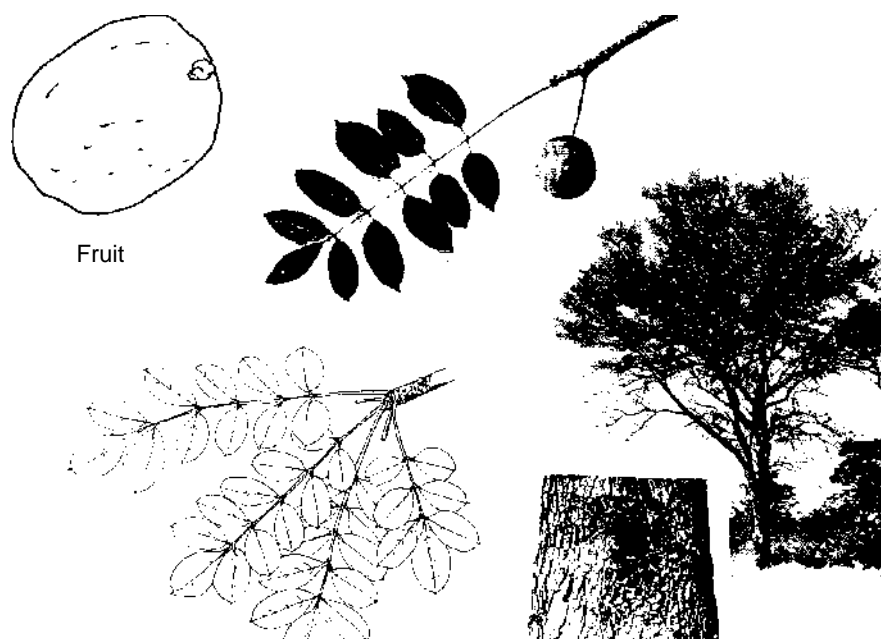
Seed: No. of seeds per kg: 400–450. Germination rate 40% after 6 weeks.

treatment: Soak in cold water for 24 hours.

storage: Use fresh seed.

Management: Coppicing, pruning.

Remarks: The fruits are well liked by children and rich in vitamin C. ICRAF, in collaboration with national researchers is looking into possibilities for domestication. The fruits are eaten by a wide variety of game including elephants.



Senna siamea (*Cassia siamea*)

Caesalpinioideae

South-East Asia

English: Yellow cassia

Kunda: Makeche

Nyanja: Makeche

Senga: Makeche

Ecology: A medium to large tree cultivated all over the tropics from sub-humid to semi-arid and even arid zones. Tolerates a variety of soils. In Zambia widely planted as an avenue and ornamental tree and for windbreaks. Common in Eastern Province.

Uses: Firewood, charcoal, timber (furniture), **poles**, medicine (bark), **shade, ornamental**, mulch, soil conservation, **windbreak**.

Description: An evergreen tree occasionally up to 30 m high, often smaller or shrub-like. **BARK:** smooth, pale grey-brown. **LEAVES:** compound, grooved, **leaflets oblong, round at base and tip, which may be notched**, dark, shiny green above. **FLOWERS:** **pale yellow** in dense heads. **FRUIT:** pods, in dense **clusters**, **flat, yellow-brown** and smooth, slightly curved.

Propagation: Seedlings, wildings, direct seeding.

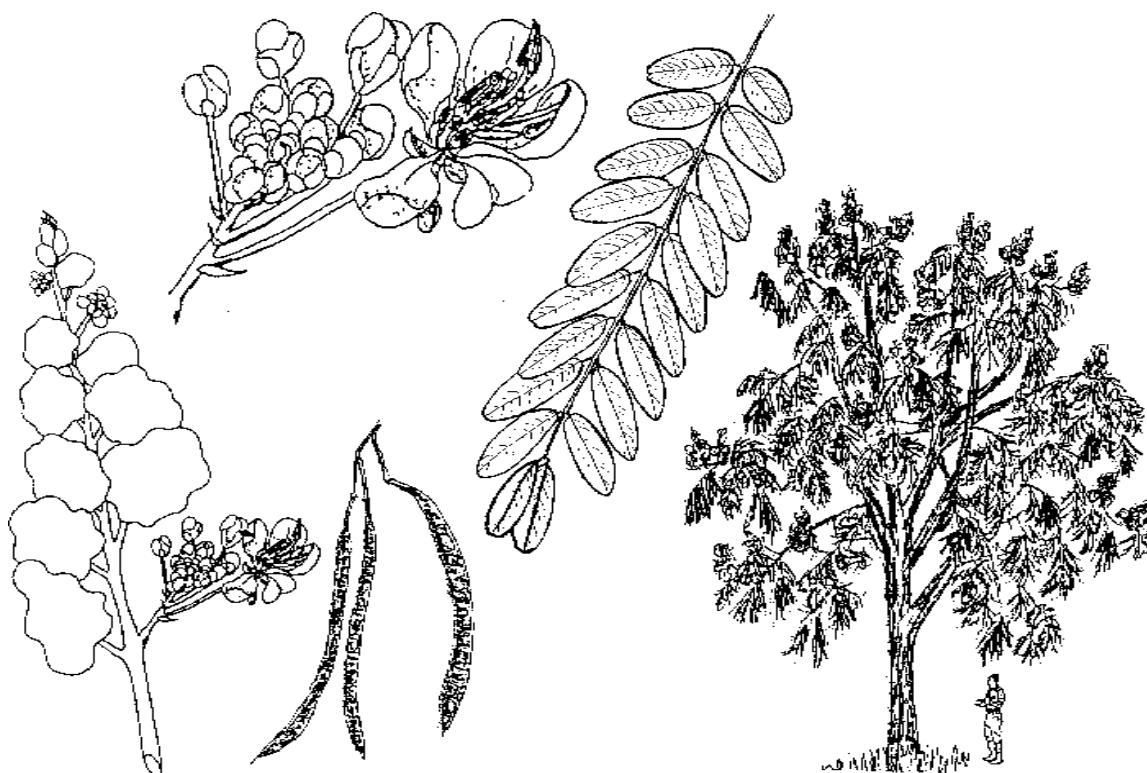
Seed: This tree is a prolific seeder. No. of seeds per kg: 30,000–45,000.

treatment: Fresh seed requires no pre-treatment. Soak old seed in cold water for 24 hours.

storage: Seed can be stored for up to one year but germination rate drops with time.

Management: Lopping, coppicing.

Remarks: Fast growing. This species is not browsed and so is easy to establish. Foliage is poisonous to pigs but not to cattle or sheep. Resistant to termites; ideal for school compounds, for example. In Eastern Province extension efforts are being made to promote *S. siamea* to replace some eucalyptus which are not growing well because of a lack of inputs. *S. siamea* is a low-input tree crop. The bark is used to treat sexually transmitted diseases and diarrhoea.



Senna spectabilis (*Cassia spectabilis*)

Caesalpinioideae

Tropical America

English: Golden cassia.**Ecology:** One of the exotic *Senna* species introduced into Zambia. This attractive tree needs a good rainfall and does best in moist sandy loam, 0–2,000 m. It also grows in the heavy clay soils around Mambwe boma.**Uses:** Firewood, charcoal, timber (tool handles), poles, bee forage, **shade, ornamental**, windbreak.**Description:** A semi-deciduous tree to 10 m with showy flowers. The bole is short, branching to give a rounded or flat crown. BARK: smooth grey, later rough. LEAVES: compound on a stalk to 40 cm, up to 15 **pairs leaflets**, each narrow with a **long pointed tip**. The stalks feel **softly hairy** as well as the underside of leaflets. FLOWERS: bright yellow heads which stand up cover the tree like golden “candles”, 30 cm or more high. FRUIT: pods, **almost cylindrical**, to 30 cm, turning from green to black. They open slowly to set free many seeds from individual sections, September–October.**Propagation:** Seedlings, direct seeding.**Seed:** Seeds profusely. No. of seeds per kg: 31,000–45,000.**treatment:** Immerse in hot water and allow to cool for 24 hours.**storage:** Seed can be stored for up to 2 years under cool, dry conditions.**Management:** Coppicing.**Remarks:** It is very common in Zambia; excellent shade when in leaf, so a popular avenue tree. Wood is termite-resistant. Easy to raise. Fast growing on good sites, slow on drier sites.

Sesbania macrantha

Papilionoideae

Indigenous

Senga: Chizonga

Ecology: The genus *Sesbania* contains some 50 species which continue to fix nitrogen in quite difficult sites. Several are indigenous to Africa and this species extends from east to southern Africa. In Zambia it grows in riverine areas beside lakes Bangweulu, Mwense and Tanganyika and rivers Shambeshi and Luapula and along dambo margins. In Eastern Province it grows around dams and dambos. Very common in Luangwa Valley. It is found in acid and saline soils and tolerates both seasonal and permanent waterlogging.

Uses: Medicine, fodder (leaves), mulch, **nitrogen fixation, soil improvement.**

Description: A soft-wooded shrub, tall and straight, often unbranched in crowded stands to 6 m, otherwise low and spreading, multistemmed but stems hollow. Stems, leaf and flower stalks prickly. **LEAVES:** compound, **usually about 30 pairs leaflets** along the stalk, each one about 1–2 cm long. Leafy stipules at the base, about 1 cm. **FLOWERS:** **yellow**, 9–12 flowers on a short stalk, the **largest petal about 2 cm, spotted green outside, marked violet inside**, wide wing petals. **FRUIT:** a very **narrow curved pod 20–30 cm, only 5 mm across**, beaked, with 35–40 brown seeds in **1–cm sections**.

Propagation: Direct sowing on site.

Seed: No. of seed per kg: 85,000–130,000.

treatment: Soak seed in cold water.

storage: Seeds can be stored.

Management: Very fast growing but short lived; lopping, pruning, short rotations.

Remarks: The stem yields a strong fibre which is especially durable in water



Sesbania sesban (*S. aculeata*)

Papilionoideae

Indigenous

English: River bean**Kunda:** Jelejele, soyo**Nyanja:** Jelejele, msalasese, chigoma, soyo

Ecology: One of the many African *Sesbania* spp. which can grow in shallow water and also fix nitrogen, 100–2,000 m. It is widely distributed in Zambia, conspicuous on the flood plains of the Kafue flats, Bangweulu and Chambeshi swamps and in most river valleys. In Eastern Province, it grows around dams and dambos; very common in Luangwa Valley together with *S. macrantha*. Found in acid and saline soils, it tolerates both seasonal and permanent waterlogging.

Uses: Firewood, fodder (leaves, pods), **nitrogen fixation, soil improvement** (fallows).

Description: A semi-deciduous shrub or small tree to 8 m, branching and giving light shade. BARK: red-brown; young shoots and leaf stalks white hairy. LEAVES: **compound**, stalk narrow, blue-green, about 2 cm, **tip rounded or notched**. FLOWERS: in **few-flowered sprays**, to 15 cm, each flower **pale yellow, the largest petal spotted with purple**. FRUIT: **thin pods hang in clusters**, each pod to 30 cm, twisting open to set free many dark brown seeds which lie in sections.

Propagation: Direct seeding, seedlings.

Seed: The species is a prolific seeder with a high germination rate. No. of seeds per kg: ± 80 –110,000.

treatment: Not necessary, but hot-water treatment may hasten germination..

storage: Seed can be stored for long periods.

Management: Coppices well only when young. *Sesbania sesban* has been extensively tested by researchers for use in improved fallows and farmers in Eastern Province have started to adopt the technology.

Remarks: Very fast growing. Shoots are, however, often attacked by beetles (*Mesoplatys ochroptera* and *Ootheca* spp.) and the roots by nematodes. The nematode population may increase with *Sesbania* (especially in sandy soils). This tree has a short life span, often only a few years.



Spathodea campanulata (*S. nilotica*)

Bignoniaceae

East, Central and West Africa

English: Flame of the forest, Nandi flame, African tulip tree

Ecology: An attractive flowering tree now widely planted in the tropical belt as an ornamental although it may be bare for many months, 0–2,000 m. It grows best in forest soil with good rainfall but is drought-resistant once established. In Zambia, it is a common tree of parks and gardens and along streets.

Uses: Firewood, charcoal, shade, **ornamental**.

Description: A handsome deciduous tree usually to 10 m; branching, the crown dense and shady. **BARK:** smooth, pale grey-brown with buttresses at the base. **LEAVES:** compound, to 40 cm long, 3–6 pairs leaflets and a central leaflet, each one oval and pointed to 12 cm, yellow-green, yellow-hairy below. Young shoots, buds and branchlets have yellow-brown hairs. **FLOWERS:** fiery orange-red, clusters stand out all over the tree, a yellow edge on the red petals. Hairy buds contain watery liquid. **FRUIT:** brown woody capsules to 25 cm, split on the ground setting free many small winged seeds.

Propagation: Seedlings.

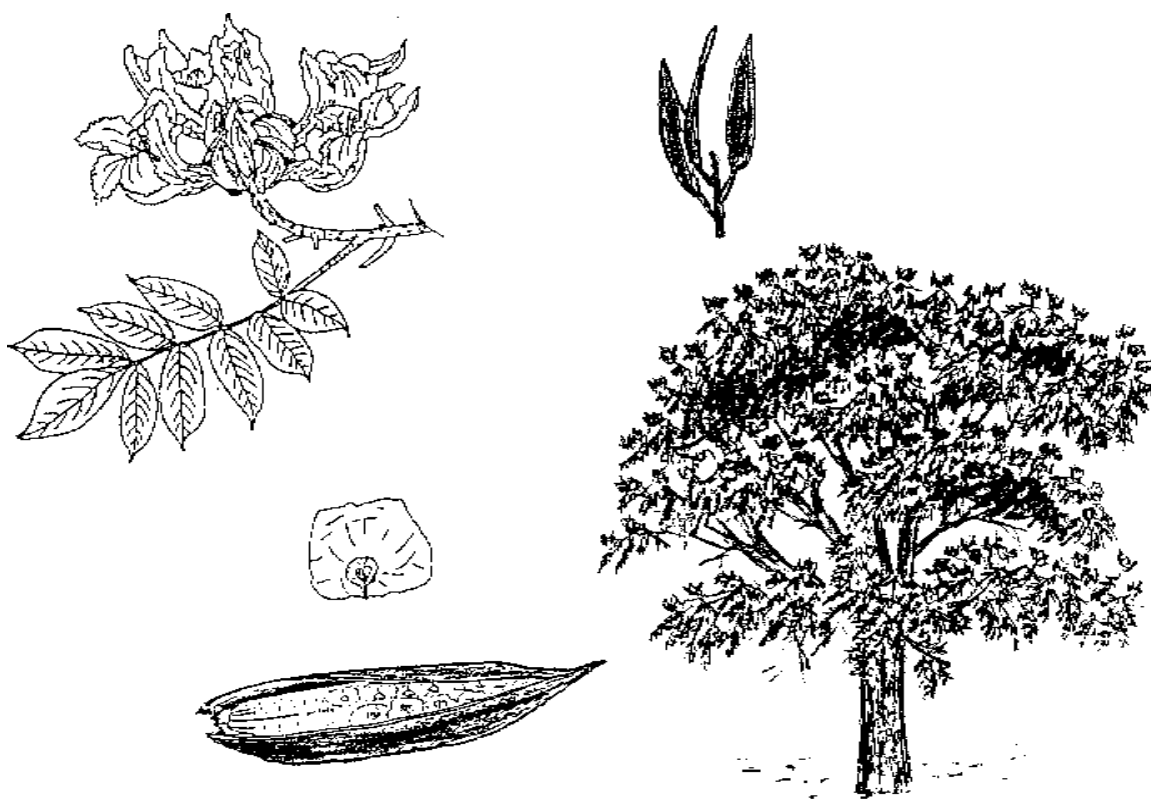
Seed: Good seed germination rate. No. of seeds per kg: $\pm 150,000$.

treatment: Not necessary.

storage: Seed does not store well; it should be sown fresh.

Management: Coppicing.

Remarks: Not browsed by domestic animals.



Sterculia africana

Sterculiaceae

Indigenous

English: Tick tree, African star-chestnut**Kunda:** Mulele**Nyanja:** Mgoza, Mlele**Senga:** Mgozga**Tumbuka:** Mgozga

Ecology: A tree of lower altitudes, north to Kenya and south to South Africa. It occurs in the southern half of Zambia from Sesheke to Lundazi. In Eastern Province, it is scattered in valleys and on rocky hillsides, often on the fringes of mopane woodland. The bare-branched tree with pale bark stands out; often found in hot dry areas—common below 600 m.

Uses: Timber (furniture), bee forage, **rope** (bark).

Description: A deciduous tree, 10–15 m tall, with thick, fluted trunk, the erect branches spreading to a rounded crown. **BARK:** smooth, often shiny white, later flaking irregularly into patches to reveal purple-green-white-brown underbark. **LEAVES:** crowded at ends of branches, deeply **divided, 3–5 lobes**, over 10 cm across, on **stalk to 10 cm**, the lobes pointed. **FLOWERS:** appear on the bare tree, in branched heads to 9 cm, male and female flowers separate; green-yellow sepals (no petals) to 2.5 cm across with red honey-guide lines within; September–November. **FRUIT:** **1–5 woody beaked sections**, “boat-shaped”, with short yellow hairs. One side only breaks open to free 3–10 fat, **blue-grey seeds which hang looking like ticks around the open edge**; April–July. In between the seeds are irritating hairs.

Propagation: Seedlings, cuttings.

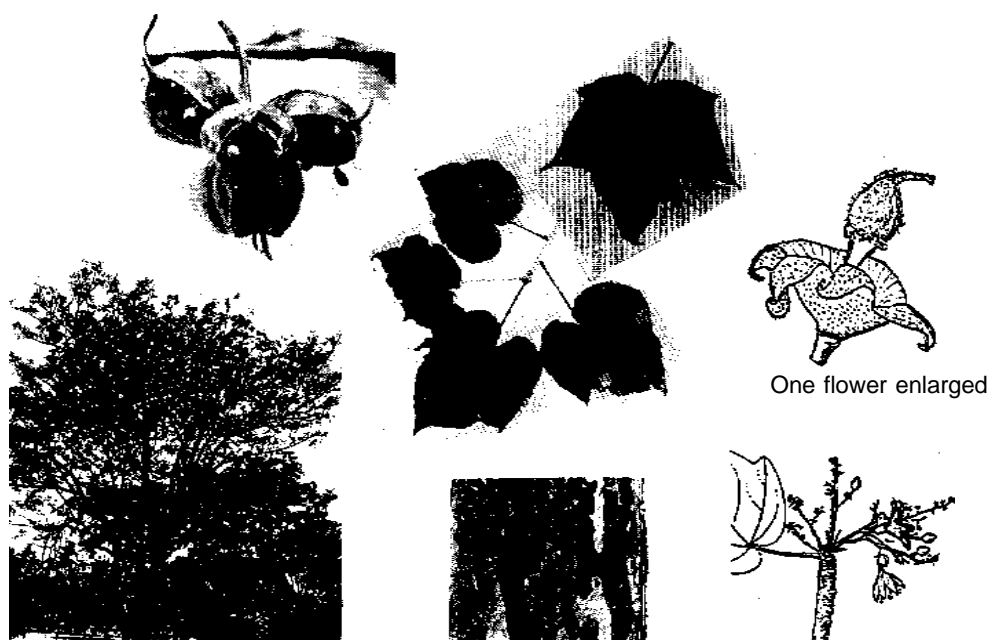
Seed: No. of seeds per kg: 15,000–17,000. Germination good and fast. Complete germination after 20 days.

treatment: Not necessary.

storage: Can retain viability for about 2 months.

Management: Coppicing, pruning.

Remarks: The light wood is soft and can only be used for cheap furniture. The bark rope is used to tie thatch grass and poles in house construction. It is also used to make mats.



One flower enlarged

Sterculia quinqueloba

Sterculiaceae

Indigenous

English: Large-leaved star chestnut
Kunda: Mulele
Nyanja: Mgoza, mlelezombo, msambamfumu
Senga: Kaiwami
Tumbuka: Kaiwami

Ecology: A conspicuous, deciduous tree of central and southern Africa and north to Tanzania. It grows at medium to low altitudes in most types of woodland, occasionally on termite mounds and on rocky hillsides in most parts of Zambia excluding Western Province.

Uses: **Timber** (heavy construction, furniture), medicine (barks, leaves), **ornamental**, gum, **rope** (bark), mats (bark).

Description: A small-to-medium sized deciduous tree, usually 5–12 m, occasionally to 18 m, with thick trunk and branches. **BARK:** very distinctive, **smooth pale and shiny, yellow-cream-pink-brown with some flaking; when cut a pale brown gum exudes.** **LEAVES:** **very large, to 40 cm across, with 3–5 lobes, stalks over 20 cm**, crowded at ends of branches, yellow-green, woolly hairs below; showy yellow-orange before they fall in May–July. **FLOWERS:** very small, yellow, in big heads to 30 cm appear with the leaves in February–June or occasionally in September. **FRUIT:** in **5 sections, each section to 6 cm, with golden hairs** and pointed, breaking open like a star; **2–3 grey-black seeds seen around the rim**, with irritating hairs between, June–October.

Propagation: Seedlings, cuttings, truncheons.

Seed: No. of seeds per kg: 24,000–28,000. Germination up to 65% after 20 days.

treatment: Not necessary.

storage: Remain viable for 2 months at room temperature.

Management: Pruning, coppicing.

Remarks: The timber makes fine furniture. The wood has also been used in the mines. Although the gum is good quality, its flow is seasonal. The tree has been planted in parks and along avenues.



Strychnos cocculoides

Loganiaceae

Indigenous

English: Corky-bark monkey orange**Nyanja:** Mzai, mzimbili, temya**Senga:** Kabeza

Ecology: A spiny shrub found throughout the drier parts of tropical Africa north to Tanzania. It is a popular fruit tree distinguished by its corky bark, 0–2,000 m. Occurring throughout Zambia; it is found in moist woodland types scattered in sandy soils on rocky slopes.

Uses: **Timber** (utensils, tool handles), **food** (fruit), medicine (fruit, bark, leaves, roots).

Description: An evergreen shrub or tree 2–8 m, the branches spreading to a rounded crown. **BARK:** cream-brown, thick, corky, **deeply cracked in ridges**. Branchlets thick, purple and hairy, the **strong paired spines, curved, 1 cm or more**. **LEAVES:** oval to circular, up to 5 cm long, somewhat rounded at the base, dull below, 5 veins from the base. **FLOWERS:** white-cream-green in dense heads about 3 cm across, September–November. **FRUIT:** **woody balls about 7 cm across**, spotted green and yellow, **darker yellow when mature**, many seeds within. The fruit takes up to a year to ripen.

Propagation: Seedlings, rootsuckers.

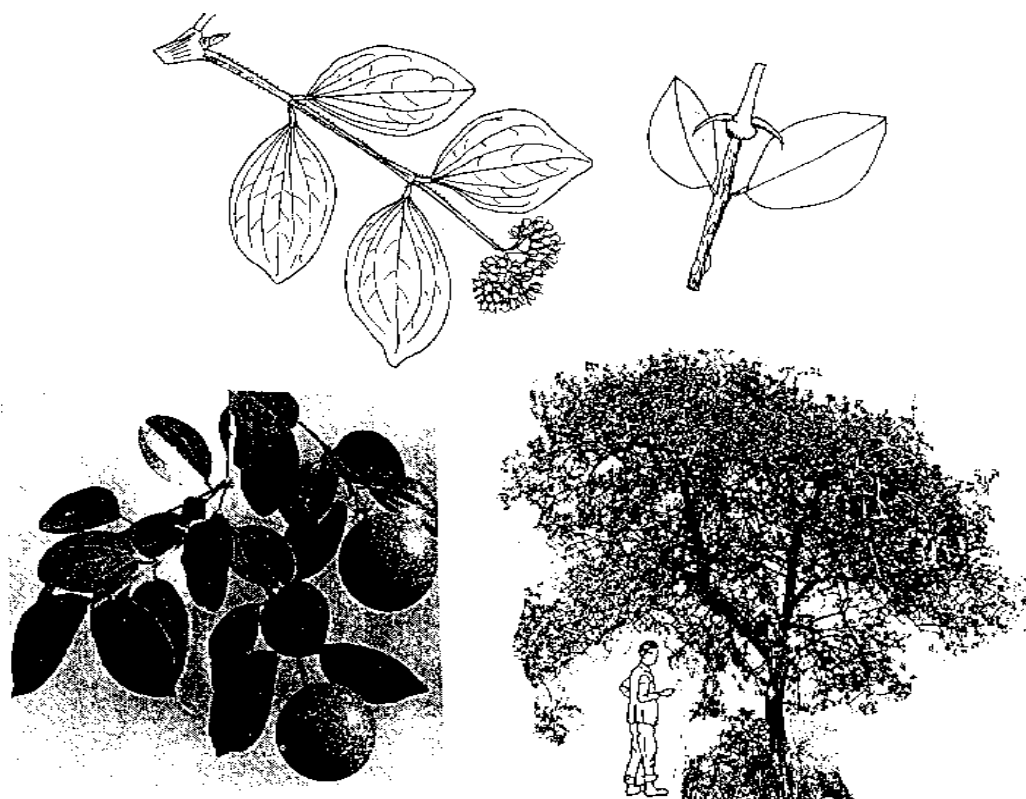
Seed: Seed have a hard coat. No. of seeds per kg: $\pm 1,800$. Poor germination.

treatment: Soak in cold water.

storage: Can be stored for about 2 months at room temperature.

Management: Coppicing. Protect saplings from fire.

Remarks: This tree is valued for its fruit and is usually left when fields are cleared. Fruits are eaten by both children and adults and many prefer them to those of *Strychnos spinosa*. The wood is white and tough, rather soft and pliable. The fruit mixed with honey is used to treat cough. The root cures gonorrhoea and when chewed alleviates eczema.



Strychnos innocua

Loganiaceae

Indigenous

Nyanja: Mteme, mtulutulu, kamwelalumba, kabulukulu, kambeli

Ecology: A tree growing in lowlands from Kenya to Malawi and South Africa. In the northern region of Zambia it is found in plateau areas and on rocky slopes, e.g. on the Muchinga escarpment.

Uses: **Firewood**, timber (utensils), poles, **food** (fruit).

Description: A shrub or small tree, usually 3–6 m, **without spines**, branches often twisted, branchlets hanging down. **BARK:** pale grey, smooth, branchlets powdery grey-green to yellow-brown. **LEAVES:** in opposite pairs, widely spaced, tough, **dull blue-green** with 3–5 main veins and clear net veining, **both sides similar**, wider at rounded tip, 4–10 cm. **FLOWERS:** small, green-cream, 2–4 in stalked clusters beside leaves, calyx shorter than petals. **FRUIT:** **round with a thick woody shell**, 5–7 cm across, blue-green, turning **yellow-orange**, containing many seeds in pulp.

Propagation: Seedlings, rootsuckers.

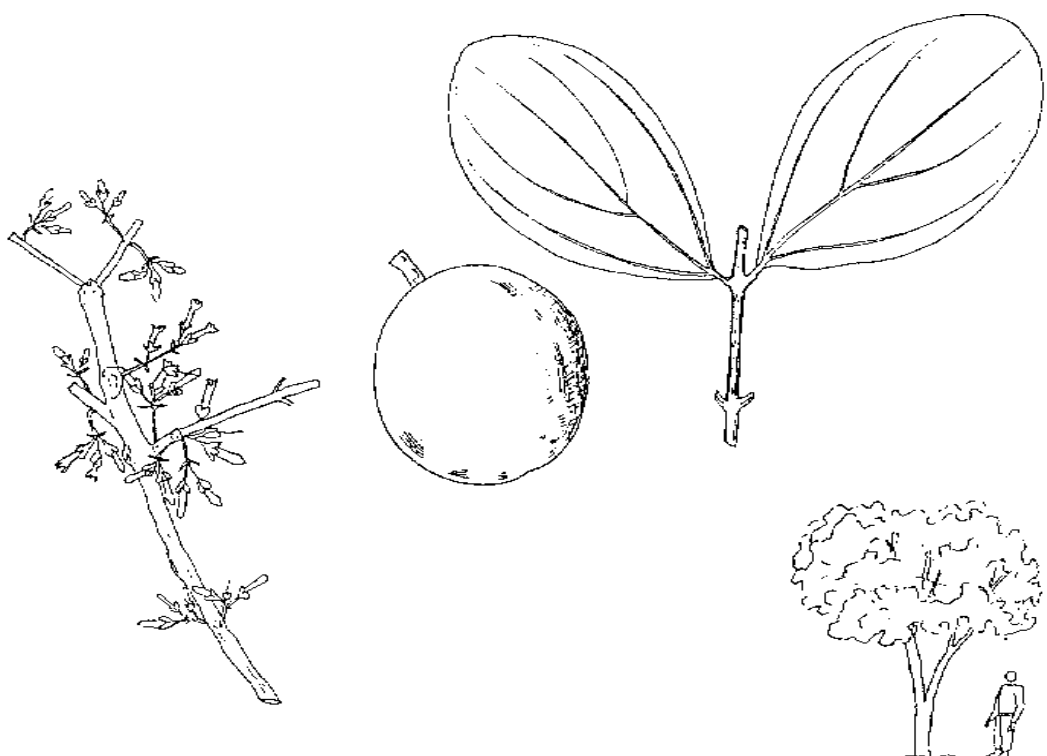
Seed: No. of seeds per kg: $\pm 1,800$. Germination is poor.

treatment: Soaking in cold water for 12 hours may improve germination.

storage: Can retain viability for only a short period (2 months).

Management: Pruning, coppicing.

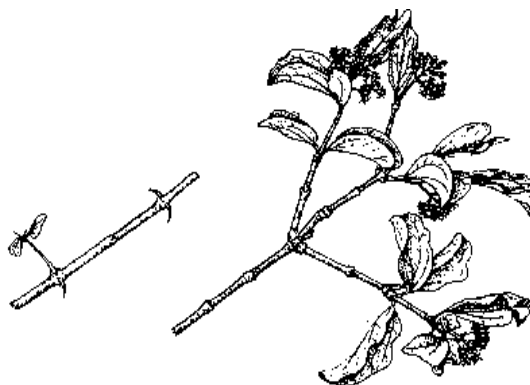
Remarks: The tree is often left in farmland because of its edible fruit. Even the fresh wood burns, so it is useful as firewood. A useful homestead tree for fruits and firewood.



Strychnos spinosa

Loganiaceae

Indigenous

English: Elephant orange, spiny monkey orange**Kunda:** Mzimbili**Nyanja:** Temya, mzai, mzimbili**Senga:** Msongolo, masongolo**Ecology:** A spiny shrub or tree found all over tropical Africa in a wide variety of dry open woodlands, 0–1,500 m; frequent on sandy soils of river banks. It grows throughout Zambia and is normally left in gardens for the fruit.**Uses:** Firewood, charcoal, timber (boxes), **food** (fruit), **medicine** (fruits, leaves, bark, roots), fodder (leaves), musical instruments (dry fruit shell).**Description:** A semi-evergreen thorny tree often multistemmed, usually 2–5 m, up to 9 m, the crown rounded. **BARK:** grey-brown, rough with **short black-tipped hooked thorns, in pairs** along the branches. **LEAVES:** **opposite, oval to round, to 10 cm**, shiny green and leathery, edge wavy, 3–5 veins from the base. **FLOWERS:** Small cream-green-white, in bunches at branch ends, September–November. **FRUIT:** **rounded and woody**, yellow-brown when ripe, to 12 cm across; conspicuous and hang many months on the tree; 10–100 pale seeds are surrounded by **juicy, rather acid flesh**.**Propagation:** Seedlings, rootsuckers.**Seed:** Seed has a hard coat. No. of seeds per kg: $\pm 1,800$.**treatment:** Soak seed in cold water.**storage:** Can be stored.**Management:** Root suckers can be encouraged by exposing roots. Coppicing.**Remarks:** Although the fruit is edible, seeds are toxic. Wood is pale, straight-grained and planes well. Like most *Strychnos*, it is not easy to cultivate. The hard fruit can be cracked open by throwing it on the ground. Unripe fruit may be poisonous.

Swartzia madagascariensis

Papilionoideae

Indigenous

English: Snake-bean tree

Nyanja: Mchelekete

Tumbuka: Mulundu

Ecology: A small tree distributed from West Africa to Tanzania and South Africa at medium to low altitudes. It is an occasional tree of deciduous woodland throughout Zambia, either in sandy soils or the clay-loams of valleys.

Uses: **Timber** (carving), **medicine** (pods, bark, leaves), bee forage, fish poison (pods), **insecticide** (crushed pods, bark, roots).

Description: A small deciduous tree, usually 3–4 m but up to 15 m; the **trunk and branches** often twisted; the **crown dense and rounded when in leaf**. **BARK:** very rough and thick, with long lines of cracks. **LEAVES:** compound, grey-black, **7–11 leaflets alternate along the stalk**, plus one leaflet at the tip; each one leathery, tip rounded or notched to 7 cm, yellow hairy below. **FLOWERS:** in sprays of 2–10, sweet-smelling, each flower with **one large erect petal**, September–November, and casual flowering March–May. **FRUIT:** the long heavy fruit hang on the bare tree, **cylindrical dark brown to 30 cm**, the “snake-bean”, straight or curved. The pods eventually fall and 10–15 seeds are set free from the gummy yellow tissue when the pods rot, May–September.

Propagation: Seedlings.

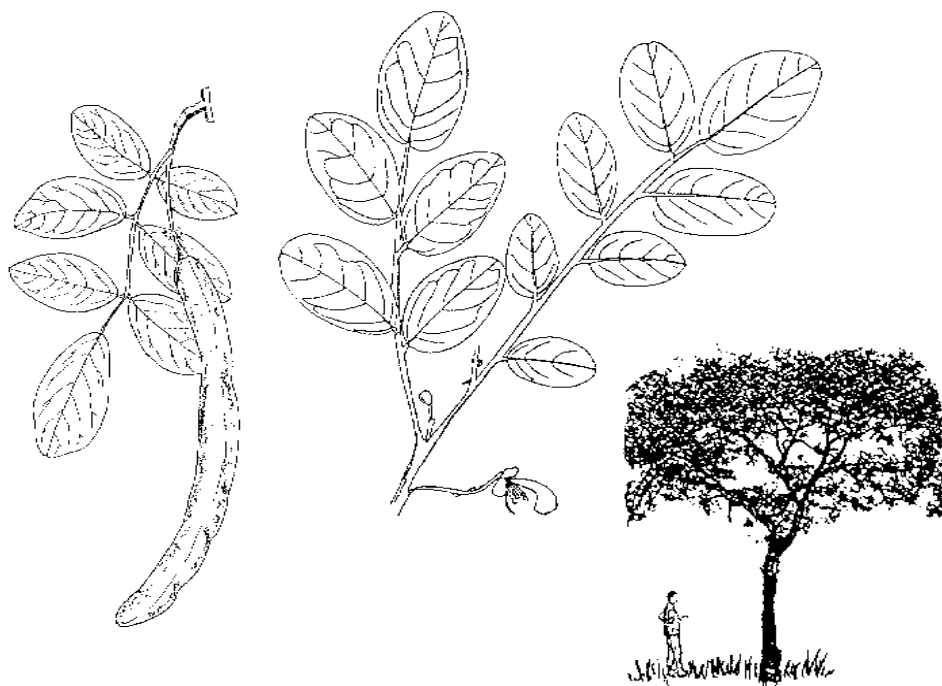
Seed: No. of seeds per kg: 2,500. Germination is good, up to 70% after 20 days.

treatment: Soak in hot water and allow to cool for 24 hours.

storage: Can be stored.

Management: Pruning, coppicing.

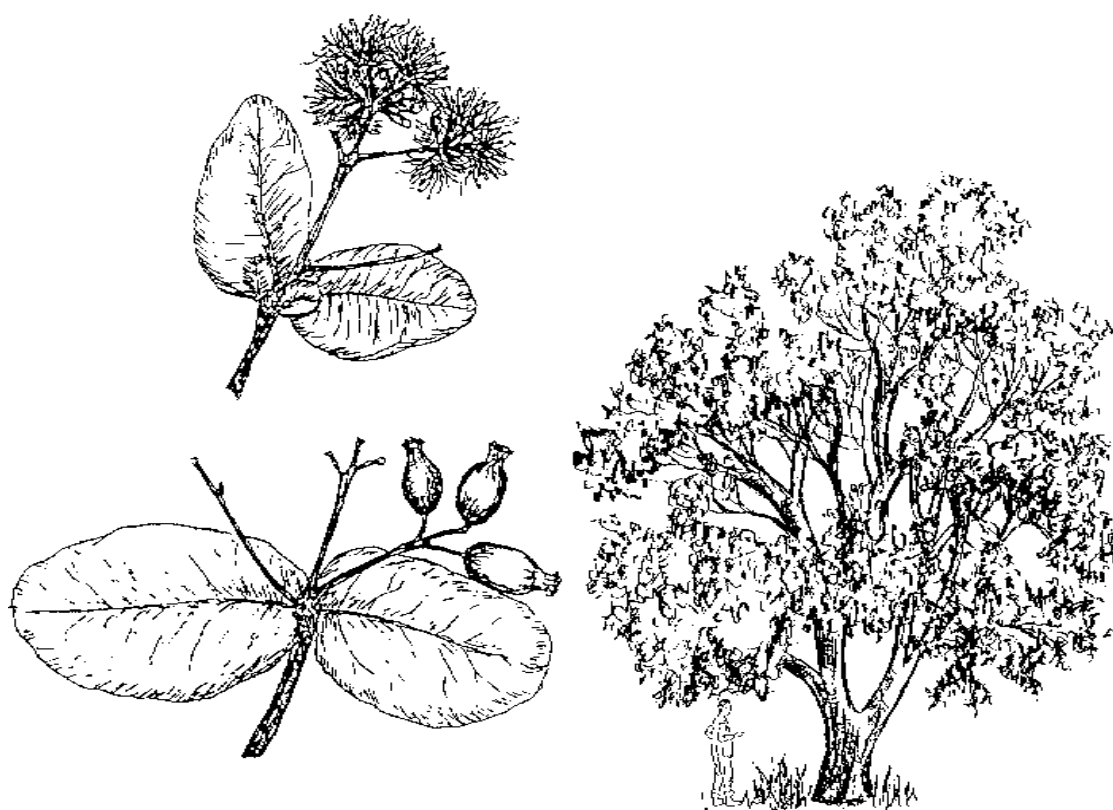
Remarks: This tree has many uses and should be cultivated by farmers. Termite-resistant. The wood is even and close-grained. The red-brown heartwood, which is favoured by wood carvers, may become purple-black. Pods contain saponin and if fed to cows may taint their milk. Crushed pods have been used in storage bins to protect grain from weevils. Powder from pods mixed with bark and roots may be added to hot water and the cooled liquid sprayed around the seedlings to protect against termites.



Syzygium cordatum

Myrtaceae

Indigenous

English: Waterberry tree**Nyanja:** Msinyika, mchisu**Ecology:** A waterside tree found in East and Central Africa, south to Natal. The tree is found all over Zambia; locally frequent around wet dambos and on anthills. Usually seen along river banks in Eastern Province.**Uses:** **Timber** (construction, furniture), **food** (fruit), medicine (leaves, bark, roots), **bee forage**, dye (bark).**Description:** A medium-sized evergreen tree, usually 8–15 m. The trunk short and thick, occasionally buttressed, branching to a heavy rounded crown. **BARK:** grey to dark brown, deeply cracked, often breaking into small squares. **Branchlets** square in section, **edges winged**. **LEAVES:** very many, near ends of branches, **clasp the stem** in opposite pairs, the **next leaf pair at right angles**, leathery, blue-green, **oblong to circular**, to 8 cm long, **leaf base heart-shaped** (cordatum). **FLOWERS:** dense, branched clusters to 10 cm across, sweet-scented with much nectar, white-pink, July–November. **FRUIT:** abundant, deep purple when ripe, oval, to 1.5 cm, edible but acid with 1 seed, November–March.**Propagation:** Seedlings, direct seeding.**Seed:** Germination is good but takes up to 25 days. No. of seeds per kg: 400–450.**treatment:** Not necessary.**storage:** Avoid storage.**Management:** Coppicing, pollarding.**Remarks:** The pink-brown timber is hard and strong, saws and works easily, and is moderately borer-proof. The pleasant aromatic smoke from the burning wood is used to season milk gourds. An infusion of the leaves has a purgative action.

Syzygium guineense

Myrtaceae

Indigenous

English: Woodland waterberry

Nyanja: Katope

Senga: Katope

Tumbuka: Katope

Ecology: A common tree of river banks; but will also grow in open woodlands, all over Africa north to Ethiopia and south to South Africa, 0–1,800 m. In Zambia, there are 4 subspecies, but in Eastern Province *ssp. guineense* and *huillense* are the most common. The latter is small and bushy; found mostly in dambo margins and wet grasslands. As the trees hybridize easily, detailed characteristics vary considerably.

Uses: Firewood, charcoal, **timber** (furniture, general construction, tool handles, carving), **poles**, **food** (fruit), medicine (bark, roots, leaves), fodder (fruit), **bee forage**, dyes, tannin (bark).

Description: A leafy evergreen tree, usually 10–15 m, but may reach 25 m in the most favourable conditions. The trunk sometimes buttressed, crown irregular to rounded, branchlets drooping. **BARK:** smooth, grey-brown, black and rough with age, exudes a watery red sap if cut. **LEAVES:** opposite, to 12 cm, shiny dark green but young leaves purple-red, oval, and **narrowing to the base, stalked**. The leaf edge may be rolled under. **FLOWERS:** in branched heads 10 cm across, white and fragrant, the **stalks somewhat square**, August–October. **FRUIT:** oblong to 3 cm, shiny **purple-black, in big bunches of 20–30**, one stony seed; very attractive to birds, October–January.

Propagation: Seedlings, wildings, direct seeding.

Seed: No. of seeds per kg: 400–500. Good germination, 85%.

treatment: Not necessary.

storage: Avoid storage.

Management: Pollarding, coppicing.

Remarks: The wood is brown, hard and strong. It is easily worked but liable to split. The fruit is liked by children. It is also used to treat dysentery. The bark is used to treat diarrhoea.



Tamarindus indica

Caesalpinioideae

Indigenous

English: Tamarind
Kunda: Mwembe
Nyanja: Mwemba
Senga: Wembembe

Ecology: A well-known African tree from West to East Africa and south to South Africa. It is a very adaptable species but prefers semi-arid areas, 0–1500 m. It has been planted in gardens and at roadsides in many tropical countries and is drought-resistant once the deep roots are established. In Zambia, it is very common in the Zambezi and Luangwa Valleys on river banks and on anthills. Elsewhere, it is only found around lakes Tanganyika and Mweru.

Uses: Firewood, **charcoal**, **timber** (furniture, boats, general purposes), poles, **food** (fruit, pulp for drink, spice), medicine (bark, leaves, roots, fruit), fodder (leaves, fruit), bee forage, **shade**, ornamental, windbreak, tannin (bark).

Description: A large semi-evergreen tree to 30 m with a **heavy, dense crown**, a short trunk and drooping branches. **BARK:** pale grey-brown, flaking into rounded scales. **LEAVES:** compound, on a stalk to 15 cm, **10–18 pairs dull green** leaflets each one **oblong, rounded to 3 cm**. **FLOWERS:** small, yellow with red veins in small groups, October–February. **FRUIT:** pale brown, **sausage-like, hairy pods to 18 cm**, when dry they crack open showing sticky brown pulp around **brown-black, angular seeds**. July–November.

Propagation: Seedlings, wildings, direct seeding.

Seed: No. of seeds per kg: 1,400–2,600.

treatment: Germination rate about 90%. Soak seed in hot water and allow to cool for 24–48 hours.

storage: Seed can be stored for more than 2 years.

Management: Pollarding, coppicing.

Remarks: The dark brown heartwood is tough and well grained. It can make very good charcoal. The fruit pulp is used to make a refreshing drink and the pulp is also mixed with porridge. This fruit pulp is very rich in vitamin C. It has potential in drier areas although it is slow growing.



Tephrosia vogelii

Papilionoideae

Indigenous

English: Fish bean
Kunda: Buba
Nyanja: Mtetezya, wombo
Senga: Wombo
Tumbuka: Wombo

Ecology: The origin of this species is unknown but it now grows from West to East Africa, from Ethiopia through to Zambia. A shrub which is widely cultivated as a hedge in Northern Province of Zambia. Grows well on sandy-loam soils but can grow on a wide range of soils. Found largely in grasslands or at forest edges, 0–2,100 m; it is also seen on waste land and old cultivation sites, growing best in high-rainfall belts. Grows in the valley and plateau of Eastern Province.

Uses: **Soil improvement, nitrogen fixing, insecticide** (leaves and bark).

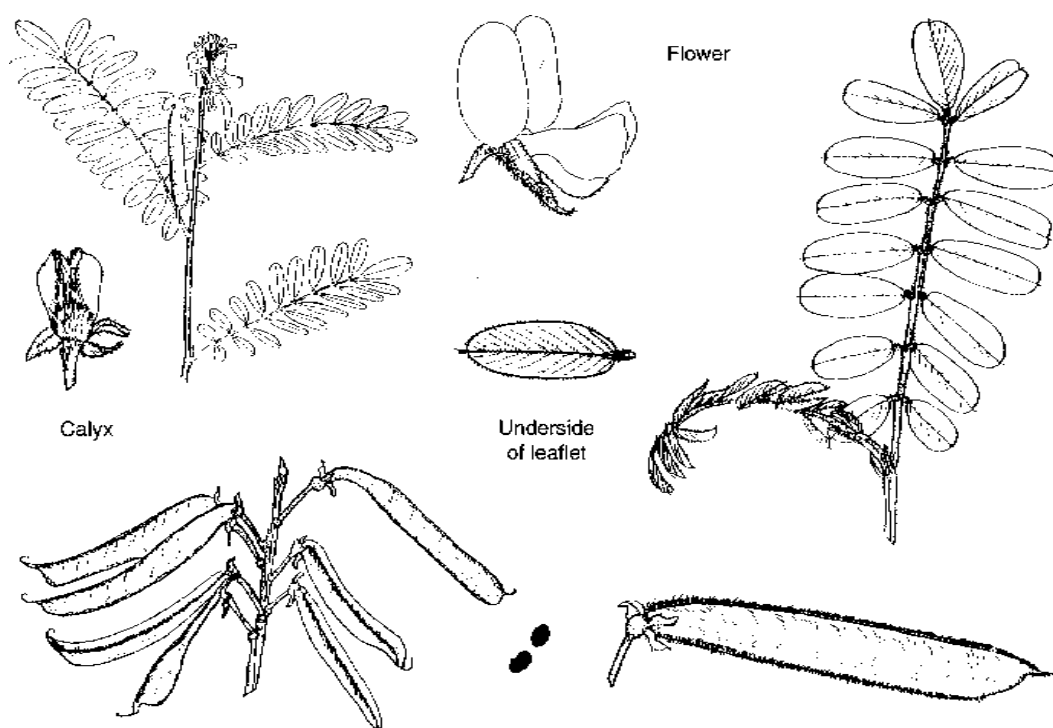
Description: An erect shrub to 4 m high and 8 cm diameter with spreading branches. **BARK:** brownish to grey, branchlets with **dense grey velvety to silky hairs**. **LEAVES:** alternate, compound with 6–12 pairs. Opposite leaflets, upper surface without hairs, lower surface with hairs. **FLOWERS:** large **white**, red or violet-purple. **FRUITS:** flat-oblong black pod 1 cm or more wide and up to 15 cm long, usually straight with **furry yellow hairs**; contain 12–16 smooth black oval seeds.

Propagation: Seedlings, direct sowing at site.

Seed: No. of seeds per kg: 17,000–33,000.
treatment: Soak in hot water for 24 hours to hasten germination.
storage: Can be stored.

Management: Weeding.

Remarks: ICRAF is testing the potential of this species in improved fallows. The leaves of *Tephrosia vogelii* contain a chemical called rotenone which can be used as an insecticide to control pests like aphids, caterpillars, beetles, mites and termites. The leaves contain 15% of tephrosin while seeds contain 30%. Therefore it is a shrub which should be planted by farmers for its insecticidal properties.



Terminalia sericea

Combretaceae

Indigenous

English: Silver terminalia**Nyanja:** Gonondo**Senga:** Mupululu**Ecology:** This is a typical tree of the extensive savannah woodlands of central and southern Africa, north to Tanzania and south to South Africa, 450–1,300 m. It may be a dominant tree or a co-dominant in mopane woodland, often in sandy soils.**Uses:** **Timber** (tool handles, construction, furniture), **poles, fence posts**, medicine (roots), dye (bark), rope (bark).**Description:** A deciduous tree 3–16 m with spreading wavy branches to a light round or flat crown. **BARK:** pale cream to grey-brown-black, with wide angular grooves. Branchlets with characteristic purplish bark peeling off in strips to show paler bark below. **LEAVES:** **crowded all around the end of the branchlet**, leathery, oval but narrowed to the base, up to 12 cm long, with clear side veins. Below there are **silky white hairs** (sericea), hence the English name. Young leaves are pink and dying leaves deep pink before they fall. **FLOWERS:** September–November; appearing with new leaves, in short spikes about 5 cm, green-white, buds silky hairy. **FRUIT:** **pink-purple-brown to 4 cm long**, oval and flat, **winged around the central seed, tip notched**, December–April.**Propagation:** Seedlings, rootsuckers.**Seed:** No. of seeds per kg: $\pm 1,200$. Germination good with fresh seed.**treatment:** Remove wing before sowing.**storage:** Seed can be stored if kept dry. Viability is up to 3 years.**Management:** Pollarding, coppicing.**Remarks:** The hard yellow wood is resistant to both termites and borers and is a useful general purpose wood. In Eastern Province, the timber is used to make axles for ox-drawn wagons (*ngolo*). Posts both for fences and houses last a long time and are generally insect-resistant. The tree can be used for land reclamation. The root is used to treat diarrhoea, pneumonia, bilharzia and colic and the leaves to treat stomach disorders.

Thevetia peruviana (*T. neriifolia*)

Apocynaceae

Central and South America

English: Yellow oleander

Nyanja: Savesha

Ecology: A small tree with attractive foliage and flowers, widely planted throughout the tropics, 0–2,000 m. Commonly used as a hedge. It has been planted all over Zambia, largely in townships, but is a useful hedge even in dry areas and tolerates both clay and sandy soils.

Uses: Shade, **ornamental**, **live fence**.

Description: An evergreen multistemmed shrub or tree usually about 4 m, shady when full sized. LEAVES: shiny, **narrow, in spirals** around the branchlets, to 15 cm long. FLOWERS: **bright yellow** or pale orange trumpets to 6 cm long; **twisted in bud**, the green base reaching the edge of the petals. FRUIT: fleshy, 4-angled to rounded, 3 cm across on a long stalk; 1–2 large brown-black triangular seeds inside.

Propagation: Seedlings, cuttings.

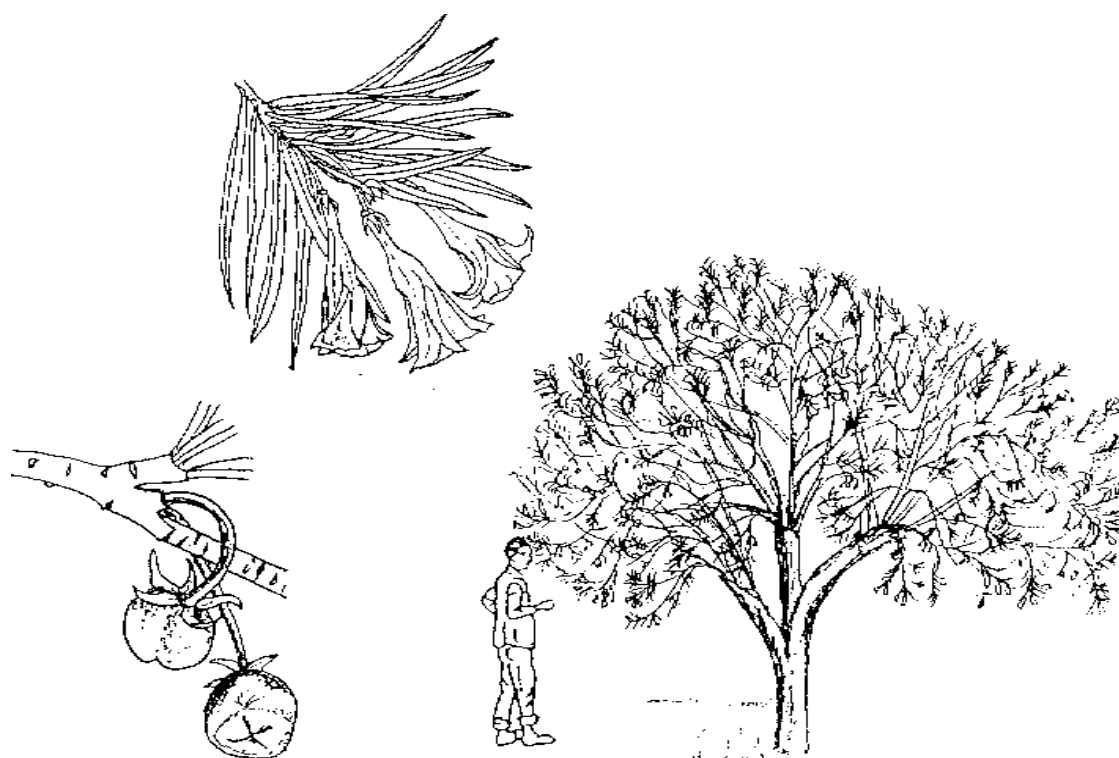
Seed: Germination rate of 80%. No. of seeds per kg: ± 300 .

treatment: Not necessary.

storage: Seed can be stored for about 3 months.

Management: Prune about a month before the rains to induce flowering.

Remarks: All parts of this tree are poisonous if eaten, so take care with children. Livestock can also be poisoned by this plant. The plant is cultivated in Hawaii for a powerful heart drug which can be extracted from the seeds.



Toona ciliata

Meliaceae

Tropical Asia

English: Toona tree**Nyanja:** Senderela**Senga:** Sindelela

Ecology: A commonly planted exotic tree from tropical Asia, 0–1,200 m. In Zambia, it has been planted as an avenue tree. It grows best on good well-drained soils and does not tolerate sandy soils. The tree is frost-hardy but sensitive to drought.

Uses: Firewood, **timber** (furniture, light construction), **shade**, windbreak.

Description: A semi-evergreen tree usually 10 m but may reach 21 m, with **large branches** to a spreading crown. **BARK:** grey-brown, rough and cracking into squares. **LEAVES:** compound, very long up, to 90 cm with 10–14 pairs of leaflets, narrow leaflets up to 15 cm long, **often unequal sided**, tapering to a fine tip, smell of onions when crushed. **FLOWERS:** very small, white, appear July–October, **bell-shaped, in inconspicuous sprays**. **FRUIT:** **brown capsules**, split open November–December into dark brown star shapes, releasing small winged seeds.

Propagation: Seedlings, cuttings, truncheons, root suckers.

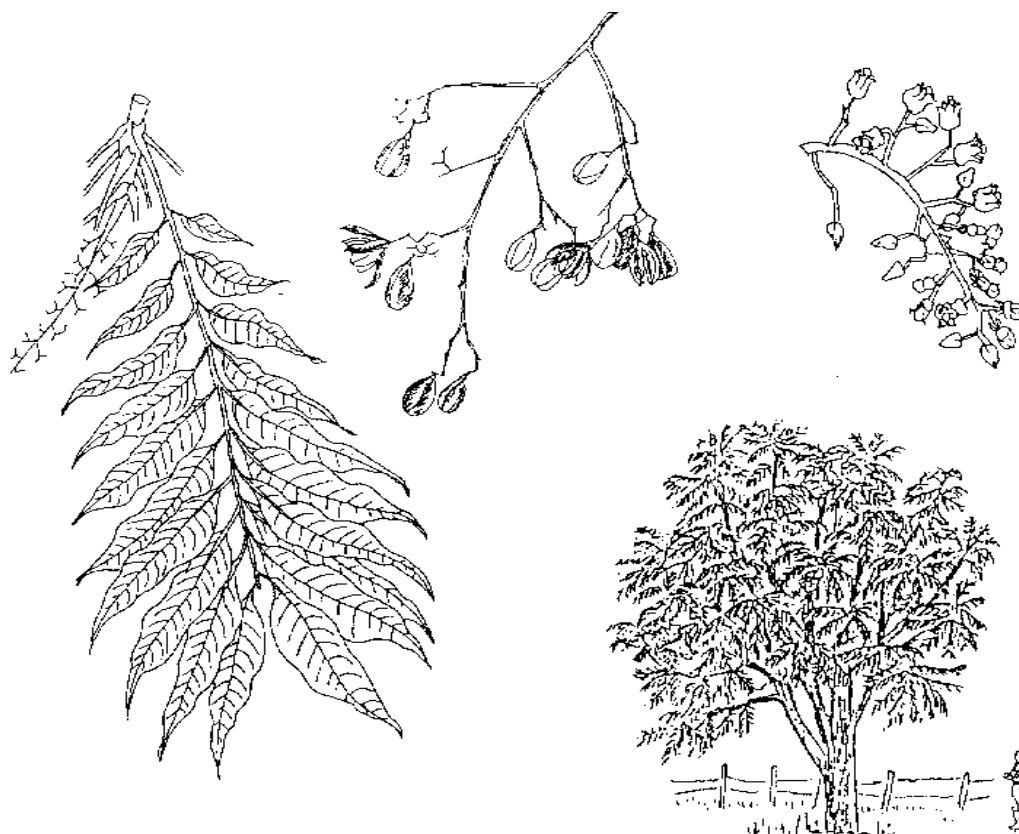
Seed: No. of seeds per kg: 300,000–380,000. Germination rate 40–60%.

treatment: Not necessary.

storage: Can store up to 6 months.

Management: Coppicing, pollarding.

Remarks: The tree is not suitable for planting near food crops because of its shallow and aggressive root system. The wood is soft, light and moderately durable. Good for school compounds and roadside.



Trichilia emetica

Meliaceae

Indigenous

English: Capemahogany

Nyanja: Msikizi

Senga: Msikizi

Ecology: A large timber tree, found throughout tropical Africa even into Yemen and south to South Africa, 0–1,800 m. It grows in most parts of Zambia and is locally frequent in wetter areas along rivers, in swamp forest and on escarpment miombo. It has been planted as an ornamental. Prefers well-drained rich soil and high groundwater.

Uses: Firewood, **timber** (furniture, tool handles, boats), poles, medicine (leaves, bark, oil), **shade**, ornamental, **windbreak**, oil, soap, cosmetics (seed).

Description: An evergreen tree, 15–30 m high, with dark hanging foliage, pyramid shaped when young. Later the crown is well rounded and heavy; the trunk rather smooth, swollen or fluted when old. **BARK:** grey-red-brown rather smooth with fine shallow grooves, later cracking into small sections. **LEAVES:** compound, 4–5 pairs of leaflets, **dark-green**, thick and shiny, **leaflets increase in size** towards the largest central leaflet, to 16 cm, **below midrib continues into an unusual hairy tip**. Leaf and stalk hairy below. **FLOWERS:** inconspicuous in fragrant clusters, cream-green, 5 thick petals and a hairy centre of stamens, July–November. **FRUIT:** round red-brown hairy capsules to 3 cm across, dry and split into 3 or 4 parts. Up to 6 seeds hang out, shiny black, almost covered by a soft orange-red coat, December–March.

Propagation: Seedlings, direct seeding, root suckers.

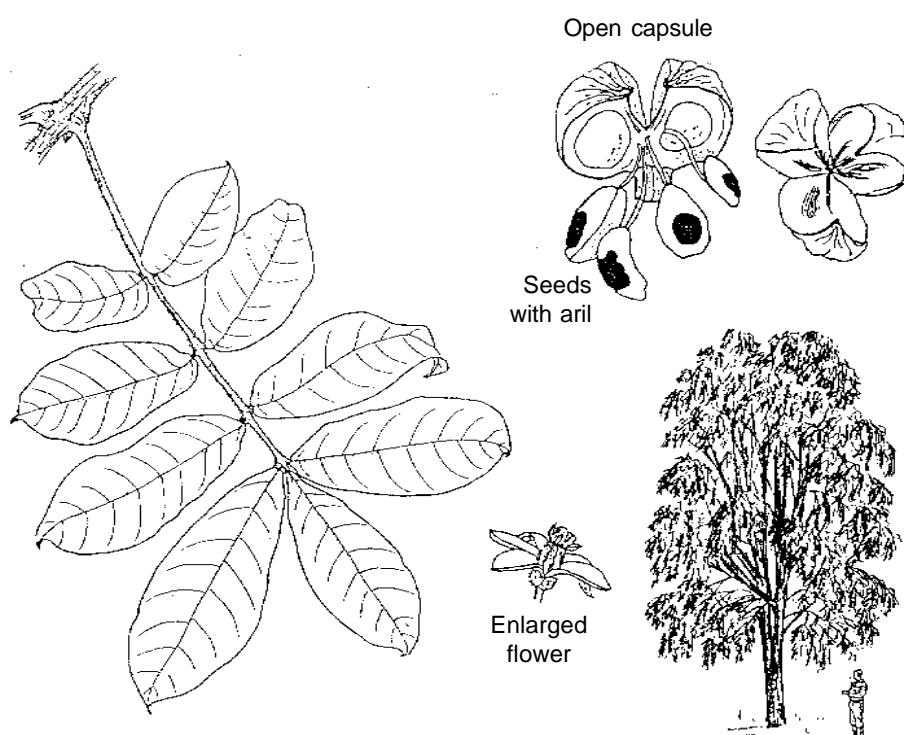
Seed: No. of seeds per kg: 300. Collect seed when capsules start opening, dry in shade. Sow fresh seed for best results.

treatment: Not necessary.

storage: Seeds lose viability quickly. Sow within 3–4 days.

Management: Coppicing, pollarding.

Remarks: A fairly fast growing tree with excellent shade. Timber is pink-grey-brown, very susceptible to insect attack. Oil from the seed has been used to make soap and can also be used to treat hair and skin disorders. It is very poisonous.



Uapaca kirkiana

Euphorbiaceae

Indigenous

English: Wild loquat**Nyanja:** Msuku**Senga:** Musuku**Tumbuka:** Musuku

Ecology: A well-known fruit tree of central and southern Africa north to Tanzania; 800–1,900 m. The tree grows throughout Zambia except in the sandy soils of Kalabo District. In Eastern Province, it is an occasional tree of open woodlands, stony hills and valley soils. Its presence indicates poor and shallow soils.

Uses: Firewood, charcoal, **timber** (general purposes), poles, **food** (fruit, drink), medicine (roots, bark, leaves), fodder (leaves, fruit), bee forage, shade.

Description: A small semi-deciduous tree, usually 5–6 m, with a **characteristic dense rounded crown**. BARK: rough, grey-black, shallow vertical grooves, scaly. LEAVES: grouped at branch tips, **large and leathery, to 17 cm**, shiny dark green above, **orange-yellow woolly hairs below**, especially on the prominent veins; **tips notched**. FLOWERS: male and female trees, with flowers produced on the old wood, **male flowers orange-yellow in bunches**, female green-white solitary; January–April and casual flowering September–November. FRUIT: abundant, **rounded, yellow-orange to 3 cm; pulpy, sweet flesh** surrounds 3–4 seeds.

Propagation: Seedlings, root suckers, wildings.

Seed: No. of seeds per kg: $\pm 2,500$. Germination from fresh seed is good.

treatment: Remove seed coat to enhance germination.

storage: Sow fresh seed as it does not store well.

Management: Coppicing, protect wildings. Symbiosis with mycorrhiza is required for good growth. Collect nursery soil from underneath mature trees.

Remarks: ICRAF researchers are looking into possibilities for domestication of this useful tree. Wine can be made from the fruit. People often leave this species when clearing land for crops as the fruit can be sold in local markets. If the roots are damaged, root suckers readily develop. The flowers are valued as bee forage. The timber has white sapwood and red-brown figured heartwood and is useful for furniture. If large tracts of land are cleared for agriculture, it is important to leave both male and female trees for sustained fruit production. This tree can be distinguished from *U. benguelensis* by the latter's smooth, dark grey bark.



Uapaca nitida

Euphorbiaceae

Indigenous

English: Narrow-leaved mahobohobo

Nyanja: Kasokolowe

Senga: Kasokolowe, mnengo, msechela

Ecology: A well-known fruit tree of southern Central Africa from Zaire to Mozambique. Found throughout Zambia. It is frequent in miombo and chipya woodland and occasionally in Kalahari woodland, an obvious indicator of poor soils. Occurs in miombo woodland in Eastern Province.

Uses: Firewood, **timber**, poles (building and joinery), **food** (fruit), medicine (leaves, twigs and roots), fodder (fruit), shade.

Description: A small evergreen tree to 12 m with a light rounded crown. The young shoots are hairless. **BARK:** grey-black, fissured and scaling in varying shapes. **LEAVES:** **alternate, simple, glossy, narrow** and thinly leathery, **5–16 cm long, the tip broadly rounded**, the base narrowed to a **yellow-green stalk to 5 cm long**; veins clear above, the edge sometimes wavy. Leaves usually crowded at the ends of branches. **FLOWERS:** **creamy yellow, on stalks below the leaves. Male and female flowers on different trees**, March–May. No true petals but coloured bracts at base of flowers. Female flowers have a **single ovary with thick branched styles**. Male flowers smaller in dense heads. **FRUIT:** abundant, small, **rounded, to 2 cm across** ripening to orange in six months, September–November. It has edible tasty flesh (but not as good as *U. kirkii*)..

Propagation: Seedlings, rootsuckers, wildings.

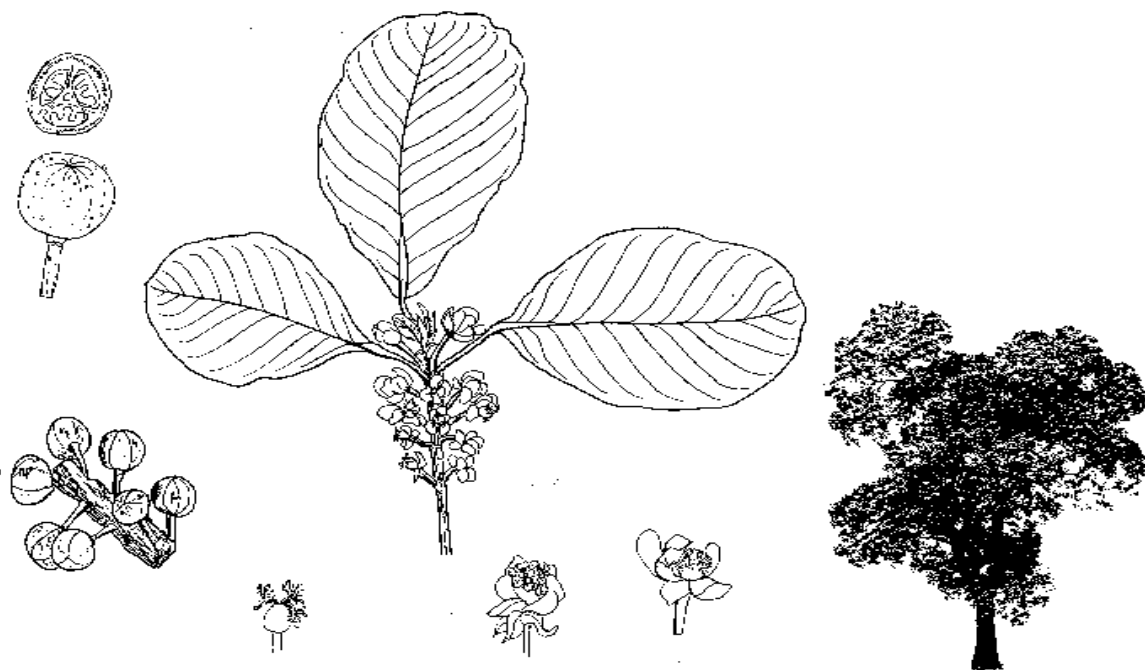
Seed: –

treatment: Not necessary.

storage: Not recommended.

Management: Coppicing, protect wildings.

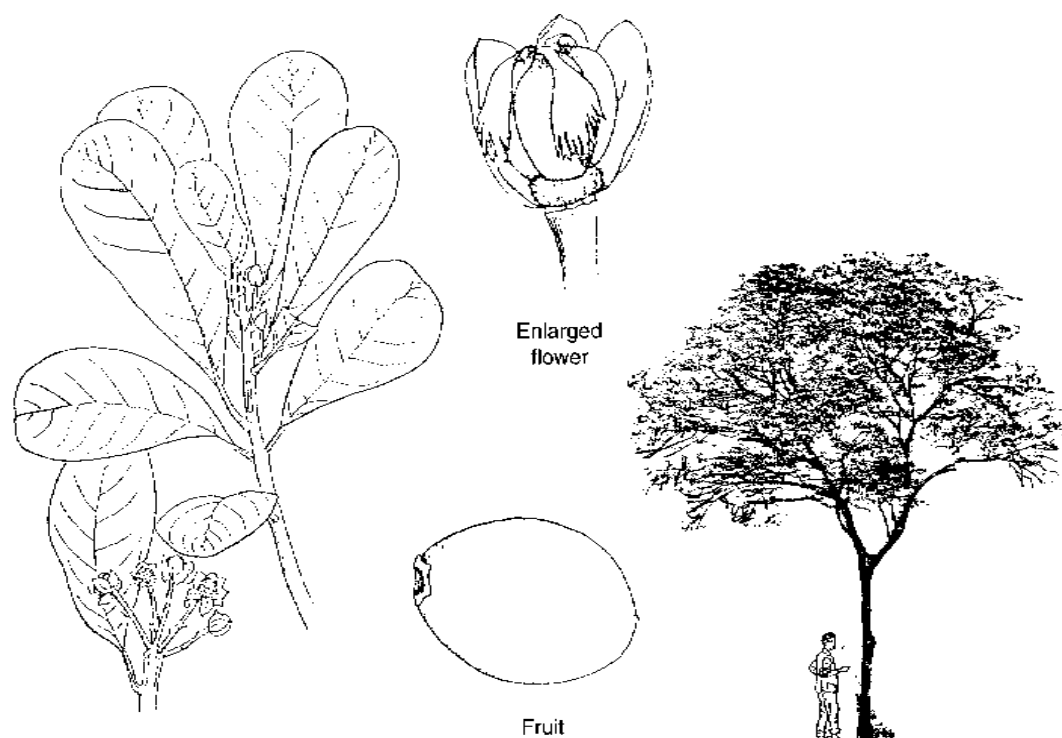
Remarks: The fruit makes a very nourishing pig feed. Charms made from the wood are often carried by hunters. The smoke from burning twigs of *Uapaca nitida*, *Ziziphus abyssinica* and grass from a dead person's house is alleged by some people to drive away evil spirits.



Uapaca sansibarica

Euphorbiaceae

Indigenous

Nyanja: Kasokolowe, katoto, kansima**Ecology:** Found in wooded grasslands in eastern and central Africa from southern Sudan to Mozambique. One of four *Uapaca* species in Zambia, this one occurs in almost all parts of the country except Western Province and Kalomo District. It is commonly found in lake basin chipya (Bangweulu) and frequently occurs on dambo margins throughout the region as well as in plateau miombo woodland.**Uses:** Firewood, poles, **food** (fruit), medicine (roots, bark, leaves), fodder (fruit, leaves), bee forage, dye (roots).**Description:** A small semi-deciduous tree to 14 m high, often less, the crown heavy, flat to rounded. **BARK:** grey-black, smooth then **cracked into small square or oblong scales**. **LEAVES:** alternate and simple, **leathery, shiny dark green in terminal tufts, about 12 cm long, wider at tip than base, tip rounded**, base narrowed to a stalk 1–2 cm, duller below with yellow veins. **FLOWERS:** male and female separate on the same tree: male flowers surrounded by leafy bracts, **in stalked clusters, female flowers solitary and stalked—both yellow-green**, January–March. **FRUIT:** rounded, **orange-brown and fleshy to 2 cm**, containing 3 seeds, about 1 cm, June–October. The edible flesh is yellow, jelly-like and sweet.**Propagation:** Seedlings, wildings.**Seed:** –**treatment:** Not necessary as it germinates easily.**storage:** Not recommended.**Management:** Coppicing, pollarding, lopping; protection of wildings and seedlings from fires, wildlife and livestock.**Remarks:** Its poles are remarkably resistant to termites, borers and fungi. Roots, bark and leaves are used in local medicine. Scrapings from the roots yield a blue dye when boiled.

Vitex doniana

Verbenaceae

Indigenous

English: Black plum
Nyanja: Mfifya, mfutu
Senga: Mufito, mfutu

Ecology: A woodland tree, the tallest and most common of several *Vitex* species found throughout Africa from the Sahel to South Africa, 0–1,800 m. It grows in most parts of Zambia, an occasional tree of evergreen thicket to open woodlands both in the valleys and on the plateau. It prefers a high water-table.

Uses: Firewood, charcoal, **timber** (construction, furniture), poles, **food** (fruit), medicine (bark, leaves, roots, fruit), fodder (leaves, fruit), bee forage, shade, dye (bark).

Description: A semi-deciduous tree, 8–15 m, with a **heavy rounded crown** and a clear bole. **BARK:** rather smooth and pale at first, finely grooved, later darker with large scales. **LEAVES:** compound and **opposite**, the **5 finger-like leaflets** held up on a **stalk to 15 cm**, the 2 lowest leaflets smaller, each one wide and oblong to 14 cm, shortly stalked, pale grey-green below, leathery. **FLOWERS:** fragrant, in dense bunches to 12 cm across on a long stalk; each flower bell-shaped, hairy inside, **cream but one larger lobe hairy, blue-violet**, August–January. **FRUIT:** **oblong-round to 3 cm**, black when ripe, thin flesh around a very hard nut which contains 1–4 seeds. A conspicuous calyx remains around the fruit and curls back, April–August.

Propagation: Seedlings, direct seeding, wildings, cuttings.

Seed: No. of nuts per kg: 900–1,300. Each nut contains several seeds.

treatment: Remove fleshy part of the fruit and soak nut in cold water for 24 hours.

storage: Sow fresh for best germination results.

Management: Coppicing, lopping.

Remarks: The species regenerates naturally by seed and root suckers and then grows fairly fast. The tree produces a teak-like timber and edible fruits. The fruits may be picked when green and allowed to ripen in storage. The wood is suitable for furniture, carvings and boat building. The roots are used to treat gonorrhoea, jaundice, leprosy, dysentery and enhance fertility. Cultivation of this tree should be encouraged.



Ximenia americana**Olacaceae**

Indigenous

English: Wild plum, sour plum
Kunda: Nthengele, kamlawe
Nyanja: Nthengele, mtundulukwa
Senga: Wabona

Ecology: Widespread throughout the tropics, 0–2,000 m. Found throughout Zambia in all vegetation types, frequent in plateau miombo and mopane woodland. Grows on sandy soils and stony slopes.

Uses: **Firewood**, charcoal, **timber** (utensils), **food** (fruit), drink (fruit), medicine (roots, bark, leaves), tannin (roots, bark).

Description: A semi-deciduous shrub or small bushy **spiny tree**, **3–5 m**, but may reach 8 m high. **BARK:** grey-black with small scales. **LEAVES:** alternate, simple or tufts, **blue-grey-green**, to **7 cm**, fold upwards along midrib; tip round or notched, smell of bitter almonds when crushed; **spines 1 cm**, **thin**, **straight**. **FLOWERS:** fragrant, white-green or pink in small branched clusters, July–October. **FRUIT:** **round to 2.5 cm**, **thin** skin, yellow-pink-red, pulp sour but refreshing, **1 large seed**, containing oil.

Propagation: Seedlings.

Seed: No. of seeds per kg: 660–1,400.

treatment: Not necessary.

storage: Seed cannot be stored longer than 3 months. Sow fresh seed for good germination.

Management: Coppicing.

Remarks: The wood is fine-grained, heavy, hard and very durable. The seed contains a non-drying oil which is suitable for soap manufacture and lubrication. It has also been used as a body and hair oil and for softening leather. The tree is drought-hardy. Leaves and twigs are used to treat fever, colds and eye infections and can also be used as a laxative. Roots are used to treat headaches, sexually transmitted diseases and skin disorders, and the bark to treat headaches, kidney and heart disorders. A decoction of roots and fruits is used to treat dysentery in calves.



Ziziphus abyssinica

Rhamnaceae

Indigenous

Nyanja: Kankande, mlasawantu, mushawankhunzi

Senga: Kangolobozi

Tumbuka: Kangolobozi

Ecology: A common tree of medium to low altitudes, from Senegal to Ethiopia to South Africa, 400–2,200 m. It is found in the drier areas of Zambia in open woodlands; locally frequent in chipya, Kalahari and also in munga scrub.

Uses: Firewood, charcoal, timber (tool handles, handicrafts), fence posts, food (fruit), medicine (roots, leaves), fodder (leaves, fruit), **bee forage, live fence.**

Description: A spiny tree about 3–6 m, **crown rounded.** BARK: grey, deeply grooved; thorns may be single or paired, one recurved, the other sharp and straight to 2 cm. LEAVES: leathery, broadly oval to 8 cm, **the leaf base unequal, shiny green above, hairy yellow-grey below, veins distinctive,** edge finely toothed, shortly stalked. FLOWERS: green-yellow, in small groups, October–March and casual flowering May–June. FRUIT: **rounded to 3 cm, shiny red-brown,** edible when ripe, 1–2 seeds inside the stone, April–August; remaining a long time on the tree.

Propagation: Seedlings, direct seeding, root suckers, cuttings.

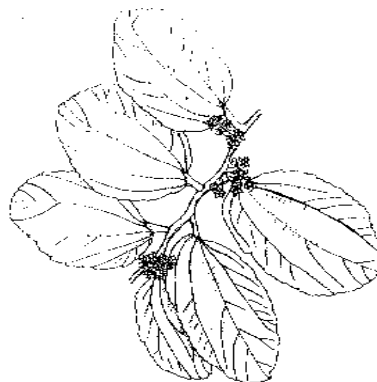
Seed: Germination rates often low. No. of seeds per kg: 430–2,000.

treatment: Soak in hot water and allow to cool for 24–48 hours, or crack hard seed cover.

storage: Seed can be stored for up to a year.

Management: Lopping, pollarding, pruning, coppicing.

Remarks: This is a useful live fence around dimba because of the vicious thorns and farmers should be encouraged to plant it because of the edible fruit and excellent bee forage. Thorny branches are sometimes put over graves in Eastern Province as a protection from animals. The timber is heavy, hard and resistant to termites and borers. Ash from burnt leaves mixed with salt is used to treat tonsillitis.



Ziziphus mauritiana

Rhamnaceae

Middle East and India, naturalized

English: Indian jujube

Kunda: Masau

Nyanja: Masau, msau

Senga: Masau

Ecology: A small drought-resistant tree now widespread in Africa and from the Mediterranean to India, 0–1,500 m. The tree is cultivated for its fruits in some countries where thornless varieties have been developed. It is widespread in the Valley areas of the Eastern Province of Zambia and has a strongly developed root system, preferring a high water-table.

Uses: Firewood, charcoal, timber (utensils), **food** (fruit), **fodder** (leaves, fruits), bee forage, **live fence**, tannin (bark), dye (bark).

Description: A thorny semi-evergreen shrub or tree 3–6 m; branches drooping down form a rounded crown. **BARK:** grey-black; pairs of dark brown thorns, both straight and recurved (“thumb-pointer”). **LEAVES:** markedly alternate along the stems, oval, variable in length to 8 cm; leaf bases **rounded and equal**, yellow-green above, **hairy below**. **FLOWERS:** small, yellow-green. **FRUIT:** **rounded, 1–2 cm**, yellow to red-brown, 2 seeds in a large stone, surrounded by thin edible pulp.

Propagation: Seedlings, direct seeding, root suckers, cuttings.

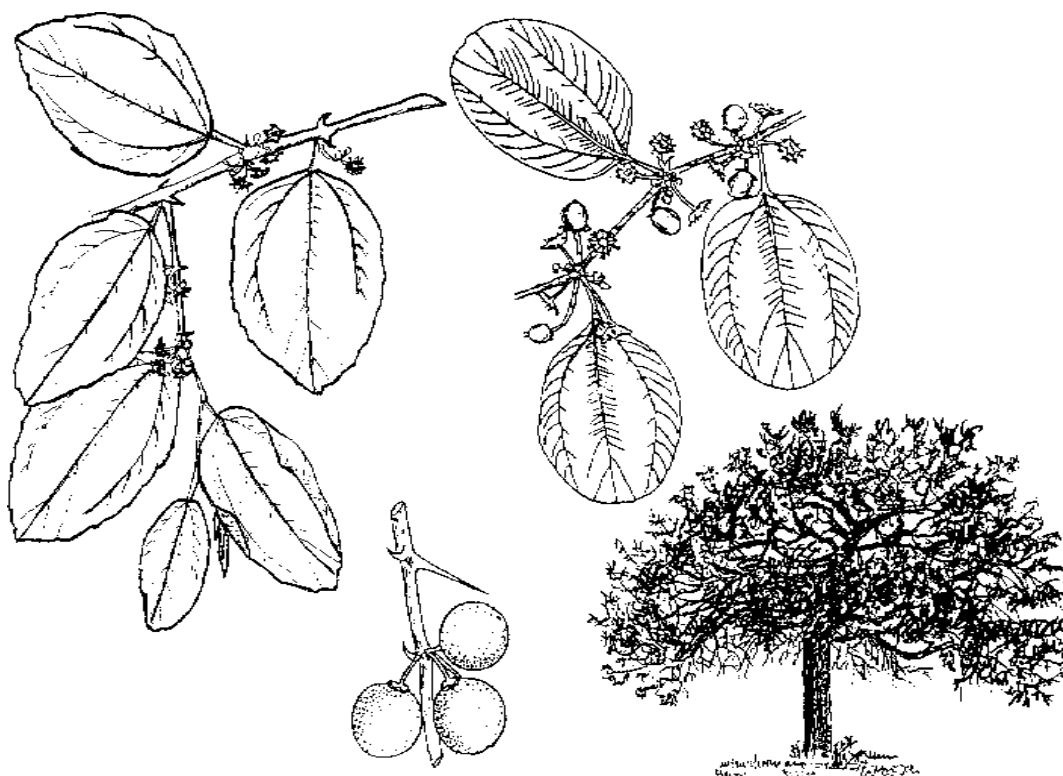
Seed: Germination rates are low. No. of seeds per kg: 650–3,500.

treatment: Soak in hot water and allow to cool for 24–48 hours; first crack or otherwise remove the hard seed cover.

storage: Can store up to a year.

Management: Lopping, pollarding, pruning, coppicing.

Remarks: The fruit is usually sold in markets to eat raw or to make an alcoholic drink (*kachasu*). This tree has very similar uses to *Ziziphus abyssinica*.





Appendices





Appendix 1

Medicinal plants

Trees, shrubs and, to some extent, grasses are being used for treatment of various diseases. Forests, therefore, are natural pharmacies where medicines can be obtained. Literate and illiterate people still use local plants as drugs. Many manufactured drugs (medicines) are based on plant tissues.

Traditionally, knowledge on medicinal plants is passed from one generation to another, usually through firstborn sons or grandsons, or occasionally through other trusted relatives. Traditional healers are not keen on disclosing information on traditional medicines but there is a need for further research to investigate the chemical composition of some of the plants which are reputed to cure diseases.

Users of these medicines should observe good standards of hygiene and take great care with dosages. Too much of modern drugs or local drugs is dangerous to both human beings and livestock.

Collection of parts of medicinal plants

Sustainable methods of collecting parts of the trees and shrubs for medicinal purposes:

- Remove thin strips of bark with a sharp knife or machete. Do not ring bark trees as most trees will be killed by this.
- Collect roots on one side of the tree by digging. Cover the remaining exposed roots with soil. Do not remove large roots which support the tree.
- When collecting leaves, leave some on the plant to ensure continued survival and vigour.

Care should be taken when collecting these plants. Some plants are very poisonous. The local names of the plants sometimes apply to several species. Therefore, users of these plants have to be confident on the species. The chemical properties of plants vary even between closely related species. There are certain species such as acacias where poison may be absent from ripe (mature) pods but unripe ones may be poisonous.

Drying of medicinal plants

Roots and bark can be dried in the sun at any time. Flowers and leaves should be dried in the shade to maintain their efficacy (strength). Direct sunshine affects the efficacy of some plants like neem.

Preparation of medicine





- **Pounding:** This breaks up the fibres of the bark, leaves or roots. The powder is then applied directly to the affected parts.
- **Chewing:** Commonly used with leaves, roots or bark.

Application of medicine

The application methods depends on the preparation and the disease to be treated. The following methods are commonly used:

- **Drinking or eating:** The juice from the boiled or soaked herb is drunk for internal treatment or the prepared drug is swallowed, e.g. to cure stomach disorders. The medicine can either be swallowed plain or mixed with food and eaten.
- **Bathing:** Used for external diseases.
- **Incision:** The skin is cut on the affected part using a razor blade and then the powder or ash is rubbed in the incisions.
- **Steaming:** Either inhaling the vapour through the mouth/nose or covering the patient with a blanket and making him sweat in the steam (like a sauna).
- **Chewing:** Commonly used for quick treatment such as snake bite. The drug plant is chewed and then applied to the affected part.
- **Rubbing:** This is mainly used for external diseases.
- **Taken mixed with drinks** such as tea or beer, e.g. aphrodisiac drugs.





Medicinal plants used to treat human and livestock diseases in Eastern Province

Scientific name	Common name	Part used	Reported diseases/conditions treated
<i>Canthium</i>	Mkuzyangombe	<ul style="list-style-type: none">• Leaves• Roots	<ul style="list-style-type: none">• Lung and chest troubles• Stomach pains
<i>Combretum</i>	Kafifi, mzunganyewe	<ul style="list-style-type: none">• Leaves pounded in water	<ul style="list-style-type: none">• Madness, rheumatism
	Lumpangala, mfungu, mpamba	<ul style="list-style-type: none">• Roots	<ul style="list-style-type: none">• Aphrodisiac, gonorrhoea
<i>Combretum</i>	Chisiyo, denganya, uzimwe	<ul style="list-style-type: none">• Dried leaves + fruits• Fresh gum• Bark	<ul style="list-style-type: none">• Leprosy, ulcers• Dysentery, ophthalmia, fever, leprosy, sexually transmitted diseases• Impotence
<i>Canthium</i>	Ngowe	<ul style="list-style-type: none">• Roots• Gum• Bark	<ul style="list-style-type: none">• Snakebite, gonorrhoea• Aphrodisiac• Sore throat, diarrhoea
<i>Combretum</i>	Mtubetube, mtwetwe, mzizi	<ul style="list-style-type: none">• Roots• Bark	<ul style="list-style-type: none">• Coughs• Gonorrhoea
<i>Combretum</i>	Mlambe	<ul style="list-style-type: none">• Boiled bark	<ul style="list-style-type: none">• Body pains
<i>Combretum</i>	Mpapa	<ul style="list-style-type: none">• Bark + roots	<ul style="list-style-type: none">• Gonorrhoea, pneumonia, bilharzia
<i>Combretum</i>	Mtanga	<ul style="list-style-type: none">• Bark• Root	<ul style="list-style-type: none">• Bronchitis, scabies• Eye inflammation, snakebite, stomach-ach
<i>Combretum</i>	Msase, chisale	<ul style="list-style-type: none">• Root• Sap	<ul style="list-style-type: none">• Colds, coughs, gonorrhoea, internal bleeding• Aphrodisiac• Cuts and wounds
<i>Combretum</i>	Msasengoma, msasempanga, mlilanzeze	<ul style="list-style-type: none">• Roots	<ul style="list-style-type: none">• Headache, syphilis, gonorrhoea, sore eyes, blindness, skin rash
	Anyenze, onion	<ul style="list-style-type: none">• Half cup of chopped onions with half cup of water. Drink in several doses• Half a cup of chopped onion	<ul style="list-style-type: none">• Cough, sore throat• Gastro-intestinal infection, urinary tract infection, diabetes, fungal infection, improves memory





Scientific name	Common name	Part used	Reported diseases/conditions treated
<i>...pus andongensis</i>	Chintembwe, pozo Msengena	<ul style="list-style-type: none">• Leaves• Root• Bark• Powdered seed	<ul style="list-style-type: none">• Burns and scalds, cough, sexually transmitted diseases• Diarrhoea• Antidote to snakebite• Ulcers
<i>...sus</i>	Chinanazi, pineapple	<ul style="list-style-type: none">• Drink a lot of fruit juice• Unripe fruit juice• Mix 500 g of unripe fruit with 0.7 litres of water, boil together and drink in several doses	<ul style="list-style-type: none">• Scurvy, fever• Indigestion• Haemorrhoids, urinary tract infection.
<i>...alensis</i>	Mpovya	<ul style="list-style-type: none">• Roots• Leaves	<ul style="list-style-type: none">• Skin rash, aphrodisiac• Snakebite
<i>...ndica</i>	Nimu, neem	<ul style="list-style-type: none">• Pour 1 litre of boiling water on 15 g of dried leaves, drink the brew in several doses during the day to treat malaria (in case of emergency when tablets are not available)	<ul style="list-style-type: none">• Malaria, rheumatism
<i>...ptiaca</i>	Nkurya	<ul style="list-style-type: none">• Gum mixed with porridge• Bark• Fruit saponin• Oil from fruit kernel	<ul style="list-style-type: none">• Chest troubles• Syphilis, skin ulcers• Kills bilharzia-carrying snails• Sleeping sickness
<i>...ertii</i>	Mbuwu	<ul style="list-style-type: none">• Bark• Roots	<ul style="list-style-type: none">• Gonorrhoea, malaria, constipation• Diarrhoea, leprosy
<i>...longifolia</i>	Mchenga, msamba, mfundanzizi	<ul style="list-style-type: none">• Bark• Inner bark	<ul style="list-style-type: none">• Stomach-ache• Removal of worms





Latin name	Common name	Part used	Reported diseases/conditions treated
<i>gagneaudi</i>	Mwanjane, mpasa	● Bark	● Skin diseases, antidote for arrow poisoning
<i>na</i>	Kapanga, kawizi, mkoso, ngalati	● Bark + roots	● Smallpox, dysentery, pneumonia, headache, joint pains, scurvy, septic sores, toothache, cough
<i>assum</i>	Mapoloakalulu	● Roots	● To initiate maturity in teenage males
<i>tescens</i>	Mpilipili, sabola	● Fruit	● Newcastle disease in chickens
<i>a</i>	Papayi, pawpaw	● Roots	● Syphilis, gonorrhoea
		● Few drops of pawpaw sap.	● Indigestion
		● Eat a lot of fruit	
		● 1 handful of male pawpaw flowers and 1 litre of water frequently	● Hepatitis
		● Latex (sap)—use the following dosages: – ½ teaspoon 6 months–1 year – 1 teaspoon 1–6 years – 2 teaspoons 7–13 years – 4 teaspoons 14 years and over	● Tapeworm
<i>s</i>	Mbangonge, nyakoko	● Smoke young dried leaves	● Asthma attacks
		● Powdered root added to porridge	● Gonorrhoea
		● Roots	● Stomach-ache
<i>iana</i>	Mtantanyelele	● Crushed roots	● Snakebite
		● Pods	● Skin diseases
		● Roots + bark	● Syphilis
		● Roots	● Stomach-ache, coughs
<i>eana</i>	Kalibabwe, kalusapwe, mtawatawa, mtantanyelele	● Leaves and flowers	● Sore eyes (wash affected eyes)
		● Roots	● Gonorrhoea





me	Common name	Part used	Reported diseases/conditions treated
	Mdimamadzi	<ul style="list-style-type: none">• Roots + bark• Leaves	<ul style="list-style-type: none">• Gonorrhoea• Asthma
	Ndimu, lemon	<ul style="list-style-type: none">• Boil 2 handfuls of young leaves (dry or fresh) with 1 litre of water. Filter and drink in several doses during the day• Chop lemon peel and leave it to dry. Add 1 handful to 1 mug (200 ml) of boiling water and leave to cool for 15 minutes, then filter. Daily dosage:<ul style="list-style-type: none">– adults 3 tablespoons– children 1½ tablespoons• Squeeze a piece of fresh peel in boiling water and inhale the vapour• To strengthen the immune system, give the patient a mixture of 500 ml of hot water and the juice of 1 lemon 3 times daily	<ul style="list-style-type: none">• Cough• Bronchitis• Cold, fainting• Scurvy, fever, malaria
<i>capitatum</i>	Ngwevula	<ul style="list-style-type: none">• Infusion of leaves applied to the head• Leaves	<ul style="list-style-type: none">• Epilepsy• Headache
<i>molle</i>	Kalama	<ul style="list-style-type: none">• Roots• Crushed leaves• Powdered roots	<ul style="list-style-type: none">• Wounds• Wounds• Syphilis





Latin name	Common name	Part used	Reported diseases/conditions treated
<i>Antifebrifuga</i>	Kangwe, kapulukoso, mwavi, mlamafupa, mgowogowo	<ul style="list-style-type: none">• Infusion of bark and roots• Bark	<ul style="list-style-type: none">• Syphilis• Malaria, diarrhoea
<i>Leptocarpus</i>	Lemon grass	<ul style="list-style-type: none">• Boil 1 handful of old leaves of mango or eucalyptus and 2 handfuls of fresh or dried lemon grass in 5 litres of water, filter and pour into a basin. Take a hip bath for 20 minutes• Chew a piece of fresh grass 2–3 times a day. Prepare an infusion with 2 handfuls of lemon grass and 2 litres of water. Drink warm in several doses during the day	<ul style="list-style-type: none">• Haemorrhoids• Toothache, bad breath, fever, malaria
<i>Albizia</i>	Kabulasese, milolasinga, mvungwe, mzembe	<ul style="list-style-type: none">• Roots• Infusion of powdered roots in porridge• Powdered roots• Powdered bark rubbed into incisions on the chest• Bark	<ul style="list-style-type: none">• Gonorrhoea, cough• Constipation• Spleen pains• Pneumonia• Sores, wounds
<i>Myrsine</i>	Mkanganjovu, kafunabakweo, msansale	<ul style="list-style-type: none">• Roots are purgative	<ul style="list-style-type: none">• Diarrhoea, dysentery, syphilis, stomach ulcers
<i>Calocarpum</i>	Kalumpangala	<ul style="list-style-type: none">• Bark + leaves + roots	<ul style="list-style-type: none">• Glands, conjunctivitis, toothache, epilepsy, TB, foot and mouth disease (cattle)
<i>Condylocarpon</i>	Mtowa	<ul style="list-style-type: none">• Roots• Vapour from boiling roots and fruits is inhaled• Roots + porridge• Powdered roots	<ul style="list-style-type: none">• Leprosy, sore throat, syphilis• Chronic cough, pulmonary TB• Aphrodisiac• Colic, diarrhoea, constipation, trachoma, ulcer, snakebite





Scientific name	Common name	Part used	Reported diseases/conditions treated
<i>pteropus</i>	Mlungalunga	<ul style="list-style-type: none">Leaves mixed with mudPowdered leaves	<ul style="list-style-type: none">Mending of broken limbs (equivalent to plaster)Burns
<i>inica</i>	Chikumbambu, chisekele, chowgololo, nyanyata	<ul style="list-style-type: none">Roots	<ul style="list-style-type: none">Fits in children, fever, rheumatism, mental chest pains, hunting charm
<i>um zambesiicum</i>	Mkalakate	<ul style="list-style-type: none">Dried roots are peeled and pounded. One teaspoon mixed in porridge or tea taken once a month	<ul style="list-style-type: none">Aphrodisiac
<i>op.</i>	Bulugamu	<ul style="list-style-type: none">Chew half a leaf slowly 3 times a day.Boil 1 handful of leaves with 3 bottles of water for 5 minutes. Drink hot in several doses during the day.Heat 1 handful of dried and pounded leaves with half a glass of oil for 5 minutes. Rub the chest briskly with this mixture.Pound 1 handful of dried or fresh leaves and boil with 1 bottle of water for 5 minutes. Filter and drink several doses during the day. This tea can also supplement tuberculosis treatment.	<ul style="list-style-type: none">Sore throatFever, malariaColds, rheumatismCough, urinary tract infection, sore throat
<i>oida</i>	Msangu	<ul style="list-style-type: none">RootsPowdered rootsBark	<ul style="list-style-type: none">Gonorrhoea, syphilis, bronchial coughPneumoniaDiarrhoea





Latin name	Common name	Part used	Reported diseases/conditions treated
<i>...dica</i>	Chikulumawe, mkuyu	<ul style="list-style-type: none">• Bark• Root + bark• Latex	<ul style="list-style-type: none">• Gonorrhoea• Lung complaints• Dressing burns
	Ntudza	<ul style="list-style-type: none">• Powder from the outer layer of roots applied to incisions on the chest• Fruit• Leaves• Chopped roots used in porridge	<ul style="list-style-type: none">• Pneumonia• Syphilis• Gynaecological problems• Fits
<i>...lensis</i>	Matatane, msongwa, msinda, msamusa	<ul style="list-style-type: none">• Powdered bark• Root• Infusion of bark used as an eyewash	<ul style="list-style-type: none">• Syphilis sores• Constipation• Cataract
<i>...madagascariensis</i>	Msuwasuwa	<ul style="list-style-type: none">• Pounded bark• Roots soaked in porridge• Leaves	<ul style="list-style-type: none">• Scabies• Diarrhoea• Dysentery
<i>...a trifoliata</i>	Chinkulu	<ul style="list-style-type: none">• Smoke from burning leaves and twigs is inhaled• Root• Leaves	<ul style="list-style-type: none">• Headache• Sexually transmitted diseases, sore throat• Stomach disorders
<i>...paniculata</i>	Mtondo	<ul style="list-style-type: none">• Bark	<ul style="list-style-type: none">• Sore throat, common cold
<i>...na</i>	Chizutu, mvunguti, mvula	<ul style="list-style-type: none">• Ash powder from fruit• Fruit• Root power soaked in water• Roots• Root powder	<ul style="list-style-type: none">• Sores, cuts• Newcastle disease (vet. medicine: chicken)• Dysentery• Sexually transmitted diseases• Goitre, syphilis, swollen testicles, ulcers, palpitations





me	Common name	Part used	Reported diseases/conditions treated
or	Chaumbu	<ul style="list-style-type: none">● Inner bark soaked in water● Roots	<ul style="list-style-type: none">● Diarrhoea● Stomach troubles
dica	Manga, mango	<ul style="list-style-type: none">● Infusion of pounded leaves, pawpaw● Roots + pawpaw roots + <i>Euphorbia</i> roots + lemon roots● Eat plenty of fruit or chew 3 young mango leaves daily. Note: old leaves are poisonous.● Take 30 g (1 handful) of fresh leaves and boil them in 1 litre of water for 10 minutes, gargle with half a cupful every hour.● Take 30 g (1 handful) of fresh young leaves and boil them in 1 litre of water for 10 minutes. Filter and drink in several doses during the day.● Take 30 g (1 handful) of young leaves, boil with 1 litre of water for 30 minutes, filter and drink in several doses during the day.● Take 50 g of bark or older leaves and boil in 5 litres of water for 30 minutes. Filter and use this decoction for a hip bath.	<ul style="list-style-type: none">● Stomach-ache● Sexually transmitted diseases● Inflammation of the gums caused by vitamin deficiency.● Sore throat.● Cough, bronchitis● Diarrhoea, amoebic dysentery.● Haemorrhoids





Latin name	Common name	Part used	Reported diseases/conditions treated
<i>Prunella africana</i>	Mtototo	<ul style="list-style-type: none">● Pounded roots + porridge	<ul style="list-style-type: none">● Aphrodisiac
<i>Thonningia</i>	Msekese	<ul style="list-style-type: none">● Leaves + bark + fruit● Roots● Burnt leaves (ashes)	<ul style="list-style-type: none">● Colic, rheumatism, sexually transmitted diseases● Stops prolonged menstruation in women, coughs, throat and chest troubles, conjunctivitis● Malaria, poison spread on wounds from snake bites, toothache
<i>Stylosanthes bifolia</i>	Msolo	<ul style="list-style-type: none">● Roots● Bark + roots● Chicken soup + roots	<ul style="list-style-type: none">● Stomach troubles, diarrhoea, sore eyes, syphilis, bleeding● Dysentery● Fits
<i>Guajava</i>	Gwawa, guava	<ul style="list-style-type: none">● Eat lots of ripe fruits.● Boil 2 handfuls of fresh leaves in 1 bottle of water for 1 hour to make one full mug (200 ml). Filter and use for washing the wound.● Leaves● Take a handful of young leaves and boil in 0.7 litres of water for 20 minutes and filter, add 3 tablespoons of sugar and a pinch of salt. Boil again for a few minutes and pour into a bottle. <p>Dosage: children < 6 months, up to 1 bottle daily 6 months–2 years, up to 2 bottles daily 2–5 years, up to 3 bottles daily 7 years and older, 4–5 bottles daily</p>	<ul style="list-style-type: none">● Scurvy (vitamin C deficiency)● Bleeding wounds● Coccidiosis (vet. medicine: chickens)● Diarrhoea





Scientific name	Common name	Part used	Reported diseases/conditions treated
<i>...ava</i> (contd)		<ul style="list-style-type: none">Take 1 handful of fresh leaves, pound and add 1 teaspoon of salt and 1 teaspoon of sugar. Heat in a pan without water until the mixture turns brown. Make a compress for affected parts	<ul style="list-style-type: none">Eczema, abscesses
<i>...ata</i>	Miloswe, mleza, mtantanyelele	<ul style="list-style-type: none">LeavesBark + rootsCrushed leaves + rootsRoots	<ul style="list-style-type: none">Headache, toothacheFever, syphilis, gonorrhoea, dysentery, smSnakebiteInfertility in women
<i>...m</i> <i>...culoides</i>	Msalasase, jelejele, chigoma Mzai, mzimbili, temya	<ul style="list-style-type: none">Pounded leavesRootsLeaves are chewed and smeared on swellingRoots of <i>Strychnos</i> and roots of <i>Annona senegalensis</i> + boiled egg	<ul style="list-style-type: none">Swollen parts of the body, rash, bathing soSwollen testicles, syphilisSwollen baby heads (hydrocele)To prevent harm to the child during birth the husband's unfaithfulness.
<i>...agens</i> <i>...agascariensis</i>	Chizaye, mgundungulwe Mchezekekete	<ul style="list-style-type: none">RootsRoots soaked in waterRaw rootsPodsBarkLeaves	<ul style="list-style-type: none">SnakebiteCataract, diarrhoeaAphrodisiacNewcastle disease (vet. medicine, chicken)Stomach-acheHeadache, cough
<i>...na</i>	Msuku	<ul style="list-style-type: none">RootsYoung leavesBark	<ul style="list-style-type: none">Gonorrhoea, bronchitisChest troublesDysentery





me	Common name	Part used	Reported diseases/conditions treated
na	Chibukuzela, changalume, mkangaluche, msefu Vingobe, mumbu, chimanga, maize	<ul style="list-style-type: none">• Dried flowers• Powdered root• Take 15 g of dried maize “hair” and boil it in 1 litre of water for 15 minutes. Drink in portions during the day. Note: Follow diet restrictions for diabetes, limit consumption of salt and avoid sugar completely. Combine with other plants which help to lower the blood sugar such as onions or bean pods.	<ul style="list-style-type: none">• Dressing wounds• Analgesic• Diabetes

Appendix 2

Traditional dyes

Introduction

Natural dyes can easily be obtained from plants found in the miombo (*Brachystegia*) woodlands. Zambia is endowed with a rich variety of plants from which different-coloured dyes can be obtained.

It is important to use careful collection methods which will preserve the different herbs and trees providing raw materials so that they continue to benefit all users of natural dyes. Local people, who have a lot of indigenous knowledge on natural dyes, should be consulted for more information.

Collection of raw material for dyes

Sacks and labels should be used on each part of the plant collected.

Equipment/materials required

- Axe
- Hoe
- Sacks
- Sharp knife
- Labels

Methods of collection

BARK

Remove pieces of bark with a sharp axe or machete; always remove the minimum amount necessary. In shrubs remove one or two whole stems. Cut as near to the ground as possible.

LEAVES

Collect not more than one quarter of the plant's leaves. Try to collect evenly from all sides of the plant so that it is not left lopsided.

ROOTS

Dig out roots on one side of the tree. Cover any remaining exposed roots with soil. Take only the minimum amount required.

Points to remember when collecting dyes

- Always remove bark from the tree on the side facing away from the path or road to avoid attracting passersby.

- Always remove the bark from one side only or in alternate strips. Avoid removing bark all the way round (ring barking) as this will kill the tree.
- When collecting leaves, a large proportion should be left on the tree to keep it alive.
- When collecting roots, leave enough to keep the plant alive. Always cover any roots left exposed after removing your portion. Do not remove large roots which support the tree.
- Do not collect at camp sites and recreation areas or any popular sites.

Preparation of the dye and cloth

Tools/equipment and materials required

- Pestle and mortar
- Plastic pails (buckets)
- Stirring sticks
- Water
- Salt
- Fire
- Alum (when available)
- Sieve or strainer.

Preparation of the dye

BARK AND ROOTS

Remove the outer dead layer with a sharp knife. If there is one, also remove the inner white layer. If the material is to be stored for future use, break it into small pieces and dry in the shade for a few days. The bark or roots can also be used fresh though some people have found that the dye is stronger when the material has been dried. Pound the material with a mortar and pestle to break down the fibres.

LEAVES

Pound the leaves in a mortar to break down the fibres. In some cases, treatment such as soaking in water or mud may improve the process.

Preparation of the cloth

COTTON

- Boil the fabric with soap and hot water for 30 to 60 minutes to remove the starch. This will allow the dye to penetrate fix/attach well to the cloth.
- Boil again with caustic soda or wood ash to remove any remaining starch and increase the ability of the cloth to absorb the dye. Where possible, bleach and rinse well before dyeing. This will lighten the fabric and produce brighter colours.

Dyeing

- Place the pounded material (bark, root, leaves) in the dye pot with water and bring it to a boil. Strain the dye liquor to remove all the fibres and then add the wet fabric to be dyed
- Add alum if available or leaf ash of *Brachystegia* or *Julbernardia* spp to assist in fixing the dye.
- Leave the fabric in the dye batch for 30 minutes, boiling and stirring constantly.
- Avoid using iron pots as they will contaminate the dye.
- Use separate pots/container for each colour.
- Rinse the fabric until the water runs clear, then dry in the shade

Points to note

The amount of water and dye material (root, bark or leaf) will depend on:

- The amount of fabric to be dyed.
- The state (fresh or dry) of the dyeing material.
- The time of the year the dye material is collected
- The age of the plant or tree.

Table A2.1 Species yielding dyes

1. Blue dye

Specific name	Local name	Part used
<i>Cocculus hirsutus</i>	Chipapata, Msisisi	Fruit
<i>Diospyros mespiliformis</i>	Mchenja, Mvimbe	Bark
<i>Indigofera</i> spp.	Kabeleka, Mtanga, Tanga, (Indigo)	Leaves, Flowers Kampete
<i>Mapaca sansibarica</i>	Kasokolowe, Katoto	Outer layer of roots
<i>Piliostigma thonningi</i>	Msekese, Chitimbe	Seeds and pods
<i>Polygonum</i> spp.	Chikanda, Njovu, Kalumanda, Mswente	Roots (indigo)
<i>Syzygium cordatum</i>	Katope, Kansimia, Kasokolowe	Bark
<i>Terminalia sericea</i>	Mgonondo, Gonondo	Leaves
<i>Uapaca sansibarica</i>	Katoto, Kansima, Kasokolowe	Roots

2. Green dye

Specific name	Local name	Part used
<i>Diospyros batocana</i>	Mdimba	Leaves
<i>Grewia</i> spp.	Chisese, Msipani, Kazaza	Roots
<i>Lablab niger</i>	Kayela, Nchunga	Leaves
<i>Mucuna</i> spp.	Chitedze/Nkasi	Leaves

3. Orange-brown dye

Specific name	Local name	Part used
<i>Brachystegia longifolia</i>	Mnchenga, Msamba, Mfundanzinzi	Bark
<i>Brachystegia spiciformis</i>	Mputi	Bark
<i>Ficus sur</i>	Mkuyu	Bark

4. Yellow-brown dye

Specific name	Local name	Part used
<i>Acacia tortilis</i>	Nsangunsangu, Mzunga, Nyoswa	Bark, Roots
<i>Annona senegalensis</i>	Mpovya, Mtopa	Bark, Leaves
<i>Garcinia buchananii</i>	Matatane, Msongwa	Bark, Leaves
<i>Lannea stuhlmanni</i>	Shaumbu, Msambandola, Chisula	Bark

5. Yellow dye

Specific name	Local name	Part used
<i>Borassum aethiopum</i>	Chipamba, Kakoma, Mlaza	Roots and stems
<i>Combretum collinum</i>	Kalama, Mkute, Mtebelebe	Roots, Fruit
<i>Combretum zeyheri</i>	Kalamafupa, Kadale	Roots
<i>Dalbergia nitidula</i>	Mzembe, Mvungwe	Bark, Roots
<i>Harungana madagascariensis</i>	Msuwasuwa	Latex, Roots, Stem
<i>Pterospermum</i> spp.	Kavundula, Mziloti	Roots, Stem
<i>Terminalia mollis</i>	Gonondo	Roots

6. Red-brown dye

Specific name	Local name	Part used
<i>Bridelia duvigneaudi</i>	Mwanjane	Bark
<i>Commiphora africana</i>	Chololo, Chitongo, Mchovwa	Bark
<i>Khaya nyasica</i>	Mubawa, Mlulu	Bark
<i>Kigelia africana</i>	Mvungula, Mvunguti	Pods
<i>Parinari curatellifolia</i>	Mpundu, Mbula	Bark
<i>Parkia filicoidea</i>	Mpeza, Msenya	Bark
<i>Tephrosia purpurea</i>	Kalela, Katenda, Zomba, Msenya	Leaves

7. Brown dye

Specific name	Local name	Part used
<i>Berchemia discolor</i>	Mtacha, Mziyi	Bark and wood
<i>Cassythia filiformis</i>	Mzewa, Sakazinje, Sangazinje	Stems
<i>Combretum imberbe</i>	Chilusaka, Mlita, Nyonja	Roots, Wood ash
<i>Erythrina abyssinica</i>	Mlunguti, Msungwa	Bark
<i>Ficus capensis</i>	Mkuyu	Bark
<i>Julbernardia globiflora</i>	Kamponi	Bark
<i>Julbernardia paniculata</i>	Mtondo	Bark
<i>Lannea stuhlmanni</i>	Chisula, Kawumbu, Mbale, Msambandola	Bark
<i>Peltophorum africana</i>	Mteta, Nyele	Bark
<i>Phoenix reclinata</i>	Kanchita	Roots
<i>Phyllanthus muellerianus</i>	Kapikanduzi, Lungwishi, Mkuzandola, Mpika	Bark
<i>Piliostigma thonningii</i>	Msekese	Roots, Bark
<i>Pterocarpus angolensis</i>	Mlombe, Mlombwa	Latex, Bark, Roots
<i>Trema orientalis</i>	Mchende	Leaves
<i>Ziziphus mauritiana</i>	Msau	Bark

8. Pink to red dyes

Botanical name	Local name	Part used
<i>Adansonia digitata</i>	Mlambe, Mkulukumba	Roots
<i>Berchemia discolor</i>	Mtacha, Mziyi	Bark and wood
<i>Combretum molle</i>	Kalama, Mkute	Leaves
<i>Dalbergia melanoxylon</i>	Kasalusalu, Mkelete, Mkumundwe, Musalu, Pulupulu	Heartwood
<i>Dalbergia nitidula</i>	Kabulasese, Mkolasinga, Mzembe	Bark, Roots

<i>Elephantorrhiza goetzei</i>	Chiteta	Roots
<i>Erythrina abyssinica</i>	Mlunguti	Roots
<i>Faurea saligna</i>	Saninga, Chinsense, Kayeza, Chipepe	Barks, Leaves
<i>Garcinia buchananii</i>	Matatane, Msongwa	Barks, Leaves
<i>Grewia</i> spp.	Chinteshya, Chisese, Kanjili, Kazaza	Fruit, Pulp
<i>Hymenocardia acida</i>	Kabale, Kalalitsi	Bark
<i>Lannea stuhlmannii</i>	Msambandola, Kawumbu, Chisula	Bark
<i>Parinari curatellifolia</i>	Mpundu, Mbula	Leaves
<i>Piliostigma thonningi</i>	Msekese, Mfumbe	Root, Bark
<i>Popovia obovata</i>	Mchinga, Mlungulwa	Fruit pulp
<i>Protea</i> spp.	Kayeze, Msakata	Roots
<i>Pterocarpus angolensis</i>	Mlombe, Mlombwa	Wood
<i>Securinega virosa</i>	Chipyezo, Kapilashila, Kapyaiyai	Fruit
<i>Swartzia madagascariensis</i>	Mchelekete, Ndale, Kasokosoko	Heartwood
<i>Xeroderris stuhlmannii</i>	Chitondotondo, Mlombeye	Bark

9. Black dye

Botanical name	Local name	Part used
<i>Acacia nilotica</i>	Chisiyo, Uzimwe, Denganya	Bark and pods
<i>Berchemia discolor</i>	Mtacha, Mziyi	Roots and bark
<i>Brachystegia longifolia</i>	Msamba, Muombo,	Bark (6–13% tannin)
<i>Brachystegia spiciformis</i>	Mputi, Mfundanzizi	Bark (6–13% tannin)
<i>Bridelia micrantha</i>	Mlebeli, Mwazi, Msongamino	Wood chips, fruit
<i>Conyza persicifolia</i>	Kabwani, Msanda, Zungumbwa	Leaf sap
<i>Crotalaria</i> spp.	Chekwechekwe, Kalonganda, Zumba	Whole plant
<i>Diospyros batocana</i>	Mdimba	Bark
<i>Diospyros mespiliformis</i>	Mchenja, Mvimbe	Bark
<i>Eclipta prostrata</i>	Kalile	Whole plant
<i>Gardenia spatulifolia</i>	Mtala, Mvalani	Fruit pulp
<i>Julbernardia paniculata</i>	Mtondo	Bark soaked in mud
<i>Mucuna</i> spp.	Chitedze, Nkasi, Nkunga	Roots
<i>Parinari curatellifolia</i>	Mpundu, Mbula	Fruit
<i>Parinari excelsa</i>	Mbula, Mkangula, Mpundu	Fruit
<i>Phyllanthus reticulatus</i>	Kapululu, Kapulula, Mbuzi	Root and bark
<i>Piliostigma thonningi</i>	Msekese, Mfumbe, Mtukutu	Seeds and pods
<i>Pterolobium stellatum</i>	Kambola, Kambola	Leaves
<i>Salix subserrata</i>	Msondozi	Leaves
<i>Securinega virosa</i>	Chipyezo, Kapilashila, Kapyaiyai	Leaves
<i>Syzygium cordatum</i>	Katope, Msombo, Mchisu, Mwenya	Bark
<i>Terminalia mollis</i>	Gonondo, Kalamabondo	Bark
<i>Trema orientalis</i>	Mchende	Bark

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