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Piliostigma reticulatum (DC.) Hochst

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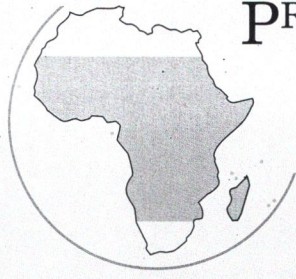
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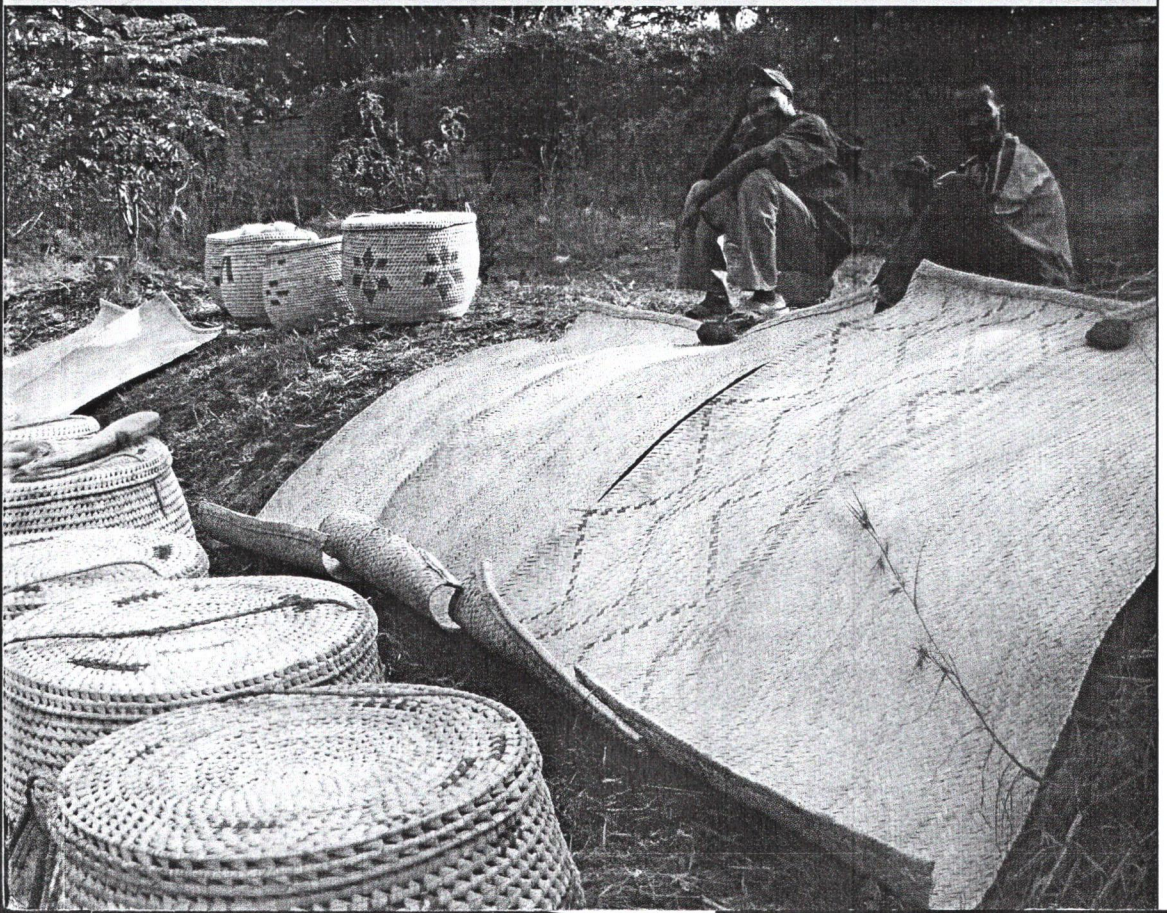
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veined, callus 0.5–1 mm long with hairs 5–7 mm long; palea 2–6 mm long; anthers 3 (2 in sterile floret), c. 2 mm long; ovary glabrous, with 2 stigmas. Fruit a caryopsis (grain) with elliptical hilum.

Phragmites is a cosmopolitan genus of about 4 species, of which 3 occur in tropical Africa. The species are very similar, distinguishing characters overlap and combinations of characters are needed to distinguish the species. The genus is sometimes considered monospecific. *Phragmites mauritianus* is most closely related to *Phragmites frutescens* H.Scholz from the eastern Mediterranean. The latter may represent a group of isolated, perhaps relictual, populations of *Phragmites mauritianus*. Clones of *Phragmites australis* from the Gulf Coast of the United States show close resemblance to *Phragmites mauritianus* in leaf characteristics. *Phragmites mauritianus* is vigorous and fast growing. In undisturbed places in Lake Victoria accumulated dry phytomass reached 64 t/ha, of which about 70% above-ground and 30% below-ground. The growth rate after cutting was about 30 t/ha of dry matter in a period of 4 months.

Ecology *Phragmites mauritianus* is common along rivers, lakes and dams and in swamps, floodplains and vleis, often growing partially submerged. It occurs at altitudes of 580–1500 m.

Stands along rivers are very dynamic. Observations in Kruger National Park in Mpumalanga, South Africa indicated that propagation by seed must play an important role in the establishment of new colonies, especially when reeds colonize the previously un-vegetated edges of new active channels. These new patches would then expand by clonal growth. Destruction of reed patches by flooding, wave action, herbivores or prolonged drought contribute to the dynamics of the vegetation.

Management In the Okavanga delta in Botswana *Phragmites mauritianus* is preferred to *Phragmites australis* for harvesting. It is more common than the latter, taller and more productive. In Hluhluwe-Umfolozi Park, South Africa, harvesting the reedbeds in Fuyeni causes a decrease in average reed size through the removal of large reeds: in uncut areas 66% of the total reed density consists of large reeds, in cut areas only 15%. Reed regeneration after cutting is rapid, but the proportion of large reeds remains low. Harvest of no more than 30% of the large reeds is recommended and a given area should not be harvested more fre-

quently than biennially to allow young shoots to mature into large, usable reeds.

Phragmites mauritianus is often grown in natural or constructed water-clearing wetlands. In swamps bordering Lake Victoria, sludge effluent from water treatment plants had little negative effect on the productivity of *Phragmites mauritianus*. It seems less suitable to clear paper-mill effluents, because they contain compounds that are not easily biodegradable.

Genetic resources and breeding *Phragmites mauritianus* is widespread and locally dominant. It is not in danger of genetic erosion except where it is heavily harvested or grazed. *Phragmites mauritianus* is not represented in germplasm collections and no breeding or selection work is known.

Prospects *Phragmites mauritianus* will remain an important source of thatch and construction material. Its role in water clearing is likely to increase and deserves more research attention. The taxonomy of *Phragmites* and the distribution of its species also need research attention.

Major references Clayton & Renvoize, 1982; Clayton, Harman & Williamson, 2006–; Fanshawe, 1972; Kaseva, 2004; Lambertini et al., 2008.

Other references Abira, Ngirigacha & van Bruggen, 2003; Bingham, 1990; Gelfand et al., 1985; Kambizi & Afolayan, 2001; Koechlin, 1962; Kotschy & Rogers, 2008; Launert, 1971; McKean, 2001; Mugisha et al., 2007; Neuwinger, 2000; Okurut, Rijs & van Bruggen, 1999.

Authors L.P.A. Oyen

PILIOSTIGMA RETICULATUM (DC.) Hochst.

Protologue Flora 29: 599 (1846).

Family Caesalpiniaceae (Leguminosae - Caesalpinoideae)

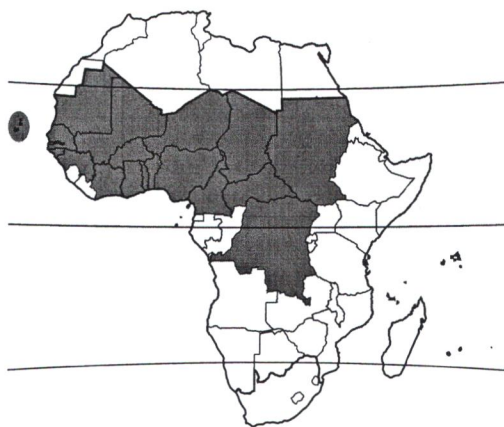
Chromosome number $2n = 28$

Synonyms *Bauhinia reticulata* DC. (1825).

Vernacular names Camel's foot (En). Pied de chameau, semellier (Fr). Musacanca (Po).

Origin and geographic distribution *Pilostigma reticulatum* occurs in the Sahelo-Sudanian region from Senegal and Mauritania eastward to Sudan. It has been introduced into Mozambique.

Uses The fibrous bark is used for tying. In Burkina Faso and Niger, for instance, the bark is used for tying roof rafters of granaries, huts or houses, and it is used in the production of articles such as baskets, chairs, mats, arrows



Piliostigma reticulatum - wild

and masks. In Senegal Serer fishermen make nets from the bark. In northern Benin farmers use the bark to tie firewood gathered in the bush or to tie up sheep and pigs to houses during the rainy season. In Sudan it is made into cloth. The bark and resin from the bark are used for fastening the metal parts of tools and weapons to the handles. The leaves are used to wrap foods. The stems are used as toothbrushes.

The tree provides poles and the wood is used for making tool handles, household utensils, stools, masks and other small articles. It is also used as tinder, as fuelwood and for making charcoal. The use of the bark for house building and as fuel is reported in south-western Niger. In Burkina Faso the young leaves, fruits and roots are cooked and eaten. The boiled leaves are added to cereal porridge to make it more acid and keep it edible for several days. The young fruits are eaten as a vegetable, and the seeds as a condiment or as food in times of scarcity. The pounded and boiled fruits are made into drinks. The leaves, branches, pods and seeds are eaten by cattle, sheep, goats and camels.

The roots yield a red dye, the fruits and seeds a blue one. The bark is used for tanning hides and chewed to stain the teeth red. Young leaves are used for coagulating rubber. In Burkina Faso a leaf decoction is used for making the skins of drums supple. The fruits are burnt for smoking beehives to make these attractive to bees. In Nigeria the fruits are burnt as fuel or used for strengthening uncured clay pots. A perfume is made from the seeds. In Nigeria the seeds are sometimes chewed as a

substitute of kola nuts or to stain the lips red. In central Burkina Faso, the plant is considered to contribute to soil improvement and farmers use the leaves for mulching. In addition *Piliostigma reticulatum* provides shade during agricultural activities, e.g. in nurseries. The species is extensively used in traditional medicine. The roots are used for the treatment of gonorrhoea, hookworm, ascites and dropsy. Root infusions are taken against diarrhoea and uterine pain. Root decoctions are used in preparations against liver and gall complaints, and are drunk as an antidote for plant poison. Root decoctions or macerations are taken or used in vapour baths against cough, diarrhoea, constipation, stomach-ache and muscular pain. The sap of ground roots is applied on swellings in dislocations, and taken against painful pregnancy and nausea.

The bark is widely used on wounds, cuts, ulcers and sores as an astringent, haemostatic, antiseptic and cicatrisant. Bark decoctions are used for washing wounds and as a mouthwash, and for the treatment of fever, colds, stomach-ache, indigestion and diarrhoea. A decoction of the bark boiled in milk or bouillon is drunk against gonorrhoea. Bark infusions are taken against toothache and vomiting. The bark is chewed against cough, or a bark maceration is drunk. A maceration of the inner bark is used as a wash against ringworm. The fresh bark is attached to body parts that are swollen due to inflammation. In Gabon the bark is used to immobilise fractures. In Niger the aerial parts are used as a tonic for women who have given birth and they form part of preparations against fever in children. Boiled young shoots are chewed by children with toothache.

The leaves are used against fever and as a tranquillizer, and for the treatment of a range of ailments including colds, bronchitis, headache, rheumatism, ophthalmia, toothache, mumps, syphilis, vertigo and epilepsy. Leaf preparations are often applied on wounds, ulcers and sores; they are considered haemostatic, antiseptic and cicatrisant. Ground fresh leaves are applied in case of inflammation. Young leaves are eaten raw against nausea. Boiled leaves are rubbed in against lumbago. In northern Senegal a decoction of the leaves in a vapour-bath is used against conjunctivitis. Leaf decoctions are taken by women in labour to ease delivery, and are used in draught and in baths as a sedative and against epilepsy and possession. Leaf decoctions are also taken against dysentery, haemorrhoids, malaria and

hernia. In Nigeria leaf decoctions are used to foment fractures and to get rid of guinea worm. A leaf decoction is rubbed into scarifications for the treatment of leg pain. Leaf infusions are used in drinks or baths as a sedative and anti-rachitic for new-born children, and to stimulate their appetite. Macerations of young leaves and flower buds are given against rickets in babies, kwashiorkor and anorexia.

The fruit is used as a laxative and for the treatment of wounds, sores, ringworm, headache, encephalitis, bronchitis, cough, liver problems and indigestion. In Burkina Faso crushed or powdered fruits are applied on the skin for the treatment of wounds and skin problems, and burnt and crushed fruits against cough. In Senegal the powdered fruit in water is taken by draught or used topically in case of snake bites.

In traditional veterinary medicine the powdered root is put into drinking-water for the treatment of diarrhoea in cattle. In Nigeria powdered seeds are added to brewery waste and given to animals against trypanosomiasis.

Production and international trade *Piliostigma reticulatum* yields many products of local importance. However, no statistics are available on their production and trade. In Burkina Faso small rolls of the bark are sold on local markets as tying material.

Properties The fibre is recorded to be strong. The wood is reddish, darkening to brown. It is heavy, hard, strong and tough. It works well, but the usually small size limits its usefulness. The wood is liable to attacks by termites and borers. It is good fuelwood, because it does not burn fast. The wood fibres in samples from Nigeria were 0.7–1.2 mm long, with a cell wall thickness of c. 5.8 μm .

The bark contains up to 20% tannin. Alkaloids and saponins have been reported present in the roots and bark, and phenolics, triterpenes and phlobatinins in the bark. Fresh leaves contain per 100 g edible portion: water 78.3 g, energy 268 kJ (64 kcal), protein 4.8 g, fat 0.1 g, carbohydrate 14.4 g, fibre 6.8 g, Ca 435 mg, P 80 mg, ascorbic acid 68 mg (Leung, Busson & Jardin, 1968). The leaves have an acidic taste. One kg of fruits contains 55–67 g digestible crude protein. Seeds from Nigeria contained 30.3% crude protein and 27.9% oil. The leaves and the fruits are rich in l-tartaric acid; d-tartaric acid has been isolated as well.

Methanolic root extracts have shown in-vivo anti-diarrhoeal and anti-ulcerogenic properties in rats. Aqueous extracts of the bark showed

in-vivo anti-inflammatory and analgesic effects in mice and rats. Ethanolic and aqueous bark extracts showed antibacterial activity. Leaf extracts showed anti-inflammatory activity in the carrageenan-induced rat paw oedema model and antimicrobial activity, especially against Gram positive bacteria. Piliostigmol and various flavonoids isolated from the leaf also showed anti-inflammatory and antimicrobial activity. Methanol extracts from leaves have proved to be trypanocidal against *Trypanosoma brucei brucei* and *Trypanosoma congolense*. Leaf decoctions showed in-vivo anticonvulsant and sedative activity in mice. Butanol and ethyl acetate fractions of the leaf extract exhibited strong antioxidant activity. Quercetin and quercetin glycosides isolated from the ethyl acetate fraction also showed antioxidant activity.

Leaves of *Piliostigma reticulatum* exhibited fast decomposition rate and in the Sahel the plant is considered one of the most promising species to provide organic manure to crops. However, in experiments in Senegal soils amended with leaf residues immobilized nitrogen during the first 62 days, and addition of stems even prolonged the immobilisation period.

Adulterations and substitutes Traditionally, people use *Piliostigma reticulatum* and *Piliostigma thonningii* (Schum.) Milne-Redh. in the same way.

Description Dioecious shrub or small tree up to 10(–15) m tall; bole short, rarely straight, up to 30 cm in diameter; outer bark deeply fissured to cracked, grey to brown, inner bark pink to red; crown rounded and dense; branches grey, waxy and glabrous. Leaves alternate, conspicuously bi-lobed; petiole 1–3.5 cm long, swollen at both ends; blade 5–12 cm \times 4–18 cm, cordate or rounded at base, lobes rounded or more or less cuneate, coriaceous, glabrous, greyish-green, palmately veined with 8–11 basal veins. Inflorescence an axillary or terminal panicle, 5–15 cm long, shortly pubescent. Flowers unisexual, c. 2.5 cm in diameter; calyx 5-toothed, 15–20 mm long; petals 5, obovate, white with pink stripes; male flowers with 10 stamens, anthers brown. Fruit an oblong pod 15–30 cm \times 2.5–5 cm, straight, undulate or twisted, woody, hard, glabrous or sparsely pubescent, brown, flat, pruinose, sometimes twisted and cracked, indehiscent and persisting, many-seeded. Seedling with epigeal germination.

Other botanical information *Piliostigma*



Piliostigma reticulatum - 1, flowering twigs; 2, fruit.

Redrawn and adapted by Iskak Syamsudin

comprises 3 species in tropical Africa, Asia and Australia. *Piliostigma reticulatum* is frequently confused with *Piliostigma thonningii* due to similarity in appearance, but the latter has larger leaves with hairs on the lower surface, and usually occurs in less dry areas.

Growth and development The growth of *Piliostigma reticulatum* is recorded to be slow. Flowering is in the dry season. In Benin flowering and fruiting occur in October. In drier areas *Piliostigma reticulatum* is semi-deciduous, losing most of its leaves at the end of the dry season, but in more humid zones the leaves are often persistent. The plant resprouts after the stem has been cut. Animals eating the fruits contribute to dispersal of the seeds.

Ecology *Piliostigma reticulatum* occurs from sea level up to 2000 m altitude in areas with an annual rainfall of (200–)400–1000 mm, mainly on heavy and poorly drained soils, but also on sandy soils. It is a pioneer species in woodland, wooded scrubland, wooded grassland, valleys and disturbed habitats such as cultivated fields, fallows and roadsides. The species is common and locally abundant.

Propagation and planting *Piliostigma reticulatum* can be propagated by seed. One kg contains 11,000–14,500 seeds. Germination is poor, but can be improved by soaking the seed successively in 90% H₂SO₄ for 30 minutes and in water for 24 hours, or by soaking them in hot water overnight or in 98% HCl for 90 minutes. Due to the fast growth of the root system, seedlings can be planted out already at 5–7 weeks after sowing.

Management The tree is spared during land preparation and maintained in agroforestry systems. The density of the species in parklands is very variable.

Diseases and pests *Piliostigma reticulatum* is a host of *Caryedon serratus*, a major pest of stored groundnuts. Eggs are laid on the surface of ripe *Piliostigma reticulatum* fruits, after which larvae bore through the husk and into the seed, where larval development takes place, resulting in damaged seeds.

Harvesting The bark is harvested by cutting the branches. It is hard to remove the bark when the stem is dry. For this reason it is recommended to harvest the bark as soon as the stem is cut. The bast is stripped off, dried and used as rope. Mature fruits and young leaves are directly harvested from the plant for various uses.

Handling after harvest *Piliostigma reticulatum* is not exploited for industrial fibre production. The bark is directly collected from cut branches in the field. Sometimes, collectors take the whole stem to their houses before removing the bark. The remaining wood is later used as fuel.

Genetic resources As *Piliostigma reticulatum* has a wide distribution and is common and locally abundant in its distribution area, it is not threatened by genetic erosion.

Prospects *Piliostigma reticulatum* is a valuable multipurpose plant, yielding a wide range of useful products. In Burkina Faso, for instance, it is becoming more and more important, because of the decline of other traditional agroforestry species. Integration of *Piliostigma reticulatum* in the traditional agroforestry systems in semi-arid and arid countries is important for sustainable use of the species. Further research on the domestication potential of the species is worthwhile. The antimicrobial and anti-inflammatory properties warrant further research for pharmaceutical uses.

Major references Aderogba et al., 2006; Arbonnier, 2004; Babajide et al., 2008; Baumer, 1983; Berhaut, 1975b; Burkill, 1991;

Neuwinger, 2000; Salawu et al., 2009; von Maydell, 1986; Yélérou et al., 2007a.

Other references Aderogba et al., 2004; Aderogba, Okoh & Idowu, 2005; Akin-Osanaiye et al., 2009; Atawodi et al., 2003; Aubréville, 1970; Awe & Omojasola, 2009; Ayantunde et al., 2009; Diack et al., 2000; d'Oliveira Feijão, 1961; Dossa et al., 2009; Fortin, Lô & Maynard, 1990; Geerling, 1982; Idu, Ijomah & Omonhinmin, 2002; Khan, 2001; Leung, Busson & Jardin, 1968; Ngo Bum et al., 2009; Sembène & Delobel, 1998; Toutain, 1980; Yélérou et al., 2007b; Youmbie, 2008.

Sources of illustration Andrews, 1952.

Authors F.G. Vodouhê, S. N'danikou & E.G. Achigan-Dako

PILIOSTIGMA THONNINGII (Schumach.)
Milne-Redh.

Protologue Hooker's Icon. Pl. 35: 2, t. 3460 (1947).

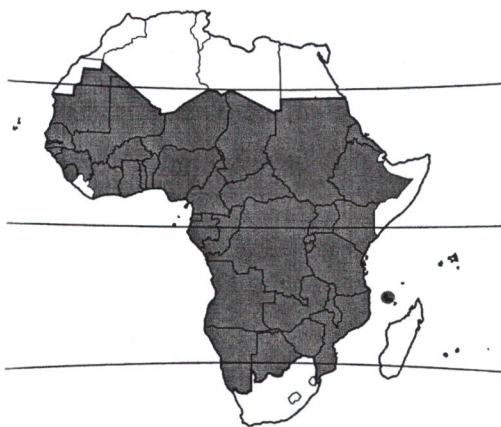
Family Caesalpiniaceae (Leguminosae - Caesalpinioideae)

Chromosome number $2n = 24, 26$

Synonyms *Bauhinia thonningii* Schumach. & Thonn. (1827).

Vernacular names Camel's foot, camel's foot tree, monkey bread, wild bauhinia, picture-frame tree (En). Pied de bœuf (Fr). Mchikichi, mchekeche, msegese, mkoma, msabuni (Sw).

Origin and geographic distribution *Piliostigma thonningii* is native to tropical Africa. It is widespread in the Sudano-Guinean region from Senegal eastward to Eritrea and occurs southward to Namibia, Botswana, Mozambique



Piliostigma thonningii - wild

and South Africa. It also occurs in Yemen.

Uses The bark is commonly used for tying, for instance in hut, fence and bridge building. In Sudan and Mozambique the inner bark is used for binding an arrowhead to its shaft. The bark was formerly made into barkcloth. Fibres extracted from the bark are widely used for making string, rope and cloth. Root fibres are made into rope as well. The leaves are used for wrapping food, and twigs and roots serve as toothbrushes. The dried fruit is used to smooth pottery, and the roots are used for giving a glaze to gourds.

The bark provides tanning material and yields a red-brown dye used for cloth and wooden tools. The root yields a red-brown or black dye, and the fruit and seeds a black or blue one. In Ghana, Nigeria and DR Congo women chew the root-bark to redden their lips; the bark is also rubbed on the lips to colour these red. Hausa in Nigeria stain their teeth red by chewing the bark.

The fruit is eaten as a snack or as an emergency food, especially by children and herdsman. In times of scarcity the fruits are ground and boiled into porridge or made into drinks. In Sudan the roasted seeds are eaten. In Kenya the bark is eaten in times of severe food shortages. Maasai people in East Africa chew the leaves as thirst-quencher. The foliage and fruits are browsed by cattle and other livestock. The flowers are a substitute for tobacco, and the roots are used to increase the strength of tobacco. Mature fruits are burnt to obtain a salt.

The tree provides poles and timber for local house construction. The wood is also used for kitchen utensils, tool handles, furniture, bedposts, wheel-work and carpentry. The Maasai make bows from the wood. The wood is used as firewood and for making charcoal.

The unripe fruits are used as a soap substitute, and the ash of ripe fruits is also used in soap making. In Côte d'Ivoire dried leaves are used together with those of *Parinaria curatellifolia* Planch. for making gunpowder. Infusions of the bark, leaf or pod are used to coagulate *Funtumia* latex in making rubber. The bark yields a gum that swells and softens in water and is used for caulking. A resin obtained from the unripe fruit is used as glue for fastening the iron parts of tools and spears to the handles.

Piliostigma thonningii is an agroforestry tree, suitable for intercropping with crops. It provides good shade and serves as shelterbelt in homesteads when in full foliage. It is used in