

Plants For a Future 2021CE

Hardiness Zone 12, Wet, Heavy Clay

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1 Introduction

This is a book of plant information harvested from pfaf.org the goal is for future generations to have access to this valuable plant information. This book does Not contain any plant identification material, so you will need to use other references for actually identifying the plant. This book does contain information on how to grow the plants and their edible and other uses.

The plants are sorted by nitrogen-fixing ability, edibility, plant height, other uses, medicinal uses, and latin name. They start with nitrogen fixers because those are typically the easiest to establish pioneer plants.

Instructions for food forest design are in separate books. But basic idea is to have thorny plants on the border as a form of fence to keep out predators and animals that want to raid your food forest, with the shortest plants closest to the border, then gradually getting taller plants as you go in. For example starting with thorny herbaceous, then row of thorny shrub, the row of thorny trees. Afterwards can put in several rows of your staple crop, which typically is a variety of nut, acorn and bean producing tall trees. Then can put in a long rotation coppice of hardwood lumber trees you find useful, then a row or more of fruit trees, then a short rotation coppice to use for firewood, then some rows of berry, bean and nut shrubs, with the closest circle near the community being vegetables and perennials that take more care than the others.

You need about a hectare of land (2.5 acres) per person if you have 6 months growing season (where average temperature is above 10C), at least half of which should be dedicated to food, the other half can be to lumber, but can also be food trees that are occasionally used as lumber. A general formula is 6/monthsGrowingSeason to see how many hectares you need. This assumes you have at least 600mm of rainfall per year, and only works if you have more than 3 months growing season, as very little you can grow in less than that.

If you live in a dry area, especially one prone to flash floods, then it is imperative that you spend your dry season digging swales and vernal pools, that will collect the rain water during the flash floods and keep it in place so that it enters the ground, then you can grow things downhill of your vernal

pools and swales. It is generally more important that they be extensive than deep. You want to ideally catch every drop, so that none of it leaves your property.

By contrast if you live in a very wet area with more than enough water, then you want to have ditches to help the water leave the property and not waterlog your soil.

If you have a slope exceeding 30 degrees then you will want to reinforce with terraces any water catchment areas such as vernal pools or ponds, also can use terraces for growing tubers or anything that requires digging to plant or harvest, otherwise your soil is liable to wash away. You may wish to use terraces with smaller slopes as well if you are doing soil tilling or digging. In a food forest permaculture system generally you want to minimize soil disturbance and focus on getting your food from fruits, leaves, bark or other above ground sources.

In a medium wetness area you can use either method to create various microclimates for different kinds of plants.

In either case you want to start with about 1 in three plants being a nitrogen fixer (bwon), as it will help your food forest grow faster.

Summaries are given in the Cosmic Language (KsomPyash). Long descriptions are in English.

1.1 Pronunciation guide

a /a/, b /b/, c /j/ "sh", d /d/, e /e/, f /f/, g /g/, h /h/, i /i/, j /j/ "zh", k /k/, l /l/, m /m/, n /n/, o /o/, p /p/, q /ŋ/ "ng", r /r/, s /s/, t /t/, u /u/, v /v/, w /w/, x /x/ /ʒ/ "gh", y /j/, z /z/, 2 /ɹ/ (low tone), 6 /ə/ "uh", 7 /ɹ/ (high tone).

1.2 vocabulary

tlin /tlin/ cold hardiness, cyuc /tju/ heat hardiness, kcak /kjak/ food (rating), tcan /tʃan/ other (uses rating), dwat /dwa/ medicinal (rating), hkuc /hku/ (adult) height, hsi2n /hsi.ln/ (adult) width, ksan /ksan/ least (minimum).

pcim /pʃim/ full (shade), hmim /hmim/ medium (shade), htut /htut/ no (shade), cyut /tju/ shade. li /li/ realis-mood (end of sentence), ta /ta/ topic-case.

hgat /hga/ drought (tolerant), kyuc /kju/ dry, tcup /tʃup/ damp, hja7n /hʒa.ln/ wet, hs6s /hsəs/ puddle, hwic /hwɪ/ water (requirement).

hyis /hjis/ poor (soil), hras /hras/ sandy, jlut /ʒlut/ loamy, nyik /njik/ mud (silt/clay loam), frip /frip/ pottery (heavy clay), hpa7t /hpa.t/ topsoil.

frus /frus/ corrosive (very acid), flat /flat/ acid, prik /prik/ passive (neutral), lwis /lwis/ alkaline, slip /slip/ slippery (very alkaline), hsom /hsom/ salt (saline), hpa7mwa /hpa.tmwa/ topsoil taste.

fyif /fjif/ self (fertile), xre7t /ʒre.t/, nyanhjen /njanhʒen/ male-female (dioecious, distinct male and female plants), hjon /hʒon/ sex.

hmcuc /hmu/ purpose, pcis /pʃis/ danger, trot /trot/ temperature, prop /prop/ fertile, tcan /tʃan/ other, hyum /hjum/ uses, dwat /dwa/ medicine, drut /drut/ description, kcac /kʃe/ region, tfo2n /tfo.ln/ nitrogen-fixing, xlutkfam /ʒlut.kfam/ plant quantity, bwon /bwon/ bean, mran /mran/ corn/grain non-nitrogen-fixing plant, nrak /nrak/ continent (of origin), ksac /ksa/ circumstances/habit.

12 hmuctrotkcec, hja7n hmuchwic, 0 ksankcak, frip hmuchpa7t, prik hmuchpa7mwa, 14 xlutkfam.

2.0.1 Ipomoea aquatica

Kangkong, Swamp Morning Glory

7 tlin 12 cyuc 4 kcaak 0 tcan 2 dwat 0.5 m hkuc
htut cyutli tcuphja 7nhs6s hwicli hrasjlutnyikfrip hpa7tli frusflatprikhwis hpa7tmwatli fyif hjonli

drutta *Ipomoea aquatica* is an evergreen Annual/Perennial growing to 0.5 m (1ft 8in) by 0.3 m (1ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 8. The flowers are pollinated by Bees, Butterflies. The plant is self-fertile. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid soils. It cannot grow in the shade. It prefers moist or wet soil and can grow in water.

pcista Accumulation of heavy metals in the plant has been reported in Asia, mainly because the plants are often grown in polluted water[299].

kcakta Edible Parts: Leaves Root Shoots Edible Uses: Leaves and young shoots - raw or cooked[296 , 298]. The tasty leaves are produced all year round[296]. The youngest shoot tips can be added to salads, older leaves are cooked and make a mild-flavoured spinach[298]. The leaves can be stir-fried, steamed, boiled for a few minutes or lightly fried in oil and eaten in various dishes. They are often mixed with hot peppers and garlic and prepared with a savoury dish[299]. Very nutritious, the leaves are a good source of protein as well as providing good quantities of vitamin A, iron, calcium and phosphorus[298]. Roots - occasionally cooked and eaten[29 , 301].

dwatta Antidote Antihemorrhoidal Antitussive Febrifuge Hypoglycaemic Laxative Laxative Poultice Skin Tonic The young shoots are mildly laxative and are used by diabetic patients[272]. A decoction of the leaves is used to treat coughs[272]. The fried leaves are eaten to cool down a fever[310]. The crushed leaves are applied as a poultice on sores and boils[310 , 348]. A paste made from the buds is used to treat ringworm[272 , 299]. The roots are laxative, tonic and antidote[310]. They are used in the treatment of opium or arsenic poisoning, and also to counter the effects of drinking unhealthy water[310]. A decoction of the roots is used as a wash against haemorrhoids[310 , 348]. The plant has shown oral hypoglycaemic activity in tests with diabetic humans; it was shown that an aqueous leaf extract can be as effective as tolbutamide in reducing blood glucose levels[299].

nrakta Pantropical. ksacta Moist, marshy or inundated localities, shallow pools, ditches, rice fields, forming dense masses[310]. Also found along roadsides at elevations from sea-level up to 1,000 metres[310].

propta Seed - sow in situ in moist to wet soil[300]. Only the annual form is usually propagated this way[300]. Germination rates of local cultivars are often low (less than 60%) because of hard-seedness induced by long storage. Reliable seed companies supply improved cultivars with a high (in excess of 80%) germination percentage. The seeds do not germinate well at temperatures lower than 25°C[299]. Cuttings of young shoots at any time of the year. The shoots readily produce roots, even whilst still on the parent plant[300].

nwatta Swamp morning glory is a plant of the moist to wet, lowland tropics, where it is found at elevations up to 1,000 metres. It grows best in areas where annual daytime temperatures are within the range 15 - 35°C, but can tolerate 10 - 40°C[418]. It prefers a mean annual rainfall in the range 2,000 - 2,500mm, but tolerates 700 - 4,200mm[418]. Plants grow well in full sun[296]. A very easy plant to grow, it succeeds in bathtubs, ponds and still water[296]. Succeeds in a wide range of soils, including heavy clays[300]. Best leaf production comes from plants grown in soils rich in organic matter[298]. Prefers a pH in the range 5 - 7, tolerating 4.3 - 7.5[418]. The plant is widespread as a swamp weed in all tropical and many subtropical lowland areas. It is a declared aquatic or terrestrial noxious weed in the south-eastern United States[299]. A very fast-growing plant, it starts developing lateral branches from cotyledonary buds 2 - 3 weeks after sowing. Thereafter the main axis and both laterals each produce about one leaf every 2 - 3 days[298 , 299

J. Cultivars selected for once-over harvest or propping have retarded branching or almost no branching. Their harvest takes place 21 - 30 days after sowing[296 , 299]. Cut and come again harvesting of vegetatively propagated plants or wild plants can start about one month after plant establishment[299]. Flowering commences after 2 - 5 months, but the plant continues to form new leaves and branches[299]. Swamp morning glory is a quantitative short-day plant, early flowering being induced by short days of less than 12 hours. Flowering is also stimulated by drought[299]. There are some named varieties[301]. Two main forms exist in cultivation:- A short-lived perennial form grows in very wet soils and water (it has been named *Ipomoea aquatica aquatica* by some authorities). This form can produce yields of up to 90 tonnes per hectare in Thailand[300]. An annual creeping form tolerates drier conditions (this has been named *Ipomoea aquatica reptans*)[300]. Under dryland cultivation, yields per crop can range from 7 - 30 tonnes per hectare, averaging 20 tonnes. In theory one crop can be produced every month leading to a potential yield of around 240 tonnes per hectare in a year[299] produce.

3 9 tlin

3.1 bwon

3.1.1 Sesbania grandiflora

Vegetable Hummingbird, Agati,

htu2n 9 tlin 12 cyuc 3 kcaak 4 tcan 2 dwat 12 m hkuc

htut cyutli hgattcuphja 7n hwicli hyishrasjlutnyikfrip hpa7tli frusflatprikhwisom hpa7tmwatli hjonli

drutta *Sesbania grandiflora* is a deciduous Tree growing to 12 m (39ft) by 10 m (32ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 9. The flowers are pollinated by Birds. It can fix Nitrogen. It is noted for attracting wildlife. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid and saline soils. It cannot grow in the shade. It prefers moist or wet soil and can tolerate drought. The plant is not wind tolerant.

kcakta Edible Parts: Flowers Leaves Seed Seedpod Shoots Edible Uses: Condiment Gum Tea Flowers - raw or cooked[301]. Added to salads, boiled as a potherb, fried or used in curries[46 , 301]. Considered a delicacy in India[307]. Rich in sugar and iron, with a flavour like mushrooms[301]. The centre part of the flower is usually removed because it is very bitter[301]. White flowers are generally preferred to red ones[303]. Seedpods - raw or cooked[46]. The long, narrow pods are boiled and eaten like string beans[301 , 303]. The very young seedpods can be added to salads[302]. The pods can be up to 50cm long and 8mm wide[303]. Seed. The protein rich seeds are fermented into tempeh[301]. Young leaves and shoots - raw or cooked[301 , 303]. Added to salads, cooked as a potherb or added to stews[301]. A clear gum obtained from the bark is used in foods[303].

tcanta Adhesive Biomass Charcoal Fencing Fibre Fodder Fuel Green manure Gum Mulch Paper plant support Shelterbelt Soil conditioner Soil reclamation Tannin Wood Small flowering tree. Specimen. Large planter, Xerophytic, Conservatory. Agroforestry Uses: Fast growing, with an extensive root system that fixes atmospheric nitrogen, the plant is ideal for rehabilitating eroded hills[303]. The fruits, falling leaflets and flowers make excellent green manure or mulch and improve soil fertility[303]. The plant has been used to provide shade in nurseries; for some plantation crops such as coffee, tea and cocoa; and as a windbreak for citrus, banana and coffee[404]. It can be used as a living fence, as shelterbelt, or as a live support for crops such as vanilla and pepper[404]. Crops continue to grow well when interplanted with this species since its open canopy allows sunlight to pass[404]. Other Uses: Bark exudate and seed endosperm gums are produced. The clear bark gum is used in adhesives as a substitute for gum arabic[303]. The bark yields tannins[272 , 303]. The white wood is soft and rather light. The density of the wood increases with age, however, and the timber from 5 to 8 year-old trees can be used in house construction or as craft wood[303 , 404]. The trunk has been

used for poles but may not last long due to rot and insect infestation[303]. The light wood is used in floating fishing nets[303]. The wood is a major source of pulp for use in making paper. The fibres are short and they can also be blended with long-fibred bamboo pulp in suitable proportions in order to give good strength[303]. The wood is used for fuel and to make charcoal[404]. It is not highly regarded as a fuel because it smokes excessively when burning. Having a weight of only 500 kg/square metre, it burns rapidly without much heat. But the tree's fast growth and availability within a year of planting make it a locally popular fuel wood[303]. The wood should be well dried, as it deteriorates in storage and becomes corky, dusty and unfit for burning. Its calorific value is 17.91 MJ/kg, with a high ash content (6%) and low percentage of carbon (11.7%)[303].

dwatta Anthelmintic Antibiotic Antidiarrhoeal Antipyretic Antirheumatic Antitumor Aperient Astringent Diuretic Dysentery Emollient Febrifuge Laxative Malaria Ophthalmic Poultrice TonicThe leaves are aperient and diuretic[272]. Crushed leaves are applied as a poultice to sprains and bruises of all kinds, swellings, rheumatism, itching etc[303]. A tea made from the leaves is believed to have antibiotic, anthelmintic, antitumor and contraceptive properties[303]. The bitter bark is considered as an astringent, febrifuge, tonic and an antipyretic, a remedy for gastric troubles, colic with diarrhoea and dysentery[46 , 272 , 303]. A bark decoction is taken orally to treat fever, diarrhoea, dysentery and diabetes[272 , 303]. The flowers are emollient and laxative[272]. Juice of the flowers, put in the eyes, is said to relieve dimness of vision[303]. Sinus congestion is reduced by taking a decoction of the flowers[303]. The root is a well-known medicine for malaria[303]. Root juices are used for poultices[303]. A paste of the root is applied externally in the treatment of rheumatism[272].

nrakta E. Asia - Probably originally from Malaysia and/or Indonesia, but original habitat is uncertain. ksacta Dry wasteland and roadsides[307].

propta Seed - it has a hard seedcoat and may benefit from scarification before sowing to speed up germination. This can usually be done by pouring a small amount of nearly boiling water on the seeds (being careful not to cook them!) and then soaking them for 12 - 24 hours in warm water. By this time they should have imbibed moisture and swollen - if they have not, then carefully make a nick in the seedcoat (being careful not to damage the embryo) and soak for a further 12 hours before sowing[302]. Easily propagated by direct seeding[303]. It is not hard seeded and usually germinates well without scarification[303]. Cuttings of half-ripe wood.

nwatta Agroforestry Services: Crop shade Agroforestry Services: Living fence Agroforestry Services: Living trellis Agroforestry Services: Nitrogen Agroforestry Services: Windbreak Fodder: Bank Industrial Crop: Biomass Management: Coppice Management: Standard Minor Global CropWell adapted to hot, humid environments in the lowland tropics[303]. It succeeds at elevations below 1,000 metres with a mean annual temperature in the range 22 - 30°C, and a mean annual rainfall of 2,000 - 4,000 mm, exceptionally tolerating rainfall as low as 800mm per year[303]. It lacks tolerance for cool temperatures below about 10°C[303]. It seems to prefer a bimodal rainfall distribution, growing rapidly during the wet season, but is capable of withstanding prolonged dry seasons of up to 9 months[303]. Requires a sunny position for best growth[404]. Prefers a fertile, moist but well-drained moderately light soil, though it succeeds in light sandy, medium, heavy clayey and low fertility soils[200 , 302 , 404]. Prefers a pH in the range 5.5 - 8.5, but can tolerate acid conditions down to 4.5[404]. Requires a position sheltered from strong winds[303]. The plant has an outstanding ability to tolerate waterlogging and is ideally suited to seasonally flooded environments[303]. When flooded, it initiates floating, adventitious roots, and protects their stems[303]. The species is very fast growing, but does not live long - it has a life span of about 20 years[303]. Plants have reached a height of 3.2 metres in just 9 months when raised in loamy soils, but only 1.8 metres when growing in sandy soils[303]. The plant tends to grow too quickly, resulting in brittle and weak limbs[307]. At a very short rotation of 3 - 4 years, the tree is capable of producing much higher cellulose raw material per unit area than most other pulp woods[303]. Even trees 3 - 4 years old can be pulped without debarking and are suitable for chemical pulping for use as cheap printing, writing, magazine and

newsprint paper[303]. On a 3-year rotation, about 41 tonnes of pulp per hectare per year can be harvested[303]. Young plants respond well to the first time they are coppiced, but tend to coppice less well with repeated cuttings[404]. Plants can flower all year round[307]. There are some named varieties[301]. This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby[200 , 404]. Flowering Time: Blooms all year. Bloom Color: Red White/Near White. Spacing: 10-12 ft. (3-3.6 m).

3.2 mran

3.2.1 Toona ciliata

Mountain Cedar, Australian Red Cedar, Toona
9 tlin 12 cyuc 2 kcak 4 tcan 2 dwat 30 m hkuc
pcimhmimhtut cyutli hgattcuphja7n hwicli jlutnyikfrip
hpa7tli frusflatprik hpa7tmwatli hjonli

drutta Toona ciliata is a deciduous Tree growing to 30 m (98ft) by 30 m (98ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. The flowers are pollinated by Bees, Moths. Suitable for: medium (loamy) and heavy (clay) soils, prefers well-drained soil and can grow in heavy clay soil. Suitable pH: mildly acid and neutral soils and can grow in very acid soils. It can grow in full shade (deep woodland) semi-shade (light woodland) or no shade. It prefers moist or wet soil and can tolerate drought.

pcista Sawdust from machining operations has been reported to cause dermatitis in some individuals[303].

kcakta Edible Parts: LeavesEdible Uses: Leaves - cooked[303].

tcanta Shade tree. Street tree. Public open space. Timber tree. Agroforestry Uses: Mountain cedar has been used in reforestation projects and is also planted to provide fire-breaks[303]. Other Uses The flowers contain a red colouring matter and also a sulphur-coloured dye[46 , 266 , 303]. Cotton and woollen fabric can be dyed a dull yellow by mere immersion in a boiling extract of the flowers. Used in conjunction with safflower and turmeric, they produce a sulphur-yellow colour[303]. The bark contains tannin[303]. A fibre obtained from the bark has been used traditionally for twines and the manufacture of string bags[303]. An aromatic oil can be extracted from the fruit[303]. Some extracts from the bark have insect-repellent properties[303]. Extracts from the bark, heartwood and leaves apparently have insecticidal qualities[451]. The wood is used for shitake mushroom culture[303]. The heartwood is pale brown, cedar brown, dark red-brown or brick red when first cut, darkening upon exposure to a rich reddish-brown with darker brown streaks. The sapwood is pinkish-white, red or pale yellow-brown, it smells strongly of cedar when cut[266 , 303]. The grain is generally straight to somewhat interlocked, the texture moderately close and uneven, and the wood lustrous[303]. A strong, fragrant, long-lasting spicy odour is usually present[303]. The wood is moderately hard, lightweight, tough and durable[272 , 307]. Staining is satisfactory, and the timber takes both water- and oil-based paints well[303]. The wood has a variety of uses such as for carvings, boat building, cabinet making, cigar boxes, matchboxes, decorative plywood and veneer, food containers, high-grade furniture, interior trim, joinery, musical instruments, ornamental work, panelling, boxes and crates, building materials, exterior uses, millwork, mouldings[272 , 303 , 307]. The timber of this species has always been highly regarded in the manufacture of light-weight racing boats particularly sailing boats and dinghies[713].

dwatta DysenteryVarious parts of the plant are used medicinally throughout its geographical range[266]. The bark is a powerful astringent, febrifuge, tonic, and antiperiodic[266 , 272]. It is used to treat chronic dysentery and wounds[266 , 272]. A resinous gum obtained from the bark is used to treat boils[272]. The flowers are emmenagogue[266].

nrakta E. Asia - China, Indian subcontinent, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Indonesi ksacta Common to abundant in shade or open habitats: valleys, ravines, woods, thickets, forests, hillsides, mountain-

slopes, near rivers, near rivers, especially through Yunnan, at elevations of 400 - 2,800 metres[266].

propta Seed - germinates quicker and better under shade[303]. It should be broadcast thinly on raised and shaded nursery beds soon after collection[303]. Germination takes 8 - 15 days and fresh seed has a germination rate of 50 - 80%[303]. Natural regeneration is profuse even in areas outside its natural range. Good natural reproduction can be induced by clearing the ground in the vicinity of seed bearers[303]. Orthodox seed storage behaviour; 90% germination after 12 months? storage in polythene bags at 5 - 8°C with 34-12.9% mc; complete loss of viability after 3 months at room temperature[303].

nwatta A plant of the moist to wet tropics and subtropics, where it is found at elevations from 400 - 2,800 metres[266 , 418]. It grows best in areas where annual daytime temperatures are within the range 18 - 34°C, but can tolerate 8 - 48°C[418]. When dormant, the plant can survive temperatures down to about -3°C, but young growth can be severely damaged at 0°C[418]. It prefers a mean annual rainfall in the range 1,100 - 3,000mm, but tolerates 750 - 4,500mm[418]. Young trees require some protection from direct sun, but become more light demanding as they grow older[418]. Prefers a rich, deep, water-retentive soil[307]. Does not do well on wet, compacted or poor sandy ones[303]. Prefers a pH in the range 5.5 - 6.5, tolerating 4.5 - 7.5[418]. Widely grown as a timber tree, it has wind-dispersed seeds and has become naturalized in some areas. It needs to be monitored for potential invasiveness[305]. *Toona ciliata* grows rapidly[299]. In Hawaii an average tree height of 10 metres and an average bole diameter of 9.6 cm had been reached after 8.7 years[299]. Trees may reach a height of 35 metres with a bole diameter of 70 cm when 40 years old[299]. In plantations in tropical Africa, growth declines seriously after 40 years[299]. Trees planted in open localities may already flower and produce seed after 6 years[299]. It coppices well and produces plentiful root suckers[303]. The tree has a spreading superficial root system, which may have adverse effects on the growth of agricultural crops[303]. The tendency to become branchy should be controlled by close initial spacing. Thinning is required from the 4th year, and thereafter every 5 years[303]. A very variable tree[266]. Flowering: early spring, mid spring, late spring. Bloom Color: red, pink, white.

3.2.2 *Cyperus textilis*

Flat sedge, Basket grass,
9 tlin 12 cyuc 0 kcak 4 tcan 0 dwat 1.5 m hkuc
pcimhmimtut cyutli tcuphja7nhs6s hwicli hrasjlutnyikfrif
hpa7tli flatprikliwis hpa7tmwatli hjonli

drutta *Cyperus textilis* is an evergreen Perennial growing to 1.5 m (5ft) by 1 m (3ft 3in) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils. It can grow in full shade (deep woodland) semi-shade (light woodland) or no shade. It prefers moist or wet soil and can grow in water. It can tolerate atmospheric pollution.

tcanta *Cyperus textilis* is an important material for the weaving of mats, basketry and ropemaking. It is a traditional building material for peoples of southern Africa, particularly the Khoi who primarily use the plant to weave mats as a hut covering, bound in place by twine made from the same plant. The rope is also used to bind thatch (South African National Biodiversity Insitute 2008). Reed beds with *Cyperus textilis* and similar plants (reeds, bulrushes and sedges) are used worldwide to clean polluted water. The plants take up the excess nitrogen and phosphates from treated sewage, and have also proved effective in removing heavy metals and phenolic compounds from waste water. Carbon Farming Solutions - Industrial Crop: biomass. (Crops grown for non-food uses. Industrial crops provide resources in three main categories: materials, chemicals, and energy. Traditional materials include lumber and thatch, paper and cardboard, and textiles) [1-1].

nrakta South Africa - Eastern Cape, KwaZulu-Natal, Western Cape ksacta Along the coast in wet places or in still or flowing shallow water along streams and rivers, 5-1,680m.; Perennial Helophyte.

propta Division of the clumps is best - use young growth and discard old growth. Seed. Cuttings. Cuttings take the top 5cm (2inch), including the 'umbrella'.

nwatta Industrial Crop: Biomass Management: Hay Regional CropClimate: Mediterranean, warm temperate. Humidity: aquatic. Plant in sun or semi-shade. In bright sun the clumps will be more compact and the stems more closely packed, whereas in the shade the plants will grow taller with fewer stems giving a more graceful effect. Grows in any good soil. Can grow in shallow water, waterlogged soil and moist soil. Can be grown in containers or water features. Good for heavy clay soils. A tender perennial, surviving with minimum is -7°C / 30°F (USDA zone 9). Frost kills the foliage but the plant will resprout in spring provided the roots were not frozen. Carbon Farming Solutions - Cultivation: regional crop. Management: hay (Describes the non-destructive management systems that are used in cultivation) [1-1].

4 10 tlin

4.1 bwon

4.1.1 *Samanea saman*

Rain Tree, False Powder Puff, Monkey Pod
tfo2n 10 tlin 12 cyuc 3 kcak 4 tcan 2 dwat 20 m hkuc
hmimtut cyutli hgatkyucuphja7n hwicli hyishrasjlutnyikfrif
hpa7tli frusflatprikliwislphsoms hpa7tmwatli hjonli

drutta *Samanea saman* is a deciduous Tree growing to 20 m (65ft) by 30 m (98ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10 and is frost tender. The flowers are pollinated by Bees. It can fix Nitrogen. It is noted for attracting wildlife. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid, very alkaline and saline soils. It can grow in semi-shade (light woodland) or no shade. It prefers dry moist or wet soil and can tolerate drought. The plant can tolerate strong winds but not maritime exposure.

pcista Parts of plant are poisonous if ingested Handling plant may cause skin irritation or allergic reaction

kcakta Edible Parts: SeedpodEdible Uses: Drink Gum-Children eat the pods, which contain a brownish, sticky, liquorice-like, sweet-flavoured pulp[303 , 307]. A lemon-like fruit drink is also made from the pulp[269 , 303]. The pods are more or less straight with conspicuously thickened edges, 12 - 20cm long, 1 - 2cm wide and 1.2cm thick[303]. The tree yields a gum of inferior quality which could be used as a poor man's substitute for gum arabic[269]. Carbon farming - Staple Crop: balanced carb.

tcanta Alcohol Charcoal Containers Fencing Fodder Fuel Gum Resin WoodStreet tree. Public open space. Xerophytic. Agroforestry Uses: The tree is grown to provide shade for other crops, including cocoa, coffee, tea and peppers[303 , 404]. The dome-shaped, low crown provides a very strong shade even at low sun positions[325]. The leaves fold up during rain, allowing more moisture to reach the crops below[325]. Other Uses The bark is an abundant source of gums and resins[303 , 320]. The tree yields a gum of inferior quality which could be used as a poor man's substitute for gum arabic[269]. Pods can be ground up and converted to alcohol as an energy source[269]. Yields of 1,150 litres of absolute alcohol can be obtained per year from 1 hectare[269]. The heartwood is brown when freshly cut, turning golden-brown upon exposure; the thin layer of sapwood is a cream colour. The wood is light in weight; soft but strong; durable to very durable. It takes a high polish but is often very cross-grained, making it difficult to work except when green. With its rich dark-and-light pattern, the wood is highly prized for carvings, furniture and panelling. The wood shrinks so little that products may be carved out of green wood without fear of splitting or warping as the wood dries[303 , 404]. In Hawaii, bowls and other craft products made from the wood are in such high demand that the local wood supply is supplemented by imports from Indonesia and the Philippines[303]. A moderately durable wood, it is also used in boat building[303]. The wood is very durable against rot

and termites[307]. The beautiful, high-quality wood is used for interior trim, crafts, boxes, veneer, plywood and general construction[303]. The fact that S. Saman wood produces 5,200 - 5,600 kcal/kg when it burns, and that it regrows vigorously after lopping or pollarding, makes it a valuable source of high-quality firewood and charcoal[303]. However, where there is a strong market for wood carvings, the wood is considered too valuable to be used as fuel[303]. Carbon Farming - Agroforestry Services: nitrogen, crop shade, living trellis. Fodder: pod, bank, insect.

dwatta Antidiarrhoeal Laxative StomachicA decoction of the inner bark and fresh leaves is used as a treatment for diarrhoea[303]. A brew of small sections of the bark is taken to treat stomach-ache[303]. A crude aqueous or alcoholic extract of the leaves is observed to have an inhibiting effect on *Mycobacterium tuberculosis*[303]. The alkaloid fraction of the leaves is effective on the CNS and PNS[269]. An infusion of the leaves is used as a laxative[269]. The fruit decoction is used as a CNS-sedative[269]. The seeds are chewed for treating a sore throat[269].

nrakta Northern S. America - Colombia, Venezuela, north through Central America to Nicaragua and El Salvador. ksacta Dry lowland grassland, coastal bushland and forest[307].

propta Seed - stores well at ambient temperatures[325]. Fresh seed that is still moist usually germinates freely without pre-treatment[325]. Once the seedcoat has dried and hardened it needs to be treated to allow the ingress of moisture. This can be done by carefully making a nick in the seedcoat (being careful not to damage the seed) or soaking larger quantities of seed in hot water for 3 minutes. In either case, the seed is then soaked for 12 - 24 hours in warm water before sowing[325]. Treated seed usually germinates quickly, in 6 - 8 days under optimal conditions[325]. Cuttings.

nwatta Agroforestry Services: Crop shade Agroforestry Services: Living trellis Agroforestry Services: Nitrogen Fodder: Bank Fodder: Insect Fodder: Pod Management: Standard Regional Crop Staple Crop: Balanced carbA plant of the lowland, humid tropics, growing from sea level to an elevation of 1,300 metres[303]. It prefers a mean annual temperature in the range 20 - 35c, being liable to damage if temperatures ever drop below 8c. It tolerates a mean annual rainfall in the range 600 - 3,000mm[303]. In areas of high rainfall the tree has a tendency to be shallow-rooted, but is deep rooted when grown in drier areas[303]. Prefers a position in full sun[307]. A fairly easy tree to grow, tolerant of a range of conditions, it grows on light or heavy soils and tolerates infertile or waterlogged conditions[303]. Normally found on neutral to moderately acid soils, it can grow on soil with pH as low as 4.6[303]. Established plants are very drought tolerant[307]. Yields of up to 275 kilos of pods per year can be obtained from trees 15 years old[269]. The trees provide a microclimate effect for the plants growing under their canopies. At night and on cloudy days, branches hang down and the leaves fold down and inward, allowing rain to fall directly on the ground and promoting cooling through exposing the ground[303]. In the morning the leaves unfold and resume a horizontal position, giving full shade and helping to preserve moisture[303]. The species is used as a shade for tea, coffee, cocoa, nutmeg and vanilla, and provides shade for pasture and grazing animals[303]. The tree responds to pruning and coppices well, regrowing rapidly when lopped or pollarded[303]. The tree is listed as undesirable in environmentally sensitive areas of Australia[307]. This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby[755]. Flowering Time: Late Spring/Early Summer Mid Summer. Bloom Color: Pale Pink/Pink White/Near White (red, pink). Spacing: 30-40 ft. (9-12 m) over 40 ft. (12 m). Carbon farming - Cultivation: regional crop. Management: standard.

4.1.2 Vachellia karroo

Cape Thorn Tree

tfo2n 10 tlin 12 cyuc 2 kca 4 tcan 1 dwat 10 m hkuc
thut cyutli hgatkyuctcuphja7n hwicli jltunykfrrip hpa7tli frus-
flatprikwis hpa7tmwatli dyat hjonli

drutta Vachellia karroo is an evergreen Tree growing to 10 m (32ft) by 12 m (39ft) at a medium rate. See above for USDA hardiness. It is hardy to UK zone 10. The flowers are pollinated by Insects. The plant is not self-fertile. It can fix Nitrogen. Suitable for: medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid soils. It cannot grow in the shade. It prefers dry moist or wet soil and can tolerate drought.

kcakta Edible Parts: SeedEdible Uses: Coffee GumThe gum is eaten as a confection[303]. The roasted seeds are used as a substitute for coffee[303]. Children chew the sweet thorns[303].

tcanta Charcoal Dye Fibre Fuel Gum Pioneer Soil conditioner Soil reclamation String Tannin WoodAgroforestry Uses: Universally accepted for use as a rehabilitation plant in degraded sites and dunes[303]. It produces a new flush of leaves when the temperatures are highest and before the rains, when there is a great need for shade to reduce soil temperatures[303]. It stimulates the development of an understory of perennials, palatable and nutritious grasses (such as *Cenchrus ciliaris*, *Panicum maximum*) through providing them shade, fixing nitrogen and improving soil structure and infiltration[303]. A pioneer species with a climax of 40 years, it occupies a successional position between the tropical forest and the bushveld[303]. The long flowering season makes this plant a useful tree for apiculture. Bees collect both pollen and nectar from the flowers[303]. Large specimens are an indicator of underground water[303]. Other Uses A gum is obtained from the stems[46]. It resembles gum arabic and is used regionally in southern Africa as a substitute for that gum[46, 303]. It cannot be exported to Europe or the USA because it has not been cleared for toxins[303]. Annual production is 25-30 t/ha[303]. The bark and seedpods are sources of tannins[46]. They impart a reddish colour[46, 303]. The bark contains up to 19% tannins[303]. The Nama people of southern Africa extract a red dye from the bark[46]. The root bark is used for twine and rope (like in the traditional Nama mat house)[46]. The wood is hard, tough and moderately durable, but few trees reach a commercial size, thereby limiting its commercial use[46, 303]. It saws easily; planes to a smooth finish; glues and varnishes well - it is used for furniture and the interior finish of buildings[46, 303]. It is, however, likely to twist in seasoning and is susceptible to attack by borers and fungi[303]. Kraft properties have been tested, and it pulps quite easily under standard kraft macro-pulping conditions[303]. The wood burns brightly, with very little smoke and no odour[303]. It splits easily and once dried does not absorb moisture from the atmosphere. It has calcium oxalate crystals that give its embers high temperatures and make them long lasting. These clean burning traits, ideal for cooking and heating, make it excellent firewood wherever it grows[303]. In the coastal dunes of Zululand, South Africa, it is reputed as an excellent charcoal source[303].

dwatta Antidiarrhoeal Antirheumatic Aphrodisiac EmeticA root infusion is taken by local people to treat pain in the alimentary canal, rheumatism, convulsions, gonorrhoea and as an aphrodisiac[303]. Root powder is applied to penile sores for treating syphilis[303]. A bark decoction is an emetic for treating diarrhoea[303].

nrakta Southern Africa, from the Cape as far north as Angola and Kenya. ksacta Woodland, wooded grassland, coastal scrub, often by rivers and in valleys, from near sea-level to 1,520 metres[308]. Found in riverine communities and even in arid environments, where it can do well provided there is an assured supply of groundwater[303].

propta Seed - soaked in hot water, leave in the water to cool overnight, and then sow the next morning[303]. The seeds can be planted either directly into small black nursery bags or in flat seedling trays filled with seedling mix[303]. They germinate in 3-12 days[303]. In its natural range, A. karroo is reported as being easy to raise from seed and has been planted widely for firewood on experimental plots in South Africa and Botswana[303].

nwatta Succeeds in subtropical to tropical areas where it is found at elevations from sea level to 1,000 metres[303]. It grows best where the mean annual temperature is in the range 12 - 40c and the mean annual rainfall is between 200 - 1,500mm[303]. Mature plants can tolerate some frost[303]. Prefers heavy black, hydromorphic cracking vertisols with high pH, or deep alluvial clay-loam soils in river valleys[303].

]. It sometimes does well on shale and even on acid soils[303]. Established plants are drought tolerant[303]. It competes for space, water and nutrients with pasture grasses, thus replacing them[303]. It also regenerates rapidly by means of suckers, aggressively colonising nearby grasslands[303]. For these reasons it is included in the national weed list in South Africa[303]. Cape thorn tree tolerates drought, fire, frost and termites[303]. The flowers are fragrant[200]. The species has a mixed mating system. It exhibits a tendency towards out-crossing, as evidenced by the existence of trees that are entirely male. It is zoomophilous, principally insect pollinated because the strong colour of inflorescence and the heavy pollen grains attract insects[303]. Isolated plants bear no fruits[303]. The plant has an invasive root system, making it unsuitable for planting near buildings or paved pathways[303]. Considered to be a good indicator of fertile soils for crops and an indicator of surface or underground water[303]. Acacia karroo shows a wide range of variation, but not in such a way as to allow any infraspecific taxa to be recognized[308]. This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby[200].

4.1.3 Sesbania sesban

Sesban

fto2n 10 tlin 12 cyuc 2 kca 4 tcan 2 dwat 5 m hkuc
htut cyutli hgattcuphja7n hwicli hyishrasjlutnyikfrip hpa7tli
frusflatprikrlwissliphsom hpa7tmwatli hjonli

drutta Sesbania sesban is a SHRUB growing to 5 m (16ft) by 5 m (16ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. The flowers are pollinated by Bees. It can fix Nitrogen. It is noted for attracting wildlife. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid, very alkaline and saline soils. It cannot grow in the shade. It prefers moist or wet soil and can tolerate drought. The plant is not wind tolerant.

pcista Fresh seeds are poisonous to humans but are eaten after soaking for 3 days and then cooking[418].

kcakta Edible Parts: Flowers Leaves Seed Edible Uses: Flowers - cooked[301 , 418]. They are included, perhaps as a decorative or festive ingredient, in foods such as omelettes[303]. The leaves and flowers are eaten as vegetable[301 , 317]. The seeds are ground into a powder and fermented to make a paste, known as 'soumbara', used as a flavouring[301]. Fresh seeds are poisonous to humans but are eaten after soaking for 3 days and then cooking[418].

tcanta Fodder Agroforestry Uses: This tree should prove to be an excellent pioneer species for establishing native woodland and woodland gardens[K]. It is fast-growing, short-lived, fixes atmospheric nitrogen, provides a large bulk for revitalising the soil, and has a wide range of uses[K]. The plant has been used to shade plantations of coffee, tea and cocoa[303]. It has also been used to provide a windbreak for bananas, citrus and coffee[303]. The growing plant will increase soil nitrogen levels through symbiotic interaction with bacteria, it has the ability to stabilize soil, and in Asia has been used as green manure for rice[303]. Its branches have been used as mulch and leaves as a green manure[303]. It improves soil fertility in a short-term rotation fallow[303]. The plant is also useful in combating the parasitic plant striga weed (Striga hermonthica). It stimulates the Striga weed to germinate, but is unsuitable as a host, so the Striga dies unless it can find another host nearby[303]. Some studies indicate that a one year fallow with this plant can increase maize yields from 2 to 4 tonnes per hectare without the application of nitrogen fertilizer[303]. It is a promising shrub for alley cropping because it is easy to establish, grows rapidly, coppices readily and provides mulch material of high nutrient content (particularly nitrogen)[303]. In some climates, such as in the highlands of Kenya, it may have a sparse canopy, and weed competition can be a problem[303]. The trees are suitable for use as live trellises for growing pepper plants (Piper spp.) on[303]. Other Uses Fibres obtained from the bark are used for making ropes and nets[46 , 303 , 317]. It has the potential for pulpwood production[303]. The saponin, stigmasta-galactopyranoside, which is isolated

from the seeds, has glucuronide derivatives of oleic acid, which has been shown to have molluscicidal activity against *Biophalaria glabrata*, one of the known snail vectors of schistosomiasis[303]. The seeds and bark produce a gum[303]. The wood is used traditionally for making arrows, pipes, toys etc[418]. A popular crop for firewood and charcoal because it produces a high woody biomass in a short time, which, although soft, is relatively smokeless, quick kindling and hot burning[303]. The calorific yield for a 3-year-old tree is approximately 4350 kcal/kg[303].

dwatta The fresh roots and leaves are used to treat scorpion stings, boils and abscesses[303]. The leaves are considered to have antibiotic, anthelmintic, antitumor and contraceptive properties[303]. A decoction is used to treat sore throat, gonorrhoea, syphilis, spasmodic fits in children and jaundice during pregnancy[303]. An oil obtained from the seeds is accorded special properties in ayurvedic medicine and is reported to have antibacterial, cardiac depressant and hypoglycaemic actions[303]. The saponin, stigmastagalactopyranoside, which is isolated from the seeds, shows spermicidal and haemolytic activity[303].

nrakta Africa, through Arabia, southern Asia to Australia. Widely naturalised in other areas of the tropics. ksaacta Common along streams, swamp banks and moist and inundated bottomlands[303].

propta Seed - requires pre-treatment to soften the hard seedcoat and allow the ingress of water[303]. This can be done by soaking the seed in a small amount of nearly boiling water (which cools down quickly and does not cook the seed) and then soaking the seed for 12 - 24 hours in warm water. Alternatively, a small area of the seed coat can be abraded, being careful not to damage the embryo[K]. The germination rate of treated seed is about 65% in about 16 days[303]. Seed storage behaviour is orthodox. Viability can be maintained for 2 years in open storage at room temperature[303].

nwatta Agroforestry Services: Alley crop Agroforestry Services: Crop shade Agroforestry Services: Living fence Agroforestry Services: Living trellis Agroforestry Services: Nitrogen Agroforestry Services: Windbreak Fodder: Bank Industrial Crop: Biomass Management: Coppice Management: Standard Minor Global Crop Staple Crop: ProteinA plant of the subtropics, also succeeding at higher elevations in the tropics, being found at elevations of 100 - 2,300 metres[303]. It grows best in areas where annual daytime temperatures are within the range 18 - 28°C, but can tolerate 10 - 45°C[418]. When dormant, the plant can survive temperatures down to about -5°C, but young growth can be severely damaged at -1°C[418]. It prefers a mean annual rainfall in the range 800 - 2,000mm, but tolerates m350 - 2,500m[418]. Requires a sunny position[418]. Tolerates saline, acidic and alkaline soils[303]. The plant has an outstanding ability to withstand waterlogging and is ideally suited to seasonally flooded environments. When flooded, it initiates floating, adventitious roots and protects its stems, roots and nodules with spongy, aerenchyma tissue[303]. It also shows some tolerance to moisture stress and tolerates soil alkalinity and salinity to a considerable degree[303]. Prefers a pH in the range 5 - 7, tolerating 4 - 9.9[418]. A fast-growing, but short-lived plant, often dying before it is 10 years old[303 , 418]. It has been reported to attain a height of 4 - 5 metres in only 6 months[303]. It thrives under repeated cuttings and coppices readily, with many branches arising from the main stem below cutting height[303]. Cutting frequencies are generally 3 - 4 cuts/annum, but up to 8 cuts are made in some areas[303]. Yields have ranged from 4 to 12 tonnes/hectare dry matter per year, depending on location[303]. Cutting height can also influence yield, with cutting heights of 50 - 76 cm favouring plant survival and productivity[303]. This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby[200]. The rhizobium requirements vary. There is a host-strain interaction, and different accessions of the plant require different strains of bacteria[303].

4.1.4 Sesbania bispinosa

Prickly Sesban

10 tlin 12 cyuc 2 kcaak 4 tcan 2 dwat 2 m hkuc
htut cyutli tucphja7n hwicli hyishrasjlutnyikfrp hpa7tli frus-
flatprikliwssllphsom hpa7tmwatli fyif hjonli

drutta Sesbania bispinosa is a ANNUAL/BIENNIAL growing to 2 m (6ft) by 1 m (3ft 3in) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. The flowers are pollinated by Bees. The plant is self-fertile. It can fix Nitrogen. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid, very alkaline and saline soils. It cannot grow in the shade. It prefers moist or wet soil.

kcakta Edible Parts: SeedEdible Uses: GumMature seeds - cooked[303]. Mainly used in times of famine[418].

tcanta Fertilizer Fibre Fuel Green manure Gum Hedge Mulch Paper Parasiticide Shelterbelt Soil conditioner Soil reclamation StringAgroforestry Uses: The plant fixes atmospheric nitrogen and is capable of growing in soils where few or no other crops can grow, such as on alkaline or saline soils of low fertility and poor texture. It has a remarkable sustaining quality on such soils and also improves soil permeability[303]. The leftover stalks, roots and fallen leaves enrich the soil still further by adding organic matter[303]. It is used as a temporary shade, windbreak or as a hedge[303]. An important green manure crop - rice yields, after a green manure crop was ploughed in 60 - 70 days after planting, are equal to those obtained with the application of about 80 kg N/ha of chemical fertilizer[303]. Other Uses A fibre, known as 'Dundee Fibre', is obtained from the stem[46]. It is used for making sails, nets etc[46 , 303]. The fibre is said to be very useful and durable when used in water-related activities. In durability and strength, it is reputed to be even superior to jute fibre (from *Corchorus* spp)[303 , 418]. The stems can also be a good source of pulp and paper[303 , 418]. The seed has been found to be a potential source of cheap galactomanan gum, as the plant can be cultivated on substandard soils without extra care or investment[303]. S. Bispinosa yields light, small-sized firewood. When fully grown and dried, it provides good fuel with a calorific value of 4281 kcal/kg[303].

dwatta Antibacterial Antiinflammatory Antitumor Astringent Parasiticide Poultice SkinThe leaves and flowers are astringent[303]. They are used in the treatment of inflammations, bacterial infections and tumours[303]. They are prepared as poultices for external use or taken as a decoction for internal ailments[303]. The seed, mixed with flour, is used to treat ringworm and other skin diseases and worms[303].

nrakta Eastern tropical Africa; Afghanistan, Iran, Indian subcontinent, China, Myanmar, Thailand, Vietnam, Cambodia, Laos. ksacta Marshes, ditches, river margins; also a weed in cultivations on alluvial land, especially in rice fields; often in saline areas; flood-plains, seasonally inundated depressions, sandbanks of brackish lagoons; occasionally in open miombo woodland[328].

propta Seed - no pre-treatment is required. The plants can easily be established by direct seeding[303]. The seed has a hard seedcoat and may benefit from scarification before sowing to speed up germination. This can usually be done by pouring a small amount of nearly boiling water on the seeds (being careful not to cook them!) and then soaking them for 12 - 24 hours in warm water. By this time they should have imbibed moisture and swollen - if they have not, then carefully make a nick in the seedcoat (being careful not to damage the embryo) and soak for a further 12 hours before sowing[K]. Seed storage behaviour is orthodox; a germination rate of 24% has been recorded following 41 years of open storage at room temperature[303].

nwatta A plant of subtropical to tropical areas, where it is found at elevations up to 1,200 metres[418]. It grows best in areas where the mean annual temperature falls within the range 18 - 30°C, though it can tolerate 10 - 34°C[418]. It prefers a mean annual rainfall of 700 - 1,200mm, but tolerates 500 - 2,900mm[418]. Prefers a sunny position[418]. Succeeds in heavy soils[303]. Grows well under both waterlogged or non-irrigated conditions[303]. The plant is very tolerant of soil types, tolerating a pH ranging from 4.3 right up to 10[303 , 418]. The plant can become a weed in rice

paddy fields[303]. A very fast growing plant, it competes well with weeds and may even suppress growth of *Imperata cylindrica* on sites where moisture is adequate[303]. A green manure crop can be produced in 2 - 3 months from seed, and a fuel wood or seed crop in 5 - 6 months[303]. Seed yields may be 600 - 1000 kg/ha, f[418]. If used as a green manure crop for rice, the plant should be ploughed in just before the rice is planted out[303]. Delaying the rice planting may lower its response to the green manure[303]. The leaves of sesbania follow the direction of sunlight and fold at night[303].

4.2 mran

4.2.1 Pouteria campechiana

Canistel, Eggfruit

10 tlin 12 cyuc 4 kcaak 2 tcan 2 dwat 15 m hkuc
htut cyutli hgatkyuctucphja7n hwicli hrasjlutnyikfrp hpa7tli
flatprikliwshsom hpa7tmwatli hjonli

drutta Pouteria campechiana is an evergreen Tree growing to 15 m (49ft) by 15 m (49ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils, prefers well-drained soil and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in saline soils. It cannot grow in the shade. It prefers dry moist or wet soil and can tolerate drought. The plant can tolerate maritime exposure.

kcakta Edible Parts: FruitEdible Uses: The fruit is excellent when eaten raw, it can also be used in cakes, pies, ice creams, puddings etc[301]. It has a yellow to orange pulp that is soft and mealy in texture with a very rich, sweet flavour that is somewhat reminiscent of a baked sweet potato[301]. The fruit somewhat resembles the yolk of a hard-boiled egg[301]. It is not highly regarded by many people because it is not crispy and juicy like so many other fruits[303]. The fruit is extremely variable in form and size, ranging from almost round to oval or spindle shaped[303]. It ranges in size from 7 - 12cm long and 5 - 7.5cm wide, though there is a shrubby form (var palmeri) where the fruits are only 2.5cm long[303].

tcanta Latex WoodOther Uses: The tree produces an abundant latex[31]. It is extracted from the tree and has been used to adulterate chicle[303 , 331]. The fine-grained, compact, strong, moderate to very heavy and hard timber is valued especially for planks and rafters in construction. The heartwood is greyish-brown to reddish-brown and blends into the sapwood, which is somewhat lighter in colour. The darker the colour, the more resistant to decay[303].

dwatta Febrifuge SkinA decoction of the astringent bark is taken as a febrifuge and is applied on skin eruptions[303]. A preparation of the seeds has been employed as a remedy for ulcers[303].

nrakta Central America - Panama, north to Mexico. ksacta Moist or wet mixed forest, sometimes in pine forests, often on limestone, at elevations that are mostly below 1,400 metres[331].

propta Seed - remove it from its husk before sowing[200]. The seeds lose viability quickly and should be germinated within a few days after removal from the fruit[306]. Seedlings grow rapidly and may produce fruit in 3-4 years[306]. Side-grafting. Air-layering may be possible[200]. Canistel seeds lose viability quickly and should be planted within a few days after removal from the fruit. If decorticated, seeds germinate within 2 weeks; otherwise there may be a delay of 3 - 5 months before they sprout. The seedlings grow rapidly and begin to bear in 3 - 6 years. There is considerable variation in yield and in size and quality of fruits. Vegetative propagation is preferred in order to hasten bearing and to reproduce the best selections. Side-vener grafting, cleft grafting, patch budding and air-layering are usually successful. Cuttings take a long time to root

nwatta A plant that can succeed in the lowland moist tropics or subtropics, growing at elevations up to 1,400 metres[303]. In its native range it experiences an average annual temperature of 26°C, with a maximum 36.7°C and a minimum of 14.9°C[303]. Plants can tolerate occasional, short-lived frosts[335]. Average annual precipitation is approximately 1,288mm, ranging between 900 - 1,800mm[303]. It

more than moderate precipitation and does well in regions with a long dry season[303]. It is very susceptible to drought according to another report[200]. It grows well in maritime areas, where it shows good wind resistance[200]. Tolerant of a wide range of soil types, including sandy and heavy clay soils[200 , 303]. Requires a very well-drained soil[200]. It makes the best vegetative growth in deep, fertile, well-drained soils, but is said to be more fruitful on shallow soils[303]. It can be cultivated on soil considered too thin and poor for most other fruit trees[303]. Tolerates a pH in the range 5 - 7[200]. This species has become invasive in Florida[307]. Seedling trees can commence fruiting when 5 - 7 years old, grafted trees can fruit when 3 - 4 years old[335]. The mature but still firm fruits should be clipped to avoid tearing the skin. When left to ripen on the tree, the fruits split at the stem end and fall[303]. Some trees can produce fruit more or less continuously throughout the year[303]. There are some named varieties[301].

4.2.2 Metroxylon amicarum

Caroline Ivory Nut Palm

10 tlin 12 cyuc 3 kcaak 4 tcan 1 dwat 25 m hkuc
htut cyuti tcuphja7n hwicli hyishrasjlutnyikfrip hpa7tli frus-
flatprikliwshom hpa7mwatli hjonli

drutta Metroxylon amicarum is an evergreen Tree growing to 25 m (82ft) by 15 m (49ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid and saline soils. It cannot grow in the shade. It prefers moist or wet soil. The plant can tolerate maritime exposure.

pcista Plant has spines or sharp edges; use extreme caution when handling

kcaakta Edible Parts: Apical bud Seed Stem Edible Uses: Sago is sometimes prepared from the pith of this tree. It is said to keep well and not to be injured by salt water[459]. It is considered a valuable food to take on canoe journeys[459]. Not as productive as the sago palm (Metroxylon sago), it is more likely to be viewed as an emergency food[312]. The apical meristems or palm hearts are large and soft. The trees may be harvested prior to maturation exclusively for this purpose, with the meristem and several feet of the immature leaves being used. These palm hearts are used locally or are sold in local markets. They are eaten raw as a vegetable or cooked with other foods, often in curries[312]. Harvesting the palm heart leads to the death of the tree since it is unable to produce side branches[K]. Immature seeds are sometimes eaten by children[312].

tcanta Basketry Broom Buttons Containers Fencing Fuel Nails Needles Pins Roofing Soil stabilization Thatching WoodAgroforestry Uses: Especially when in wetter soils, the roots help to stabilize the soil by trapping silt[312]. Young palms, with their numerous spines, act as effective barriers for livestock and potential trespassers. As the palms mature and develop above-ground stems, new palms may be planted adjacent to the juveniles to maintain the spininess of the fence[312]. Other Uses The large, very hard, ivory-like seeds are used to make a range of carved items and also to make buttons[46 , 312]. The leaves and their petioles have a wide range of applications. In particular, they are one of the major sources of thatch, roofs made from these leaves are said to last for 5 years[312]. In addition, the leaflets can be woven into temporary baskets or used to line cooking pits[312]. Gourd bottle-corks/stoppers are made from lightly rolled discs of sago leaves[312]. Whole leaves are used to cover and protect dry-stored canoes[312]. The leaf sheaths are commonly covered externally with rough spines and/or rib-like protuberances. These rough sheaths have served as rasps in the preparation of sago and other food products that must be grated[312]. The stiff, hard midribs may be used to make brooms, may serve as temporary sewing needles or pins, or may be used as thatch sheet skewers[312]. The smooth inner surface of the sheaths can be used as temporary containers, and as kneading boards for bread made from sago[312]. Children sometimes make surfboards from the petiole base (leaf sheath) that can be up to one metre wide[312]. Bats, balls, and rafts are made by children from the leaf base[312]. The wood (outer cortex) of the stems is

used as flooring and as planking for crossing short streams or swampy areas. The wood is not reported as being long lasting or durable, but is employed as a by-product by those who extract starch. Wood has also been used as house rafters and as wall material, although this is an infrequent usage[312]. The bark can be used as a fuel[312].

dwatta The roots, young leaves, and stem cork are used for traditional medicine[312].

nrakta West Pacific - Caroline Islands. ksacta Moist forest at elevations up to 550 metres in mountainous areas[338]. Freshwater wetlands, either coastal or moist upland rain-forest[312].

propta The seed loses its viability rapidly when stored and does not tolerate dry conditions. It is best sown as soon as it falls from the tree, usually germinating within 1 - 2 months[312]. They germinate best at a temperature of 30°C, though temperatures above 38°C can harm the seeds[312]. Seeds sometimes germinate whilst still attached to the inflorescence and can grow to a height of 90 - 120cm before falling to the ground[312]. Germination can be speeded up if the seed husk is removed and the covering over the embryo is loosened. Care should be taken not to damage the embryo[312]. The large seed size and rapid early growth mean this species is well suited for direct-seeding in the field, assuming conditions are consistently moist. Seedlings can also be germinated in a nursery and transplanted bareroot. They transplant well as long as the roots are not bound[312]. Plants should be planted out as soon as possible. Although best planted out whilst fairly small, specimens with several sub-mature leaves 1 - 2 metres long and a well developed root system have been successfully planted out[312].

nwatta Industrial Crop: Vegetable ivory Management: Managed Multistem Regional Crop Staple Crop: Basic StarchA plant of the humid, tropical, lowland forests, able to succeed at elevations up to 700 metres[312]. It prefers a mean annual rainfall in the range 2,000 - 5,000mm, and does not tolerate more than a short dry period[312]. It prefers a mean annual temperature of around 25°C with a minimum of 17°C. It is not tolerant of frost, though it can succeed in cooler areas of the tropics such as Hawaii, but then grows more slowly[312]. Prefers a relatively sunny position[312]. Succeeds in a wide range of soils, preferring medium to heavy soils with somewhat impeded drainage[312]. It can persist on well drained, poor quality materials including sand, clay, or 'ai' lava[312]. It will grow in soil that is periodically inundated by salt water as long as fresh water flow is more prevalent[312]. Plants are not very tolerant of water shortage, but nor do they like inundation for more than short periods[312]. Succeeds in a wide range of pH, from 4 - 7.4[312]. Plants are tolerant of strong, salt-laden winds[312]. Plants usually take 12 - 15 years to come to flowering maturity from seed, though in ideal conditions this can be reduced to about 10 years[312]. Unlike other members of this genus, which flower once and then die, this species is able to flower for a number of years before dying[312]. The seeds can be transported by water from one island to another[312]. Judging by the plants natural range, the seed viability is likely to be fairly short in salt water[K]. Spacing: 20-30 ft. (6-9 m) 30-40 ft. (9-12 m).

4.2.3 Sonneratia caseolaris

Firefly mangrove, mangrove apple

10 tlin 12 cyuc 2 kcaak 4 tcan 2 dwat 15 m hkuc
htut cyuti tcuphja7n hwicli hrasjlutnyikfrip hpa7tli flatprikli-
wissliphsom hpa7mwatli hjonli

drutta Sonneratia caseolaris is an evergreen Tree growing to 15 m (49ft) by 15 m (49ft) at a medium rate. See above for USDA hardiness. It is hardy to UK zone 10. The flowers are pollinated by Moths, bats, birds. It is noted for attracting wildlife. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very alkaline and saline soils. It cannot grow in the shade. It prefers moist or wet soil.

kcaakta Edible Parts: Fruit Leaves Edible Uses: PectinYoung berries - raw or cooked[301 , 451]. They can be eaten as a fruit, or cooked as a vegetable[418]. A sour flavour[451]. A cheese-like flavour[301]. The fruits are a source of pectin[418]. Young leaves - raw[418].

tcanta Fuel Furniture Parasiticide Pectin Pioneer Soil stabilization Tannin WoodAgroforestry Uses: A very important tree in the coastal swamp community, helping to protect the soil from erosion and providing an important habitat for wildlife[K]. A fast-growing, pioneering species that colonizes newly formed mudflats and can expand rapidly in number, especially in optimum conditions of low salinity[338]. Other Uses The pneumatophores (vertical roots rising above ground) are used as floats for fish nets and, being corky in texture, are employed in the manufacture of inner soles for shoes and can be used as a substitute for cork or pith[345]. The roots are boiled before being used[451]. The bark is a source of tannins[418]. The heartwood is light brown to dark chocolate, the sapwood light greyish brown and 3 - 8cm thick[345]. When wet or under varnish, the heartwood of old mature trees looks almost black. The grain is straight or very slightly crossed; the texture fine, very homogeneous, smooth, but not glossy; it has a distinct salty taste and a fishy or swampy odour, especially when fresh[345]. The wood is moderately hard and moderately heavy to heavy[345]. It is easy to work; lasts well in the ground and even the sapwood is rarely attacked by insects; the heartwood is said to resist teredos very well[345]. The wood contains a small amount of salt, making the use of copper nails and screws necessary. It is used for piles, posts, poles, railway ties, paving blocks; ship, bridge, and wharf building; general strong construction; doors; siding, sheathing, ceiling, flooring, and all kinds of interior finish; ship planking and decking; furniture and cabinetwork; and musical instruments[345]. The wood is used for fuel, but only when better woods are not available[451].

dwatta Antitussive Haemostatic Parasiticide Poultice SkinThe plant is said to be haemostatic[269]. It is a folk remedy for sprains, swellings, and worms[269]. The old fruit walls are used as a treatment for worms[269]. Half-ripe fruits are a treatment for coughs[269]. The fruits are used to make poultices[269]. The pounded leaves are used as a treatment for haematuria and smallpox[269]. The leaves are crushed, mixed with salt and applied as a poultice onto cuts and bruises[269].

nrakta E. Asia - S. China, India, Sri Lanka, Thailand, Cambodia, Vietnam, Malaysia, Indonesia, Philippines, New Guinea, northern Australia, Pacific Islands. ksacta Coastal mangrove communities, tidal creeks, in muddy soil[266]. Less salt parts of mangrove-forests on a deeply muddy soil, never on coral-banks, often along tidal creeks with slow-moving water and ascending these as far as the flood mounts[451].

propta Seed - it has a low viability of less than three months[338].

nwatta A plant of coastal areas in the tropics. It grows best where the mean annual minimum and maximum temperatures are within the range 20 - 30°C, though it tolerates 10 - 38°C[418]. It prefers a mean annual rainfall of 1,500 - 2,500mm, tolerating 1,000 - 3,000mm, and succeeds in areas with no dry season as well as those with a dry season. Prefers a sunny position[418]. Prefers a heavy soil, but tolerates most soil types[418]. Grows in areas that are inundated by salt water at high tides. Prefers a pH in the range 6.7 - 7.3, but tolerates 6.5 - 7.5[418]. Plants are tolerant of strong, salt-laden winds. The flowers are nocturnal, opening in the evening and closing in the early morning[451].

4.2.4 Manihot carthaginensis glaziovii

Ceara Rubber Tree, Tree cassava
10 tlin 12 cyuc 2 kcaak 3 tcan 2 dwat 6 m hkuc
htut cyutli hgatkyuctcuphja7n hwicli hyishrasjlutnykfrip hpa7tli frusflatprikwlis hpa7tmwatli hjonli

drutta Manihot carthaginensis glaziovii is a deciduous Tree growing to 6 m (19ft) by 4 m (13ft) at a fast rate. See above for USDA hardiness. It is hardy to UK zone 10. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils, prefers well-drained soil and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid soils. It cannot grow in the shade. It prefers dry moist or wet soil and can tolerate drought.

kcakta Edible Parts: Leaves RootEdible Uses: Leaves -

cooked[303]. Eaten as a vegetable[303]. The leaves contain hydrocyanoic acid, which is toxic, but it is destroyed by heat and so the cooked leaves are safe to eat[303]. Root - cooked[301 , 303]. A famine food, it is eaten in times of food scarcity[303]. The root is rich in starch but it is hard and woody[303]. It also contains hydrocyanoic acid (see note above re the leaves)[303]. Seed - oily[301].

tcanta Agroforestry Uses: The tree is used to provide temporary shade for cocoa plants[303]. The leaves are applied as green leaf manure[303]. In some areas, especially where the rainfall is low, the species is used as a hedge[303]. Other Uses: The plant is used in breeding programmes for cassava (*Manihot esculenta*), being used to improve disease resistance[303]. The tree is a source of latex that can be used to make rubber[303]. The rubber is said to be of good appearance, but the resin content, at 3 - 12%, is too high[303]. It is, therefore, considered to be uneconomical when there are other sources. The latex can be used as a glue for paper[303]. The seeds contain 90 % unsaturated oil[303]. (This seems a very high figure[K].) The oil might possibly be used as a fuel for pre-combustion diesel engines[303]. The wood is coarse-textured, straight-grained, very light in weight, very susceptible to wood-eating organisms[625]. Easy to cut but of quite low quality, it is used to make items such use boxes[625].

dwatta The stem and root are ingredients in a remedy for skin infections[303].

nrakta S. America - northeast Brazil. ksacta Often left behind as a relict of cultivation and therefore found in scrubs, secondary forest and waste places along roads and rivers, near paddies, old cultivated fields[303]. Also found occasionally in dense, primary forests[625].

propta Seed - usually sown in situ[303]. Seed - best sown as soon as it is ripe in a partially shaded position in a nursery seedbed. A germination rate of around 50% can be expected, with the seed sprouting within 30 - 50 days[625]. Cuttings[303].

nwatta Agroforestry Services: Crop shade Industrial Crop: Hydrocarbon Management: Standard Regional CropA plant of the semi-arid tropics, where it is found at elevations from sea level up to 1,200 metres[303]. It grows in areas where the mean annual rainfall is within the range 600 - 700mm[303]. Prefers a position in a sunny position[625]. The tree tolerates a wide range of soils including very poor and acidic soils[303]. It can succeed in sticky red soil, which may be water logged[303]. Established plants are very drought tolerant[303]. Plants have escaped from cultivation in many of the areas in which they have been grown[305]. They are reported to be invasive in Hawaii[305]. The growth of young plants is rapid[625]. The plant can flower the whole year through, it probably also fruits the year round but no data is available[303]. The tree can be tapped at the age of 3 years[303].

4.2.5 Fagraea fragrans

Ironwood, Tembusu

10 tlin 12 cyuc 0 kcaak 4 tcan 2 dwat 25 m hkuc
htut cyutli tcuphja7n hwicli hyishrasjlutnykfrip hpa7tli frusflatprikwlis hpa7tmwatli hjonli

drutta Fagraea fragrans is an evergreen Tree growing to 25 m (82ft) by 20 m (65ft) at a slow rate. See above for USDA hardiness. It is hardy to UK zone 10 and is frost tender. The flowers are pollinated by Insects, Birds, Bats. It is noted for attracting wildlife. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay and nutritionally poor soils. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid soils. It cannot grow in the shade. It prefers moist or wet soil.

pcista Skin rashes may develop when handling green logs with bark on[316].

kcakta The root may be edible.

tcanta Street tree, Public open space, Specimen in large garden, Bonsai. Agroforestry Uses: The tree is used for reforestation purposes, at least partly due to its ability to suppress the dense cover of weeds, including *Imperata cylindrica* and *Gleichenia linearis*[303 , 404]. It is planted in some regions to control soil erosion[307]. It occurs naturally as a pioneer in burnt-over areas and poor sites such as along along (*Imperata cylindrica*) grassland[303 , 325]. Other Uses The latex found under the skin of the fruits is

often used as an adhesive[451]. The heartwood is light yellowish brown, the sapwood light yellow with an unpleasant smell[325]. The wood is medium weight, hard and very durable[325 , 404 , 451]. This species is the main source of tembusu timber, considered to yield a first-class turnery timber[303]. The nailing properties are good. The wood can be peeled into 1.5 mm thick veneer at a 90° peeling angle without pre-treatment with good results[303]. This valuable and durable timber is used both as sawn wood as well as roundwood for posts and piles in the construction of houses, bridges and ships, and for railway sleepers, posts for electric and telephone lines, barrels, chopping blocks, furniture, cabinet work, door and windows sills and wood carvings[303]. The wood yields a very high-quality fuel wood and charcoal[303].

dwatta Dysentery MalariaA decoction of the bark is used as a febrifuge to treat conditions such as malaria[303 , 451 , 598]. A decoction of twigs and leaves is used to control dysentery and severe diarrhoea[303 , 598].

nrakta E. Asia - India, Myanmar, Malaysia, Thailand, Indo-China, Indonesia, Philippines, Papua New Guinea, ksakta Light primary and secondary forest in humid or seasonally inundated locations, avoiding stagnant water. In freshwater-swamp forest, found in association with Melaleuca spp. Also occurs naturally as a pioneer in burnt-over areas and lalang grassland[303

propta Seed - it has quite a long viability. When sown fresh it has a viability of 65 - 80% and germinates in 15 - 60 days or more[303]. The very fine seed should be mixed with fine sand and sown under light shade[303]. It needs protection from ants[303]. Watering should be done by spraying gently so as not to disturb the seed[303]. The seedlings can be transplanted to open nursery beds or containers after 2 months, when 5 - 7 cm tall, and they can be planted out in the field when 30 - 45 cm high with adhering soil clump[303]. The seed has an initial viability of 80%, which reduces to 65% after being stored for 3 months in air-tight containers[303]. Seeds can be stored for 6 months, but they lose their viability very soon when kept inside the fruit[303]. The fruit should be macerated by hand to extract the seeds, which should then be washed and dried[303]. Allowing the seed to ripen for 1 month after collection is reported, but immediate sowing also gives good results[303]. The whole berry can also be sown, but then seedlings do not appear until after 6 weeks[303]. Root suckers are an easy method of propagation[303]. Cuttings with several internodes taken from the branches of mature trees failed to root, but when taken from coppice shoots they rooted successfully[303].

nwatta A plant of the wet, lowland tropics, where it is found at elevations up to 400 metres. It grows best in areas where annual daytime temperatures are within the range 20 - 30°C, but can tolerate 10 - 36°C[418]. It prefers a mean annual rainfall in the range 2,000 - 3,000mm, but tolerates 1,000 - 4,000mm[418]. Grows best in a sunny position[418]. Thrives in well-drained to swampy, periodically inundated habitats, occasionally even on permanently inundated localities, often along rivers or creeks[303]. It can succeed on poor or degraded soils so long as they are well-drained, and even in lalang (Imperata cylindrica) grasslands, where it suppresses this noxious grass[303]. Prefers a pH in the range 5 - 6, tolerating 4.5 - 6.5[418]. Established plants are moderately drought tolerant[307]. Considered a useful plantation species, as it is adaptable and hardy[303]. The corky bark gives it some resistance to fire - an 8-year-old plantation in alang alang grassland suffered no damage from a passing fire[303]. The lower branches are very persistent and pruning these promotes height growth[303]. Trees coppice freely; locally, trees may often be pollarded for poles[303]. Large trees are frequently hollow[303].

5 11 tlin

5.0.1 Metroxylon sagu

Sago Palm
11 tlin 12 cyuc 4 kak 3 tcan 0 dwat 10 m hkuc
tntut cyutli tcuphja7n hwicli hrasjltutnyikfrip hpa7tli frusflat-priklywshism hpa7tmwatli dyat hjonli

drutta Metroxylon sagu is an evergreen Tree growing to 10 m (32ft) by 10 m (32ft) at a medium rate. See above for

USA hardness. It is hardy to UK zone 10. The plant is not self-fertile. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. Suitable pH: mildly acid, neutral and basic (mildly alkaline) soils and can grow in very acid and saline soils. It cannot grow in the shade. It prefers moist or wet soil. The plant can tolerate maritime exposure.

pcista Plant has spines or sharp edges; use extreme caution when handling

ksakta Edible Parts: Apical bud Fruit Stem**Edible Uses:** The pith of the stem is rich in starch. This has been widely used to make sago[297]. The stem is cut down shortly before the tree flowers, since the carbohydrate content is then at its highest[314]. It is chopped into sections and the fibrous inside is washed to extract the starch[200 , 297]. Hot water is poured over the slightly sour wet starch and stirred. The resulting glue-like mass is eaten with fish and vegetable dishes[303]. Usually, the wet starch extracted from the stems is boiled, fried or roasted, alone or mixed with other foodstuffs[418]. It is also used industrially in the manufacture of cakes, noodles, kerupuk and custard powders[418]. The fully ripe fruit is astringent, but is eaten as a delicacy by local people[301]. Apical bud - raw or cooked[418]. It is commonly steamed and eaten as a side dish with rice or added to stews[301]. Harvesting this bud effectively eventually kills the individual trunk because it is unable to make side branches[301].

tcanta Alcohol Fencing Fertilizer Fibre Fodder Fuel Nails Paper Shelterbelt Soil stabilization Thatching Weaving WoodAgroforestry Uses: Sago palm has been planted in buffer zones as a method of rehabilitating degraded lands, for instance the coastal plains of Indonesia where thousands of hectares of land had been abandoned[303]. Especially when in wetter soils, the roots help to stabilize the soil by trapping silt[312]. Young palms, with their numerous spines, act as effective barriers for livestock and potential trespassers. As the palms mature and develop above-ground stems, new palms may be planted adjacent to the juveniles to maintain the spininess of the fence[312]. Other Uses The leaves, and the fibres obtained from them, are commonly used for thatching, weaving mats etc[297 , 303]. It is said that thatch made from this plant will last for at least 5 years[314]. Processing of the pith to yield starch produces a fibre[303]. The waste from pith processing is used as a fertilizer[303]. Dextrose sugar extract from sago palm starch can be processed to yield alcohol for use as a biofuel[303 , 418]. The starch obtained from the stems is also used for various other products including to make a sizing paste for paper and textiles[418]. The cortex of the trunk is also used for firing in paper mills[303]. The bark may be used as a domestic fuel after drying[303]. The frond rachis is often used for fastening between horizontal posts in walls[303]. The bark may be used as a flooring material[303]. The hard outside of the trunk is used for building purposes[297].

nrakta E. Asia - Malaysia. ksakta Lowland rain forest[297]. Dominates mainly in permanent or seasonal lowland freshwater swamps, preferably on mineral soils with a pH higher than 4.5[303].

propta Seed - pre-soak for 24 hours in warm water and sow in containers[297]. Germination usually takes several months. The seed germinates only under wet conditions[303]. A rosette grows from the seed, out of which a new bole and new suckers may be formed[303]. Division of suckers[297]. The suckers have the advantage of being readily available and of producing homogeneous offspring, which allows selection of superior forms[303].

nwatta Agroforestry Services: Windbreak Fodder: Insect Industrial Crop: Fiber Management: Managed Multi-stem Regional Crop Staple Crop: Basic StarchSago palm succeeds in wet, lowland tropical climates where it is found at elevations from sea level to 700 metres[297 , 303]. It grows best in areas where annual daytime temperatures are within the range 25 - 36°C, but can tolerate 18 - 40°C[418]. When dormant, the plant can survive temperatures down to about 10°C[418]. It prefers a mean annual rainfall in the range 3,000 - 4,500mm, but tolerates 2,100 - 5,800mm[418]. Plants grow well in full sun, even when small[297]. They grow best in clay soils with a high organic-matter content[303]. In the wild, the plant grows on mineral rich soils with a pH of 4.5 or more[303]. Prefers a pH in the range 5.5 - 6.5, tolerating 4.5 - 8.5[418]. Plants can be grown in soils with very high water tables, succeeding even in swamps.

They can even tolerate occasional flooding with saline water[418]. Sago palm is hapaxanthic[303]. Each trunk lives for a number of years without flowering but, once it has flowered and fruited, the leaves senesce and the trunk dies completely. However, one or more suckers develop from the base and take over[303]. The vegetative growth phase lasts for at least 8 years before the tree flowers[303]. A single palm may yield about 180 - 350 kilos of sago[418]. It has been

calculated that the labour requirement for each kilo of starch obtained from this plant is far less than for any other starch producing plant[297]. There are hermaphroditic and male flowers[303]. The palm can be classified as a nearly complete obligatory cross-breeder, with easy vegetative multiplication[303]. Spacing: 15-20 ft. (4.7-6 m) 20-30 ft. (6-9 m) 30-40 ft. (9-12 m).

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