

## Cocos nucifera

coconut

### LOCAL NAMES

Bengali (narikel); Burmese (on,mak-un); Creole (kokoye); Dutch (cocospalm,coco,cocos,klapperboom); English (coconut palm,coconut); French (coco,noix de coco,cocotier,cocoyer,coq au lait); German (kokospalme,kokosnusspalme); Indonesian (kelapa); Italian (cocco); Lao (Sino-Tibetan) (phaawz); Malay (kelapa); Mandinka (tubab sibo,coc); Portuguese (coco da India,coco da Bahia,coqueiro de Bahia); Spanish (cocotero,coco de agua,coco,palma de coco,palmera de coco); Swahili (mnazi); Tamil (tennai-maram); Thai (ma phrao); Trade name (coconut); Vietnamese (dũa)

### BOTANIC DESCRIPTION

*Cocos nucifera* trees have a smooth, columnar, light grey-brown trunk, with a mean diameter of 30-40 cm at breast height, and topped with a terminal crown of leaves. Tall selections may attain a height of 24-30 m; dwarf selections also exist. Trunk slender and slightly swollen at the base, usually erect but may be leaning or curved.

Leaves pinnate, feather shaped, 4-7m long and 1-1.5 m wide at the broadest part. Leaf stalks 1-2 cm in length and thornless.

Inflorescence consists of female and male axillary flowers. Flowers small, light yellow, in clusters that emerge from canoe-shaped sheaths among the leaves. Male flowers small and more numerous. Female flowers fewer and occasionally completely absent; larger, spherical structures, about 25 mm in diameter.

Fruit roughly ovoid, up to 5 cm long and 3 cm wide, composed of a thick, fibrous husk surrounding a somewhat spherical nut with a hard, brittle, hairy shell. The nut is 2-2.5 cm in diameter and 3-4 cm long. Three sunken holes of softer tissue, called 'eyes', are at one end of the nut. Inside the shell is a thin, white, fleshy layer known as the 'meat'. The interior of the nut is hollow but partially filled with a watery liquid called 'coconut milk'. The meat is soft and jellylike when immature but becomes firm with maturity. Coconut milk is abundant in unripe fruit but is gradually absorbed as ripening proceeds. The fruits are green at first, turning brownish as they mature; yellow varieties go from yellow to brown.

The generic name seems to be derived from the Portuguese 'coco', meaning 'monkey'.

### BIOLOGY

The tall varieties reproduce by cross-pollination. Male flowers open first, producing pollen for about 2 weeks. Female flowers are not usually receptive until about 3 weeks after the opening of the inflorescence, making cross-pollination the usual pattern. Wind is the main pollinating agent. Reproduction in dwarf varieties is generally through self-pollination. Female flowers are receptive about a week after the male flowers open, both ending at about the same time. *C. nucifera* flowers approximately after the 6th year.

L.

Areaceae



Coconut palms: Planted along irrigation canal. (Rafael T. Cadiz)



Inflorescence: Inflorescence of golden dwarf coconut variety. (Rafael T. Cadiz)



Immature nuts (Rafael T. Cadiz)

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L.

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## ECOLOGY

*C. nucifera* is unknown in the wild state. In the coastal areas of the tropics and subtropics where it is grown, it requires a hot, moist climate and deep alluvial or loamy soil, thriving especially near the seaboard, but also considerable distance inland, provided climatic conditions and soil are suitable. Rocky, laterite or stagnant soils are unsuitable.

## BIOPHYSICAL LIMITS

Altitude: 520-900 m, Mean annual temperature: 20-28 deg. C, Mean annual rainfall: 1000-1500 mm

Soil type: *C. nucifera* is tolerant to soil variations but its natural preference is for sandy, well-aerated and well-drained soils. It has considerable ability to adapt to soils of heavier texture.

## DOCUMENTED SPECIES DISTRIBUTION

Native: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam

Exotic: Argentina, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chad, Chile, China, Colombia, Cook Islands, Cote d'Ivoire, Ecuador, Fiji, French Guiana, Gambia, Ghana, Guinea, Guyana, Haiti, India, Jamaica, Kenya, Kiribati, Liberia, Madagascar, Mali, Marshall Islands, Mauritania, New Caledonia, Niger, Nigeria, Papua New Guinea, Paraguay, Peru, Samoa, Senegal, Sierra Leone, Solomon Islands, Sri Lanka, Surinam, Togo, Tonga, Uganda, Uruguay, US, Vanuatu, Venezuela, Zanzibar



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

**PRODUCTS**

**Food:** Copra, the dried coconut endosperm, contains an edible cooking oil (coconut oil). The apical region of *C. nucifera* ('millionaire salad') is a food delicacy in areas where it is grown. Other food derivatives of coconut include coconut chips, coconut jam, coconut honey, coconut candy and other desserts.

**Fodder:** Copra meal and coconut cake, the residues of oil extraction from copra containing approximately 20% protein, 45% carbohydrate, 11% fibre, fat, minerals and moisture, are used in cattle feed rations.

**Apiculture:** *C. nucifera* is an important pollen source for honey production. Where sap is tapped from unopened inflorescences for toddy-making, many bees drain in the collecting pots. The honey may be greenish-yellow like the motor oil and crystal clear if monofloral. Granulation is medium (takes up to 3 months).

**Fuel:** The high moisture content of *C. nucifera* wood and the difficulty of splitting it has made it relatively unpopular as firewood. Coconut shell charcoal is a major source of domestic fuel in the Philippines. It is also exported to Japan and the USA. Coconut oil can be used as a substitute for diesel oils, for electric generating plants and motor vehicles. However, this use is non-economic in most situations at the present prices of fuel oil.

**Fibre:** Three types of fibres are obtained from the coconut husks: mat fibre or yarn fibre, used in making mats; bristle fibre, used for brush making; and mattress fibre, used in stuffing mattresses and in upholstery. Leaflets are used in braiding mats, baskets and hats.

**Timber:** *C. nucifera* timber has traditionally been used in tropical countries for the structural framework of houses. Coconut timber taken from the lower and middle parts of the trunk can be used for load-bearing structures in buildings, such as frames, floors and trusses. Coconut trunks can be used for poles, as they have great strength and flexibility. The wood can also be used for furniture and parquet flooring.

**Lipids:** The oil contains fatty alcohol and glycerine used in soaps, detergents, shampoos cosmetics, pharmaceuticals and explosives.

**Alcohol:** Sap from the tender, unopened inflorescence (coconut palm sap) is used in the producing areas for toddy, or tuba, a beverage obtained by natural fermentation. Tuba contains 6-7.5% alcohol. The distillation of fermented coconut toddy yields a spirit called arrack, produced commercially in Sri Lanka and the Philippines.

**Other products:** Coconut-shell flour, obtained from grinding clean, mature coconut shells to fine powder, is used as a filler in thermoplastic industry and an abrasive for cleaning machinery. Coconut-shell charcoal may be processed further into activated carbon that has many industrial applications, including general water purification, crystalline sugar preparation and gold purification. The edible mushrooms of the genus *Auricularis* grow well on coconut stems and are readily sold in China and elsewhere.

**SERVICES**

**Soil improver:** Burnt husks form a useful sort of potash that is used to fertilize the trees. The husks also make valuable mulch for moisture conservation in the dry season and help to suppress weeds.

**Ornamental:** Planted widely as an ornamental tree.

**Intercropping:** Coconut palm is one of the most widely grown tree crops in the tropical countries. Its growth characteristics are ideal for small production and also for combining with other crops. The crown morphology and the relatively wide spacing facilitate the planting of a wide spectrum of field crops in coconut plantations. It has therefore been intercropped with cereals (cassava, sweet potatoes, yams) or fruits (bananas, passion fruit, pineapples and ground nuts) in many countries including Thailand, India, Sri Lanka, the Philippines etc.

**TREE MANAGEMENT**

The correct planting density depends on soil moisture, variety and soil type. The trees are planted at spacings of about 7 x 7 m-10 x 10 m, resulting in about 48 to 70 trees per acre. In home gardens, they should be planted where they will receive full sun and not be crowded. The new tree should be watered immediately after planting and frequently thereafter until it is well established. At least 2.5 cm of water should be supplied weekly by rain or by irrigation. When cattle grazing is integrated with coconut cultivation, severe competition for moisture between palms, bush and grass can be minimized. Mulch applied to the soil surface around the tree will help retain soil moisture and restrict weed growth. About 12% of the old trees (over 60 years old) should be felled each year, resulting in the entire removal of an initial 94% stand over 8 years. All fronds, logs and stumps should be removed to control the spread of the rhinoceros beetle (*Oryctes rhinoceros*, *O. moceros*). There is need for a legume cover crop to fix nitrogen to the soil.

**GERMPLASM MANAGEMENT**

Seed storage behaviour is recalcitrant; 70% of excised embryos survived desiccation to 14-15% and 44% to 8-9% mc. Cryopreservation techniques for coconut embryos comprise 4 hours of pretreatment in a medium containing 600 g/l glucose and 15% glycerol, followed by rapid freezing and thawing. With this technique, 43% of embryos excised from immature fruits (7-8 months after pollination) survived 1 month's cryostorage. A few cryopreserved embryos produced whole plants, but 33-93% of embryos excised from mature fruits that had been dried for 4 hours under a flow hood and then placed in the glucose and glycerol medium detailed above for 11-20 hours before rapid freezing in liquid nitrogen produced whole plants with growth delayed by 1-2 months compared with non-frozen embryos.

Flower pollen oven-dried at 40 deg. C for 40 hours can be stored over 35% sulphuric acid at room temperatures for 3 weeks. Pollen can be freeze-dried and stored under vacuum for 1 year or more. Freeze-dried pollen can be transported at ordinary pollen temperatures and will retain its viability for 4 months. In ordinary pollen samples, about 25% may be defective. The best germination was given at 30-35 deg. C with sucrose concentration of 10% and gelatin concentration of 30%.

**PESTS AND DISEASES**

Bird pests include the Hispaniolan woodpecker, which attacks the trunk for nesting sites and damages immature nuts, and the village weaver, which strips the leaves for nest building. The nematode *Rhadinaphelenchus cocophilus* invades the stem and crown base, causing red-ring disease. More than 100 species of insects afflict the tree, including rhinoceros beetle (*Oryctes rhinoceros*, *O. moceros*), coconut mite (*Aceria guerreronis*) and coconut weevil (*Rhynchoporus cruentatus*). Other important coleopteran species include *Strategus* spp. (attacking the softwood and the heart of the tree), *Brontispa* spp. (severely damaging leaves) and leaf miners (*Promecotheca* spp.) that render leaves non-functional.

Lethal yellowing is the most important disease of *C. nucifera*. Since it was discovered in Key West, Florida, USA, over 200 years ago, it has crept northward, killing hundreds of thousands of palm trees and endangering virtually all of the tall coconut palms. Lethal yellowing is suspected to be caused by a tiny mycoplasma-like organism, visible only with the aid of an electron microscope. Early symptoms are premature dropping of coconuts and blackening of flower stalks. The leaves then turn yellow; beginning with the lower ones and progressing to the crown, which dies and eventually topples from the tree. The tree usually dies within 6 months after exhibiting the 1st symptoms. An injection of the antibiotic oxytetracycline may result in remission of symptoms within 4 weeks, but additional applications at 4-month intervals are required to keep the tree alive. Rouging and destruction of the infected palms and replacement with the resistant Malayan Dwarf coconut palm is recommended.

Bud rot, caused by the fungus *Phytophthora palmivora*, is found in all areas where *C. nucifera* is grown. Early symptoms, found on young developing leaves, are brown sunken spots, yellowing or withering. The leaves turn a light greyish-brown, becoming darker brown as they collapse at the base. The infection spreads inward to the bud and outward to surrounding leaves, which turn yellow and fall off. Young nuts fail to develop and fall, but those well-formed before infection continue to mature. A disagreeable odour emanates from the decaying bud. Disease development most commonly occurs after periods of heavy rains. Early detection is essential for successful control. Application of a Bordeaux paste to the buds in early stages may result in recovery if the apical meristem is not infected. Remove fronds showing early symptoms. Palms showing advanced symptoms should be removed and destroyed, since they may serve as a source of inoculum.

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**SUGGESTED CITATION**

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