Oil palm, a crop for the future

Elaeis guineensis

The **stem**, which is not ramified, has diamond-shaped scars where the leaves have been cut, which spiral around the stem.

The **leaves** or **fronds** surround the terminal bud. The palm puts out new leaves continuously from the centre of the crown, while the older leaves are pruned or dry out and fall. They are 6 to 9 metres long and have more than 300 blade-like leaflets on several levels.

The first palms appeared some 85 million years ago in a wide range of environments, but the 2800 species that exist today are primarily found in the intertropical zone.

Palms are perennial plants, of every imaginable size. They are not trees : they have a stem rather than a trunk. Since time immemorial, palms have provided people with foodstuffs, personal hygiene products, medicinal preparations, building materials, etc, etc.

The scientific name for the oil palm, *Elaeis guineensis,* comes from the Ancient Greek elaia = olive, because of its oil-rich fruits. This elegant palm, which originated in humid intertropical Africa, is a distant relative of the coconut palm.

Fruits

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Palm oil is primarily for food use

Red palm oil is generally refined, bleached and deodorized before being used directly or processed further.

- Some 80% is used for human consumption: salad oil (in tropical countries), cooking oil, margarine, butter substitutes, biscuits, cakes and confectionery.
- The rest is used in soaps, detergents, cosmetics and the oils and fats processing industry.
- A biofuel, palm oil methyl ester, is set to grow in importance, like all renewable energies.

Oil palm produces two different types of oil at the same time:

- **palm oil,** from the fruit pulp: 20 to 26% of fresh bunch weight; in its unprocessed state, it is red, due to its carotenoid content.
- **palm kernel oil (PKO),** from the fruit kernel: 2 to 3% of fresh bunch weight; it is a creamy colour, and has very similar characteristics to coconut oil.

Palm oil extraction

This is done on site, within 48 hours of harvesting, by cooking the bunches (sterilization), stripping and pressing the fruits, and decanting the oil.

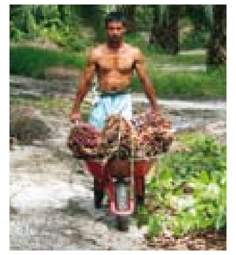
Modern oil mills are high-capacity (several dozen tonnes of bunches per hour), while small-scale mills in Africa handle less than a tonne per hour, if not per day.

Nutritional quality beyond reproach!

Palm oil performs like maize, sunflower, soybean or rapeseed oils, which are rich in essential fatty acids. The high carotenoid content of the unprocessed oil boosts vitamin A levels in the blood, hence its preventive effect on certain eye diseases. Palm oil can resist high temperatures, and is primarily used for frying.

Palm oil is the world's leading oil, ahead of soybean

- The oil palm production chain: **10** million hectares planted, **36** million tonnes of palm oil + **4** million tonnes of PKO.
- With 4 tonnes of oil/hectare/year, yields are seven to ten times higher than for annual oil crops: soybean, rapeseed, sunflower, etc.
- However, because oil palm has to be harvested by hand, a harvester cannot cover more than 8 hectares of oil palm, compared to 200 ha of soybean.



Production dominated by Asia

Wild palms are still harvested in Africa.

The first plantations date back to the start of the 20th century, and the sector has really taken off since 1960, with a boom in large agroindustrial plantations (10000 ha and more), particularly in Asia.

Malaysia and Indonesia combined produce 86% of the world's palm oil!

The **flowers** develop on inflorescences, some male, some female (which become bunches once fertilized), in the axil of each frond, except in the event of early abortion.

The **fruits,** which are very rich in oil, are oval, fleshy drupes grouped together in "bunches" which, when adult, weigh anything from 15 to 25 kilos and have around 1500 fruits.

Continuous harvesting, by hand

In plantations, there are two or three harvesting rounds per month, producing 10 to 30 t of bunches per hectare per year in all.

Pests and diseases

Oil palm suffers from many pests and diseases that can have a serious impact on palm growth, yields and survival.

- **Rodents** (rats, agoutis, etc), porcupines and wild boars attack very young palms and eat the terminal bud.
- **Limacodidae insects** (brightly coloured, highly urticant caterpillars) cause defoliation and subsequently yield losses.
- **In Africa,** oil palm vascular wilt is a major problem.
- **In Southeast Asia,** basal stem rot caused by *Ganoderma* is having an increasing impact in replantings.
- **In Latin America,** oil palm bud rot causes substantial losses and has even wiped out whole plantations in Colombia, Brazil, Surinam and Ecuador.

The main three types of oil palm differ in terms of the thickness of the fruit shell

- The *dura type,* has a thick shell.
- The *pisifera type,* does not have a shell, but these palms are sterile females and only very rarely bear fruit.
- The *tenera type,* a hybrid of the above two, has a thin shell.

Research for sustainable oil production

Issues

- Satisfying growing global demand for vegetable oils.
- Producing more, while respecting biodiversity and the environment.
- Allowing for the impact of an emerging biofuel production chain.

Research for sustainable production

- Working towards ecological intensification of existing plantations.
- Managing land to ensure rational choice of new planting sites.
- Promoting high quality oil.

Expanding oil palm plantings without threatening biodiversity

To avoid setting up new plantings in zones that should be preserved, CIRAD assesses:

- The importance of the zone in question for local people (agriculture, gathering, hunting, fishing, sacred sites).
- Threatened plant and animal species, the susceptibility of various ecosystems, the degree of biodiversity, etc.

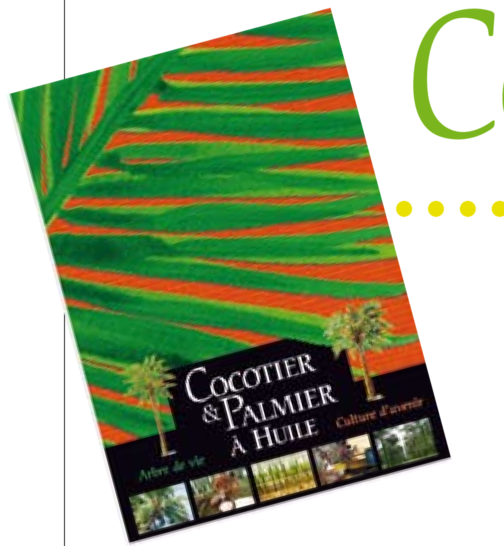
The chosen zone has to have sufficient agricultural potential.

Boosting plantation productivity

To boost plantation potential, CIRAD has been working for decades with various partners—IRAB (Benin), IRAD (Cameroon), CNRA (Ivory Coast), SOCFINDO (Indonesia), La Cabaña (Colombia) and Palmeras del Ecuador (Ecuador)—on a genetic improvement programme.

The hybrid seeds developed are resistant to lethal diseases and ensure yields of anything up to 8 tonnes of oil per hectare and more.

Using in vitro culture (somatic embryogenesis) to reproduce elite palms is also looking very promising.



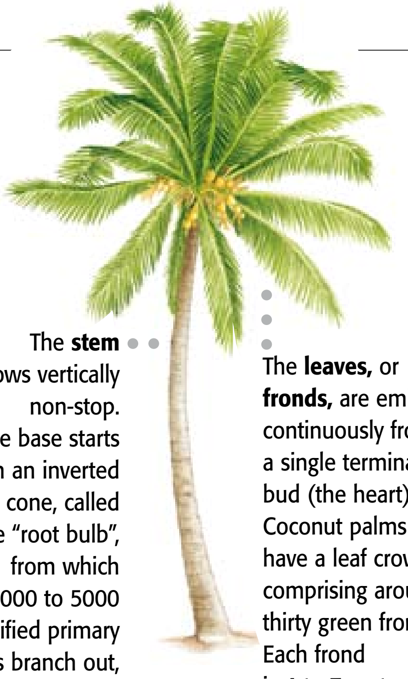
Coconut, the tree of life

Cocos nucifera



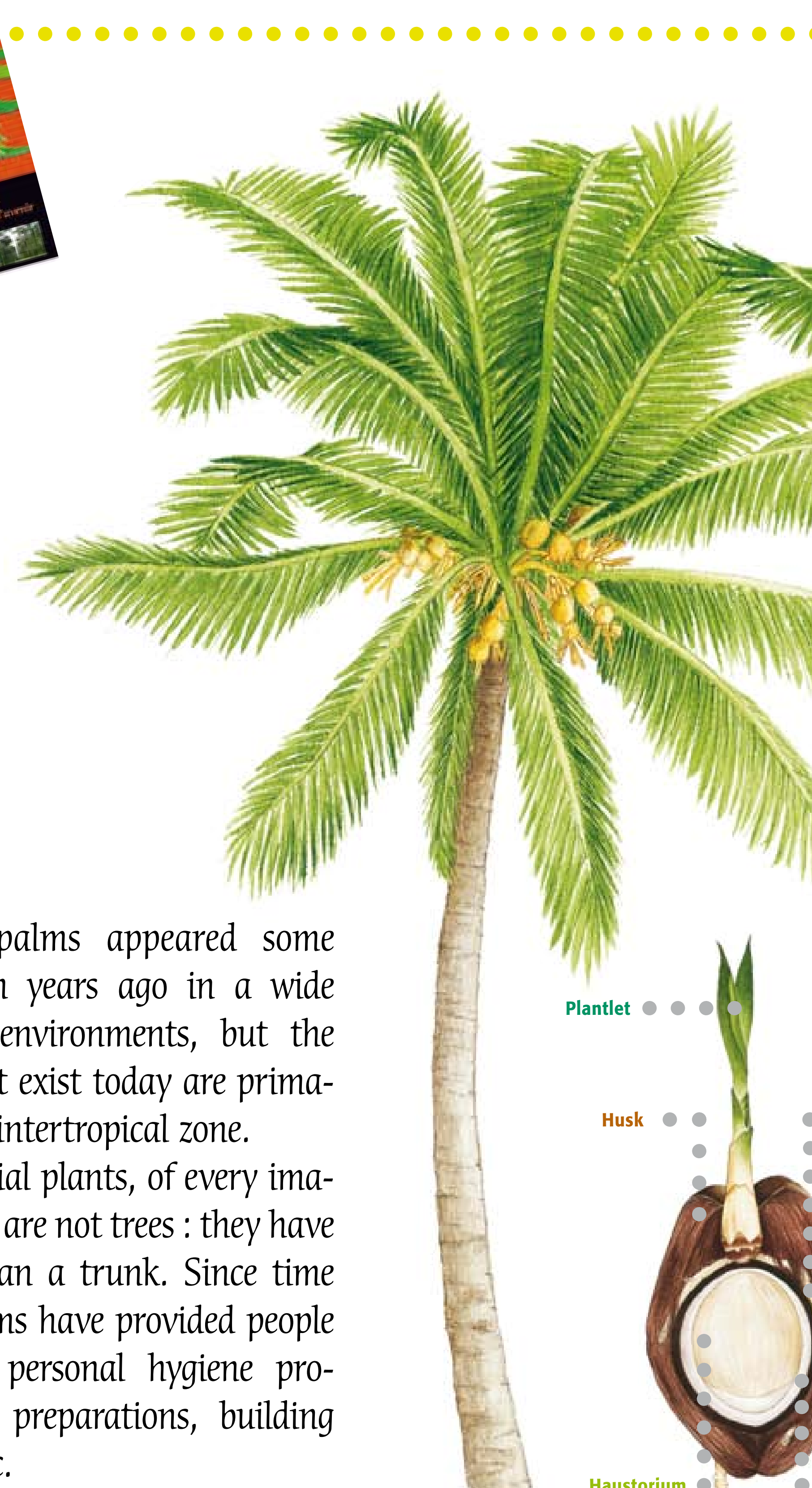


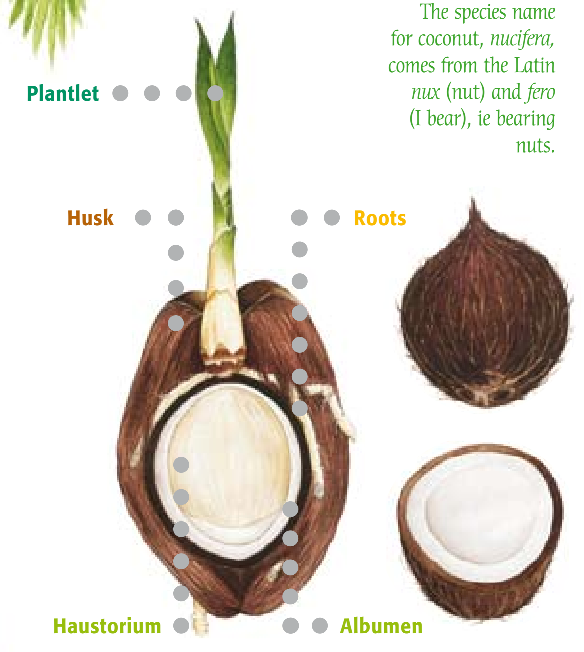




The **stem** grows vertically non-stop. The base starts from an inverted cone, called the "root bulb", from which 3000 to 5000 ramified primary roots branch out, anchoring the palm in the soil to protect it from strong winds.

The **leaves**, or **fronds**, are emitted continuously from a single terminal bud (the heart). Coconut palms have a leaf crown comprising around thirty green fronds. Each frond is 4 to 7 metres long and has around 200 leaflets.





The species name for coconut, *nucifera*, comes from the Latin *nux* (nut) and *fero* (I bear), ie bearing nuts.

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Coconut palms are tropical plants that bear fruit all year round

They are found on all sorts of soils, even very poor ones (coastal sands, peat, etc) that are unsuitable for other crops.

There are Tall, Dwarf and hybrid coconut varieties.

They begin to bear after **four to ten years**, grow up to **12 m** tall in the case of Dwarf varieties and **30 m** for Talls, and live for up to a hundred years.

Is coconut the tree of life?

Some 96% of coconut palms are grown by ten million smallholders, mostly in Asia and the Pacific. Their plantings generally cover less than four hectares, but are vitally important for these growers, who often have to cope with numerous difficulties: low copra prices, ageing plantations, the risks of lethal diseases and the difficulty of switching to other crops.

Global oil production

Asia is the main production zone, with 84% of global output and relatively stable yields (5 tonnes of nuts/ha).

Global copra oil production totals about 3 million tonnes a year.

In Africa, the Caribbean and Oceania, copra is still the only source of income and trade for smallholders.

The main copra oil producing countries are the Philippines, Indonesia and India. Most of the oil is consumed in producing countries. Exports account for less than half of the total output (1.3 million tonnes a year). The European Union is the leading importer, followed by the United States.

Coconuts comprise a smooth epidermis whose colour depends on the variety and the stage of ripening, covering a thick fibrous layer, the "husk".

The husk covers the actual seed: a nut with a very hard shell.

The inside of the shell is coated in albumen, an oily white kernel, surrounding a large cavity containing a sterile liquid, "coconut water". This is the coconut's fresh water reserve, which enables it to germinate regardless of the outside conditions, provided the temperature is right.

The **inflorescences** comprise spikelets bearing female flowers at the base and male flowers towards the tip.

The **fruits**, produced after fertilization of the female flowers, are drupes, commonly known as "coconuts".



Every part of a coconut palm has its uses!

Coconuts are rich in nutrients and minerals and filled with sweet, sterile, fresh water. They can be stored for long periods. Coconut water, desiccated coconut and coconut milk are all nourishing and delicious.

The kernel of ripe nuts can be oven-dried to produce copra. The oil is extracted under high pressure, and has many uses: cooking oil, margarine, biscuits, soaps, cosmetics, detergents, biofuels, etc.

Coconut palms also have other uses: activated charcoal, roofing, fencing, basketwork, weaving, flooring, various utensils, decorative objects, etc, etc.

The astonishing genetic diversity of coconut

Over the centuries, numerous varieties have been created for food, medicinal or ritual purposes. However, this diversity is now under threat as a result of agricultural and cultural uniformization.

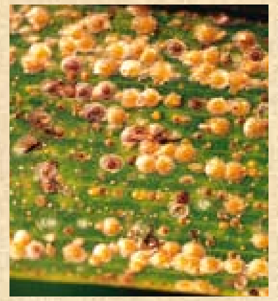
CIRAD has helped to inventory the different varieties and develop new hybrids. One of the main objectives is resistance to lethal diseases.

Pests and diseases

Coconut palms are affected by numerous pests and diseases:

- **Insects** attack the terminal bud, leaves, stem, roots, inflorescences and fruits.
- **Parasitic fungi** such as *Phytophthora katsurae* and *P. palmivora* cause rotting of immature nuts and the terminal bud, in Southeast Asia, Africa and the Caribbean.
- **Rats and coconut crabs** can also severely damage nuts, and groups of wild boars can destroy young plantings in a single night.
- **A disease**, "lethal yellowing", caused by a microorganism called a phytoplasma, does considerable damage and has destroyed many coconut plantings worldwide.





Coconut, the tree of life

Issues

- Making coconut plantings more productive.
- Boosting incomes for families who make a living from coconut.

Scientists watching over coconut

- Controlling lethal yellowing.
- Optimizing crop management sequences.
- Diversifying the range of coconut products.
- Promoting those products on local and export markets.

Research on coconut is primarily conducted by national research systems in producing countries, working together in networks supported by CIRAD.

Lethal yellowing

Lethal yellowing, which is caused by a microorganism, a phytoplasma, has destroyed coconut plantings in both Africa and the Americas.

Research by CIRAD and partners in Ghana and Mexico is centring on characterizing the phytoplasma, identifying the as yet not fully known sap-sucking insects that carry the disease, and testing and disseminating resistant varieties.

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