

kraft and speciality paper. Unlike abacá, sisal ropes tend to break suddenly without warning. Sisal tow and off-grade fibres, unsuitable for twines, may be made into paper and fibre board, or used as padding in motorcars and upholstery. Waste pulp from processing is returned to the field as a fertiliser.

Sap from the inflorescence stalk of *Agave* spp. may be fermented to produce pulque – the national drink of Mexico. Incidentally, the sap contains hecogenin, a source material for the synthesis of cortisone. A row of *Agave* plants also makes an impenetrable living fence.

A recent report published by the Swedish Council for Building Research has revealed that concrete can be reinforced significantly by the admixture of sisal and other vegetable fibres. The ultimate strength of sisal fibre was found to be equal to that of normal reinforcing steel. However, the report also suggests that more thorough research is necessary before sisal fibres can be recommended for this use.

Henequen, a native of the Yucatan Peninsula of Mexico, is a well-known substitute for sisal and is mostly grown there, accounting for nearly 90 per cent of world's production. The remaining supply chiefly comes from Cuba and El Salvador.

Coconut

Cocos nucifera L. (n = 16)

Family: Arecaceae

*MORPHOLOGY

Commercial coir is obtained from the fibrous husk (mesocarp)* of the fruits of the coconut palm that is confined to the coastal and deltaic regions of the tropical and subtropical countries. The fibre is valued for its lightness, elasticity, exceedingly high resistance to mechanical wear and dampness, especially in sea water and its sound insulating quality. However, it is less durable and more rough surfaced than other vegetable fibres but the low production cost makes it competitive despite its limitations. It has been used for centuries in the manufacture of marine cordage, fishing nets and other nautical items as well as matting of all kinds.

The origin, botany and cultural requirements of coconut palm will be discussed in Chapter 6 on Vegetable Oils and Fats.

PRODUCTION

At present, India is the principal producer and exporter of coir and coir products, followed by Sri Lanka. Elsewhere, coir production is very little. The global production of coir during the year 2012 was 1 102 800 tonnes. India is by far the largest producer, contributing 542 000 tonnes (49 per cent of the share). Some other major producing nations are Malaysia, Bangladesh and Côte d'Ivoire. India is the largest exporting country of coir yarn, the supplies going to the Netherlands, Italy, Belgium, Germany, Russia, Japan and the United States. However, Sri Lanka is the largest supplier of brown fibres as well as coir twine, brushes, brooms and coir mats. India and Sri Lanka together accounts for about 90 per cent of the global coir production. The Philippine is the largest exporter of raw coconut (coir) fibres, while Morocco is the largest importer of the product.

The major producing Indian states are Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Orissa (now known as Odisha) and West Bengal. In India, about 40 per cent of the 5000 million nuts

produced annually are used for the production of fibre. Almost all comes from the state of Kerala where extensive backwaters, streams and lagoons provide good conditions for the retting of coconut husk. Coir and coir goods earn a considerable amount of foreign exchange. The production of fibre, yarn and ropes is essentially a cottage industry. Of the fibre produced in South India, only a little is exported; much of the production is spun into yarn by hand or with two spinning wheels. The superior quality yarn is manufactured into mats, matting, rugs, carpets and bags while inferior grades are employed for ropes and twines. India is the chief exporter of coir yarn and coir mats and matting.

Sri Lanka's coir industry, on the other hand, consists chiefly of mechanically separated bristle and mattress fibres; obtained mainly from the mature husks that are left after copra extraction. Sri Lanka is by far the largest exporter of bristle and mattress fibre, with only a little coir yarn.

European countries and the USA are the largest importers of coir and coir products.

HARVESTING AND PROCESSING

EXTRACTION *

* (The fruits are harvested when still green to obtain the best quality coir. Early harvesting yields weak fibre while delayed picking produces hard and dark brown fibre, which is difficult to twist and is used mostly for the upholstery work and brush making. The fruit is dehusked in two ways; by ramming the coconuts against a sharp iron spike fixed firmly in the ground at an inclined level and splitting the husks into three or four pieces, or by splitting with a cutlass and with the help of bursting machines, which is mostly practised in Sri Lanka and Trinidad. It is said that a skilled worker can dehusk as many as 2000 nuts a day. The husk is then subjected to retting to remove the tough interstitial substances closely adhering to the fibrous mass. The retting operation is usually done by submerging the husk in lagoons or in soaking pits (or in trenches and ponds) just within the reach of brackish sea water. The finest grade fibre is obtained from the husks that are retted in tidal creeks where the water moves slowly with the rising and falling tide. This periodic change of water helps to remove the decomposing binding material. After charging, the pits are covered with palm leaves and weighted down with mud to prevent the husks from floating.

The retting time depends on a number of factors such as the salinity of water, temperature and also on the type of the product to be manufactured. For the manufacture of coir yarn, the retting process is continued for eight to nine months or even longer in India. However, for the production of bristle and mattress fibres, as practised in Sri Lanka, the husk is retted for just two weeks. In some factories, the duration of the retting period is reduced by pre-soaking the husk for thirty to forty hours in hot water.

When the retting is complete, the husks are taken out of the water and washed thoroughly and repeatedly to remove mud and dirt. The skin is peeled off and the husks are beaten with the wooden mallets to knock out the pith and other extraneous matter. Disentangled fibres, after rinsing with water, are spread in the sun for drying. The fibres are further cleaned and hackled with steel combs to separate the stiff fibres and are then graded. Hand processing is believed to produce a superior grade fibre.

In Sri Lanka, specially designed machines are used to disintegrate the coconut husk. The retted fibrous mass is fed into the rollers of the machines, where dust and extraneous matter, including short fibres, fall under the machine. The short fibres are removed from time to time and are referred to as mattress fibres. The long fibres (about 20 cm long), 'bristle fibre' or coco fibre are left in the operator's hand. Bristle fibres, on hackling, give around 20 per cent middle-grade fibres (combing). Various grades of fibres, after bleaching over sulphur pans, are baled and shipped for export.

Husk retted in saline water yields stronger and better coloured fibre than those retted in fresh water. Dry milling of unretted husk is also done in some places to produce only mattress fibre.)

FIBRE CHARACTERISTICS

Coconut fibre strands are up to 0.3 m in length, the surface of the fibre bundle being occasionally covered with small lens-shaped silicified stegmata, about 15μ in diameter. Each fibrovascular bundle consists of a thick walled sclerenchymatous sheath surrounding a collateral bundle which disintegrates on maturity resulting in a hollow cavity with the remnants still visible (Figure 2.16). Individual fibre cells are 0.3-1.0 mm (averaging 0.7 mm) long and 0.01-0.02 mm in diameter, and are polygonal to round or oblong in cross section. The ratio of the length to the thickness is 35. The cell wall of each fibre is thick but rather irregular, resulting in the irregular outline of the lumen.

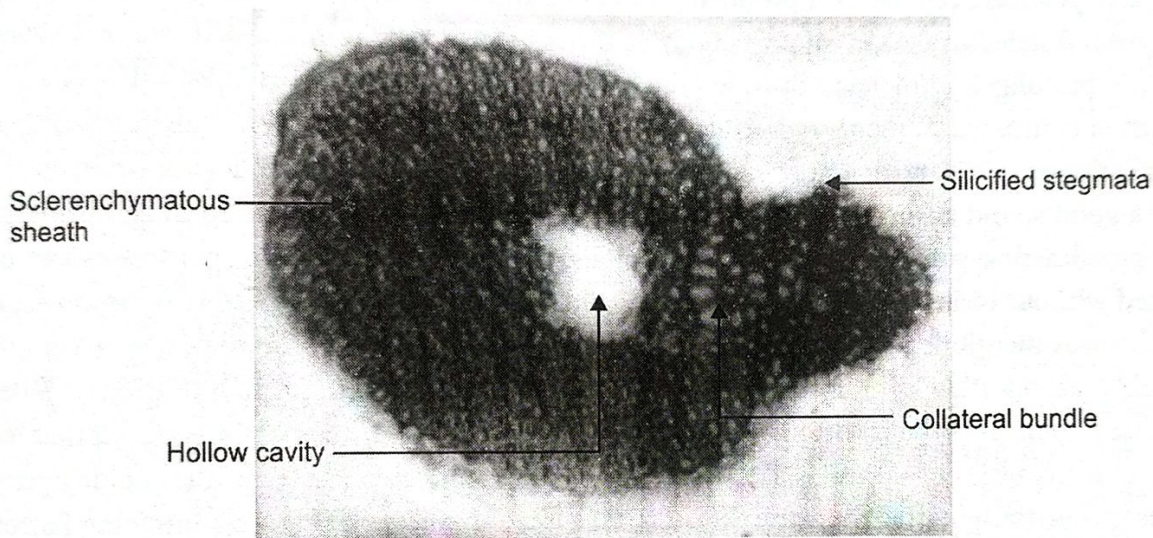


Figure 2.16 T.S through the fibre bundle of coconut (coir) with hollow centre that encloses air which helps in buoyancy.

* USES

“(There are scores of uses for coir in the home, on the farm, in industrial establishments and number of other places. The fibre has a natural resilience, durability and resistance to water and, therefore, is useful for the manufacture of cordage, particularly marine cables and hawsers for ships and sailing craft. Apart from this, coir fibres find wider application in the manufacture of mats, matting and coarse cloth; rubberised coir for making cushion seating; coir bags for lifting coal from mines and for shipping coconuts; belting for industry; packing material to protect against shock and heat; waterproof, soundproof and fireproof boards; thermal insulation; as a source of furfural and tannins; as an absorbent for nitroglycerine in the making of explosive and as paper pulp. Coir is used in Italy for filtering olive oil. Bristle fibres are used for making brushes and brooms, while the mattress fibres are used for mattresses and as a substitute for horse-hair upholstery. Unspun fibre is used for caulking boats.)”

The by-products of the coir industry, that is, pith or bast and coir dust or cocopeat are also useful. The former, owing to its high potash and phosphorus content, is used as manure, while the cocopeat is used as ‘mulch’ to improve the soil tilth since it conserves nearly eight times more moisture than its own weight.