

Biodiversity in coconut for rich dividends

Coconut (*Cocos nucifera*), the most widely cultivated palm, is a native of the humid tropics and an important plantation crop of India. The CPCRI, Kasaragod, now holds the largest collection of 398 accessions, including 266 indigenous and 132 exotic accessions in field gene banks. Coconut exhibits diversity in forms, size, number and colour of fruits. The institute also hosts the International Coconut Gene Bank for South Asia under the umbrella of Coconut Genetic Resources Network (COGENT), of the Bioversity International (formerly International Plant Genetic Resources Institute). Conservation and utilization of coconut biodiversity has resulted in development of 32 improved varieties and contributed to improving coconut productivity.

Coconut is a monoecious perennial monocotyledon and belongs to a monotypic genus *Cocos* and is placed in Arecaceae family. Coconut, in spite of the absence of wild relatives or closely related genera, offers variability in forms. The diversity available in nature is used in the coconut improvement programme. Locating, maintaining and using genetic diversity of coconut presents substantial challenges; the wide dispersal of the species, the limited

The efforts for establishing the International Coconut Genebank for South Asia were initiated during 1996 and this led to a spurt in germplasm prospection and collecting efforts, both within and outside the country. Planting of coconut accessions in the ICG-SA was initiated in 1998. Presently, 91 accessions are planted in the ICG-SA and represent indigenous coconut germplasm as well as coconut ecotypes of Philippines, Malaysia, Sri Lanka, Bangladesh, Indian Ocean Islands of Mauritius, Madagascar and Seychelles, Comoros and Reunion, Maldives, Pacific Ocean Islands, Africa and the Caribbean Region. The optimum population size for coconut accessions being maintained in the ICGs is 90 palms and hence requires a very vast area, approximately 0.5 ha for each accession conserved.

knowledge of history of that dispersion and of the current extent and distribution of diversity. The large, recalcitrant seeds also add to the complexity of managing coconut germplasm. Genetic diversity is desirable for long-term crop improvement and reduction to vulnerability to important crop pest and pathogens. The CPCRI, Kasaragod, is actively involved in collection and conservation of coconut biodiversity in field gene bank for

utilization in coconut improvement programme. A total of 398 coconut accessions, with 266 indigenous collections and 132 exotic collections have been collected.

INTERNATIONAL COCONUT GENE BANK

India hosts the International Coconut Genebank – South Asia (ICG-SA), which has been established at CPCRI Research Centre, Kidu, Karnataka. The International Coconut Genebank (ICG) has been established to enable the efficient conservation, evaluation and safe movement of coconut germplasm and is a part of the International Network of *ex situ* collections, provided for in Article 7 of the International Undertaking on Plant Genetic Resources with the Food and Agriculture



International Coconut Gene Bank at Kidu, Karnataka

Organisation (FAO) of the United Nations acting as the trustee. The ICG-SA is one of the five multi-site gene banks of coconut, as identified by the COGENT Steering Committee with the rest being located in Indonesia (for Southeast and East Asia), Papua New Guinea (for the South Pacific), Cote d' Ivoire (for Africa and the Indian Ocean) and Brazil (for Latin America Caribbean).

DIVERSITY IN GENETIC RESOURCES

The Indian coconut population harbours a wide range of diversity. The islands of Lakshadweep and Andaman and Nicobar with their natural coconut populations, some of which have established with no human interference, are reservoirs of vast genetic diversity. Majority of the native populations in the traditional coconut-growing zones, belong to the wild type (*Niu Kafa*) with greater proportion of husk while some of the evolved types have lesser husk and more endosperm (*Niu Vai* or domesticated types). Further, introgression between the *Niu Kafa* and *Niu Vai* types in the nature has resulted in the emergence of intermediate types.

Talls

Tall palms are referred to as var. *typica* and are the most commonly cultivated for commercial production in all coconut-growing regions of the world. Tall palms grow to a height of 20-30m, first flowering in 6-10 years after planting. Among the indigenous tall cultivars, West Coast Tall (WCT), East Coast Tall (ECT), Benaulum Tall (BENT), Tiptur Tall (TPT), Andaman Ordinary Tall (ADOT) and Laccadive Ordinary Tall (LCT) are popular. Some popular exotic tall cultivars are Fiji Tall, Philippines Ordinary Tall, Sri Lankan Tall, West African Tall, Panama Tall, Malayan Tall, Jamaican Tall and San Ramon Tall.

West Coast Tall: This is the common tall cultivar extensively cultivated along the west coast of India. The WCT palms normally come to bearing in about 5-7 years. The annual nut yield of these palms ranges from 50 to 100 nuts with a mean of 80 nuts. The average copra

content in the nut is 176 g with an oil content of 68%. This is used as a parent for production of commercial coconut hybrids. A selection from this cultivar has been recommended for release under the name Kera Keralam.

Kappadam Tall: This cultivar resembles the ordinary tall type, but it is more robust particularly in size of the fruit which is one of the largest, among the indigenous types. The shape of the nut is broadly ellipsoid. The yield is about 77 nuts, the range being 62-99 nuts/palm/year. The copra content is high, 284 g/nut, and the copra is thick and hard. The oil content in copra is 67%. This cultivar is grown in parts of South Malabar. This cultivar is also known as 'Chappadan' in some parts of Kerala.

The size, shape and colour of fruit of coconut palms present considerable diversity. The colour of the fruits varies from yellow, shades of green and brown to orange (red). The fruits can either be large, medium, small or very small in size (= 5 cm long as in Laccadive Mini Micro), while the shape of the fruit is broadly classified as round, oblong or elliptic and similar variations in shape and size of the nut inside the fruit are also observed. Certain variant forms of coconut palms, such as *spicata* (having unbranched inflorescence with few male flowers) or *plicata* (with fused leaflets) are also observed in nature. Further, while the endosperm of normal coconuts are solid and firm, when mature, certain palms bear fruits with buttery (jelly-like) endosperm and are referred to as Thairu Thengai (India) or Makapuno (Philippines). In terms of plant habit, coconut palms are broadly grouped into talls and dwarfs. The tall cultivars are the most commonly cultivated for commercial production in all coconut growing regions of the world while the dwarf varieties are usually grown for ornamental and breeding purpose.

Laccadive Ordinary Tall: This cultivar is from the Lakshadweep Islands. The palms are similar to WCT in growth as well as nut characters. The average annual yield is 100 nuts/palm. The copra content 176 g/nut and oil content 70-72%.

These palms are good for tapping sweet toddy. This cultivar has been released under the name Chandra Kalpa.

Laccadive Micro Tall: This is another cultivar from Lakshadweep Islands. The palm resembles WCT in appearance, but the fruits are small in size and the average annual yield varies from 100 to 320 nuts/palm. The nuts though smaller have a thick layer of endosperm and suitable for the production of ball copra. The copra content ranges from 60 to 132 g/nut and oil content is 75%, the highest recorded among the cultivars.

East Coast Tall: This is a common cultivar extensively cultivated along the East Coast of India. It is similar to WCT in gross morphology. The average yield is 73 nuts/palm/year and average copra content is 125 g/nut. This is used as a parent for production of commercial coconut hybrids.

Benaulum Tall: This is a popular cultivar in Goa, Konkan and Coastal Maharashtra. Bunches of this palm are closely packed with large number of medium-sized nuts. The average annual yield ranges from 139 to 160 nuts with a copra content of 152 g/nut and an oil content of about 59%. The oil of this cultivar is more suitable for industrial uses for the manufacture of binder, emollient and cosmetics. It has been released as Pratap for

commercial cultivation in Goa and the Konkan region of Maharashtra.

Arasampatti Tall: Arasampatti Tall is a high yielding variety of Tamil Nadu. A selection from Arasampatti Tall has been released as Aliyar Nagar-1 (ALR-1) for commercial cultivation in Tamil Nadu. It comes to bearing in 4-5 years. The annual yield is 126 nuts/palm and copra content 131 g/nut.

Assam Green Tall: Assam Green Tall is the common cultivar of Assam. A high yielding selection of this cultivar has been released as Kamrupa for commercial cultivation in Assam. The palms of this variety, on an average, yield 101 nuts/palm/year. The copra content is 162g/nut and oil content in the copra is 64%.

Andaman Ordinary Tall: Andaman Ordinary is a high yielding and promising cultivar of the Andaman and Nicobar Islands: The palms are tall and comparatively more vigorous than WCT palms in vegetative growth. The nuts are medium to large in size with an annual yield of 77-94 nuts/palm/year. The copra content is 169 g/nut with an oil content of 66%. VPM-3, a selection from Andaman Ordinary Tall, has been released for commercial cultivation in Tamil Nadu.

Tiptur Tall: This is a popular cultivar of Karnataka State. The palms resemble WCT in most of the morphological characters. The colour of the fruits varies from green, greenish yellow to brown. The palms take about 6-7 years for flowering. The fruits are oval in shape and the average yield is 86 nuts/palm/year, the range being 70-110 nuts. The mean copra content is 178 g/nut. The oil content in copra is 68%. A high yielding selection from Tiptur Tall has been released for commercial cultivation as Kalpatharu.

Dwarfs

Dwarf palms are referred to as var. nana. They are not grown on a commercial scale. They are of shorter stature, 8-10m high when 20 years old and start bearing about 3-4 years after planting and have a short productive life of about 40-50 years. The dwarf palms are more homozygous than tall, due to a high degree of self pollination. They produce fruits, which are generally small to medium in size. The dwarfs are presumed to have originated from tall either through mutation or by inbreeding. The popular dwarf cultivars grown in India are Chowghat Green Dwarf (CGD), Chowghat Orange

Dwarf (COD), Kenthali Orange Dwarf (KTOD) and Gangabondam Green Dwarf (GBGD). Among the exotic dwarf cultivars, Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD) and Malayan Green Dwarf (MGD) have become popular in all coconut growing countries of the World.

Chowghat Orange Dwarf: This indigenous dwarf cultivar is found sparsely cultivated throughout the West Coast of India, particularly in the Chavakkad area of Thrissur District in Kerala and also in Karnataka. It is referred to as Kenthali Dwarf in Karnataka. The cultivar is also known as 'Gowrigathram' or 'Chenthengu' in Kerala. The palms have a characteristic orange colour on the leaf petioles, spadices and nuts. This cultivar commences flowering in about 4 years and the average annual yield is 63 nuts/palm. Traditionally this cultivar is grown as an ornamental palm. COD is best suited for tender nut purpose. The tender nut water of this cultivar is sweet with a total sugar content of 7 g/100ml and this cultivar has been released as a tender nut variety. COD is used as a parent for the production of Dwarf x Tall hybrids.

Chowghat Green Dwarf: This is another indigenous dwarf cultivar found sparsely cultivated in the West Coast of India, particularly in the Chavakkad area of Thrissur District in Kerala. This is an early bearer and is also referred to as



Diversity in nut size and shape in Lakshadweep

'Pathinettampatta' in Kerala as well as Tamil Nadu as the first inflorescences emergences from 18th leaf axil. The nuts, leaves and the petioles are dark green in colour. The nuts are smaller with a prominent beak when fully mature. The mean annual yield is 77 nuts/palm with a range of 30-107 nuts. The copra content is low with a mean of 60 g/nut and 66 % oil. The tender nut water is sweet, but the quantity is low. This cultivar has higher level of resistance to root (wilt) disease and is extensively used in the resistance breeding programme. A high yielding selection has been recommended for release, for cultivation in the root (wilt) prevalent tracts, under the name Kalpasree.

Gangabondam Green Dwarf: This dwarf cultivar is mainly grown in the East Godavari district of Andhra Pradesh. The nuts are medium sized and papaya shaped. This cultivar starts bearing by 3rd or 4th year after planting. The mean annual yield is 67 nuts/palm with a range of 50 to 90 nuts. The nuts are relished for tender nut purpose.



Chowghat Green Dwarf



Variability in coconut fruit colour and shape

The copra content is 153 g/nut with 67% oil. GBGD is a good combiner and hence used as a parent for production of Tall × Dwarf hybrids. A high-yielding selection, Gautami Ganga, has been recommended for release for cultivation in Andhra Pradesh.

Malayan Yellow Dwarf: This is a dwarf cultivar introduced from Malaysia. The leaf petioles, inflorescences and nuts of this cultivar are yellow in colour. It comes to bearing in about 4 years after planting. The mean annual yield is 66 nuts/palm, with a range of 35 nuts to 90 nuts/palm. The palm has a tendency of alternate bearing. The average copra content per nut is 140 g and oil content is 66%. Malayan Yellow Dwarf is more homozygous than the two other Malayan dwarfs, *viz.* green and orange and is extensively used as a parent for hybrid seed production.

Malayan Orange Dwarf: This cultivar, introduced from Malaysia, is popularly known as Malayan Red Dwarf (MRD). The palms are very attractive with dark orange colour of nuts, spadices and leaf petioles. The fruits are ovoid in shape. The palm comes to bearing in about 3-4 years and the mean annual yield is 65 nuts with a range of 50-100 nuts/palm. The average copra content is 185 g/nut with 66% oil. This cultivar is mostly cultivated for ornamental purpose. Malayan Orange Dwarf is also being widely used as a parent for the production of hybrids.

Malayan Green Dwarf: This is a semi-tall cultivar, even though the name indicates a dwarf type. This cultivar was also introduced from Malaysia. It is an early bearing type and produces medium sized and oval shaped green nuts. The annual yield ranges from 50-120 nuts. The average copra content is 172 g/nut, oil content is 65% and quality of copra is good.

Utilization of Coconut Biodiversity

Value of germplasm is realised only when it is utilized for the improvement of the crop. In coconut, improvement has been through screening and selection of local/exotic germplasm for adaptation to the local environment and exploitation of hybrid vigour.

Selection

A number of high yielding varieties of coconut have been released, through selection and evaluation of promising accessions conserved both at the institute as well as the various coordinating centres under the All India Coordinated Project on Palms as well as State Agricultural Universities. So far, 18 varieties have been released, *viz.* Chandra Kalpa, Pratap, Chowghat Orange Dwarf, Kera Chandra, VPM 3, Kamrupa, ALR 1, Kera Sagara, Kalpa Pratibha, Kalpa Dhenu, Kalpa Mitra, Kalparaksha, Kalpatharu, Kalpasree, Kera Keralam, Kera Bastar, Kalyani Coconut and Gautami Ganga. The varieties suitable for cultivation in the different states of the country.

Exploitation of Hybrid Vigour

In coconut, heterosis has been tapped through hybridization between Talls and Dwarfs. India was the first country in the world to report on heterosis/hybrid vigour in coconut. More than 100 cross combinations have been developed for evaluation of yield potential at CPCRI, SAUs and the centres. So far 15 hybrids have been released.

SUMMARY

Coir industry basically utilizes byproduct of coconut. However, identification of accessions with long, stiff fibres could promote the industry as well as benefit the coconut farmers to a great extent. Similarly, specific genotypes suitable for production of coconut chips, higher recovery of inflorescence sap, and preparation of shell products need to be identified for utilization in breeding programmes. Dual purpose varieties for tender nut and copra production are being developed.

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