

# High Yielding Coconut Cultivars and Hybrids

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India ranks third in the world in both area and production of coconut. Since 1949-50, the area under coconut cultivation has increased from 0.59 million hectares to 1.518 million hectares in 1991-92 and the production from 3292 million nuts to 10,043 million nuts. The national productivity was about 5759 nuts/ha/year in 1950-51 and the same increased to 6616 in 1991-92. The productivity in Andhra Pradesh with 15,129 nuts/ha is the maximum whereas Kerala which accounts for approximately 50 per cent of total area under cultivation produces only 4970 nuts/ha. The low productivity in Kerala is mainly due to the irregular plantings in home-steads leading to over-crowding, non-adoption of management practices, severe drought in northern districts and root (wilt) in eight southern districts. Most importantly, the inferior planting material with poor genetic potential used has also contributed to poor productivity.

Crop improvement through selection, breeding and management has been one of the major objectives of coconut research workers for the last 60 years.

## GERMPLASM HOLDINGS

In India, the collection of coconut germplasm dates back to 1924, when some of the cultivars were introduced from the important coconut producing countries in the world, namely, the Philippines,

Malaysia, Fiji, Indonesia, Sri Lanka and Cochin China (Cambodia). These collections were planted at Central Coconut Research Station, Pilicode (now under Kerala Agricultural University) and these formed the nucleus populations for coconut improvement research programmes. Open pollinated and selfed progenies of these introductions were later planted at the Central Coconut Research Station

(CCRS), Kasaragod in 1940's. Systematic introductions of coconut germplasm was further intensified in 1952 and in 1958, a survey for collection of indigenous types was launched.

At present, CPCRI is maintaining the world's largest coconut germplasm assemblage which consists of 86 exotic and 46 indigenous collections (Table-1). These exotic collections from 22 countries of

**Table-1 : Coconut Germplasm Holdings at CPCRI (as on 1993)**  
*Exotic - 86 Accessions*

Place of collection	Tall	Semi-tall	Dwarf	Total	
South East Asia	16	1*	3	20	*SS Green
Central & South America, Atlantic Region	6	-	1	7	
African Regions	4	1*	2	7	*Mawa Hybrid
Pacific Ocean IS	39	-	6	45	
Indian Ocean IS	3	-	4	7	
	68	2	16	86	

*Indigenous - 46 Accessions*

Place of collection	Tall	Dwarf	Total
Kerala	4	2	6
Tamil Nadu	4	5	9
Karnataka	1	1	2
Andhra Pradesh	4	1	5
Goa	3	-	3
Gujarat	1	1	2
Orissa	4	-	4
West Bengal	1	-	1
Andamans	10	1	11
Laccadives	2	1	3
	34	12	46

South and South East Asia, Caribbean Islands, Indian Ocean Islands, Pacific Ocean Islands and African countries, comprise of 72 tall, 12 dwarfs, one semi-tall and one hybrid. Among these, 24 collections made during 1981 from six Pacific Ocean Territories are being maintained at World Coconut Germplasm Centre, Andamans, with a view to screening for their reaction to root (wilt) disease, which is prevalent in eight southern districts of Kerala. Sub-samples of some of these collections are also being maintained at State Agricultural University Centres under the All India Coordinated Research Project on Palms namely, Aliyarnagar and Veppankulam (Tamil Nadu), Ambajipet (Andhra Pradesh), Arsikere (Karnataka), Konark (Orissa), Jagadapur (Madhya Pradesh), Jalalgarh (Bihar), Mondouri (West Bengal), Ratnagiri (Maharashtra) and Kahikuchi (Assam) to assess their performance in different agro-climatic regions.

### VARIETIES EVOLVED OUT OF SELECTION

Based on the preliminary evaluation of cultivars available at Kasaragod, a multilocation trial was started in 1972 in different states. Based on the overall superior performance of Lakshadweep Ordinary in various research centres located in Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra, this cultivar has been selected and released by CPCRI in 1985 for commercial cultivation in these four States under the name 'Chandrakalpa' (Fig. 1).

Another cultivar, Banawali Green Round from Ratnagiri (Maharashtra) has been selected and released in 1987 by Konkan

**Table-2 : Performance of released indigenous coconut cultivars**

Cultivar	Mean yield nuts/palm/year	% increase over local Tall	Copra yield		% increase over Local Tall
			Mean /nut (g)	Mean/palm /year(Kg)	
1. Chandrakalpa (Laccadive Ordinary)	98	21.3	195	18.9	32.3
2. Pratap (Banawali Green Round)	151	88.8	160	22.7	57.6
3. Local Tall	80	-	180	14.4	-

Krishi Vidyapeeth, Dapoli, for cultivation in Konkan coast, under the name 'Pratap'. The performance of these two cultivars is given in Table-2.

Based on the organoleptic test for tender nut water in 46 cultivars, 12 cultivars were selected for detailed bio-chemical traits such as total sugars, amino acids, sodium and potassium contents. In view of the superior quality of tender nut water, Chowghat Orange Dwarf (COD) (Fig.2) was recommended for release during 1991 as a tender nut variety for cultivation in Kerala.

Leaf polyphenol levels were taken as a parameter to assess the genetic variability in different coconut cultivars. Thirty six cultivars belonging to eight different geographical origins namely Africa, America, Pacific Ocean Islands, Malaysia, Indonesia, Philippines, Sri Lanka and India were studied. The polyphenol levels showed significant differences among the cultivars. Chowghat Green Dwarf and Kappadam, the two cultivars from Kerala (India), had higher phenol levels (10.82 and 10.74 mg/g fresh weight respectively) than other cultivars.



Fig. 1. Chandra kalpa

Maximum variability was also seen among the cultivars from India which ranged from 4.72 mg for Lakshadweep Ordinary to 10.82 mg for Chowghat Green Dwarf. The cultivars from Sri Lanka (Gonthembili and Ceylon Tall), Lakshadweep Micro from Lakshadweep Islands and also those from Pacific Ocean Islands (Guam I & II), Fiji Tall and British Solomon Islands showed lower leaf phenol levels.

### EXPLOITATION OF HYBRID VIGOUR

The discovery of hybrid vigour in coconut by Patel (1937) in crosses between West Coast Tall (female parent) and Chowghat Green Dwarf (male parent) made in 1932 in Nileswar Coconut Research Station (now under KAU) was a significant landmark in the history of coconut improvement. He observed that these hybrid seedlings showed early germination, increased collar girth and higher leaf number as compared to the progenies of the female parent. This

important finding paved the way for successful breeding programmes in many of the coconut growing countries.

Till the middle of 1950's the emphasis was on the production of TxD hybrids, as the number of dwarf palms available were very few. Among the different palms tested as male parents, Chowghat Orange Dwarf (COD) and Gangabondam (GB) were found to be superior to Chowghat Green Dwarf (CGD). More than 90 hybrid combinations, have been evaluated over the years at CPCRI, Kasaragod and the various centres of All India Co-ordinated Research Project on Palms. In view of their superior performance, COD x WCT and LO x COD developed at CPCRI were recommended for release during 1985 under the name 'Chandrasankara' (Fig.3) and 'Chandralaksha' (Fig.4), respectively. LO x GB developed by the Kerala Agricultural University was also recommended for release under the name 'Lakshaganga' (Fig. 5). Two Tall x Dwarf hybrids de-

veloped at Veppankulam Centre namely VHC-1 and VHC-2 were also released for cultivation in Tamil Nadu. Recently, another hybrid, WCT x COD developed at CPCRI was recommended for release in 1989 under the name 'Kerasankara' (Fig.6) for large-scale cultivation in Kerala, Coastal Maharashtra, Coastal Andhra Pradesh and Karnataka, based on its superior performance.

So far, nine hybrids have been released for large scale cultivation in various parts of the country. The details are given in Table-3. It can be seen from the Table, that the yield of hybrids in terms of nut production were much higher (95 or more nuts/palm/year) compared to around 80 nuts produced by Local Tall cultivar.

The difference in copra yield is more marked in Chandrasankara giving as much as 25 kg per palm per year in comparison with 14 kg in West Coast Tall. However, the selection of individual palms within the tall and dwarfs is necessary for realising uniformity in

Table-3 : Performance of released coconut hybrids

Hybrid/Variety	Nut yield/ palm/yr.	Copra yield		Copra yield/ ha (t)	Oil content (%)	State for which recommended
		Mean/ nut (g)	Mean/ palm (kg)			
1. Chandrasankara (COD x WCT)	116	215	25	4.4	68	Kerala, Karnataka, Tamil Nadu
2. Kerasankara (WCT x COD)	108	187	21	3.5	68	Kerala, Karnataka
3. Chandralaksha (LO x COD)	109	195	21	3.7	69	Kerala, Karnataka
4. Lakshaganga (LO x GB)	108	195	21	3.7	70	Kerala
5. Anandaganga (AO x GB)	95	216	21	3.6	68	Kerala
6. Keraganga (WCT x GB)	100	201	21	3.5	69	Kerala
7. VHC-1 (ECT x DG)	98	135	13	2.3	70	Tamil Nadu
8. VHC-2 (ECT x MYD)	107	152	16	2.9	69	Tamil Nadu
9. ECT x GB	140	150	21	3.7	68	Andhra Pradesh
10. WCT	80	176	14	2.5	68	Control

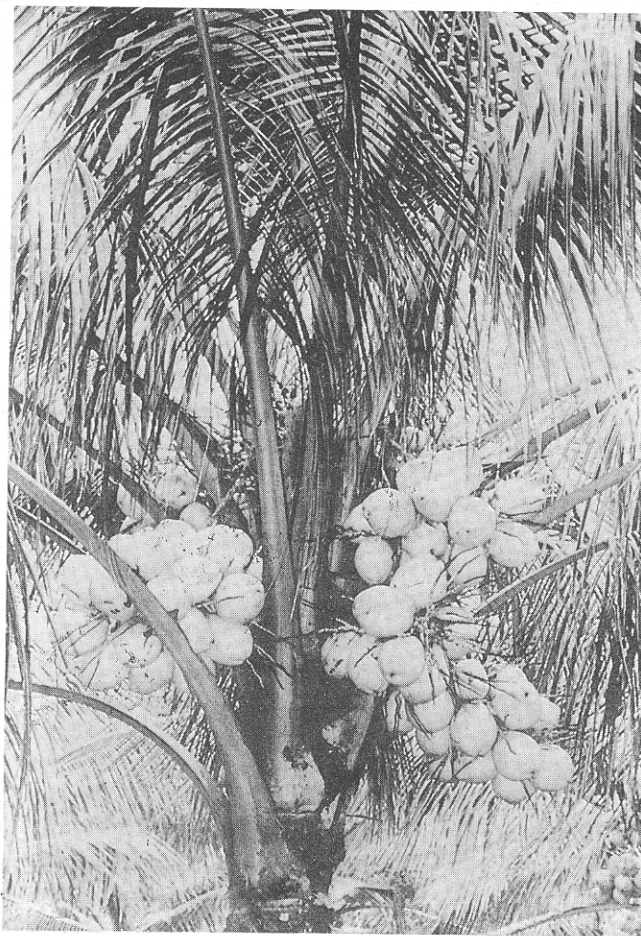


Fig. 2. Chowghat Orange Dwarf

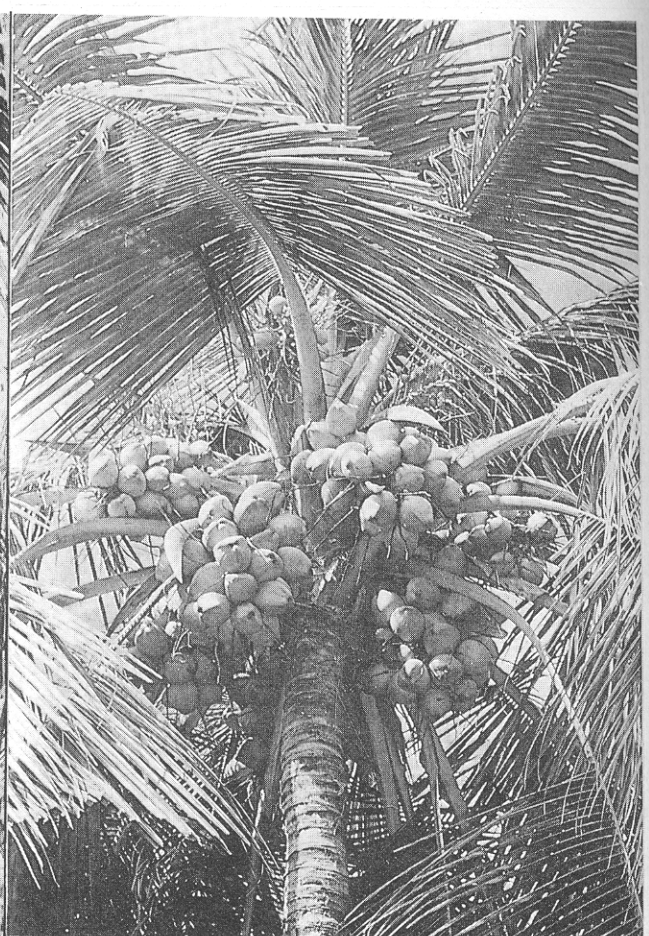


Fig. 3. Chandra Sankara

the hybrid progenies as well as for higher recovery of hybrids. The fact that geographically diverse dwarfs resulted in superior hybrids was confirmed by Bavappa, Sukumaran and Mathew (1973). Kannan and Nambiar (1974) indicated that the best among the six combinations was in which Gangabondam was the common male parent.

In view of the vast potential of coconut hybrids in achieving high levels of production, emphasis should be laid in future to select promising tall and dwarfs from different geographical regions based on their combining ability. Developing uniform population of Talls and Dwarfs by successive

cycles of in-breeding will receive greater attention as it is a pre-requisite for the successful exploitation of hybrid vigour.

#### BREEDING FOR SPECIAL CHARACTERISTICS

Drought is one of the major limiting factors that considerably reduces the productivity. However, severity of drought and response of palms to drought are location specific. Therefore, once physiological traits are identified, selection of most appropriate genotypes for a given environment is possible. Lakshadweep Ordinary was found to be relatively more tolerant to drought than other tall cultivars. The hybrids LO x COD and

LO x GB were also found to give higher yield even under drought conditions (Bhaskara Rao *et al.*, 1991). Rajagopal *et al.* (1990) screened 23 genotypes for drought tolerance based on some sensitive characters like accumulation of epicuticular wax on the leaf surface (ECW), low stomatal frequency (SF), low stomatal resistance (S) and leaf water potential (LWP). The pattern of soil moisture depletion and the stability of the activity of certain enzymes like glutamate oxalacetic transaminase (GOT) and acid phosphatase (APH) were also found to have their influence on drought tolerance (Rajagopal *et al.*, 1988)

Among the cultivars/hybrids

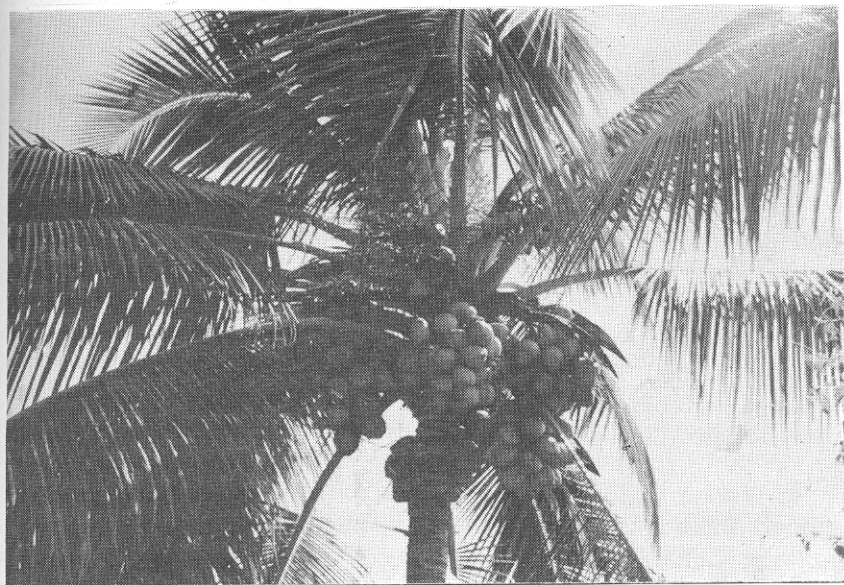


Fig. 5. *Laksha Ganga*

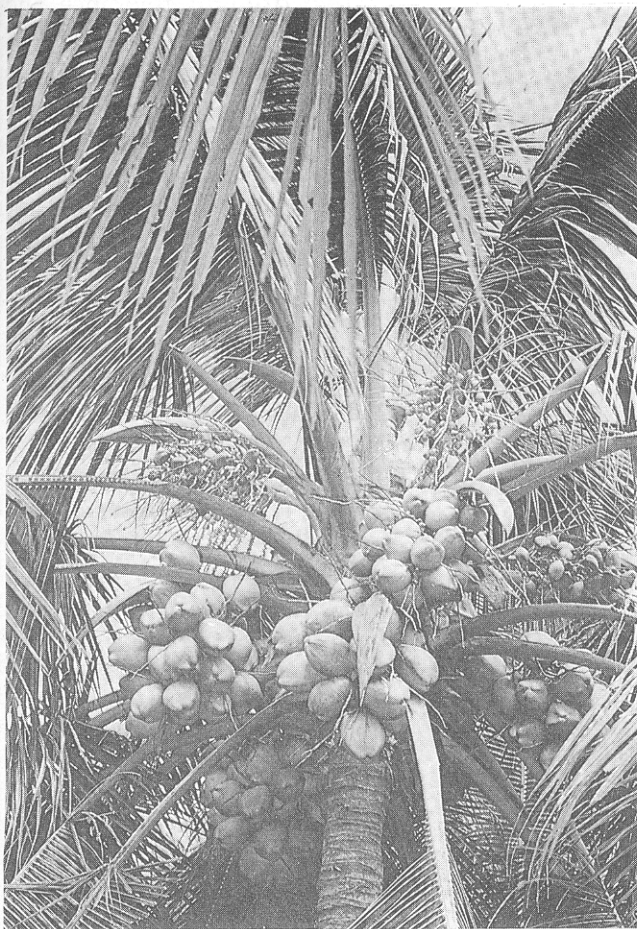


Fig. 4. *Chandra Laksha*



Fig. 6. *Kera Sankara*

screened, WCT x WCT, Federated Malay States (FMS), Java Giant, Fiji, Andaman Giant and LO x COD were found to be drought tolerant. All the identified drought tolerant cultivars are currently being utilized in the breeding programme at CPCRI, Kasaragod to identify high yielding hybrids possessing drought tolerance.

#### **BREEDING FOR DISEASE RESISTANCE / TOLERANCE**

Coconut root (wilt) disease is the most serious problem causing an annual production loss of 968 million nuts. The disease is prevalent in a contiguous manner in eight southern districts and in isolated pockets in northern districts of Kerala. As no control measures

are available for this disease, developing resistant/tolerant genotypes is the only lasting solution for this malady.

The first step in developing resistant/tolerant genotypes is the identification of sources of resistance. Screening of 48 cultivars and 62 hybrid combinations in the past have not yielded any resistant type. Hence, a survey for the identification of disease-free palms in the 'hot-spot' areas (heavily diseased tracts) was undertaken and 140 palms were selected as 'disease free palms' based on the serological and physiological tests. Also 19 Chowghat Green Dwarf palms were identified as disease-free palms in 'hot-spot' areas.

These palms are being utilized in our breeding programme for the production of tolerant/resistant WCT x WCT, CGD x WCT, WCT x CGD and WCT (self) hybrids.

#### FUTURE STRATEGY FOR YIELD IMPROVEMENT

**1. Collection of Germplasm:-** Most of the exotic collections were assembled through exchange programmes and hence, only a limited sample size could be collected from very few individual palms. In view of this, broadening the genetic base through collections from Melanesia, Micronesia and Indian Ocean Islands which are known to have a wide variability should be taken up immediately.

**2. Prepotency:** Since the possibility of selecting prepotents has been adequately demonstrated, what is now required is the identification of a large number of such palms which could be used as parents in the breeding programmes and can also be used directly to improve the local Talls.

**3. Crosses Involving Introduced Germplasm:-** Most of the

hybrids tested so far were produced utilizing Local Talls and Dwarfs with narrow genetic variability. However, efforts are being made to utilise introduced germplasm in the hybridization programmes. Rennel Tall from Solomon Islands has been reported to be a good general combiner in many countries. It will be rewarding to try cross combinations involving Rennel Tall and indigenous dwarfs. Work has already been initiated in this direction.

**4. Tall x Tall Crosses:** Although, there are reports of high yielding Tall x Tall crosses elsewhere, the performance of these hybrids in India has not been encouraging. It is likely that by a judicious choice of the parent talls, better yielding Tall x Tall hybrids could be evolved. Pollen from important Talls like Rennel Tall, Rangiroa Tall (French Polynesia) and Natava Tall (Papua New Guinea) maintained at World Coconut Germplasm Centre, Andamans is being used to cross with West African Tall at CPCRI, Kasaragod.

**5. Homogenous Dwarfs:** In spite of the reported self-pollination of dwarfs, considerable variability is observed in the dwarf progenies. Efforts are under way to develop homogenous dwarf lines so that the recovery of D x T hybrids can be enhanced.

**6. Establishment of Seed Gardens:** At present the planting material requirement is to the tune of 20 lakh seedlings annually, while the available sources cannot meet this demand. Hence, there is a need to establish new seed gardens to meet this demand and also to produce new hybrids which have been released recently. Coconut Devel-

opment Board has programmes to establish five more seed gardens in states of Kerala, Karnataka, Andhra Pradesh and Orissa during VIII Plan period.

**7. Breeding for Genotypes Suited to Multiple Cropping System:** With the declining trend of monoculture system and adoption or multiple cropping, great demand is anticipated for cultivars or hybrids suited to such situations. Continued work on ideotypes for various coconut based farming systems will be required in the near future.

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