COCONUT VARIETIES: A PROMISING SOLUTION FOR SUSTAINING ENVIRONMENTAL EQUITY

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Cocos is a genus in the family Arecaceae, which includes 27 genera and 600 species. Coconut (*Cocos nucifera* L.), the only species in the genus, is an important perennial tropical plantation crop with no known truly wild forms. This palm grows in more than 90 countries which can be grouped into eight distinct coastal/oceanic regions on four continents.

There are two main categories of coconut palms. The Talls ('typica') are naturally cross-pollinating types, have more economic value, are vigorous growing, comparatively late flowering and the fruits are with intermediate colors of brown, green, yellow, orange among individual palms. The Talls flower at 6-10 years with an economic life span of 60-70 years. Dwarfs ('nana'), in contrast, are naturally self-pollinating types with reduced growth habitat, early flowering and produce large number of medium to small, distinctly colored (green or yellow or orange or brown) fruits. Dwarfs have a productive life span of 30-40 years but usually start flowering in the third year.

Information on genetic diversity is of relevance from the breeding point of view, especially in the context of hybrid variety development. Genetic diversity is usually thought of as the amount of genetic variability among individuals of a variety, or population of a species. It results from the many genetic differences between individuals and may manifest in differences in DNA sequence, in biochemical characteristics (e.g. in protein structure), in physiological properties (e.g. abiotic stress resistance) or in morphological characters such as flower colour or plant form. Conservation of coconut diversity in farmers gardens (original location) which is termed as In situ conservation is the best technique for enriching diversity.

Beside the Tall-Dwarf duality, there is considerable morphological variability between ecotypes including the characteristics of the fruit and vegetative organs. This variability is expressed in the size, shape and colour of the fruit and has been used to propose diversification model for the coconut palm based on a comparison between a wild type (Niu kafa) and a selected type (Niu vai). Many efforts are ongoing in coconut growing countries to conserve the rich natural diversity existing in coconut germplasm collections for further utilization in crop improvement programs so that it becomes a more profitable crop for small-farm

holders, who constitute the vast majority of coconut growers. As a first step towards this goal, assessment of genetic diversity assumes significance for germplasm conservation and their subsequent utilization.

Collecting, conserving, evaluating and enhancing coconut germplasm of member countries, and locating and characterizing genetic diversity using morphometric and molecular biology techniques, have been some of COGENT's major concerns. ICAR-Central Plantation Crops Research Institute (CPCRI) is involved in collection and conservation of coconut germplasm in India. ICAR-CPCRI hosts the International Coconut Genebank for South Asia (ICG-SA). The field genebank in Kidu Farm, Karnataka, which is the ICG-SA field genebank, is supported technically by the laboratory facilities at ICAR-CPCRI, Kasaragod. CPCRI maintains the world's largest assemblage of germplasm by undertaking the planting and maintenance of the field gene bank and activities on embryo culture, assessment of diversity using molecular markers and disease indexing.

The establishment of gene pools and the conservation of genetic resources are basic to crop improvement. Hence, maintenance of large assemblage of genetic diversity is a vital aspect since crop improvement objectives change over time and it is difficult to predict the future needs accurately. Being a perennial crop with a persistent capacity for sexual reproduction, coconut gene pools serve in two ways; as a collection for breeder's work and as a base collection for conservation. Despite the necessity, it is very important to the country because there are original populations native to areas, which has not being subjected for any artificial selection. Initially the information regarding diversity in coconut ecotypes in collected during exploratory visits undertaken to different coconut growing regions (within India and abroad). Coconut farmers recognize varieties mainly based on colour, shape and size of nuts. The colour of nut varies from dark green to deep orange or brick red. The shape of nuts may be globular, while others may be spindle shaped or even distinctly triangular.

- Kaitha thali: Among the tall palms of the West Coast there is a variety called kaitha thali which is rare. It has soft fleshy edible husk. In the tender nut, the fibres are poorly developed that the husk sometimes eaten raw and is said to be a very good antidote against sea sickness

- Spikeless or spicata: this is quite distinct from ordinary coconut palm in having no branches or spikes in the inflorescence. In the variety, femaleness is most and maleness is least expressed, because of the number of male flowers is as low as 50. It is found that about 50 per cent of the progeny of this variety breed true to type.

- San Ramon: this is a very high yielding type with large nuts mearly twice as large as the ordinary. It requires about 3270 nuts to produce a ton of copra whereas

ordinary tall palms require about 6000 nuts.

- Caumanis: sweet tender husk which is eaten like artichoke which it resembles much in flavor

- Thairu thengai: There are certain palms among tall type of the West Coast, which is locally known as thairu thengai (curd coconut). In the nut there is no milk, but is completely filled with a jelly of the consistency of thick curd from which the name is derived. The kernel is not hard to make copra but it is good for eating. These nuts do not germinate but a few in every bunch produced in such trees are quite normal and when planted may give rise to trees of this type.

- Klapawangi: Fragrant endosperm

- Kappadam: this is grouped along with ordinary tall type, but is more robust in all characters particularly in the size of nut which is one of the largest on record.

- Laccadive micro: the nuts are very small and yield is about 160 nuts per palm per year. Average copra content is about 80 to 95 g per nut with oil content of 75 per cent.

Rare traits such as plicata, late flowering, bispatheate (spadix covered by two spathes instead of one) and secondary spikelets (further branching of spikelets) have been reported in Talls. Dwarfs possess other rare traits such as polyembryony, vivipary (general observation) and variegation (pigment variation in leaf / nuts). There are other morphological variants (Menon and Pandalai 1960) such as albinism (lack of chlorophyll), aromatica (fragrant endosperm), change in sex expression and plicata (fused leaflets), bulbils (emergence of shoots from the normal inflorescence with a green spathe covering in the leaf axil), midget palm (flowering in early infant stage), pink husked palm, horned coconut. The variations in such traits could be either genetic or physiological in nature. These unexploited traits have lot of scope for use in the breeding program and they are not been used to their potential.

Varieties developed through selection

Selection and evaluation of promising accessions conserved at CPCRI, coordination centres at All India Coordinated research Project on Palms and the State Agricultural universities have resulted in the development and release of 27 high yielding varieties of coconut, suitable for different agro climatic zones through application of mass selection. Breeding efforts in the country in addition to development of high yielding varieties suitable for copra/oil/ tender nut have also focused on development of disease resistance, especially to root (wilt) disease of coconut. Chowghat orange Dwarf (COD) is recommended as the best tender nut variety.

Sl. No.	Variety	Important trait	Nut yield (nuts/ha/ year)	Copra yield (t/ha)	Agency responsible for release
Tall					
1	Chandra Kalpa	Drought tolerant, high copra oil content, suitable for neera	17700	3.12	CPCRI
2	Kerachandra	High yield, dual purpose	19470	3.86	CPCRI
3	Kalpa Prathibha	High nut, oil yield , dual purpose	16107	4.12	CPCRI
4	Kalpa Mitra	High nut, oil yield, drought tolerant	15222	3.68	CPCRI
5	Kalpa Dhenu	High nut, oil yield, drought tolerant	14160	3.41	CPCRI
6	Kalpa Haritha	Dual purpose, less eriophyid mite damage	20886	3.70	CPCRI
7	Kalpatharu	Drought tolerant, ball copra, high yield, coir fibre amenable for dyeing	20709	3.64	UAS, Karnataka
8	Pratap	High yield	26727	4.01	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Maharashtra
9	Kamrupa	High yield	17877	2.90	AAU,Assam
10	ALR (CN) 1	High yield	22303	3.50	TNAU
11	Kera Bastar	High yield	19470	3.18	Indira Gandhi Agricultural University, Chhatisgarh
12	Kalyani coconut 1	High yield	14160	3.84	Bidhan Chandra Krishi Viswavidyalaya, West Bengal
13	Kera Keralam	High yield, drought tolerant, suitable for neera	26019	3.53	TNAU
14	ALR (CN) 2	High yield	21240	2.89	TNAU
15	VPM 3	High yield, drought tolerant	14868	3.41	TNAU
16	Kera Sagara	High yield	17523	3.64	KAU

Dwarf/ semi tall					
17	Chowghat Orange dwarf	Tender nut purpose, orange nuts	19824	2.78	CPCRI
18	Kalparaksha	Semi tall, green colour	13260 (17748)	2.85 (3.34)	CPCRI
19	Gauthami Ganga	Tender nut pupose , green colour fruit	11505	1.80	ANGRAU
20	Kalpasree	Early flowering, green fruit, recommended for root (wilt) tract	15930	1.54	CPCRI
21	Kalpa Jyothi	Tender nut purpose, yellow color fruit	20178	2.86	CPCRI
22	Kalpa Surya	Tender nut purpose, orange color fruit	21771	4.07	CPCRI
23	Kera Madhura	Semi tall, dual purpose	24480	4.80	KAU
24	CARI-C1 (Annapurna)	High copra content, tender nut purpose, green fruit	9133	2.20	CARI, Andamans
25	CARI- C2 (Surya)	Ornamental purpose, orange color fruit	20231	1.41	CARI, Andamans
26	CARI- C3 (Omkar)	Ornamental purpose, yellow color fruit	24072	1.77	CARI, Andamans
27	CARI- C4 (Chandan)	Ornamental purpose, orange color fruit	16373	1.67	CARI, Andamans

Hybrid development:

Among the several breeding methods, exploitation of heterosis has the maximum impact on improvement of cross-pollinated crops. Since the desired characters such as high yield, precocity in bearing, better quality, high copra and oil content, drought tolerance and disease resistance are distributed among different varieties or different individuals of the same variety, hybridisation is by far the most useful method to bring together the desirable traits. Harland advocated the exploitation of hybrid vigour to increase the productivity of

coconut. A new dimension to coconut improvement was added with the discovery that the hybrids made by Dr. J S Patel (1937) between Tall and Dwarf cultivars showed enormous vigour, enhanced production potential and early bearing tendency.During 1970-1990 production of T x D hybrids was common throughout India. However, efforts to evaluate D x T hybrids started simultaneously and the first D x T (Chandra Sankara) was released during 1985. Nowadays, D x T is more common due to the ease with which it can be produced compared to T x D hybrids. Efforts are also for evaluation of precocious and high yielding D x D hybrids. For carrying out hybridization (D x T or T x D) in coconut, knowledge about the floral biology and the hybridisation technique is essential. So far, 19 hybrids, including eight superior Dwarfs x Tall hybrid varieties and 11 Tall x Dwarf varieties have been developed in India for commercial cultivation in different regions.

Sl No.	Hybrid	Parents	Important trait	Nut yield (nuts/ha /year)	Copra yield t/ha)	Agency
1	Chandra Sankara	COD x WCT	High yield	20532	4.27	CPCRI
2	Chandra Laksha	LCT x COD	High yield, drought tolerant	19293	3.76	CPCRI
3	Kera Sankara	WCT x COD	High yield, drought tolerant	19116	3.78	CPCRI
4	Kalpa Samruthi	MYD x WCT	Dual purpose, drought tolerant	20744	4.35	CPCRI
5	Kalpa Sankara	CGD x WCT	Tolerant to root (wilt) disease	14868	3.20	CPCRI
6	Kalpa Sreshta	MYD x TPT	Dual purpose, high yield	29227	6.28	CPCRI
7	Laksha Ganga	LCT x GBGD	High yield	19116	3.73	KAU
8	Ananda Ganga	ADOT x GBGD	High yield	16815	3.63	KAU
9	Kera Ganga	WCT x GBGD	High yield	17700	3.56	KAU
10	Kera Sree	WCT x MYD	High yield	23364	5.05	KAU
11	Kera Sowbhagya	WCT x SSAT	High yield	23010	4.49	KAU

12	VHC-1	ECT x MGD	High yield	21240	2.87	TNAU
13	VHC-2	ECT x MYD	High yield	25134	3.74	TNAU
14	VHC-3	ECT x MOD	High yield	27612	4.47	TNAU
15	Godavari Ganga	ECT x GBGD	High yield	18585	2.79	ANGRAU
16	Konkan Bhatye Coconut Hybrid 1	CGD x WCT	High yield	20532	3.47	Dr. SSKKV
17	Kalpa Ganga	GBGD x FJT	High yield, suitable for ball copra	21417	3.38	UHS
18	Vasista Ganga	GBGD x PHOT	High yield	22125	3.88	Dr. YSR Horticultural Univ.
19	Ananta Ganga	GBGD x LCT	High yield	22656	3.85	Dr. YSR Horticultural Univ.

Conclusion

Although the large standard collection of coconut germplasm has been used for development of many varieties, there is an urgent need to utilize the special types such as aromatic coconut and sweet coconut in breeding programs to diversify the coconut cultivation. Considering the achievements made and opportunities available, the strategies suggested for future breeding programs include in situ conservation of unique types and those with rare traits have lot of relevance in the present situation wherein climate resilient varieties are the need of the hour. Climate resilient varieties will evolve and adapt only in diverse environment. Such evolution is curtailed in gene banks where we promote uniform environment and the best management practices. In situ conversation and on-farm conservation techniques which will conserve the unique environment and soil microbiome are to be promoted. Efforts in this direction for germplasm conservation will pay rich dividends in the coming years as we can expect evolution of climate resilient varieties.