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CURRENT STATUS OF COCONUT GENETIC RESOURCES RESEARCH IN INDIA

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ABSTRACT

In India coconut germplasm collection programme dates back to 1924, when some cultivars were introduced mainly from important coconut producing countries in Southeast Asia and Pacific Islands. These introductions formed the nucleus material for the crop improvement research programmes. Subsamples generated by collecting both open-pollinated and selfed seeds were assembled at Kasaragod in the forties which at present can be considered as the main germplasm holding.

In the early fifties, systematic introductions of exotic germplasm as well as indigenous collections were undertaken. The present holding of 86 exotic and 40 indigenous accessions planted at Central Plantation Crops Research Institute, Kasaragod and World Coconut Germplasm Centre, Andamans forms probably the largest collection in the world. These collections comprise 102 talls and 24 dwarfs, with two accessions classified as semi-talls and one MAWA hybrid introduced from Ivory Coast. While the introductions were limited to few seednuts in each accession, the exotic collection from South Pacific consisted of 100 seednuts each.

A limited number of subsamples of germplasm accessions (distinct types) are also being maintained in Agricultural University Research Centres in different coconut growing states. Efforts were made to characterise the germplasm based on the fruit component analysis. Characterisation of indigenous tall types also enabled identification of distinct indigenous types both in respect of morphological characters and fruit components. Efforts made in evaluation indicated the possibility of identifying the elite types by correlating the initial years' yield with the stabilised yield.

INTRODUCTION

Among the coconut growing nations, India is the first country to initiate coconut research in the world. The first priority identified was to collect, conserve and evaluate the coconut germplasm and to exploit the high yielding potential in some of the germplasm accessions through hybridisation. In India,

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coconut germplasm is being maintained at 18 research stations/centres of which four are under Central Plantation Crops Research Institute (CPCRI), while the remaining 14 fall under the University/All India Coordinated Research Project on Palms centres of state agricultural universities.

GERMPLASM COLLECTION

The earliest record of germplasm introduction into the country dates back to the early twenties when few coconut types were introduced from Malaysia and the Philippines. The progenies of these introductions were raised at the Central Farm, Trichur (Kerala) and Government Coconut Farm, Vaithila (Kerala). Emphasis on exotic introduction was given since 1927 and the introduced accessions were raised at Central Coconut Research Station, Pilicode (Kerala). Exotic accessions were made from Vietnam (Indochina), Indonesia, Thailand, Malaysia, Sri Lanka, Fiji, Papua New Guinea and the Philippines. During 1940, the open-pollinated seednuts of the introduced accessions were collected from Central Coconut Research Station, Pilicode and the first germplasm bank was started at the erstwhile Central Coconut Research Station, Kasaragod (Kerala), (Presently the CPCRI, Kasaragod). The programme on survey and collection of indigenous coconut germplasm was initiated in 1952 and the systematic collections from different coconut growing regions of the country were made and added to the germplasm assemblage. In 1981, with the financial assistance from International Board for Plant Genetic Resources, CPCRI has launched a survey collection for coconut germplasm in the Pacific Ocean Islands. This probably is the first attempt (Bhaskara Rao and Koshy, 1981) to systematically collect coconut germplasm with a recommended sample size of 100 nuts for each accession. Earlier introductions comprised only a few nuts (ranging between five and 20) in most of the accessions. During this IBPGR funded project an attempt has also been made to observe strict quarantine regulations both at the collection site as well as at the port of entry. All the collections were subjected to quarantine treatment comprising removal of calyx, giving the nuts a wash in 'teapol' and dipping them in a solution comprising insecticide and fungicide. Further, wherever facilities were available, the nuts were also fumigated at the port of export before shipment from the collection site. All the accessions introduced into India were subjected to quarantine inspections at the port of entry and also were fumigated with methylbromide before the same were transshipped to Andaman Islands for raising an offshore nursery and establishing the World Coconut Germplasm Centre.

The primary purpose of conceiving the offshore germplasm centre is two-fold. As is well known in India, the diseases like root (wilt) disease in Kerala, Thatipaka disease in Andhra Pradesh, Thanjavur wilt and Ganoderma in Tamil Nadu impose restrictions on maintaining germplasm collections as active collections in the field, on the mainland. At a future date if these precious accessions collected from different countries are infected, their utility for breeding programmes will be considerably reduced. At the same time it

also imposes restrictions on drawing subsamples for testing these accessions against different diseases. A given accession susceptible to one disease could be resistant/tolerant to other diseases. These considerations prompted us to establish the offshore germplasm centre in a relatively pest/disease free location in Andaman Islands. Further as the accessions have gone through the strict quarantine check and treatment both at the site of collection as well as at the port of entry, it is safe to assume that no unknown or harmful insect/disease is being introduced and is safe to plant in a protected area (Bhaskara Rao and Koshy, 1984).

GERMPLASM HOLDING

Currently the germplasm holding at CPCRI, Kasaragod (Kerala) and Andaman comprises 126 accessions of which 99 are classified as talls and 24 as dwarfs (Table 3.1). In addition, there are two semi-tall accessions, namely, SS Apricot and Niu Leka and one hybrid PB-121 introduced from Ivory Coast. Considering the morphological characters and growth habit of the two semi-tall accessions it may be appropriate to reclassify SS Apricot as a tall accession and the Niu Leka as a dwarf. Among the Tall accessions, maximum number of 40 are from the Pacific Ocean Islands. Concentrated effort has been made in the germplasm collection programme, to collect the accessions from the South Pacific region which is believed to be the centre of origin of coconut. The second largest collection is from Asia and Southeast Asia with 20 talls and six dwarfs.

Table 3.1: Geographical distribution of germplasm accessions

Region	*No. of collections*			
	Talls	*Dwarfs*	*Semi-talls*	*Hybrids*
Indigenous				
India	29	11	–	–
Exotic				
Asia and Southeast Asia	20	6	1	–
Africa	4	2	–	1
Central and South America	6	1	–	–
Pacific Ocean	40	4	1	–
Total	99	24	2	1

The subsamples generated through collection of both open-pollinated nuts and *inter se* mated nuts were sent to different university centres as well as coordinating centres under the All India Coordinated Research Project on Palms. Maximum number of 62 accessions are at Coconut Research Station, Pilicode (Kerala). These subsamples were generated based on preliminary evaluation done at CPCRI, Kasaragod (Kerala). The primary purpose of distribution of subsamples to different Coconut Research Stations in India is for evaluating these accessions for yield stability in the different agroclimatic

regions. Further, the coordinating centres were also given the mandate to collect the regional germplasm and to utilise the available accessions in the breeding programme.

STATUS OF GERMPLASM HOLDING

In most of the accessions, the number of palms available are less than 30. As mentioned earlier, in the early exotic introductions, only few nuts in each accession were introduced and the seedlings raised from them were planted in the field. Among the exotic accessions, in 28 accessions the number of palms in each is less than 10, while in only seven accessions more than 50 plants are available in the germplasm holdings. In 48 exotic accessions, the number ranged between 10 and 15 palms in each accession.

DOCUMENTATION

Fairly foolproof documentation procedures were conceived for recording the data during different periods of growth of germplasm accessions (Bhaskara Rao and Nayar, 1980). The data collected on nursery characters is recorded in the nursery register. Growth measurements of individual plants in accessions up to the fifth year are recorded annually and subsequently once in five years, in a "vegetative growth measurement register". For the adult palms, the data collected on harvest and fruit analysis are documented in a separate register. Recently computerised data base has been developed at CPCRI.

EVALUATION

Preliminary evaluation is done by laying out replicated trials either in RBD or CRD with three to four replications and with six plants per plot. However in recent years, row-trials with 10 to 49 plants are being planted for evaluating the yield.

Among the exotic accessions, collections from Fiji and the Philippines gave the highest copra outturn of over 20 kg per palm per year (Table 3.2). The nut yield ranged from 64 nuts in San Ramon to 108 nuts in SS Green and Philippines Ordinary. Oil content was between 65 and 68 per cent in these accessions. Among the indigenous accessions two island accessions, namely, Andaman Ordinary and Lakshadweep Ordinary gave the highest number of nuts. Copra outturn was over 21 kg. However, the highest copra outturn of 26.9 kg per palm per year was recorded in an accession 'Kappadam' collected from Kerala.

Lakshadweep Ordinary was tested in four coconut growing states under All India Coordinated Research Project on Palms. In all the four locations, the performance of Lakshadweep Ordinary palms ranging in ages from 12 to 40 years was superior to local popular cultivars of comparable ages (Table 3.3) This was the first coconut variety to be released in India in 1985 with the name 'Chandrakalpa'.

Coconut germplasm evaluation for yield performance is a long drawn process as the stabilisation of the yield is achieved only between 17 and 20

Table 3.2: Performance of promising germplasm accessions

Cultivar	Mean yield of nuts (17–20 years)	Weight of copra/nut (g)	Outturn of copra (kg)	Oil content (%)
Exotic				
1. Fiji Tall	106	199.1	21.1	65
2. Fiji Longwan	104	210.5	22.0	66
3. Philippines Ordinary	108	198.1	21.1	66
4. Philippines Laguna	88	258.9	22.7	66
5. SS Green	108	186.1	20.1	68
6. San Ramon	64	349.6	22.4	68
Indigenous				
1. Andaman Ordinary	127	169.0	21.5	66
2. Kappadam	90	299.0	26.9	67
3. Lakshadweep Ordinary	127	172.0	21.8	68
4. West Coast Tall	70	176.0	12.3	66

Table 3.3: Performance of Lakshadweep Ordinary (LO) in different states

Centre	State	Age (years)	LO	Local
Ambajipet	Andhra Pradesh	21	135.5	85.2
		12	23.5	14.7
Ratnagiri	Maharashtra	20–25	134.0	88.0
Veppankulam	Tamil Nadu	20	58.7	55.1
		12	43.0	31.0
Kasaragod	Kerala	20	88.3	59.5
		40	100.0	75.0

years. An attempt has been made to correlate the initial years yield with the stabilised yield for drawing early inference on the performance. It was found that the cumulative yield of the first eight annual harvests gave a fairly good indication of the yield potential of a given accession (Bhaskara Rao *et al.*, 1978). Ranking of the accessions after the eight annual harvests was found to be correlated (R^2 = 0.95) with the stabilised yield in the twentieth year (average of 17 to 20 years).

GERMPLASM CHARACTERISATION

Efforts have also been made to discriminate coconut accessions based on nursery characters such as number of days for germination, height of seedlings, number of leaves, length of petiole, and length by breadth of the last fully opened leaf at the twelfth month in the nursery. It was found that the girth at collar, number of days for germination and the number of leaves are important characters based on which five distinct groups can be identified.

Based on the nursery characters an index was also developed by Bhaskara Rao and Mathew (1981) using mean value and CV of these characters for characterisation of germplasm at the nursery stage. For each character the

highest mean value and lowest CV were given first rank and the lowest mean value and highest CV were given the last rank. However, for characters which have negative correlation with yield the ranking was reversed. This has enabled identification of the accessions with higher heterozygocity (accessions with the highest CV) as well as those which are relatively more homozygous (low CV). This procedure will also enable the germplasm collector to assess the population status in a given region, based on which, whether sampling should be extensive or intensive can be decided.

Characterisation of the germplasm was also attempted from the fruit component analysis as proposed by Harries (1978). Among the Southeast Asian types NIU KAFA types had husk percentage ranging between 41 and 52 with percentage copra ranging from 7 to 11 (Table 3.4). NIU VAI type in the Southeast Asian Region had a much lower husk percentage (28 to 38) while the copra ranged between 16 and 30 per cent. Collections from Pacific and African regions showed both NIU KAFA and NIU VAI types. Highest husk percentage in the NIU KAFA type was recorded in accession 'Seychelles' which had 59 per cent husk while the least copra percentage was in Fiji Rotuma (7.7 per cent).

Table 3.4: Fruit components of few coconut germplasm accessions

Accession	*Fresh weight (g)*	*% husk*	*Yield (nuts)*	*% copra*
I. SOUTHEAST ASIAN NIU KAFA TYPES				
1. West Coast Tall	902	52	70	11
2. Benaulim	884	45	73	10
3. ST Kudat	820	44	46	7
4. Ceylon Tall	1013	41	39	8
5. Gonthembili	847	41	49	9
6. P. Dalig	836	42	72	9
II. SOUTHEAST ASIAN NIU VAI TYPES				
1. Kappadam	1806	38	90	27
2. San Ramon	1753	28	64	22
3. P. Laguna	1624	35	91	19
4. Borneo	1288	33	24	16
5. Java	1261	29	101	30
6. FMS	1242	35	82	20
III. PACIFIC NC AMERICA AND AFRICA				
1. Fiji Rotuma	1448	30	40	8
2. Blanchissues	831	29	93	12
3. Zanzibar	826	32	101	22
4. B.S.I.	685	31	106	17
5. Jamaica	1551	39	61	17
6. Panama	1609	42	74	18
7. Seychelles	908	59	73	11

GERMPLASM UTILISATION

In India utilisation of germplasm for hybridisation programme received consideration right from the thirties. West Coast Tall in the west coast and

East Coast Tall in the east coast of India were used as both female and male parents. In addition, Andaman Ordinary and Lakshadweep Ordinary Tall types were also used as female parents for production of hybrids. Among the dwarfs, Chowghat Orange Dwarf and Gangabondam were used as female parents as well as male parents in hybrid production. Promising hybrid combinations with all these parents were released in India during the last decade.

Germplasm is also being used for screening against diseases (root (wilt) disease and Thatipaka disease) and for screening against burrowing nematode, *Radopholus similis* (Sosamma *et al.*, 1980). While a tolerant/resistant type is yet to be located for the root (wilt) disease (Chowghat Green Dwarf is reported to be less susceptible to root (wilt) disease) accessions like Java Tall, Klapawangi and Chowghat Green Dwarf were found to be tolerant to burrowing nematode. Polyphenol assessment and study of the isozyme pattern are also in progress for characterisation of the germplasm.

QUARANTINE CONSIDERATIONS

As mentioned earlier, prevalence of root (wilt) disease in Kerala, Thatipaka disease in Andhra Pradesh, Thanjavur wilt and Ganoderma in Tamil Nadu restrict the movement of germplasm especially in exchange of germplasm with other countries. However, coconut germplasm from India can be obtained with the approval of Indian Council of Agricultural Research (ICAR). The nodal agency for coordinating germplasm exchange in India is the National Bureau for Plant Genetic Resources, while the CPCRI is the authorised agency for phytosanitary clearance. For importing the germplasm into India, the regulations prescribed are as follows:

a) A collection team consisting of breeders and pathologists should identify and document the pests and diseases prevalent in the country of collection. Collections should be restricted to disease/pest free areas.

b) Quarantine treatment is to be given both at the port of export as well as port of entry. A nursery will be raised under strict quarantine precautions in the offshore island of Andamans. The nursery will be inspected periodically by the scientists from germplasm nodal agency, namely, NBPGR, quarantine authority in India (the Directorate of Plant Protection and Quarantine) and CPCRI which has the mandate to maintain the coconut gene bank.

FUTURE PRIORITIES

Future priorities for coconut genetic resources research in India include collection of germplasm from Indian Ocean Islands and from Micronesia; screening the collected accessions for biotic and abiotic strains; and, utilisation of the germplasm especially from those collected from the Pacific Ocean Islands for production of new cross combinations and for evaluating them for yield as well as for disease resistance.

ACKNOWLEDGEMENTS

Authors are grateful to Dr. M.K. Nair, Director, CPCRI, Kasaragod for permitting us to prepare this status report for presentation in the International Symposium on Coconut Research and Development (ISOCRAD-II).

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DISCUSSIONS

Dulce Warwick: How do you screen for resistance to root (wilt) disease?

E.V.V. Bhaskara Rao: The seedlings are planted in 'hot spot' areas and disease reaction is recorded.

B.C. Viraktamath: How do you explain the distinctness of Benaulim Tall as compared to other cultivars?

E.V.V. Bhaskara Rao: It could have naturally evolved from the natural stands in Konkan Coast and later multiplied consciously for its better yield.