Prospection and Collection of Coconut Diversity

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Introduction

Coconut is one of the important multipurpose perennial palm that sustains the livelihoods of millions of resource poor families in coastal ecosystems. The crop has been improved to serve the human needs using methods like gene pool enrichment, selection and hybridization. Prospection and collection of coconut diversity is an important step in improvement. The present paper details the techniques available, variability reported and earlier attempts made so far, along with hints on practical problems. In India, the crop is grown in wide range of agroclimatic and sociocultural-economic conditions. Indian area represents latitude (23.83^0 N to 6^0 S) and longitude (94.78^{0}E to 60^0 E) ecosystems such as high rainfall zones (North east) to arid zones (99 % to 46 % relative humidity) , extremes of temperature (35 ^{0}C to 4 ^{0}C) , presence of biotic stress (root (wilt) disease, tatipaka disease and mite) and abiotic stress (wind damage in coastal Andhra Pradesh, drought in major cultivation zones) association of faunal diversity such as robber crab (*Birgus latro*) as seen in South sentinel (Andman) and Nicobar group of islands. Wide range of cultural systems such as home garden even amidst concrete jungles as lone crop or with other companion crops, growing in bunds and channels , growing with multistorey high density intercropping with other perennials or annuals. Management of the crop ranging from unutilised plants of uninhabited - remote islands , total neglected cropping to highly intensified management practices and industrial processing of product(s). Planting density also varied from high dense stands of Lakshadweep to recommended level of 7.5 m x 7.5 m . Culture of the human races and ethnic groups benefited by multitude of the products offered by the crop also varies ranging from aboriginal tribes of bay islands to highly civilized groups.

Crop Spread in India

North East: Manipur state (10 ha. of bearing plants available presently) Other parts such as Nagaland are being recently planted with coconut by CDB).
East: Andaman & Nicobar islands
West: Lakshadweep islands
South: Kanyakumari (TN)
South -East: Camp bell bay (Great Nicobar)

Distribution of Crop

The crop is distributed throughout the humid areas of 30 degrees south and north of equator. New Caledonia (20 8' to 22 25 ' S), Pitcairn is. (25^{0}S) & Brazil (27 ^{0}S) and Hawaii is. & Bonin islands of Pacific (26 ^{0}N) are the known south and north extremes in which coconut crop is seen.

Sampling Strategies

IPGRI has provided many protocols for the collecting and conserving the diversity of the crop. They recommend coarse grid sampling strategy thereby entire region is divided to grids of 40 km square and population representative of each grid wherever crop is available could be studied and collected. They also advise to select 30 (Tall) or 10 (Dwarf) individuals per site. Collection from more sites is better than more individuals at one site. A minimum of 200 seednuts or 600 embryos is must to represent a population. The principle behind this is to include the various latitude, longitude differences and the adaptive behavior of the plant to such differences. Knowledge of sampling the crop variability to obtain true genetic diversity eliminating the effects of environment, age, cultural differences is a pre-requisite for an explorer. Biased fine grid sampling helps to get rare types and sub-samples within a population.

Earlier Attempts

CPCRI erstwhile CCRS had carried out systematic surveys inside and outside the country from 1916. Whitehead (1966, 1968) of Jamaica has made worldwide survey for obtaining lethal yellowing resistant accessions. Rao and Koshy (1981) Koshy (1984) and Koshy and Kumaran (1997) are the collection missions carried out in Pacific, Malaysia and Indian Ocean regions respectively. Harries (1978) reviews the earlier attempts made by different countries in coconut seed material movement. Dwyer (1938) explains the seednut movement between Samoa and New Guinea. During 1905-10, seeds from Ceylon including King coconut were brought to Seychelles. Some of the reports on indigeous coconut variability available in different countries are as follows.

Country	Reference
Western Samoa	Leach, 1977
Seychelles	Durocher, 1953
Madagascar	Prudhhome, 1906
Maldives	Wickramasuriya, 1975
Rangiroa & other Frech Polynesian is.	Millaud, 1959 & Sproat, 1967
South Pacific	Parham,1960, Ashburner *et. al.*, 1997
Phillipines	Zuniga *et al.* 1980 & Gruzeo,1990
Indonesia	Tammes,1955; Liyanage, 19 74 Tampake *et al.*, 1982 and Davis *et al.* 1985
Costa Rica	Richardson *et al.* 1978
Brazil	Romney and Dias , 1981
Mexico	Zizumbo-Villareal *et al.*, 1993
Sri Lanka	Liyanage,1958
Papua New Guinea	Ovasuru,1993
Bangladesh	Islam *et al.*1994
Nigeria	Akpan, 1994
Thailand	Harries *et al.* 1982
World varieties listed	Gangolly et al. 1957

In India, survey and collection from Andaman and Nicobar region was carried out by Balakrishnan and Nair (1979) and Dhanapal & Jerard(1999 unpublished). In Orissa state the work was taken by Panda (1982) , Dash et al. (1995) and Kumaran Arunachalam and Dash (1998 unpublished.) . In West Bengal the work was taken up by CPCRI, 1998-99 in collaboration with BCKV. Jacob and Krishnamoorthy (1981) made survey in Lakshadweep islands and listed the types available. AICRP (Palms) centres and CPCRI have collected many interesting types. To mention a few, Uddagangapani and Chittagangapani which were Tall and Dwarf forms of tendernut types respectively. Among Tiptur Tall (T.T) populations, two sub-populations could be identified T.T .I having large sized round nuts with 250 g copra and T.T .II having small angular nuts with 200 g copra/ nut. From Konkan/Goa region, Banawali types were collected and being maintained at Ratnagiri centre (Maharashtra).

Harries (1978) classified dwarfs into three groups viz.,

Type	*Stem*	*Pollination*	*Fruit size*
Nana	Slender	Self	Small
	Example: Coconino, CGD, COD		
Javanica	Medium	Self	Medium
	Example: Malayan dwarfs, Ganagabondam		
Allogamous	Stout	Cross	Large
	Example: Niu Lekha, Tambulilid		

Objective(s) of collection: Objective of the collection mission could be for 1. yield of copra or nuts, 2. tendernut type, 3. to protect the hitherto unknown forms from extinction. 4. to obtain resistance sources for biotic and abiotic stress (lethal yellowing disease , root (wilt) disease , mite, drought and storm) .5. samples to represent latitude/ longitude locations :6. Improving product quality of copra, desiccated coconut etc., But, when the survey is made for one purpose, we also come across types with other desirable traits. Based on the objective the selection of mother palms could be carried out. Pankajakshan et al. (1963) recommended the selection of best 10 % of the palms in a farm based on annual nut yield records of 4 years. This could be used in farms wherever yield records are available and good palms could be selected for yield.

Major Coconut Populations Cultivated in the World

(Batugal and Rao,1998) list the different local coconut populations dominant in different coconut growing countries viz.

India: West Coast Tall, East Coast Tall, Tiptur Tall, Sakhigopal
Sri Lanka: Sri Lankan Tall,
Indonesia: Mapanget, Bali, Tenga,
Phillipines: Bay Bay Tall, Bago- oshiro, Laguna
Thailand: Maphhreao Yai/Thai Tall, Pak Chok
Vietnam: Ta, Dau
Fiji: Fiji Tall
Africa: East African Tall, West African Tall,
Jamaica: Panama Tall, SanBlas
Mexico: Atlantic Tall, Pacific Tall
Malaysia: Malayan Tall, Malayan Dwarf

Some of the coconut accessions so far reported in India:

Andaman & Nicobar islands :
(CPCRI ,1973, Balakrishnan and Nair, 1979 and Chander Rao, unpub. 1985)
*[1]Portbliar Tall
Andaman Ordinary
Andaman Giant
Andaman Yellow Dwarf
Andaman Orange Dwarf
Car Nicobar
*[5] Kinmai
*[5] Katchal
*[5] Kimos
*[5] Auck Chung
*[5] Tamaloo
*[5] Campbell Bay
Recent survey adds 17 accessions to this.

Karnataka:
Tiptur Tall I and II
Uddagangapani
Chiddagangapani
Arsikere Tall

Kerala :
Kappadam
*[2] Komadan
Chavakkad Dwarfs (Green , Orange)
Kaithathali
Spicata
West Coast Tall

Tamilnadu :
Arasmapatti Tall
*[3]Salem
Aliyarnagar Tall
Kulasekharam Dwarf (Yellow, Orange, Green)
Pattukottai Dwarf (Red, Green)
East Coast Tall
Ayiramkachi
Adirampattanam Tall

Gujarat :
Gudanjali Dwarf
Gujarat Zanzibar

Lakshadweep:
*[4] Lakshadweep Orange Dwarf
*[4] Lakshadweep Green Dwarf
*[4] Lakshadweep Yellow Dwarf
Lakshadweep Ordinary
Lakshadweep Small
Lakshadweep Micro
Lakshadweep Mini-micro

Maharashtra / Goa
*[7] Banawali Green Round (Pratap)
*[7] Banawali Green Long
*[7] Banawali Red Round
*[7] Banawali Yellow Long
*[7] Banawali Yellow Round
*[3] Bombay

Orissa
Sakhigoapl local
*[6] Triangular
*[6] Dhanei
*[6] Bana
*[6] Jahaji
*[6] Dhilla
*[6] Suryabana
*[6] Bangera
*[6] Chaka
*[6] Khila
*[6] Goja
*[6] Ladehi
*[6] Haladi
*[6] Orissa Green Dwarf
*[6] Odissi Giant
*[6] Dhila
*[6] Jahaji Yellow

West Bengal :
Hazari Tall
Navasi Tall
Mondouri Tall
Recent survey adds 11 accessions which include
Chandannagar Tall ,
Badajaguli Dwarf .

Assam :
Kahikuchi Tall

Andhra Pradesh :
Gangabhavni
Gangabondam
Gangapani

*1 - CARI , Port Blair
*2 - Gopimony, 1982
*3 KAU - Nileswar
*4 ICAR RC (CPCRI) Lakshadweep , Minicoy
*5 WCGC - CPCRI, Sipighat, Port Blair
*6 Dash *et al.* 1995, AICRP (Palms). Konark Centre.
*7 AICRP (Palms) Ratnagiri Centre.

Data to be recorded
1. **Location data** (edapho-climatic parameters)
Soil texture :
Soil type
Rain fall (mm)
Latitude
Longitude
Altitude (m above msl)
Distance from sea (kms)

2. **Plant data** :
Stem characters :
Plant height (m)
Collar girth (cm)
Internodal length (cm)
Leaf characters :
Length of leaf bearing portion (cm)
Length of petiole (cm)
Cross sectional area of petiole (cm^2)
Length of leaflet (cm)
Breadth of leaflet (cm)
Length of petiole (cm)
Number of leaflets
Leaf sheath fibre thickness (mm)
Number of sheath strands/10 cm
Inflorescence characters :
Length of inflorescence (cm)
Length of stalk (cm)
Number of spikelets
Length of spikelet (cm)
Number of female flowers/ inflorescence
Setting per cent
Yield data :
Annual nut yield /pl.
Number of bunches with nuts
Number of bunches with buttons
Nuts/bunch

Fruit component analysis :
Length of fruit (cm)
Breadth of fruit (cm)
Weight of fruit (GM.)
Weight of husked nut weight (GM.)
Volume of nut water (ml)
Thickness of kernel (mm)

Thickness of shell (mm)
Cavity diameter (cm)
Cavity volume (ml)
Weight of shell (GM)
Weight of copra (gm.)
Husk %/ fruit ([wt. of fruit -wt. of nut]*100/wt.of fruit)
Copra (%) /nut [wt. of nut - wt. of copra]*100/ wt. of nut
Shell (%)/nut [wt. of nut - wt. of shell]*100/ wt. of nut
Water (%)/nut [wt. of nut - wt. of water]*100/ wt. of nut

3. In case of remote island situations where the time is available is very limited it could be restricted to few characters of conservative nature :
Collar girth (cm)
Leaflet number
Leaflet length (cm)
Leaflet breadth (cm)
Inflorescence length (cm)
Husk proportion (%)
Husk thickness (cm)
Biometric analysis of data:

Data entry into computer

Principal Component Analysis
or
Mahalonobis D^2 distance
divergent types identification
use in core collections / hybridisation program.

Biometric Analysis

The data so recorded could be fed into computer using any spreadsheet program. Using the methods like UPGMA (Ovasuru, 1993) or Mahalonobis D^2 distance or Principal component analysis as used by Kumaran et al. (1998), Sugimura et al. (1997), Zizumbo-Villareal and Pinero (1998) the divergent accessions could be identified. Principal component analysis is best among these methods.

Source of Information

Information on variability of coconut could be obtained from farmers, Agricultural extension officers, marketing agents, field staff in Govt./ Private research / development coconut farms and local people in the area. Sometimes rare occurences, abnormalities of coconut are given as news in newspaer.

Quarantine Problems

Crop genetic diversity hotspots are often associated with faunal and floral diversity, which could be parasitic or symbiotic. Thus, one should be careful not to introduce a serious pest or disease into the region along with germplasm material. There are serious threats for which effective curative measures are yet to be developed in the crop. They occur in some areas where care should be exercised to prospect and maintain the diversity within the region (Frison *et al.*, 1982)
Cadang cadang disease : Phillipines
Lethal yellowing disease : Jamaica and Carribean region
Root (wilt) disease : Central and south Kerala, India
Tatipaka disease : Andhra Pradesh, India
In case of internally seed borne diseases like seedling blast observed in Western Samoa (Rao and Koshy,1981) also care is needed.
Treatment of seednuts using suitable pesticides or fungicides is essential wherever the problems are seen.

Success Stories from Germplasm Collections

India
Release of varieties Chandrakalpa (Laccadive Ordinary)
Pratap (Banawali Green Dwarf)
Chavakkad Orange Dwarf (for tendernuts)
Suitable male parent : Gangabondam
Field tolerance to root (wilt) disease : Few palms in hot spot area of
Chavakkad Green Dwarf
West Coast Tall
Jamaica:
Malayan Dwarf (resistance to lethal yellowing disease)
Phillipines :
Makapuno type (industrial use)
Indonesia :
Kopyor type (industrial use)

Mode of collection

Embryos
Seednuts
Pollen
Embryos are the safest mode of collection from quarantine point of view. But, depending upon the financial position and tissue culture lab facilities available at the center, this could be thought of. Seednuts are the universal way of collection from 1900s. Pollen could be collected if the type is male palm, barren nut type or seednuts are not available due to various reasons. Based on biometric analysis if the type is found suitable as a breeding material , pollen could be used to effect hybridisation directly.

Constraints

1. Transport and communication
When the survey is conducted at a far -off place, prior intimation is a must to ensure proper transport, staff and other requirements.
When the site is situated in remote islands, knowledge of

various transport facilities available and their frequency is important.

Unavailability of boats in remote islands and isolated coasta is another problem. National institute of Ocean technology, IIT Campus, Chennai has two marine vessels for research purpose (Oceanography) which are operated throughout the coasts of main land and bay & lakshadweep groups of islands. If collaboration is made with them, this problem could be tackled.

2. Natural calamities
a) Rain
b) Hot wave
c) Cyclones

A breeder should know the seasonal occurrence of these calamities in a region before attempting the survey. This could help in performing the survey in a good way.

3. End use of the crop :

Another problem faced by coconut breeders while collecting the germplasm is the unavailability of mature nuts at the time of visit . This is especially noticed in dwarf types where most of the nuts are harvested during summer as tendernuts. To avoid this, knowledge of the season of mature nut harvest in the region is a must. Arranging the survey during the favourable season could help.

References

Akpan, E.E.J. 1994. Oleagineux. 49(1). 13-20.

Ashburner, G.R , W.K.Thompson,G.M. Halloran, M.A.Foale. 1997. Genetic resources and Crop Evol. 44: 327-335.

Balakrishnan, N.P. and Nair, R.B. (1979. Ind. J. For. 2(4): 350-363.

Batugal P.A. and Rao, V.R. (1998) (Ed.) Coconut breeding. IPGRI/ COGENT. 150pp.

Capuno, M.B. and L.B.de Pedro,.1984. Annals of Tropical Res. 4(4): 274-280.

Dash, D.K, T. Maharana, S.C. Sahoo and J.N Dash. 1995. Cocor. 1: 16-18.

Davis, T.A., C.P. Corputty, and T. Mochtar.1980. Phi.J. Coconut Stud. V(1): 23-30.

Davis, T.A., H. Sudasrip, and H. Aziz.1981. Proc. Indian National Science Academy B . 47(4):527-535.

Davis, T.A. , H. Sudasrip. S.N. Darwis. 1985. Coconut research Institute, Manado, Indonesia. Overview of research activities. 165 pp.

Dwyer, R.E.P. 1938.New Guinea Agric. Gaz. 4: 24-102.

Durocher, Y. von. 1953. World Crops. 5: 437-441.

Frison, E.A. Putter, C.A.J. and M. Diekmann.1982 . FAO/ IBPGR guidelines for the safe movement of coconut germplasm. FAO/IBPGR.

Gangolly, S.R. and Nambiar, M.C .1953. Indian Coconut J. VII(1) 5-19.

Gangolly, S.R. Satyabalan, K. and Pandalai, K.M .1957. Indian Coconut J. X:3-28.

Gopimony, R.1982. PLACROSYM V: 177-179.

Gruezo, W.Sm .1990. Phil. J.Coconut Stu. XV (1): 6-15.

Harries, H.C. 1978a. Report on the visit to Cuba. Coconut Industry Board, Jamaica.

Harries, H.C .1978. Botanical Rev. 44: 265-319.

Harries, H.C., Anupap Thirakul and V. Rattanapruk. 1982. Thai. J. Agric.Sci. 15: 141-156.

IBPGR.1978. Coconut genetic resources . Consultative meeting, AGEF/IBPGR/78/4. 24pp.

Islam, M.S., T.K.Paul., M.A. Rasheeid. and A. Ahmed.1994. Indian Coconut J. 25(6):10-12.

Jacob, K.C. 1941.J. Bombay natural History Soc. 41: 906-907.

Jacob, P.M. and B. Krishnamoorthy. 1981. PLACROSYM IV: 3-8.

John, C.M. and G.V. Narayana. 1942. Madras Agric. J. 30:351-352.

Koshy, P.K. and P.M Kumaran .1997. Survey and collection of coconut germplasm from Indian ocean islands (20-4.97 to 23.05.97) CPCRI Deputation Report. 108 p.

Koshy, P.K. .1984. Malayan Yellow Dwarf seed coconut collection from Malaysia. (7May - 4 June 1984) CPCRI Deputation Report . 14 p.

Kumaran, P.M. Koshy, P.K. Arunachalam, V Niral, V. and Parthasarathy, V.A. 1998.PLACROSYM XIII (In Press).

Leach, B.J. 1977. Observations on flowering and morphology of coconuts of Western Samoa. Internal Report, FAO, Rome.

Liyanage, D.V .1958. Ceylon Coconut Q. 9: 1-10.

Liyanage, D.V (1974) Report on survey of coconut germplasm in Indonesia. FAO, 26p.

Menon, K.P.V. and Pandalai, K.M. 1960. The coconut palm-a monograph. Indian Central Coconut Committee. 384 pp.

Michal, K.J.1963. Indian Coconut J. XVI (2) : 78-80.

Millaud, R. 1959.SPC Quart. Bull. 9: 35-37,48.

Ninan, C.A and T.C. Ratnam. 1962. Indian Coconut J. XIV (4): 144-151.

Ninan, C.A. and I.H.Louis.1972. Coconut Bull. 2: 9, 2-5.

Ovasuru, T.1993.ACIAR Tech. Bull. 53: 33-40.

Pancho, J.V .1960. Coconut Bull. 13: 403-404.

Panda, A.K .1982.Indian Coconut J. XIII (3) : 10-18.

Pankajakshan, A.S. George,M. Krisna Marar, M.M .1963. Indian Coconut J. XVI (2): 47-62.

Parham, R.W. .1960. SPC Information Bull. No. 1.

Rao E.V.V. B. and P.K Koshy. 1981. Coconut germplasm collection in Pacific Ocean islands. CPCRI Deputation Report. 47 p.

Prudhomme. E: .1906." The coconut cultivation and Industry and commerce in the principal countries of production Copra, oil, coir and other derivaitves.(Fr.) "491p. In Harries, H.C .1998. Rare books on coconut. Cocoinfo International. 5(2); 15-18.

Puskharan, K. and T.E. George. 1990. Indian Coconut J. XXI:

Rao , P.S.P and Kumar, S. 1998. Curr.Sci. (In Press)

Richardson, D.L. Harries, H.C. and Balsevicius, E. (1978. Turrialba. 28: 87-90.

Romney, D.H. and Dias, B.C. (1981) Phil J. Coconut Studies. 6: 30-31.

Sproat, M. (1967) Composition of the coconut variety Thifow, indigenous to Yap, TTPI. SPC Tech. Meet. Coconut prod. Rangiroa.

Stockdale, F.A. (1924. Trop.Ag. 62: 204-218.

Sugimura, Y, M. Itano, C.D. Salud, K. Ostuji and H. Yamaguchi.1997. Euphytica. 98(1/2): 29-35.

Tahardi, J.S. 1997. Kopyor coconut as an alternate agribusiness commodity. warta pusat penelitian biotecknologi perkebunan. 3 (1): 16-21.

Tammes, P.L.M. 1955 Euphytica 4: 17-24.

Tampake, H. T. Kuswara. and T.A. Davis. 1982. Indonesian Agril. Res. & Dev. J. 4(2): 52-61

Whitehead, R.A. 1966. Sample survey and collection of coconut germplasm in Pacific Ocean islands.(30 May - 5 Sep. 1964) Ministry of Overseas Development and HMSO, London.

Whitehead, R.A. 1968. Euphytica. 17: 81-101.

Whitehead, R.A. 1968a. Collection of coconut germplasm from the Indian / Malaysian region, Peru and the Seychelles islands and testing the resistance to lethal yellowing disease. FAO, CPL17.

Wickremasuriya, C.A. 1975. Situation of coconut industry in the republic of Maldives. FAO 4th Tech. Working Party CPP. Kingston, Jamaica.

Zizumbo-Villareal, D. and D. Pinero. 1998. Am. J. Bot. 85: 855-865.

Zizumbo-Villareal, D. F. Hernandez-RoqueD. and H.C. Harries 1993. Econ. Bot. 47:65-78.

Zuniga, L.C. Vilegas, L.G. Penaflorida, G. 1980. Collection of coconut cultivars in the Phillipines. In Coconut Production in the Phillipines. R.G Emata (ed.).

Appendix: Coconut variability documented so far

Character	Commonly observed	Peculiarities observed	Reference
Germination	3-4 months after sowing	Vivipary to 6 months after sowing	
Polyembryony	One plant / seed	Twins to 5 plants /seed @	
Seedling leaf colour @	Green,normal	yellowish , viridis	
Flowering in seedling	Absent	1)Axillary (midget) 2) Terminal (hapaxanthic	Davis *et al.* 1985
Branching	No branches	upto 27 branches	
Leaflets of bearing plant	Split	Fused / Fetish / Plicate*	
Growth habit	Tall	Dwarf	
Persistence of leaves and inflorescence	Fall off	Remain in plant (Andaman) (Mozambique)	Rao and Kumar, 1998
Shedding of nuts	Fall off	Remain in plant (Takame)	Gangolly *et al.* 1957
a) Inflorescence b) Spahte	Branched Single	Spicata, Bispatheate multi (5) spatheate	Jacob, 1941 Michael,1963
Spadix	Flowers	bulbils of leafy shoots	Davis *et al.* 1985
No. of flowers/ inflores-cence		ten thousand in Idi village of Indonesia , Ayiramkachi of TN , India	
Sex expression	Monoecious	Male palm Abnormal male flowers Dioecy Hermaphrodite flowers (0 to 4 /inflorescence in Nias Yellow Dwarf of Indonesia) Male sterile palm	John and Narayana,1942 Puskhran and George, 1990 Ninan and Ratnam, 1962 Davis *et al.* 1985 Ninan and Louis, 1972
Pollination behavior	Allogamous predominated talls	Autogamous predominated dwarfs except Niu Lekha	

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Character	Commonly observed	Peculiarities observed	Reference
Interspadix overlapping		Nil in Solomon Tall	
Intraspadix overlapping		100 % in Niu Oma Dwarf	
Endosperm a) Texture b) Fragrance	Liquid nut water +solid kernel No fragrance	Makapuno (Phil.), Kopyor (Indonesia), Thayiru tengai (India) (gelly like) Klapawangi (fragrant)	Tahardi , 1997 Menon and Pandalai, 1960 Gangolly *et al.* 1957
Colour - nut/ I nflorescence / petiole	Green	Brown – red - orange - yellow - green - Apricot, stripes of green and white	Menon and Pandalai, 1960
Husk (a) texture (b) colour	Hard Brown	Soft & edible (Kaithathali) Pink: Kalambahim (Phil.), Narangi (Orissa)	
Shape of nut	Round -	Triangular - Boat shaped Lanceo-late	
Size of nut	medium	Biggest (SanRamon of Phil.) Giant (Andaman) - medium - micro - mini micro (Lakshadweep)	
Fruit components a) High liquid endosperm content b) Long fibres	Less water Less weighing fibre	max. water in Niu Vai (998 g /nut) max. fibre in Niu Afa (1608 g / fruit)	Ashburner *et al.* 1997
Shell hardness	2-4 mm	Tough shell Dikri Pol (Sri Lanka) Ladehi (Orissa)	Dash *et al.* 1995
Absence of fibrous peri-carp		Absence reported in East Africa Peeling off like onion in kelapa bawangi of Indonesia	Davis *et al.* 1985
Stylar end of fruit	Round	Beaked or constriction as in CGD	Balkrishnan and Nair,1979
Colour of fruit pericarp	Brown or green or yellow	White (coco blanc) in Madagascar	Pruddhome,1906
Presence of horns on fruit	Absent	Horns on pericarp	Balkrishnan and Nair,1979
Oil content	65- 68 %	75 % in Laccadive Micro	

* Possible causes other than genes (Boron def. / 2, 4 -D injury / hispid beetle attack)