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Ensuring quality planting material for sustainable coconut production

Coconut is a long duration crop with a long juvenile period, spanning 7-10 years and a long productive period of above 50 years. But, initial flowering and stabilization of yield take 5-7 and 10-12 years, respectively. The long juvenile period slows down the multiplication of planting material. Mother palm population of a newly developed variety is possible only after a gap of 10-14 years. Another impediment in coconut seed production is the low number, approximately 50, of planting material possible from a mother palm. As a consequence of all these factors, spread of a new variety possible in the first 10 years is 0.25 ha/annum/mother palm. Initial number of mother palms available at the time of release of a new variety determines quantity of planting material possible and speed of spread of the variety. If a variety is released with 100 mother palms, it can spread to 250 ha during the first 10 years which is only 0.01% of total area under coconut in India. Planting advanced lines or promising lines in nurseries and farms under public sector will improve the availability of mother palms when these lines are released as new varieties. Another approach can be the farmer participatory evaluation where advanced lines or promising lines are evaluated on farm. Mother palm blocks of released varieties can be established in nurseries under public and private sector as long-term strategy to improve the availability of planting material.

TREMENDOUS progress has been made in increasing the production and productivity of coconut in our country. The CPCRI, Kasaragod, stands out amidst research organisations in our country with its accomplishments and is celebrating its 100 years of research, during 2016. The Institute has provided an inspiring leadership in research and development of technologies contributing to India's emergence as the world leader in coconut production. There is largest germplasm of coconut in the world that provides diversity required for developing new varieties. Enhancing productivity through cultivation of improved varieties is one of the major strategies needed to make coconut farming sustainable.

Coconut is cultivated in 2.1 million ha land in India. The average annual requirement of coconut seedlings is estimated at 15 million. However, production and supply of coconut seedlings by the public sector research and developmental agencies including CPCRI, State Agri/Horticulture Departments and Coconut Development Board is only 5.5 million seedlings per year. It is projected that another four million seedlings comes from private nurseries and farmers. That means there is a huge gap of 5 million seedlings annually in the country.

Breeding new varieties is faced with many problems that are unique to coconut. In spite of its long juvenile period, requirement of climber to make crosses, large area required for planting field evaluation trials and slow multiplication rate, many selections and hybrids have been developed in coconut. Today there are 49 improved varieties in the country (Tables 1 and 2), which include 29 high-yielding selections consisting of 11 dwarfs and 18 talls and 20 hybrids consisting of 8 D×Ts and 12 T×Ds. Among these, 16 varieties have been recommended for tender nut purposes, 35 for copra, 6 for dual purposes and three for ornamental purposes.

PRODUCTION OF QUALITY PLANTING MATERIAL

Long-term as well as short-term strategies are required to overcome the challenges in production and distribution of quality coconut seedlings to meet the demand from coconut growers.

Long-term Strategies

The important long term strategy to meet the growing demand for coconut seedlings is to establish new seed gardens in suitable locations in different coconut growing tracts. Besides, rejuvenation of existing seed gardens and replanting with planting material of newly released varieties for different agro-ecological zones also needs much attention. Many of the coconut nurseries under the State Department of Agriculture/ Horticulture do not have sufficient number of mother palms to produce seedlings of coconut varieties

Table 1. Selections developed in coconut

Selection	Source population	Nut yield (kg/ha/year)
Chandra Kalpa	LCT	17,700
Kera Chandra	PHOT	19,470
Kalpa Pratibha	CCNT	16,107
Kalpa Mitra	JVT	15,222
Kalpa Dhenu	ADGT	14,160
Kalpa Haritha	KGT	20,886
Kalpatharu	TT	20,709
Pratap	Benaulim	20,826
Kamarupa	Assam Tall	17,877
Aliyarnagar Tall 1	Arasampatti	22,302
Kera Bastar	Fiji Tall	19,470
Kera Keralam	WCT	26,019
Aliyarnagar Tall 2	TT	21,240
Kalyani Coconut	Jamaican Tall	14,240
VPM-3	ADOT	14,868
Kera Sagara	Seychelles Tall	17,523
Double century	PHOT	23,140
Chowghat Orange Dwarf	COD	12,852
Kalpa Jyothi	MYD	19,935
Kalpa Surya	MOD	21,593
Kalparaksha	MGD	17,748
Kalpasree	CGD	18,360
Gautami Ganga	GBGD	13,260
Kera Madhura	MGD	24,480
CARI-C1 (Annapurna)	Nui Leka	20,231

recommended to the respective regions. For example, Kerala has nine coconut nurseries and one seed garden complex for production and distribution of coconut seedlings state. A total of 3,430 mother palms are only available in these nurseries. Of which, 2,905 mother palms are of WCT variety. The situation calls for urgent steps to restructure the existing coconut nurseries by establishing mother palms of newly-released varieties as a long-term strategy. Rapid multiplication of coconut using tissue culture technique is the most viable strategy for ensuring supply of quality seedlings of improved varieties. Hence, it is needless to emphasize the relevance and significance of evolving tissue culture protocol for rapid multiplication of coconut for which research has to be strengthened.

Short-term Strategies

Utilisation of superior genetic resources of coconut available in farmers' gardens is most important short-term strategy to meet the demand. However, it has to be ensured that utmost care is taken to locate and identify superior mother palms of locally adapted varieties in farmers' gardens. Criteria fixed for identification of mother palms have to be scrupulously followed. Pressure to achieve the physical target should in no way dilute the scientific procedures to be followed in selecting mother palms. Inventory with GPS based photo tags of available mother palms in farmers' garden can be prepared by all agencies involved in coconut planting material production.

Table 2. Hybrids of coconut released in India

Hybrid	Source of parents	Nut yield (kg/ha/year)
Chandra Sankara	COD × WCT	20,532
Kera Sankara	WCT × COD	19,116
Chandra Laksha	LCT × COD	19,293
Kalpa Samrudhi	MYD × WCT	20,744
Kalpa Sankara	CGD × WCT	14,868
Kalpa Sreshta	MYD × T T	29,225
Laksha Ganga	LCT × GBGD	19,116
Ananda Ganga	ADOT × GBGD	16,815
Kera Ganga	WCT × GBGD	17,700
Kera Sree	WCT × MYD	23,364
Kera Sowbhagya	WCT × SSAT	23,010
VHC-1	ECT × MGD	21,240
VHC-2	ECT × MYD	25,134
VHC-3	ECT × MOD	27,612
Godavari Ganga	ECT × GBGD	18,585
Konkan Bhatye coconut hybrid 1	GBGD × ECT	20,532
Kalpa Ganga	GBGD × FJT	21,417
Vasista Ganga	GBGD × PHOT	22,125
Ananta Ganga	GBGD × LCT	22,656
VPM-5	LCT × CCNT	28,175

Evaluation of mother palm resources of coconut in existing seed gardens to mark the superior mother palms also needs attention so as to enhance the efficiency of quality seedling production in these nurseries.

Seedlings of hybrid coconut

Coconut nursery accredited with 4 star ready for distribution

Quality Control in Planting Material Production

Ensuring a viable quality control mechanism in planting material production is critical in promoting sustainable growth of coconut sector. Unfortunately, such a mechanism is yet to be evolved in our country. Since there is a huge gap between the demand and supply of quality seedlings, the coconut growers many a times are exploited by agencies who sell inferior seedlings. Nursery accreditation should be made mandatory to ensure quality control in planting material production and its distribution.

Planting Material for Disease Prevalent Tracts

To augment seedling production in root (wilt) disease prevalent tract, selection and identification of disease-free mother palms in 'disease hotspots' should be given more emphasis rather than large-scale procurement of seed nuts from other areas. For achieving this, a farmer participatory decentralized approach is to be followed with technical support from research institutions.

Decentralized Farmer Participatory Seedling Production

Farmer participatory seedling production initiatives are to be promoted to meet the planting material requirement utilizing the locally available resources/mother palms. Decentralized approach for enhancing production of seedlings of improved varieties should be promoted by establishing more number of nucleus seed gardens. Such seed gardens may be encouraged in marginal and small farmer holdings. Identification of superior mother palms with farmer participation and its validation by seedling progeny testing as well as molecular markers assumes much significance. Such initiatives will empower local farming community for mother palm selection, controlled pollination for seed nut production, community management of nursery and seedling selection. This can set in a movement that will result in the establishment of highly productive palms leading to higher productivity in coconut. Coconut Producers' Societies (CPS), the grassroot level collective of coconut growers facilitated by Coconut Development Board, and trained youths under the Friends of Coconut Trees (FoCT) programme can play a significant role in the decentralised production and distribution of quality hybrid coconut seedlings.

Mother Palms

Mother palms in seed gardens should be certified by the agency involved in developing the variety. Seed nuts should be collected only from the certified mother palms. All certified mother palms should be registered with CDB. Mother palm certification and registration should be made mandatory for nursery accreditation. Committee for nursery accreditation will have the responsibility for seedling certification and they also should ensure that only labeled seedlings are distributed from accredited nurseries. Training programmes for department personnel farmer, organizations/private nurseries/NGOs should be organized by research institutes/KVKs and certificate of attending such training should be made mandatory for applying for nursery accreditation.

Seedlings in polybags

Planting Material Production

Mother palm selection: The procedure for mother palm selection was evolved to enable identification of potential high yielders using some of the easily observable traits, which are considered to be associated with yield potential. The important features to be considered in talls are: a) straight stout trunk with even growth and closely spaced leaf scars (number of leaf scars vary from 13 to 17); b) spherical or semi-spherical crown with healthy fronds; c) short and stout bunch stalks without the tendency of drooping; d) more number of leaves (>25) and one inflorescence on each leaf axil; e) inflorescence with good number of female flowers (>20); f) high and consistent yield of nuts (>80); g) high copra turn out (>175g/nut) and h) absence of disease and pest incidence. Trees growing closer to households, cattle sheds, compost pits and other favourable conditions are to be avoided as it is not possible to differentiate inherently superior palms from those whose performance is due to favourable environment.

In case of dwarf mother palms, care should be taken to select true dwarf palms and avoid naturally crossed palms. The characters used to select dwarf mother palms are palm height, trunk girth, number of leaf scars, colour of the petiole and nut, leaf length, frond tip and crown size. Height of palms is major indication of dwarfness, they reach around 4 m at the age of 20 with around 30 leaves on crown. The true dwarf palms have narrow trunk which is narrower at the base than at the middle. Number of leaf scars at 1 m above ground will be 25-30. Heavy bearers in dwarfs are generally avoided because of possibility of heterozygous nature of such palms.

Collection and storage of nuts: Collect mature nuts at 11 months in dwarfs and 11–12 months in talls. Care should be taken, not to injure the nuts while harvesting. Lowering of bunches by means of ropes may be done when the palms are tall and ground is hard. Discard unhealthy nuts. In tall × dwarf hybrids and talls, store seeds in shade for a minimum period of 60 days prior to sowing in nursery. Seed nuts from dwarf × tall hybrid and dwarfs can be sown immediately after harvesting.

Sowing of nuts: Plant the seed nuts at a spacing of 30 cm (between rows) × 30 cm (between nuts) with four or five rows per bed. The nuts may be planted either horizontally with the widest of the segments at the top or vertically with stalk-end up. While sowing vertically, set the nuts firmly in either upright or slightly tilted position with the germ end at the top. Then cover them with soil, with about two-thirds of their size buried. Alternately, sow the seed nuts in the beds in trenches 25-30 cm deep and cover with soil so that top portion of husk alone is visible.

Selection of seedlings: Remove seed nuts, which do not germinate within 6 months after sowing as well as those with dead sprouts. Select only good quality seedlings (9-12 months old) by a rigorous selection based on early germination, rapid growth and seedling vigour. Six to eight leaves for 10-12 month old seedlings and at least four leaves for 9-month-old seedlings, collar girth of 10-12 cm, early splitting of leaves are characters for selection.

Production of Hybrids

In coconut, both T×D (Tall × Dwarf) where tall palm is the female parent and DvT (Dwarf × Tall) where dwarf

Seednuts in pregermination nursery bed

palm is the female parent are produced. Only healthy palms should be selected as parents. Selected palms should be closely observed to note the inflorescence opening. Entire work of crossing like emasculation, bagging, pollination, etc. depends on the date of inflorescence opening. Generally, artificial pollination is avoided during rainy season. In west coast it can be from November to May. Approximately 8-10 bunches can be used for artificial pollination in a season.

Emasculation and bagging: All the male flowers are to be removed well before the female flowers come to receptivity. Generally, the emasculation is carried out as soon as the inflorescence opens on the first day itself. After emasculation, the bunch is covered with a bag.

Pollen collection and processing: Collection of pollen from an inflorescence between 6 to 8 days after opening is recommended. Spikelets containing mature male flowers are removed from bunch to separate them. Male flowers are placed between folds of thick paper and gently crushed with the help of a roller. Male flowers are then dried in an oven at 36 ± 3°C for 24 hours or in room temperature for 48 hours. After drying, sieve the flowers to separate the pollen from the debris. Pollen collected in glass vials are stored in desiccators over fused calcium chloride.

Pollination: The pollination technique to be used in a garden depends on the type of plantation. When the female parents are scattered in a garden and one inter-planted with different types of tall cultivars 'controlled hand pollination' technique is to be used. This method involves bagging of emasculated bunches for the entire period of female phase and pollinating with desired pollen. The same procedure is also to be followed in the production of T × D hybrids.

The plantations of pure blocks of dwarf and dwarfs inter-planted with a single tall cultivar are suitable for commercial production of coconut hybrids. The former is more suitable than the latter as when the talls and dwarfs are inter-planted only a single hybrid combination can be produced in that garden without bagging. In this case, all the inflorescence in dwarf palms is to be emasculated so that only pollen from tall is available in the garden. All the nuts collected from the dwarfs after emasculation will be hybrid nuts (D × T). However, to increase the setting percentage, assisted pollination with the tall pollen is advisable. In the plantations of pure blocks of dwarfs, more flexibility is possible. Depending on the need, by changing the pollen in the assisted pollination technique, different combinations of hybrids can be produced. However, assisted pollination is mandatory in the pure blocks of dwarf, while it is optional in blocks inter-planted with talls. As the procedure is simple, it is very easy to produce a large number of hybrids from this (pure blocks of dwarfs) type of gardens.

SUMMARY

The production of quality planting material has been limited by various factors like limited number of mother palms, huge area required for raising seed gardens, lack of skilled man-power/climbers etc. Absence of a mechanism to ensure quality planting material in the distribution chain has added to dismal performance of the sector. Concerted efforts of all the relevant stakeholder categories are needed to overcome the challenges in increasing production of quality planting material in coconut in our country to meet the demand.

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