Decentralised planting material production in coconut

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Coconut, the Kalpavriksha, is useful to mankind in many ways. It is cultivated all over the tropical world, mostly in the coastal belt. In India, it is cultivated in an area of 2.1 million hectares. While the all India average productivity of coconut is around 10614 nuts/ha, in Kerala it is 9641 nuts/ha. Cultivation of high yielding improved varieties is one of the important means to enhance productivity of coconut to make it a remunerative crop. The most important input for increasing productivity is cultivation of high yielding varieties. Traditional or local varieties in coconut yield up to 9000 kg/ha. of husked nuts and 15 kg copra/palm. Improved varieties have the potential to give yield up to 15000 kg/ha. of husked nuts and 25kg copra/palm. By cultivating improved varieties, the farmer can realise an additional 6000 kg/ha. of husked nuts or an additional 10 kg of copra/palm. Research on development of new varieties has received due attention from the very beginning.

Efforts to enhance genetic potential resulted in the development of many improved varieties. There are 25 selections and 16 hybrids in the country today developed by Central Plantation Crops Research Institute (CPCRI), Kerala Agricultural University (KAU), Tamil Nadu Agricultural University (TNAU), Andhra Pradesh Agricultural University (APAU), Konkan Krishi Vidyalaya (KKV) and Assam Agricultural University (AAU). Though a large number of improved varieties and hybrids have been released

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by different research institutes, the level of adoption of these varieties by coconut farmers is not satisfactory. Lack of availability of quality seedlings continues to be a major problem faced by farmers in adopting the improved varieties. Coconut is a long duration crop with a long juvenile period spanning from 7 to 10 years and a long productive period of above fifty years. Hence, use of quality planting materials is very important in realizing high productivity.

For a sustainable growth of coconut sector, it is recommended to have tall, dwarf and hybrid varieties cultivated in the ratio of 60:20:20. However, the field level scenario indicates a different story; tall cultivars constitute more than 90 per cent of coconut palm population. In Kerala the productivity is low compared to other states like Tamil Nadu and Andhra Pradesh. Predominance of senile and unproductive genetically inferior local tall palm population is a major constraint in improving productivity of coconut in major coconut growing tracts like Kerala. Massive programmes for replacing old and unhealthy palms are necessary to increase productivity and make coconut cultivation profitable. Replacing old palms will require enormous quantity of seedlings.

Demand for coconut seedlings and present status of supply

In Kerala on an average 28-30 lakh coconut seedlings are required annually. But as per the official statistics of coconut seedling supply for the year 2014, State Department of Agriculture, the major agency involved in coconut seedling distribution in the state, could supply only about 6.5 lakh seedlings which include about 6 lakh WCT, 9000 dwarf and about 40000 hybrid seedlings, revealing a huge gap between demand and supply. Unscrupulous elements have been hugely benefitted by the situation which supplies inferior/spurious planting materials to farmers thus adversely affecting the sustainable growth of coconut sector.

Strategies for enhancing planting material production

Utilisation of superior genetic resources of coconut available in farmers' gardens is the most important short term strategy to meet the demand for coconut seedlings. However, it has to be ensured that utmost care is taken to locate and identify the superior mother palms of locally adapted coconut varieties in farmer's garden. 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. Public sector agencies including CDB and State Agri/Horticulture Departments are having programmes for procuring seednuts from farmers' gardens.

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 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 plam selection, controlled pollination for seednut production, community mangement of nursery and seedling selection. This can set in a movement that will result in the establishment of highly productive palms leading higher productivity in coconut. Coconut Producers' Societies (CPS), the grass root 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 coconut seedlings including hybrids. Empowering farmers and coconut climbers with the technique of hybrid production will help in localised production of coconut hybrids. The process can be technically supported by research organisations such as CPCRI.

Quality control in coconut planting material production

Ensuring a viable quality control mechanism in coconut 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 coconut seedlings coconut growers many a times are exploited by agencies which sell inferior quality seedlings. Nursery accreditation should be made mandatory to ensure quality control in coconut planting material production and distribution. A committee needs to be constituted for each state involving members from CPCRI, SAUs, CDB and State Departments to prepare norms for accreditation.

Mother palms in the 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. There is a need to develop seedling standards, by the research agency which develop the varieties, for selecting 6, 9, 12 month old seedlings for distribution to farmers. Committee for nursery accreditation will have the responsibility for seedling certification and they also should ensure that only labelled seedlings are distributed from accredited nurseries. Training programmes for department personnel's/ Farmer Organizations/ Private Nurseries/ NGOs should be organized by research institutes/KVKs and certificate of attending such training will be made mandatory for applying for nursery accreditation.

Directorate of Plant Quarantine need to be requested to develop guidelines and monitor movement of coconut seedlings and enforce quarantine related rules. Only 12 month old coconut seedlings should be distributed to farmers for planting. Agencies distributing 6, 9 month old seedlings may do so after the seedling standards for such seedlings are developed.

Strengthening functional linkage

Strong functional linkages among CPCRI, Universities, CDB, State Department of Agriculture/ Horticulture, Farmers Organizations, NGOs and private sector agencies are essential for effectively streamlining and regulating the planting material production in coconut in the country.

The technique of coconut hybrid production

Breeding behaviour

Knowledge in breeding behaviour of coconut is a prerequisite for making hybrids. A coconut palm produces 12-15 inflorescences (bunches) in a year, which is approximately one bunch in a month. The inflorescence contains male and female flowers arranged on branches called spikes. In each spike, one or two (rarely more than two) female flowers, are found at the base. Male flowers, many in numbers, are found above the female flowers. The coconut palm is protandrous (male flowers mature before female flowers) and male flowers open immediately after splitting of the spadix. In tall palms, the duration of male phase is about 18-22 days. The female flowers are comparatively few in number in an inflorescence, about 20-40 in tall palms. Dwarf palms generally carry more number of female flowers in a spadix compared to tall palms. Female flowers become receptive when it opens with three protruding stigmas and nectar is secreted. Female phase is much shorter than the male phase and lasts for about 5-7 days in tall palms and twice as long in some dwarfs. In the tall coconuts, there is a distinct gap between the male and the female phases aiding cross-pollination. In dwarf coconuts, the interval between the two phases is either nil or negligible thereby increasing the chances for self-pollination. It takes about 11 to 12 months for the flower to develop to maturity after fertilization.

Making hybrids

Male and female parents are selected based on the hybrids to be produced. For DxT, dwarf is the female parent and tall is the male parent and it is vice versa for TxD. Production of hybrids starts with artificial pollination followed by harvest of mature nuts, sowing of nuts, nursery management and selection of hybrid seedlings. Pollination is the process of transfer of pollen from male flowers to the stigma of the female flowers to effect fertilization. In nature, it is aided by wind and insects. Artificial pollination is the application of pollen collected from male flowers to the stigma of the receptive female flowers by artificial means. It involves emasculation, bagging, pollination, bag removal, pollen collection and harvest of mature nuts.

Emasculation

The process of artificial pollination starts with emasculation, the removal of male flowers from the inflorescence of the female parent to prevent self-pollination. To avoid any chance of contamination, it is done on the day of inflorescence opening. Extreme care should be taken while removing male flowers from the spike. It should be done

without any injury to the spike or inflorescence. Individual male flowers can be removed by hand or the spike can be cut 5 cm above female flower and rest of the flowers can be removed by hand. Care should be taken to remove male flowers on the sides of the female flowers.

Bagging

Covering the inflorescence with a bag is called bagging. It is done to avoid unwanted pollination or contamination with other pollens. Bagging of emasculated bunches is required for the entire period of female phase and pollination. Inflorescence is covered five days before the first female flower become receptive. Another indication for timing of the bagging is the appearance of white dots on the female flowers. Bagging should be done before the appearance of white dots on any of the female flowers on the bunch. Flowers with white dots at the time of bagging should be removed.

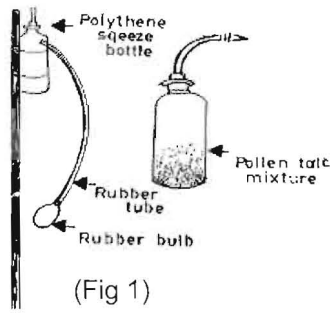
Pollen collection

Spikes with male flowers from the inflorescence of male parent are collected within 6 to 8 days after opening. Male flowers are then separated from spikes, kept between two layers of news paper, slightly pressed using a roller and dried in an oven at 35-40°C for 10 to 12 hours or at room temperature for 48 hours. Dried male flowers are sieved in three tier sieve to collect pollen. Collected pollen should be used within 48 hours to avoid loss of pollen viability. Storage of pollen for using beyond 48 hours requires special care to control moisture content and temperature. For this, pollen collected in small vials or packed in butter papers are stored in desiccators (air-tight containers) containing calcium chloride or silica gel to absorb air moisture inside the desiccators. To extend the storage period, the desiccators can be kept under refrigeration. Pollen from different male parents can be collected, processed and stored under refrigerated condition in research stations where male parents are available. This stored pollen can be made available to centres where female parents are available for pollination. In this manner, various hybrids can be produced in various locations in a participatory mode.

Pollination

At the time of application, pollen is mixed with chalk powder in 1:9 ratio and carried in a plastic squeeze bottle. For effecting pollination, pollen is released to cover the female flowers in an inflorescence within the bag. The process is repeated on the alternate days starting from the day when the first female flower comes to receptivity and continuing till the last flower becomes receptive. The bags are removed 2-3 days after completing pollination. Each inflorescence is labelled to complete the artificial pollination. Pollinated female flowers develop in to fruits and fruit matures in 11 to 12 months time.

A simple device has been developed to pollinate the dwarf palms from the ground. It consists of a polythene squeeze bottle, a rubber tube and bamboo pole (or aluminum rod). The squeeze bottle is tied at the end of a bamboo pole of 2 to 3m length. A rubber tube with a rubber bulb at one end is connected to the bottle just below the neck. When the rubber tube is pressed, it injects air into the squeeze bottle and in turn, the pollen-talc mixture kept inside the bottle is released. When the receptive female flowers are to be pollinated, the nozzle of the bottle is placed near the inflorescence through the window on the pollination bag and the rubber tube is pressed (Fig 1). The pollen-talc mixture released will cover the inflorescence effecting the pollination. The device can be used when palm is of suitable height and it helps to reduce number of climbing required for effecting pollination.



(Fig 1)

Bag removal

When all the female flowers in a bunch are pollinated, the bag covering inflorescence can be removed. But it is safe to keep bag for two more days after completing pollination to avoid contamination. Button shedding will be more if the bag is kept for more days. Hence, it should be removed as early as possible starting from the second day after completing pollination.






Harvest and Storage of nuts

Mature nuts are harvested 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. Unhealthy nuts are discarded. In the case of tall x dwarf (TxD) hybrids, seeds have to be stored in shade for a minimum period of 60 days prior to sowing in nursery. Seed nuts from dwarf x tall (DxT) hybrids can be sown within 30 days after harvest. Care should be taken to store seeds in shade to avoid drying of nut water. Seeds should be sown before complete drying of nut water.

Sowing of nuts

The seed nuts are planted at a spacing of 30 cm (between rows) x 30 cm (between nuts) with four or five rows per bed. The nuts can be planted either horizontally with the widest of the segments at the top or vertically with stalk-end up. While sowing vertically, the nuts are set firmly in either upright or slightly tilted position with the germ end at the top, covered with soil, with about 2/3 of their size buried.

Seedling selection

Seed nuts, which do not germinate and those with dead sprouts, are removed within six months after sowing. Only good quality seedlings are to be selected by a rigorous selection-based early germination, rapid growth and seedling vigour. One year old seedling should possess six to eight leaves, 10-12 cm girth at collar and should exhibit splitting of leaves. Change in collar colour is an indication that crossing was successful and can be used to select seedlings of DxT hybrids by selecting seedlings with green to light green coloured collar.

Genetic purity assessment with molecular markers

It is essential to verify the hybrid nature of seedlings at an early stage to ensure enhanced field performance and yield. Morphological markers used are not efficient in the selection of true hybrids and resulted in rejecting hybrids when strict compliance with criteria is applied. Informative molecular markers capable of distinguishing the parental lines have been developed. Based on the complementary banding patterns between the hybrids and their parents, a panel of microsatellite and RAPD markers has been developed to monitor the seed purity of DxT and TxD hybrid coconut combinations. Use of these markers will thus ensure hybrid seedling quality and supply of genuine hybrid seedlings to farmers. Hybrid seedlings developed in farmer's gardens can be tested by the research institutes using molecular markers for their purity.

High demand for hybrid coconut seedlings can be met only through decentralised production of seedlings. Any skilled climber can produce hybrids by selecting COD palms near to his place by collecting pollen from good high yielding WCT palms and using it to pollinate the selected COD palms. Alternately, pollen can be sourced from pollen storage centres. Following the scientific procedures for pollination, selection of seed nuts and seedlings will ensure production of quality hybrid seedlings. Mechanism for monitoring and supervision to maintain the quality of hybrids should be put into place. Capacity building of coconut producer's societies (CPS) and members of friends of coconut programme on the scientific methods of hybrid seedling production techniques thus assumes much significance. ■