

Hybrids and hybridization techniques in coconut

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Non-availability of Dwarf mother palms in large numbers and alternate bearing tendency are the major constraints in large scale production of D X T hybrids.

Coconut is one of the most useful crops of the tropics, providing food, livelihood and shelter to several millions of people in developing countries. The most extensively cultivated coconut varieties in India are tall types. Hybrids of coconut are grown throughout the world mainly for their earliness in flowering (3-4 years after planting), high nut yield, good quantity and quality of copra and oil (65-68 %).

The yield levels of the released coconut hybrids ranges from 2.3 to 4.5 tonnes of copra/ha/year under optimum management conditions.

Though hybrid vigour in coconut was first reported from India by J. H. Patel in 1932, large scale production and adoption of hybrids in India became popular only during 1970's. Two coconut hybrids (Chandra Sankara and Chandra Laksha) developed from CPCRI were officially released for cultivation in India during 1985. Even after 25 years, the area covered by hybrids is less than 2-3% of the area under coconut. The major constraint in extending the area is the lack of availability of quality planting material of released hybrids. This article lists the coconut hybrids released for cultivation for various states in India and the technique adopted in production of hybrid seed nuts and the procedure followed to select hybrid seedlings of coconut at nursery stage.

Difference between D X T and T X D hybrids

In general, coconut hybrids are of two types (either D X T or T X D) depending on the type of female and male parents. D X T hybrid is produced when a dwarf variety is used as female parent and a tall variety is used as the male/pollen parent (eg: Chandra Sankara, Kalpa Sankara). T X D is produced when tall is used as the female parent and dwarf is used as the male parent (eg: Kera Sankara, Chandra Laksha). In India, during the period 1970-1995



Kalpa Sankara

most of the hybrids released were T X D's and of late the focus is on developing D X T hybrids. It is very cumbersome to produce T X D hybrids as a climber has to climb a tall female parental palm (which grows to a height of 30-40 feet) at least 7-10 times (for activities like emasculation, bagging, pollen application for 4-5 days and bag removal) to carry out artificial pollination in one inflorescence. It is comparatively easy to produce D X T hybrids due to the shorter stature of dwarf mother palms. However, non-availability of dwarf mother palms in large numbers and alternate bearing tendency noticed in dwarf palms are the major constraints in large scale production of D X T hybrids.

Technique for production of hybrids in coconut

For production of hybrids, it is essential to know the inflorescence structure and the floral biology of the crop. The coconut inflorescence called 'spadix', is 1-2 m long, and consists of a central axis or rachis, with lateral branches called rachillae, each bearing 200-300 male flowers from the top down and some rachillae have one or more female flowers at their base. The female flowers also known as buttons develop into nuts, whereas male flowers are shed after dehiscence of anthers.

The male flowers are the first to open in an inflorescence, beginning at the top of each spikelet and proceeding towards the base. In tall palms, the male phase extends for 16-22 days and the female phase usually begins 22 days after the spathe has opened and lasts for 4-6 days. In tall varieties, there is a gap of 2-3 days between male and female phases. However, in dwarf varieties, the male and female phases overlap, resulting in self-pollination. Coconut is essentially entomophilous and agents like honeybees facilitate natural pollination, apart from pollination by wind. Artificial pollination means that the natural process of pollination is replaced by artificial methods.

Selection of parental palms

The selection of the parental palms has great

bearing on the quality of planting materials finally produced. Hence care should be taken while selecting the parental palms (both male and female) for artificial pollination. The parental palms selected should be high yielding (80-100 nuts per palm per year) and should be free from all pests and diseases.

Equipments required

1. Pollination Bag: It is essential to protect the receptive female flowers from pollinating agents. Cotton cloth bags, measuring approximately 75 cm x 50 cm, having a transparent plastic window (to view the receptive stage of female flowers) are used as pollination bag.

2. Applicator for spraying pollen grains: Pollen applicator consists of a plastic squeeze bottle with a rubber tube at its mouth. Another rubber tube with a rubber bulb at one end is connected to the plastic bottle just below the neck. When the rubber bulb is pressed, it pumps air into the squeeze bottle and the pollen-chalk mixture inside the bottle is released as a cloud, into the pollination bag.

3. Dessicator: Pollen is usually stored in a dessicator with fused calcium chloride as desiccant. The pollen collected in small vials, is plugged with non absorbent cotton and kept in dessicator. They can be stored for 10-12 days without appreciable loss of viability.

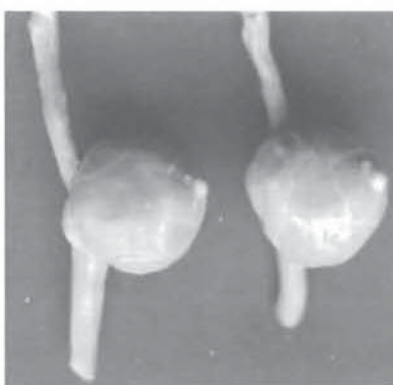
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Collection of male flowers and Processing of pollen

The male flowers collected from the male parental palms are processed for pollen collection. The male flowers on the middle portion of the spikelets produce more fertile pollen compared to those on the upper and lower portion of the spikelet. Male flowers should be collected from the male parental palms before opening of individual male flowers (usually done 2-4 days after the opening of inflorescence). Maturity of the male flower is



Male flowers



Receptive flowers



Pollination equipments

indicated by the bluish green tinge at the tip. These mature male flowers are placed in between two sheets of newspaper and slightly crushed using a wooden rolling pin to separate the perianth parts. The crushed male flowers are dried in an incubator maintained at 40°C for a period of 24 hours. In case if incubator is not available, it can also be shade dried for 1-2 days. On completion of drying, the pollen is collected by sieving the dried male flowers using a sieve with mesh size of 0.2 mm. Pollen is preserved in dessicator to maintain its viability.

Emasculation & Bagging

The process of removal of male flowers from the female parental palm is called emasculation. Emasculation is usually done by cutting the spikelets 5 cm above the female flowers using a secature / knife. Sometimes a few male flowers are seen in between/near to female flowers and they should be removed by hand. Dwarf parental palms have to be emasculated within 3-5 days of opening of the inflorescence.

Bagging is done to prevent pollination in emasculated

inflorescence by natural means and is done a few days before the female flowers become receptive. Bagging is done 3-4 days before the initiation of female phase in an inflorescence.

Method of artificial pollination

The pollen grains is usually mixed with a suitable diluent like purified talc in 1:9 ratio and filled in the applicator, just before pollen application on to receptive female flowers. Twenty gram of pollen will be sufficient to pollinate 45 to 50 bunches. Pistillate flowers become receptive during early morning

Table 1. Coconut hybrids released in India

S N	Hybrid	Parentage	Nut yield (palm/year)	Copra (g/nut)	Agency	Area for which recommended
D X T						
1	Chandra Sankara	COD X WCT	110	208	CPCRI	Kerala, Karnataka, TN
2	Kalpa Samrudhi	MYDX WCT	117	219	CPCRI	Kerala & Assam
3	Kalpa Sankara	CGD X WCT	84	170	CPCRI	Root (wilt) disease prevalent tract
4	Konkan Bhatye Coconut Hybrid-1	GBGD X ECT	122	180	DBSKKV	Konkan Region
T X D						
1.	Kera Sankara	WCT X COD	106	198	CPCRI	Kerala, Karnataka, Maharashtra, AP
2.	Chandra Laksha	LCT X COD	109	195	CPCRI	Kerala, Karnataka
3.	Laksha Ganga	LCT X GBGD	108	195	KAU	Kerala, Tamil Nadu
4.	Kera Ganga	WCT X GBGD	100	201	KAU	Kerala
5.	Kera Sree	WCT X MYD	112	216	KAU	Kerala
6.	Kera Sowbhagya	WCT X SSAT	130	195	KAU	Kerala
7.	Ananda Ganga	ADOT X GBGD	95	216	KAU	Kerala
8.	Godavari Ganga	ECT X GBGD	140	150	ANGRAU	Andhra Pradesh
9.	VHC-1	ECT X MGD	98	135	TNAU	Tamil Nadu
10.	VHC-2	ECT X MYD	107	152	TNAU	Tamil Nadu
11.	VHC-3	ECT X MOD	156	161	TNAU	Tamil Nadu

Table 2. Colour of petiole in hybrid seedlings

Dwarfs (Female parent)	Talls (Male Parent)	
	Green nut type	Orange/ Red nut type
Orange Dwarf	Green / Bronze	Bronze
Green Dwarf	Green	Bronze
Yellow Dwarf	Greenish Yellow	Orange Yellow

hours as indicated by a reflexed and moist stigmatic surface. In addition to the stigmatic appearance, nectar is secreted at the base of the stigma and at the three pores on the pericarp. Besides, during receptive period, the stigma is expanded as three erect teeth and is ivory coloured. The receptivity of the female flowers can be observed through the transparent plastic

that the pollen-chalk mixture cloud covers the receptive female flowers. All the female flowers do not attain receptivity on the same day, so the above process should be repeated till all the female flowers in an inflorescence become receptive. Care should be taken to close the hole after spraying the pollen-chalk mixture, using adhesive tape. It should be



Artificial Pollination

window of the pollination bag. At this stage, a small hole should be made on the plastic sheet and the tube of the pollen applicator should be inserted through this hole. The rubber bulb attached with the applicator should be pressed afterwards to spray the pollen-chalk mixture inside the pollination bag. This pollen application process should be carefully done to ensure

kept in mind that the pollen from the same parent should be used for individual inflorescence. Since stigmatic exudation occurs progressively during the morning hours, 7 am to 11 am is the most ideal time for carrying out artificial pollination.

On completion of the fertilization process the stigma turns brown and the secretion of

nectar stops. After 3-5 days, when all the buttons in an inflorescence attain this stage, the pollination bag should be removed and the bunch should be labeled properly. Mature nuts can be harvested 11 months after pollination in dwarf palms and 12 months after pollination from tall parental palms. The mature seed nuts should also be labeled and sown in nursery.

Selection of hybrid seedlings

Hybrid coconut seedlings are identified in the nursery stage based on characters like early germination, petiole colour and seedling vigour. However, petiole colour is the most widely used marker to select hybrid seedlings in the nursery stage. D X T hybrid seedlings can be selected based on the exclusive characteristics of the male parent viz., colour of petiole, length and breadth of leaves and leaflets. One year old seedlings usually show hybrid vigour for collar girth, number of leaves, length and breadth of leaves and leaflets. Colour of petiole is one of the most commonly used distinguishing characteristics and hybrids are usually selected based on the colour of petiole and collar girth (Table 2).

Cultivation of hybrids will significantly increase the coconut productivity in India and will also enhance the income of coconut farmers. Hence, large scale production of released hybrids of coconut should be given top priority by various developmental agencies, agricultural universities and research institutes.

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