

Coconut Seed Production

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1. INTRODUCTION

Coconut which is a major source of edible oil is propagated at present only through seed. The plant has a juvenile period of 4 to 6 years and a bearing period of over 60 years. Hence, greater emphasis is required right from the seed selection for the production of quality planting material. Once a mistake is committed in the selection of planting material, it will be too late for any correction. By the time the palms comes to bearing, sizeable amount of resources like money, energy and time would have been spent unfruitfully. Hence, a strict selection of seed nut and seedling is the prime need for profitable coconut cultivation. India is third in the world with regard to area and production. Coconut is grown in this country in over 15.13 lakh hactares. Of the total area under this crop, over 91 per cent of the area is concentrated in the four southern states of Kerala, Tamil Nadu, Karnataka and Andhara Pradesh. Out of this Kerala State alone accounts to 58.8 per cent area and Tamil Nadu 14.5 per cent. The area of coconut cultivation had a steady rate of increase. A total of over 3.82 lakh ha have increased during the last decade. If the overall increase in the country is taken into account, it is to the tune of 382.1 thousand hactares over the past ten years. Most of the area expansion was taken up using the locally available seed materials. Quality planting material production does not commensurate with the annual requirement of 15 million seedlings.

2. STRATEGY

The strategy for the production of coconut seedlings is based on : (a) the area expansion in non-traditional areas, (b) new plantings in traditional areas other than Kerala, (c) regular under plantings in traditional areas, and (d) rehabilitation of root (wilt) affected areas in Kerala. To meet the demand of coconut by 2000 AD, it is necessary to take new plantings at the rate of 30,000 ha annually as against the present rate of 13,500 ha Rethinam (1988). The annual requirement of seedlings have been estimated to be 15 million. The total production of planting materials in coconut in the country is estimated to be over 10 million seedlings annually. Out of this, 5.2 million seedlings are produced by various state government nurseries. Over 4.3 million seedlings are produced by the private nursery men as well as by the farmer himself. This is the case of the tall seedlings. Annual production of hybrids, both Tall X Dwarf and Dwarf X Tall is around 2.0 million

only (Table 1) These hybrids are produced in five major coconut growing states, namely, Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Orissa. The annual production of ten million seedlings is sufficient to cover an area of 50,000 ha of new area every year. But the average annual growth rate in area under coconut for the last ten years is only 13,500 ha. Kerala State, which has an area of over 60 per cent, produces annually over 25 lakh seedlings both from the government and private sectors. Major portion is used for underplanting and replanting. The overall production of seedlings is on the surplus side in all the southern states except in Kerala where the demand for regular planting and replanting even at the modest rate of 2 per cent works out of 24 lakh seedlings. The adverse climatic conditions in the initial years of planting takes a heavy toll of seedlings so much so, the increase in area in relation to the production figures does not tally. In order to bridge the gap of production and requirements, it is necessary to establish new seed gardens in the country, especially in states like Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Goa, Gujarat, Pondicherry, Tripura, West Bengal, Lakshadweep and Andamans since no seed gardens are available in these

Table 1 : Annual Production of Coconut Seedlings in India (1990-1991)

Sl. No.	States	Production of hybrids (T × D and D × T) (Govt. sector) (in lakhs)	Production of tall seedlings	
			Govt. Sector (in lakhs)	Private sector.
1.	Andaman & Nicobar Islands	—	0.30	0.25
2.	Andhra Pradesh	1.00	5.00	8.00
3.	Assam	—	0.60	—
4.	Bihar	—	1.60	—
5.	Goa	—	1.50	0.50
6.	Gujarat	0.15	2.50	1.00
7.	Karnataka	0.50	10.00	5.00
8.	Kerala	2.00	13.00	10.00
9.	Lakshadweep	—	0.50	0.25
10.	Madhya Pradesh	—	0.70	—
11.	Maharashtra	0.25	3.00	2.00
12.	Orissa	3.00	3.00	5.00
13.	Pondicherry	—	0.37	0.10
14.	Tamil Nadu	8.50	7.00	10.00
15.	Tripura	—	2.75	—
16.	West Bengal	—	1.00	1.00
Total		43.10	52.82	15.40

Source : Coconut Development Board, Kochi.

states. For these seed gardens possible parental materials have been identified (Table 2). Based on the requirement of planting materials the approximate area to be brought under seed garden is also worked out (Table 3). It is also envisaged that not only the tall variety alone is produced but also the promising hybrids will be produced using the dwarfs and the tall planted in these seed gardens.

3. VARIETIES

In coconut only two varieties namely the Tall and the Dwarf are available. The late bearing tall palms belong to the former group while the early bearing short palms are called dwarfs. Clear identifiable characters separate these two group of palms.

3.1 CHARACTERS OF TALL PALMS

Tall palms are those plants which normally take more than five years to commence its flowering. They live up to 100 years and have an economic bearing period up to 60 years. These palms have stout stems with long internodes which are clearly visible on the stem. These palm have enlarged base which is commonly called bole. On shallow planting, the bole becomes very large for the tall. These palms are cross-pollinated

Table 2 : Parents Suggested for Different States for Establishing Elite Seed Gardens

State/UT	WCT	LO	AO	ECT	TT	BEN	COD	MYD	GB	GD
Andamans	—	√	√	√	—	—	√	√	—	—
Andhra Pradesh	—	√	√	√	—	—	√	√	√	—
Assam	—	√	√	—	—	—	√	√	—	—
Bihar and Madhya Pradesh	√	√	√	√	—	—	√	√	√	—
Gujarat	√	√	—	—	—	—	√	√	—	√
Karnataka	√	√	—	—	√	—	√	√	—	—
Kerala	√	√	√	—	—	—	√	√	√	—
Lakshadweep	√	√	—	—	—	—	√	√	—	—
Maharashtra & Goa	√	√	—	—	—	√	√	√	√	—
Orissa	√	√	√	√	—	—	√	√	√	—
Pondicherry	—	√	√	√	—	—	√	√	√	—
Tamil Nadu	√	√	√	√	—	—	√	√	√	—
Tripura	√	√	√	—	—	—	√	√	√	—
West Bengal	—	√	√	√	—	—	√	√	√	—

WCT — West Coast Tall

AO — Andaman Ordinary

BEN — Benaulim

COD — Chowghat Orange Dwarf

GB — Gangabondam

LO — Chandrakalpa (Laccadive Ordinary)

ECT — East Coast Tall

TT — Tiptur Tall

MYD — Malayan Yellow Dwarf

GD — Goodajali Dwarf.

Table 3 : Projected Seed Garden Requirements of Various States with Suggested Parents

State	Name of Dwarf parent	Area to be covered (ha)	Name of Tall parent	Area to be covered (ha)
(1)	(2)	(3)	(4)	(5)
Andamans	COD	15	ECT	10
	MYD	15	AO	25
Andhra Pradesh	COD	25	ECT	25
	MYD	25	AO	25
	GB	25	LO	20
Assam	COD	10	AO	10
	MYD	10	LO	10
Bihar & Madhya Pradesh	COD	30	WCT	10
	MYD	20	ECT	10
	GB	10	LO	10
Gujarat	COD	15	WCT	25
	MYD	15	LO	25
Goa	GD	25		
	COD	10	LO	10
Karnataka	MYD	10	BEN	20
	GB	10		
Kerala	COD	140	WCT	60
	MYD	35	TT	60
Maharashtra			LO	60
	COD	800	WCT	290
	MYD	75	LO	200
Manipur	GB	100	AO	10
	COD	20	WCT	20
	MYD	20	LO	10
Orissa	GB	10	BEN	20
	COD	5	WCT	5
	MYD	5	ECT	5
Tamil Nadu	GB	5	AO	5
	COD	120	WCT	20
	MYD	20	ECT	30
West Bengal	GB	20	LO	20
	MYD	20	AO	10
	GB	20	AO	10

(Contd.)

(1)	(2)	(3)	(4)	(5)
Tamil Nadu	COD	80	ECT	30
	MYD	50	LO	20
	GB	25	AO	30
Tripura	COD	5	WCT	5
	MYD	5	LO	5
	GB	5	AO	5
West Bengal	COD	30	LO	10
	MYD	20	AO	10
	GB	10	ECT	10
Total Dwarfs:		Total Talls :		
	COD	1300 ha.	WCT	435 ha.
	MYD	325 "	ECT	120 "
	GB	220 "	LO	390 "
	GD	25 "	AO	130 "
	TT	60 "		
	BEN	40 "		
	1870	ha.		1175 ha.

generally. But when the inflorescences are produced at shorter intervals, inter-spadiX pollination takes place. The leaves have longer petioles, long leaflets and the lamina is broader when compared with dwarfs. The nuts are bigger with or without ridges and contain kernel, when dried gives quality copra with oil content ranging from 68 to 75 per cent by chemical extraction. They have a larger life span when compared with dwarfs. These palms are largely cultivated in our country and they are generally known by the name of the area of its cultivation. The Tall palms cultivated on the West Coast of India are known as West Coast Tall. Similarly, the tall palms grown on the East Coast is known as East Coast Tall, those grown at Tiptur area in Karnataka is known by the name Tiptur Tall. Tall palms grown in Lakshdweep is Laccadive Ordinary. The dwarf palms also to some extent derived their name from the locality. For example Chowghat Orange Dwarf and Chowghat Green Dwarf.

3.2 Characters of Dwarf Palms

Dwarf palms are precocious in flowering. They come to flowering within three years as seen in Chowghat Green Dwarf (CGD). The other dwarfs like Chowghat Orange Dwarf (COD), Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD), which is also known as Malayan Red Dwarf (MRD), Malayan Green Dwarf (MGD), Gangabondam, King Coconut, Kenthali, etc., take a longer time than CGD for flowering. The dwarfs are generally smaller in size, except for the nut size. The stem is thinner, the internodal

distance is very little so much so it is rather difficult to separate the left scars seen on the stem. One of the important characters of the dwarf is that even on surface planting (planting about 25 to 30 cm below the ground level), there will not be enlargement at the base (bole) of the stem. However, in palms belonging to the Talls, this enlargement can be noticed with varying intensities. This only shows their level of homozygosity. Another important character of the dwarf is that self-pollination prevails in the dwarf even though the percentage of selfing varies depending upon the homozygosity level. Coconut flowers are unisexual. So in the strict sense, there is no possibility for self pollination because self-pollination is possible only in bisexual flowers. But in coconut, when the male flowers in the inflorescence pollinate the female flower in the same inflorescence by the over lapping of the male and female phases, it is termed as self-pollination. When the pollination is between two inflorescences in the same tree, it is termed as interspadix pollination. Another important character of the dwarf is the retention of few unfertilized female flowers in the bunch along with the normal developing nuts. In dwarfs generally, three colour groups alone are seen. They are green, yellow and orange. The different shades of the colours and combination colours are not seen in dwarfs. The nuts of the dwarfs contain less copra and oil when compared with talls. Each dwarf has got varying content of copra. It is also observed that the tender nut water in the dwarf contains more sugars (Damodaran *et al.*, 1991) and, hence, they are more suited for tender nut consumption. The oil content in copra is less when compared with talls. In coconut as mentioned earlier, there are only two varieties, viz., Tall and Dwarf. However, another term is in use to denote a particular variety of tall, viz., Philippine Ordinary cultivar. When a particular type is cultivated on extensive scale on a plantation or even as individual palms in house compounds they are referred as cultivar. Therefore, West Coast Tall, Philippine Ordinary, etc., are tall cultivars. Similarly, in dwarfs also, a few cultivars exists. When a particular type is found very rarely, they are still referred as type. A type gets the status of a cultivar when it is extensively cultivated and they are economically viable. Hence, most of the presently known varieties are really cultivars.

4. SELECTION OF SEEDNUTS

Selection of seednut is of prime importance in coconut as the performance of the progeny can be evaluated only after several years of planting. Should the seednuts happen to be of poor quality, the new plantation will prove to be uneconomic causing considerable loss of time and money to the grower. The fact that the coconut is a cross-fertilized palm and that it does not breed true to type, makes the selection of seednuts and then seedlings in the nursery all the more difficult and important. By means of a series of selections made at different stages, it is possible to eliminate poor quality seednuts and seedlings. The criteria of selecting tall and dwarf should be separate since they belong to two different sets of palms.

4.1 Selection of Seed Garden

It is always desirable to select suitable seed gardens for collecting seednuts. The garden should be one with a record of consistently high yield. Such gardens should

contain a high proportion of heavy bearers. The garden should be free from the incidence of disease and not prone to severe attack of pests. It is not advisable to select mother palms from very small holdings maintained under highly favourable conditions of growth. Palms growing under such situations and receiving special care should be avoided as it will be difficult to assess their inherent yielding capacity, because the superior performance of the palm may be due to the favourable environment. Palms located near cattle sheds, compost or manure pits, waterways, etc., should preferably be avoided.

4.2 Selection of Mother Palms

The palms are to be selected with great care on the basis of several characters which are listed below

4.2.1 Yield

The palms selected as mother palms should be regular bearers and should give annual yield of not less than 80 nuts under rainfed condition. The copra content per nut should be around 150 g. Wherever there are difficulties in getting the yield data, the yield of the trees can be estimated by counting the number of nuts on the crown at a given time.

4.2.2 Age of Palm

When mother palms are to be selected from large plantations of unknown percentage, it is advisable to select palms which have reached the full bearing stage and have been giving regularly high yield at least for four years consecutively. Also very old trees (above 60 years) may be avoided. Seednuts can be collected from newly established seed gardens irrespective of the age of the palms, if the performance of the parents of those palms are known and only high yielders are maintained in the seed garden.

4.2.3 Nature and Disposition of Leaves

A mother palm should have at least 30 fully opened leaves on the crown. The leaves should have short and strong petioles with wide leaf base firmly attached to the stem. Long and thin petioles are not desirable because they are liable to be weak and may easily bend or break under slightest pressure. The disposition of the leaves on the crown should be such that the leaf petioles of the lower whorl will provide adequate support to the developing bunches thus reducing the possibility of buckling of the bunches and thereby shedding of the tender nuts in the immature stage itself. The trees with crown having leaf orientation to all directions which are commonly known as umbrella shape is ideally suited as mother palms. These trees having a drooping or upright position for the leaves are generally poor yielders and such palms should be avoided.

4.2.4 Nature and Sequence of Production of Inflorescence

Every leaf axil should have one inflorescence with a large number of spikes. It has been proved that the female flower distribution per spike determines the yielding capacity of the tree. If the female flowers are one or two per spike, those trees ensure high set and stability in yield. At any time, there should be minimum 12 bunches with nuts in different stages of development on the crown. The peduncle should be short and stout so that there is no chance of buckling of the bunches. Palms with long pendulous inflorescence are unsuitable for selecting as mother palms.

4.2.5 Size and Shape of Nut

There are mainly three different shapes for nut. The size of the nut depends upon the cultivar. In West Coast Tall palms as well as in East Coast Tall palms, the size variation is noticed. However, all the three shapes are prevalent, viz., the oblong, round, and elliptical. Except in the case of round and elliptical shapes, there are nuts with prominent ridges in the oblong group. Where ever the ridges are prominent, the husked nuts will be small and a large proportion of husk is noticed in the nut. For seed purpose, it is always preferable to have nuts of round and oblong shapes without ridges as they have larger proportion of husked nut. The vigour of the seedling greatly depend upon the size of the husked nut, the thickness of kernel and the size of the embryo present in the kernel. Palms, having a higher proportion of the above components, should be selected for seed purpose. Palms known to produce barren nuts, alternate bearing and irregular bearing should be avoided as mother palms. The vigour of the seedlings, resistance to pests and diseases, and the early germination of nuts (within 25 weeks of sowing) are the main points to be kept in mind while selecting the seednuts. Many times, they are ignored with a view to supplying more number of seedlings.

4.2.6 Collection of Seednuts

The proper time for the harvest of seednuts depend, to a large extent, on the seasonal conditions prevailing in those region. Under West Coast conditions, January to May is considered to be optimum because the nuts harvested during this session are larger in size and have greater copra content than those nuts harvested during the other seasons of the year and these nuts give a higher percentage of germination. The seednut collecting season have to be adjusted according to the rainy season of the area as the seednuts have to be sown in the nursery at the onset of monsoon. Generally, for the Tall cultivars, two months storage of the seednuts are required for greater germination. At any cost, nuts having fully dried husk alone should be sown lest the germination will be delayed considerably. However, the dwarf cultivars does not require storage to this extent. Fifteen days to one month storage is required for dwarf nuts. The stored seednuts should retain its nut water for proper germination. To prevent the loss of water from the nuts they should be stored under shade and in case it is suspected that drying is likely, sprinkling of fresh water once a week is suggested so that inside water is not completely lost.

4.2.7 Maturity of Seednuts

The seednuts should be fully mature i.e. about 12 months old. However, nuts having 11 months maturity can also be used for seed purpose. The maturity of the seednuts can be judged on the basis of the following observations.

- a) Mature nuts will produce on tapping with a finger a resonant and ringing sound which can be identified by experience. Immature nuts will produce a dull sound.
- b) Fully mature nuts will change its colour to dull brown and the inner fibres will have a distinct browning.
- c) Free movements of water within the nut can be felt on shaking the nut.
- d) The nuts will be lighter in weight when compared with ten or nine months mature nuts.

4.2.8 Method of Harvest

In India coconuts are harvested generally by climbing the tree and cutting the outer most bunch at the base of the peduncle. The nuts then fall to the ground under the palms. When the palms are tall or if the ground is hard, there is always the possibility of breaking some nuts when it falls. In some parts of the country harvesting is done from the ground itself using a bamboo pole having curved knife attached to its end. This however, is possible only when the palms are at a height of up to 10 or 15 metres. Where the palms are not very tall and the soil is loose and friable, the seednuts can be harvested by cutting the bunches and allowing them to fall to the ground and where the palms are tall and the ground is hard the bunches should be brought down by means of ropes.

Nuts with irregular shape and size, and improper development should be rejected. Those nuts having cracks on the husk at the stalk and or at the base should be discarded.

4.2.9 Storage of Seednuts

A period of storage is necessary for the better germination and production of quality coconut seedlings. Generally, two months storage is recommended for tall nuts. The dwarf nuts require less period of storage. The earlier method was to store the nuts in sand beds one above the other with the stalk ends up till the onset of monsoon for sowing. By this time, all the good nuts would have started sprouting and some of them grown out of the sand bed here normally three to four or even five layers are kept. These sprouted seednuts turn out to be lean and lanky seedlings. Hence sand storing is not recommended now.

5. RAISING NURSERY

5.1 Location, Bed Preparation and Sowing

The nursery should be located in well drained sandy soils. The area should have assured irrigation facility. Raised beds may be prepared where drainage may be impeded during heavy rains. If the soil is not sandy, it is essential to treat the soil with insecticides to prevent the attack of white ants and root grub. BHC (10%) at 60 kg/ha or chlordane (5%) dust at 120 kg/ha may be applied in the nursery beds. Nursery raised in open area with adequate shading during summer season is ideal. However, it can be raised in coconut gardens in the interspaces where the ground is not completely shaded and where the trees are fairly grown up. Too much of shading the nursery makes the seedlings lean and lanky. The beds should be preferably long and narrow with a spacing of 30 cm between the beds and 40 cm between rows. The width may be adjusted to have four to five rows in bed. A distance of 80 cm may be provided between beds (Mulyar and Pillai, 1989). This is necessary for proper observation of the sprouting seednuts and later on seedlings and to carry out weeding and other operations. The conventional system is to plant the seednuts in the nursery either horizontal or in the vertical way and after five months time all the ungerminated and dead sprouts removed from the beds. The seedling selection is also done only at the time of pulling out the seedlings from the nursery for planting purpose. A modified system now developed and adopted in few seed gardens helps in the selection at the sprouting stage itself. In this method, all the seed nuts are sown in a compact area with all the nuts touching each other. When the sprout is visible outside the nut, they are removed and planted in the nursery bed at the recommended spacing. These nuts thus removed can also be placed in poly bags and the seedlings raised. The sprouts can be collected at every fortnight and planted separately. Few advantages of this are, less area of nursery maintenance, uniformity in the growth of seedling and absence of a secondary selection at the time of pulling. Supply can be effected from the first seedling bed onwards. The percentage recovery can be fixed at the sprouting stage itself and all the ungerminated ones can be disposed off at the recovery of the desired germination percentage.

5.2 Time of Planting

The proper time of planting seednuts in the nursery will vary from tract to tract depending upon the monsoon. By planting at the commencement of the rainy season, it will be possible to avoid frequent watering required for better germination.

5.3 Pre-treatment of Nursery Bed

In soils, where white ant attack is anticipated, it is safe to dip the nuts in a suspension of BHC (400 g of 5% wettable powder in 100 litres of water) at the time of sowing. The nursery bed as a whole can be treated with BHC before sowing. If the soil is dry and the rains are delayed, soaking the seednuts in water prior to sowing may be examined separately so that nut without water discarded and those which have

rotten kernel rejected from planting. This can be done by shaking of nut at the time of planting.

5.4 Method of Sowing

There are two methods adopted in the sowing of seednuts. They are the vertical method and the horizontal way of putting the nut in the trenches taken at the time of sowing. The seednuts may be kept in trenches of 20 cm depth and 40 cm apart with a distance of 30 cm from nut to nut. Even though a higher germination is obtained in the horizontal sowing, no appreciable differences could be noticed in the performance of the trees grown from horizontally sown seednuts. When seedlings are intended to be transported to long distances, vertically planted seedlings are easier to handle and can be compactly packed without any damage to the collar region of the seedling. In the horizontal planting, the nuts may be sown with the widest of the ridge facing upwards and, in the vertical method, the stalk end of the nuts in the upward direction. In both the cases, the depth of planting the seednut may be adjusted according to the size of the nut so that the husk is just visible at the soil surface.

6. RAISING SEEDLINGS IN POLYBAGS

In order to reduce the transplanting shock it is preferable to use polybag raised seedlings. Here the advantage is that none of the roots are damaged at the time of planting the seedling in the main field. Normally, when the seedlings are pulled from the nursery, all the roots outside the husk are damaged and they are to be cut at the time of planting. Moreover, the maintenance of the polybag seedling are much easier than the nursery beds. The disadvantages of polybag seedlings are that it will be very costly to transport the seedling and the extra cost involved in the purchase of 500 gauge polybags of 60 x 40 cm size required for this purpose.

7. SEEDLING SELECTION

Selection of seedling is of utmost importance. The parent palms, which are being established in the various seed gardens in the country, should be capable of giving higher yield. Coconut palm being heterozygous, all the seedlings raised from a single mother tree may not be alike even in its phenotypic characters. Hence, strictly selection criteria are to be adopted to select the best seedlings. Some of the important characters used in this selection are early germination of nut, more number of levels, early splitting of the leaf into leaflets and the greater girth at collar region of the seedling. A selected one year old seedling should have minimum 6 leaves, 10-12 cm girth at the collar and the splitting of the leaf should have started at the 8th leaf.

8. PRODUCTION OF HYBRID COCONUTS

Even though the first coconut hybrid was produced in India in the early thirties it had made no impact on the production even today. The first coconut hybrid was a



Fig. 1 : General view of coconut seed garden.

combination of West Coast Tall with Chowghat Green Dwarf popularly known as T X D hybrid. It was mainly due to the non availability of enough hybrid seedlings for distribution among the farmers, it could not make any impact even though the productivity of these hybrids were far superior to the tall. In earlier years the hybrids were produced by hand pollination. Since every female flower has to be pollinated by hand it was laborious and time consuming method especially when large scale production was needed. An efficient and easy method for the large scale production of hybrid was developed during 1983. (Pillai and Rao 1988). Using this method, it is now possible to produce lakhs of seed nuts depending upon the availability of mother palms. The only constraint now facing the production is the lack of sufficient female palms for the production of hybrids. The process of hybrid production involves a few steps, viz., emasculation, pollen collection and processing, pollination, collection of seednuts, storage and sowing at the appropriate time.

8.1 Emasculation

Taking advantage of the two distinct phases in its floral biology, the removal of the male flowers are done prior to the opening of the female flowers. This process of the removal of the male flower is known as emasculation. A coconut inflorescence has hundreds of male flowers and few female flowers. All the male flowers are removed to avoid any self pollination by cutting the spikes (the branches in the inflorescence which bears the male and female flowers) about 4 to 5 cm away from the last female flower. The remaining flowers are removed by hand (Fig. 2 & 3).

8.2 Pollen Collection and Processing

In order to pollinate the female flowers in the selected mother palm, pollen has to be collected from mature male flowers from the selected male parent. The male flowers on the top and middle portion of the spike produces more fertile pollen. Maturity of the

male flower can be judged by observing the tip of the stamen. The mature stamen with plenty of pollen will have a bluish green tinge at its tip. The male flowers thus collected are processed as follows:

- a) place the male flowers between folds of thick papers and gently crush them with the help of a rolling pin (crushing is only to crack the buds and not to damage the anthers).
- b) Keep the crushed male flowers in an oven kept at 40°C for 24 hours.
- c) Using a 0.2 mm mesh sieve, separate the pollen from the debris.
- d) Test the germination of the pollen on a sugar, agar and gelatin medium (8 : 2 : 2 sucrose : gelatin : agar). Only pollen with atleast 50 per cent germination should be used for pollination.
- e) Collect pollen in glass vials and store in desiccator over fused calcium chloride. Pollen so stored can be used for 10 to 15 days.
- f) If longer storage is required, seal the glass vials and store them in deep freezer (-20°C). This pollen can be used for 3 to 5 months.
- g) Dilute the pollen with neutral talc powder in 1 : 9 proportion before use. If the pollen stored in deep freezer is to be used first allow the pollen to come to room temperature before diluting.

If the pollen drying equipment 'Fluid Bed Drier' is available, the pollen can be collected within four hours, and used on the same day. The instrument is useful in processing coconut pollen by exposing fresh male flowers to hot air. The air temperature and the blower speed can be controlled, at 40°C and a blower speed of 5 to 6 the male flowers can be dried within four hours, This is especially useful in seed gardens where large quantity of pollen is required every day. The pollen processing steps are the same except that at step 2, the crushed flowers are fed to the fluid bed drier. It is preferable to use freshly prepared pollen for pollination. This will ensure good setting. Only when there is paucity of pollen, storage of pollen is recommended. When the pollen is stored in desiccator ensure to check the calcium chloride for its dryness and the lid to be sealed with grease properly.

8.3 Pollination

Unlike emasculation and pollen processing, the pollination technique to be used in a seed garden depends upon the type of plantation. If the female parents are scattered and are inter-planted with different type of cultivars, 'controlled hand pollination' is to be adopted. This method involves bagging of emasculated inflorescences for the entire period of female phase and pollinating with desired pollen (Fig. 4 & 5). The procedure is the same for the production of both T × D and D × T hybrids.



Fig. 2 : Hand emasculating of male flowers.

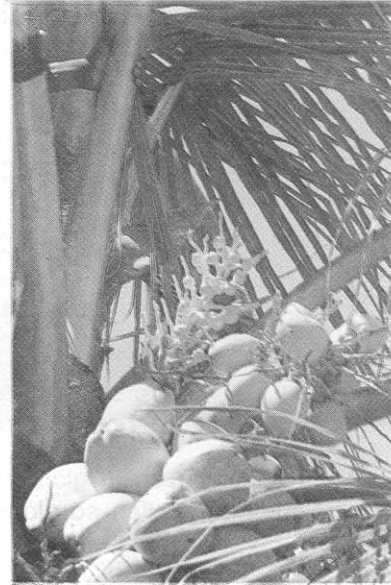


Fig. 3 : Emasculating of male spikes by cutting the spikes.

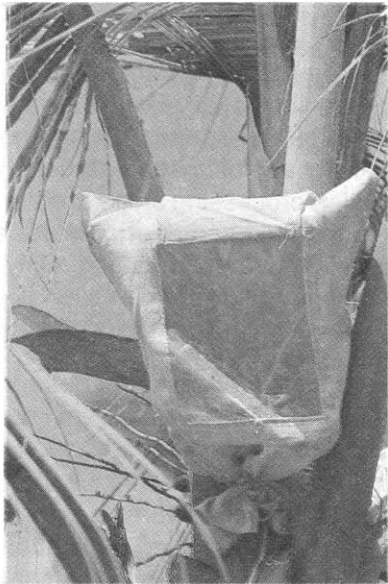


Fig. 4 : Covering the female flower after emasculating with Drill cloth bag.



Fig. 5 : Dusting pollen using the device.

Plantations of pure blocks of tall and dwarf are suitable for hybrid production on commercial scale. When both tall and dwarf are inter-planted, only a single combination can be produced without bagging the inflorescence. To increase the setting and recovery of hybrids, it is advisable to resort to, assisted pollination. In plantations of pure blocks of dwarf or tall, the flexibility is possible for the production of different hybrids. Depending upon the need, changing the pollen, any desired hybrid can be produced. Assisted pollination is mandatory in the pure block of dwarf for hybrid production while in gardens where inter-planting of dwarf and tall are done, it is optional.

For effective and speedy pollination, a simple device has been developed. It consists of a polythene bottle, a rubber tube and a bamboo pole. The squeeze bottle is tied at the end of the pole. This can be aluminium rod also. The pole must be around two to three metres. A rubber tube with a rubber bulb is connected to one end and the other end is fixed below the neck of the bottle so that when the bulb is pressed, air gets into the bottle. The pollen talc mixture is taken in this bottle. When air gets in, because of pressure developed inside, clouds of pollen talc mixture escapes through the nozzle of the bottle. When receptive female flowers are present on the coconut inflorescence, the nozzle of the applicator is directed near to the receptive female flowers and the bulb pressed. The pollen talc mixture released will cover the inflorescence and effect the pollination. The pollination has to be repeated on the third and fifth day so that all the female flowers are pollinated. The receptivity of the female flower is indicated by the presence of nectar at three places below the stigmatic end of the female flower and also by the splitting of the stigma to three lobes. When the stigma turns brown or black the female flower is no more receptive. The reach of the pollen applicator at present is about five metres. All the palms which are about five metres can be pollinated from ground. The squeeze bottle without the rubber tube can be used for pollinating taller palms by climbing to the crown of the palm. The setting percentage on assisted pollination was found to be higher than the natural setting (Pillai, 1990).

The hybrid nuts are harvested after they are fully mature. Normally, 12 months are required for maturity in tall palms while in dwarf, 11 to 11-1/2 months are only required. The harvested nuts may be stored properly and sorted and sown at the onset of monsoon. The seedlings raised from these nuts are F_1 generation of the hybrid.

In order to increase the production, it is necessary to plant good planting material. This can be hybrids or genetically superior tall. But strict selection criteria has to be adopted so that only genetically superior materials alone goes to the field. Since the crop is committed to the land for over a generation, any mistake made in the selection of planting material is bound to create problems in later years. Hence, careful planning the execution in the early years is absolutely essential.

Since the only way now available for propagation of this crop is through seed selection, the steps at various levels discussed assumed more importance. Until such time when micropropagation through cell culture becomes a reality, the selection criteria has to be strictly followed and more and more productive lines evolved.

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