



## QUALITY PLATING MATERIAL PRODUCTION

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Cocoa can be multiplied both by seeds and vegetative means which offers wide scope for multiplication of planting materials in multitudes. The demand for cocoa in Indian chocolate industry is portrayed as 60,000 MT for the year 2025. About 2,20,000 ha of area to be brought under cocoa to meet out this demand for which 150.7 million seedlings are required. It necessitated improved varieties, mother trees, seed gardens/ clonal orchards, scion banks, scientific production and management strategies and incessant supply of planting materials. Health and quality of the seedlings in the nursery will decide the performance of this perennial crop in the plantation and so the knowledge on basic and advanced nursery techniques is very important.

### a) Seed propagation

#### 1) Selection of mother trees and seed pods

To identify suitable mother trees from larger populations of cocoa especially from native cultivars, local land races and adaptive types in the region, selection criteria are being followed. Progressive farmers can follow these criteria for their own selection, planting and propagation of promising types.

#### 2) Seed gardens or clonal orchards

Presence of self incompatibility is observed in many cocoa populations. It is the failure of fruit setting with pollen from the same plant (self-incompatibility) or with pollen from other plants (cross-incompatibility). Among the populations, self-incompatible but cross-compatible genotypes are available which are widely used for hybrid production. The purpose of seed garden or clonal orchard is to produce seeds of known parentage and proven performance in terms of high yield. Based on earlier progeny trials, best combining parents are selected, multiplied as clones and established as seed gardens or clonal orchards (Fig.1). These well designed gardens will produce hybrid pods through natural cross pollination. If the orchards are assembled with two self-incompatible but cross-compatible parents they are called as bi-clonal orchards and if planted with multiple clones called as poly-clonal orchards. It is important to establish such gardens in research institutes and regional nurseries to meet out the huge demand of seedlings and it should be at an isolation distance of 200 – 400 m to avoid unwanted crosses. Six bi-clonal and one poly-clonal orchards with 1500 trees were established during 1987 and maintained at CPCRI, Research Centre, Kidu, Karnataka for supply of seed pods.

Mother trees	:	Forastero and Trinitario type of cocoa with green or red pods, free from major pests and diseases
Bearing	:	80-100 pods/ tree/ year after twelve years of age
Pod type	:	Smooth surfaced with shallow furrows without prominent constriction at the neck
Pod size	:	Medium to large pods of not less than 350 g weight with 120 g wet beans/ pod
Pod value	:	No. of pods required to produce 1 kg beans to be not >12
Husk thickness	:	1 cm
No. of beans	:	>35/ pod (bold beans from middle of pods)
Bean weight	:	Wet: 3 g, Dry: 1 g and above

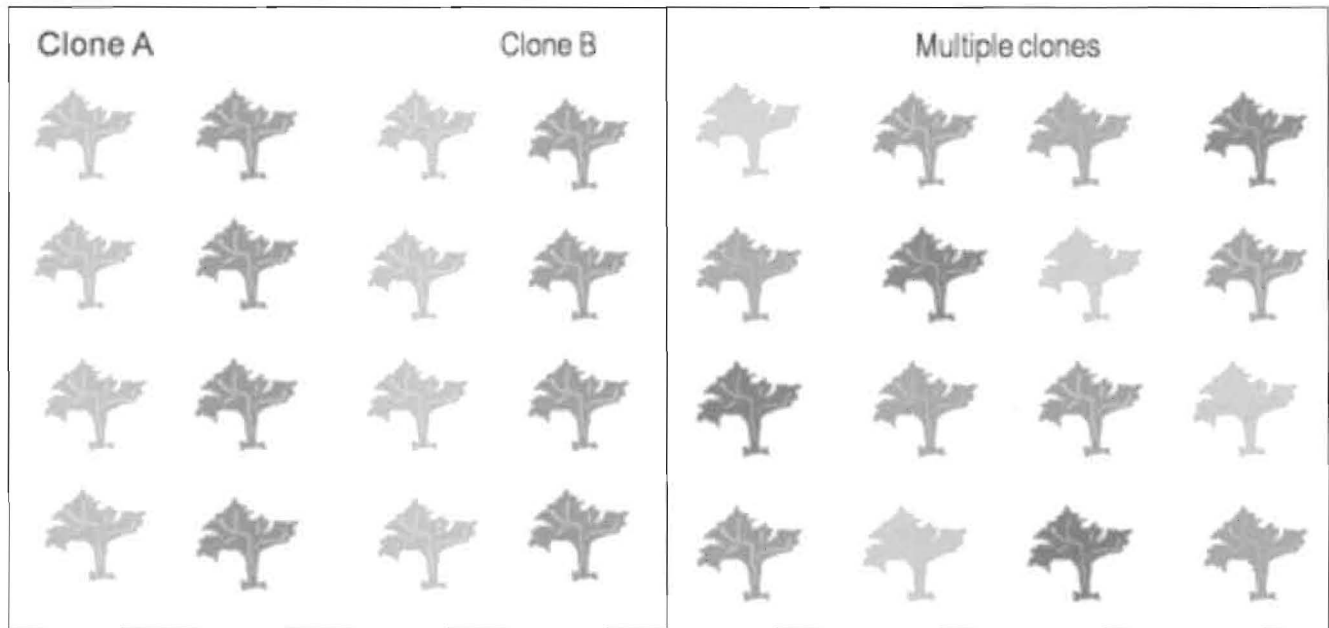


Fig.1. Establishment of clonal seed garden

### 3) Seed pod harvest and sorting

- Ten to twelve year old mother trees are used for seed pod collection if it is of seedling origin and five to six years old in case of clonal trees.
- Cocoa pods take 150-170 days to attain harvest stage after pollination. Correct stage of maturity is assessed from visible change of colour of green pods to yellow and red pods to orange. Immature pods will give poorer seedlings with leaf abnormalities and over ripe pods tend to have viviparous germination.
- Harvesting of seed pods is done with a sharp knife without damaging the flower cushions or the bark as flowering and fruiting in cocoa is cauliflorous *i.e.* truncate bearing. CPCRI developed a cocoa harvester with light weighted telescopic pipe and blades sharpened at both sides.
- Well matured seed pods (Fig.2) are broken either by hitting against a hard surface or with a wooden hammer. Gentle cut with knife may be practiced with due care

without damaging the seeds. Seeds are to be extracted without placenta.

- If pods are harvested at third- fourth maturity they can be kept for four days in the nursery in shade and used for long distance transportation.



Fig.2. Seed pod

### 4) Seed standards, viability and seed treatment

- Seeds/ beans in cocoa are recalcitrant without dormancy period and so beans once extracted from pods are to be sown immediately.
- Bold and big beans extracted from middle portion of the pods will give 90-95% germination.



- In the ripe pod, seed is surrounded by a mucilaginous pulp which can be removed by gentle rubbing of seeds with sand or saw dust to speed up the germination.
- Germinability of freshly extracted seeds can be extended for four to six weeks by storing in moist charcoal and packed in poly bag, which favours long distance transport and in germplasm exchange programs. In few countries, the seeds are mixed with sawdust, testa is removed, peeled seeds are then treated with a fungicide either by washing in a fungicidal solution or by dusting and packed in polythene bags. It is observed that seed stored by this method preserve its viability without germinating for three to four weeks.
- Shade net (50-75%) covering either green or black nets with permanent pillars in an area of 2 acres will hold 50,000 bagged seedlings. Polybags are to be arranged in neat rows leaving walking path for monitoring and better management.
- Cocoa is sensitive to water stress and so regular watering is required. Misting is good in the initial days of germination followed by hose irrigation.
- Drainage in the nursery is important during monsoon season.
- Soil less culture also tried with vermicompost, coir and cocoa shell composts which showed positive impact on germination and growth of seedlings.

#### 5. Polybag nursery

- To get better root and shoot growth, to make the planting and transportation easy sowing seeds in polythene bags is being followed.
- Black polybags of 6"x 9" size with 250 gauge thickness with drain holes is used.
- Potting mixture for cocoa is 2:1:1 Soil: Sand: FYM. Organic manures like coir compost, vermicompost, neem cake and bean husk/shell composts can also be used in place of Farm Yard Manure.
- Soil solarization by sun drying and covering of potting mixture with black polythene sheet during March-April will enhance seedling vigour and health (Elain Apshara, 2011).
- Polythene mulching in nursery floor will inhibit the weed growth.
- Biopriming of potting mixture with 'Cocoa Probio' formulation developed by CPCRI with *Pseudomonas* microbial cultures will enhance the growth and health of seedlings.

#### 6. Sowing and germination

- Main harvest season in the traditional zones starts in April- May months and sowing to be completed before onset of monsoon by May 15<sup>th</sup>. If delayed continuous showers will inhibit germination and invite fungal infections (Elain Apshara and Venkatesh Hubballi, 2012).
- Sowing is to be done by keeping seeds horizontally and just covering with sand. Shallow sowing is preferable.
- Seeds start germination in about a week and will continue for another one week. Epicotyl type germination is observed in cocoa, where cotyledons are taken above ground in the process and is called 'soldier phase'.
- May sown seedlings (Fig.3) will be readily available for planting during September-October, the post monsoon season in the high rainfall zones like Kerala and Karnataka.

- Compact blocks on varieties raised with clonal plants showed second season of bearing during post monsoon season which is good for nurseries which are in operation throughout the year. It favours planting during June- July with onset of monsoon in low rainfall areas or the non-traditional zones.



Fig.3. Quality seedlings

#### **b).Vegetative propagation**

Grafting and budding are being followed in multiplication of cocoa. Cocoa is a cross pollinated crop showing wide genetic variability. To maintain true to types of genotypes, to get early yield, to maintain optimal canopy, asexual or vegetative or clonal propagation is followed. It also ensures multiplication of identified high yielding varieties and elite clones in large quantities. Soft wood grafting method is standardized in cocoa at CPCRI with 85% success rate. For the grafting technique to be successful stock and scion compatibility is very important, which exists in cocoa.

##### **1. Root stock and scion selection**

- Three to four months old seedlings raised in polybags are used as root stocks for grafting.
- Scion sticks of 12- 15 cm length with 2- 3 buds are collected from desirable high yielders.
- Root stock stem and scion stick are to be same thickness and physiological age for successful graft union.
- Scion sticks of chupons (orthotropic shoots) will give seedling like architecture, whereas

bud sticks of fan branches (plageotropic shoots) will give bushy appearance. Since the availability of fan shoots are more it is widely used in commercial nurseries and it is compulsory to practice formation and structural pruning in the second year of planting itself to maintain optimal canopy and exploit its true potential in clonal plants.

##### **2. Grafting technique**

- Grafting is done by giving a horizontal cut in the upper portion of the root stock with a grafting knife.
- Making a vertical slit of 2 to 3 cm down (cleft) on the decapitated root stock.
- Giving a 'V' shaped slanting cut of 2 to 3 cm length (wedge) to the defoliated scion stick.
- Insertion of the scion into the stock (wedge into the cleft).
- Tying tightly with a polythene strip or tape of 1.5 cm width over the joint.
- Covering with polythene pouch so that the graft joint and scion stick won't dry up and be removed after 15-20 days.
- Perfect graft joint will occur in one month, polythene strip tied over graft joint will be removed after two months. Successful graft will be ready in 5 months for field planting (Fig.4).

A skilled person can make 300 grafts per day. The emerging shoots from the rootstocks to be removed regularly. October to December season is best for grafting and all other seasons are suitable with sufficient irrigation. Grafting pest and disease resistant clones on susceptible rootstock is an added advantage of this technique and old, unproductive plants can be rejuvenated through this technique by top working. Conservation of multiple varieties on a single tree is also possible.



Fig.4. Grafts

### Transplanting

Only vigorous seedlings are to be used for transplanting based on height and stem girth. Both seedling and graft standards are developed by CPCRI (Elain Apshara, 2010). While planting poly bag seedlings, the poly covers are to be removed and graft joint should be above the soil. The planting material may be of 4-6 month old seedling or grafted or budded plant. It is advised to plant seedlings and clones of multiple genotypes to overcome the incompatibility problem in cocoa.

### Strategy for diseased tracts

Seed pods free of *Phytophthora*, thrips, mealy bug and tea mosquito bug attacks are only to be harvested. Pods half eaten or damaged by rats and squirrels can be discarded. Nursery shouldn't be raised in areas susceptible to vascular streak die back (VSD). Poly green house can be utilized for screening, protection and hardening of seedlings. Preventive sprays to be taken up during monsoon season. *Trichoderma* enriched vermicompost as soil less media found to be effective in avoiding infection by soil borne pathogens in the high rainfall zone.

### Selection of seed centres

CPCRI nurseries are recognized by National Horticulture Board (NHB) with four star grading and accredited with Directorate of Cashewnut and Cocoa Development (DCCD), Cochin. It is

advisable to procure planting materials from research institutes, recognized nurseries and regional nurseries. CPCRI supplied parental material to seventeen regional nurseries established in five states with funding from DCCD. These are in operation in Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Goa for unhindered supply of planting material in the region. Apart from that parental clones and hybrids are supplied to AICRP-Palms centres to meet out the location specific demands.

### Cost of planting materials at CPCRI

Seed pod- Rs.25/-, Seedling- Rs. 10/-, Graft- Rs. 30/-

Seed centres of CPCRI: Regional Station, Vittal and Research Centre, Kidu

- It is important to procure planting materials from research institutes, regional- clonal gardens and recognized nurseries.
- Calendar of operations in the nursery should be followed strictly to improve and maintain the growth and health of seedlings.
- Identifying root stock for specific purpose, soil less culture and tissue culture will further enhance the advancement in nursery techniques.

### References

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