

# **COCOA PLANTING MATERIAL PRODUCTION**

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**And**

**DIRECTORATE OF CASHEWNUT AND COCOA DEVELOPMENT**

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## INTRODUCTION

Cocoa, the chocolate tree, is an important plantation crop grown as a mixed crop in arecanut, coconut, oil palm gardens and partially cleared forests. Commercial cultivation of Cocoa in India was started during 1960's and its mainly grown in Kerala, Karnataka, Andhra and Tamil Nadu states occupying an area of 46,318 ha with a production of 12,954 MT as per 2010 data. The demand for cocoa beans in Indian chocolate industry and confectionaries is portrayed as 30,000 MT for the year 2015 by the Directorate of Cashewnut and Cocoa Development (DCCD), Cochin, for which, around 75.35 million seedlings are required to bring 1,10,000 Ha under cocoa cultivation. With the sole aim of encouraging this remunerative crop, intensive area expansion programmes in new areas which are conducive for cocoa are being taken up by DCCD, Central Plantation Crops Research Institute (CPCRI) and State Departments through National Horticulture Mission (NHM). The foremost necessity to get sustainable and profitable yield is the supply of quality planting materials. Several propagation methods of cocoa were standardized and followed by research institutes spread over different countries. Cocoa can be multiplied both by seeds and vegetative means. The production and management of seedlings in the nursery decide the performance of cocoa in the field and ultimately the end product. This manual envisages the scientific nursery techniques to be followed for cocoa planting material production.

### Cocoa varieties

At CPCRI Regional Station, Vittal cocoa research started with germplasm introduction, conservation, characterization and evaluation strategies. Systematic breeding methods followed on collected germplasm for their adaptability, bearing potential and genetic behavior resulted in identification of clones with desirable traits. With specific characteristics like high yield, quality beans, black pod disease resistance and drought tolerance certain parents were selected for hybridization and clonal trials, which further resulted in production of high yielding varieties. Four hybrids and one clone were released. Along with these developed varieties, few clones are also being multiplied and supplied to farmers.

#### Selected high yielding clones/ parents

S.No.	Clone	Genotype	Bean wt. (g)	SI/SC
1	VTLC-1	Jerangau Red Axil	1.17	SI
2	VTLC-5	Landas-364	1.34	SI
3	VTLC-7	Landas-357	1.06	SC
4	VTLC-8	Amelonado x PA-7	1.06	SI
5	VTLC-9	Amelonado x NA-32	1.09	SI
6	VTLC-11	PA-7 x NA-32	1.20	SI
7	VTLC-30	T-86/2	1.08	SI
SC= Self Compatible			SI= Self Incompatible	

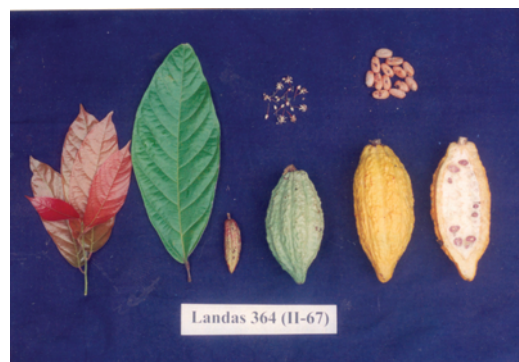
### VTLC-1 (I-14)



**VTLC-1 (EC 631531)**

Origin: Malaysia
Self Incompatible & Cross Compatible
Pods/tree/year: 56.3
Beans/pod: 45
Dry bean yield: 2.51 kg
Single dry bean weight: 1.17 g
Shelling: 10.5%      Fat content: 50.3%
Special feature: Heavy bearer, parental line, have red axil marker

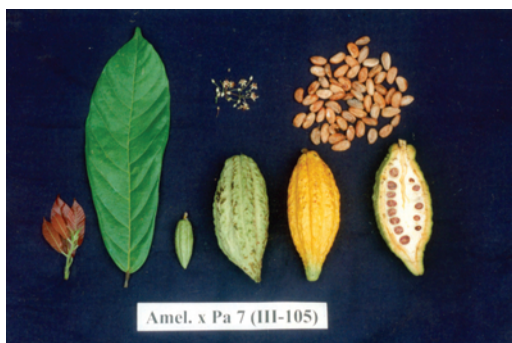
### VTLC-5 (II-67)



**VTLC-5 (EC 631534)**

Origin: Malaysia
Self Incompatible & Cross Compatible
Pods/tree/year: 50.7
Beans/pod: 40
Dry bean yield: 2.51 kg
Single dry bean weight: 1.10 g
Shelling: 13%      Fat content: 52.1%
Special feature: Pollen parent, high yielder, moderate resistant to pod rot

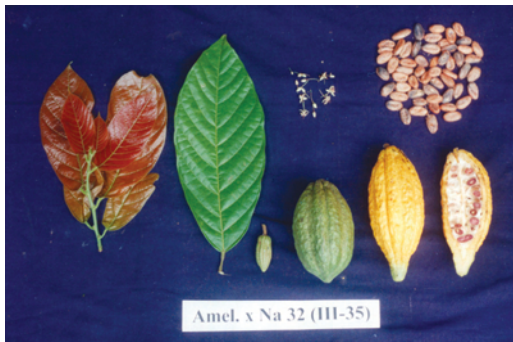
### VTLC-8 (III-105)



**VTLC-8 (EC 631537)**

Origin: Malaysia
Self Incompatible & Cross Compatible
Pods/tree/year: 55.5
Beans/pod: 42
Dry bean yield: 2.00 kg
Single dry bean wt.: 1.06 g
Shelling: 16%      Fat content: 53%
Special feature: Heavy bearer, parental line for hybridization

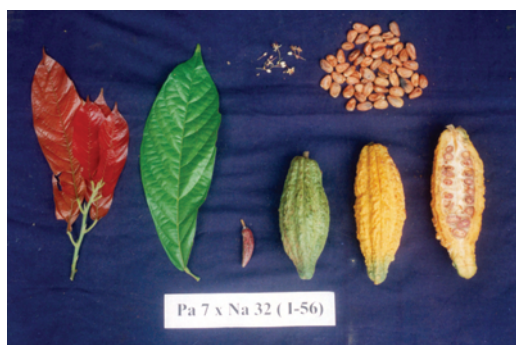
### VTLC-9 (III-35)



**VTLC-9 (EC 631538)**

Origin: Malaysia
Self Incompatible & Cross Compatible
Pods/tree/year: 65.6
Beans/pod: 42
Dry bean yield: 3.00 kg
Single dry bean weight: 1.09 g
Shelling: 16%      Fat content: 55%
Special feature: High yielder, parental line in hybridization

### VTLC-11 (I-56)



**VTLC-11 (EC 631540)**

Origin: Malaysia
Self Incompatible
Pods/tree/year: 60.9
Beans/pod: 42
Dry bean yield: 2.00 kg
Single dry bean weight: 1.20 g
Shelling: 14%      Fat content: 52.2%
Special feature: Potential high yielder, parental line, bigger bold beans

### VTLC-30 (NC-42/94)



**VTLC-30 (EC 631556)**

Origin: Nigeria
Self Incompatible & Cross Compatible
Pods/tree/year: 43.2
Beans/pod: 40
Dry bean yield: 1.54 kg
Single dry bean weight: 1.08 g
Shelling: 15.5%      Fat content: 46.5%
Special feature: Potential high yielder, parental line, bigger bold beans



**VTLCH 1**  
**Vittal Cocoa Hybrid 1**



- Parents: I-56 x II-67 (Malaysia)
- Vigorous, early, heavy bearer
- Suitable for areca & coconut gardens of Karnataka, Kerala
- Green to yellow pods
- No. of pods/tree/year: 50
- Pod weight: 350 g
- No. of beans: 42
- Dry bean yield/tree/year: 1.48 kg
- Yield/Ha: 1014 kg
- Single dry bean weight: 1.00 g
- Shelling: 13%
- Fat content: 53.6%

**VTLCH 2**  
**Vittal Cocoa Hybrid 2**



- Parents: ICS-6 x SCA-6 (Malaysia)
- Early, heavy bearer, medium canopy, black pod disease tolerant
- Suitable for areca & coconut gardens of Karnataka, Kerala
- Green to yellow pods
- No. of pods/tree/year: 70
- Pod weight: 350 g
- No. of beans: 40
- Dry bean yield/tree/year: 1.15 kg
- Yield/Ha: 800 kg
- Single dry bean weight: 1.15 g
- Shelling: 11%
- Fat content: 54%

**VTLCH 3**  
**Vittal Cocoa Hybrid 3**



- Parents: II-67 x NC-29/66 (Malaysia & Nigeria)
- Early, heavy bearer, suitable for water limited conditions
- Suitable for rainfed & irrigated areca and coconut gardens of Karnataka, Kerala, Tamil Nadu, Andhra, Maharashtra & Goa
- Green to yellow pods
- No. of pods/tree/year: 45
- Pod weight: 430 g
- No. of beans: 43
- Dry bean yield/tree/year: 1.45 kg
- Yield/Ha: 993 kg
- Single dry bean weight: 1.07 g
- Shelling: 13%
- Fat content: 52%
- Stomatal resistance (s/cm)- 2.42

**VTLCH 4**  
**Vittal Cocoa Hybrid 4**



- Parents: II-67 x NC-42/94 (Malaysia & Nigeria)
- Early, heavy bearer, suitable for water limited conditions
- Suitable for rainfed & irrigated areca and coconut gardens of Karnataka, Kerala, Tamil Nadu, Andhra, Maharashtra & Goa
- Red to orange pods
- No. of pods/tree/year: 40
- Pod weight: 425 g
- No. of beans: 43
- Dry bean yield/tree/year: 1.25 kg
- Yield/Ha: 856 kg
- Single dry bean weight: 1.01 g
- Shelling: 12%
- Fat content: 53%
- Stomatal resistance (s/cm)- 2.41



## **VTLCC 1**

### **Vittal Cocoa Clone 1**



- Nigerian selection
- Early, heavy bearer, both self and cross compatible
- Suitable for areca gardens of Karnataka & coconut gardens of Kerala, Tamil Nadu & Andhra
- Green to yellow pods
- No. of pods/tree/year: 75
- Pod weight: 320 g
- No. of beans: 36
- Dry bean yield/tree/year: 1.33 kg
- Yield/Ha: 911 kg
- Single dry bean weight: 1.05 g
- Shelling: 12%
- Fat content: 52.5%

## **ESTABLISHMENT OF SEED GARDENS OR CLONAL ORCHARDS**

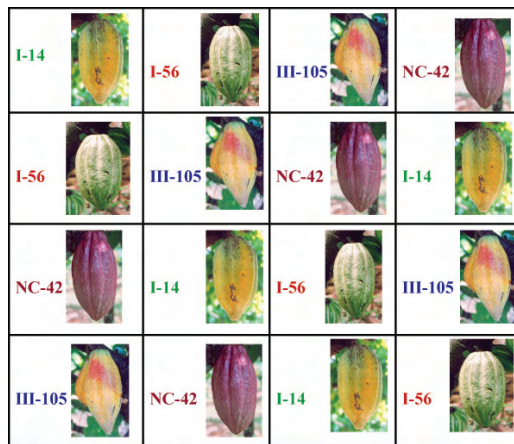
### **Selection of seed gardens or clonal orchards**

The purpose of seed garden or clonal orchard is to produce seeds of known parentage and proven performance in terms of high yield. The compatibility reactions shown by cocoa varieties are different to each other and self incompatibility is predominant among populations. Though seed is the cheapest and most convenient planting material in cocoa, open pollination results in larger variability. Therefore, based on the performance of earlier progeny trials the parents with best combining ability were selected. These identified parents which are self - incompatible but cross-compatible are to be multiplied vegetatively and planted in the properly designed clonal gardens. The self-incompatible female parent resulted in F1 hybrids through natural cross-pollination. The gardens with two and multiple self-incompatible parents are called as bi clonal and poly clonal orchards, respectively. In a poly clonal orchard pollen parent is planted in a ratio of one to five female parent trees and seed is collected only from the self-incompatible parent. It has been estimated that one acre of such seed garden can produce enough seed to plant 400 acres and 1200 acres in the fourth and eleventh year, respectively. Well designed 6 bi clonal and 1 poly clonal seed gardens has been established with 1500 trees and maintained at CPCRI, Research Centre, Kidu exclusively for F1 seed production.





**Bi clonal orchard**



**Poly clonal orchard**

### Selection of seed centres

High yielding clones/ hybrids/ varieties are being multiplied as seedlings and grafts to the tune of 50,000 each annually from CPCRI, RS, Vittal with a well furnished nursery which is in operation throughout the year. Annually 10,000 F1 seed pods are also being supplied from compact blocks of elite clones. With DCCD funding 17 regional nurseries have been established in five states viz., Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Goa for multiplication and unhindered supply of quality planting materials. They were supplied with grafts of superior mother trees of selected clones of CPCRI.

#### Supply of cocoa grafts to Regional Nurseries (Year 2002)

State	No.	Grafts supplied
Karnataka	9	11,250
Andhra Pradesh	2	2,500
Tamil Nadu	3	3,750
Maharashtra	2	2,500
Goa	1	1,500
<b>Total</b>	<b>17</b>	<b>21,500</b>

## **ESTABLISHMENT OF NURSERY**

### **Selection of Site**

#### **Soil:**

Cocoa requires well drained as well as moisture retentive soil. It thrives well on wide range of soil types like clayey loams, loams and sandy loams with pH ranging from 4.5-8.0 and optimum being 6.5-7.0.

#### **Climate:**

Cocoa is a crop of humid tropics. It comes up well in altitudes ranging from 300 m to 800 m above mean sea level. It requires well distributed rainfall with an annual precipitation of 1500-2000 mm. Dry seasons of more than 3-4 months should be supplemented with irrigation. It grows within a temperature range of 18-32°C and optimum temperature is around 25°C with high relative humidity. Cocoa, whose natural environment is the lower storey of the forest, requires 50% shade when young.

#### **Water Source:**

A perennial source of water is required for maintenance of mother trees of cocoa and seedlings. Further, the nursery has to be irrigated regularly through sprinkler/ microjet irrigation during early stages of germination and growth, whereas hose method is the best during later stages. Young seedlings needs lots of water and should be irrigated gently every day in summer and once in alternate days in other seasons. Upto 2 months it can be kept in glass/green house with fine misting and is preferable during rainy season. As cocoa is very sensitive to drought daily watering should be done during summer for which 2 persons per day is required if hose irrigated.

#### **Nursery Structures:**

Cocoa nursery is to be located in a shaded area. The initial shade is usually quite heavy, somewhat in excess of 50 percent but decreases as the seedlings grow. Shade net (75%) nursery with permanent pillars in an area of 2 acres will hold 50,000 bagged seedlings.

#### **Skilled Manpower:**

Skilled person is required for selection and collection of scion sticks and grafting/budding, who can make an average of 300 grafts per day. Nursery assistant/skilled supporting staff is needed for removal of polythene pouch after graft set, polythene sheet tied over graft joint at correct time, maintenance of the nursery and for identifying and lifting good quality seedlings.

## Management:

A record should be maintained indicating the name of variety sown, date of sowing, number of seeds sown, seedbed number and date of seed pod harvest. A signboard should be placed preferably in front of each bed indicating the name of variety sown along with the date of sowing. Seeds of clones begin germination within 10-15 days after sowing and seeds of hybrids germinate in 7-10 days after sowing. Seeds that do not germinate within 15 days after sowing as well as those with dead sprouts can be removed from the nursery. Proper drainage should be provided during rainy season to prevent stagnation of water and rotting of seedlings. Chemical fertilizers like urea or organics like composts may be added to enhance vigorous growth. For varietal evaluation or seedlings production application of chemical fertilizers may be avoided as it can mask the true genetic potential of seedlings, making the selection of genetically superior seedlings difficult. The nursery should be kept free of weeds to allow good growth of the seedlings.

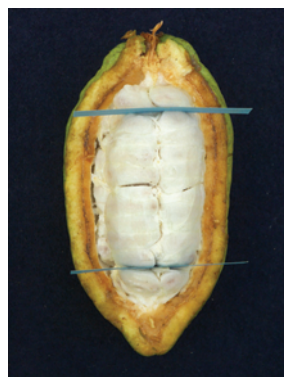
## Selection of mother trees and seed pods

If seed gardens or clonal orchards are not available selection criteria for mother trees should be strictly followed.

- Trees of Forastero and Trinitario types with green pods which turn to yellow when ripe may be selected.
- Trees bearing lot of fruits with 70-100 pods/tree/year, having medium to large pods of not less than 350 g weight, smooth or shallow furrows on the surface without prominent constriction at the neck can be selected.
- Husk thickness of pods to be more than 1 cm.
- Pod value (number of pods required to produce 1 kg beans) to be not more than 12.
- Number of beans per pod should be more than 35.
- The best seeds for sowing are those from the middle of the pod.
- Bean dry weight should be more than 1 gram.



**Mother tree Forastero**



**Extract middle beans**

## METHOD OF HAND POLLINATION

For production of hybrids with specific objectives and to confirm the compatibility reaction hand pollination is being practiced. Hand pollination coupled with well designed seed gardens will encourage more seed production.

- In artificial pollination, a flower bud which will open the following day, recognized by its whitish colour and swollen appearance, is selected.
- The bud is covered with hood of plastic tube/hose pipe piece 5 cm x 1.5-2 cm, which is sealed to the bark using materials like plasticine/glaze putty.
- The tube is covered with muslin cloth at the top, kept in place with a rubber band. This ensures circulation of air and exclusion of insects.
- Opened flowers are collected from the desired male parent and stamens are carefully taken out by pushing the corresponding petal.
- One entire anther with a part of the filament is deposited on the stigma.
- The style is surrounded by a ring of staminodes and if these are long, removal of two or three staminodes should be done for easy access to style.
- Emasculation is not necessary due to the presence of self-incompatibility. For selfing, hand pollination is done using stamens from the same flower.
- The pollinated flowers are labeled using tin foil pieces fixed in the cushion using ball pins.
- The hoods are removed 24 hrs after pollination and in three to five days, fertilization is confirmed by the visual swelling of the ovary.
- In order to prevent undue shedding and wilting of fruits from hand pollinations, it is usual to remove all the developing fruits on the tree produced by open pollination.
- Developing pods are covered with wire mesh after six to eight weeks to protect them from mammalian pests.
- Where flowers are plentiful a good operator can do 300 pollinations per day along with marking of pollinated flowers, which will be resulting in 150 pods.
- If unpollinated, the flower abscises within 24 hours and a conspicuous feature of cocoa tree is the heavy loss of flowers at certain time intervals. A full- grown tree may produce 10,000 flowers in a year of which perhaps 50 to 100 will develop as mature fruits. Estimates of the proportion of flowers pollinated range from 1 to 50 per cent according to the season and number of flowers opening at the time.
- Natural pollination to some extent is effected by insects like flying female midges of the genus *Forcipomyia* and by crawling insects such as thrips and aphids.
- The pollen dispersal may be upto 40 metres. Most pollination occurs in the morning and artificial pollination should always be done before midday during fine weather.





**Bud selection**



**Covering with plastic tube**



**Pasted with plasticine**



**Removal of staminodes**



**Pollination**



**Labeling after pollination**



**Fertilized flower**



**Covered hand pollinated pod**

## **Controlled pollination in Cocoa**

### **Seed pod harvest and handling**

- Cocoa pods take 150-170 days from pollination to attain the harvest stage.
- The stage of maturity is visible from the change of colour of green pods to yellow and red pods to orange. They remain without damage upto a maximum of about one month on the tree and so the harvest interval may be of 15 days. Rodents attack will be more if pods are allowed to ripe on the tree.
- Matured pods will be available during May month under Karnataka condition.
- Harvesting of seed pods should be done with a sharp knife without damaging the cushions since cocoa has cauliflorous bearing nature. Never pick the pods by pulling them off.
- Harvested seed pods can be stored in shade upto one week. Viviparous germination is reported in ripe cocoa which may affect the percentage of germination if it stored beyond one week.

### **Seed standards, viability and storage**

- Well matured seed pods will be broken by hitting against a hard surface or with a wooden mallet and extract the seeds without placenta.
- Seeds should be bold, large, weighing around 3 grams when wet and 1 to >1 gram when dry.
- Seeds in cocoa are recalcitrant without dormancy period. Seeds once extracted from pods should be sown immediately as they lose viability quickly.
- Germinability can be extended for some more days by storing freshly extracted seeds in moist charcoal and packed in poly bag for a period of four weeks.
- Seeds mixed with sawdust, testas removed and treated with fungicide either by washing in a solution or by dusting can be stored to preserve its viability for three to four weeks.
- Seeds normally start germination in about a week and will continue for another one week.

### **Seed treatment and sowing**

- When taken from the ripe fruit, the seed is surrounded by a mucilaginous pulp which contains a germination inhibitor.
- Germination can be speeded up by removing this pulp with the testa which is thin and leathery. The testa is usually called the skin or, when dry, the shell. A trained person can peel 200 seeds per hour.

- Rubbing of the beans carefully with dry sand or wood ash to remove the mucilage is practiced in India.
- If sown with mucilage insects will be attracted. Seed dressings with insecticides can be used in very rare occasions with lesser dosage.
- Treating with fungicide Bavistin at rate of 2 g for 1 kg seeds may be practiced in adverse situations.
- Seeds should be kept horizontally or vertically with hilum end down and just covered with sand.
- Pushing of seeds deeply into the potting mixture should be avoided because lack of air may affect seed germination since it is epigeal where cotyledons are taken above ground in the process. This stage of germination is called as soldier phase.
- Healthy seeds from well matured pods usually give a germination of 90 to 95 per cent.
- Cocoa seeds will germinate at any time of the year with adequate irrigation.
- Sowing should be completed before the onset of monsoon otherwise continuous shower affects the germination.
- May sown seedlings will be ready for planting during September-October, the post monsoon season in the high rainfall zones like Kerala and Karnataka.
- Compact blocks on varieties raised with grafted plants showed second season of bearing with extended days of harvest during post monsoon season which will be good for nurseries in operation the whole year.

### **Polybag nursery**

- To get better root and shoot growth, to make the planting and transportation easy sowing seeds in polythene bags can be followed. Polybags are usually cheaper more durable and simpler to store.
- Black polybags of 6"x 9" size and 250 gauge thickness with around 9 drainage holes filled with potting mixture 2:1:1 Soil: Sand: FYM is recommended.
- Soil solarization by sun drying and covering of potting mixture with black polythene sheet during March-April will enhance seedling vigour and health.
- Top soil and sand should be sieved before filling.
- Organic manures like coir compost, vermicompost, neem cake, bean shell also been used in place of Farm Yard Manure.

- Biopriming of potting mixture with *Pseudomonas* microbial cultures KDSF-7 and KDSF-23 will enhance the growth and health of seedlings.
- Big poly bags of 30 cm length and 20 cm width can also be used if the seedlings are to be kept in the nursery for longer periods.
- Poly bags should be arranged in rows of ten leaving 1.5 feet spaced path between the rows for monitoring. Support for the bags is usually provided by strips of bamboo or split areca stem. Shade nets or covering by thatches is needed.



**Soldier phase of germination**



**Stages of seedling**

## **VEGETATIVE PROPAGATION**

Grafting and budding are being followed in multiplication of cocoa. As the seedling progenies showed wider genetic variability, to maintain true to type, asexual or vegetative propagation is followed. It also ensures multiplication of identified high yielding clones in large quantities and also early bearing nature. Soft wood grafting method is standardized in cocoa at CPCRI, Regional Station, Vittal with 85% success rate.

### **Stock and scion selection**

- 3 to 4 months old seedlings raised in polybags can be used as root stocks for grafting.
- Scion stick of 12-15 cm length with 2-3 buds from desirable disease resistant high yielders can be collected.
- Scion sticks of chupons can be taken if seedling like architecture and lesser pruning is preferred. Whereas for early evaluation works and large-scale commercial production fan branches are preferred.
- Root stock stem and scion stick should be of same thickness and physiological age.



## Grafting Technique



1. Give a horizontal cut in the upper portion of the root stock with a grafting knife



3. Give a 'V' shaped slanting cut of 2 to 3 cm length (wedge) to the defoliated scion stick



5. Tie tightly with a polythene strip or tape of 1.5 cm width over the joint



7. Perfect graft joint will occur in one month, remove the polythene sheet after 2 months



2. Make a vertical slit of 2 to 3 cm down (cleft) on the decapitated root stock



4. Insert the scion into the stock (wedge into the cleft)



6. Cover with polythene pouch so that the graft joint and scion stick won't dry up, remove it after 15-20 days



8. Successful graft will be ready in 5 months for field planting

### After care

- The emerging shoots from the rootstocks should be removed.
- October to December season will be the best for grafting and all other seasons are suitable with sufficient irrigation.
- Grafts will start yielding from the second year onwards.
- 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.
- When budded or grafted plants are used select two or more clones for planting, as the use of single clone may not yield due to the existence of self-incompatibility in cocoa.
- Bud wood can be stored by dipping in benzyl chloride followed by washing in water and then sealing the cut ends using molten wax. Wrapping in moist cotton wool or wet tissue paper or blotting paper and packing in boxes by covering with polythene sheets will extend the storage life of the bud wood upto 10 days.

### Selection of seedlings and transplanting

- Only vigorous seedlings are to be used based on height and stem girth.
- When seedlings are grown under heavy shade, hardening for 10 days by exposing to higher sun light may be necessary before transplanting.
- Watering of the nursery beds should be done before lifting seedlings for transplanting to avoid breakage of roots and should be taken along with little earth around the roots.
- If raised in polythene bags, the poly cover should be removed and the seedlings are planted with ball of earth into the pit.
- The seedling/graft/budded plant should be planted in the centre of the pit, not too deep.
- While planting grafts polythene strip tied over graft joint should be removed and the joint should be above the soil.
- The planting material may be of 4-6 month old seedling or grafted or budded plant.
- Avoid planting seedlings with twisted or damaged tap root or pot bound plants.
- For long distance transportation seedlings can be packed with moisture retaining materials like coir compost.

## Strategy for diseased tracts

Seed pods free of *Phytophthora*, thrips, mealy bugs and tea mosquito bugs should be harvested. Pods half eaten or damaged by rats and squirrels can be avoided. Nursery shouldn't be raised in areas susceptible to vascular streak die back (VSD) and collection of clonal materials such as bud or scion sticks from VSD affected trees may be avoided. Poly green house can be utilized for screening, protection and hardening of seedlings.

## Nursery diseases

Seedling dieback/seedling blight caused by *Phytophthora palmivora* Butl. is very common in the cocoa nurseries of Kerala and Karnataka during rainy season. Younger seedlings are more susceptible to the disease and severe infections observed in grafted and budded plants also. It initiates from the collar region, cotyledonary stalk or leaves as dark brown to black discoloration. It spreads to the entire stem causing wilting, defoliation and ultimate death of the seedlings.

Removal and destruction of infected seedlings from the nursery are very important to check the secondary spread of the disease. The disease incidence can be considerably reduced by improving the drainage facilities in the nursery and by providing proper shade. Drenching the seedlings with Bordeaux mixture (1%) just before the onset of monsoon and thereafter at frequent intervals will control seedling dieback.



**Seedling dieback**



**Caterpillar attack**

## Nursery pests

Myllocerus weevils (*Myllocerus viridanus*) skeletonise the foliage and its occurrence will be more during July to September. Spray under surface of the foliage with Fenthion 0.05%.



**Tree from seedling**



**Tree from graft**

### **Cost of production of grafts**

<b>No.</b>	<b>Item</b>	<b>Rate (Rs.)</b>	<b>Quantity</b>	<b>Cost (Rs.)</b>
1	Shade net (75%) (sq.m)	Rs.12.00	3000	36,000
2	Farm Yard Manure (MT)	Rs.1000	50	50,000
3	Polythene bags 6x9" size 250 gauge with 9 punches (kg)	Rs.70	350	24,500
4	Pepsi covers (15 x 6 cm) (kg)	Rs.60	350	21,000
5	Preparation of potting mixture (2:1:1:Soil:Sand:FYM) collection of sand, sieving, mixing, filling, arranging in beds and sowing (bag)			
		Rs.1.25	50,000	62,500
6	Grafting (collection of scion, rearranging grafted seedlings and left over rootstocks) (per graft)			
		Rs.1.10	50,000	55,000
7	Labour charges for watering and maintenance of nursery	Rs.70 2 men/day	1 year	50,000
	Cost of production	I year	Total	2,99,000
	Sale of graft	Rs.12/graft	50,000 nos.	6,00,000
		Cost: Benefit ratio		1:2
		II year onwards (without shadenet cost)		1:2.5



### Cocoa Seedling Standards

No.	Characters	Standards
1	Age of the seedling	5- 6 months
2	Height of seedling	45-50 cm
3	Girth of seedling	3.5- 4 cm
4	No. of leaves	5- 6 pairs
5	Growth	Straight from the middle of the poly bag, without branching or jorquetting
6	Foliage	Green, healthy, without crinkling, nutrient deficiency, middle leaves of 15cm length and 6 cm width
7	Root	Tap root spreading without netting
8	Potting mixture	2: 1: 1 Soil: Sand: FYM in poly bag of 6" x 9" size and 250 gauge thickness
9	Precautions	Free from nursery diseases and pests
Earth in poly bag should be wet, loose, no pot bound condition. No breakage or damage to tap root. Seedlings should not be kept in the nursery over ten months.		

### Cocoa Graft Standards

No.	Characters	Standards
1	Method	Wedge grafting
2	Type of root stock	Bulk Forastero and hybrid seedlings
3	Root stock raising	Poly bag nursery
4	Age of root stock	4- 5 months
5	Root stock size	Height 50 cm, 3.5 cm girth with 7 pairs of leaves
6	Scion size	Thickness same as root stock, soft woods of 12- 15 cm length with 2- 3 buds, defoliated
7	Graft union	20 cm above soil, about 2 cm thickness, should be covered with polythene pouch to avoid drying
8	Grafted plant without jorquetting	Height 60 cm, 7 pairs of healthy leaves, stem straight
9	Root	Tap root with well spread young roots
10	Precautions	Remove the polythene pouch after 15-20 days
<p>Remove polythene stripe after 2 months.</p> <p>Graft joint should be above ground while planting and no breakage.</p> <p>Emerging shoots from root stock should be nipped off.</p> <p>Free from nursery diseases, pests, deficiencies, pot bound condition.</p>		

## Label for sale of planting material

Size: 12 cm x 8 cm

Name of the crop: Cocoa	Botanical Name: <i>Theobroma cacao</i> L.
Variety: VTLCH-1	Source: CPCRI
Propagule: F1 Seedling/Graft	Age of the plant: 5 months old
Height: 60 cm	Girth: 4 cm
No. of leaves: 7 pairs	Stem: Straight without jorquette
Free from: VSD/nutrient deficiency	Quality tested: Good

## Persons to be contacted for planting materials & details

1. Head,  
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2. Director,  
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3. President,  
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4. Manager,  
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Puttur, Karnataka- 574201.

## CALENDAR ON NUSERY OPERATIONS

### JANUARY

Shade net erection



### FEBRUARY

Watering



### MARCH

Soil solarization



### APRIL

Mother tree selection



### MAY

Harvesting seed pods



### JUNE

Sowing





**JULY**  
Drainage



**SEPTEMBER**  
Pest control



**NOVEMBER**  
Weeding



**AUGUST**  
Plant protection



**OCTOBER**  
Grafting



**DECEMBER**  
Pollination

