NURSERY GUIDELINES INDONESIA

FOR THE PRODUCTION OF HIGH-QUALITY PLANTING MATERIALS ON COCOA LIFE COMMUNITY NURSERIES IN INDONESIA

Mondelēz International

COCOA LIFE

SUMMARY OF KEY METRICS FOR A COMMUNITY NURSERY

- Recommended annual minimum output of seedlings: 100,000 plants
- Approximate land area requirements: Total area =~4,000 m2, net nursery area 3,300 m2
- Approximate annual labour requirements: 6900 man days, which is 870 man days

SEEDLING NURSERIES

The main goal of a nursery is the production of high quality and vigorous grafted seedlings free of major pests and diseases. Plants with an insufficient quality are more difficult to establish in the field, they are more affected by the adverse growing conditions, and further fruiting can be affected. A longer period before production means higher cost and poor cash returns.

CONSIDERATIONS BEFORE INSTALLATION OF THE NURSERY

- Identify a flat, well drained and uniform area
- Ideally the area should not be exposed to frequent strong winds or storms
- The nursery should be located at least 100 m away from a commercial cocoa orchard to prevent the infestation with pest and diseases and its vectors
- A continuous water supply is required; plants should be water, depending the environmental conditions. Water should be free of contaminants and salinity
- The site should have access to the main roads, and accessible to the farmers
- 40-30% of shade is required, accomplished with the construction of an artificial ceiling made with bamboo/steel poles and shading nets. Cover the sides with the same material
- It is recommended to construct a shading house of 2 meter tall
- Use of top soil (0.1-0.2 m) as planting substrate is feasible, but the use of professional planting substrate (soilless or a mixture of different organic y/o inorganic elements) from a certified source is recommended.
- The use of top soil or professional planting substrate should be certified by a technical officer or extension agent
- When the wind is strong, installation of windbreaks should be considered
- Irrigation in the nursery should be done with the use of sprinklers
- Use of healthy seed for the rootstocks
- Use recommended clones to the area and keep in consideration the pollen compatibility of the clones
- Distribute auto-incompatible clones with their corresponding pollen donors; if possible distribute inter-compatible clones together. Self-compatible clones can be distributed alone
- Use budwood of recommended clones from certified sources (clonal gardens), to ensure high production and tolerance to pest and diseases

Equipment and inputs required

- Cutlass
- Pick axes
- Shovels
- Plastic and metal containers of several sizes
- Earth chisels
- Hand trowels
- Mixer (concrete) to prepare growing media (200 L)
- Wood/ metal poles
- Shading net
- 7” X 9” Polythene bags
- Pumps and sprinklers
- Wheel barrows
- Picket rammers
- Hand sprayers
- Buckets
- Seeds (pods)
- Budwood (cuttings)
- Fertilizers
- Chemicals to control pest and diseases
- Pod breakers (wooden mallets)
- Grafting tools (knife, scissors, plastic string, and plastic tape)

Basic components of a nursery

- **Fence:** To facilitate security, to isolate the nursery, and restrict the entry of animals that can cause serious damage
- **Windbreak curtains:** Installed when they are needed
- **Office and storage facilities:** It is necessary to have an adequate office and storage for materials and equipment, required for the nursery’s operations
- **Seed cleaning and media preparation:** Adequate facilities should be implemented to prepare and mix the growing media, seed cleaning and conditioning
- **Irrigation system:** If it is possible the irrigation should be made using sprinklers
- **Planting rows:** 8 bags width to allow access for weeding
- **Alleyways between rows:** The separation between the rows must be a minimum of 0.40 m to allow the worker’s transit

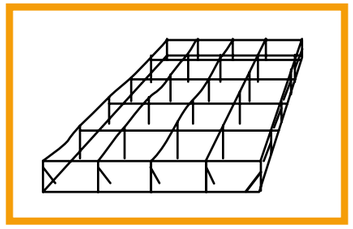
DESCRIPTION OF ACTIVITIES

Cleaning and land levelling (40-50 man days, start construction on December to January)

- Ideally, the nursery should be located 100 meters or more away from existing cocoa trees
- Clean and remove weeds from the nursery site
- Level the land. The top-soil (0.1-0.2 m) could be collected to prepare the growing media
- Mark the nursery area, the holes for the poles, the entrance, alleyways, the main and secondary drainage, the planting beds, and the fence line

Shade house construction (30-40 man days)

- Cut the wood/metal poles 2.5 meters long
- Make holes 0.5 m. deep and bury the poles compacting the soil around
- Build the roof with the wood or metal strips
- Cover the roof and the sides of the shade house with a shading net (40 to 30 % of shade)



Nursery layout (15-20 man days)

- Mark a central walkaway of 2.0 m width, and cover it with concrete or gravel
- Mark lateral walkaways between planting beds (0.40 -0.50 m)
- Build the drainage system to reduce water flooding and reduce environmental humidity, to prevent pest and diseases

Substrate preparation, filling and bag arrangement (180 man days, start in February)

- Remove the top soil (0.10 - 0.20 m)
- Clean the top soil through a sieve to remove stones and foreign material
- Mix the top soil with solid fertilizers (i.e. ammonium nitrate, TSP, and potassium nitrate), recommended concentration of major nutrients is 1600, 1400 and 1300 g of NPK per ton of substrate
- It is recommended to use professional media or substrate mixtures (i.e. 20% coconut peat, 20% rice hull, 20% rice husk burnt, 20% soil, 10% sand and 10% manure) from certified sources

- Cut holes at the bottom of the bag (if the bag is not pre-perforated)
- Bags are completely filled and the substrate compacted with a slight pressure with the fingers or tapping the base of the bag against the ground. Leave 2.5 cm free from the top of the bag
- Arrange the filled polythene bags in rows of 8 by 50 bags leaving a path of 0.40-0.50 m between rows

Obtaining seed and planting (220 man days, start planting in March)

- Seed must come from healthy ripe pods supplied from a certified source
- Pods should not be stored for long periods, use seeds within 4 days after pod harvest
- Open the pod, avoid cutting or damaging the seeds, the best method to open the pod is the use of a wooden mallet
- Extract the seeds from the pods and remove flat, damaged, germinated, small or diseased beans
- Remove the mucilage from the seeds, rubbing the seeds with jute bags or saw dust
- Wash seeds and treat them with fungicides to protect from soil-borne diseases (e.g. Benlate, Dithane)
- Seeds can be planted directly after cleaning
- Place one bean with the root tip pointing down into a prepared polythene bag
- Make a small hole about 1 cm deep for this and leave about half of the seed out of the potting media
- Cover the seed with extra soil or media

Nursery management and maintenance (60 man days, from April to July-August)

- Maintain the soil/media moisture by watering once every two days and removing weeds from the bags and pathways between rows
- Each day check the general state of the seedlings
- Control the entry of unauthorized personal to the nursery since they can be a vehicle for pest and diseases
- Prevent entry of animals to the nursery, and in general to the other facilities
- Maintenance of fences and windbreaks
- Keep the nursery free of pests like aphids, and foliar worms
- In the case of agro-chemical use, follow the recommendations for rational use
- Take special care of the irrigation system to avoid excess of moisture and flooding, since it could be favorable for pest development
- Remove stunted, slow growing, or unhealthy plants, and plants showing yellowing
- Keep records of the number of bags filled, seeded bags, germinated, and seedlings removed, and management practices (such as pest control)
- Maintain the nursery surroundings clean and free of weeds

Top grafting of seedlings (300 man days, done in August)

- The seedlings are ready for grafting after 4 months
- The budwood cuttings should come from healthy and mature mother plants, use the recommended clones by ICCRI and other institutions
- The mother trees are trimmed 3-5 months before the extraction of budwood cuttings, the diameter of the cuttings and seedling rootstocks should match
- Prepare the budwood and seedling rootstock following established procedures (training from competent experts is essential)
- The cuttings are 30 cm long, use clean cutters or pruning scissors **(1)**
- Cut ¾ of the area from the leaves, use paraffin to seal the ends of the cutting to prevent water loss **(2)**
- Use soaked paper in water to wrap and pack the cuttings for transportation
- Cut the seedling at 30-50 cm height **(3)**
- Make a longitudinal cut of 4-5 cm long in the center of the seedling **(4)**

- Prepare the scion, cutting a segment of 3-4 budwood from the long budwood cuttings **(5)**
- Make two lateral opposite cuts forming a point in the base of the cutting **(6, 7)**
- Introduce the scion in the open seedling's trunk (rootstock), ensure a good joint of the cut surfaces **(8)**
- Secure the joint of the rootstock and scion with plastic tape **(9)**
- Cover the grafted plant with a loosely fitting transparent plastic bag **(10)**
- Once the grafted scion has produced a further 3-5 leafs remove the bag **(11)**
- Remove the plastic tape from the graft union once a good callus is formed
- Grow the plants for a further 2-3 months before transplanting to the field

SAFETY AND RECOMMENDED PROCEDURES

Seed collection

- Use an automated pod opener or a wooden hammer to avoid cuts and injuries
- Train the worker to avoid postural or overuse injuries, even if workers are not experiencing discomfort
- It is better to work on raised tables rather than on the ground
- Maintain a safe working distance between team members
- Wear appropriate personal protection equipment e.g. gloves, safety glasses, etc.

Bag filling and sowing

- Wear gloves when handling soil and treated seeds, use additional personal protective equipment (PPE) as necessary
- Conduct a visual inspection of the growing media/soil and remove potential risks such as broken glass, wire, etc.
- Use kneeling mats or padding if there is a danger of spike injuries from glass, stones, etc.
- Take regular breaks
- Maintain a safe working space between team members

Nursery building

- Where possible, arrange with contractors to build the shade house, fence, and other construction
- No construction or major repair should be carried out alone
- Team members must only use mechanical equipment, if they have received appropriate training
- Arrange delivery of materials at the time when the material is needed and as near to the construction sites as possible e.g. minimize the need for carrying of materials and equipment in areas not directly involved
- Wear gloves and eye protection whenever working with, or in close proximity to, wire that is coiled or under tension. Gloves should have gauntlets that protect the wrists when barbed wire is manipulated
- Demonstrate correct use of picket rammers, with emphasis on head, eye, and hand safety
- Maintain safe working space between team members, especially when digging postholes or ramming the base of posts
- Keep the working site clear of trip hazards such as posts, wire off cuts, stones, tools, etc.

Working with chemicals

- Read and keep the relevant information about the chemicals used in the operations, read and identify the toxicity and safe handling recommendations
- Check that there are no leaks in containers, and check that the spray equipment is operating correctly
- Wear appropriate PPE as advised on the instructions of safe handling, note that the use of certain PPE may accelerate the onset of heat stress. The general recommended PPE are gloves, googles, long sleeves shirts, long pants, and hats
- Explain and demonstrate how to use, carry and store chemicals correctly
- Maintain safe working distances when spraying to avoid splash or spray drift contamination
- Provide adequate washing facilities as directed by the handling instruction
- Keep storage containers closed when are not in use
- Keep adequate supplies of water close by for diluting spills
- Maintain and keep a "spill kit" close by in case of spills
- Do not lift any heavy weight container without assistance

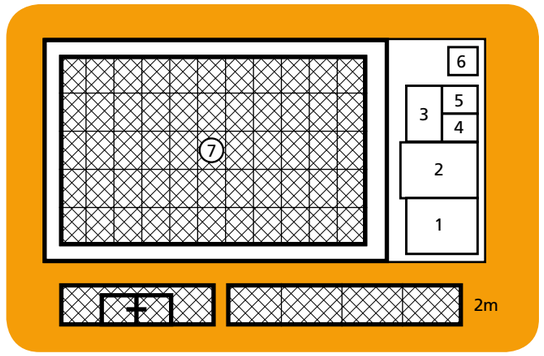
Grafting

- Always practice safe knife handling

Weeding

- Maintain a safe working space between team members
- Use knee pads or kneeling boards if ground is wet or uneven
- Work in pairs

Conceptual layout for a nursery:



1. Office and general storage
2. Media preparation and bag filling area
3. Seed conditioning
4. Equipment storage
5. Chemical storage
6. Well and pump
7. Shadding house (nursery)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