MANUAL ON COCONUT NURSERY ESTABLISHMENT AND MAINTENANCE

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Nursery Establishment and Management

1.0 Introduction

Success of coconut plantation establishment starts with the production of good quality planting materials. Selecting the best planting materials before field planting assures higher productivity. Planting coconut seednuts directly in the field is not recommended and care must be taken in choosing the seedlings to start a plantation since high quality planting materials provide a good head start to sustain the coconut palms productive and economic lifespan of 60 or more years. The rearing of coconut seedlings in a well-maintained nursery facilitates efficient selection of normal uniform seedlings (Santos et al., 1996; Baylon and Rivera, 2016).

The authors of the present publication have observed that most farmers in Caribbean countries do not practise proper nursery establishment and management and this lack of good agricultural practice obviously impacts negatively on the productivity and income generation of their plantations. The present publication is intended to provide information on proper coconut nursery establishment and management using high quality planting materials that have been selected according to guidelines presented in Chapter 1 of the Technical Report “Coconut Production Technology” (Ramkhelawan and Paul, 2016).

1.1 Steps in establishing and managing a coconut nursery

Selection of mother palms for seed nut production

Seed nut harvest, selection and storage

Nursery site selection

Seedbed preparation in pre-nursery

Planting in the pre-nursery seedbed

Selection of seedlings from the pre-nursery for planting in the nursery bed

Planting germinated seednuts in the nursery beds [polybags can be used instead of nursery beds]

Maintenance of pre-nursery seedbeds and nursery beds

Records and signage

Transplanting of seedlings from nursery beds to field
These steps are also illustrated in Plate 1.


1.2 Nursery site selection

The production of coconut seedlings in a well–designed and maintained facility, facilitates efficient selection of uniform, vigorous seedlings (Plate 2). The nursery can be located in the interspaces of the coconut plantation where coconut trees provide shade but if an open space is selected, the area should be provided with shade using 50 - 75% shade cloth as shown in Plate 2 (TNAU, 2012).

Plate 2. Well-designed nursery facility, Central Farm, Belize.
The nursery site should have the following characteristics (Santos et al., 1996; Ghose and Gopalakrishnam, 2013):

- Be open, level, well-drained and not prone to flooding.
- Have a light or loose-textured soil to facilitate nursery operations; therefore, a sandy or sandy loam soil is recommended.
- Have adequate amount of sunlight and a source of water for irrigation in close proximity.
- The site should have agricultural access roads for transportation.
- It should be away from potential sources of pests and diseases and be fenced for security.
- The site should have a shed or containers to store materials and supplies, farm implements and small equipment.
- Have sufficiently trained manpower available to carry out nursery operations.

1.3 Seedbed preparation in the pre-nursery

A pre-nursery is used to obtain uniform planting material prior to planting in a nursery proper. It facilitates the sorting of seedlings by age, size or colour, and is especially useful to identify and eliminate off-types. A pre-nursery is also useful to discard seednuts that do not sprout after a specific time (3 - 4 months, depending on variety) along with any chlorotic, contorted, damaged or otherwise unsuitable seedlings (Harries, 2016).

The site should be cleared, ploughed and rotoverted to a fine tilth (Plate 3). The beds should be 10 - 20 cm in height to provide adequate root-room and drainage. They should be 2 m in width to enable ease of planting, inspection, management and maintenance operations. A space of 60 cm between two beds will facilitate ease of inspection, selection, and seedling transfer activities (TNAU, 2012).

A well-drained plot with friable, sandy loam/loam soils is best suited due to the relative ease in removing the seedlings from the nursery. Heavy clayey soils and waterlogged soils should be avoided. The ideal soil pH ranges from 5.5 - 7.0; however, seedlings are tolerant to a pH range of 4.5 - 8.5 (TNAU, 2012).
1.4 Planting in the pre-nursery seedbed

The distance between two seednuts along the row should be about 15 cm and the distance between two adjacent rows should be about 15 – 20 cm. Seednuts should be laid in trenches in which the depth is 10 – 15 cm. The seednuts are planted by firmly setting them either horizontally or vertically or slightly tilted with the embryo end at the top and the widest of the three segments uppermost. Vertically-planted seednuts suffer more from drought and are less robust than those from flat or horizontal planting although notching hastens their germination. With horizontal planting, rate of germination and subsequent growth of seedlings are faster compared to vertical planning; this is especially the case with Dwarf cultivars (TNAU, 2012; Coconut Cultivation Board, 2011; Ghose and Gopalakrishnan, 2013).

The seednuts are then covered with topsoil so that 1/3 of their upper surface is visible (Plate 4). Seednuts should not be completely covered with soil. Five rows of nuts may be planted in each bed accommodating 20 - 50 nuts per row. Each bed should carry the same variety and all seednuts should be of the same age. It is better to time the sowing of seednuts with the onset of the rains. Normally dry coconut fronds and/or coir can be utilised as a mulch for the seedbeds (Ghose and Gopalakrishnam, 2013).

Seednuts of Tall varieties begin germination within 2 - 4 months after sowing and seednuts of Dwarf varieties usually germinate 1 - 3 months after sowing. Generally, germination is recorded till the 5th month of sowing and a good seed lot will have 80 - 90% germination. Seednuts that do not germinate within 5 months can be removed from the pre-nursery and composted. A 12% discard of seedlings is acceptable at the pre-nursery seedbed stage (Coconut Research Institute of Sri Lanka, 2006; TNAU, 2012).
Plate 4. Seednuts sown in pre-nursery beds (Photo credit: Coconut Development Board, 2014; diagram at right showing vertically-planted nuts from Santos et al, 1995). Distance between seednuts along row 15 cm; interow spacing = 15 – 20 cm; seednuts covered with topsoil so that 1/3 of their upper surface is visible.

1.5 Selection of seedlings from the pre-nursery for planting in the main nursery bed

After 4 months, early-germinated nuts which have about 5 – 6 cm long shoots are selected for transplanting into main nursery beds (Plate 5) or into polyethylene bags. This operation allows the seedlings more space to grow vigorously and permits screening out of unsuitable seedlings. Earliness of germination is correlated with early yield and early splitting of leaves into leaflets is directly related with speed of germination (Santos et al, 1996).

Seedlings with sprouts that are single, sturdy, straight and well-set into the husk should be selected. Off-colour seedlings and those with thin or spindly sprouts, two or more stems and short leaf blade should be discarded. All selected seedlings must be free from diseases and pests (Nagarjuna Group, 2016).
Plate 5. Seedlings in pre-nursery ready for selection and move to the main nursery about 4 months after sowing (Photo credit: Indiamart, 2016).

1.6 Planting germinated seednuts in the main nursery beds

Selected germinated nuts are removed from the seedbed by lifting with a spade and the roots are trimmed before transferring to the nursery bed which has soil of fine tilth. The trimming of the roots assists the seedlings to establish quickly and will induce them to produce new roots. Seedlings should never be lifted from the soil by pulling the leaves or stem (TNAU, 2012).

Seedlings should be planted as early as possible after removal from the pre-nursery; they are planted 1/3 deep in the soil. All vacated plots in the pre-nursery seedbed should be refilled with topsoil so as not to destabilise the remaining ungerminated seednuts. The spacing of seedlings in the main nursery should be as shown in Plate 6 (TNAU, 2012; Kissan Kerala, 2016).

Plate 6. Planting distances for seedlings in the main nursery bed (Photo credit: Dreamstime, 2016).
1.7 Maintenance of pre-nursery seedbeds and main nursery beds

1.7.1 Irrigation
After sowing, the seednuts should be irrigated thoroughly to saturation levels (TNAU, 2012). The seedbeds should be irrigated regularly to ensure that the soil is moist. Regular application of water is compulsory under dry weather conditions. Keep seednuts cool by sprinkling water on the nuts as required, to avoid drying out of water in the endosperm. This can be done using overhead sprinklers or a garden hose fitted with a nozzle. In the pre-nursery beds, apply 0.5 litres water to each sprouted seedling at least once every 3 - 4 days depending on weather conditions (Coconut Cultivation Board, 2011). In the nursery bed, apply 1 litre of water to each seedling every 2 days if there is no rain.

1.7.2 Weed management
Weeding helps in moisture conservation of the seedbed and should be conducted manually by hand-pulling once or twice per month (Coconut Cultivation Board, 2011) or with a wick wiper containing a systemic herbicide.

1.7.3 Fertiliser application
Chemical fertilisers need not be applied to the seedlings in the pre-nursery during the first 2 months after sowing since the seedlings are usually nourished by the endosperm (TNAU, 2014). Thereafter, a blend of fertilisers can be prepared by mixing 1 unit urea with 2 units TSP and 4 units KCl. The blend should be applied at a rate of 30 g/plant at 2 months after germination and at 60 g/plant at the 4th and 6th months. From the 2-month stage and onwards, a solution of MgSO₄ should be applied monthly at a rate of 10 ml per 4.5 litres water (Ramkhelawan, 2013).

1.7.4 Mulching
During hot, dry periods, pre-nursery and main nursery beds can be shaded with 65% shade cloth, mounted on posts 2 m high (Plate 2). The surface of the bed can be mulched with dry fronds and/or coir (Plate 7). This can promote early and more efficient germination, good seedling growth and better establishment.
1.7.5 Pest and disease management in the nursery

Careful inspections should be regularly made to detect incidence of pest and diseases in the nursery. Scales, whiteflies and mealy bugs are often found on the underside of the leaves. Dimethoate sprayed at 0.05% and a spreader sticker can be alternated with Triazophos 40% EC to keep these pests at a manageable level. The biological insecticide, Bioneem or Neemex can be sprayed with a sticker onto the under surface of the leaves to control mites.

For leaf spot and bud rot diseases, preventative treatments of 1% Bordeaux fungicide alternated with 0.3% Idofil M-45 should applied twice per month. Severely infected leaves should be removed and burnt (Ramkhelawan, 2013).

1.7.6 Seedling selection from the main nursery bed for transplanting to the field

After 4 - 5 months in the main nursery bed, seedlings are ready for planting out in the field and this should coincide with the onset of rains. Proper selection of seedlings in the main nursery alone ensures a 10% improvement in yield. The following considerations should be made when selecting seedlings for transplanting to the field (Plate 8):

- Shoots should have a girth of 10 - 12 cm at the collar.
- There should be a minimum of six leaves with youngest already differentiated into leaflets.
- The leaf stalks should be short and thick.
- Seedlings should have a robust healthy appearance and be free from pests and diseases.
- If rigorous standards of selection are adopted, 60 - 65% high quality seedlings in a nursery can be obtained from the total nuts sown (Ghose and Gopalakrishnam, 2013).

Seedlings that do not meet these criteria should be rejected (Plate 9).
Figure 1 shows a timeline for the various stages of operations in the pre-nursery and main nursery prior to planting out the seedlings in the open field.

Seedlings should be removed from the main nursery by lifting with a spade and the roots carefully cut. Seedlings should never be lifted from the soil by pulling the leaves or stem. It is important to keep the seedlings in the shade and out of the sun and to have them planted as early as possible after removal from the main nursery (Kissan Kerala, 2016).

Plate 8. Seedlings being removed from nursery bed for planting in the field.
1.8 Production of seedlings in polyethylene bags (polybags)

Coconut seedlings can also be produced in polybags (Plate 10). The advantages of using polybags instead of field plots are as follows (Santos et al., 1996; Thomas, 2007):

- More vigorous seedling with better root system.
- Better establishment and early bearing.
- Transplanting shock is greatly minimized since there is no root damage, thereby promoting early establishment of transplanted seedlings.
- Seedlings can be retained longer in the nursery when conditions for field planting are not favourable.
- Weeding, watering and elimination of unwanted seedlings as well as seedling selection for planting out to field are more easily accomplished.

However, in the Caribbean, a polybag nursery can be quite expensive (cost of media, bags, labour, transport of bags with seedlings).

Using this type of nursery, polybags, preferably black, UV resistant for durability and measuring 40 - 45 cm wide with 8 - 10 holes at bottom and sides are half-filled with soil and compost mixed at a 50:50 ratio. Decomposed sawdust, corncobs, rice hull and other organic materials can be used so as to reduce the weight of the half-filled polybag and improve drainage and soil fertility (Santos et al., 1996).

**Polybag planting method 1**

In this method, the seednuts are pared at the top to facilitate emergence of the sprout (Plate 10). The nut is then placed in the half-filled bag in the upright position in the centre of the bag. Next, the bag is filled with soil with the sides slightly pressed to keep the nut firm until it is almost covered. As the soil settles, it will cover up to 2/3 of the nut (Santos et al., 1996).
In this method, there is no pre-nursery since the seednuts are placed directly into the polybag before they are germinated. The germinated seedlings are later picked out from the nursery once 80% of the nuts have germinated or about 5 months from sowing, whichever is earlier, and then laid out in the nursery as shown in Plate 12.

**Polybag planting method 2**

In this method, the nuts are sown in a pre-nursery bed as explained in Section 1.4 and when the sprouts are 5 - 6 cm long (about 4 months after sowing), each seedling is then placed in the half-filled polybag with the sprout in an upright position in the centre of the bag (Santos et al., 1996; Thomas, 2007). Next, the bag is filled with soil with the sides slightly pressed to keep the nut firm until it is almost covered (Plate 11).

In both methods, the size of a polybag nursery could be 3 m x 6 m with about 1.5 m spaces between plots. Each plot will easily accommodate about 115 seedlings.

Plate 10. Pared seednut placed in polybag (Left diagram from Elfick, 2016; right diagram redrawn from Elfick, 2016).

At 5 - 6 months after sowing, the polybagged seedlings are laid out in a larger polybag nursery as shown in Plate 12 (Nos. 1 and 2). Equal setting of the seedlings at optimum distance allows them more space to grow and develop rapidly. The technique follows a triangular system with equal spacing of 60 cm.

The polybagged seedlings are set in the same order as they germinated with the earliest germinating seedlings being placed in the first row in the eastern side of the area. The last ones to germinate are placed in the western section of the area. This practice reduces the competition for sunlight from among the earliest and latest germinating seedlings. Most importantly, selection of vigorous seedlings is facilitated and since the first pricked seedlings are placed in rows, culling or judging by age is easily accomplished (TNAU, 2014).


1.8.1 Maintenance of polybag nursery
The same practices of watering, weeding and inspection for pest and disease incidence used in prenursery and field plot nursery production of seedlings are recommended. Apply 30 g per bag per month of granular fertiliser (mix 1 unit urea + 2 units TSP + 2 units KCl + 1 unit MgSO₄) directly to the soil mix, in a ring around the seed nut (Ramkhelawan, 2013). Afterwards, the soil is lightly cultivated to promote faster dissolution and absorption of fertiliser. Topping up the surface of the soil mix with coir can prevent weed growth and reduce evapotranspiration (Plate 12 (No. 3).
1.8.2 Transplanting from polybags to the field
Leaf splitting (differentiation) occurs 4 - 5 months after polybagging, indicating that the seedlings are ready for field planting. Transplanting steps from the polybag to the field are shown in Plate 12 (No. 4).

1.9 Records and signage in nursery beds
In addition to keeping a records file, a signboard should be placed in front of each nursery bed and should provide the following information (Santos et al., 1996; Baylon and Rivera, 2016):

- Name of variety/cultivar.
- Date when nuts were harvested.
- Date when nuts were received in the nursery.
- Date of sowing.
- Number of seeds sown.
- Seedbed number.
ANNEX I - Poor nursery practices observed in the Caribbean

1. **Totally covered seednuts (Plate 13)**
   In this example, the seednuts were completely covered with soil and upon examination one month after sowing, several seednuts were found in a decomposed state (inset in Plate 13).

![Plate 13. Example of poorly sown nursery beds wherein seednuts were totally covered with soil. Inset is a rotten seednut taken from the nursery bed shown in the forefront one month after sowing.](image)

2. **No soil cover on seednuts (Plate 14).**
   Seednuts were placed in the nursery bed with no soil cover resulting in slow and poor germination.
   Some seednuts were already sprouted leading to non-uniform seedling emergence and development.
   The seednuts in each plot were from different varieties. The proper procedure is that each plot should contain seednuts from the same variety and that these are clearly identified in the sinage of the plot.
   Some seednuts did not appear to be of good quality (often shrivelled and damaged by mites) indicating that they were not selected from quality mother palms.
3. **Seedlings gathered from seednuts fallen from palms in the plantation** (Plate 15).
Seednuts were allowed to sprout and develop in a drain at the base of a coconut tree in the plantation (Plate 15 at left) with no mother palm nor seednut selection. They were of different ages and sizes and appeared etiolated and of poor quality. Obviously, there was no care of the developing seedlings.
It was observed that the farmer had “harvested” some of these and planted them in his field resulting in very poor early growth of the seedlings (Plate 15 at right).
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