

The Oil Palm Nursery: Foundation for High Production

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The nursery is the foundation for every successful oil palm plantation. It must produce healthy seedlings having the potential for sustaining large oil yields for 25 years or more.

Currently, all modern, commercial planting material consists of *tenera* palms or DxP hybrids, which are obtained by crossing thick-shelled *dura* with shell-less *pisifera*. Although common commercial pre-germinated seed is as thick-shelled as the *dura* mother tree, the resulting tree will produce thin-shelled *tenera* fruit. Only certified pre-germinated oil palm seed from established seed gardens should be used.

The near-future alternative to pre-germinated seed, once constraints to mass production are overcome, is tissue-cultured or “clonal” palms which provide “true copies” of high yielding DxP palms.

Site Selection

Ideally, the nursery should be located on a level, well-drained area that is easily accessible and close to the centre of the future plantation. It is essential to have an uninterrupted supply of clean water and topsoil which is both well-structured and sufficiently deep enough to accommodate three rounds of on-site bag-filling. Approximately 35 ha can grow enough seedlings over a three-year period to plant a 5,000 ha plantation.

Type of Nursery

Double stage nurseries, compared to a single stage nursery, are preferred because they require less space and irrigation, and allow for more efficient upkeep and selection (culling). However, the double stage nursery involves transplanting pre-nursery seedlings to the main nursery, which if done improperly, may cause transplanting shock.

Each nursery should have lockable stores for parts, tools and equipment and for chemicals and fertilizers (near a water supply). Herbicides must be clearly marked and kept separately from insecticides, fungicides, and foliar fertilizers to prevent contamination and incorrect handling.

Pre-Nursery: Materials, Preparation and Practice

Pre-nursery seedling beds, normally 10 m in length x 1.2 m in



Photo 1. A seedling at approximately 21 days old, ready for planting. Shoot (plumule) and root (radicle), which is pointing downward, are clearly distinguishable.

width, hold 1,000 seedlings (100 x 10) planted in 250 gauge, black UV stabilized, 15 cm x 23 cm polybags. Two rows of drainage holes are punched in the bags.

Using the best available hygienic soil, and after sieving it through a 5 mm metal screen and amending it with phosphorus (P) fertilizer, bags should be filled to within 2 cm of the rim. The fertilizer should be mixed thoroughly with the soil to provide optimum P availability to the seedling's root system. If quality topsoil is used, no further manuring is required in the pre-nursery. The filled polybags must be prepared four weeks before the seed arrives and should be watered daily until planting to ensure adequate P availability.

Rankine and Fairhurst (1998) suggest the following planting procedure:

1. Pre-germinated seeds received by the grower must be kept under shade and cool. Once seed bags are opened, maintain moist seeds by sprinkling them with distilled water.
2. The two-person planting team should work as follows: The 'seed handler' places the seed on the soil (which is about 2 cm below the top of the bag) with the root (radicle) pointing downwards. The 'planter' positions the seed correctly so that the shoot (plumule) is 1 cm beneath the surface after covering the seed with soil and gently tamps and levels the added soil with the palm of his hand.
3. Return the empty seed bags containing the rejected seeds to the recording staff so they can note seed quality.
4. Irrigate the seedlings immediately after planting.

When ambient solar radiation levels and very high mid-day temperature prevail, shade is required for at least six weeks, after which the plants are exposed to increasing amounts of sunlight. Coconut or oil palm fronds are often used for shade. In Mexico, the National



Photo 2. Pre-nursery shade house with shade partly withdrawn. The 60-day-old plants are ready for transplanting in the main nursery. Sprinkler heads, installed 1.5 m above ground at 9 m intervals, supply irrigation water through a pressurized, underground tube system.

Institute for Research on Forestry, Plant and Animal Sciences (INIFAP) designed a shade house which provides 40 percent shade for 100,000 plants within a 1,800 m² area. The shade house, measuring 120 m x 15 m, is constructed of metal (PTR) uprights and steel lines to secure shade cloth. Columns at the centre of the shade house are 3 m high, and the two parallel steel lines are fixed 2 m above the floor (**Photo 2**).

Pre-nursery seedlings must be watered daily. Whenever rainfall is less than 10 mm per day, irrigation is required, and the system must be capable of uniformly applying 6.5 mm water per day. The irrigation systems most commonly used have overhead sprinklers at about a 2 m height (**Photo 2**), or flat sprinkler tubes with two rows of holes in the upper surface to spray a fine mist at opposite angles when the tube is pres-

surized. Hand watering systems may be adequate in small (less than 1 ha) nurseries. Monitoring during irrigation ensures complete soil wetting and avoids over-watering, which can cause soil loss from the pots and result in the roots of the seedlings being exposed.

Weed control, if required, must be done manually to avoid seedling damage. The normal rule is to not use herbicides in pre-nurseries.

Insect control is most effective when pests are detected early and treated promptly after clear identification. In Mexico and other places, the insecticide Carbofuran (75 percent, 1 g per polybag) is used to control leaf-cutting worms, and Metamidofos (49 percent, 3.75 ml per liter of irrigation water) is applied for control of leaf insects.

Disease control may be required in the pre-nursery, particularly when hot and humid conditions prevail. During the early stages of development, the best means for controlling leaf diseases is to reduce excessive shade and ensure adequate air movement. Preventive fungicide applications may start 25 days after emergence and continue at intervals of 15 days. (Benomil 50 percent, 2.5 g/l; Captan 50 percent, 5 g/l; or Clorotalonil 40 percent, 2 g/l water, are commonly used.)

Transplanting

Pre-nursery seedlings in the four-leaf stage of development (10 to 14 weeks after planting) are usually transplanted to the main nursery, after their gradual adjustment to full sunlight and rigid selection process. During culling, seedlings with abnormal characteristics such as “grassy”, “crinkled”, “twisted”, or “rolled” leaves should be discarded. In case of doubt, the seedling should be removed.

Main Nursery

Pre-nursery seedlings are transplanted into main nursery polybags (i.e., 40 cm x 45 cm, 500 gauge, black UV stabilized) containing soil prepared in the same manner as for the pre-nursery. A 25 cm deep hole is made with a trowel or a cylindrical core cutter in each main nursery polybag. The seedling is transplanted after removing the pre-nursery polybag. Temporary shade (e.g., nipah palm leaflet) and watering should be applied immediately following transplanting to reduce transplanting shock.

Also, a 2.5 cm deep layer of disease free mulch should be uniformly spread around the seedling soon after transplanting to prevent soil erosion, to regulate soil moisture and soil temperature, and to suppress weed growth in the polybag. Commonly used materials are oil palm kernel shells, shredded coconut fibre, rice husks, peanut shells, and coffee shells.

Manuring and Fertilizer Management

With the exception of P, plant nutrient deficiencies can be corrected through surface or foliar application of fertilizer to transplants in the

Table 1. N, P, K, and Mg fertilizer nutrient application schedule for the main nursery (g per seedling).

Weeks after transplanting	N	P ₂ O ₅	K ₂ O	MgO
1	0.8	0.8	0.3	0.2
3	0.8	0.8	1.2	0.1
5	1.1	1.1	0.4	0.3
7	1.2	1.2	1.7	0.2
10	1.5	1.5	0.6	0.4
13	1.2	1.2	1.7	0.2
16	2.3	2.3	0.9	0.6
19	1.8	1.8	2.6	0.3
22	3.0	3.0	1.2	0.8
25	2.4	2.4	3.4	1.3
28	2.4	2.4	3.4	1.3
32	3.0	3.0	4.3	1.4
36	3.0	3.0	16.3	2.0
40	3.0	3.0	4.3	2.0
44	3.6	3.6	5.1	2.0
48	3.6	3.6	5.1	2.0
52	3.6	3.6	5.1	4.0
56	3.6	3.6	5.1	5.3
Total	41.9	41.9	62.7	24.4

main nursery. It is essential that the required amount of P (e.g., 300 g P₂O₅ per tonne of soil) be applied and mixed in the soil before bag filling. Granular compound fertilizers are often used as they provide all necessary nutrients in a single application. In Southeast Asia, the two most frequently used compound fertilizer formulas are 15-15-6-4 [nitrogen (N)-P₂O₅-K₂O-MgO] and 12-12-17-2+micronutrients [N-P₂O₅-K₂O-MgO+boron (B), zinc (Zn), manganese (Mn) etc.]. The recommendation in Mexico is to apply 5 to 10 g 18-46 (N-P₂O₅) per seedling at weeks 3 and 6 after transplanting, followed by rates of 12 to 23 g 17-17-17 (N-P₂O₅-K₂O) per seedling in 3-weekly intervals until week 30.

Table 1 provides a generic, main nursery fertilizer schedule which can assist growers in calculating fertilizer rates based on the types and sources of materials available. Compacted ‘slow release’ fertilizer tablets are expensive in terms of nutrient unit cost, and the benefits do not justify general usage in the main nursery.

Plastic spoons or measures must be calibrated in order to apply the correct amount of fertilizer. The fertilizer should be sprinkled in a circle around the seedling stem, ensuring that it is not in contact with the seedling. To reduce risk of planting shock, applications of fertilizer should cease one month prior to field planting (**Photo 3**). At the same date, polybags should be rotated 180° to sever all roots which may have penetrated the nursery subsoil.

Weed control

Weeds growing in the polybags must be carefully pulled out. Herbicides should not be used. If chemicals are needed, the products Gramoxone and Diuron 80 WP are preferred

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for ground weed control, but they should be applied with great care to avoid damage to seedlings (**Photo 4**).

Pest control

Numerous insects (e.g., ants, armyworm, bagworm, aphids, thrips, mites, grasshoppers, mealybugs) and vertebrates (e.g., rats, squirrels,



Photo 3. Manual fertilizer application in the main nursery.



Photo 4. Ground weed control in the main nursery using protecting devices to avoid herbicide spray contact with seedlings.

porcupine, wild boar, monkeys) are pests in oil palm nurseries and must be carefully identified before control measures are implemented. Product advice should be sought locally.

Disease control

Diseases afflicting seedlings and young plants are common in nurseries. The most prevalent among them are *Blomerella cingulata*, *Botryodiplodia spp.*, *Melanconium spp.*, blast, Curvularia blight, Corticum leaf spot, Helminthosporium, and spear or bud rot (*Fusarium spp.*). Begin prophylactic fungicide applications of Thiram 30 WP or similar fungicides when the seedling is in the sixth leaf growth stage. Curative sprays are applied once the disease symptoms appear and the disease is clearly identified. No known treatment cures plants suffering from foliar rot (Flecha-arguco), which is a disease that occurs in Mexico. Foliar rot begins with brownish lesions at the base of the leaf and progresses until it affects leaves in the crown of the plant. Since the casual agent is unknown, affected palms must be discarded and burned.

Other Disorders

After 8 months in the nursery, normal healthy plants should be 0.8-1 m in height and display 5 to 8 functional leaves, with the middle leaves forming a 45° angle with the plant's axis and leaflets spreading at an angle greater than 60° to the leaf rachis (Photo 5). At this time, a rigorous selection process should be started (Hartley, 1983).

Abnormal seedlings will not produce an economic yield and must never be dispatched from the nursery for field planting. The most common disorders requiring seedling culling are:

- Fronds set at narrow angles to the main stem.
- Flat top appearance.
- Undivided pinnae.
- Pinnae that are narrow and rolled.
- Pinnae with respectively narrow and wide internodes.

These plants must be culled after a period of close observation.

A final culling should be undertaken when seedlings are dispatched to the field. This prevents the planting of abnormal seedlings that escaped previous cullings. Culling rates are usually between 15 and 30 percent. If culling rates exceed 35 percent, the grower should consider purchasing seed from a new supplier. **BCI**



Photo 5. A main nursery in Mexico with healthy, well-developed seedlings.

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The World of Palm Oil

Asia accounts for nearly 79 percent of the world's oil palm fresh fruit bunch (FFB) yield, Malaysia and Indonesia being the two leading producers, with about 95 percent of total Asia production. Oil palm continues to be Southeast Asia's most rapidly expanding crop. Africa and Latin America also harvest significant areas of oil palm.

In 1998, total world FFB production was more than 95 million tonnes, 75 million by Asian growers in eight countries. Twenty-two countries in Africa produced 14 million tonnes, 8 million of that coming from Nigeria. Thirteen Latin American countries produced slightly more than 6 million tonnes of FFB. Highest national average FFB yield produced in 1998 was 26.5 t/ha in Nicaragua. Ten countries produced yields averaging above 15 t/ha. The world average was 10.8 t/ha. **BCI**

Sources: FAO Database, 1999; PPI-PPIC, 1999.