

CIRAD®

germinated oil palm seeds

Recommandations for prenursery
and nursery management



Disclaimer

Although the authors know the information contained in this booklet to be correct at the time of printing, it is impossible to cover all situations. The information is provided without warranty. Despite the care taken in drafting these recommendations, CIRAD shall under no circumstances be held responsible for any loss or damage resulting directly or indirectly from their application.

A network for creating, producing and distributing CIRAD® oil palm seeds

CIRAD has a mandate to contribute towards development by creating high-yielding planting material and disseminating it as widely as possible. It thus coordinates a network of researchers, producers and distributors. CIRAD® seeds are:

- developed and produced with our partners in Benin (INRAB), Ivory Coast (CNRA), Indonesia (PT Socfindo), Colombia (Promotora Herrera Vargas) and Ecuador (Danec),
- available worldwide via the CIRAD network of distributors: Colombia, Venezuela and central America (Promotora-Hacienda La Cabaña), Ecuador (Palmeras De Los Andes), Peru (Multitrading – M. Lambert Pie), Thailand (Siam Elite Palm).

The qualities of CIRAD® seeds are appreciated by all growers: high oil yields, high extraction rate, stable yields, slow vertical growth, uniformity, etc. By acquiring these germina-

ted seeds, you are benefiting from the latest advances made in the genetic improvement programme that CIRAD has been implementing with its partners for more than 60 years.

WARNING

RECOMMENDATIONS ON RECEIVING GERMINATED SEEDS

The seeds have been prepared in such a way as to preserve their physiological qualities and ensure good recovery when planted out. On arrival, check the condition of the packaging and of the seeds.

→ Where applicable, take the recording thermometer reading and fax the diagram immediately to the export service.

In principle, seeds should be transferred to the prenursery immediately on arrival. However, if they have to be stored for a few days before transfer, we advise that you take the following precautions:

→ **Transport & storage:** This must be done in the original packing cases avoiding any variations in temperature, especially exposure to heat (sunlight or poorly ventilated room) or to cold (strong air-conditioning, refrigerated sheds).

→ **Preservation measures:** We advise opening the cases and placing the bags of seeds (without opening them) on shelves in a dark room at ambient temperature. It is not necessary to open the bags for short periods (2-3 days). Beyond that time, rapid aeration and very light misting with a small hand sprayer (if the bag walls are dry) may be needed; carefully re-close the bags.

- In principle, the maximum storage period should not exceed one week.
- If seed development is insufficient for transfer to the prenursery (plumule and radicle should reach 8-15 mm), store them in their original packaging for a few days, and up to 2 weeks if necessary, in the shade at ambient temperature. The bags should show traces of humidity but excess moisture should be avoided. Slight spraying or drying might prove necessary.
- Discard poorly developed or broken seeds, seeds with brown, wilted, rotten, atrophied or twisted sprouts. The safety batch is intended to compensate for such rejects. Only normally germinated seeds with ivory coloured sprouts and differentiated plumules and radicles should be transferred to a prenursery made ready for that purpose.
- If the material shipped to you involves several seed categories, they are packed separately and marked C1001 or C2501, or another C****. Please ensure that this separation is respected from the prenursery to planting out, in order to guarantee uniform plantations.

From seed to field



To obtain 143 seedlings to plant 1 hectare, after culling in the pre-nursery and nursery, 200 germinated seeds should be placed in the pre-nursery and 170 seedlings transferred to the nursery.



200 germinated seeds



Minimum 170 pre-nursery seedlings to be transferred to the nursery



Minimum 143 seedlings to be planted out

Prenursery

When a seed germinates, a haustorium develops rapidly, gradually drawing its nutrition from the seed albumen. This process of digestion ends when the haustorium completely fills the nut cavity

The prenursery stage spans the 4 months following germination, during which the seedling grows. It passes through the following stages:

- ❑ the germinated seed, complete with radicle and plumule, is planted,
- ❑ in the first month the first two leaves and adventitious roots appear,
- ❑ a month after planting, the first lanceolate leaf appears, together with the first primary root,
- ❑ at 4 months, the seedling has three to four leaves with lanceolate lamina. The root system is well developed with primary, secondary and tertiary roots.

The plant is now autotrophic and ready to be transferred to the nursery.

SITE PREPARATION

For an estate plantation, a site close to the nursery is usually chosen. For a smaller enterprise, growers tend to choose a site close to home. The area is carefully weeded, either manually or by applying a herbicide - ametryn at 2.4 kg/ha in 300 l of water, adding a non-ionic wetting agent (1 part per thousand).

The beds are marked out using wooden laths or bamboo poles. They are 1.5 m wide and contain 5000 bags when 20 m long. The beds are separated by 0.8 m wide paths.

Some form of shading is preferable to encourage emergence and protect seedlings from dehydration. Shelters may be constructed using large wooden stakes or bamboo poles (0.1 m in diameter, 2.5 m tall) installed down the side of each bed 3.3 m apart. Light bamboo frames are attached to the poles with wire. This is completed with lighter bamboo cross-pieces installed every metre. Shade is provided by fresh palm fronds placed on the bamboo cross-pieces at a density of about three to four per linear metre. Artificial shade made of polyethylene fibres can also be used. It is worth enclosing the prenursery with a wire fence 1 m high to protect it from roaming animals. A drainage ditch 25-30 cm deep may also be dug outside the fence.

PLANTING IN POLYBAGS

Polybag characteristics are as follows:

- ❑ transparent or black polythene with a gusset,
- ❑ 5/100 mm thick,
- ❑ 8.5 cm wide,
- ❑ 20 cm deep,
- ❑ bottom perforated with 20 holes 5 mm in diameter.



The bags are filled with good topsoil (10 cm), with or without additional compost.

Once filled, the bags are disinfected a fortnight before the seedlings are transplanted with a solution containing 1 g of

neutral oxyquinoline sulphate and 0.2 g of deltamethrin in 10 l of water for 300 bags.

The seedlings should be planted in the polybags as soon as possible after they have been filled, while the substrate is still damp. The sorted germinated seeds should have a pronounced plumule and radicle, each straight and pointing in opposite directions. Total length should not exceed 10-15 mm.

A hole 2-3 cm deep is made in the middle of each bag.

The seed is placed at the bottom of the hole, radicle pointing downwards, and is covered with soil to a maximum depth of 1 cm.



Germinated seeds pricked out incorrectly

- | | | | | |
|---------------------------------------|--------------------------|----------|--------------------------|-------------------------|
| 1 | 2 | 3 | 4 | 5 |
| Germinated seed pricked out correctly | Too close to the surface | Too deep | Pricked out horizontally | Pricked out upside down |

The bag is watered lightly.

Seeds with more than one sprout can be planted in the normal way. The seedlings will be separated when transferred to the nursery proper.

Transplanting the seedlings is a delicate job and should be carried out by experienced staff.

Each bed is identified with a sign indicating its number, the transfer date, the planting material identity code and the number of seeds planted.

MANAGEMENT



All operations, from transplanting germinated seeds to despatching seedlings, should be recorded down to the last detail in a prenursery logbook.

Weeding

For small areas, paths and polybags are weeded manually. For larger areas, a chemical such as ametryn can be used. When treating paths, and polybags prior to emergence, the recommended dose is 2.4 kg/ha for 300 l of water. After emergence only the paths should be treated and polybags should be weeded manually.

Watering

If no rain falls, 4 mm of water should be applied every 2 days. The irrigation jets should be adjusted to fine to avoid unearthing the roots. In a small prenursery a watering can with a rose can be used.

Fertilizer application

The substrates used should be fertile enough to allow the seedlings to get off to a good start. From the end of the first month, a weekly supplementary application of 25 g of urea in 10 l of water per 1000 seedlings can be applied, with light watering afterwards to avoid the risk of leaf scorch.

Protection

Damage and losses, including outbreaks of insect pests or diseases, can occur in the prenursery, such as:


- ❑ **Seedlings fail to develop** - this may be due to poor quality substrate, inadequate soil disinfection, poor planting, over- or under-watering or a pest attack.
- ❑ **Foliage appears scorched** - the causes may be inadequate watering after fertilizer applications, application rate errors, wrong choice of product when applying pesticides, or too sudden a removal of shade.
- ❑ **Foliage turns yellow** - this is often the result of insufficient shade, nitrogen deficiency beyond the third month, or too much water.
- ❑ **Brown necrosis at leaf tips** - this can occur if there is too much shade (anthracnose).
- ❑ The main disease likely to occur in the prenursery is anthracnose following excess ambient humidity. Good aeration will reduce the risk. Nevertheless, a preventive fungicide may also be applied twice a month (2 g of mancozeb or chlorothalonil per litre of water at a rate of one litre of mixture per bed).
- ❑ The few leaf-eating insects that may cause damage can be controlled by spraying a solution of 0.8 to 1.0 g of carbaryl or 0.024 g of deltamethrin per litre of water at a rate of one litre of solution per bed. Young seedlings should be protected from ants, termites and crickets by sprinkling a band of deltamethrin powder around the planting area. Snails and slugs can be controlled with metaldehyde.

based pellets sprinkled at random on the beds. If rodents attack, clean the perimeter of the prenursery, check protective fencing and bait with anticoagulant poison.

Shade removal

To acclimatize the seedlings gradually to full sunlight, every third frond is removed 3 weeks before the seedlings leave the prenursery, followed 1 week later by every other frond, removing the remaining shade 1 week later. No shade removal is required with mosquito netting.

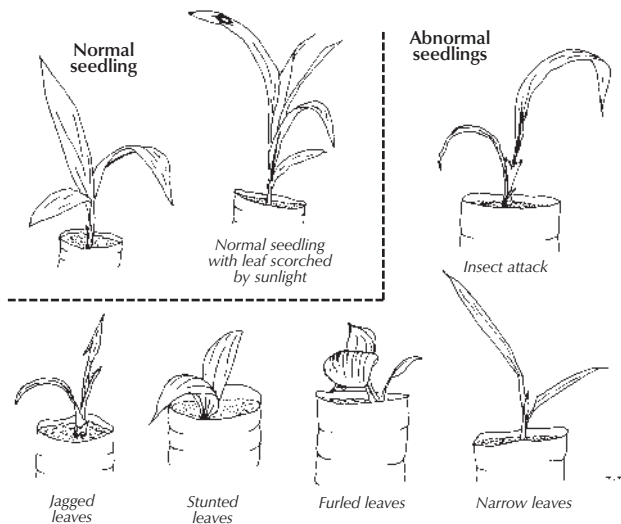
CULLING IN THE PRENURSERY



At the end of the prenursery stage a normal seedling has three to four lanceolate leaves. Each leaf emitted is longer than the last by the time it is fully developed. The height of the seedling, with the leaves fully extended, is 20-25 cm. The collar girth is 4 cm.

When transferring seedlings to the nursery proper, further culling is carried out to discard abnormal seedlings: poorly developed, stunted, spindly, with fused leaves, with narrow or furled leaves.

Culling is carried out bed by bed of supposedly uniform planting material and per germinated seed transfer date, referring to the mean for the seedlings. Discarded plants must be destroyed.



The maximum acceptable loss rates in the prenursery are as follows:

- ❑ seedlings that have failed to develop and dead seedlings: 5%,
- ❑ abnormal seedlings: 10%,
- ❑ i.e. a total of 15% at the most.

Thus, if 200 germinated seeds are planted per hectare, it is acceptable to keep only 170 seedlings/ha at the end of the prenursery.

Nursery

The nursery stage lasts 7-10 months, after which plants are finally transferred to the field. During this period, the palm loses its juvenile appearance and its leaves begin to resemble true fronds. During the nursery stage the plants remain in polybags but without shade.

SITE PREPARATION

The nursery must be located close to an abundant water source that will be able to provide nearly 100 m³ of water per hectare per day towards the end of the cultivation period. A slightly sloping well drained soil will help remove surplus water. As far as possible, the nursery should be located close to the future planting site.

The soil is clean-weeded and levelled. The surrounding area should be cleared of food crops, and grasses, and a cover crop (*Pueraria*, *Calopogonium*, *Mucuna brachiata*, etc.) should be sown inside a radius of 50 m. Manual or chemical weeding should then be carried out, using ametryn (at 3 kg a.i./ha), glyphosate (1.5 l a.i./ha), or diuron (at 3 kg a.i./ha).

The black polybags used in the nursery should be 0.15 mm or 0.2 mm thick, 40 cm by 40 cm in size, without a gusset, with a volume of 15 l and able to contain 20-25 kg of soil. The lower half of each bag is perforated with three rows of holes 5 cm apart and 3-4 mm in diameter.

The substrate for filling the bags should come from a site near the nursery. Of a sandy texture, it can be sieved (2 cm mesh) at the collection site and may also be enriched with compost.



Never collect soil from areas known to be infected with root disease organisms such as *Fusarium* or *Ganoderma*.

The bags should be laid out in rows in a 70-cm equilateral triangle arrangement (60 cm between rows). Main paths should be 5 m wide and minor paths should be made by removing a row or column of bags for easy movement within the nursery, and to mark out beds. The shape and size of beds depends on the watering system adopted. Keep the bags in an upright position. Each bed should be identified with a sign indicating the number of plants, the transfer date and the category of planting material.



A one-hectare nursery can hold from 18 to 20 thousand seedlings.


TRANSPLANTING

A small trowel is used to make a hole in the middle of each bag. The hole should be vertical and slightly larger than the ball of soil formed during the prenursery stage (around 12 cm in diameter and 17 cm deep). The base of the prenursery bag is torn away and the plant, with its ball of soil intact, is slid from its bag into the new hole. Pull the old bag upwards to remove it. A little soil is carefully heaped and carefully pressed around the ball of soil. The collar of the plant should be level with the soil surface.

Where a seed has produced two or three seedlings, these may be separated. If well developed, the extra seedlings can also be used in the nursery. They should be planted, with bare roots, in large bags.

After transplanting, water in well to facilitate recovery.


MANAGEMENT



All operations, from transplanting to despatching palms, should be recorded down to the last detail in a nursery logbook.

Weeding

Nursery upkeep primarily entails careful weeding to remove all weeds, especially grasses, which are host plants in blast disease zones, especially in Africa.



Bags are always weeded manually. While weeding, the bags can be straightened up and the soil round each plant firmed where necessary.

For the areas between bags a hoe may be used or herbicides may be applied. In the latter case, use sprayers with a guard to protect the operator and the plants. These sprayers should be clearly marked "Nursery Herbicide". Herbicide treatment should be carried out on a still day, without spraying the bags or the leaves of the palms. Do not water for 48 hours after treatment. The preferred product to use is ametryn, applied at 3 kg a.i./ha in 300 l of water. This remains effective for 3 months.

Watering

Care should be taken to fully meet the water requirements of the plants throughout the nursery period. Irrigation equipment ensures regular, fine spraying. Supports for the sprinklers should be vertical. The number of watering points is determined by the total area of the nursery, bearing in mind that the ideal distance between two sprinklers is 1.5 times the range of the sprinkler.

Seedlings should be watered three times a week. The amount applied depends on the age of the plants: from 0-4 months, apply 9 to 12 mm on each watering round; from 4-8 months, 16-24 mm, unless rainfall is sufficient. Micro-perforated polyethylene pipes (Kirico©) can be used, installing one line of piping every four rows of bags.



Remember that excessive watering can do more harm than a slight lack of water.

Fertilizer applications

The quality of the substrate, together with any basic dressing of fertilizer or compost, is important in ensuring that the nursery gets off to a good start. Subsequent maintenance applications of fertilizer will be needed at regular intervals.

Nitrogen is very important for promoting green leaf development. It also significantly increases plant girth and height. As an aid to decision-making table 1 shows typical fertilizers and amounts routinely applied in Ivory Coast (tertiary sands), Malaysia (inland soils) and Indonesia.

Table 1. Fertilizer types and amounts (g/plant/month) applied in Ivory Coast, Malaysia and Indonesia.

Months	Ivory Coast		Malaysia		Indonesia	
	Compound (a)	Urea	Compound	Kieserite	Compound (b)	Urea
1	5	0	10 (b)	0	5+5	
2	5	0	10 (b)	0	5+5	
3	5	5	10 (b)	0	7+7	
4	5	5	10 (b)	0	15	
5	5	5	10 (c)	0	0	10
6	10	5	15 (c)	0	25	
7	10	5	15 (c)	10	0	15
8	10	5	30 (c)	15	30	
9	10	10	30 (c)	15	0	20
10	10	10	35 (c)	30	35	

(a) 11.6.7.2 compound fertilizer; (b) 15.15.6.4 compound fertilizer; (c) 12.12.17.2 compound fertilizer.

Crop protection


With constant monitoring of plant health in the nursery, outbreaks of insect pests or of diseases can be detected early.

The most frequently occurring diseases are blast, dry bud rot and fungal leaf diseases caused by *Curvularia*, *Helminthosporium* and *Cercospora*.

Blast disease is very common in West Africa. Its vector is *Recilia mica* (Homoptera Jassidae) a type of leafhopper that lives mainly on grasses. The symptoms are damp rot at the base of the spear, yellowing at the base of young leaves, wet rot of the root cortex and orange-brown discoloration


of the growing point. The plant dies quickly. Partial recovery is, however, possible.

Dry bud rot is a common disease in West Africa. Small yellow and white spots appear on the spear or on leaf 1. This is accompanied by an abrupt halt to the growth of young leaves. Translucent, oily, grey-brown or violet-coloured areas appear in the apical meristem of old plants. The causal agent is not known but the disease is transmitted by two planthoppers (Homoptera Delphacidae), *Sogatella cubana* and *S. kolophon*.



Both blast and dry bud rot can be controlled by eliminating grasses around the nursery and applying insecticides on young plants twice a month throughout the period of susceptibility to the disease (September to February).

If they are not controlled, fungal diseases may severely affect plant growth and cause severe leaf desiccation. The most important of these diseases are *Cercospora* leaf spot, which causes brown or brownish-orange spots to develop on older leaves, which then dry out, and *Curvularia* leaf spot (rounded brownish-orange to brown spots on all the fronds).



These diseases can be prevented by treating weekly or fortnightly, alternating the following fungicides: mancozeb (2 g a.i./l), and thiophanate-methyl (1 g a.i./l).

These treatments also offer the advantage of being effective against various leaf fungi of secondary importance. The equipment used for fungicide treatments should be clearly marked "Nursery Fungicide".

Many insect pests attack oil palms in the nursery, especially the leaves, spears and base of the stem. Snails and rodents may also sometimes attack.



Treatment against blast and bud rot, and careful site upkeep, should be sufficient to protect the nursery from all these problems.

In areas where blast is not a threat, insects can be controlled with a product more specific to the pest involved. Rodents may still attack in such areas, in which case the use of baits is recommended.

CULLING IN THE NURSERY

Strict culling at the end of the nursery stage is the key to achieving satisfactory yields from the plantation. Culling is carried out in a single operation, moving through each bed of homogeneous planting material: same transfer date and same category.



At 8 months, a normal seedling displays the following characteristics:

- height: 0.6 to 1 m,***
- collar girth: 18 to 22 cm,***
- number of functional leaves: 7 or 8.***

Culling should be carried out when the seedlings are 6-8 months old. Later than this the process is made difficult by the size of the plant. Sick or chlorotic plants, or those that have

been severely attacked by insects (*Oryctes* or *Augosoma*) or by fungal diseases, together with any stunted or otherwise abnormal plants (fused leaves, leaves inserted at an acute angle, short or narrow leaves, leaves spaced too far apart), should all be discarded.



The normal culling rate in the nursery must not exceed 15%, dead plants included.

DIRECTLY-SOWN NURSERIES

Direct sowing of nurseries is becoming widespread if there is sufficient room. The aim is to gain 1-1.5 months in plant development by skipping the prenursery stage. Germinated seeds are transferred directly into the larger bags.

For every 100 germinated seeds, 90 nursery bags and 10 prenursery bags are required. The retention of a small prenursery will allow the replacement of plants that die or are culled at early stages in the nursery proper.

The layout is exactly as in a normal nursery, but 4 or 6 rows of bags are grouped side by side, to install shade during the first 2 months to help the seedlings to recover. The shade is gradually removed the following month. At this stage any stunted or dead plants are discarded and the bags are then placed at their ultimate spacing. Once the seedlings are in their ultimate positions, they are treated as in a normal nursery.

Timetable of operations

Two important factors need to be considered when ordering seeds: the optimum planting date (which is at the beginning of the rainy season) and the area to be planted.

If the seedlings are to be ready when needed, they must be ordered well in advance. For example, in the cropping calendar shown (table 2), for planting in May or June of year N, seed availability should be checked in the first quarter of year N-2, the seeds should be reserved and a firm order should be placed in the second quarter of year N-2 and the order should be finalized during the second half of the year for a delivery in the first quarter of year N-1.

Tables 3 and 4 show timetables and labour requirements.

Table 2. Timetable of operations for planting in May-June of year N

Year	Month	Activity
N-2	6	Checking of CIRAD® seed availability. Reservation & firm order
	7	
	8	
	9	
	10	
	11	
N-1	12	Placing in germinator (by CIRAD distributor and delivery)
	1	
	2	
	3	Transfer to prenursery
	4	
	5	
	6	Transfer to nursery
	7	
	8	
	9	Planting
	10	
	11	
N	12	Planting
	1	
	2	
	3	
	4	
	5	
6		

Table 3. Work required for a 1 000 m² prenursery (80 000 polybags).

Task	Date or frequency	Contract (man-days)	Number of man-days	Number of tractor hours	Requirements
Land preparation	D - 45	x	y		Ametryn (240 g)
Beds, fencing, ditch	D - 30		15		Wire netting (160m), bamboo poles, stakes
Shade	D - 25		20	5	Fronds (1 200), wire, tacks
Substrate					
– excavation, sieving	D - 25	0.5 m ³	130		Soil (65 m ³)
– transport	D - 20	2	32	20	
– bag filling, installation	D - 20	500	160		Polybags (80 000)
– disinfection	D - 15		1		Oxyquinoline sulphate (270 g)

Task	Date or frequency	Contract (man-days)	Number of man-days	Number of tractor hours	Requirements
Transfer	D	2 500	32		
Herbicide	D + 10		1		Ametryn (240 g)
Fungicides	15 days		6		Mancozeb or chlorothalonil (300 g)
Insecticides					As needed
Watering	2 days		15		Water (4 m ³ /application)
Manual weeding		5 beds	90		As needed
Fertilization	D + 75		3		Urea (2 kg)
Shade removal (3 stages)	D + 98 105, 112		6		
Culling, seedling dispatch	D + 115	1 250	64		Transport cases

Table 4. Work required for a 1 hectare nursery (20 000 seedlings, duration 8 months).

Task	Date or frequency	Contract (man-days)	Number of man-days	Number of tractor hours
Land preparation	D - 90		x	y
Substrate				
– collection	D - 30	2 000 kg	180	110
– bag filling	D - 25	150 polybags	120	
– bag installation	D - 15	250 polybags	80	
Stake cutting and lining	D - 20	1 000 + 400	85	
Transfer	D	250 polybags	80	
Bag weeding + hoeing between bags	Monthly	3 600 + 600	300	
Watering	Constant	1/2 ha	250	
Fertilization	Monthly	1 800 polybags	90	
Insecticide (6 rounds)	Monthly	1 500 polybags	80	
Fungicides	Weekly	4 000 polybags	175	
Monitoring	Constant		240	
Culling	D + 200	4 000 seedlings	5	

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