

TRAINING MANUAL

CULTIVATION, PROCESSING AND MARKETING OF OIL PALM



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1.Introduction

Oil palm (*Elaeis guineensis* Jacq.), is a native of West Africa and popularly known as African oil palm or red oil palm. It is grown extensively in South-East Asian countries, (Malaysia, Indonesia and Papua New Guinea {80- 90% of world's palm oil production}), African countries, (Nigeria, Ivory Coast, Ghana, Liberia, Sierra Leone, Cameroon, Republic of Congo and Zaire) and South American countries (Costa Rica, Panama, Columbia, British Guyana, Peru, Ecuador, Venezuela and Brazil). Malaysia, Indonesia and Nigeria are the leading producers of oil palm.

It is known to be the highest edible oil yielding perennial crop. It produces two distinct oils, i.e., palm oil and palm kernel oil. Palm oil is derived from fleshy mesocarp of the fruit, which contains about 45-55% of oil. The palm kernel oil, obtained from the kernel of stony seed, is a potential source of lauric oil.

Oil palm is the crop of the present and future vegetable oil economy of world as well as India. Palm oil has good consumer acceptance as cooking medium because of its price advantage. It is a good raw material for manufacturing oleo chemicals used in making soaps, candles, plasticizers etc. It has also a variety of uses, ranging from edible oil, cosmetics, and pharmaceuticals to bio-fuel and bio-lubricant.

1.0 Indian Scenario

India is one of the largest consumers of palm oil, which is used in almost everything from soaps to chips. But the country still imports most of its palm oil. India also produces a range of other vegetable oils, like mustard and soybean, but it has seen exponential demand for palm oil over the last few years.

India imported more than eight million MT (metric tons) of palm oil every year between 2016-17 and 2018-19. In fact, in 2018 India was the biggest importer of palm oil in the world and also the biggest importer of palm oil from Malaysia. To reduce dependence on other countries and cut down on import bills, the government decided to boost domestic production of the commodity. India has consistently increased its palm oil production over the last five years from – 275 lakh tonnes in 2014-15 to 365.65 lakh tonnes in 2020-21. India currently produces palm oil on more than 300,000 hectares (2021) (741,316 acres) of land and plans to cover an additional area of 650,000 (160, 6184 acres) hectares by 2025-26. India requires 25 million tons of palm oil every year. The country produces around 10 million tons and imports

a further 15 million from other countries. India's expanded coverage will help boost production by 1.12 million metric tonnes.

Table 1: Target and Achievement of Area Expansion from 2010-11 to 2015-16, under ISOPOM, NMOOP and OPAE. (Figure (a))

All India	TARGET	ACHIEVEMENT
2010-11	28770	17925
2011-12	60270	28388
2012-13	49932	26300
2013-14	41347	23183
2014-15	28146	17143
2015-16	27337	14425

Table 2: Year-wise production of Crude Palm oil (CPO). 2010-11 to 2015-16. (Figure (b))

All India	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Production	79187	110541	138567	180727	191510	217258

Table 3 Financial Outlay, year-wise fund allocation and releases. (2014-15 to 2016-17). (Figure (c))

(₹ in Lakhs)

Year	Allocation	Release	Expenditure
2014-15	7172.05	3993.93	4550.35
2015-16	6581.10	3794.79	3250.54
2016-17	8028.67	4226.63	1414.99

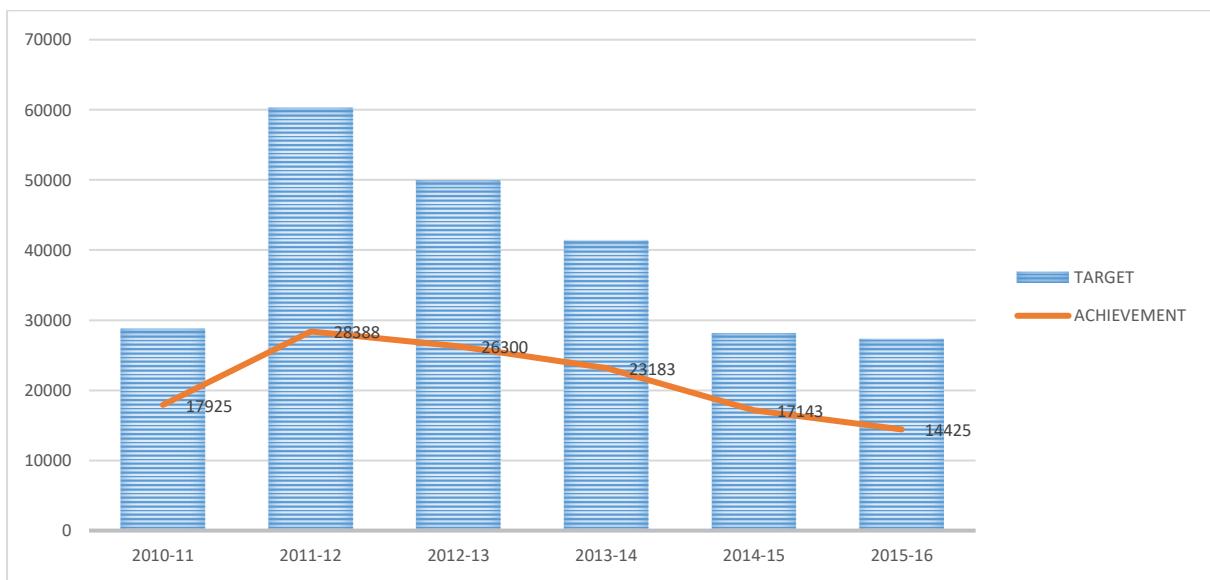


Figure (a)

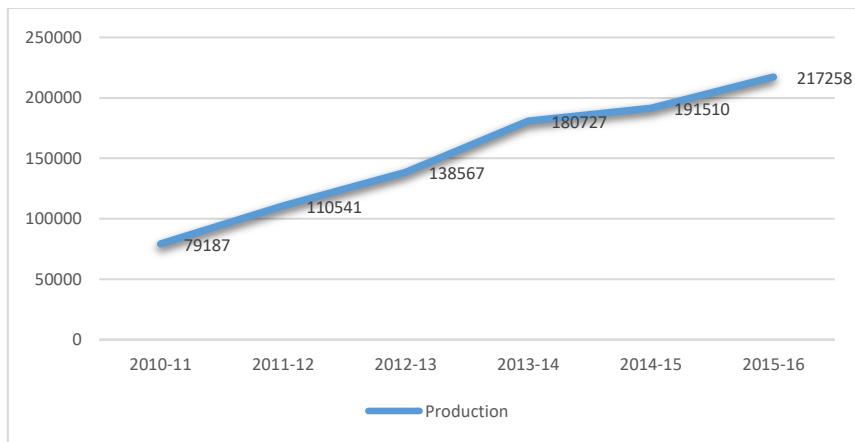


Figure (b)

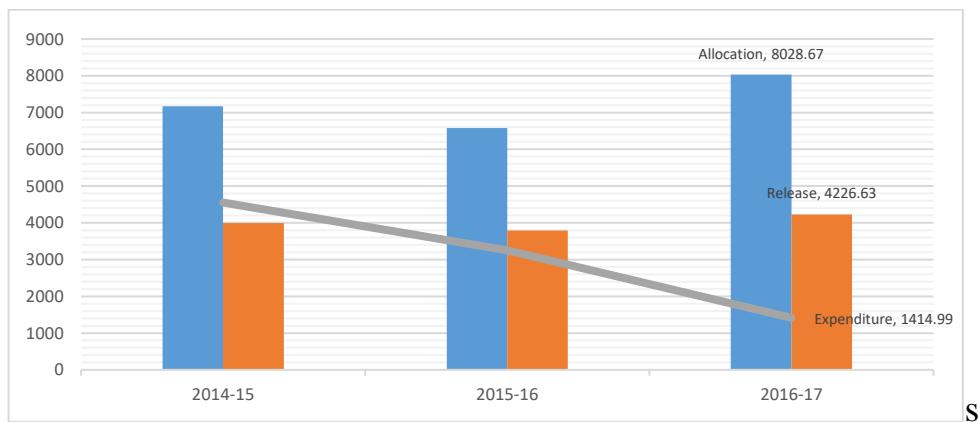
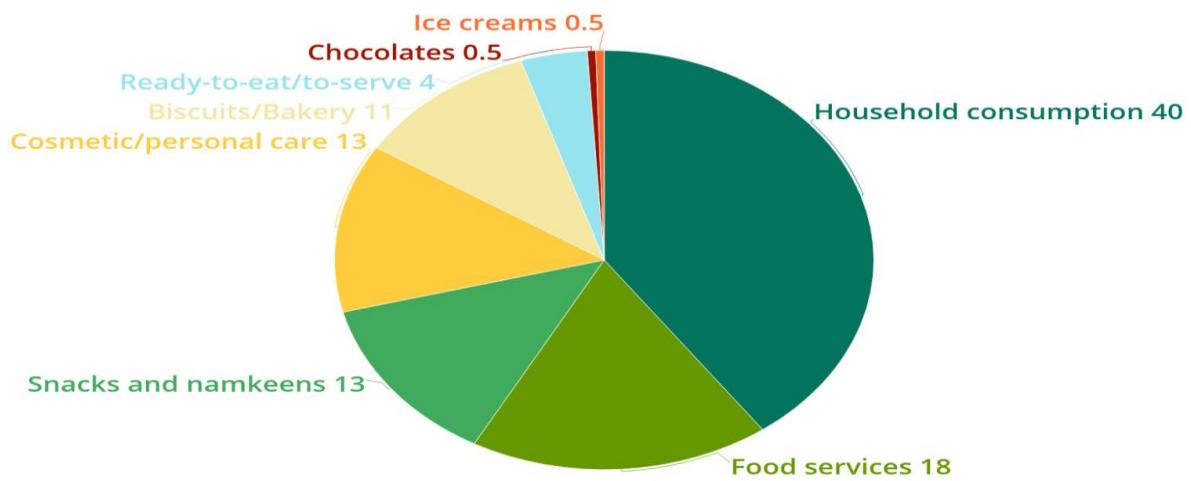


Figure (c)

End-users of palm oil in India (in percentage)

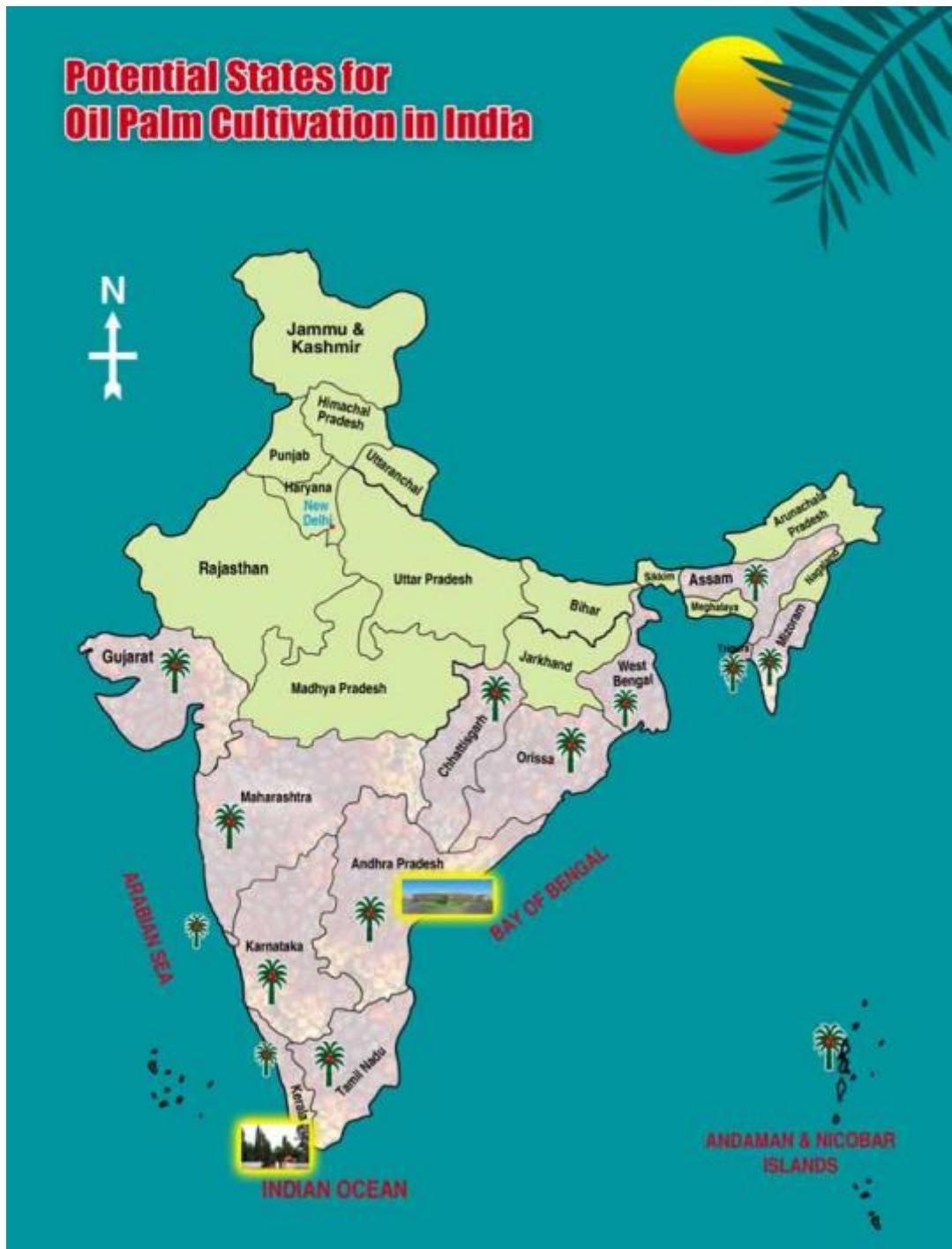


<https://bit.ly/3qOESk4>

Fig. 1.0 Scenario of Oil Palm in India

1.2 Potential

Under the New Mission on Oil palm (2021) known as the National Mission on Edible Oils – Oil Palm (NMO-OP), potential Oil Palm cultivation area of 20,29,523 hectares have been identified in 14 states.



<https://iopr.icar.gov.in/pdf/FAQs.pdf>

Fig. 1.1 Potential States/UT for Oil palm cultivation in India.

1.3 Government Intervention

- **New Mission on Oil palm (2021) known as the National Mission on Edible Oils – Oil Palm (NMOE-OP).** Under this scheme, it is proposed to cover an additional area of 6.5 lakh hectare (ha.) for oil palm till the year 2025-26 and thereby reaching the target of 10 lakh hectares ultimately. The production of Crude Palm Oil (CPO) is expected to go up to 11.20 lakh tonnes by 2025-26 and up to 28 lakh tonnes by 2029-30.
 - ✓ A new Centrally Sponsored Scheme with a special focus on the North east region and the Andaman and Nicobar Islands.
 - ✓ A financial outlay of Rs.11,040 crore out of which Rs.8,844 crore is the share of Government of India.
 - ✓ Focus on increasing area and productivity of oilseeds and Oil Palm.
 - ✓ Assistance to seed gardens specially for North-East and Andaman regions.
 - ✓ Price Assurance to Oil Palm farmers for Fresh Fruit Bunches.

Viability Price

The centre will give a price assurance to oil palm farmers to protect them from the fluctuations of the international market. This will be known as the viability price. It shall be the annual average price of the last 5 years adjusted with the wholesale price index to be multiplied by 14.3 per cent.

Formula Price

A formula price will also be fixed which will be 3 percent of crude palm oil price and will be fixed on a monthly basis.

Viability gap funding

The viability gap funding will be difference between the viability price and formula price and if the need arises, it would be paid directly to the farmers.

Two major focuses

1. The price of planting material for oil palm has been increased from Rs 12,000 per ha to Rs.29,000 per ha.

A special assistance of Rs 250 per plant is being given to replant old gardens for rejuvenation of old gardens.

2. To address the issue of shortage of planting material in the country, seed gardens will

Years	2021-22	2022-23	2023-24	2024-25	2025-26
Andhra Pradesh	2500	4000	11000	17500	5000
Assam	1500	2500	86000	100000	10000
Kerala	0	1000	1500	2000	2000
Mizoram	2000	3000	10000	10000	2000
Karnataka	2000	3300	4000	5000	5000

be provided assistance up to Rs.80 lakhs for 15 ha. in rest of India and Rs.100 lakhs for 15 ha in North-East and Andaman regions.

Further, assistance will be provided for seed gardens at Rs.40 lakhs for rest of India and Rs.50 lakhs for North-East & Andaman regions.

Table 4: Area Expansion state-wise target proposed by GoI and NMEO. (Figure (d))

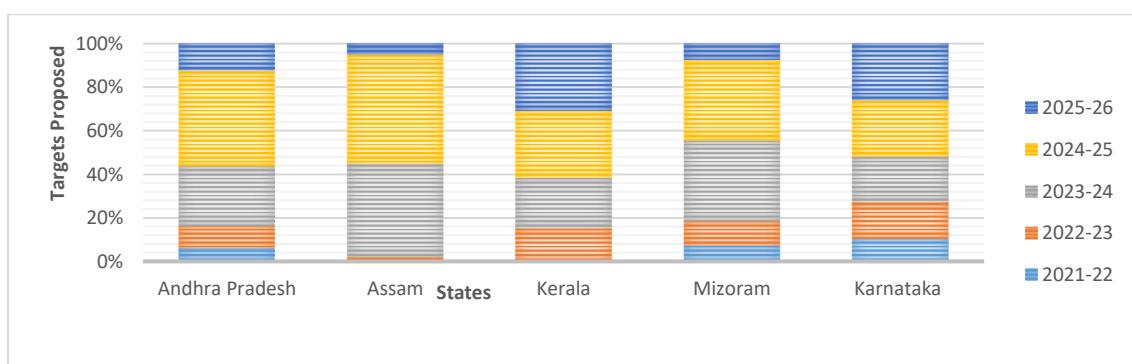
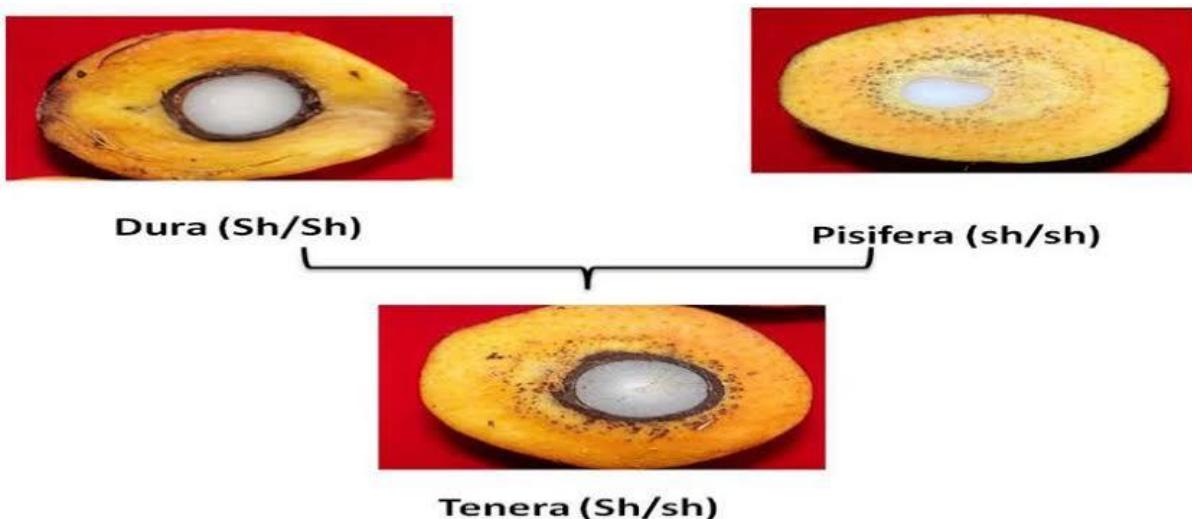


Figure (d)

2.Varieties and Preparation of Quality Planting Material

2.0 Varieties

There are three naturally occurring forms of the oil palm fruit, termed Dura, Tenera, and Pisifera. Most cultivars are the Tenera form which produces fruit with higher oil content. The only variety recommended for commercial cultivation is Tenera, which is a hybrid between Dura and Pisifera.



Source: Babu, B. & Mathur, Rk & Naveen Kumar, Penjerla & Ramajayam, Devarajan & Ravichandran, Govindan & Venu, M. & D.S. Sparjan. (2017). Development, identification and validation of CAPS marker for SHELL trait which governs dura, pisifera and tenera fruit forms in oil palm (*Elaeis guineensis* Jacq.). PLOS ONE. 12. e0171933. 10.1371/journal.pone.0171933.

Fig. 1.1 Tenera hybrid with thin shell and medium to high mesocarp and high oil content.

2.1 Nursery practices

The fruits are separated from the bunch and seeds are extracted by scraping off the exocarp and mesocarp with a knife, or by retting in water. The seeds are then dried by spreading them on concrete or wooden floors under shade for two days. Such seeds can be stored for 3-9 months at about 27 °C without much reduction in viability. Seeds are soaked in water for five days, changing the water daily. Thereafter, the seeds are spread out to dry for 24 hours. The dried seeds are put in polythene bags and placed in germinator maintained at a temperature of 40 °C. After 80 days, the seeds are removed from polythene bags, soaked in water for 5 days changing the water daily and dried in the shade for two hours. The seeds are then put back into bags and kept in a cool place in order to maintain the moisture content. Germination commences in about 10-12 days. The percentage of germination obtainable by this method is 90-95. Raising nursery Polybags (preferably black) of 400-500 gauge measuring 40 x 35 cm are used. The young plants (seedling or ramets) are removed from the pre-nursery after about two to three months,

or when four to five leaves have emerged. Roots will begin to emerge from the drainage holes in the planting bags after two months, thus these emerging roots will be disturbed during the potting-on process. Culling of abnormal plants should be carried out at this time. The bags are filled with topsoil and compost and are arranged at a spacing of 45 x 45 cm and one sprouted seed is dibbled per bag. 10-14 months old healthy seedlings with 1-1.3 m height from base and 13 functional leaves with good girth at collar are used for planting. Seedlings up to 24 months age can also be used.

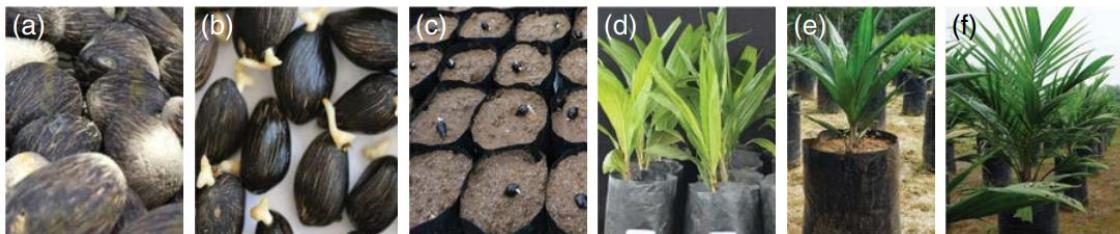


Fig. 1.1. Seed and seedling development in an oil palm nursery. a) Un-germinated seed; b) Germinated seed ready for sowing (0 weeks); c) Sowing seedlings; d) Seedlings in small bags ready for transplanting (12 weeks); e) Transplanted seedling in big bag with spacing (main nursery); f) Palms in big bag ready for field planting (36–48 weeks).



Fig. 1.2 The germinated seed placed on top of individual bags in the bed.

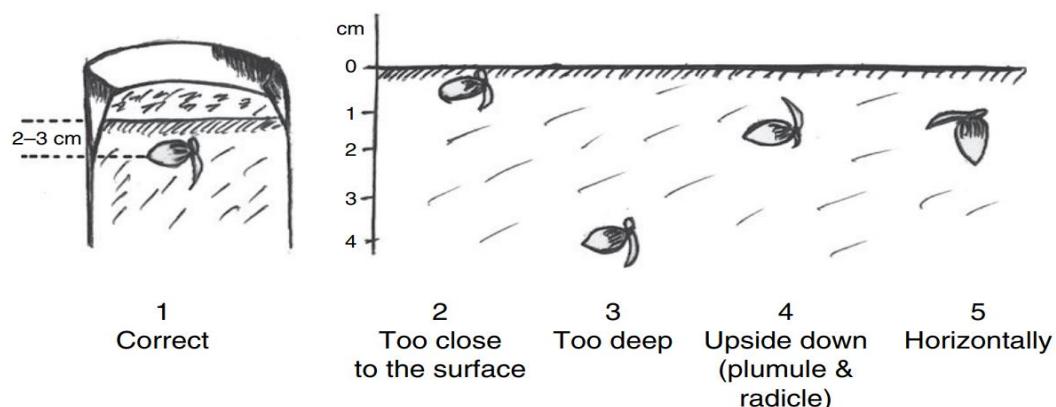


Fig. 1.3 Correct and incorrect orientation of germinated seed



Fig. 1.4 watering after planting.



Examples of abnormal seedlings: a) Narrow leaf; b) Crinkled leaf;
c) Twisted leaf; d) Rolled leaf.

Fig. 1.5



Fig. 1.6 Placing young plants to their new bags.



Fig. 1.7 Young plants placed in their new bags.



Fig. 1.8 Transportation of young palms to the field.

Source: *Nursery practices in oil palm : a manual / Nur Dian Laksono, Umi Setiawati,Fazrin Nur, Miranti Rahmaningsih, Yassier Anwar, Heru Rusfandi, Eben Haeser Sembiring, Brian P. Forster, Avasarala Sreenivasa Subbarao, Hafni Zahara.*

3. Cultivation Practices for Oil Palm

3.0 Plant

Oil palm can reach 60-80 ft in height in nature, but is rarely more than 20 or 30 ft in cultivation. Leaf bases are persistent for years, and prominent leaf scars are arranged spirally on the trunk of mature palms where bases have fallen. Leaves are up to 25 ft in length, with leaflets numbering 200-300 per leaf, about 3-4 ft long and 1.5 - 2.0" wide, with entire margins. Leaflets cover the distal 2/3 of the leaf, and the lower 1/3 is spined with spines increasing in length acropetally.

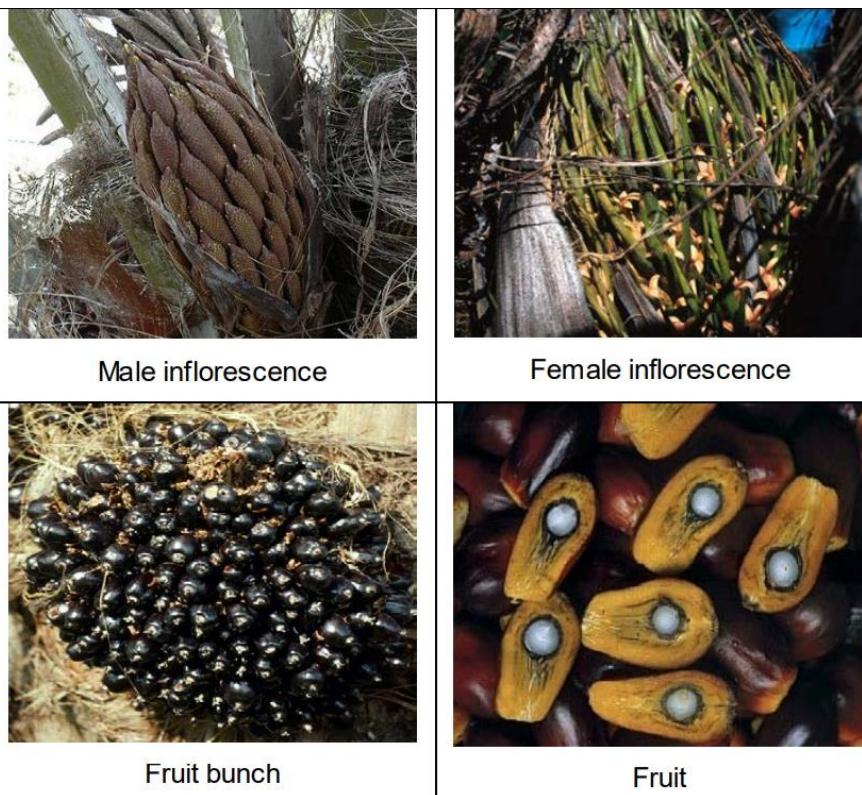


Fig. 2.0 Botany of Oil palm.

Source: <http://eagri.org/eagri50/HORT282/lec20.html>

3.1 Climatic requirements:

Oil palm is a humid crop. Requires evenly distributed rainfall of 150mm/ month or 2500-4000mm/ annum. Rainfall distribution in India is not even and adequate. Hence grow oil palm under assured irrigation conditions by adopting recommended practices. Crop comes up well between 29-33°C max. and 22-24°C min. temperatures and with bright sunlight for at least 5 hrs. per day. Humidity of more than 80% is required to come up well.

3.1.0 Soils: Best-suited soils are moist, well-drained, deep, loamy alluvial soils, rich in organic matter with good water permeability. At least one-meter depth of soil is required. Avoid highly alkaline, highly saline, waterlogged and coastal sandy soils.

3.1.1 Cultivated variety: Tenera is the ruling hybrid and it is a cross between thick-shelled Dura and shell less Pisifera. Tenera has a thin shell, medium to high mesocarp content and high oil content. (Fig 1.0)

3.1.2 Planting: Best season for planting is June-December i.e., during monsoon. In case of planting during summer, adequate irrigation, mulching and growing cover crops like sun hemp in the basin would help in avoiding hot winds during summer. 12 -14 months old healthy seedlings with 1-1.3m height and 13 functional leaves are recommended for planting. While planting, 143 plants per hectare should be maintained with a spacing of 9m x 9m x 9m (triangular planting). Planting should be done in pit size of 60 cm x 60 cm x 60 cm (length, breadth and depth).

Apply 250g Di Ammonium Phosphate or 400g Single Super Phosphate, 50g Phorate and mix with the soil at the base of the pit. Immediately after planting, form basin and give copious irrigation.

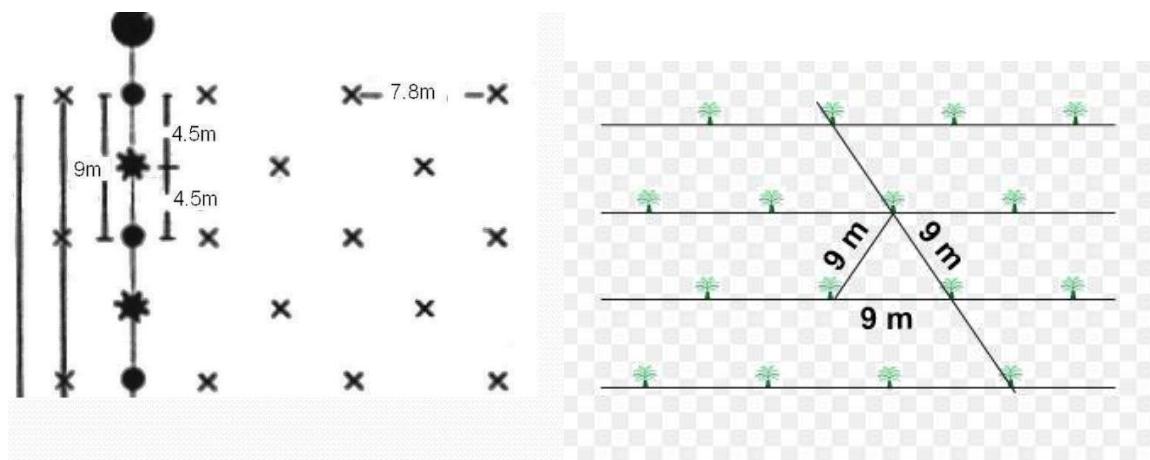


Fig. 2.1 Spacing for Oil palm.

Source : <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

3.2 Planting method:

- Fill the gap in the pit with soil and press firmly leaving the top portion so that the seedling bowl will be 25 cm below the ground level.
- Immediately after planting form basin and give copious irrigation. □ Provide a wooden support if wind is more.
- Take care to see that the soil does not get accumulated at the crown region, which may lead to rotting of crown.

- In case of low lying wet land soils planting should be done in raised mounds to avoid water logging and poor aeration.
- Do not store the seedlings for days together in open place after lifting and transporting to the farm.

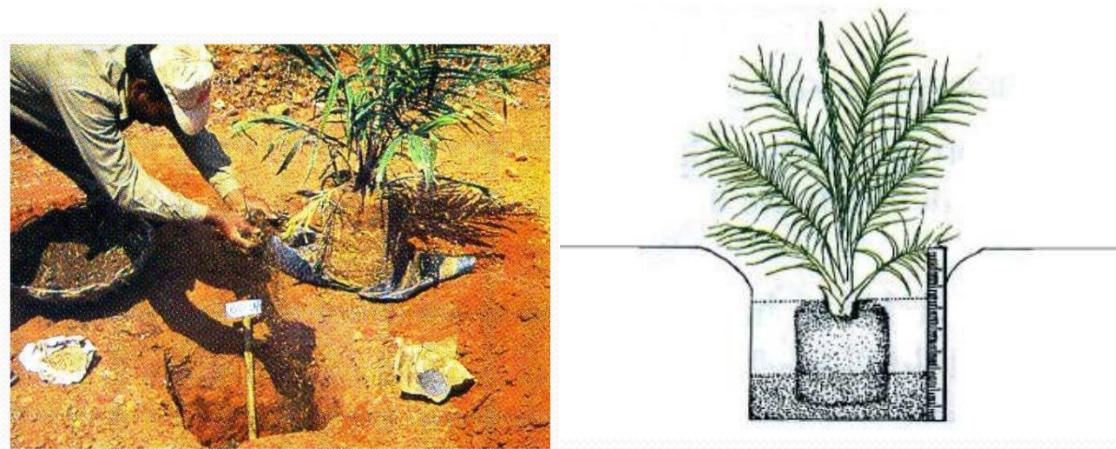


Fig. 2.2 Method of planting Oil palm.

Source : <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

3.3 Irrigation Management:

- Oil palm requires sufficient irrigation, as it is a fast growing crop with high productivity and biomass production. Do not grow oil palm if assured and adequate irrigation facility is not available. Insufficient irrigation will reduce the rate of leaf production, affects the sex ratio and results in inflorescence abortion and yield reduction.
- For grown up yielding palms of 3 years age and above a minimum of 200-250 liters of water per day is must. However, in older plantations during hot summer this amount may be increased up to 300-350 liters.
- When irrigation is not a constraint, basin irrigation can be taken up. Prepare irrigation channels in such a way that, the individual palms are connected separately by sub channels. If irrigation water is limited and land is of undulated terrain drip or micro sprinkler irrigation will be of advantage.



Fig. 2.3 Basin Method of Irrigation.

Source: *Mitigation methods in oil palm cultivation under delayed monsoon conditions*
<https://bit.ly/35czfnm>

- If irrigation water is limited and land is of undulated terrain drip or micro sprinkler irrigation can be advantageous. In drip system, a minimum of four drippers has to be placed for each palm. If each dripper discharges 8 liters of water per hour, 7 hours of irrigation per day is sufficient to discharge 224 liters per day. Drippers should be checked periodically for proper discharge of water. Basins must be adequately mulched, which will help to conserve moisture.



Fig. 2.4 Drip Irrigation for oil palm. Source: *Drip irrigation helps increase the world's vegetable fat source* <https://www.netafim.africa/crops-and-yields/oil-palm/>



Fig. 2.5 Sprinkler Irrigation for oil palm.

Source: Senninger agriculture irrigation <https://www.senninger.com/node/65956>

Subsidy for drip irrigation for oil palm is available on the drip material, 50-70%, not exceeding Rs. 50,000/- per farmer. Please contact the office of the Assistant Director of Horticulture/Agriculture of the respective district.

3.4 Irrigation Management during summer:

- When temperature reaches $> 40^{\circ}\text{C}$ and RH is low, if heat waves exist during summer, the adverse climate will affect oil palm growth and yield. Hence necessary precautions need to be taken during summer in oil palm plantations (Water stress to the palm can be identified in oil palm with the presence of two or more unopened spindles on the crown).
- If irrigation is provided through basin method, in light soils provide more frequently with recommended quantity. In heavy soils provide recommended quantity in less frequency. If irrigation is provided through micro irrigation, check the discharge of drip/jets.
- **Mulching** : In order to avoid losses through evaporation, check weed growth and conserve moisture, practice mulching in the palm basins with coconut husk, oil palm empty fruit bunches, oil palm/coconut fiber, maize stalk, dried oil palm fronds etc.



Fig. 2.6 Mulching for oil palm.

<https://bit.ly/3tK44d9>

<https://www.netafim.africa/crops-and-yields/oil-palm/>

3.5 Nutrient Management:

- Oil palm is a heavy feeder and demands a balanced and adequate supply of macro, secondary and micro - nutrients for growth and yield. For newly planted crop, the first dose of fertilizer can be applied three months after planting.
- **Borax @ 100 gm per palm per year is recommended when the deficiency symptoms are noticed.** Fertilizers are to be applied in a minimum of three to four equal splits in a year. If good FYM is available, add 50 – 100 kg FYM or 100 kg green manure per palm along with the second dose of fertilizer application. Five kg of neem cake per palm can also be applied. However care should be taken to reduce the nitrogen through chemical fertilizer in proportion to that available in FYM.
- Broadcast the fertilizers around the clean weeded basin, about 50 cm away from the palm base as the absorbing roots are concentrated there and incorporate fertilizer into the soil by forking. Irrigate the palms immediately after fertilizer application.

- If the native soil fertility is high, nitrogen application can be reduced. Where yields are 30-35 t/ha amount of potash may be increased to 1800-2400 gms/palm/year. (3-4kg of muriate of potash/palm/yr.)

Fertilizer calculator: <https://iiopr.icar.gov.in/fertilizercalculator.php>

3.6 Fertilizer application

If fertilizers are applied in the form of urea, single super phosphate and muriate of potash, following quantities may be applied in three to four equal splits.

Age of the palm	Urea (gms/palm/yr)	Single super phosphate (gms/palm/yr)	Muriate of potash (gms/palm/yr)
First year	870	1250	667
Second year	1740	2500	1333
Third year and above	2610	3750	2000

If fertilizers are applied in the form of DAP, urea, and muriate of potash, following quantities may be applied in three to four equal splits. .

Age of the palm	Urea (gms/palm/yr)	Diammonium phosphate (gms/palm/yr)	Muriate of potash (gms/palm/yr)
First year	700	435	667
Second year	1400	870	1333
Third year and above	2100	1305	2000

If fertilizers are applied in the form of Ammonium sulphate, Single super phosphate and muriate of potash, following quantities may be applied in three to four equal splits.

Age of the palm	Ammonium sulphate (gms/palm/yr)	Single super phosphate (gms/palm/yr)	Muriate of potash (gms/palm/yr)
First year	1942	1250	667
Second year	3883	2500	1333
Third year and above	5825	3750	2000

If fertilizers are applied in the form of Urea, complex fertilizers (10:26:26) and muriate of potash, following quantities may be applied in three to four equal splits.

Age of the palm	Urea (gms/palm/yr)	Complex fertilizer (10:26:26) (gms/palm/yr)	Muriate of potash (gms/palm/yr)
First year	703	769	333
Second year	1405	1538	667
Third year and above	2108	2308	1000

If fertilizers are applied in the form of Urea, complex fertilizer (17:17:17) and muriate of potash, following quantities may be applied in three to four equal splits.

Age of the palm	Urea (gms/palm/yr)	Complex fertilizer (17:17:17) (gms/palm/yr)	Muriate of potash (gms/palm/yr)
First year	434	1176	333
Second year	870	2353	667
Third year and above	1304	3529	1000

<https://iiopr.icar.gov.in/pdf/FAQs.pdf>

3.6.0 Basin management: During first year, basins of 1-m radius, second year 2- m radius, and the third year 3- m radius are to be taken around the palm by removing the soil from inside so that the soil will not accumulate at the collar region. Basin area of oil palm represents its active root zone. Hence it must be kept clean and weed free to avoid competition for nutrients and water.



Fig. 2.7 Basin management in oil palm.

3.7 Weeding: Take up regular weeding manually or with the use of only recommended herbicides. Use preferably contact herbicides.

Herbicide mixtures of Paraquat with Atrazine, Monuron and Diuron sprayed on ground, twice a year can control the weeds, effectively.

Mulching, growing cover crops and inter-crops minimizes weed growth.

- Do not use 2, 4-D, 2, 4, 5-T halogenated aliphatic acids, Dalapon and TCA. These compounds produce abnormalities in Oil Palm.

See that the spray fluid does not spill on the Oil Palm plants.



a)

<https://bit.ly/3GP8DGJ>



b)

<https://www.flickr.com/photos/iita-media-library/7996213432>



c)

Fig. 2.8 a) Mechanical b) manual c) chemical weeding in oil palm. *Source: <https://bit.ly/33Xwrtr>*

3.8 Pruning

- Maximum number of green leaves should be retained on the palm.
- Only the lower dried and diseased leaves must be pruned.
- While pruning give a clean cut to the petiole as close to the stem as possible with a sharp chisel.
- Any damage to petiole or stem will attract disease organisms.
- Don't: Severe pruning will adversely affect both growth and yield of the palm.



Fig. 2.9 Pruning in oil palm.

Source : <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

3.8 Inter-cropping: Oil palm is a wide spaced perennial crop with a long juvenile period of 3 years. Inter and intra row space can be used to generate income during the juvenile phase of the crop. Inter crop selected should be compatible with the main crop and should not compete with oil palm for light, water and nutrients. Any remunerative crop can be grown, but the most suitable crops are vegetables, banana, flowers, tobacco, groundnut, chillies, turmeric, ginger, pineapple etc. While growing inter crops in mature oil palm gardens of 8- 12 years age or palms attained a height of 3 meters, intercrops should be able to grow under partially shaded conditions and should not compete with oil palm for water, sunlight and nutrients (eg. cocoa, pepper, heliconia and ginger lilly).

- ✓ Do not cut the oil palm fronds.
- ✓ Do not tie oil palm fronds close to the stem for inter-cropping, which will reduce photosynthetic activity.
- ✓ Do not plough close to the palm base, which will cut the absorbing roots and thereby reduce intake of water and nutrients. Maximum number of green leaves should be retained on the palm.



Fig. 3.0 Oil Palm with Banana

Source : <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>



Fig. 3.1 Oil Palm with Chillies

<https://bit.ly/3tMxVBH>



Fig. 3.2 Oil Palm with Pineapple

Source : <https://doi.org/10.20546/ijcmas.2018.712.312>



Fig. 3.3 Oil Palm with Elephant foot Yam

Source : <https://doi.org/10.20546/ijcmas.2018.712.312>



Fig. 3.4 Oil Palm with Groundnut.

Source : <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

3.9 Flowering:

- Oil Palm comes to flowering 14 -18 months after planting.
- It produces both male and female flowers separately on the same palm (monoecious).
- Male and female phases do occur naturally in consequent cycles in a palm.
- Some individual trees may exhibit a phenomenon of producing more male inflorescences and less number of female inflorescences.
- Overall there should be an average of 10-12 bunches per tree per year.

3.9.0 Causes for increased male inflorescence

- Insufficient irrigation and irrigation at longer intervals
- Non-application of recommended doses of fertilizers and other manures in appropriate quantities and time. Excessive pruning of fronds.
- Ploughing deeply and close to the palms damaging the active feeding roots.



Fig. 3.5 a) Male inflorescence



Fig. 3.5 b) Male inflorescence and female Inflorescence

<https://bit.ly/3tNmJEY>

3.9.1 Ablation: Ablation is the removal of male and female flowers produced in the early stages of plantation. This enables the plant to gain adequate stem girth, vigour and develop adequate root system. Flowering starts from 14th to 18th month after planting. Start ablation immediately after the appearance of inflorescences on the palms. They can be removed easily by hand pulling. Ablation can be extended up to 2-1/2 to 3 years depending upon the plant growth and vigour.

3.9.2 Pollination: Oil palm is a highly cross-pollinated crop. Wind and insects assist pollination, but wind pollination is not adequate. Effective pollinating insects like *Elaeidobius kamerunicus* helps in good pollination and fruit set. Release of this weevil after 2-1/2 year of planting is advisable. If the plants are not having good girth and vigour, release the weevils after 3 years.

Fig. 3.6 a) Manual pollination of oil palm



<https://bit.ly/3fLaa4R>



<https://bit.ly/3FQlLub>

Fig. 3.6 b) Elaeidobius kamerunicus (pollination weevil for oil palm)

3.9.3 Harvesting of oil palm

Harvesting should be aimed at recovering the whole harvestable produce without loss of oil or loose fruit.

Good harvesting Indices

- Fruits in the bunch turn yellowish orange.
- 5-10 fruits from each bunch drop on their own.
- When pressed hard with the fingers, orange yellow coloured oil exudes from the fruit.

3.9.4 Harvesting Method

In tall and older plantations harvesting can be done with the help of sickle attached to an aluminium pole of 12ft. height. (1.5" inner diameter and 2 mm thickness). By using male and female joint, the height of the pole can be increased by fixing additional poles of 12ft height.



Fig. 3.8 Ripe oil palm bunch <https://bit.ly/3rlId1kD> <https://bit.ly/3qRoiQh>



Fig. 3.8 Harvesting of Oil palm <https://bit.ly/35gi3xj>



Fig. 3.8 Oil palm Harvesting tools

<http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

- While harvesting a stalk length of 5 cm alone should be left.
- Harvesting should be done at 10-12 days interval.
- During rainy season harvesting should be done at closer interval of 6-7 days as ripening is hastened after hot summer.

3.9.5 Yield:

At yield stabilizing period (4-8 years): 12t/ha

At yield stabilized period (>8 years): 20t/ha

4. Integrated pest Management in Oil Palm

Pests of nursery:

a) Spindle bug:

Symptom:



Fig. 3.9 Spindle bug.

<https://bit.ly/3FXqCcS>

Necrotic lesions and dry brown patches on leaves.

Spindle fails to open.

Control: Keep Phorate (2g) filled perforated poly sachets in the leaf axil.

b) Tussock caterpillar:

Symptom: Defoliation of leaves.



Fig. 4.0 Tussock caterpillar infestation

Control: Hand picking of caterpillars.

Cut and burn the damaged leaves.

Spray Monocrotophos (0.036%) or Carbaryl (0.1%) if infestation is severe.

c) Root grubs/Cockchafer beetles:



Fig. 4.1 Cockchafer grub and beetle <https://bit.ly/355CuNc>

Symptom: Sudden death of young plants.

Control: Fill the seedling bags with the soil free from root grub infestation.

Apply 50g Phorate per seedling while planting the sprouts.

Don't: Do not collect the soil from root grub endemic areas for filling the seedling bags.

d) Termites:



Fig. 4.1 Termites and termite mould

Symptom: Stunted growth of the plant.

Control: Give copious irrigation.

Apply quinalphos (0.06%) or chloropyriphos (0.05%)

e) Wild boar:



Fig. 4.2 Wild boar and destruction of seedling <https://bit.ly/3FTh1E3>

Symptom: Destruction of the boll region.

Control: Wild boar scaring device may be kept.

Pests of adult palms:

i) Major pests:

a) Rhinoceros beetle:



a) <https://bit.ly/35hTShZ>



Fig. 4.2 a) & b) Symptoms visible at different parts of plant



Fig. 4.2 b) V shaped fonds <https://bit.ly/3FSsFPC>



Fig. 4.2 c) Rhinoceros beetle

Symptom: "V" shaped gaps in the leaf silhouette. Hole at the leaf base and chewed up fibre is seen at that place.

Control:

- Destruction of breeding sites. Maintain sanitation in the orchard.
- Extraction and killing of insect from spindle portion with metallic hook.
- Trap the adults with fermented castor cake or pheromone bait.

- For preparation of fermented castor cake, take fresh castor seeds and roast them. Grind them and mix with 'rice water' or 'yeast' for fermentation. After 12th day keep sufficient quantity into individual wide mouthed earthen pots and place them near Oil Palm plant to attract the adult beetles.
- Use bio-agents like virus (*Baculovirus oryctes*) and fungi (*Metarrhizium anisopliae*).
- Treat the compost pits with insecticides like carbaryl or quinalphos (0.025%) regularly to kill the young stages of the pest.

Don't: Do not apply partially rotten Farm Yard Manure or Compost to the palms as they may contain grub stages of the pest.

b) Red Palm Weevil:



Fig. 4.3 a) Red palm weevil

Fig. 4.3 b)



Fig. 4.3 b) & c) Visual symptoms of weevil infestation

<https://bit.ly/3KySac5>

Symptoms:

- Palms show gradual wilting and drying.
- Presence of few holes and oozing of brown viscous liquid from these holes at the base of the palm. Grubs feeding inside the trunk make characteristic sound.

Control:

- Removal of damaged and dead palms, rotten bunches from the orchard. Apply 'tar' to the wounds and cuts on stem portion to avoid the egg laying.
- Trap the adult beetles using log or pheromone baits.
- Maintain good sanitation in the orchard. Root feeding of monocrotophos (mix 10 ml of insecticide in 10 ml of water) may be followed.
- **Don't:** Do not make wounds on the stem portion of the palm.

c) Case worm:



Fig. 4.4 Caseworm in Oil palm

<https://bit.ly/3ocxSMf>

Symptoms:

- Holes on the leaves.
- Occasional defoliation.
- Cone shape bags on the under surface of the leaves.
- Control: Cut and burn badly infested leaves.
- Spray carbaryl (0.1%) on infested leaves.
- Root feeding of monocrotophos (mix 10 ml of insecticide in 10 ml of water) may be practised if infestation is severe.

d) Birds:

Symptoms: Bird feeding symptoms on mesocarp of fruits resulting in fruit and oil loss.

Control: Cover the fruit bunches with wire net or Coconut or Oil Palm leaves after 150 days of fruit set. Use bird scare devices.

e) Rats:



a) <https://bit.ly/3fWykd>



Fig. 4.5 a) & b) Rat infestation symptoms and control in oil palm

<http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

Symptoms:

- Damage symptoms on young fruits.
- Gnawing symptoms on exposed pericarp of the fruit.
- Damage to the boll region and killing the young palms.

Control:

- Follow integrated management practices using all the possible measures of control.
- Baiting with Zinc Phosphate, use of iron live trap, snap trap, death fall trap or bow trap etc. Keep Aluminium phosphide tablets in the rat holes.
- Cover the base portion of the plant with wire mesh while planting.
- Keep anticoagulants like 'ratabar' in the crown region on the bunches.

Minor pests

a) Scales and Mealybugs:



Fig. 4.6 Mealy bugs in Oil palm

<https://bit.ly/3tP8bVx>

<http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

Symptoms: Yellowing of unfolding leaves.

Stunted growth, Infests on fruit bunches.

Control: Naturally suppressed by bioagents.

If need be spray any systemic insecticide like phosphamidon or dimethoate (0.03%).

b) Termites:

Symptoms: Feeding on the spear leaves, male inflorescence and fruit bunches.

Control: Give copious irrigation.

Apply quinalphos (0.06%) or chlorpyrifos (0.05%) in the basins if infestation is severe.

Find the termite nests/mound and destroy.

5. Integrated Disease Management in Oil Palm

a) Stem Wet Rot:



Fig. 4.6 Stem wet rot in oil palm <https://bit.ly/3KBpmj7> <https://bit.ly/3KyG3vN>

Symptoms:

Sudden death of spear leaves including the young expanded fronds surrounding the spear. Remaining fronds show yellowish discolouration and then rapidly wither and die.

Sometimes, the older leaves die first and the symptoms progress to the younger fronds.

Effect: The affected palm usually will have a cavity of variable size filled with rotten fibrous mass at the centre of the stem.

- Rotting mass will be generally bright yellowish in colour.
- At the base of the stem it is fibrous usually black in colour and slightly wet.

Management:

- Improvement in agronomic practices, providing drainage, avoid flooding of the field etc.
- Early detection of the disease and trunk surgery can save the palm.
- In case of suspected palms for confirmation of the disease, a sharp iron rod may be pierced into the stem base, which gives out some liquid.
- If the liquid gives putrified smell, the palm should be subjected to trunk surgery immediately.



Fig. 4.7 Trunk surgery <http://odihort.nic.in/sites/default/files/Oilpalm-Cultivation-in-Odisha.pdf>

- Trunk Surgery:
 - ✓ Trunk surgery is done to excise all affected fibrous tissues from inside the trunk. First the outer stem tissues and frond butts should be chiseled.
 - ✓ The inner most disease tissues including yellowish lesions which are generally seen along with the border of healthy and diseased tissues also should be removed.
 - ✓ When the surgery is completed a protective covering with carbendazim (1%) + monocrotophos (1ml) paste followed by hot coal tar should be given to prevent the wound invading micro-organisms and insects.

Don'ts: Do not allow water to stagnate in the fields, avoid flooding of the field. →Do not leave the tissues exposed after trunk surgery. Give protective coat with coal tar and fungicides immediately or on the following day.

Don't use copper fungicides.

b. Bud rot disease:



Fig. 4.8 Bud rot

Source :Woittiez, L.S., Haryono, S., Turhina, S., Dani, H., Dukan, T.P., Smit, H. 2016. Smallholder Oil Palm Handbook Module 5: Pests and Diseases. 3rd Edition. Wageningen University, Wageningen, and SNV International Development Organisation, The Hague. 29 pages

Symptoms:

- Yellowing of the spear leaves which subsequently turns to brown.

- Affected spear bends at the base and seen hanging down in the crown.
- The basal tissues of the spear completely gets rotted, as a result it collapses and can easily pulled out.
- The rotten tissues emit offensive odour.
- Continuous and unchecked rotting leads to total destruction of meristem and ultimately death of the palm.
- Often, the disease becomes rampant during, the monsoon season when the inoculum build up reaches high.
- Palms of all ages are prone to this disease.

Disease Management: It is possible to cure very effectively, if the disease is detected in the early stages i.e. when the spindle starts showing symptoms of withering, yellowing and dropping down.

- The affected spear should be pulled out along with the decayed tissues.
- The affected tissues in the crown should be removed and drenched with fungicide solution, like Carbendazim or Thiram (0.1%)
- For treating advance stage disease affected palms, first of all, the leaves surrounding the spear should be cut and the affected tissues of the meristem should be removed layer by layer till fresh tissues are seen.
- Once the affected tissues are completely removed the exposed tissues of the apical bud should be cleaned and smeared with 1% carbendazim solution. The exposed portion should be covered with dried leaves or perforated polythene sheet.
- Prophylactic Check: Where the beetle damage is predominantly high, it should be checked by keeping 10 g of phorate granules in perforated polythene sheet.

Dont's: Do not delay in giving treatment.

- Curative measures like removing the rotten tissues, crown surgery should be done as early as possible after the initial symptoms are seen.
- The rotten tissues and spear removed from the affected palms should not be left in the field. Those should be collected and burnt.
- While doing crown surgery to remove the rotten tissues care should be taken not to split or damage the apical bud.

c) Basal Stem Rot (ganoderma):



a) Ganoderma infection



Fig. 4.9 b) Basal stem rot (Ganoderma)

Source :Woittiez, L.S., Haryono, S., Turhina, S., Dani, H., Dukan, T.P., Smit, H. 2016. Smallholder Oil Palm Handbook Module 5: Pests and Diseases. 3rd Edition. Wageningen University, Wageningen, and SNV International Development Organisation, The Hague. 29 pages

Generally the disease incidence can be expected in the coastal estates where the old coconut plantations are already affected by the disease and soils are infected with the pathogen.

Symptoms:

- Withering, yellowing and orange discolouration of the leaves followed by necrosis on one side of older fronds.
- Desiccated fronds drop or break at some point along the rachis.
- Appearance of light brown lesions / rotting of the bole at the stem base is characteristic symptom at the advanced stage of disease.
- The infected palms appear suffering with malnutrition.
- The disease produces dry rot of internal tissues at the base of trunk.
- The roots become friable and disintegrate easily. The internal tissues turn into dry and powdery mass.

Management of the disease:

- Field Sanitation: Removal and destruction of the dead and diseased palms in order to prevent the spread of the disease.
- Isolation of diseased Palms: The palms in the early or middle stages of the disease should be isolated from the neighbouring palms by taking trenches of 1 m deep and 30 cm wide.
- Affected palm should be given 5 kg of neem cake/year.
- The disease affected and apparently healthy palms should be treated with 10 ml. Calixin (tridemorph) or 10 g Aureofungin sol (in 100 ml of water) per palm through root feeding.
- The suspected disease palms should be uprooted and destroyed immediately as soon as they are noticed.

Dont's: Do not plant the Oil Palm seedlings in the area where Ganoderma disease of coconut is prevalent or the area is prone for the Ganoderma.

Water movement, ploughing and other management practices should not be allowed to move from the disease affected palm site to the other areas of the garden.

d) Bunch Rot:



Fig. 5.0 Bunch rot

<https://bit.ly/3qT2NP7> <https://bit.ly/3AnFuQG>

Bunch rot disease is one of the important diseases affecting the fresh fruit bunches thus causing direct economic loss.

Symptoms:

- During the early stages of infection, strands of mycelium can be seen spreading over the bunch surface.
- Mycelium development is profused particularly at the back of the bunch.
- In the later stage, the mycelium grows over the fruit surface and penetrates into the mesocarp.
- The infected bunch becomes completely rotten and unfit for harvest.

Cause: Diseased bunches left on palms itself spread the disease from one bunch to other bunch of the palm.

Control: Sanitation: Before on-set of monsoon, crown cleaning by means of removing the dead inflorescences, bunch stalks, aborted bunches etc. will help in reducing the inoculum build up and harbouring of pathogen.

Chemical Control: To check the spread of the disease and to eradicate the inoculum of the fungus, crowns of the infected palms should be thoroughly cleaned and sprayed with 0.1% Carbendazim solution.

Don'ts: Do not leave the rotten, aborted bunches and dried inflorescences on the crown.

Don't use copper fungicides. Oil palm is sensitive to them.

6.0 Processing of Oil Palm

Research and development work in many disciplines - biochemistry, chemical and mechanical engineering - and the establishment of plantations, which provided the opportunity for large-scale fully mechanised processing, resulted in the evolution of a sequence of processing steps designed to extract, from a harvested oil palm bunch, a high yield of a product of acceptable quality for the international edible oil trade. The oil winning process, in summary, involves the reception of fresh fruit bunches from the plantations, sterilizing and threshing of the bunches to free the palm fruit, mashing the fruit and pressing out the crude palm oil. The crude oil is further treated to purify and dry it for storage and export.

Large-scale plants, featuring all stages required to produce palm oil to international standards, are generally handling from 3 to 60 tonnes of FFB/hr. The large installations have mechanical handling systems (bucket and screw conveyors, pumps and pipelines) and operate continuously, depending on the availability of FFB. Boilers, fuelled by fibre and shell, produce superheated steam, used to generate electricity through turbine generators. The lower pressure steam from the turbine is used for heating purposes throughout the factory. Most processing operations are automatically controlled and routine sampling and analysis by process control laboratories ensure smooth, efficient operation. Although such large installations are capital intensive, extraction rates of 23 - 24 percent palm oil per bunch can be achieved from good quality Tenera.

Conversion of crude palm oil to refined oil involves removal of the products of hydrolysis and oxidation, colour and flavour. After refining, the oil may be separated (fractionated) into liquid and solid phases by thermo-mechanical means (controlled cooling, crystallization, and filtering), and the liquid fraction (olein) is used extensively as a liquid cooking oil in tropical climates, competing successfully with the more expensive groundnut, corn, and sunflower oils.

Extraction of oil from the palm kernels is generally separate from palm oil extraction, and will often be carried out in mills that process other oilseeds (such as groundnuts, rapeseed, cottonseed, shea nuts or copra). The stages in this process comprise grinding the kernels into small particles, heating (cooking), and extracting the oil using an oilseed expeller or petroleum-derived solvent. The oil then requires clarification in a filter press or by sedimentation. Extraction is a well-established industry, with large numbers of international manufacturers able to offer equipment that can process from 10 kg to several tonnes per hour.

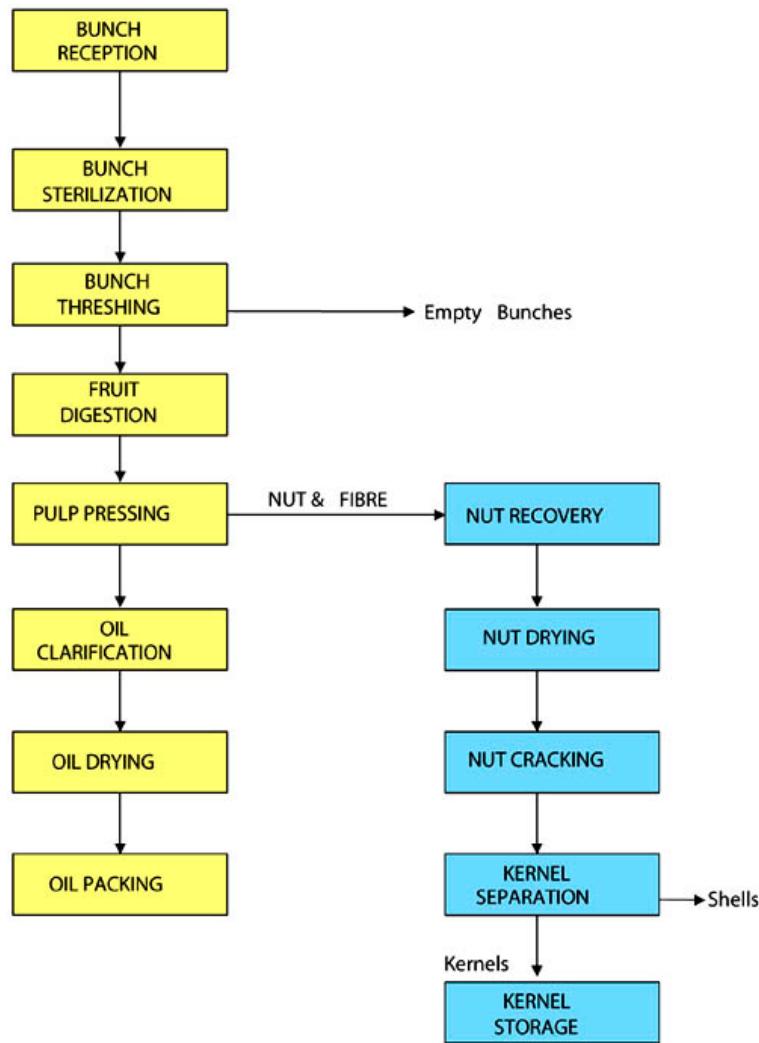


Fig. 5.1 Oil palm processing unit operations

<https://www.fao.org/3/y4355e/y4355e04.htm>

Unit operation	Purpose
1. Fruit fermentation	To loosen fruit base from spikelets and to allow ripening processes to abate
2. Bunch chopping	To facilitate manual removal of fruit
3. Fruit sorting	To remove and sort fruit from spikelets
4. Fruit boiling	To sterilize and stop enzymatic spoilage, coagulate protein and expose microscopic oil cells
5. Fruit digestion	To rupture oil-bearing cells to allow oil flow during extraction while separating fibre from nuts
6. Mash pressing	To release fluid palm oil using applied pressure on ruptured cellular contents
7. Oil purification	To boil mixture of oil and water to remove water-soluble gums and resins in the oil, dry decanted oil by further heating
8. Fibre-nut separation	To separate de-oiled fibre from palm nuts.
9. Second Pressing	To recover residual oil for use as soap stock
10. Nut drying	To sun dry nuts for later cracking



Fig. 5.2 Machines used in oil palm processing

<https://bit.ly/3Aqe5O6>

Government Support for Oil palm Processing Mills

For North east states and Andaman & Nicobar Islands 50% of the cost limited to Rs.500 lakh for a unit of 5.00 MT/Hr for new oil palm Mill with pro rata increase.

6.1 Marketing of Oil palm

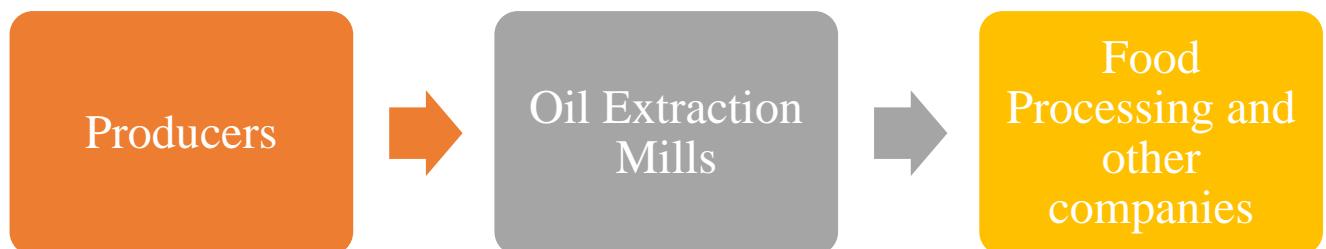
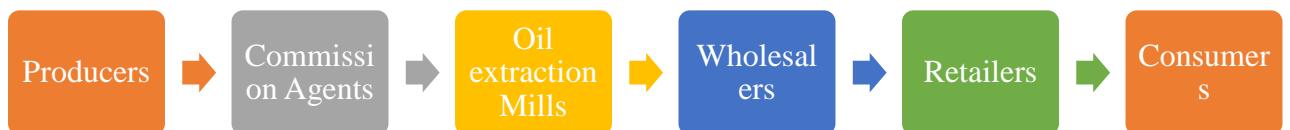
Palm oil consumption in India was reached over 8.5 million metric tons in fiscal year 2021. This was a slight increase in the domestic consumption of palm oil from the previous year. The palm oil consumption in India fluctuated around eight to nine million metric tons since the financial year 2012.

Value and Supply chain

Market in India is mainly driven by large volumes in the food and cooking oil sectors that accounts for 90%, with smaller volumes, which accounts for 10%, in consumer goods such as processed food and cosmetics. Here, a significant portion of Indian consumers buy so-called loose palm oil, without any brand association. Therefore, establishing a transparent supply trail becomes difficult in these conditions. Further, palm oil for cooking is primarily used by commercial establishments, government procurement and in low to middle-class households. Government procures imported palm oil in bulk through its trading agencies for distribution and sale to lower income consumers at subsidies rates in the interest of food security during periods of price inflation. The widespread use of palm oil and reliance on imports have

prompted the Indian government to devise schemes to promote domestic production by increasing plantation acreage in the country. Currently, a number of large Indian companies including ITC, Godrej Agrovet, and Ruchi Soya are engaged in oil palm cultivation in India. Many of their plantations are in collaboration with provincial governments, particularly in the southern states of Andhra Pradesh, Telangana, Karnataka and Tamil Nadu.

Examples of Marketing Channels for Oil Palm



Under the New Mission on Oil palm (2021) known as the National Mission on Edible Oils – Oil Palm (NMEO-OP),

The Government of India for the first time has introduced the concept of a Viability Price of Fresh Fruits Bunches (FFS) as assured returns to the oil palm farmers. The Viability Price shall be declared by the Department of Agriculture and Farmers Welfare in the month of November each year and this will be 14.3% of the annual average price of Crude Palm Oil (CPO) of the last 5 years adjusted with Wholesale Price Index (WPI) of all India. The CPO price would be the CPO price for Kandla delivery traded on the Multi Commodity Exchange of India Ltd. (MCX) moderated on a lower side by 1.5% The Viability Price shall be declared by the Government of India through a duly constituted committee.

Further, for assured payment to the farmers, a concept of formula price for the FFB shall also be declared. A simplified formula price has been approved for the scheme which will replace the CACP formula of 2012. The formula price for the FFDs would be 14. 3% of the CPO price. The formula price will be the average monthly (of the preceding month) landed CPO price multiplied by a multiplication factor of 14.3% is applicable in the case of Viability Price. The formula price would be used only for the calculation of viability gap funding calculation every month.

At Present the industry pays to the farmers for their FFBs produce based on monthly price fixed for FFRS. In the new scheme, if the payment to the farmers by the industry is below the Viability Price, the Government of India will provide a viability gap funding to ensure that the farmers' payment reaches the Viability Price.

State-wise list of the processing mills established so far in the country

Sl. No.	Name of the Unit	Sector
A. Andhra Pradesh		
1	APOILFED, Pedavegi-West Godavari	A.P. Govt. Subsidiary Unit
2	M/s. Radhika Veg. Oil Pvt. Ltd., Garividi-Vijaya Nagaram	Pvt
3	M/s. RSIL, Ampapuram-Krishna Distt	Pvt
4	Simhapuri Agro Products Ltd., Manubrola-Nellore	Pvt
5	M/s. Godrej Oil Palm ltd., Potheppalli-West Godavari Distt.	Pvt
6	M/s. Godrej Agrovet, Oil Palm ltd., Chintampalli	Pvt
7	M/s. RSIL, Peddapuram-East Godavari Distt	Pvt
8	M/s. Nav Bharat Agro Products, Jangareddygudem-West Godavari Distt.	Pvt
9	3F Oil Palm Agrotech Pvt. Ltd. Yernagudem Village Devarapalli Mandal West Godawari Distt.	Pvt
10	M/s. Agro Co-operative Corporation, Butchiyyapeta (M), Vishakhapatnam Dist.	Pvt
11	M/s Sri Srinivasa Palm Oil Mill, Srikakulam dist.	Pvt
12	M/s Subrahmanyeshwara Agro Products, Siripalli Ainavilli Mandal, East Godavari	Pvt
13	M/s Lakshmi Balaji Oils, Tekarandi (V), Vizianagram dist.	Pvt
B. Telangana		
14	A.P. Oilfed (Khammam District)	A.P. Govt. Subsidiary Unit
15	M/s. Telangana State Co-operative Oilseeds Growers Federation Ltd.(except the Mandals allotted to M/s Godrej Agrovet)	Coop
16	M/s. Pre-Unique (India) Pvt. Ltd	Pvt
17	M/s Ruchi Soya Industries Ltd.,	
18	M/s. Vishwatej Oil Industries Pvt Ltd.	Pvt
19	M/s. Matrix Security and Surveillance Pvt. Ltd	Pvt
20	M/s. Ramcharan Oil Industries	Pvt
21	M/s. Suven Agro Industries Pvt. Ltd.	Pvt
22	M/s. Tirumala Oil Chem India Pvt. Ltd.	Pvt

23	M/s. KN Biosciences (India) Pvt. Ltd.	Pvt
24	M/s Godrej Agrovet Ltd.,	Pvt
25	M/s Lohiya Edible Oils Private Limited	Pvt
C. Karnataka		
26	M/s. Bhadravathi Balaji Oil Palm Ltd. (BBOP Ltd.), Shimoga	Joint Venture of State & M/s. B.B.O.P.Ltd.
27	Govt. Oil Palm Processing mill, Kabini, Mysore. Leased to M/s Ruchi Soya industries Ltd.	State Government (leased to M/s. Ruchi Soya industries Ltd.)
28	M/s. Simhapuri Agri Tech Company Pvt. Ltd., Davangere	Pvt
30	M/s. 3F Oil Palm Agrotech., Koppal	Pvt
D. Tamil Nadu		
31	M/s. Godrej Agro Ltd., Varanasi, Ariyalur dist.	Pvt
E. Kerala		
32	OPIL, Yerror Estate, Kollam	Public sector
	Total	
F. Andaman & Nicobar		
33	Andaman & Nicobar Islands	State Government
F. Gujarat		
34	Shri Kalyan Agri. Crops Sales & Processing Coop. Society Ltd., Navasari	Cooperative Sector
G. Odisha		
35	M/s Lakshmi Balaji Oil Mills (P) Ltd. Attada, Rayagada	Pvt
36	Godrej Oil Plantations Ltd.	Pvt
37	3F Oil Palm Agrotech Pvt. Ltd.	Pvt
38	Ruchi Soya Industries Ltd.	Pvt
39	Vaidehi Palms Pvt. Ltd.	Pvt
40	Ingaran Biotech	Pvt
H. Mizoram		
41	M/s Godrej Agrovet Ltd. Kolasib Dist.	Pvt
42	M/s Ruchi Soya Industry Ltd.,	Pvt
43	M/s 3F Oil palm Agrotech	Pvt
I. Arunachal Pradesh		
44	3F Oil Palm Agrotech Pvt. ltd	Pvt
45	Ruchi Soya Industries Ltd	Pvt

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<https://www.dw.com/en/indias-ambitious-palm-oil-push-triggers-biodiversity-fears/a-59098806>

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<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1746942>

Short Videos on Oil Palm-available on Youtube

Irrigation Management in Oil Palm
(2.31 Min)

<https://www.youtube.com/watch?v=SUHUhvQcdDQ>

Fertilizer Management in Oil Palm
(3.29 Min)

<https://www.youtube.com/watch?v=X1iJ8k6D42M>

Pest Management in Oil Palm
(4.31 Min)

<https://www.youtube.com/watch?v=c1navCCwX8I>

Disease Management in Oil Palm
(4.51 Min)

<https://www.youtube.com/watch?v=41d7asABW-4>

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(1.51 Min)

<https://www.youtube.com/watch?v=oZS2xoPKIPc>

Intercrops in Oil Palm (1.56 Min)

<https://www.youtube.com/watch?v=i-xl2ntSo90>

Mulching in Oil Palm (1.08 Min)

https://www.youtube.com/watch?v=dTq_wCt2GqmA

Green Manuring and Cover Crops in Oil Palm
(1.35 Min)

https://www.youtube.com/watch?v=_HtkDCNLHkQ