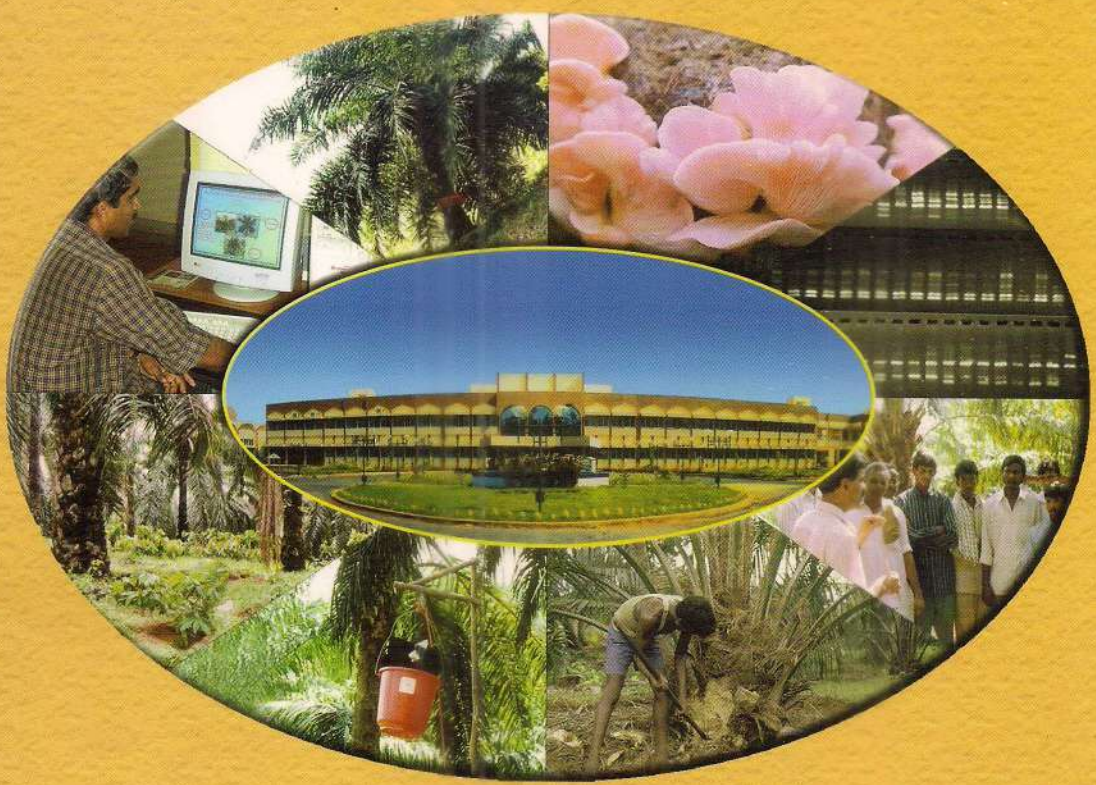
RESEARCH HIGHLIGHTS

2003



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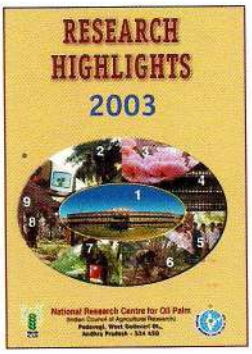

1 NRCOP, Pedavegi
2 Dwarf oil palm
3 *Pleurotus eous* on oil palm mesocarp waste
4 DNA fingerprinting of oil palm germplasm
5 Oil palm training programme
6 Control of oil palm disease
7 Pheromone trap for rhinoceros beetle
8 Cocoa as companion crop in oil palm plantation
9 Computer application in oil palm R&D

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FOREWORD

I have great pleasure in presenting this publication, the first one after my taking over as Director of the National Research Centre for Oil Palm on 9th April, 2003. This small booklet gives a gist of the Research Achievements made in the areas of Crop Improvement, Crop Production, Crop Protection, Post Harvest Technology, Extension and Computer Application on Oil Palm at the headquarters of National Research Centre for Oil Palm, Pedavegi and its Regional Station, Palode.

Oil Palm was identified as one of the important oil seed crops for achieving self-sufficiency in edible oil production in the country and to save valuable foreign exchange by avoiding large scale imports. Under the Oil Palm Development Programme of the Technology Mission on Oilseeds and Pulses, Govt. of India, Oil Palm development has taken a new dimension and achieved rapid progress in terms of area expansion and processing units. With the establishment of National Research Centre for Oil Palm at Pedavegi under the aegis of Indian Council of Agricultural Research and the merger of erstwhile CPCRI Research Centre at Palode with NRC-OP, multifaceted progress has been achieved in Oil Palm research and development in terms of indigenous hybrid seed production, increase in production and productivity of oil palm, imparting training to trainers, extension personnel, farmers etc.

If the same tempo of progress is continued with the sustained efforts of all of us, I am confident that the day is not far that we can fulfil the dream of accomplishing the 'Yellow Revolution' and achieve self-sufficiency in edible oil production.

Finally, I heartily congratulate my colleagues for their devoted efforts in promptly bringing out this publication for release at short notice.

Palode
Dated May 20, 2003.

(M. Kochu Babu)
DIRECTOR

OIL PALM AT A GLANCE

Oil palm	:	Highest vegetable oil yielder per unit area (3-6 t/ha)
Family	:	Palmae
Species	:	*Elaeis guineensis* (African Oil Palm) *Elaeis oleifera* (American Oil Palm)
Source of oil	:	Palm oil : Mesocarp, Kernel oil : Kernel
Fruit forms (Variety)	:	*Dura* (Thick shell) *Pisifera* (Shell less) *Tenera* (Thin Shell)
Economic cropping period	:	25-30 years
Climatic requirements	:	Above 2000 mm distributed rain/ irrigation Max. temp. 29-36°C Min. temp. 18-24°C Sunshine hours - 5 & above
No. of palms/ha	:	143 (9 x 9 x 9 m triangular)
Nursery period	:	12 - 18 months
Pollination	:	Insect (*Elaeidobius kamerunicus*)
Tree height	:	20 - 30m
Leaf production/year	:	24-30
Leaf length	:	6 - 8 m
First harvest	:	36 months after planting
Yield of FFB/ha	:	15 - 30 t
No. of bunches/palm/year	:	5 - 12
No. of fruits/bunch	:	Above 2000
Av. bunch weight	:	25 kg.
Weight of fruit	:	30 gm.
Fruit to bunch	:	42 - 65%
Mesocarp to fruit	:	60 - 83%
Oil to mesocarp	:	77 - 81%
Kernel to fruit	:	7 - 12%
Oil to kernel	:	49 - 52%
Shell to fruit	:	3 - 11%
Palm oil yield/palm	=	Bunch weight/palm x fruit/bunch x mesocarp/fruit x oil/mesocarp

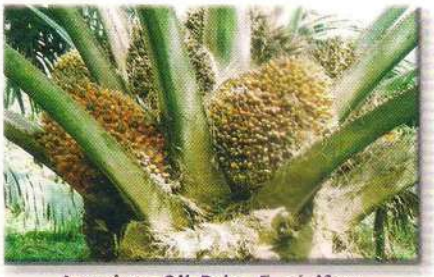
CROP IMPROVEMENT

Research work on improvement of Oil Palm was initiated at the then Central Plantation Crops Research Institute (CPCRI), Research Centre at Palode, Kerala as a collaborative venture with the Department of Agriculture, Government of Kerala, during 1974. The Oil Palm Plantation established during the 1960s at the Oil Palm Station, Thodupuzha, Kerala with materials introduced from Malaysia and Nigeria as the base population for improving the crop initially.

- A trial using 11 selected duras of Thodupuzha and *pisifera* pollen grains imported from Nigerian Institute For Oilpalm Research (NIFOR), Nigeria were utilized for producing *tenera* hybrids for the first time in India.
- From the data collected on a comparative evaluation trial during the past 25 years, two high yielding hybrid combinations having yield potential up to 4.6 tonnes of oil/ha under rainfed conditions were evolved. Oil yield was also found to be highest in these two combinations on the basis of bunch analysis data. They have been christened as Palode 1 and Palode 2.

Superior *tenera* hybrid "Palode 1"

- The oil palm germplasm assemblage being maintained at NRCOP, Pedavegi and Palode consists of 5 indigenous and 78 exotic accessions. Evaluation of four such accessions including one hybrid of Palode showed no significant difference among them. However, Palode had a slight edge over the others and 20 superior palms have been selected for inclusion in the breeding programme. Two accessions of *Elaeis oleifera* were introduced from Malaysia and Costa Rica. The performance of Malaysian *oleifera* has been exceedingly good with a potentiality of yielding 215 kg FFB during the current year.



American Oil Palm *E. oleifera*

- A large number of drought and cold tolerant accessions were prospected and collected from Guinea Bissau, Cameroon, Zambia and Tanzania and these are being evaluated at various locations in the country.
- Commercial hybrid seed production started at Thodupuzha utilizing indigenous *duras* and *pisiferas* from 1982.
- Seed processing and

Dura

Pisifera

Tenera

Production of *Tenera* Hybrid

germination facilities were developed and techniques have been perfected to achieve 95% germination.

- A total of over 25 lakh oil palm sprouts were distributed to various agencies in the country.

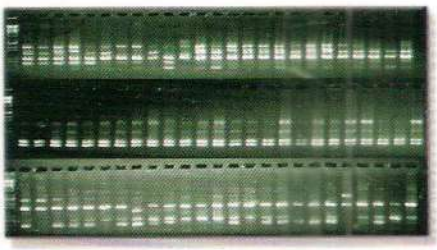
Oil Palm Sprout

- Advanced generation parent materials were evolved through a reciprocal recurrent selection programme and planted at Palode, which had now come to seed production. Selection of *duras* was done based on yield and bunch analysis data. Annually 4 lakh seeds could be produced.
- Parental *duras* and *pisiferas* (*tenera* x *tenera*) were supplied to establish 3 seed gardens by Government Department one each at Rajahmundry (Andhra Pradesh), Taraka (Karnataka) and Thodupuzha (Kerala) and at M/s. Nava Bharat Enterprises, Lakshmipuram (Andhra Pradesh).
- Commercial seed production has started at Lakshmipuram, Andhra Pradesh and has the potential to produce around 3 lakh hybrid sprouts per year.
- Hybrid seed production was started at Rajahmundry Seed Garden on a small scale and it is expected to enhance the production to the tune of over 4 lakh oil palm sprouts per year. A dwarf *pisifera* palm has been identified at Rajahmundry.
- Necessary selection of parent stocks has been initiated at the new seed Garden, Thodupuzha and is expected to start commercial seed production during 2004.
- A revolving fund scheme 'Indigenous production of oil palm hybrid seeds' sanctioned by ICAR has started functioning from 1999

Seed Processing Laboratory

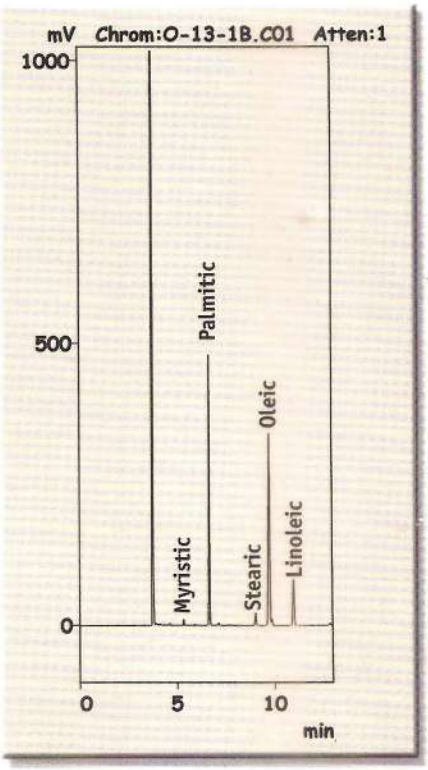
at Palode. Using the elite parent materials evolved, commercial hybrid seed production at the rate of 5 lakh seeds annually has been accomplished.

- Oil palm sprouts are supplied in large quantities to various states of the country viz., Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Orissa, Goa, Maharashtra, West Bengal, Tripura etc.
- DNA fingerprinting of different germplasms revealed that no two palms were genetically similar even within the same accessions. Wide genetic diversity was found among the different accessions by Randomly Amplified Polymorphic DNA (RAPD) analysis.



DNA fingerprinting of oil palm germplasm

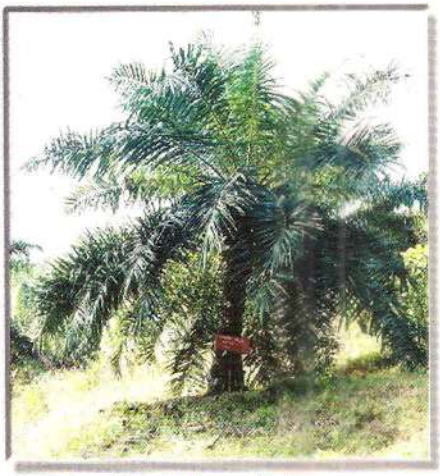
- Oil from *oleifera* palms was analysed for quality. Iodine value as well as Gas Chromatography analysis revealed wide variation in the fatty acid compositions of oil among the different *olifera* palms. However, a few *olifera* palms were found superior in terms of unsaturated fatty acid content in the oil.
- Two dwarf palms were isolated at Palode and Pedavegi from the germplasm material introduced from Nigeria and Guinea Bissau respectively.
- Comparative performance of



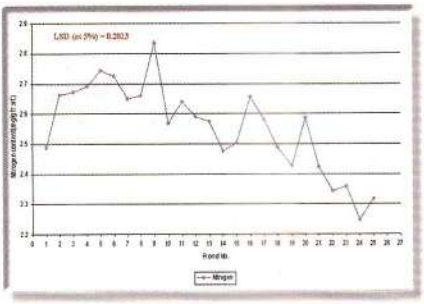
Fatty acid profile of *oleifera* oil by GLC

planting materials from different sources showed high variability among them for physiological characters. Bunch index was high in "Papua New Guinea" followed by "Palode". "Ivory Coast" was found superior to others for FFB, oil yield and quality in terms of carotenoids.

- Proven *Dura* parent materials were introduced from ASD Costa Rica and were planted at Pedavegi and Palode.
- An *in vitro* regeneration protocol was developed using explants from *tenera* seedlings.
- A total of 23 hybrid combinations received from ASD Costa Rica are being tried in three locations for isolating location-specific



Dwarf *Tenera* Palm



Nitrogen content in different fronds of oil palm

hybrids for importation, if found necessary.

- Leaf analysis for biochemical parameters (Chlorophyll, Carotenoids, total Carbohydrate, soluble proteins) and leaf nitrogen was conducted to determine an index leaf. It was found that the ninth leaf would be ideal to sample for biochemical parameters and nitrogen analysis.

CROP PRODUCTION

Crop Production work on Oil Palm was initiated during the 1970's at the then CPCRI Research Centre, Palode. A manurial trial to fix the manurial dose for oil palm was carried out in collaboration with M/s. Oil Palm India Limited, Bharathipuram Estate, Kerala. Subsequent work on different aspects of Crop Production was carried out at the National Research Centre for Oil Palm, Pedavegi and its Regional Station at Palode.

- Nutrient requirement of adult palms was arrived at under rainfed conditions. A fertilizer dose of 1200-600-1200 g N, P_2O_5 and K_2O/ palm/year applied in two equal splits was found optimum for adult palms.
- Perfected the nursery management techniques for raising healthy oil palm seedlings. Soil-sand-Farm Yard Manure or oil palm waste compost in 1:1:1 proportion was found to be an ideal potting mixture for growing seedlings. A fertilizer dose of 10-5-5 g N, P_2O_5 and K_2O per seedling was found optimum. Application of fertilizers in equal splits at three monthly intervals was suitable for optimum performance.

Oil Palm Nursery

- Irrigating palms at the rate of 90 l/palm/day during summer months has increased the annual oil yield of palms from 3.3 to 4.7 tonnes/ha under rainfed conditions.
- Based on the influence of weather parameters, yield prediction models were worked out.
- Diagnosis and Recommendation of Integrated Systems (DRIS) was developed for oil palm. Potassium nutrition was found critical under tropical conditions.

Potash deficiency

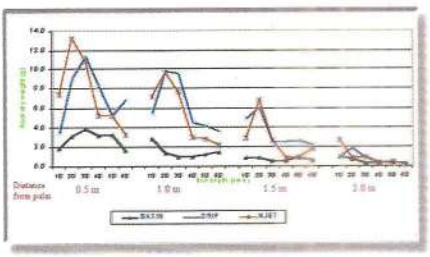
- Standardized suitable techniques for composting oil palm wastes, which are available in plenty in a plantation. The technique of Vermi composting using *Eudrilus eugineae* was perfected. Two-thirds nutrient requirements of palms would be profitably substituted through composted oil palm wastes.
- Cocoa was found to be an ideal companion crop in oil palm plantation whereas certain forest trees grown in a high density (3-4 rows in between) was found to affect the palm growth and yield adversely.

Compost from Oil Palm wastes

- Intercrops *viz.*, Maize, Tobacco, Chilly, Black Gram, Horse Gram, Red Gram, Groundnut, Sunflower, Sesame, Brinjal, Elephant Foot Yam, Cauliflower, Cabbage, Drumstick, Tomato, Ridge guard, Water melon, Banana, Pineapple, Turmeric, Cocoa, etc. were found to be promising as inter crops in West Godavari District of Andhra Pradesh.

Cocoa as companion crop

- An irrigation experiment using three irrigation systems revealed



Root distribution pattern in different irrigation systems

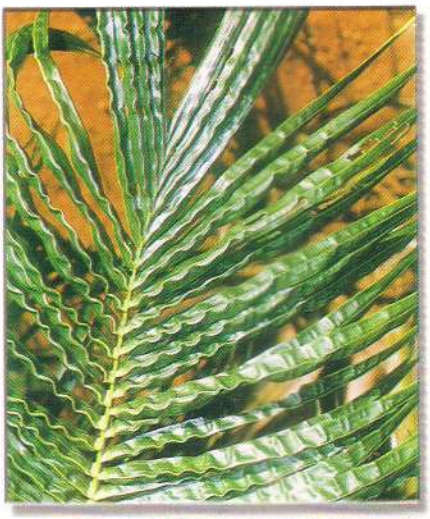
that Jet and Drip Irrigations are promising for oil palm plantations.

- The intercrop trial revealed that the highest returns were received in Maize while the lowest was with Chillies.
- The importance of nutrient budgeting in oil palm based cropping system was thoroughly investigated.

CROP PROTECTION

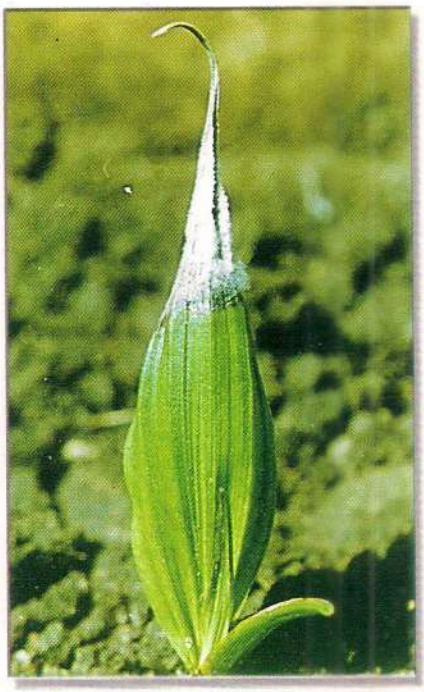
It is widely known that oil palm is the crop having very few diseases and pests. However, sporadic incidence of certain diseases of unknown etiology have posed concern to the researchers and farmers. Crop protection activities were initiated at the then CPCRI Research Centre, Palode during the 1970's. All possible efforts are made to contain/control such diseases and disorders both in the rainfed and irrigated conditions. Infrastructure and manpower are available to cope with the situation as and when found necessary. It was observed that *Metarhizium anisopliae* is a bio agent for controlling the rhinoceros beetle. Efforts are under way to control *Metarhizium anisopliae* as a natural bio control agent which, is found to be very low in coastal Andhra Pradesh. However, mass multiplication of the fungus is being carried out to be used as a control measure. Pheromones were found to be encouraging attractants for control of rhinoceros beetle and red palm weevil.

- The diseases and disorders in oil palm nurseries and plantations in India were recorded through regular survey. Control/corrective measures were evolved.



Boron deficiency symptom

- Standardized seed dressing techniques are found to prevent microbial spoilage of seeds and sprouts during storage and germination process.
- Package of prophylactic and curative/corrective measures of diseases and disorders of nursery was perfected.
- Spear rot disease, endemic to Kerala is proved to be caused by



Early leaf disease (Anthracnose)

phytoplasma and spread by insect vectors mainly *Proutista moesta* Westwood.

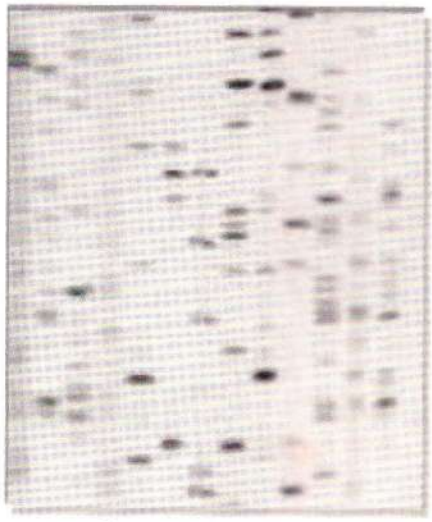
Early symptom of spear rot disease

- Techniques for the control of inflorescences diseases viz., bunch failure, bunch rot and bunch end rot have been standardized.
- Stem surgery technique for management of stem wet rot and upper stem rot was found successful.

Excision of rotten tissues from stem wet rot affected palm

- A technique for the control of bud rot, observed in all oil palm growing states, has been evolved.
- *In vitro* biomass degradation study was conducted with the different *Ganoderma lucidum* isolates. It was found that an isolate from coconut can be more damaging to oil palm. DNA finger printing of these isolates was conducted by Randomly Amplified Polymorphic DNA (RAPD) and Amplified Fragment Length Polymorphism (AFLP). A wide genetic variability was revealed from the very high number of polymorphic bands among the different isolates of *G. lucidum*.

Degradation of Oil Palm tissue by different isolates of *G. lucidum*

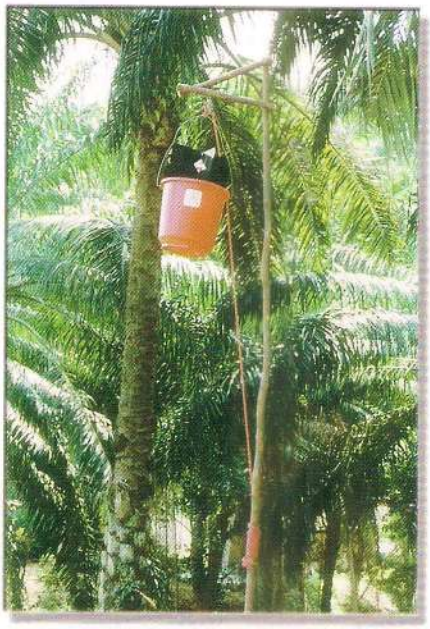


DNA fingerprinting of *G Lucidum* isolates by AFLP

- Survey on the pests of oil palm in various states of India revealed that Rhinoceros beetle is the only major insect pest of oil palm.
- The infestation of Rhinoceros beetle was brought down to 1.8% from 8.25% by the release of baculovirus infected beetles.

Baculovirus infected grub of rhinoceros beetle

- Field sanitation, setting up of pheromone traps, and application of *Metarhizium* in the breeding sites could bring down the incidence of rhinoceros beetle in a heavily infested garden.



Pheromone trap for rhinoceros beetle

- Leaf axil filling with Phorate sachets and naphthalene balls in the intervals of 45, 90 and 180 days caused substantial reduction in the damage by rhinoceros beetle.
- Infestation by rhinoceros beetle was rerecorded on the female inflorescences before anthesis.
- Red palm weevil larvae were found feeding on the mesocarp of the fresh fruit bunches causing direct economic loss.
- A Strepsipteran parasitoid - *Halictophagus palmae*.sp. nov., *Earwig - Chelisoches moris* F. , Hunting spider - *Marpissa tigrina* Tikader and *Aspergillus flavus* Sorokin were recorded as biocontrol agents of *Proutista moesta* Westwood, a vector of spear rot disease of oil palm.
- Infestation by *Dysmicoccus brevipes, Pinnaspis aspidistrae* and *Aspidiotus* sp. were commonly

noticed in the oil palm plantations of Oil Palm India Limited.

- The slug caterpillar was found migrating from coconut gardens causing damage to oil palm.

Heavy incidence of Slug caterpillar

- A leaf weber *Ambadra* sp was found to be causing severe defoliation in oil palm.
- Bagworm, *Metisa plana* was found to be endemic in older oil palm gardens
- Scale and mealy bugs were recorded as minor pests feeding on the FFB of the oil palm.

Wild boar scaring device

- The pollinating weevil, *Elaeidobius kamerunicus*, was established and the incidence of bunch failure due to inadequate pollination was prevented.
- The pollinating weevil was supplied to all oil palm growing states including the Andaman and Nicobar islands.

Wire net covering to control bird damage

- A wild boar scaring device for oil palm nurseries and young plantations was standardized.
- Covering fruit bunches with oil palm leaf/chicken wire mesh was found to prevent bird damage.

Rat damage on Oil Palm FFB

- Use of bamboo noose traps was found to reduce the burrowing rat population.

Bamboo noose trap

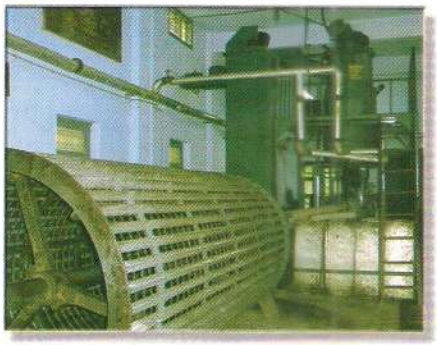
POST HARVEST TECHNOLOGY

The processing of Oil Palm Fresh Fruit Bunches (FFB) is the most crucial component when we consider oil palm cultivation as an industry. Developing suitable processing units with a high degree of efficiency so as to get maximum Oil Extraction Ratio (OER) is the ultimate aim for a successful oil palm enterprise.

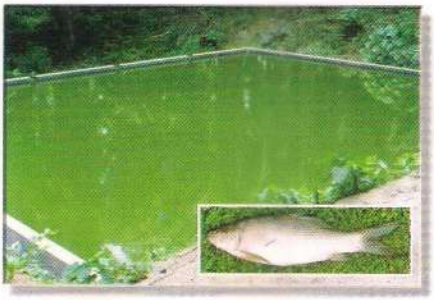
Besides main economic products like palm oil and kernel oil, from oil palm plantations, there are many other byproducts and waste products available for diversification, value addition and product utilization. Efficiency in the exploitation of these factors will supplement the industry substantially by giving additional revenue to the farmers. Efforts are under way with this aim in view and many achievements have already been attained although many more are yet to be accomplished.

- A demonstration plant of one ton/hr capacity for processing FFB was designed jointly with RRL (CSIR), Thiruvananthapuram and commissioned at Palode during 1991. This includes an effluent tank for disposing waste water from the palm oil processing unit.
- A Mini Palm oil processing unit to cater to the needs of small farmers up to (10 acres) was designed and installed in 1996 at Palode.
- The production of edible grade partially refined palm oil, rich in Vitamin A has been standardised.
- Edible mushrooms namely *Pleurotus* spp., *Calocybe indica* and *Volvariella volvacea* could be successfully and commercially cultivated using oil palm factory wastes (bunch and mesocarp wastes).
- Fresh water fish namely Rohu and Mrigal could be successfully grown in the palm oil mill effluent medium.

Pleurotus eous on oil palm mesocarp waste

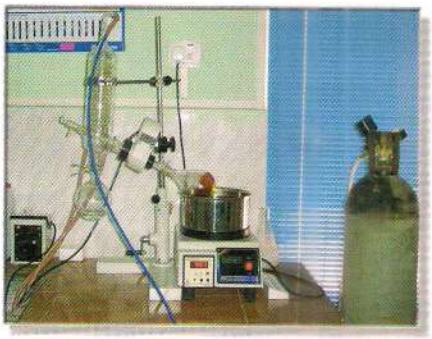


Palm Oil processing unit of 1t/hr capacity



Freshwater fish grown on pal oil mill effluent medium

- A lab - scale mini hand operated oil extraction device was developed for the extraction of oil for laboratory analysis.
- Higher levels of Carotenoids from CPO could be separated using specific adsorbent, retaining the edibility of oil. Carotenoids could be concentrated up to 160 times.



Concentration of carotenoids recovered from adsorbents

- Trials conducted on the evaluation of various methods of harvesting tools showed that the sickle attached to an aluminium pole was more efficient compared to the various traditional methods followed in different parts of the country.

Semi mechanized harvesting device

- A semi mechanized hydraulically operated harvesting device was developed for harvesting oil palm fresh fruit bunches

EFB fibre extracting decorticator

- A fibre extracting decorticator was developed with a capacity of decorticating 441 kg of Empty Fruit Bunches (EFB)/hour.

Yarn made from oil palm EFB fibre and coir blend

- Oil palm fibre from empty fruit bunches was found suitable for preparing rubberized mattresses, yarn and densified fibreboards with or without blending coir.

EXTENSION

Extension activities on the research and development of oil palm was started along with very the inception of the Centre in 1995. Initial thrust was given for developing audio visual and allied facilities including manpower in the Centre. Since then brisk activities have followed and the present Extension section is fully equipped for imparting training and transfer of technology in a 'lab to land' fashion.

- A study conducted on "Technological gap and constraints in the adoption of oil palm production technology" in two districts of Andhra Pradesh revealed that most of the area under oil palm is owned by either big farmers or small farmers.
- The reasons to cultivate oil palm by the growers are assurance of getting higher returns, regular income, less labour intensive, assured market price by government, less attack of pests and diseases and convenience for the marketing of FFB.
- Practices like plant population, planting distance and pit size are fully adopted.

Farmers, training programme in Tamil Nadu

Interface meeting at NRCOP

- Majority of the farmers are getting an average yield of 5-8t/ac/year.
- In order to create awareness and disseminate technical know-how to farmers on oil palm, a series of awareness campaigns and training programmes were organised for farmers belonging to oil palm growing states *viz.*, Andhra Pradesh, Orissa, Maharashtra, Gujarat, Karnataka, Tamil Nadu and Goa. A total of 13,544 farmers were trained in these programmes.
- Training programmes were organised to disseminate technology to officers. The subjects handled in these programmes are: Oil palm production technology, plant protection of oil palm, harvesting of oil palm Fresh Fruit Bunches, oil palm seed production and farming systems. A total of 555 officers belonging to the Department of Agriculture / Horticulture, Entrepreneurs, State Agricultural Universities and Indian Council of Agricultural Research from oil palm growing states participated in these training programmes.

- In order to exchange views on experiences, constraints, suggestions and policy issues in Oil palm cultivation, interface meets were organised. Resolutions were passed for successful cultivation of Oil palm, wherein Oil palm growers, officials of state departments and scientists working in Oil palm had participated.
- Interface meets were organised at different occasions at NRCOP, Pedavegi. A total of 562 personnel have participated so far.

Farmers' training at NRCOP

- Video shows are organised for the benefit of farmers, officers and other desirous agencies.

COMPUTER APPLICATION

The importance of computer applications in applied research mainly in the field of agriculture, needs no emphasis. Developing facilities for Agricultural Research Information System (ARIS) is the most important function for the effective utilization of the data on area, production and productivity of any agricultural crop in the country as well as in the world. It is also important to note the current price status of palm oil import and export by various countries for the correct appraisal of the edible oil scenario in the country and the world. Collection of meteorological data is equally important especially in the successful establishment and effective utilization of oil palm plantations in the country.

- Compiled mandal-wise/district/ state-wise information on area and production of oil palm
- The data on import of vegetable oils and the international prices on oil palm were compiled.
- The country-wise data on oil palm harvesting area, production of fresh fruit bunches, import and export of palm oil and the value of trade were compiled.

Computer application in oil palm R&D

- A software for computerization of oil palm germplasm with different modules has been developed and installed.
- A software for storing and retrieving the information on office communications has been designed and developed.
- A software for cataloguing the garden-wise information to cater to the needs of the oil palm growers in the country is initiated.

National Research Centre for Oil Palm, Regional Station, Palode

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