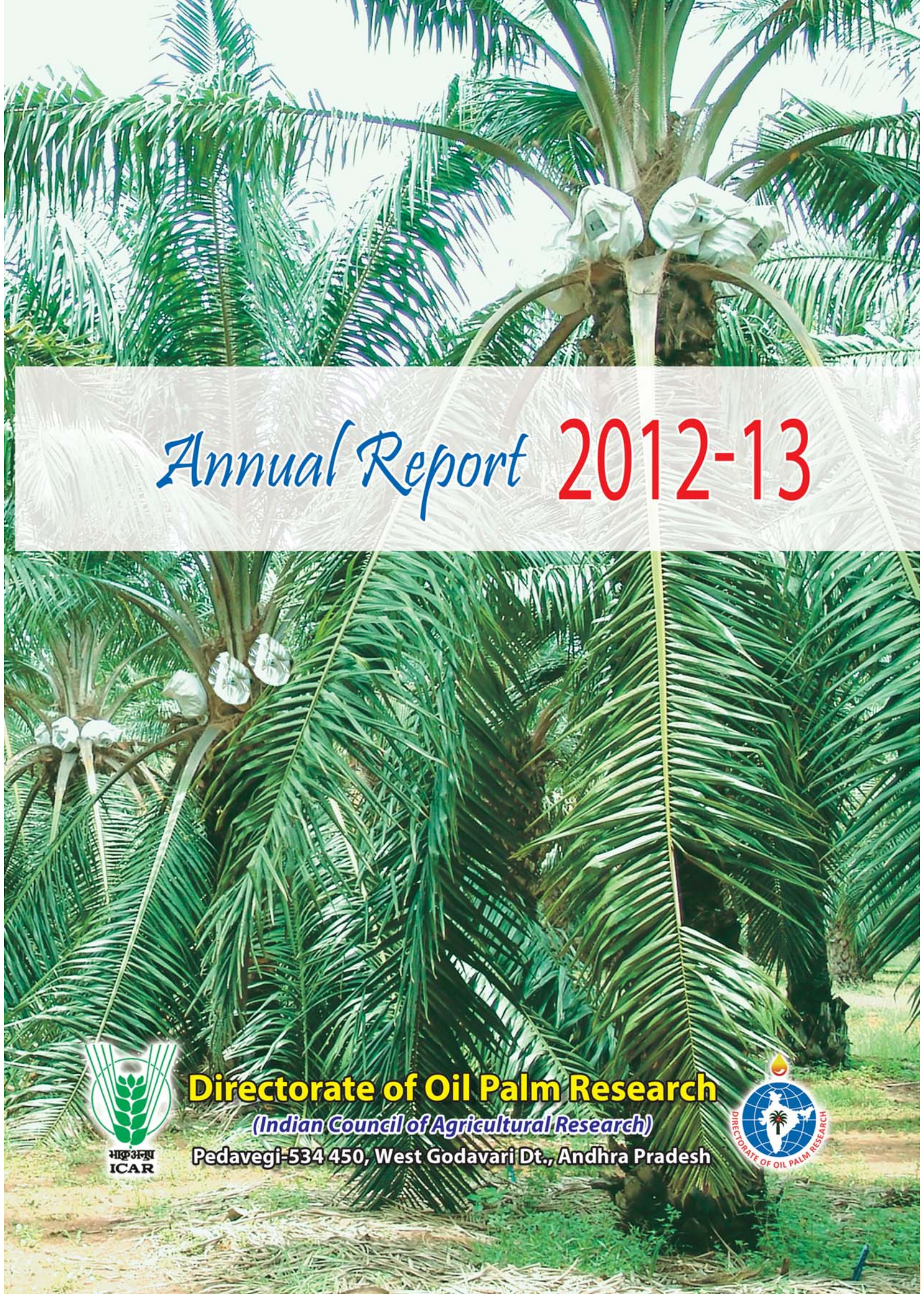

Annual Report 2012-13

Directorate of Oil Palm Research

(Indian Council of Agricultural Research)

Pedavegi-534 450, West Godavari Dt., Andhra Pradesh

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DIRECTORATE OF OIL PALM RESEARCH

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1. Preface

2012-13 has been a landmark year in the timeline of the Directorate of Oil Palm Research. During the year, we could establish four new Seed Gardens, two in Karnataka and two in Andhra Pradesh States, with the new hybrids evolved at this Institute with a productivity potential of 30 tonnes of Fresh Fruit Bunches per hectare. The seed sprouts obtained from these seed gardens would have high productivity potential and would enable us to cover an area of 20,000 ha per year. Realising the importance and contributions made by the Directorate of Oil Palm Research to the welfare of the farming community and returns to the Nation, the budget allocation for the Institute has been substantially enhanced for the XII Five Year Plan period.

The 18th Annual Report of Directorate of Oil Palm Research pertains to the 12 months period from April, 2012 to March, 2013. The Report includes results of nine Research Projects in Genetic Resources Management; Production System Management; Physiology, Biochemistry and Post Harvest Technology; Plant Health Management and Social Sciences. The first part of the Report consists of technical aspects while the second part covers various dimensions of progress achieved in the Institute. The budget and expenditure statement pertaining to the financial year 2012-13 is presented. Weather data for Pedavegi and Palode Campuses as well as publications brought out by Scientists of the Institute are also presented.

I am extremely grateful to Dr. N.K. Krishna Kumar, Deputy Director General (Horticulture) for his guidance and encouragement in the progress of the Institute. Remarkable support offered by Dr. H.P. Singh, Former Deputy Director General (Horticulture) in strengthening the research programmes of the Institute is also gratefully acknowledged. I am grateful to Dr. W.S. Dhillon, Assistant Director General (Hort.-I) for his keen interest and guidance in the Institute's progress.

I am thankful to Scientists and Staff of my Institute for their enthusiasm and hard work in achieving the mandate of the Institute. Support and encouragement given by Ministry of Agriculture, State Governments, State Agricultural Universities, Sister ICAR Institutions, oil palm Processors and farming community in the implementation of various programmes of the Institute are also gratefully acknowledged.

I acknowledge with thanks the help rendered by Dr. K. Suresh, Mrs. A. Bhanu Sri, Dr. K. Sunil Kumar, Dr. P. Naveen Kumar, Dr. L. Saravanan, Dr. K.L. Mary Rani, Dr. K. Ramachandrudu and Dr. Sanjib Kumar Behera in bringing out this Report.

01.07.2013
Pedavegi

(S. Arulraj)
Director

2. Executive Summary

Oil palm, a crop which has emerged as the highest oil yielding crop over a period of five decades has become the most economic crop in the global vegetable oil sector for food, industrial purpose and bio diesel. Through the implementation of appropriate research and development strategies, India too could emerge as one of the major producers of palm oil by cultivating oil palm as an irrigated crop in 2.00 million ha identified as potential area and there by producing 7.00 to 8.00 million tonnes of palm oil and 0.7 to 0.8 million tonnes of palm kernel oil.

To remain competitive in the emerging global scenario, a four-fold increase in land productivity, three-fold increase in water productivity, doubling of energy use efficiency and a six fold increase in labour productivity are to be envisaged for the future. India has a well established oil palm research system consisting of Directorate of Oil Palm Research (DOPR) and six Centres of All India Coordinated Research Project on Palms, with the required Infrastructural facilities.

The mandate of the Institute is to conduct mission oriented research on all aspects of oil palm with an objective to improve the productivity and quality, to serve as national repository for oil palm germplasm and clearing house for all research information on oil palm and coordinate national research project, to act as center for training in research methodology and technology of oil palm and to generate nucleus planting material.

The Institute has a sanctioned staff strength of 82, including Director, 22 scientists, 18 technical, 15 administration and 26 skilled support staff, of which 62 are in position. Total budget allocation for the Institute for 2012-13 was ₹ 784.51 lakhs and the expenditure was ₹ 784.51 lakhs with a revenue generation of ₹ 126.52 lakhs. During the period 9 institute research projects and 10 externally funded projects were taken up.

The Quinquennial Review Team (QRT) of DOPR (2006-2011) submitted the report and the recommendations are being incorporated in the Technical Programme of the Institute as well as in the XII Plan proposals as a part of strengthening the oil palm research system in India. The institute could achieve remarkable progress especially with reference to the identification of high yielding palms and crop management technologies including innovative harvesting tools for oil palm. Major highlights of achievements recorded during the year are presented here:

Genetic Resource Management

Commercial plantations of oil palm planted with external sources of planting material were surveyed in Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Maharashtra and Goa and elite palms were selected based on fruit typing, stature of the palms, various FFB parameters, yield, etc. In Andhra Pradesh, 71 palms were selected from 9 plantations, 39 palms were identified in Chithara Estate of OPIL, Kerala and 9 palms were identified and collected from Karnataka.

Oil palm germplasm accessions collected from Pune, Little Andaman, Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Tamil Nadu and a selection (CD-471) from cold and drought tolerant accessions evaluated at DOPR, Pedavegi indicated that they have more girth, compact canopy, long stalked male inflorescence, dwarf and vertical orientation of leaflets. Some palms produced only female inflorescence and

had narrow petiole with short rachis length, virescence fruit forms and recorded higher yield.

Evaluation of oil palm germplasm at Mohitnagar, West Bengal for cold tolerance indicated that CA-17 recorded the highest FFB yield and more number of bunches.

Evaluation of tenera x tenera crosses at Pedavegi indicated that eleven tenera palms recorded FFB yield of more than 200 kg/palm. Tenera palm number 149 recorded the highest FFB yield of 273 kg per palm per annum with an average bunch weight of 24.8 kg.

Nine additional dura palms at Palode and nine in African germplasm have been identified for hybrid seed production. The promising dura palms selected from African germplasm have been utilized in developing DxP hybrids by crossing with pisifera identified in TxT block. Of these developed hybrids, planting materials were supplied to AICRP system for multi-location evaluation.

Two new seed gardens were established at Kabini and Taraka in Karnataka State and another seed garden was planted at Morampudi in Andhra Pradesh State using advanced breeding materials from DOPR.

During 2012-13, 3.21 lakh oil palm sprouts were supplied from DOPR, Pedavegi seed garden and 3.15 lakh sprouts were supplied from DOPR RC, Palode.

Breeding trials for development of dwarf oil palm interspecific hybrids revealed that 16Eo x 81Eg showed compact growth in terms of height (3.87 m) and height increment (0.26 m), while palm number 48 showed compact growth (height 2.7 m and 0.18 m height increment) with satisfactory number of bunches.

E. oleifera identified in commercial plantation and field gene bank at DOPR-RC Palode were utilized to produce four new inter specific hybrid combinations and their seedlings were evaluated in the secondary nursery. Inter specific crosses consisting of three combinations namely *E. oleifera* I, *E. oleifera* II and *E. oleifera* III were evaluated for vegetative and yield parameters. Desirable characteristics were observed in *E. oleifera* II cross, while palm no. 6 showed precocity and compact nature.

A new method of testing oil palm pollen viability was developed. 2, 5-Diphenyl Tetrazolium Bromide (MTT) was the best dye for testing pollen viability. The media consisting of Sucrose + H_3BO_3 + PEG-10,000 was selected for testing pollen germinability.

Studies on seasonal influence and provenance factor on oil palm seed dormancy and germination indicated that germination of Season-I (January-February) harvested bunches was highest (60.6%) followed by Season-II (58.6%), Season-III and Season-VI (November-December).

A tissue culture methodology has been developed from inflorescence of oil palm. Commercialization process for the tissue culture technology was initiated.

Production System Management

Fertigation trial indicated that palms applied with 1200:600:1200 g NPK/palm/year through soil application recorded the lowest FFB yield (18.43 t/ha) and bunches (6.43/palm) while the highest FFB yield (24.15 t/ha) and bunches (8.37/palm) was obtained with application of 1200:600:2700 g NPK/palm/year through fertigation. Palms treated with 1200:600:1200 g NPK/palm/year recorded the lowest photosynthetic rate while the highest photosynthetic rate was observed in palms nourished with 1200:600:1800 g NPK/palm/year.

Highest FFB yield (17.06 t/ha) and more number of bunches per palm (7.75/palm/year) were recorded with application of 225 g sulphur/palm/year, while the lowest FFB yield (12.99 t/

ha) and number of bunches (5.00/palm/year) were recorded with no sulphur application. Lowest photosynthetic rate and transpiration rate were recorded in treatment 900 g sulphur/palm/year while S0 recorded highest rate.

Studies on oil palm based farming systems revealed complementary interaction between oil palm and inter crops as FFB yield was more in inter cropped area compared to that of control. Performance of cut foliage plants *viz.,* fish tail fern, ti plant/cordyline, dieffenbachia has been found to be satisfactory, if grown as interrops in oil palm plantations.

Nursery management studies conducted in oil palm to find out optimum dose of fertilizers for growth and vigour of oil palm seedlings indicated that NPK @ 30:38:25 g recorded maximum seedling height (143.52 cm), 3rd leaf area (3157.98 sq.cm), stem girth (29.14 cm), root volume (244 cc), dry biomass (532 g) and highest leaf nutrient levels.

Irrigation studies in adult oil palm plantations revealed that palms imposed with M1L3 (Microjet method of irrigation with 0.8 crop factor) recorded highest FFB yield (18.23 t/ha) while M2L1 (Drip method with 0.6 crop factor) treatment recorded the lowest yield (15.53 t/ha). In different irrigation treatments, photosynthetic rate ranged from 11.36 to 18.73 μmol m^{-2} s^{-1}. Lowest photosynthetic rate was recorded in M2L1 treatment while M1L2 recorded highest rate. Highest leaf temperature was observed in palms treated with M2L1. The VPD in the canopies ranged from 2.41 to 3.78 KPa.

In mature *dura* oil palm, photosynthetic rate, stomatal conductance and leaf water potential were studied at three different times during the season and results revealed a diurnal and seasonal pattern in response to water deficit and evaporative demand of the atmosphere. The seasonal variation in environmental conditions along with soil water availability did not alter the diurnal pattern of gas exchange parameters in oil palm. Palms grown under water deficit showed a pronounced decrease in leaf water potential. Photosynthesis in oil palm is strongly controled by stomata, which is sensitive to environmental conditions. Stomatal conductance and leaf water potential could be considered as good indicators of leaf water status in mature oil palm plantations and could therefore be used for scheduling irrigation.

Physiology, Biochemistry and Post Harvest Technology

Studies conducted to know the effect of different levels of removal of fronds on growth and yield of oil palm indicated that removal of fronds directly affected the FFB yield and bunch weight.

Destructive sampling of eleven adult oil palm hybrids belonging to different sources indicated that the total biomass and carbon content ranged from 354.9 to 764.7 kg/palm and 138.9 to 305.4 kg/palm respectively and highest contents were recorded in Deli x Ghana hybrids while the lowest levels were found in 128 x 31323 (Palode source). It was also observed that highest biomass and carbon contents were accumulated in the trunk followed by fronds.

Annual carbon sequestered by oil palm was 11.73 and 5.51 t ha^{-1} y^{-1} under irrigated and rainfed conditions respectively. The standing biomass of a ten year old oil palm plantation was of the order of 59.62 and 36.53 t ha^{-1} under irrigated and rainfed conditions.

Different physiological parameters recorded in the leaf breaking palms indicated that photosynthetic rate and its associated parameters were less compared to that of normal palms. As the stomatal conductance is getting decreased, all the gas exchange parameters are getting affected.

The duration of phenological phases (spear leaf to 17th leaf) and growing degree days (GDD) recorded in four oil palm hybrids ranged from 209 to 244 days and 2760 to 3035 heat units

respectively. Deli x Nigeria cross recorded higher GDD and phenological duration, while it was lowest in Malaysian cross.

Two models of improved harvesting sickles viz., DOPR-1 and DOPR-5, manufactured with spring steel and attached to light weight high strength poles were found satisfactory for harvesting oil palm FFB from tall palms.

Under the collaborative project with Central Institute of Agricultural Engineering, Bhopal, backpack mounted, trolley mounted and pneumatic harvesting sickles were developed and evaluated for harvesting FFB from medium tall palms and also for use in combination with high raise platform. Back pack mounted motorized harvesting equipment was found to have better adoptability and flexibility.

Elevated platform on tractor trolley was designed and developed at DOPR, Pedavegi, for harvesting FFB from tall palms. Height adjustable platform (2 m x 1.5 m) that could reach a height of 4.54 m, with 6 m aluminum pole attached to a sickle could harvest palms of 12 m height.

Plant Health Management

Fixed plot survey carried out to observe the pest problems in oil palm plantations in East and West Godavari and Krishna districts of Andhra Pradesh indicated that psychid and rhinoceros beetle among insects and crows and parakeets among avians were infesting the palms in many plantations.

Incidence of bag worm was observed at very low levels in older palms. Heavy mortality of psychids was observed in Andhra Pradesh, which might be due to high temperatures during pre monsoon period, late starting of monsoon and heavy rains during monsoon period.

The life stages and parasitism of psychids in oil palm plantations revealed that they were found to be parasitized mainly by *Brachymeria sp* with more than 40 % parasitism. The parasite activity was found more during July and December and no parasitism was observed during summer and winter months.

Studies on the seasonal activity of leaf web worm indicated that the pest incidence was observed from 4th week of October, 2012 with a larval population of 0.63 larvae/ frond. Two peaks of pupal population were observed (more than 50 pupae /frond) during 3rd week of January, 2013 and 1st week of February, 2013. It was found that larval population was negatively correlated with temperature and relative humidity and was not correlated with rainfall. Pupae were not influenced by temperature but were influenced by relative humidity.

Leaf webworm was found to be parasitized by larval parasitoid, *Apanteles hyposidrae* from 48th standard week with a parasitism range of 2.0 to 69.7 percent. Maximum parasitism was recorded during 2nd week of February 2013. The pupae of leaf webworm were parasitized by *Brachymeria albotibialis* which ranged from 7.1 to 85.0 percent. Activity of natural enemies was influenced by temperature, relative humidity and rainfall which had significant negative effect.

Insecticides like triazophos, cypermethrin and profenophos could effectively control the leaf web worm, even on the first day after spraying. Triazophos and cypermethrin continued to be effective upto 14 days after spraying, while profenophos kept the pest population under check effectively upto 10 days.

Temperature and sunshine hours have a significant negative correlation with pollinating weevil activity, while relative humidity was positively correlated. Spider webs, an ant species *Monomorium pharaonsis* and a reduviid bug, *Sycanus* sp. (Predator) were found to reduce the pollinating weevil population in oil palm.

Molecular diagnostic kit for rapid detection of basal stem rot pathogen in oil palm has been developed. The ganoderma specific primers gan-1 3'-TTG ACT GGG TTG TAG CTG-5'and gan-2

5′-GCGTTACATCGCAATACA-3′ are specific for oil palm ganoderma. Methodology for PCR amplification of oil palm ganoderma DNA was standardised and the correct tissue to be sampled for diagnosing the basal stem rot was identified.

The DNA could be isolated from basal stem tissue by modified Raedar method and the disease could be diagnosed using ganoderma specific primers.

Etiological studies of bud rot in oil palm revealed that the pathogenecity of BRI-5 could be proven *in vitro* and *in vivo*. A methodology of challenge inoculations for proving the pathogenecity of bud rot bacteria was standardised. A detached leaf methodology was derived to check the toxicity of bud rot bacteria culture filtrates on oil palm leaves, while proving the pathogenecity of bud rot *in vitro*. A methodology for DNA isolation and PCR amplification of bud rot bacterium was derived.

Application of *Trichoderma viride* multiplied on FYM @ 5 kg per basin at 2 months interval was found effective for the management of basal stem rot disease in oil palm.

A methodology for proving the pathogenecity of *Ganoderma lucidum* against oil palm through soil inoculation was standardised. The study proved that the basal stem rot caused by *Ganoderma lucidum* is not transmitted through seed externally.

Social Sciences

Designed and developed user friendly software for adoption studies in oil palm. Compiled and updated the contents pertaining to package of practices of oil palm with nine major heads for e-Manual on oil palm cultivation.

Training programmes were organised to 142 officers from Andhra Pradesh, Karnataka, Bihar, Mizoram, Odisha, Maharashtra, Tamil Nadu and Kerala States on various aspects of oil palm cultivation like Oil palm hybrid seed production, Oil palm production, Oil palm production technology, Plant protection in oil palm, Nursery management in oil palm and Soil and leaf nutrient analysis.

Training programmes on "Oil palm cultivation" were organized to 736 farmers from Andhra Pradesh, Odisha, Karnataka, Mizoram and Tamil Nadu States at Pedavegi and Palode.

During the year, IMC, RAC, IRC and QRT meetings were conducted at DOPR.