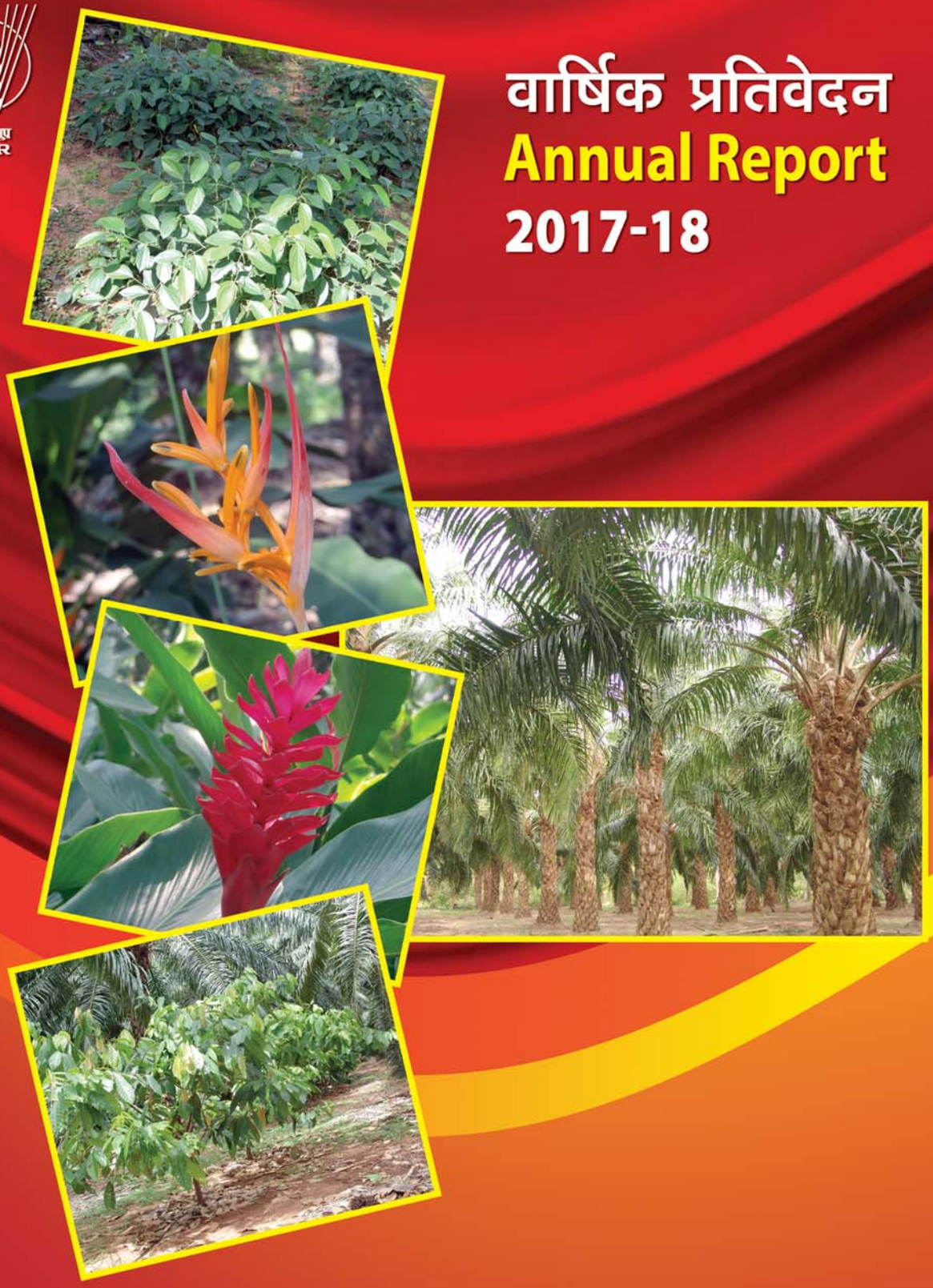
भाकृअनुप
ICAR

वार्षिक प्रतिवेदन
Annual Report
2017-18



भाकृअनुप - भारतीय तेल ताड़ अनुसंधान संस्थान
ICAR - Indian Institute of Oil Palm Research
(An ISO 9001: 2008 Certified Institute)
पेदवेगि - 534 450, पश्चिम गोदावरी जिला, आन्ध्र प्रदेश
Pedavegi - 534 450, West Godavari Dt., Andhra Pradesh

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ICAR-IIOPR Annual Report 2017-18

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1. Preface

In India, oil palm sector plays a key role by supporting the livelihood of many small and marginal farmers in oil palm growing states. The national productivity of oil palm has been very less due to climate, soil, crop and management constraints. Hence the key elements for a sustainable and vibrant oil palm sector would be to enhance yields with the help of best management practices, better planting materials, judicial utilization of natural resources and effective market access. The major cause of distress in oil palm is due to low level of farmers income and high fluctuations. Added to it, volatile market prices and increased cost of production have generated livelihood concerns of this vulnerable sector. In this regard, adequate attention has to be paid to raise agricultural income in oil palm, which would promote inclusive growth and infuse dynamism in this sector.

Doubling farmers income in oil palm is quite challenging and ICAR-Indian Institute of Oil Palm Research (IIOPR) is focusing on technological breakthroughs for shifting production frontiers and raising input use efficiency. Development of cropping/farming system models for different socio-economic and bio physical settings combining all the technologies and best practices covering production, protection and post harvest value addition are on top of agenda with an aim on doubling farm income.

IIOPR undertakes research activities related to oil palm and conducts research on developing production and protection technologies for various agro-climatic conditions, developing high-yielding hybrids tolerant to biotic and abiotic factors, germplasm collection, conservation and cataloguing, strengthening the production potential of existing seed gardens and establishment of new seed gardens, harvest and post harvest aspects of oil palm and transfer of oil palm technology. Research programmes are being strengthened and targetted for enhancing the farmers' income.

The technologies related to oil palm were disseminated to farmers by undertaking "*Mera Gauv Mera Gaurav*", under which 1490 farmers were covered during the report period. Eight modules related to technologies developed at IIOPR were initiated in two villages under Farmers First Programme in an area of 1812 ha covering 701 farm families. Programmes like Agricultural education day, International yoga day, *Swachh Bharat*, Vigilance awareness week, World soil day, etc were celebrated at IIOPR from time to time as per the directives of ICAR.

The Quinquennial Review Team, (QRT) constituted by ICAR to review the progress of work at IIOPR during 01-04-2011 to 31-03-2017 has rated the institute's performance as **OUTSTANDING** based on significant contributions made during the period. The recommendations of QRT, RAC

as well as suggestions offered by Director General, ICAR and Deputy Director General (Hort. Sc.), ICAR were duly incorporated in the technical programmes of ongoing research projects.

I am indebted to Quinquennial Review Team, Research Advisory Committee and Institute Management Committee of the Institute for their guidance and constructive suggestions in further improving the research programmes.

My bountiful thanks to Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR and Dr. A. K. Singh, Deputy Director General (Hort. Sc.), ICAR, who have been driving forces behind us and both have extended unparalleled leadership and guidance without which, our progress would not have been possible.

Dr. W. S. Dhillon, Asst. Director General (Hort. Sc.-I), ICAR, Dr. T. Janakiram, Asst. Director General (Hort. Sc.-II), ICAR and other staff of subject matter division (Hort. Sc.) were always helpful with their constant encouragement and unstinted support to IIOPR.

I wish to thank all the Scientific, Technical, Administrative and Supporting staff for their support and cooperation in implementing the Institute programmes in an effective way. Efforts taken by the Administration and Accounts section for shouldering the additional responsibility imposed on them are appreciated. New research activities initiated with additional financial support from DST and DAC&FW are duly acknowledged.

The efforts taken by Dr. K.Suresh, Principal Scientist and SIC (PME Cell) and Ms. A. Bhanusri, Senior Technical Officer (PME Cell) in bringing out this Annual Report are gratefully acknowledged.

25-06-2018
Pedavegi

(R. K. Mathur)
Director

2. Executive Summary

Oil palm is the highest oil yielding perennial crop that produces 4 to 6 tonnes of crude palm oil and 0.4 to 0.6 tonnes of palm kernel oil per ha per year from 4th to 30th year of its productive life span. The crop is being promoted by Government of India to meet the ever increasing demand for edible oils in the country. The Indian Institute of Oil Palm Research (ICAR-IIOPR) was established by Indian Council of Agricultural Research (ICAR) during 1995 at Pedavegi, Andhra Pradesh with a national mandate to strengthen research on all aspects of oil palm under irrigated conditions. The Institute is conducting research mainly on Genetic Resources Management, Biotechnology, Production System Management, Physiological and Biochemical basis for oil palm yield, Post Harvest Technology, Plant Health management and Transfer of Technology & Information and Communication Technology.

The Quinquennial Review Team (QRT) was constituted by ICAR to review the work of ICAR-IIOPR during 01-04-2011 to 31-03-2017. QRT has rated the performance of the Institute during the report period as **OUTSTANDING,** based on the significant contributions made by the Institute as well as overall development at the Institute. The ISO 9001-2008 certificate for IIOPR has been renewed for one more year based on the surveillance audit conducted on 26-02-2018. National Oil palm Seed meet-2017, Brainstorming session on Development of seed standards for oil palm seed gardens, Review meeting of R & D projects under NMOOP, Workshop on Enhancing farmers income through resource use efficiency and technological interventions in oil palm were organized. Programmes like Swachh Bharat, International yoga day, Agricultural education day, World soil day, Vigilance awareness week etc., were celebrated at the Institute in true spirit as per the directives received from ICAR. HRD programmes were implemented at the Institute as per the Annual Training Plan 2017-18 and 91.43 % of the trainings planned for different categories of staff could be realized.

The Institute has sanctioned staff strength of 82, including Director, 22 scientists, 18 technical, 15 administrative and 26 skilled support staff, of which 50 are in position. Total financial outlay of the Institute for 2017-18 was Rs. 1089 lakhs with a revenue generation of Rs. 1.30 cores. During the period, nine in-house research projects, 6 DACFW funded projects (under NMOOP), 1 DST funded project and 4 ICAR Inter-Institutional collaborative research projects were implemented. Major highlights of achievements during 2017-18 are presented here:

Survey and collection of germplasm from indigenous oil palm plantations planted with exotic genetic material resulted in identification of 4 dwarf palms in farmer's field of Pedakadimi village (Pedavegi mandal), West Godavari Dt., Andhra Pradesh. Oil palm germplasm available at IIOPR, Pedavegi was planted during 2004-2013 in 6 germplasm blocks numbered I-VI and morphological and yield characters were recorded for utilization of superior palms in future breeding programmes. Four pisifera palms with 99-100 per cent sterility and 29 virescence palms were identified in the germplasm blocks. The germplasm register was updated. Seven accessions of germplasm were submitted to NBPGR, New Delhi for getting IC numbers. Software module was developed in MS Access for evaluation of oil palm germplasm.

Dura palms from two D X D crosses viz., 44 CD (ZS-1) X 435, CD (CA-12) & 60 CD X 62 CD (ZS-8 inter se cross) selected for high yield, dwarfness and water use efficiency were evaluated and palm no. 47 (44 CD (ZS-1) X 435 CD (CA-12)) recorded highest

bunch weight (208.37 kg). One dura palm (207CD X 257CD) with high oil yield (> 25 oil/bunch), 14 dura palms with medium height increment combined with high yield and 1 dura palm with heavy bearing (>20 bunches/ palm) were selected for further utilisation in the crossing programme. Twenty palms with > 150 kg FFB yield were identified in Dura improvement V trial and 8 palms with > 100 kg FFB identified in D x P trial. Selected high yielding dura palms are being utilized in the hybridization programme both for production of commercial planting material (DxP) and advanced breeding material.

Standardized the observation procedure for TZ staining of oil palm zygotic embryo. Though all portions of the embryo responded in the media, the portion towards the operculum had given proper growth indicating that TZ staining on the half part of the embryo towards operculum is an indicator for viability. Cryopreservation of oil palm zygotic embryos was standardized and no significant difference in viability of fresh embryos and cryo treated embryos was observed. Seed, field and procedural standards were developed for oil palm seed gardens. The seed standard for the certification of oil palm germinated seeds was developed to harmonise oil palm germinated seed certification in India and will be helpful for domestic and international markets. This will be submitted to the central seed certification board. 100075 and 30000 D×P germinated seeds were supplied to different oil palm entrepreneurs from Pedavegi and Palode seed production centres respectively.

Genetic diversity and population structure of 311 African germplasm and 150 indigenous germplasm was characterized using molecular markers. Genome wide association mapping using SNPs identified 40 highly significant QTLs for different traits at a P value of d" 0.001 by MLM approach. Linkage mapping resulted in identification of one QTL for bunch number, two for oil to dry mesocarp and one for oil to wet mesocarp were identified on chromosome 1. Highly significant QTL was identified for oil to dry mesocarp at an LOD value of 13, which explains 4 % phenotypic variance. Whole genome wide scan found a total of 245654 SSR repeats, and 1, 87,980 primer pairs were designed across the 16 chromosomes of oil palm. First oil palm microsatellite database (OpSatDB) was developed for retrieval of micro satellite data based on repeat motif, motif type and repeat number for 16 chromosomes of oil palm genome. Experiments were conducted for standardization of oil palm tissue culture protocol using different explants such as seedling leaf, spear leaf, male and female inflorescence.

Studies were taken up to develop good management practices for sustainable and profitable oil palm cultivation. Application of irrigation water at CF 0.7 is recommended for higher yield coupled with recommended dose @ 1200:600:1200 g NPK fertilizers per palm per year through soil application at quarterly interval. Established inter crop cafetarium in oil palm. Crops like mango ginger, turmeric, black turmeric, ginger, colocasia, elephant foot yam have been found suitable and the same can be recommended for commercial cultivation in adult oil palm plantations. Biochar could be produced from different wastes (trunk, fronds and empty fruit bunches) of oil palm using Annual core biochar reactor. Developed the oil palm suitability map for Andhra Pradesh using thematic maps developed for various soil parameters and climatic parameters. Estimated the DRIS indices for nutrients in oil palm plantations of Krishna District, Andhra Pradesh. B>N>K>Mg>P is the order of importance of nutrients in Krishna District and the critical limits for nitrogen are high in leaf samples in comparison with values of West Godavari District. Fabrication diagrams of oil palm Ablation tool and IIOPR Sickles were completed

Studies conducted to develop management practices for leaf web worm indicated that the egg parasitoid, *Trichogramma embryophagum* was found effective with inundative releases @ 2.0 lakh per acre in six applications. A new pest namely Rugose spiraling white fly *Aleurodicus spirugulatus*

was observed in the oil palm plantations of West Godavari Dt., Andhra Pradesh. Green coloured sticky traps were more attractive to the whitefly adults compared to yellow traps. Neem oil + Rin detergent powder treatment effectively managed the pest by causing 97% mortality. Parasitoid, *Encarsia guadelopae* was found effective against the pest in the already released plantations of Kalavalapalli and adjoining areas. The predator *Chrysoperla zastowi,* a neuropteran species is also found effective in managing the pest though not to the extent of parasitoid. Crown surgery was modified by applying *Pseudomonas fluorescens* @3X10^{6}CFU/ml and Streptocycline sulphate @1% after the crown surgery instead of Carbendazim + Monocrotophos. *Trichoderma harzianum* and *Pseudomonas fluorescens* were found effective for management of stem wet rot disease in oil palm.

During 2017-18, 302 officers were trained on oil palm production technologies and 1139 farmers participated in onfarm and oncampus training programmes. Under mera gaon mera gaurav programme, 1490 farmers were covered under various technology transfer activities. Under Farmer first programme implemented 8 modules in 1812 ha of 701 farm families. 47 farmer scientist interface programmes were organised where in 910 members participated.

Mobile app on oil palm crop doctor was designed and developed. Short video films on management practices in oil palm cultivation viz., irrigation, fertilizer, mulching, green manure and cover crops, intercropping, nutrient management, pest management, disease management were developed for uploading to mobile application for crop doctor. Mobile data base of 3598 oil palm stakeholders from Andhra Pradesh, Chhattisgarh, Odisha, Tamil Nadu, Karnataka, Telangana and Gujarat were collected. Published 15 text SMS to 1.23 lakh mobiles, published 54 voice message calls to 12.21 lakh mobile numbers of 13 states in four languages, 104 voice calls and 14 SMS were published to farmer's mobile numbers under Farmer First Programme.

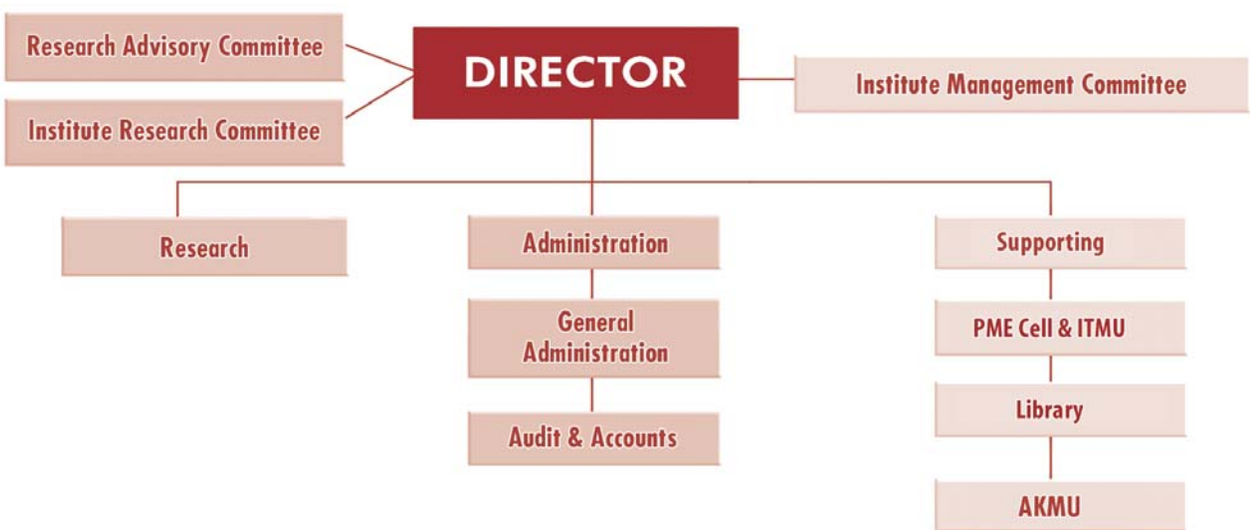
3. Introduction

To strengthen the research on all aspects of oil palm under irrigated conditions, Indian Council of Agricultural Research established the National Research Centre for Oil Palm (NRCOP) at Pedavegi, Andhra Pradesh on February 19, 1995. The Centre, over an area of 100 ha is 13 km away from Eluru, which is the district headquarters of West Godavari. Later during April 1999, the CPCRI, Research Centre at Palode was merged with NRCOP. The Research Centre at Palode is 35 km away from Thiruvananthapuram in Kerala state. The NRCOP was redesignated as Directorate of Oil Palm Research (DOPR) during the XI Plan and as ICAR-Indian Institute of Oil Palm Research (ICAR-IIOPR) during XII Plan. Since 1995, systematic efforts are being made at this Institute to cater to the needs of oil palm community and to increase the production and productivity of the crop by evolving production technology under rainfed and irrigated conditions. The Institute is conducting and coordinating research on all aspects of oil palm germplasm conservation, improvement, production, protection, post harvest technology and transfer of technology.

3.1. Mandate

- Basic, strategic and applied research on genetic resource management, crop improvement and production technologies for enhancing productivity of oil palm.
- Transfer of technologies and capacity building of stakeholders for increasing production of oil palm

3.2 Organisational setup



3.3 Financial outlay

Head	Amount (Rs. in lakhs)
Plan	1089

3.4 Externally funded projects

Name of the scheme / project	Amount (Rs.in lakhs)
National Agricultural Innovation Fund - Intellectual Property Management and Technology Transfer/ Commercialization (ITMU)	6.36
NMOOP funded scheme (Department of Agriculture, Cooperation and Farmers Welfare, Govt. of India)	
1. Utilization of oil palm biomass-as a source of various by-products	2.81
2. Dissemination of oil palm production technology through digital video films	12.74
3. Design and development of oil palm crop doctor for dissemination of technology	12.26
4. Development of elite planting material for next generation seed gardens	7.18
5. Development of seed standards for existing oil palm seed gardens	11.04
6. Strengthening of training on oil palm production technologies for stakeholders	9.64
DST Startup fellowship - Mapping QTLs for important physiological traits, oil yield related traits and construction of linkage maps in oil palm using genome wide microsatellites and SNP markers	2.27
AICRP (Palms)	2.70
Enhancing profitability of oil palm based cropping system through resource use efficient technologies with farmer-Scientist and Stakeholders Interface (Farmers first programme)	29.78

3.5 Resource Generation

During the year 2017-18, a total revenue of Rs. 1.30 crores has been generated.

3.6 Staff position

Category	Sanctioned	In-position	Vacant
Scientist (Including one RMP)	23	16	07
Technical	18	14	04
Administrative	15	06	09
Skilled Support Staff	26	14	12
Total	**82**	**50**	**32**

Library: The library has the collection of around 1700 reference books.The ICAR-IIOPR library is a member in CeRA (Consortium for e-Resources in Agriculture), which is one of the best e-journal portals. Journals primarily related to oil palm that are not included in CeRA were subscribed during the year. Five International journals worth of Rs. 47,000/- were subscribed.

Website: The Institute website houses the information regarding location map, organizational setup, cadre strength, AICRP, collaboration, awards, patents, databases/software, advisory training services and information pertaining to farmers and entrepreneurs. Downloads of annual reports and newsletters were incorporated in the website. Information pertaining to other related sub heads is being maintained. The Website ID is: http://dopr.gov.in.

Agricultural Knowledge Management Unit (AKMU): AKMU is committed to promote Information and Communication Technology (ICT) driven technology and information dissemination system for effective and quick delivery of information to the stake holders in oil palm, keeping in pace with the current knowledge. AKMU at IIOPR facilitates network connectivity in the Institute and is disseminating and sharing the knowledge and information on oil palm through web mode. AKMU, coordinates the maintenance of computers and accessories, UPS systems, networking components and internet connectivity at the Institute. It maintains the facility of NKN for the institute which provides a bandwidth of 100 Mbps. During the current year, wireless internet connectivity was provided to farm office building and auditorium.

4. Research Achievements

COLLECTION, CONSERVATION, CATALOGUING AND EVALUATION OF OIL PALM GERMPLASM

Collection and evaluation of oil palm germplasm

Survey and collection of oil palm germplasm: Four dwarf palms were identified in farmer's field of Pedakadimi village (Pedavegi mandal), West Godavari Dt., Andhra Pradesh and their characteristics are given in Table 1 and Fig.1. The palms are locally named as PKJ-1, PKJ-2, PKJ-3 and PKJ-4 and two bunches were collected from PKJ-2 and PKJ-3.

Evaluation of oil palm germplasm at Pedavegi: Oil palm germplasm available at Pedavegi was planted during 2004-2013 in 6 Germplasm Blocks

Table 1: Details of dwarf palms identified in farmer's field

Identified dwarf palm	Characteristics
PKJ-1	Annual height increment- 20.62 cm; Leaflet length- 93 cm; Leaflet width- 5.73 cm; Rachis length- 547 cm; Number of leaf lets- 342
PKJ-2	Annual height increment- 29.62 cm; Leaflet length- 117.16 cm; Leaflet width- 6.1 cm; Rachis length- 599 cm; Number of leaf lets-394
PKJ-3	Annual height increment- 22.13 cm; Leaflet length- 86 cm; Leaflet width- 7.57 cm; Rachis length- 634 cm; Number of leaf lets- 348
PKJ-4	Annual height increment- 27.12 cm; Leaflet length- 106.36 cm; Leaflet width- 7.08 cm; Rachis length- 584 cm; Number of leaf lets- 374

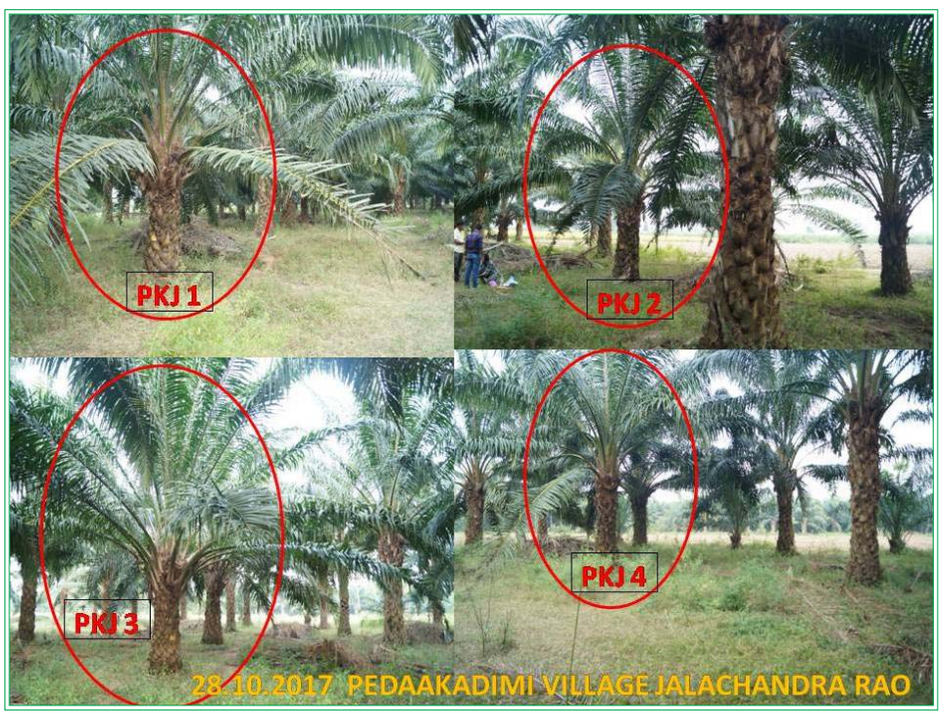


Fig. 1: Dwarf palms identified in farmer's field at Pedakadimi village, Andhra Pradesh

numbered I-VI. Morphological and yield characters were recorded in the germplasm blocks and the results are given below:

Germplasm Block I: The annual height increment was lowest (< 25 cm) in the accessions IC0610000, LA6 and selection CD471. Selection CD471 also recorded highest number of bunches, FFB yield and bunch index (Table 2). All the tenera palms recorded more oil/ bunch compared to dura palms and 15 palms recorded > 20 % oil/bunch. Based on 7 years average of FFB yield and oil/bunch data, it has been observed that the selected dura palms (No. 60 and 12) recorded higher FFB yield and oil/ bunch (> 20%) which can be used in future breeding programmes.

Germplasm Block II: The annual height increment

Table 2: Growth and yield performance of accessions in Germplasm Block – I

S. No	IC number	Height increment (cm)	Girth (cm)	Number of bunches	FFB yield (kg/palm/year)	Bunch index	Sex ratio
1	IC0610000	20.43	270.29	6.35	115.78	0.28	0.21
2	IC0610001	23.02	240.43	4.95	80.38	0.19	0.43
3	IC0610002	31.15	310.33	3.33	70.20	0.13	0.18
4	IC0610003	33.93	265.78	4.44	84.22	0.18	0.43
5	IC0610004	33.08	284.67	3.33	63.02	0.16	0.58
6	IC0610005	26.64	272.33	4.67	104.82	0.20	0.43
7	IC0610006	35.15	282.50	4.25	106.93	0.19	0.45
8	LA6	23.85	312.00	2.00	42.90	0.10	0.25
9	Selection CD471	23.65	270.38	8.05	129.08	0.30	0.25
	Max	35.15	312.00	8.05	129.08	0.3	0.58
	Min	20.43	240.43	2.00	42.9	0.1	0.18
	SE	1.83	7.43	0.59	9.238	0.021	0.05
	CV	19.73	7.99	38.63	31.283	33.39	38.42

Table 3: Growth and yield performance of accessions in Germplasm Block II

S. No	IC number	Height increment (cm)	Girth (cm)	Number of bunches	FFB yield (kg/palm/year)	Bunch index	Sex ratio
1	IC0610007	19.65	278.28	5.67	42.72	0.16	0.49
2	IC0610008	26.67	298.00	3.40	41.23	0.14	0.62
3	IC0610009	29.00	276.47	5.20	68.89	0.20	0.46
4	IC0610010	30.13	311.25	4.50	60.51	0.16	0.39
5	IC-610011	25.56	302.25	6.50	93.30	0.23	0.28
6	G8	26.67	250.00	3.00	49.51	0.15	0.80
7	IC0610012	24.25	310.45	5.15	58.46	0.16	0.75
8	G6	28.56	313.40	8.20	83.86	0.26	0.34
9	G27	25.66	302.60	4.90	80.55	0.23	0.29
10	IC0610013	21.81	336.21	7.42	103.97	0.28	0.35
	Max	30.13	336.21	8.2	103.97	0.28	0.80
	Min	19.65	250	3	41.23	0.14	0.28
	SE	1.02	7.618	0.52	6.82	0.02	0.06
	CV	12.55	8.087	30.35	31.58	25.44	39.28

(< 25 cm) was lowest in the accessions IC0610007, IC0610012 and IC0610013. Highest girth and FFB yield were recorded in IC 0610013. Highest number of bunches were recorded in G6, highest sex ratio was recorded in G8 and more total dry matter was recorded in IC0610012 (Table 3). Thirteen palms recorded > 20 % oil/bunch. Thirteen palms (221, 235, 203, 215, 183, 212, 223, 191, 138, 214, 230, 236 and 140) recorded FFB yield of more than 100 kg/palm/year based on 5 years average (2013-2017).

Germplasm Block III: The annual height increment was lowest (< 25 cm) in all the accessions except IC0610020, IC0610025, AND27, IC0610027 and IC0610028. Highest number of bunches were recorded in IC0610022. Highest FFB yield and bunch index were observed in IC0610019. Highest amount of total dry matter was recorded in the accession IC0610031 and high sex ratio was recorded in IC0610017. IC0610019 accession was found to perform better during the year based on its high FFB yield and bunch index (Table 4).

Germplasm Block IV: Height increment was lowest in the accessions IC0610036, IC0610034 and IC0610042. The girth of palm and sex ratio were more in IC0610035. Higher bunch number, FFB yield, total dry matter and bunch index were recorded in IC0610037. High bunch index was observed in IC0610034 and IC0610035 (Table 5).

Table 4: Growth and yield performance of accessions in Germplasm Block III

S. No	IC number	Height increment (cm)	Girth (cm)	Number of bunches	FFB yield (kg/palm/year)	Bunch index	Sex ratio
1	IC0610014	22.95	274.00	4.20	89.52	0.27	0.67
2	IC0610015	13.48	285.29	12.00	96.20	0.37	0.68
3	IC0610016	21.35	276.33	6.00	80.41	0.25	0.52
4	IC0610017	23.85	321.33	10.00	131.61	0.36	0.84
5	IC0610018	22.48	277.73	9.73	133.08	0.35	0.68
6	IC0610019	21.90	311.20	10.07	185.27	0.42	0.44
7	IC0610020	29.42	300.33	7.50	87.58	0.27	0.59
8	IC0610021	19.20	311.47	6.73	73.06	0.22	0.64
9	IC0610022	19.34	287.27	12.40	109.99	0.39	0.79
10	IC0610023	20.45	309.13	8.40	85.51	0.30	0.55
11	IC0610024	21.92	302.87	6.67	84.51	0.23	0.77
12	AND27	29.38	285.00	2.00	39.27	0.14	0.75
13	CO1	17.50	335.53	8.33	117.43	0.30	0.37
14	IC0610028	30.69	288.27	8.91	132.16	0.31	0.65
15	IC0610029	25.97	251.27	7.36	52.80	0.23	0.59
16	IC0610030	20.44	289.80	7.80	111.19	0.32	0.43
17	IC0610031	18.49	249.17	11.47	137.21	0.38	0.65
18	IC0610032	22.16	269.60	7.33	103.88	0.29	0.68
19	IC0610033	20.37	330.43	3.57	48.72	0.14	0.55
20	IC0610025	27.06	280.93	7.71	95.32	0.25	0.74
21	IC0610026	24.03	295.33	10.53	126.36	0.33	0.77
22	IC0610027	25.33	300.47	9.33	136.50	0.32	0.69
	Max	30.69	335.53	12.40	185.27	0.42	0.84
	Min	13.48	249.17	2.00	39.27	0.14	0.37
	SE	0.89	4.78	0.56	7.30	0.02	0.03
	CV	18.44	7.67	32.63	33.36	25.26	19.32

Table 5: Growth and yield performance of accessions in Germplasm Block IV

S. No	IC number	Height increment (cm)	Girth (cm)	Number of bunches	FFB yield (kg/palm/year)	Bunch index	Sex ratio
1	IC0610034	20.95	300.00	9.33	99.16	0.31	0.50
2	IC0610035	24.29	365.00	8.00	99.60	0.30	0.80
3	IC0610039	25.14	299.00	7.80	88.42	0.25	0.66
4	IC0610040	26.79	285.00	3.50	52.49	0.15	0.23
5	IC0610041	27.83	298.00	4.11	51.90	0.16	0.48
6	IC0610036	19.29	310.00	4.50	47.98	0.17	0.55
7	IC0610037	31.07	317.00	11.00	140.59	0.33	0.56
8	IC0610038	25.07	288.90	6.80	93.77	0.26	0.56
9	IC0610042	20.29	283.75	6.38	83.16	0.23	0.49
10	IC0610043	26.00	305.60	4.50	68.53	0.18	0.35
	Max	31.07	365.00	11.00	140.59	0.33	0.8
	Min	19.29	283.75	3.50	47.98	0.15	0.23
	SE	1.153	7.446	0.781	9.025	0.021	0.049
	CV	14.782	7.714	37.477	34.568	28.433	30.043

Germplasm Block V: Height increment was less in all the accessions except IC0610049, IC0610051 and IC0610050. Higher bunch number, FFB yield and bunch index were recorded in IC0610050. Total dry matter was highest in IC0610051 and sex ratio was highest in IC0610049, IC00610044 and IC0610047 (Table 6).

Identification of pisifera and virescence palms in germplasm blocks: Thirty two pisifera palms available in 5 germplasm blocks (GB I to GB V) were analysed and 4 pisifera palms with 99-100 per cent sterility were identified *viz.,* no. 47 (3 bunches) and no. 20 (5 bunches) in germplasm block III and no. 8 (3 bunches) and no. 13 (6 bunches) in germplasm block V. Twenty nine virescence palms were identified in the germplasm blocks.

Germplasm Block VI: The accessions available in germplasm block VI were evaluated for sex ratio. Highest sex ratio was observed in IC0621403 (0.83) followed by IC0621417 (0.82) and IC0621408 (0.80), while lower sex ratio was observed in IC0621400 (0.26) followed by IC0621389 (0.29).

Yield performance of *E. oleifera* palms at Palode: Yield performance of *E. oleifera* accessions assessed during 2017-18 indicated that the number of bunches varied from 1 to 12 and bunch weight from 20.58 kg to 317 kg. Six palms recorded FFB yield of > 200 kg/palm/year.

Growth performance of oil palm accessions imported from Malaysia

Pedavegi: Oil palm accessions (12 nos.) imported from Malaysia under exchange programme are being raised in the secondary nursery and initial growth parameters were recorded. Number of leaves varied from 15.3 to 17.67, height of seedlings (from base to first leaf tip) varied from 65.2 to 80.89 cm and girth at base varied from 18.77 to 24.86 cm.

Palode: Twenty accessions received under exchange programme from Malaysia are being evaluated in secondary nursery. The plant girth varied from 5.84 cm to 16 cm and more girth was recorded in EC869406 followed by EC869403 and EC869397. Mean height of plants varied from 29.2 cm in EC869398 to 78.4 cm in EC869396. Seedling height was maximum in EC869414 followed by EC869395 and EC869406 whereas it was lower in EC869399 and EC869408. Number of leaves ranged from 5.8 to 10.2.

Table 6: Growth and yield performance of accessions in Germplasm Block V

S. No	IC number	Height increment (cm)	Girth (cm)	Number of bunches	FFB yield (kg/palm/year)	Bunch index	Sex ratio
1	IC0610045	21.54	296.31	7.77	68.50	0.22	0.54
2	IC0610046	21.90	289.17	3.83	39.21	0.13	0.63
3	IC0610047	22.24	300.43	6.71	60.20	0.21	0.83
4	IC0610048	21.07	305.00	6.50	61.88	0.25	0.77
5	IC0610049	28.37	308.57	7.00	118.02	0.28	0.84
6	IC0610050	25.66	281.14	9.57	148.67	0.36	0.79
7	IC0610051	33.65	286.93	8.47	123.07	0.27	0.79
8	IC0610044	22.93	319.80	7.70	65.47	0.19	0.84
9	Unknown source	20.51	350.71	6.86	45.41	0.17	0.43
	Max	33.65	350.71	9.57	148.67	0.36	0.84
	Min	20.51	281.14	3.83	39.21	0.13	0.43
	SE	1.444	7.03	0.527	12.871	0.023	0.05
	CV	17.891	6.933	22.11	47.578	29.462	20.767

Cataloguing of oil palm germplasm

The germplasm register at Pedavegi was updated from Germplasm 1 to 5. Seven accessions of germplasm were submitted to NBPGR, New Delhi for getting IC numbers.

Design and development of software for oil palm germplasm: Observations recorded quarterly and annually and various calculations performed were identified as parameters for evaluation of oil palm germplasm and structure of database tables was designed. Software module was developed in MS Access for evaluation of oil palm germplasm. Data entry screens were developed for entering yield data and other morphological data. Program code has been written for calculation of various parameters like leaf area, leaf dry weight, trunk volume, trunk dry matter, total dry matter, bunch index etc.

Evaluation of African germplasm at Jambuga (Telangana)

African germplasm from 3 sources *viz.,* Guinea Bissau (4 accessions), Zambia (3) and Tanzania (2) planted in August 1998 at ITDA (Integrated Tribal Developmental Agency) farm was evaluated. The maximum number of bunches and FFB yield were recorded in ZS-5. Among the cold tolerant material, CA-10 recorded more bunches and FFB yield.

GENETIC ENHANCEMENT IN OIL PALM

Breeding for high yield in oil palm

Evaluation of DxD crosses (Dura Improvement Trial III) at Pedavegi: Dura palms from two D X D crosses *viz.,* 44 CD (ZS-1) X 435, CD (CA-12) and 60 CD X 62 CD (ZS-8 *inter se* cross) were evaluated for high yield, dwarfness and water use efficiency. Palm no. 47 (44 CD (ZS-1) X 435 CD (CA-12)) recorded highest bunch weight (208.37 kg) during 2017-18. There were significant variations between the water treatments. The cross 44 CD X 435 CD recorded more number of bunches (17.76) and bunch weight (118.45 kg) in full irrigation (Fig. 2). Maximum mesocarp/fruit (80.40 %) and oil/bunch (20.80 %) was observed in palm no. 81 followed by palm no.88.

Selection of palms for crossing (DxD Extension 100): Fourteen palms with highest yield and less height increment were selected based on the mean

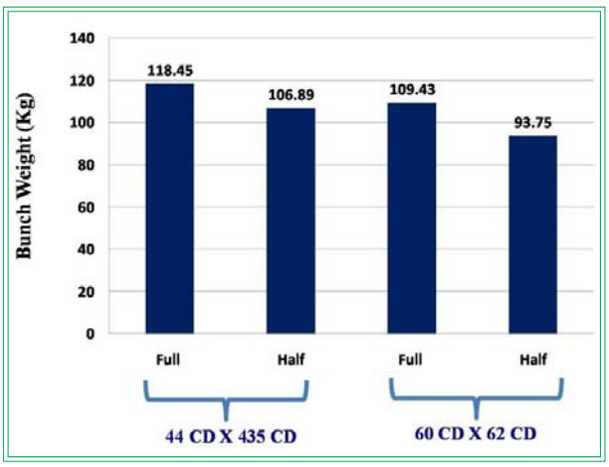


Fig. 2: Effect of irrigation on yield performance in D X D crosses

of 2 years (2015- 16 and 2016-17). Palm No. 47 & 91 recorded highest yield (> 200 kg yield/ palm) (Table 7 and Fig 3). Selected high yielding palms of dura are being utilized in the hybridization programme both for production of commercial planting material (DxP) and for production of advanced breeding material.

Evaluation of D X D crosses (Dura Improvement Trial IV): Promising palms with more number of bunches (> 20 bunches/palm) were identified as shown in Fig. 4 and Table 8. Bunch analysis indicated higher oil (>25 % oil/bunch) in cross (24 (207CD X 257CD)). More oil/bunch ratio was observed in palm nos. 158 (22.40 %), 402 (26.45 %), 164 (27.44 %), 641 (28.64 %), 401 (28.82 %), 162 (35.10 %) and 644 (35.40 %) belonging to cross 207CD X 257CD.

Fig. 3: Selected palms based on less height and high yield

In dura improvement trial, 7 palms were identified as sterile (Fig. 5). The identified palms are *viz.*, palm no. 365 (43 CD X 207 CD), 404, 642 (599NATP X 38D), 481, 482 (66CD X 4D), 542 (599NATP X 33D) and 634 (164CD X 192CD).

Performance of Dura IV at Palode: The plant girth varied from 1.06 to 1.58 m; girth was maximum in D47 X D61 followed by D20 X D35 and D20 X D23. The lowest girth was recorded in D48 X D48 followed by D80 X D85. The plant height varied from 2.95 to 3.59 m; the tallest palm being D47 X D61 followed by D20 X D35 and D48 X D61. The sex ratio ranged from 0.35 to 0.88; maximum sex ratio was recorded in D20 X D23 followed by D20 X D35 and D47 X D61. Six out of the eight crosses recorded sex ratio above 0.50. Mean number of leaves varied from 22.14 to 26.83.

Performance of Dura V at Palode: Twenty five D X D genotypes planted during 2016 were evaluated. Plant height varied from 2.58 to 6.60 m. The maximum height was recorded in TP015D followed by TP028D and lowest height was recorded in TP004D followed by TP032D and TP024D. Sex ratio varied from 0.18 in TK004 to 0.53 in TP011D. Number of leaves varied from 15.27 to 25.11.

Evaluation of planting materials for precocity: To evaluate the planting material for precocity, a non replicated trial was taken up at Pedavegi during November 2016 with 29 palms showing precocity (belonging to different crosses) along with 7 normal palms and evaluated for sex ratio and FFB yield. Results indicated that, sex ratio ranged from 0-1 and FFB yield (recorded twice) ranged from 0-2.092 kg with 0-5 bunches. It has also been observed that the precocity material started yielding, whereas the non precocity materials have not started yielding.

Table 7: Performance of selected palms based on height and FFB yield

	2015-16			2016-17			Average 2 years			
Palm no.	No. of bunches	Bunch weight (kg)	Average bunch weight (kg)	No. of bunches	Bunch weight (kg)	Average bunch weight (kg)	No. of bunches	Bunch weight (kg)	Average bunch weight (kg)	Height increment (cm)
47	19	206.15	10.85	22.67	236.39	10.42	20.83	221.30	10.42	33
91	18	202.13	11.23	22.00	214.50	9.75	20.00	208.30	9.75	32
73	20	189.58	9.48	21.00	202.18	9.63	20.5	195.90	9.63	24
33	18	143.27	7.96	23.00	220.22	9.57	20.50	181.70	9.57	18
19	22	174.61	7.94	20.00	180.72	9.04	21.00	177.70	9.04	46
74	18	165.89	9.22	24.00	184.67	7.69	21.00	175.30	7.69	36
54	18	167.81	9.32	23.00	181.95	7.91	20.50	174.90	7.91	22
72	20	145.55	7.28	24.00	202.42	8.43	22.00	174.00	8.43	30
78	19	181.75	9.57	18.00	153.35	8.52	18.50	167.60	8.52	33
2	15	46.12	3.07	17.00	135.96	8.00	16.00	91.00	8.00	35
10	16	101.65	6.35	22.00	144.80	6.58	19.00	123.20	6.58	18
13	10	54.21	5.42	25.67	214.46	8.26	17.83	134.30	8.26	20
38	6	38.95	6.49	16.00	110.04	6.88	11.00	74.5	6.88	21
43	3	19.24	6.41	18.00	145.31	8.07	10.50	82.3	8.07	19

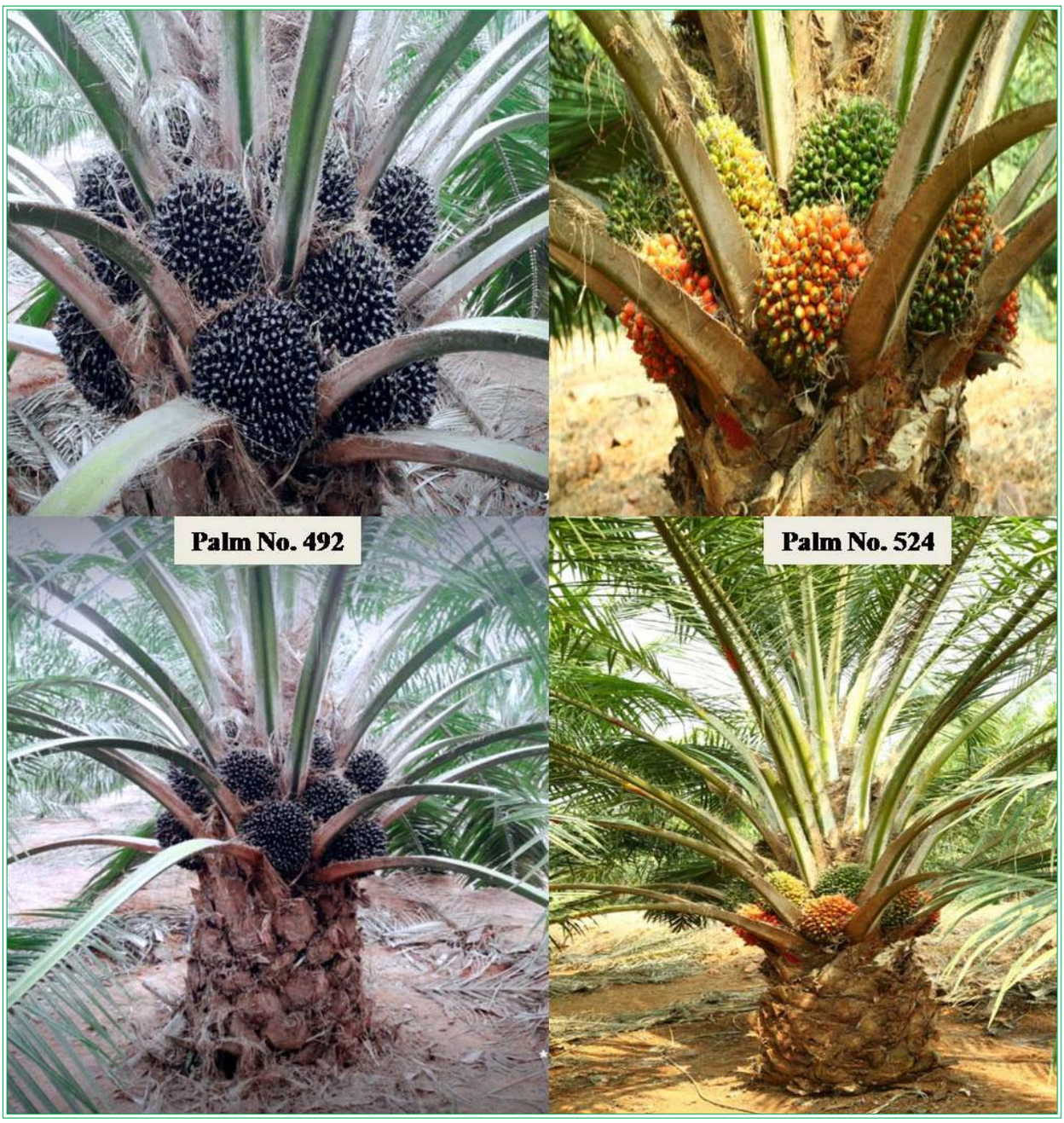


Fig. 4: High yielding palms in dura improvement trial

Breeding for dwarfness in oil palm

Bunch characteristics of Interspecific hybrid-II progenies: Among the interspecific hybrid progenies, the fruit to bunch ratio varied from 0.42 to 0.67. The highest fruit to bunch ratio was in palm no. 12. Mesocarp to fruit per cent varied from 43.08 to 81.82. Maximum oil to dry mesocarp was in palm no. 12 (79.77 %) followed by 28-I and 8-I. The lowest oil to mesocarp content was 57.71 %. Oil to bunch per cent varied from 8.78 to 20.59, the highest being in palm number 12 (20.59) followed by 28-I (17.63).

Performance of Interspecific hybrid-IV progenies in secondary nursery: Six interspecific crosses were evaluated in secondary nursery at Palode. The plant girth varied from 23.6 to 39.39 cm. Maximum girth was recorded by O7 X P66 followed by O22 X P66 and O16 X IS17. Height

Table 8: FFB yield and height in D X D crosses (Dura improvement trial IV)

S.No.	Cross	Sex ratio	Height (cm)	No. of bunches	Bunch weight (kg/palm)
1	100CD X 257CD	0.47	73.16	4.96	31.71
2	124CD X 198CD	0.38	85.19	5.54	38.98
3	164CD X 192CD	0.52	68.76	4.27	14.70
4	166CD X 93CD	0.29	81.76	5.54	36.50
5	204CD X 93CD	0.19	92.13	4.42	33.84
6	205CD X 257CD	0.25	94.33	5.88	31.01
7	207CD X 257CD	0.33	83.24	3.99	24.46
8	250CD X 257CD	0.51	78.40	5.33	28.40
9	254CD X 93CD	0.23	87.56	3.14	19.07
10	272CD X 192CD	0.19	61.19	4.00	23.43
11	328CD X 41CD	0.37	70.13	4.59	29.33
12	36CD x 123CD	0.30	78.29	5.05	38.28
13	410CD X 42CD	0.22	77.33	4.68	31.50
14	42CD Self	0.40	68.16	4.29	32.36
15	42CD X 43CD	0.42	58.50	3.95	19.21
16	207CD X 4D	0.51	86.75	5.71	34.18
17	232CD X 298NATP	0.52	70.23	4.42	30.08
18	232CD X 37D	0.47	84.19	5.38	34.55
19	250CD X 4D	0.57	72.17	4.88	27.34
20	58CD X 45D	0.36	71.29	4.68	29.41
21	66CD X 4D	0.45	83.65	5.63	34.31
22	99CD X 45D	0.42	71.81	4.91	34.51
23	599NATP X 33D	0.40	76.85	3.91	20.22
24	599NATP X 38D	0.85	83.74	13.42	69.36
25	599NATP X 63CD	0.47	68.91	4.60	29.83
26	60CD X 62CD	0.41	74.72	3.42	18.36
27	44CD X 435CD	0.44	78.48	5.43	29.10
28	42 CD X 257 CD	0.44	82.59	4.98	34.60
29	43 CD X 207 CD	0.19	92.18	4.87	33.75
SD		NS	14.65	NS	NS
CV (5%)		44.50	11.52	27.38	38.62

ranged from 1.03 to 2.95 m, highest plant height was recorded in O22 X P66 while the lowest was recorded in O16 X IS17. Number of leaves varied from 9 to 12.75.

Performance of T X T progenies in secondary nursery: Growth evaluation of six T X T crosses in secondary nursery at Palode indicated that plant girth varied from 26.65 (368 X 368) to 38.41 cm (409 X 409) cm. The plant height ranged from1.02 (368 X 368) to 1.30 m (409 X 409). Number of leaves varied from 9.69 to 14.11.

Evaluation of dwarf D X D crosses in field (Dura Improvement Trial V): Evaluation of dura improvement trial V for height and yield characters

Fig. 5: Sterile dura palms identified in dura improvement trial

was carried out with 11 different D X D crosses. The bunch number, FFB yield and average bunch weight varied from 11.19 to 19.48, 45.90 to 108.29 kg/palm/year and 3.63 to 6.67 kg respectively. More number of bunches were recorded in the cross 42CD X 257CD followed by 40CD X 282C, whereas minimum number of bunches and FFB yield were recorded in 42CD X 42CD. Highest FFB yield with average bunch weight was recorded in 465CD X 42CD with more height of palm. Based on individual palm wise FFB yield data, 20 palms were reported to record more than 150 kg FFB/palm/year.

Evaluation of dwarf dura trial (Dura Improvement Trial VI): Evaluation of five different D X D crosses was carried in the dura improvement trial VI. The sex ratio varied from 0.26 to 0.82, girth at base and height of palm up to first leaf tip were 109.12 to 136.11 cm and 273 to 341 cm respectively. Sex ratio was maximum in the cross 410CD X 42CD (0.82), followed by 40CD X 42CD (0.80) and low sex ratio was recorded in 42CD X 42CD (Table 9).

Evaluation of D X P crosses in field (Progeny Testing Trial): Evaluation of 8 D X P crosses was carried out by recording yield data and height of palm up to first leaf tip. More number of bunches were recorded in 100CD X 78P (12.33) followed by 194D X 76P (11.11), 45CD X 110P (11.03) and 166CD X 76P 90 (11.02). Highest FFB yield was recorded in 83CD X 76P (68.77 kg) followed by 166CD X 76P (68.52 kg), where as less FFB yield was recorded in 540CD X 110P (37.42 kg). Height of the palms

ranged from 593.78 cm (45CD X 76P) to 664.08 cm (166CD X 76P) (Table 10). Eight palms recorded more than 100 kg FFB/year with the average bunch weight varying from 7.3 to 10.09 kg.

Breeding for abiotic stress tolerance in oil palm

Evaluation of two dura crosses namely 44CD (ZS-1) X 435CD (CA-12) and 60CD X 62CD (ZS-8 *inter se* cross) with two irrigation levels (IW/CPE) of 1.0 and 0.5 was done. One hundred palms were evaluated for biochemical markers *viz.*, proline content, SOD activity, lipid peroxidase, epicuticular wax content were taken.

Seed studies in oil palm

Seed storage studies: The seed viability has been correlated with Tetrazolium (TZ) staining on the embryo, which has not been reported so far in oil palm. Four pieces (longitudinal and cross) of zygotic embryo were planted in the media (*in vitro*) and observed for the growth. Though all portions responded in the media, the portion towards the operculum had given proper growth indicating that TZ staining on the half part of the embryo towards operculum is an indicator for viability (Fig. 6, 7 & 8).

Seasonal influence and provisional factors on oil palm dormancy and germination: Three years data pertaining to the weather during seed development and germination (first, second and

Fig. 6: Top and bottom portion of zygotic embryo

Fig. 7: Response of top portion of zygotic embryo in the media

Fig. 8: Response of bottom portion of zygotic embryo in the media

third flush) have been collected and correlated. No clear correlation was established. This might be due to the mechanical dormancy. However, the preliminary experiment on viability of zygotic embryo through TZ test (as embryo does not have dormancy) showed an average of 93 % viability irrespective of seasons (Fig. 9).

Cryopreservation of oil palm zygotic embryos: Oil palm seeds of dura palm no. F.46 were used for the study. The operculum of kernels was removed and embryos were extracted. The embryos were kept in moist germination paper packed in plastic bags and placed in an oven at 30°C for 16 hours. Half of the embryos were tested for viability using TTC by incubating in 1% TTC at 40°C for 4 hours. 88.3 % of the embryos showed positive result against viability. Remaining half of the embryos were desiccated in a desiccator with silica gel for 18 hours. The desiccated embryos were then put in sterile cryo-vials and directly plunged into liquid nitrogen. After 1 hour incubation, cryo-vials were taken out from liquid nitrogen and put directly into water at 40 C for 2 minutes. These embryos were then kept in moist germination paper packed in plastic bags and incubated at 30 C for 1 hour and tested for viability using TTC. 86.7 % of embryos were tested positive. Hence, it is observed that there was no significant difference in viability of fresh embryos and cryo treated embryos (Fig. 10).

Production and supply of hybrid seeds at Pedavegi and Palode: 100075 and 30000 D×P germinated seeds were supplied to different companies from Pedavegi and Palode seed production centres, respectively.

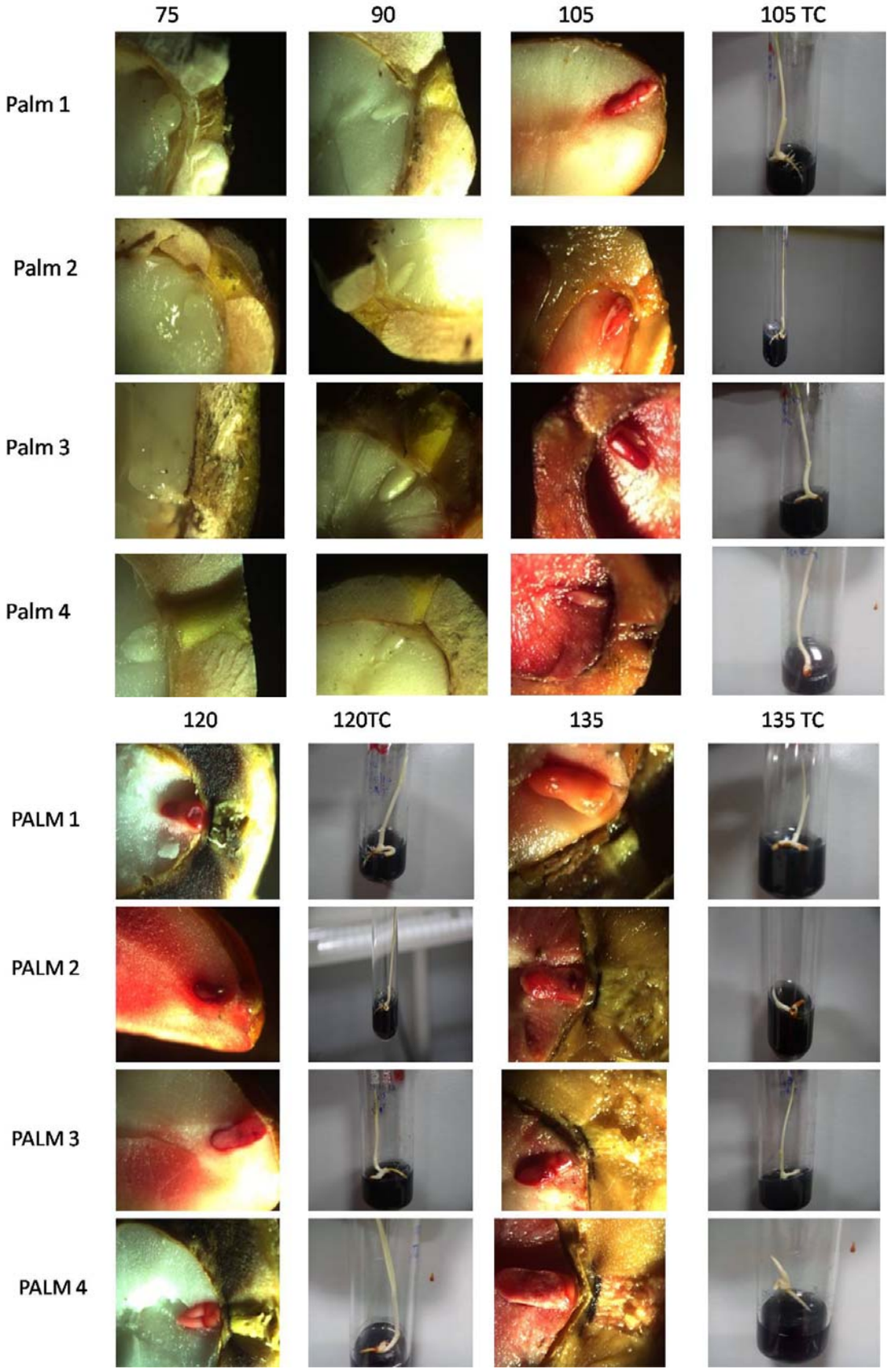
Table 9: Flowering and initial growth characters of dura improvement trial VI

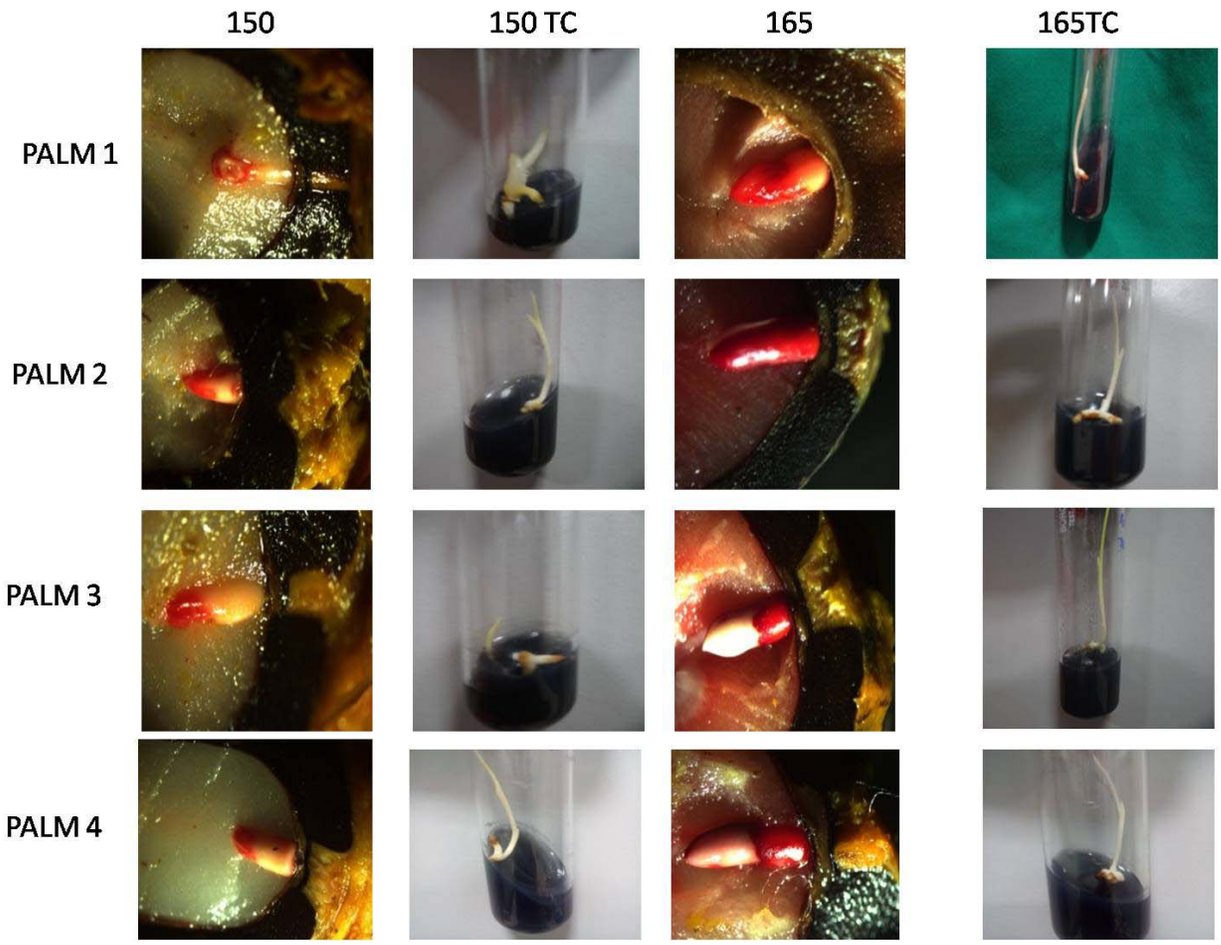
Treatment	Sex ratio	Girth at base (cm)	Height up to 1st leaf tip (cm)
T1-40CD X 42CD (135)	0.80[a]	130.06	339.62
T2-40CD X 283CD (136)	0.65[ab]	132.34	312.40
T3-410CD X 42CD (137)	0.82[a]	136.11	341.26
T4-42CD X 42CD (138)	0.26[c]	119.87	273.59
T5-42CD X 497CD (139)	0.58[b]	109.12	296.23
CD @ 5%	0.22	NS	NS
CV	23.31	28.19	29.03

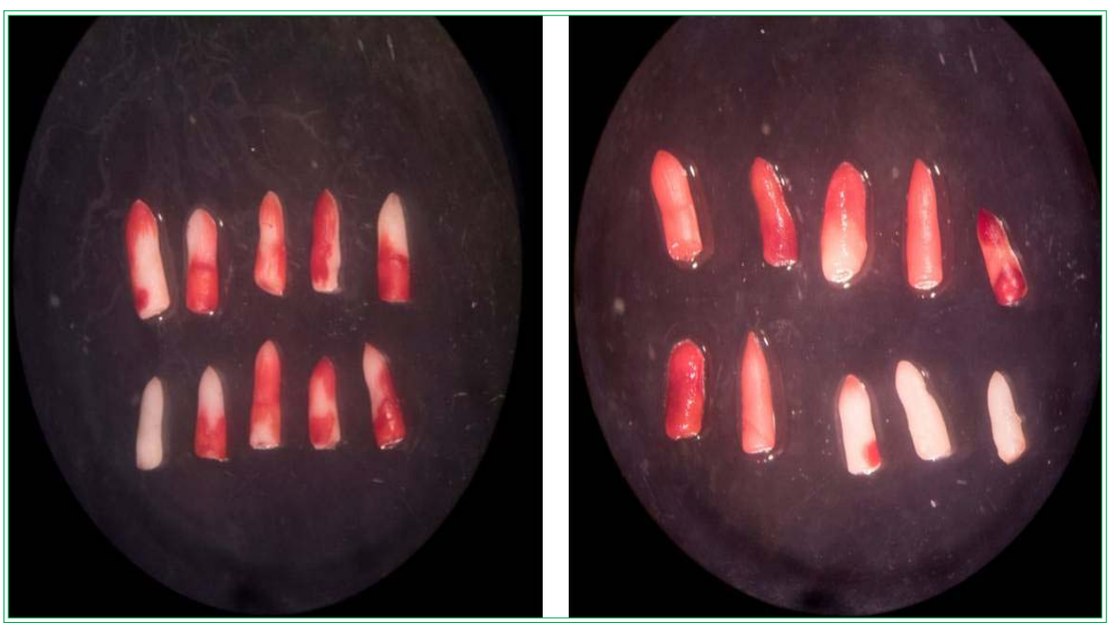
Table 10: Height and FFB yield in progeny testing trial

D X P Cross	Height (cm)	Number of bunches	Bunch weight (kg)
409CD 195P	617.87	09.56	58.10
100CD X 78P	628.73	12.33	58.84
540CD X 110P	607.83	07.96	37.42
45CD X 110P	620.24	11.03	56.94
166CD X 76P	664.08	11.02	68.52
83CD X 76P	650.67	10.51	68.77
45CD X 76P	593.78	06.28	34.77
194d X 76P	658.44	11.11	64.09
Max	664.08	12.33	68.77
Min	593.78	06.28	34.77
CV	006.95	32.73	32.17
CD	NS	NS	NS

Fig. 9: Development of operculum and embryo after pollination during seed development







Before cryo treatment **After cryo treatment**

Fig. 10: Cryopreservation of zygotic embryo

BIOTECHNOLOGICAL STUDIES IN OIL PALM

Genomics approaches for enhancement of oil palm germplasm

Genetic diversity and population structure analysis of selected oil palm genotypes: A total of 311 oil palm germplasm belonging to four African countries were evaluated for molecular characterization using 400 SSR markers, among which 200 SSRs were found to be polymorphic. 170 SSRs were used for genotyping of 311 oil palm germplasm representing different African countries. These 170 SSRs could be able to differentiate the 311 germplasm into different clusters mainly based on their geographical origin. The germplasm of Guinea Bissau formed a separate cluster than other countries (Fig. 11).

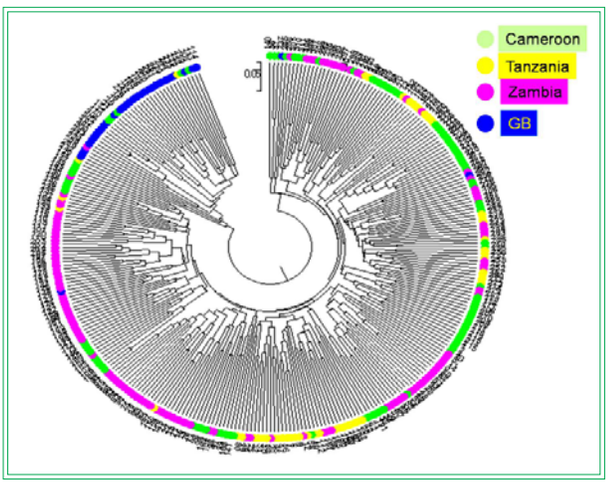


Fig. 11: Dendrogram of 311 African germplasm generated by 170 SSR markers based on power marker software

Methodology of development and design of web based software for information retrieval on oil palm genomic SSR data: Whole genome wide scan found a total of 245654 SSR repeats across the 16 chromosomes of oil palm, of which 38717 were compound microsatellite repeats. A total of 245654 microsatellite repeats were found across the 16 chromosomes. Chromosome 1 had more number of SSR repeats (39987) followed by chromosome 2 (24032) and 3 (21731). Genomic sequence data (245654 microsatellite repeats) of all 16 chromosomes of oil palm were compiled and extraction of unique forward and reverse sequence data for each of 16 oil palm chromosomes. Designed and developed web based retrieval of micro satellite data based on repeat motif, motif type and repeat number for 16 chromosomes of oil palm genome. The web based application was developed using content management software Joomla with php and MySql database. This application was included as Genomic SSRs in the OpSatDB web application with an updated design of the home page and tutorial page and version as 2.0 (Fig. 12).

Technology of Genome Wide Association (GWAS) mapping for dwarf stature of oil palm using SNPs by genotyping by sequencing method: Association mapping using SNPs resulted in identification of five significant QTLs on chromosome 6, 7 and 9. Interestingly, out of five, three QTLs located on chromosome 7 itself, while one each on chromosome 6 and 9 at a P value of <0.00001. Out of the five QTLs, qtl_{H2} on chromosome 7 were found to be highly significant which explained a phenotypic variance of 15 % at a P of $2X10^{-5}$ (Fig. 13).

Technology of Genome Wide Association (GWAS) mapping using SNPs for important traits: Association of four yield and seven oil yield related traits with SNPs resulted in identification of 40 highly significant QTLs for different traits at a P value of d"0.001 by MLM approach. More genetic loci were identified to be associated with oil to bunch (%), followed by average bunch weight (Table 11).

Construction of linkage maps and QTL mapping in oil palm: Two oil palm genotypes (240D and 280D) were selected for generating segregating populations. A total of 70 segregating progeny lines were used for genotyping and phenotyping and also for identification of QTLs of important traits. One QTL for bunch number, two for oil to dry mesocarp and one for oil to wet mesocarp were identified on chromosome 1. Highly significant QTL was identified for Oil to dry mesocarp at an LOD value of 13, which explains 4% phenotypic variance (Fig. 14).

Table 11: QTLs identified for oil/bunch by GBS method

Trait	QTL	Position	Chromosome	Phenotypic variance (R^2) (%)	P value
Oil to bunch (%)	Qtl_{OB1}	SGI|132530|	5	23.2	0.0001
	Qtl_{OB2}	SGI|527683|	13	21.3	0.0002
	Qtl_{OB3}	SGI|593593|	4	25.3	0.0004
	Qtl_{OB4}	SGI|3075511|	12	25.2	0.0004
	Qtl_{OB5}	SGI|1439833|	2	24.9	0.0004
	Qtl_{OB6}	SGI|4201862|	16	24.3	0.0005
	Qtl_{OB7}	SGI|1171494|	3	17.1	0.0005
	Qtl_{OB8}	SGI|1562591|	2	23.3	0.0006
	Qtl_{OB9}	SGI|1171500|	3	15.9	0.0007
	Qtl_{OB10}	SGI|6637|	15	14	0.0009

Fig. 12: Home page of designed oil palm micro satellite data base

Standardization of oil palm tissue culture protocol for oil palm

A total of 40 experiments were conducted on the different explants such as seedling leaf, spear leaf, male and female inflorescence. Four explants were used for spear leaf inoculation. Callusing was observed from 3-4 months after inoculation in some treatments (1-3 %). In case of seedling leaves also callusing was initiated at 3-4 months after inoculation in few treatments and callusing rate was 6-10 %. A total of 8 calluses were recorded out of which, shooting was initiated from one culture. Callusing rate in male inflorescence ranged from

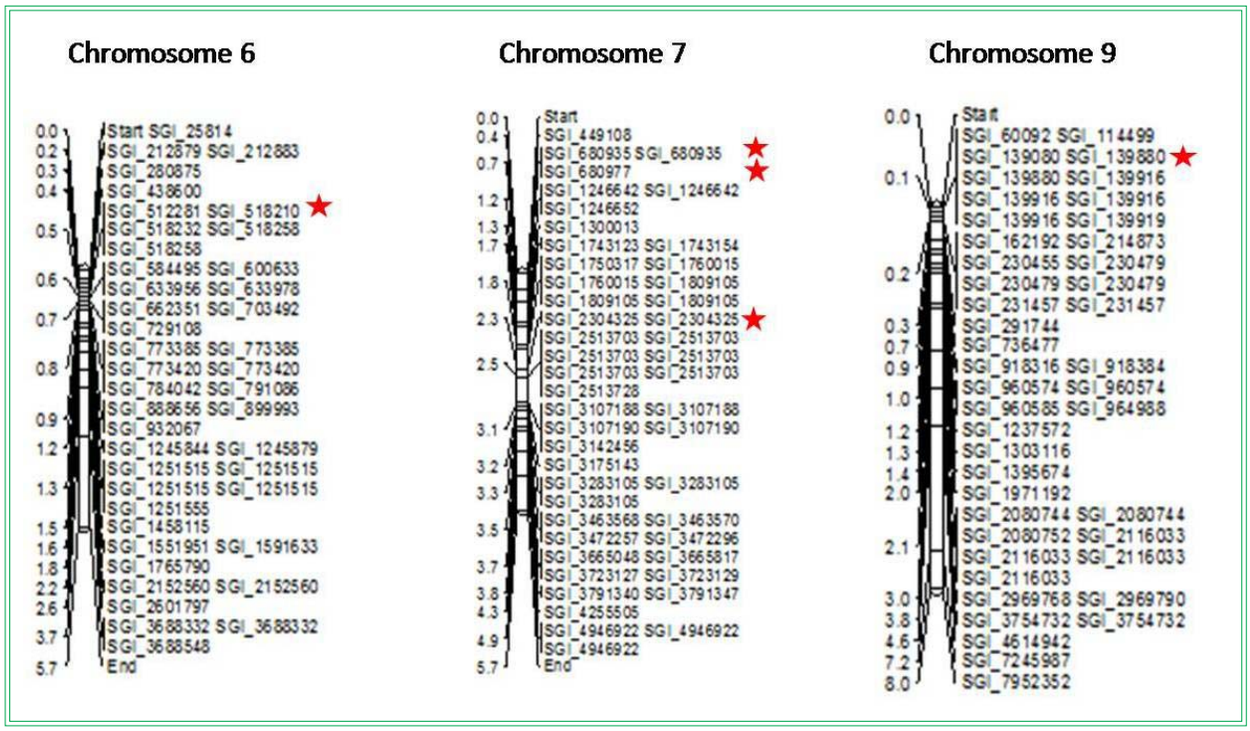


Fig. 13: Location of QTLs for height increment using SNPs by GBS method

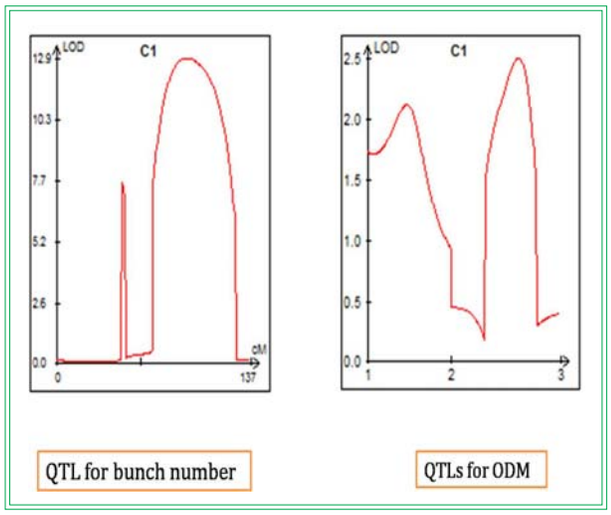


Fig. 14: LOD graph showing QTLs identified for bunch number and Oil to dry mesocarp in oil palm using SSRs by linkage mapping

5-15 %. Callusing was also observed with female inflorescence (1-3 %). Rooting and hardening were standardized in case of zygotic embryos. Fifteen seedlings at one leaf stage were transferred to mist chamber, out of which one plant survived and now it is 6 month old and is at 7 leaf stage (Fig. 15).

Fig. 15: Callusing from different explants

PRODUCTION SYSTEM MANAGEMENT

Nursery management in oil palm

Experiment was conducted with objective of quantifying the amount of water and frequency of watering required for optimum growth and development of oil palm seedlings during the primary (4 months) and secondary stage (8 months) of nursery. Study has been laid out in CRD with 4 main treatments-100 % available soil moisture (ASM), 75% ASM, 50% ASM and 25% ASM and 6 sub treatments-1-6 days interval with 5 replications. Study was taken up in poly house; treatments were imposed manually and observations were recorded during the nursery period. Shade net (50 %) was used for raising seedlings during the primary stage of nursery. Treatments were imposed during the second month after planting of seed sprouts in primary stage and 15 days gap after shifting of primary seedlings to secondary bags during the secondary stage. Among the treatments, better seedling height (36.27 cm), leaf production (6.00), cabbage/ stem girth (5.37 cm), primary root production (6.2) and total dry matter (9.35 g) were noticed under 75 % ASM (75 ml/seedling/day) with daily watering during the primary stage of nursery. During the secondary stage of nursery, maximum seedling height (166.92 cm), leaves (15.25), petiole depth (1.5 cm), stem girth (30.5 cm), primary roots (32.5) and total dry matter (469 g) were recorded with 100 % ASM (2 l/seedling/day) on alternate day watering.

Oil palm based farming systems

Introduced annual crops *i.e.*, colocasia (*Colocasia esculenta*), elephant foot yam (*Amorphophallus paeoniifolius*), turmeric (*Curcuma longa*), black turmeric (*Curcuma caesia*), ginger (*Zingiber officinale*), mango ginger (*Curcuma amada*) and tapioca (*Manihot esculenta*), perennial flower crops like torch ginger (*Etlingera elatior*), beehive ginger (*Zingiber spectabile*) and shampoo ginger (*Zingiber zerumbet*), Indian long pepper (*Piper longum*), pine apple (*Ananus comosus*), nutmeg (*Myristica fragrans*) and cinnamon (*Cinnamomum zeylanicum*) into adult oil palm plantations.

The growth and yield of mango ginger (4.82 t/ha), turmeric (4.44 t/ha), black turmeric (1.39 t/ ha), ginger (2.39 t/ha), colocasia (2.32 t/ha), elephant foot yam (3.61 t/ha) have been found satisfactory. Lanky growth and very poor tuberization were observed in tapioca (0.70t/ha). The average light infiltration in the cropping system was 215 µ moles/ 22.58 per cent.

Established inter crop cafetaria in oil palm with successful inter crops namely heliconia, red ginger, cocoa, bush pepper, Java long pepper, banana, foliage plants and fodder grass.

Irrigation management in oil palm

The present investigation was carried out on the existing eighteen years age old adult oil palm plantation planted at ICAR-Indian Institute of Oil Palm Research, Pedavegi with different methods of irrigation and crop factors with an objective to investigate the relationship between methods of irrigation using crop factor on the physiological and biochemical responses of adult oil palms.

Morphological parameters: Height and girth increment, number of leaves per palm was found non-significant with different methods and levels of irrigation. However, interaction effect between methods and levels of irrigation was found significant in height and girth increment. Micro-jet method of irrigation using crop factor 0.8 recorded significantly highest height increment of the palm (0.283 m) and was found at par with the drip method of irrigation using crop factor 0.7 (0.280 m). Whereas, application of irrigation through drip method of irrigation using crop factor 0.8 has recorded significantly highest girth increment of the palm (0.07 m). Number of leaves produced per palm during the year showed non-significant differences with methods of irrigation, levels of irrigation as well as their interaction effects. Number of male and female inflorescences produced per palm was found non-significant with different methods of irrigation and interaction between methods and levels. However, significant differences were observed in the number of male and female inflorescences produced per palm with different levels of irrigation. Among the levels of

irrigation water using crop factors 0.7 and 0.8 have recorded significantly highest number of female and lowest number of male inflorescences (7.03 and 5.75 respectively). Production of number of fresh fruit bunches per palm per year did not differ significantly between the methods of irrigation. However, found significant at different levels of irrigation. Significantly highest number of fresh fruit bunches per palm per year (7.03) was observed by application of irrigation water using crop factor 0.7 and was found at par with the application of irrigation water using crop factor 0.8. Interaction effect between methods of irrigation and levels of irrigation using crop factors was found non-significant. However, application of irrigation water through drip method of irrigation at the highest level of irrigation using crop factor 0.8 has recorded highest number of fresh fruit bunches per palm per year (7.16).

Physiological parameters: Significantly highest relative water content (97.44%), photosynthetic rate (16.46µmol m^{-2} s^{-1}) and stomatal conductance (0.307mol m^{-2} s^{-1}) were obtained in palms irrigated with micro-jet method of irrigation, whereas, significantly highest membrane stability index (25.26%) and chlorophyll content index (112.64) were observed with drip method of irrigation. Among the levels of irrigation water using crop factor 0.7 has recorded significantly highest photosynthetic rate (16.56 µmol m^{-2} s^{-1}) and stomatal conductance (0.295mol m^{-2} s^{-1}), whereas, relative water content (95.51%), membrane stability index (27.11%) and chlorophyll content index (126.25) were found significantly highest with crop factor 0.8. Among the interaction effects, significantly highest photosynthetic rate (18.73µmol m^{-2} s^{-1}) and stomatal conductance (0.322mol m^{-2} s^{-1}) were observed with micro-jet method of irrigation using crop factor 0.7, while the relative water content (98.00%), membrane stability index (28.85%) and chlorophyll content index (127.96) were found significantly highest with drip method of irrigation using CF 0.8.

Biochemical parameters: Significantly highest proline content (2.37%), total content of carbohydrates (9.77%), chlorophyll-a (2.38 mg/g), total chlorophyll (2.73 mg/g) and nitrate reductase activity (66.60 moles of nitrate min/g) were found with drip method of irrigation. Among the levels of irrigation crop factor 0.8 has recorded significantly highest proline content (2.56%), protein content (5.58%), chlorophyll-a (2.33 mg/g), lipid peroxidation (8.73 nmoles/g) and nitrate reductase (73.65 moles of nitrite/min/g) activities. Significantly highest chlorophyll-a (2.66 mg/g), total chlorophyll (3.11mg/g), proline content (2.77%), total carotenoids content (0.17 mg/g) and lipid peroxidation (9.03 nmoles/g) were observed with drip method of irrigation using crop factor 0.6. Superoxide dismutase (SOD) activity in the leaves of oil palm was found significant with different levels of irrigation. The SOD activity in the leaves of oil palm ranged between 0.02 to 0.04 irrespective of methods and levels of irrigation. Among the levels of irrigation using crop factors, significantly highest SOD activity was observed by application of irrigation water using crop factor 0.7 and 0.8 (0.03 and 0.03 units of mg protein /g FW respectively). Highest SOD activity was observed by application of irrigation water through drip method of irrigation using crop factor 0.8 (0.04 units of mg protein/g FW). It has been suggested that an increase in the photosynthetic electron flux to oxygen leads to a decrease in the photosynthetic rate thereby resulting an increase in the production of reactive oxygen species which include superoxide radicals, hydrogen peroxide and hydroxyl radicals which were found damaging the cell wall lipids, proteins and pigments unless they are scavenged rapidly within the chloroplasts by the activities of anti-oxidative enzymes

Soil and leaf nutrient parameters: Leaf N, P and K concentration were found to be in optimum range and varied from 2.02 to 2.47 %, 0.06 to 0.10 % and 0.77 to 0.89 % respectively under different treatments. The values of pH and EC were found non-significant at all three depths of soil under different treatments. The available K was medium in range (238.83 to 449.69 kg/ha) in different treatments and depths of soil and found non-significant in subplots (dose of irrigation water) at all the depths of soil under different treatments.

However, available K was found significant in methods of irrigation at 20-40 and 40-60 cm depth. Available K was in increasing trend towards lower depths in microjet method of irrigation while it was in a reverse trend in drip method of irrigation.

Yield parameters: Highest FFB yield/palm/year was observed with drip method of irrigation at factor 0.8 (148.44 kg), whereas, lowest was observed with drip method of irrigation using crop factor 0.6 (115.47 kg). The data pertaining to yield of fresh fruit bunches per palm during the year has recorded non-significant differences between the methods of irrigation. However, application of different levels of irrigation has recorded significant differences. Among the levels of irrigation, significantly highest FFB yield (19.83 t/ha) was observed by application of irrigation using CF 0.7 and was found at par with the application of irrigation water using CF 0.8 (19.61 t/ha). Interaction effect between methods of irrigation and levels of irrigation using crop factors was found non-significant.

Effect of treatments over pre-experimental performance: Highest increment of FFB yield (50.31 and 39.23%) was recorded in M1L2 (micro jet with 0.7 crop factor) followed by M2L1 (Drip with 0.6 crop factor) during the period of 2014-18 over their pre-experimental (2008-11) average. Whereas highest increase in number of bunches per palm (24.79 and 23.74%) was recorded in M1L2 (micro jet with 0.7 crop factor) followed by M2L2 (drip with 0.7 crop factor) respectively during the period 2014-18 over their pre-experimental (2008-11) average.

Dose of irrigation has significant impact on production of female inflorescences and FFB yield. Methods of irrigation (micro jet and drip) did not show any impact on yield of oil palm. Application of irrigation water at CF 0.7 is recommended for higher yield coupled with recommended dose of fertilizers @ 1200:600:1200 g NPK per palm per year through soil application at quarterly interval.

Establishment of optimum oil palm leaf nutrient concentration and assessment of soil nutrient status in oil palm cultivated areas of India

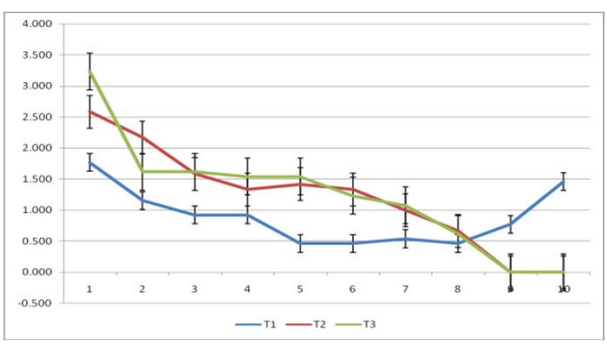
DRIS indices for oil palm plantations of Krishna Dt., Andhra Pradesh: Soil and leaf samples were collected from oil palm plantations of Krishna Dt., Andhra Pradesh, processed and analysed for N, P, K, Ca, Mg, S, B, Fe and Mn nutrients. Estimated the critical levels of nutrients in leaves and estimated the DRIS indices for Krishna Dt. The optimal ranges for N, P, K, Mg and B in leaf samples are 2.07-4.29 %, 0.13-0.27 %, 0.52-0.94 %, 0.44-0.76 % and 44.97-102.7 ppm respectively. Among the leaf samples collected, deficient number of samples had been 15 % in N and K, 3 % in P, 10 % in Mg and 9 % in B. The DRIS indices for Krishna Dt., had been -4.615, 3.32, 0.86, 3.915 and -3.485 for N, P, K, Mg and B respectively. N>B>K>P>Mg is the order of importance of nutrients in Krishna Dt., and the critical limits for nitrogen are high in leaf samples in comparison with values of West Godavari Dt. In soil, mean values of pH, EC and OC were estimated as 7.32, 0.25 and 0.57 respectively, N, P_2O_5 and K_2O had been 222.68, 101.47 and 566.13 kg/ha respectively, Ca and Mg were 4.81 and 2.11 meq/100g soil respectively and SO4-S had been 62.35 mg/kg and B was 5.98 ppm, in 0-20 cm soil. Similar trends were observed in 20-30 and 40-60 cm layers also.

DRIS Indices for Krishna Dt., Andhra Pradesh	
N Index	-4.615
P Index	3.320
K Index	0.860
Mg Index	3.915
B Index	-3.485

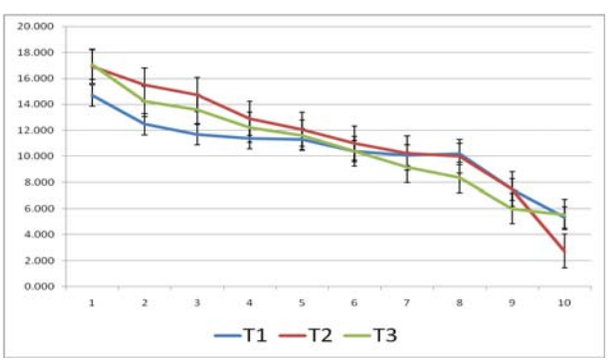
The order of importance of nutrients for oil palm plantations in Krishna Dt., Andhra Pradesh is N>B>K>P>Mg . The DRIS indices are: -4.615, 3.32, 0.86, 3.915 and -3.485 for N, P, K, Mg and B respectively.

Critical ranges for leaf samples (Krishna Dt., Andhra Pradesh)					
	Deficient	Low	Optimum	High	Excess
N %	<0.96	0.96-2.07	2.07-4.29	4.29-5.40	>5.40
P %	<0.06	0.06-0.13	0.13-0.27	0.27-0.34	>0.34
K %	<0.31	0.31-0.52	0.52-0.94	0.94-1.15	>1.15
Ca %	<0.73	0.73-0.94	0.94-1.36	1.36-1.57	>1.57
S %	<0.028	0.028-0.098	0.098-0.238	0.238-0.308	>0.308
B ppm	<16.10	16.10-44.97	44.97-102.70	102.70-131.57	>131.57
Mg %	<0.28	0.28-0.44	0.44-0.76	0.76-0.92	>0.92

Studies on effect of Boron application on leaf symptoms: In order to optimise the boron application for deficient palms, applied boron in three (100, 200 and 300 g per palm) different doses to boron deficient palms in Dura Improvement trial and collected observations on different types of deficient leaves at quarterly interval and analysed the soil and leaf samples. The number of crinkled leaves were reduced from 14.7 to 5.3 in T1, from 16.9 to 2.7 in T2 and from 17.1 to 5.5 in T3. Similarly fish bone leaves have reduced from 3.5 to 0.46 in T1, from 1.00 to 0.17 in T2 and from 1.7 to 0.10 in T3 respectively. Whereas, the number of hook leaves showed some interesting trend in which their number reduced in T2 and T3 to zero within a period of 8 months from the levels of 2.6 and 3.2 respectively but, in T1 the number decreased from 1.77 to 0.46 within 5 months period and started increasing from then onwards and reached again 1.46 by the completion of one year from the time of treatment (Fig. 16).



Hook leaves (Oct 2016 to October 2017)



Crinkled leaves (Oct 2016 to October 2017)

Fig. 16: Effect of Boron application on leaf symptoms

Fertilizer management in oil palm plantations

The two D X P crosses grown in nursery (54Dx77P) and (170Dx76P) have been transplanted in main field on 4.1.2018 in Confounded factorial (single replication). Maize crop grown has been removed manually and soil samples collected before and after growing of maize crop have been analysed for nutrient levels. The mean values of pH, EC and OC were estimated as 5.19, 0.06 and 0.51 respectively, N, P_2O_5 and K_2O had been 233.71, 16.06 and 156.67 kg/ha respectively, Ca and Mg were 2.00 and 1.30 meq/100g soil respectively and SO_4-S had been 13.08 mg/kg and B was 3.71 ppm, in 0-20 cm soil. In 20-40 cm soil layer, the mean values of pH, EC and OC were estimated as 5.26, 0.06 and 0.46 respectively, N, P_2O_5 and K_2O had been 245.06, 18.55 and 101.79 kg/ha respectively, Ca and Mg were 2.33 and 1.30 meq/100g soil respectively and SO_4-S had been 14.54 mg/kg and B was 3.71 ppm. In 40-60 cm soil the mean values of pH, EC and OC were estimated as 5.21, 0.06 and 0.44 respectively, N, P_2O_5 and K_2O had been 260.10, 19.08 and 95.28 kg/ha respectively, Ca and Mg were 2.48 and 1.15 meq/

100g soil respectively and SO_4-S had been 16.04 mg/kg and B was 3.36 ppm.

Recycling of oil palm waste through cost effective and innovative techniques

Palm oil mill waste like empty fruit bunch fibre (EFB) and palm oil mill effluent (POME) were used for the study. Partially dried empty fruit bunch fibre @ 100 kg was mixed with 200 litres of palm oil mill effluent (POME-15 days old). Left the bed for a week and then inoculated empty fruit bunch fibre with microbial decomposers consortium1- *Trichoderma viride, Pluerotus florida* and *Phanerochaete chrysosporium* and consortium 2- *Trichoderma viride, Phanerochaete chrysosporium, Aspergillus awamori* and *Aspergillus nidulans*. Maintained sufficient moisture (60-65%) content in compost beds during composting period. The time taken for complete composting of shredded EFB with microbial decomposers was about 115 days, whereas the time taken for complete composting in the control was 142 days. Total organic carbon (48 %), Nitrogen (0.65 %), C/N ratio (73.85), Phosphorus (0.05 %), Potassium (0.72 %) and Calcium (0.22 %) were estimated in the raw material *i.e.,* empty fruit bunch fibre. The final compost contains total organic carbon (26.8 %), Nitrogen (1.77 %), C/N ratio (15.1), Phosphorous (0.52 %), Potassium (1.58 %) and Calcium (0.72 %).

Studies on plant geometry in oil palm

The study was undertaken to standardize the optimum planting density in oil palm. Primary nursery with tenera sprouts (170D X 17P) has been taken up. The primary nursery seedlings were shifted to secondary nursery during July, 2016 and recorded the biometric observations at monthly intervals. The average seedling height, collar girth and number of leaves recorded during March, 2018 were 238.98cm, 149.69mm and 4.95 per seedling, respectively. The seedlings were transplanted in the main field during March 2018.

Oil Palm-Cocoa based cropping system for sustainable productivity (Extramural funded Project)

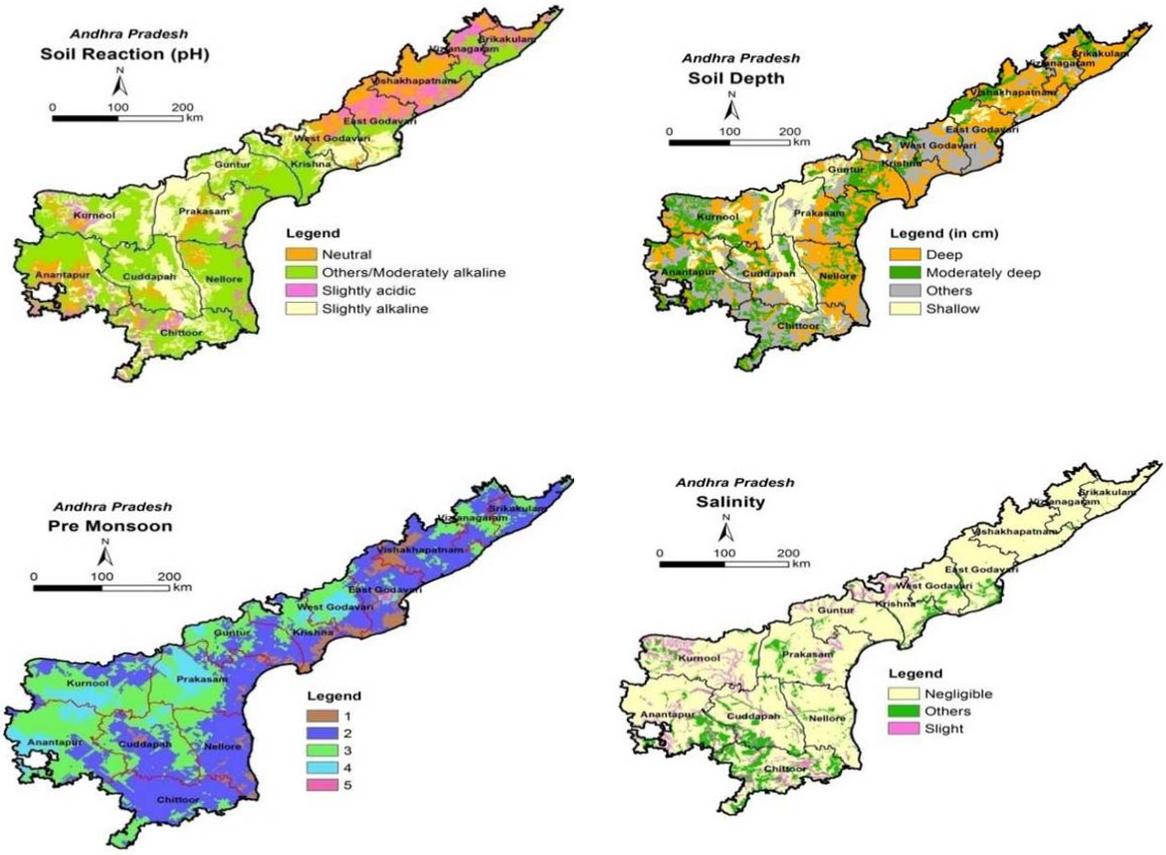
A study has been conducted based on primary data collection through personal interview method using pre-tested interview schedule with sample size of 60 farmers each in oil palm, coconut, oil palm + cocoa and coconut + cocoa cultivators belongs to six Mandals in West Godavari district of Andhra Pradesh (major oil palm + cocoa cultivated district in India) as respondents.

Discounted cash flow techniques viz., Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) were used to analyse the profitability and viability of oil palm orchards. Oil palm intercropped with cocoa recorded higher IRR (32 %), BCR (1.56) and NPV (Rs. 160237) than 28 %, 1.51 and Rs. 121873 respectively in monocrop of oil palm, which indicates that oil palm intercropped with cocoa is profitable. Further, there was no significant difference in payback period among monocrop of oil palm and in gardens intercropped with cocoa. The active roots of an adult oil palm/coconut are concentrated laterally within a radius of 2- 2.5 m from the base. Thus, in mono-crop of oil palm and coconut the soil mass of 22.39% and 22.34% respectively is actually utilized and the remaining area could be utilized for intercrop.

Light infiltration in different cropping systems is in the range of 12.21 to 35.68 per cent. It has been observed that the light infiltration rate in adult oil palm and coconut plantations are to the tune of 15 % and 36 % respectively. Higher cocoa yields in coconut than in oil palm may be due to availability of more sunlight to cocoa. Based on the above observations it is clear that cocoa could be an ideal intercrop in oil palm plantations for sustainable productivity.

Delineation of potential areas for oil palm cultivation in India using RS & GIS techniques (Inter-Institutional Collaborative Project with ICAR-NBSS & LUP)

Identified the parameters that influence the suitability of a location for oil palm cultivation. Scores for different parameters which influence the growth and yield of oil palm and thereby suitability were identified. Collected weather data for all the districts of Andhra Pradesh including ground water levels. Prepared suitability map for oil palm



Suitability maps for oil palm in Andhra Pradesh

cultivation in Andhra Pradesh using thematic maps developed for various soil parameters and climatic parameters in collaboration with ICAR-NBSS&LUP. The scores given to different parameters need thorough discussion before finalisation.

Identified the parameters and estimated the scores for different soil and climatic parameters for oil palm suitability. Generated thematic maps for various parameters for developing suitability map for oil palm cultivation in Andhra Pradesh.

Investigations on various options for effective use of oil palm biomass waste (Inter-Institutional Collaborative Project with ICAR-CTRI)

Biochar was produced from three different wastes of oil palm *viz.,* trunk, fronds and empty fruit bunches in collaboration with ICAR-CTRI. Estimated the physical properties of biochar from three different sources of oil palm in comparison with tobacco waste biochar (Table 12). Planted a trial with oil palm seed sprouts to see the suitability of different biochar materials as a medium for oil palm nursery.

Table12: Nutrient composition of biochar developed from oil palm wastes and tobacco stalks

S.No.	Type of waste	pH	EC d S m^{-1}	N %	P %	K %
1	Fronds	9.39	0.710	0.86	0.763	2.324
2	Trunk	9.57	0.52	0.85	0.842	2.364
3	Empty Fruit Bunches (EFB)	9.9	1.48	0.79	1.237	3.206
4	Tobacco stalks	9.61	0.44	0.71	0.737	1.740

Biochar could be produced from different wastes of oil palm. Biochar from Empty Fruit Bunches (EFB) recorded better P and K contents.

PHYSIOLOGICAL AND BIOCHEMICAL BASIS FOR GROWTH AND YIELD IN OIL PALM

Biochemical basis for growth and yield in oil palm

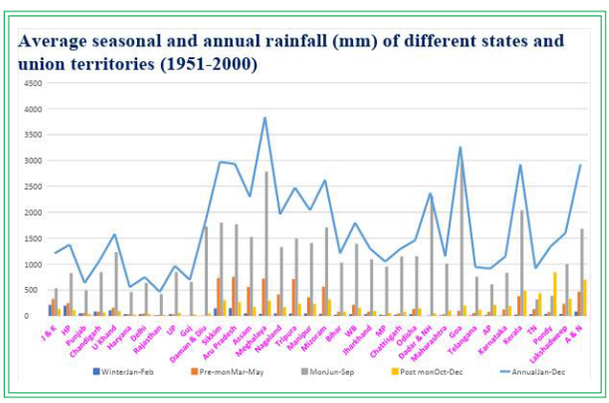
Three adult oil palm tenera hybrids *viz.*, Malaysia, Deli x Ghana and Deli x Nigeria were taken for the study. The fruitlets were collected during the final weeks of bunch maturity during rainy and summer seasons. The accumulated rainfall and temperature within 6 months before harvesting of both seasons were calculated for studying its relationship with total fruit weight, oil yield and fatty acid composition in different hybrids.

The fruit weight in the three hybrids ranged from 4.9 to 13.6 g. The highest fruit weight was recorded in Malaysian hybrid, while the lowest was in Deli x Nigeria during both the seasons. In all three hybrids, highest fruit weights were attained in bunches harvested during summer season and decreased during the rainy season. Fruit to fruit variability was also observed in all the hybrids under study but maximum fruit weight was attained during the summer season. Oil content in 3 hybrids ranged from 69.3 to 81.0 % and highest value was recorded in Deli x Ghana hybrid and lowest content in Deli x Nigeria in both seasons. Moisture percentage in fruit lets were ranged from 30.2 to 43.9 % and highest moisture content was found in Deli x Nigeria hybrid and lowest in Deli x Ghana in both seasons. An inverse relationship was observed between oil content and moisture content among hybrids.

Among three saturated fatty acids (SFA), especially myristic and palmitic increased during summer season and in contrast to this stearic acid increased during the rainy season. Myristic acid in the hybrids ranged from 0.67 to 1.32 % in which Deli x Ghana showed highest value during summer season while lowest was observed in Malaysian hybrid during the rainy season. Palmitic acid ranged from 41.9 to 49.6 % and Malaysian hybrid recorded highest and lowest contents during summer and rainy seasons. Stearic acid ranged from 3.67 to 4.86 % in which Deli x Ghana recorded highest and lowest was recorded in Malaysian hybrid. Unsaturated fatty acids both MUFA and PUFA decreased during the summer season and increased during rainy season. The oleic acid (MUFA), linoleic and linelonic acid (PUFA) ranged 36.54 to 44.1 %, 5.58 to 8.57 % and 0.22 to 0.56 % respectively. The oleic acid recorded highest and lowest in Malaysian hybrid and linelonic acid recorded highest and lowest in Deli X Ghana in both seasons. Linoleic acid recorded highest in Malaysia during rainy season and lowest in Deli X Ghana during summer season. Before the maturity of bunches i.e., at the initial growth stages, influence of both temperature and rainfall will effect fatty acid composition or may be due to genetic differences. This information on seasonal variation in assessing the fatty acid composition would also be useful to breeders in improving yield and oil quality in different hybrids.

Development of InfoCrop-Oilpalm model for Agoroecological zoning and Resource Conservation

Crop growth information was collected from Krishna and East Godavari Districts of Andhra Pradesh under three different yield levels (<15, 15-20 and >20 t FFB/ha) along with soil and leaf samples. Yield levels were compared with



management practices and conclusions were drawn. Correlation between nursery performance and main field performance was studied for 21 crosses under two different planting times. Growth performance of July nursery plants in main field also was better than December nursery plants.

Plant growth in main field in comparison with nursery

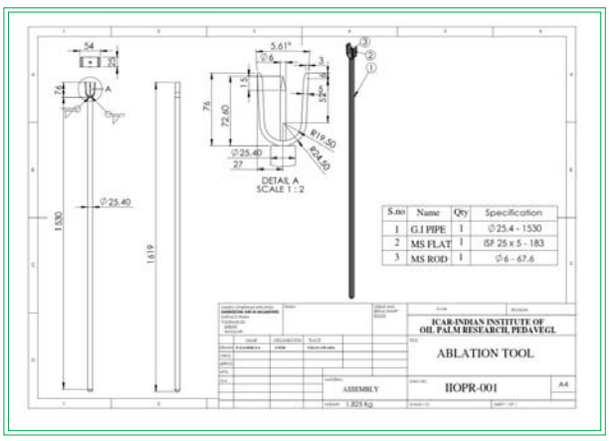
July nursery: The best performing crosses in nursery could not retain their performance in main field in terms of growth characters from July nursery. Mixed trends were observed during first one year of growing conditions. Best performed crosses in nursery had been 203CD X 195P, 250CD X 195P, 208CD X 76P. Least performed crosses in nursery had been 208CD X 17P, 164D X 17P, 234D X 17P. But the crosses 208CD X 76P and 164D X 17P performed better in main field.

December nursery: Best performed crosses in nursery had been 118D X 17P, 234D X 17P, 118D X 195P and the least performed crosses in nursery were 32D X 195P, 164D X 17P, 121D X 110P. But in main field, the crosses 78D X 195 P and 32 D X 110P performed better at initial stages of growth.

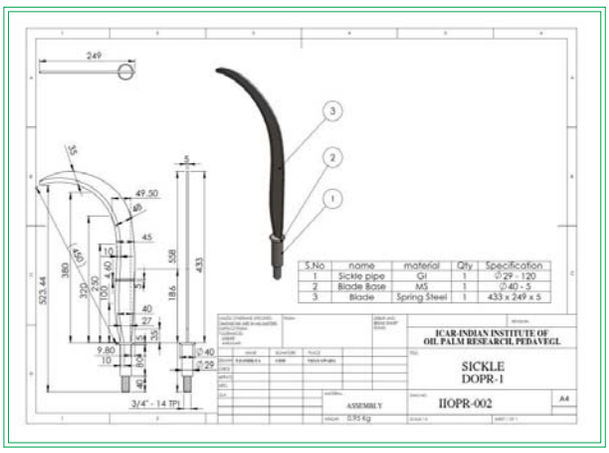
DEVELOPMENT OF LABOUR SAVING TOOLS AND MACHINERIES FOR OIL PALM CULTIVATION

Trunk chipping bucket: The chipping bucket was tested in a farmer's oil palm plantation of 23 years age. Total number of palms felled was 270. Average time taken to fell the palm was 6 seconds, could chip the palm with a height of 10.12 m, in 8.7 minutes. Average girth of felled palm is 1.7 m. Average numbers of strokes required to chip the whole palm were 98. Cost of felling and chipping per palm was Rs. 350/-. Cost of digging pit, dumping all trunk chips and covering with soil was Rs. 60,000/-. Thus cost of each palm trunk felling, chipping, pit making and covering with soil would be Rs. 572. Trunk was chipped into smaller pieces (10-11 cm thickness and with an average weight of 27 .5 kg). Two operators operated the machine. They perceived that the tool is very useful to fell and cut off the palm. Angle and sharpness of the bucket is good. No need to apply force. They perceived that chipping bucket doesn't require any modifications.

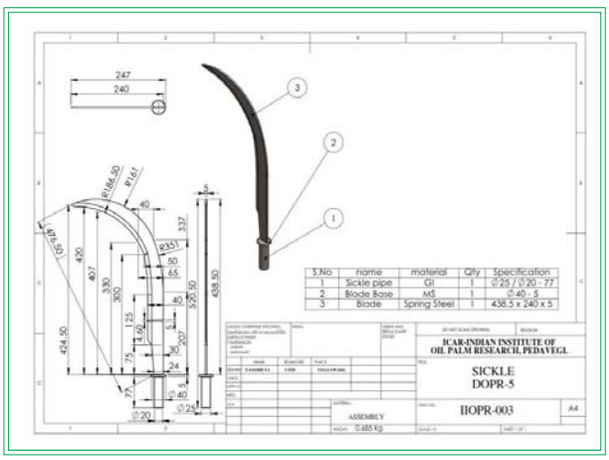
Fabrication design diagrams of Ablation tool and IIOPR Sickles 1 & 5 were completed.



Fabrication diagram of Ablation tool



Fabrication diagram of DOPR sickle – 1



Fabrication diagram of DOPR sickle - 5

Utilization of oil palm biomass as a source for various by-products (External funded)

Extraction and characterisation of fibre from different oil palm biomass: Fibre extraction was carried out from different oil palm waste. The recovery percentages were 6.37, 1.87 and 3.12 % of Type 1 , Type 2 and Type 3 fibres from Empty Fruit Bunches (EFB); 1.80, 2.23 and 2.36 in case of oil palm trunk and 1.58, 2.99 an d 4.55 in case of oil palm fronds. Analysis of moisture holding capacity of various fibres indicated that Type 1, Type 2, and Type 3 fibres of EFB could retain 58.89, 61.11 and 112.22 % moisture respectively, while the moisture holding capacity of oil palm trunk was 96.67, 101.11 and 217.78 % for Type 1, Type 2 and Type 3 fibres respectively and in case of fronds, the moisture holding capacity was 157.78, 202.22 and 261.11 % for Type 1, Type 2 and Type 3 fibres respectively. Cellulose content of different grades of fibre was estimated and it was found to be 61.54, 37.94 and 17.88 % for Type 1, Type 2 and Type 3 grades fibre from EFB. In case of fibre from oil palm trunk, it was 44.75, 35.24 and 10.1 % for Type1, Type 2 and Type 3 grades respectively, while for fronds the cellulose contents were 22.56, 15.46 and 3.21 % in Type 1, Type 2 and Type 3 grade fibres respectively.

Development of value added products from oil palm biomass

Mattress: The raw material (curled coir) is taken to untwisting machine to untwist. In case of EFB, there is no need to untwist the fibres. Then it is fed into sheet forming machine with the help of blower assembly. This curved fibre was again refined by carding assembly and fed to conveyor belts to form continuous coir sheet with required width and density. This uniform coir sheet is sprayed with rubber latex. Now this rubberised coir moves to continuous heating chamber to dry the water content of latex and coir gets permanently bonded with rubber latex. The sheet at end of conveyor get reversed and again sprayed on this side also and dried in heating chamber again. The process was repeated continuously resulting in uniform rubberised coir sheet with particular width and thickness comes out from sheet machine. The rubberised coir sheet is cut into pieces of required length bonded with one upon another having thickness of 2 inch to 8 inch as per product requirement. These bonded sheets are again sprayed manually to attain required thickness of rubberised coir mattress/sheet from hydraulic press which is heated by steam. These mattresses are kept in press from 10-15 minutes to attain desired thickness, uniform shape and final finish. These mattresses are fed into vulcanizing chamber after cutting of required size. The vulcanizing chamber dries the mattress completely and to attain the best quality rubberised mattresses.

Yarn: Select high quality EFB fibre. Four twists (10 meter each) of yarn could be obtained from approximately 1 kg of EFB with coconut fibre in the ratio 1:1. The fibres are sifted to remove dirt and other rubbish dried in the sun. Later, it was spin using machine or hand for making yarn. Yarn consisted of several strands of material twisted together. These short fibres are spun into longer filaments to make the yarn. Long continuous strands require only additional twisting to make them into yarn.

Handicrafts: Selected high quality hardwood oil palm trees are cut into small pieces of 5 cubic feet each. The wooden pieces were cleaned and levelled. Based on the products to be made, the wooden pieces have to be cut into various shapes like round, square, cylindrical etc. After drying, the waste portions were removed and corrected the level using sand disc. Again both the sides were dried. For making plates, back portion has to be dried first and then the front portion should be dried in less sunlight (up to 11.30 AM or after 3.00 PM). Then polished using sand paper. For durability, chemical treatment with 50 ml chloropyrphos 20 % mixed with 1 litre of kerosene/diesel was done and again subjected to drying in normal sunlight. During polishing, wood filler was used to seal minor holes, known as first coat, then levelled with sandpaper. Sampling healer is used as second coat. Applied two coats of touch wood polish as final coat.

INTEGRATED PEST MANAGEMENT

Studies on natural enemies of bag worms and leaf web worms

Climate change with diurnal temperatures having high day temperatures and low night temperatures caused negative impact on incidence and development of leaf web worm. This led to no incidence of bag worm during the first quarter which was supposed to be the peak stage of the pest. During the reported period, only one generation was recorded as against six to seven. Heavy and slashing rains that occurred during the rainy season devastated the existing low population. Only in the fourth quarter, pest incidence was however observed in few localities at low to very low levels. Neuropteran predators were found dominating in oil palm and cocoa plantations indicating the chances of predator as a future bioagent. Poor survival of bagworms due to abnormal abiotic conditions made the incidence and infestation at below threshold levels. Egg parasitoid, *Trichogramma embryophagum* was found to achieve good management of the leaf web worm population with inundative releases @ 200000 per acre in six applications.

Studies on pollinating weevil *Elaeidobius kamerunicus* (Faust.) in oil palm planttaions

Emergence of less number of male flowers and pollination was observed as serious problem in oil palm plantations of Karnataka. Palms having high sex ratio are supposed to have less number of male flowers. Treatments for emergence of male flowers were found successful in the old plantations. New treatments were tried using harmones and physical stress. Experiments were conducted in problematic oil palm plantations located in Mysore district of Karnataka using different treatments namely excess pruning of leaves, arresting irrigation and application of Gibberlic Acid.

The technology that was used earlier (1998-2002) in the oil palm plantations of Chandagalu village of Mandya district having similar problem of lack of pollination and pollinating weevils proved effective with good female bunches without any bunch failure. The technology implemented for the emergence of male flowers has given successful results paving the way for its further implementation in the gardens where similar problem occurred. Around 15 cement pots with aged oil palms planted in them were recommended with life saving irrigation at regular intervals. Application of Gibberlic Acid at high concentrations (100 ml in 10 litres of water) was done at every month on the few selected plants. Heavy pruning of leaves, leaving only the spindle and a whorl of nine fronds, was carried out for one plant in each row to initiate the male flowers due to stress. The results out of these treatments are encouraging and confirmation is needed. In Mizoram pollination was not found as problem in any of the areas surveyed. Pollinating weevils were observed plenty with the existence of all the stages.

Diagnostic survey for oil palm pest problems and their management

During the survey a new alien pest namely Rugose Spiraling White fly (RSW) *Aleurodicus rugioperculatus* was observed in oil palm plantations of West Godavari Dt., Andhra Pradesh. The pest was found to prefer feeding on palms of Arecaceae family. Of these, coconut was more preferred followed by oil palm and areca nut. The incidence was first observed during 2017 with the migration of pest from Kerala through the coconut nursery. Presently the pest is found in Kadiyam and dispersing to other places through nursery planting material. In West Godavari district, the incidence of pest is observed in oil palm plantations of three mandals namely Chagallu, Nidadavolu and Nallajerla. The pest is a tiny white fly with white wings and light brown coloured streaks on them. It is seen laying eggs in a serpentine/spiral manner on the under surface of the leaves. On each leaflet, nearly 13-30 spirals are seen depending on the severity. While laying eggs, the pest excretes wax to cover up eggs and immature stages most probably as a protection. Though it lays the eggs on each and every green leaf it come across, but

completion of life cycle is not found on all the plants and hence cannot be considered as true host plants. The nymphs and adults suck the sap from the leaves. Since they suck more than they need, the excess sap comes out as honey dew falling on the lower leaves of same or other plants including weeds. This attracts black sooty mold fungus which forms as a layer over the leaves hindering the photosynthetic activity. In Kadiyam nursery area, almost all the green leafy plants are harboring this pest. However, other coloured plants like red coloured crotons are free from pest attack. In Kalavalapalli, the pest was found to cause 18.88 % incidence on coconut, 5.04 % on oil palm 2.88 % on guava and 7.44 % on cocoa by having spirals.
Application of 0.1 % neem oil (10000 ppm) mixed with 10 g of Rin or Surf detergent powder recorded 97 % control with one spray. Release of bioagents like *Encarsia guadeloupe* (parasitoid) and *Chrysoperla zastowi* (predator) by collecting from already infested areas of Pollachi and NBAIR, Bengaluru respectively also proved effective in reducing the incidence. Awareness meetings were conducted in all the infested areas to make the farmers aware about the ill effects of chemical pesticides and recommended not to spray any insecticide which may hamper the development of parasitoids. The sooty mold is coming out in the form of flakes with increased temperatures and hence application of starch spray was not found necessary.

A total of 4 traps (2 with green and 2 with yellow colour) were tried in one of the nurseries in Kadiyam. This was mainly to study the comparative efficacy of different coloured traps in attracting the white fly population. Apart from this, also tried the application of Neem oil 10000 ppm @1ml per litre of water by mixing Rin detergent powder @100 g also proved effective. Mixing of Rin powder was mainly to disintegrate the wax filaments that are laid by white fly while laying the eggs. So that the eggs and other stages will be exposed to abiotic and biotic stresses and gets suppressed. The results indicate that green coloured sticky traps were more attractive to whitefly adults and hence more number were stocked to the traps compared to yellow coloured ones. Similarly the neem oil + Rin detergent powder treatment effectively managed the pest by causing 97 % mortality. Along with these successful treatments, it is also advised not to give excess irrigation which may cause congenial climate for the pest growth. Since the parasitoid, *Encarsia guadelopae* is working well in the already released plantations of Kalavalapalli and adjoining areas, the infested leaves from these gardens may be collected and released in the new areas.

The predator *Chrysoperla zastowi*, a neuropteran species is also found effective in managing the pest though not to the extent of parasitoid. It can be procured from NBAIR, Bangalore and released in their gardens. However care may be taken to conserve these natural enemies by not spraying any chemical insecticides. Similarly for the sooty mold problem, it is recommended not to use any chemical pesticides as it is falling out from the leaves automatically due to increased temperatures and waxy content on leaves. In case if it is not happened and hampering the photosynthesis of the leaves, then 5-10 % starch solution (mix 50-100 g of quality starch powder in luke warm water) is recommended on a sunny day. The starch after getting attached to the sooty mold portion of infected leaves may come out as flakes due to drying.

INTEGRATED DISEASE MANAGEMENT

Management of Bud Rot

Crown surgery was modified by applying treatments after the crown surgery instead of Carbendazim + Monocrotophos. 1. Pseudomonas fluorescens @3X10^{6}CFU/ml 2. Streptocycline sulphate @1% were used as treatments. Recovery of palms was observed after 4-6 weeks which is significantly superior over Carbendazim treatment. A set of bacteriocides and antibiotics were screened against bud rot in in vitro conditions. Vancomycine 0.1%, Streptomycine 0.05% and Rifampicine 0.05% were proved effective by forming a distinct inhibition zone.

Management of Stem Wet Rot (SWR)

For management of stem wet rot disease, biopesticides *Trichoderma harzianum* and *Pseudomonas fluorescens* were tried at field level. The affected palms with 4-6 dried leaves were selected for treatment. *Trichoderma harzianum* @ $5X10^4$ CFU/ml and *Pseudomonas fluorescens* @$3X10^6$CFU/ml were injected through stem 500 ml per palm, 3 times at 7-10 days interval.

It is observed that the SWR disease is checked by application of above biopesticides. No further drying of leaves observed and fresh leaves were developed. Affected palms with <10 dried leaves were also managed well with biopesticide treatment. However, palms with >10 dried leaves could not be managed.

Screening of germplasm for resistance to Basal Stem Rot

Nursery was raised with 10 different crosses for screening of germplasm for basal stem rot caused by *Ganoderma lucidum* and *Ganoderma applanatum*. The crosses under screening were 200 D X 78 P, 81 D X 74 P, 540 CD X110 P, 91 D X 110 P, 181D X 110 P, 213 D X 74 P, 161D X74 P, 234 D X 74 P, 191 D X74 P and 186 D X110P. Disease intensity was recorded and crosses were categorized according to their resistance and susceptibility. None of them were immune or highly resistant or resistant to the disease. Crosses 81D X 74P, 540CD X 110P, 161D X 74P were moderately resistant to the disease.

Etiology of Stem Wet Rot

SWR isolates were isolated from experimental plots and farmers fields as well. They were named accordingly as SWR-1, SWR-2, SWR-3 SWR-4 SWR-5 and SWR-6 as per the morphological characters. *In vitro* screening was done in hydroponics. Similarly challenge inoculations were also performed in pot culture. The inoculums concentration was $3X10^4$CFU/ml. Methods of inoculation were hypodermic syringe method, leaf tip cutting, cotton swab method, foliar spraying were adopted. SWR-1 and SWR-3 were provisionally manifested SWR symptoms.

DISSEMINATION OF TECHNOLOGY & ICT APPLICATIONS IN OIL PALM SECTOR

Training of extension, research workers and farmers involved in oil palm production

Officers training programmes organised

The following officers training programmes curriculum was developed and organised. Lectures were delivered through power point presentations, field visits and demonstrations were oragnised, literature was provided to the participants.

- Oil Palm Production Technology
- Skill development in Oil Palm Hybrid Seed Production
- Skill development in Plant Protection in Oil Palm
- Skill development in Nursery Management in Oil Palm
- Skill development in Soil and Leaf Nutrient Analysis in Oil Palm

During 2017-18, 302 officers were trained on oil palm production technologies and the details are as follows:

Farmers training programmes organised

During 2017-18, 1139 farmers participated in on-farm and on-campus training programmes. Farmers were exposed to different recommended package of practices through power point presentation. Organised field visits, demonstrations. Shown video film on recommended practices. Organised visit to oil palm nursery, farmer's oil palm plantations, oil palm processing unit. Provided literature to the participants.

Design and development of database applications in oil palm

Fertilizer Calculator - mobile application

- Content provided for calculation of macro and micro nutrients for application of

Officers training programmes organised at ICAR-IIOPR

S. No.	Date	Name of the programme	No. of participants	Participants from
1	August 22, 2017	MPEOs - Officers training programme on oil palm production technologies	72	Eluru, West Godavari Dt., Andhra Pradesh
2	September 11-16, 2017	Oil palm production technologies	17	Andhra Pradesh, Chhattisgarh, Tamilnadu, Kerala and Karnataka
3	October 12, 2017	MPEOs - Officers training programme on oil palm production technologies	75	Jangareddygudem, West Godavari Dt., Andhra Pradesh
4	October 16, 2017	MPEOs - Officers training programme on oil palm production technologies	25	Vijayawada, Krishna Dt., Andhra Pradesh
5	October 25-27, 2017	Skill development on Plant protection in oil palm	5	Tamil Nadu, Karnataka, Chhattisgarh
6	October 30-November 01, 2017	Skill development on Hybrid seed production in oil palm	11	Kerala
7	November 15-17, 2017	Skill development on Nursery management in oil palm	3	Telangana and Mizoram
8	November 21-22, 2017	MPEOs - Training on Oil palm cultivation practices for the extension officers of state government	82	Buttayagudem and Chintalapudi, West Godavari Dt., Andhra Pradesh
9	January 17-19, 2018	Skill development training programme on Soil & leaf nutrient analysis in oil palm	12	West Godavari Dt., Andhra Pradesh
	Total		**302**	
10	March 7-31, 2018.	Agricultural Skill Council of India (ASCI) sponsored Skill Development Programme on job role "Seed Processing Worker" to unemployed youth at IIOPR, RC, Palode	20	Kerala

recommended dose of fertilizers in oil palm plantations of different ages. Provided different combinations of fertilizers for different nutrient sources. Based on the available fertilizers with farmers, they can choose for application in their fields. Calculation criteria for recommended fertilizers developed.

- Design, development and calculation of selected common fertilizers to be applied to oil palm on per palm, per acre, per hectare

Farmers training programmes organised at ICAR- IIOPR

S. No.	Date	Name of the programme	No. of participants	Participants from
1	June 27, 2017	Farmers training on oil palm production technology	29	Durg Dt., Chhattisgarh.
2	July 4, 2017	Training programme to tribal farmers on oil palm cultivation practices	36	Krishna Dt., Andhra Pradesh.
3	July 28, 2017	Farmers training on oil palm production technology	29	Gujarat
4	August 29, 2017	Farmers training on oil palm production technology	42	Nellore Dt., Andhra Pradesh
5	September 18, 2017	Farmers training on oil palm production technology	33	Tadepalligudem, West Godavari Dt., Andhra Pradesh.
6	September 29, 2017	Farmers training on oil palm production technology	20	Farmers from Krishna Dt., Andhra Pradesh
7	December 1, 2017	Farmers training programme on Oil Palm Production Technology	38	Chhattisgarh
8	December 14, 2017	Farmers training programme on Oil Palm Production Technology	75	Eluru, West Godavari Dt., Andhra Pradesh
		Total	**302**	

On farm training programmes organised

S. No.	Date	Name of the programme	No. of participants	Participants from
1	April 25, 2017	Awareness programme on oil palm	30	Mouman, Assam
2	July 26, 2017	On farm farmers training programme on oil palm recommended practices	60	Chintalapudi, West Godavari Dt., Andhra Pradesh.
3	September 7, 2017	On farm farmers training programme on oil palm recommended practices	100	Aswaraopet, Khammam Dt., Telangana
4	September 21, 2017	Farmers training on oil palm production technology	50	D. Tirumala and Bhimadole, West Godavari Dt., Andhra Pradesh.
5	October 4, 2017	On farm farmers training programme on oil palm recommended practices	30	Aswaraopet, Khammam Dt., Telangana
6	October 6, 2017	On farm farmers training programme on oil palm recommended practices	100	Sattupally, Khammam Dt., Telangana
7	October 20, 2017	Farmers training programme on Oil Palm production technology	50	Punyakshetram, East Godavari Dt., Andhra Pradesh.
8	January 6, 2018	Farmers training programme on Oil Palm Production Technology	62	Venkatapuram, Chintalapudi mandal, West Godavari Dt., Andhra Pradesh
9	January 9, 2018	Farmers training programme on Oil Palm Production Technology	160	Eleswaram, East Godavari Dt., Andhra Pradesh
10	January 23, 2018	Farmers Training on oil palm production technology	95	Ghantavarigudem, Nallajerla mandal., West Godavari Dt., Andhra Pradesh
11	January 30, 2018	Farmers Training on oil palm production technology	100	Malakapuram village, Khammam Dt., Telangana.
		Total	**837**	

basis and total area of the plantation through the mobile application.

Diagnostic Field Visits Intranet Application

- Content (farmer's demographic characteristics, land particulars, year planting of oil palm, source of planting material, intercultural operations adopted, manures applied, fertilizers applied, source of irrigation and frequency of irrigation, pest, disease and disorders, management practices adopted, yield etc.) and parameters list for diagnostic field visit data developed.

- Design and development of data entry screens to record above parameters for diagnostic field visits through intranet application.

Application of ICT for dissemination of oil palm technology

Website

- Compiled the content of new design of IIOPR website.

- Design and development of website with database connectivity.

- Designing of banner, major screens for uploading contents for the major pages / static and dynamic pages.

Development of Oil Palm Crop Doctor

- Collected and compiled content on nutrient deficiencies & disorders, pests, diseases in oil palm and their management for uploading in mobile application.

- Developed short video films on management practices in oil palm cultivation viz., irrigation, fertilizer, mulching, green manure and cover crops, intercropping, nutrient management, pest management, disease management for uploading to mobile application for crop doctor.

- Designing and development of mobile app, with modules of user registration, information retrieval on selected nutrient deficiency, pest and disease, enquiry and notifications, fertilizer calculator.

- With this app, one can register to use oil palm crop Doctor. One can search the symptom of pest, disease and deficiency/disorder with available database symptoms. Once the data base is matching, can get the advice through text/video. If not available he can send a query through text/audio/video, to the contact scientist of ICAR-IIOPR. Reply will be sent after identifying cause (and management) for the query. This app can be downloaded from google play store.

Dissemination of technology and ICT applications in oil palm sector: Oil Palm Kisan Mobile Message Services (OPKiMMS)

A study conducted on voice call mobile message services revealed that, middle aged (81 %) oil palm growers (respondents) having primary education (53 %) are regular listeners of voice messages, listeners are having yield stabilized (37.5 %) / stabilizing oil palm plantations (50 %), majority of them are having 5-10 acres of oil palm plantations (41 %), farmers were completely satisfied with the voice calls provided by ICAR-IIOPR (56 %), voice messages are better than other sources of information, they preferred two voice messages per week with duration of 30 seconds, perceived messages are useful (94 %) and applicable as per crop growth stage.

Oil palm growers opined that the received message audio quality is good (97 %) and language is understandable (94 %), wanted to consult scientists of ICAR-IIOPR for further information on practices to be adopted, they discuss (75 %)/spread the voice call messages on practices need to be

adopted as per crop growth, adopted the technology (94 %) in their oil palm plantations based on voice messages, indicated to have call back facility (75 %) but denied to pay for the service. Due to low literacy rate, growers might have positively responded and listening voice messages regularly and created a positive impact in adoption of technology.

- Mobile data base of 3598 stakeholders from Andhra Pradesh, Chhattisgarh, Odisha, Tamil Nadu, Karnataka, Telangana and Gujarat were collected.
- Published 15 text SMS to 1.23 lakh mobiles.
- Published 54 voice message calls to 12.21 lakh mobile numbers of 13 states in four languages.
- 104 voice calls were published to farmer's mobile numbers under Farmer FIRST Programme.
- 14 SMS were sent as SMS through Farmers Portal of Government of India to Farmers FIRST Programme village farmers mobile database.
- A total of 76 phone in queries related to oil palm cultivation practices were replied. Majority of the farmers contacted ICAR-IIOPR for fertilizer management followed by pest/disease/disorders and for general information. Since farmers wanted to provide recommended fertilizers and protect the palm, they might have contacted IIOPR for information.

5. Transfer of Technology and Education

Feasibility studies

Dr. R.K.Mathur, Director and Dr. B.N.Rao, Principal Scientist conducted feasibility study for cultivation of oil palm at Bachanaki Farm, Uttara Kannada Dt., Karnataka during March 16-18, 2018.

Feasibility test for farm machinery

Dr. M. V. Prasad, Principal Scientist conducted feasibility test for the following Tractor operated stationary shredder cum chaff cutter manufactured by

- M/s. Sri Lakshmi Ganapati engineering works, Devarapalli, West Godavari District, Andhra Pradesh on April 18, 2017.
- M/s. Sri Venkateswara engineering workshop, Chintalapudi and Sri. Mohana Lahari engineering works, Jangareddygudem, West Godavari Dt., Andhra Pradesh on February 13, 2018.

Exhibitions

- VAIGA-2017 International Workshop cum Exhibition on Agro Processing and Value Addition organized by State government of Kerala at KAU, Trichur, Kerala during December 27-31, 2017 and secured second prize under Research Institutions category.
- Technology conclave and Agristartup meet 2017 organized by ICAR-CTCRI at Sreekariyam during October 27-28 2017.
- "Palode Mela" at Palode, Thiruvananthapuram, Kerala during February 7-16, 2018 and secured best stall award.
- National Oilseeds Kisan Mela at ICAR-Indian Institute of Oilseeds Research, Hyderabad during September 9-11, 2017.
- Exhibition at Tallapudi, West Godavari Dt., Andhra Pradesh on January 8, 2018 on the eve of Janmabhoomi-Ma vooru, organised by district administration of West Godavari Dt., Andhra Pradesh.
- Krishi Unnati Mela organized by Ministry of Agriculture & Farmers' Welfare and DARE, Govt. of India during March 16-18, 2018 at ICAR-IARI, New Delhi.

Diagnostic field visits

Dr. P. Kalidas

Conducted 10 diagnostic field visits in oil palm plantations of Andhra Pradesh (East Godavari, West Godavari, Krishna, Visakhapatnam Dts.), Telangana (Khammam Dt.) and Karnataka (Mysore, Chamarajanagar, Mandya Dts.).

Dr. P. Kalidas and Dr. K. Suresh

- Taraka and Kabini seed gardens and conducted diagnostic field visits in Mysore and Mandya districts of Karnataka.
- Oil Palm plantations in farmers field at Khamarang, Mizoram to observe any new emerging pests and fruit set in oil palm apart from general growth of plantations during February 2-3, 2018.

Dr. M. V. Prasad

- Conducted 24 diagnostic field visits in oil palm plantations of Andhra Pradesh (East Godavari, West Godavari and Krishna Dts.) Assam and Mizoram.

Dr K.Manorama

- Oil palm plantations at G.Kothapalli village, West Godavari Dt., on September 21, 2017 and suggested pest control measures to ants infected palms.

Dr. K. Ramachandrudu

- Made 8 diagnostic field visits to oil palm farmers' gardens in Bandivarigudem and Krishnapuram villages, T. Narsapur Mandal,

and Kalavalapalli village, Chagallu Mandal, West Godavari district, Andhra Pradesh and offered technical guidance to the problems identified.

Dr. K. Sunilkumar and Dr. G. Somasundaram

- Farmer's fields in Nanniyode village, Thiruvananthapuram Dt., Kerala on January 3 and 12, 2018 and recommended suitable cultivation and pest management practices.

Farmers' awareness programmes/workshops/ skill demonstrations

Dr. P. Kalidas

- Training on organic farming to tribal farmers of Araku Valley, Visakhapatnam Dt., Andhra Pradesh on September 12, 2017

Dr. M. V. Prasad

- Delivered invited lecture on "Personal strengthens & Value systems" to the participants of Agrl. Skill Council of India (ASCI) sponsored Skill development programme on "seed processing worker" at ICAR-IIOPR, RC, Palode on March 28, 2018.

Dr K.Manorama

- Participated as Resource person in the Awareness programme (organised in collaboration with State Department of Horticulture, Govt. of Andhra Pradesh) at G.Kothapalli village on "Management of oil palm plantations" to farmers of Dwaraka Tirumala and Bhimadole mandals, West Godavari Dt., Andhra Pradesh on September 21, 2017.
- Skill development programme on soil and leaf sample collection from oil palm plantations to farmers and processing unit staff of East Godavari Dt., at Singampally of Anaparthy Mandal, RB Patnam of Peddapuram Mandal, Kalvacherla of Rajanagaram Mandal and Singarampalem of Jaggampeta mandal during February 01-04, 2018.

Dr. K. Ramachandrudu

- Farmers Training Programme on Oil Palm conducted by TS Co-operative Oil Seeds Growers Federation Limited at Jagannadhapuram,. Khammam dt, Telangana and delivered talk on oil palm productivity enhancing technologies on 21 December 2017.

Dr. G. Ravichandran

- Training on Oil palm production technologies at Tadepalligudum, West Godavari Dt., Andhra Pradesh during September 18-19, 2017.

Skill Development Programme on Job role "Seed Processing Worker"

(Course director**:** Dr. R.K. Mathur; Coordinators: Dr. G. Somasundaram and Dr. K. Sunilkumar)

A 25 days Agricultural Skill Council of India (ASCI) sponsored Skill Development Programme on job role "Seed Processing Worker" was organized at IIOPR Research Centre, Palode during 7-31 March, 2018. Under this training programme, 20 unemployed youth from four panchayats *viz.* Palode, Nanniyode, Vithura and Peringamala were trained on seed processing. The trainees were evaluated and certified by the experts from ASCI, Gurgaon. Exposure visit on "Seed Processing" was organized to seed processing plant at Puliyankudi, Tamil Nadu on 21 March, 2018. Exposure visit was organized to seed production and processing facility at College of Agriculture, Vellayani on 23 March, 2018 .

Other Extension activities taken up

Supply of microbial agents, parasitoids and nectariferous plants to the farming community for demonstration purpose: *Metarhizium anisopliae* and *Trichoderma viride* among bioagents, *Trichogramma embryophagum* and *Encarsia guadeloupae* among parasitoids and *Antigonon leptopus* among nectariferous plants were supplied to the oil palm growers to tackle the problems of rhinoceros beetle, rugose spiraling whitefly, basal stem rot and leaf eating caterpillars of oil palm.

All India Radio/Television programmes

Radio talk

- Dr. K. Ramachandrudu participated in interaction programme on "Preparatory cultivation prior to planting of oil palm and management after planting of oil palm seedlings" (Telugu) at AIR, Vijayawada on April 21, 2017.
- Dr K Manorama delivered a talk on "Management strategies during first three years of oil palm plantations" broadcasted by AIR, Vijayawada on August 20, 2017.

Exposure Visits

ICAR-IIOPR, RC, Palode, Kerala

- Exposure visit of 50 B.Sc (Ag.) IV year students and 3 faculty members of KAU, College of Agriculture, Padannakkad, Kasaragod Dist., Kerala on May 09, 2017.
- Exposure visit of high school students (Class VIII to X) and teachers from SKV Higher Secondary School, Nanniyode, Govt. Higher Secondary School, Bharathannoor and NSS High School, Palode on September 27, 2017.
- Exposure visit on "Oil Palm Cultivation" to 20 Agricultural Officers from Department of Agriculture, Tamil Nadu on February 07, 2018.

Academic activities

- A memorandum of understanding (MOU) for the students to conduct research for their degree programme as trainees at ICAR institutions was signed between ICAR-Indian Institute of Oil Palm Research, Pedavegi and SKSD Mahila Kalasala, Tanuku on May 22, 2017
- Scientists of IIOPR were associated with the following academic activities:

Dr. P. Kalidas

- Attended the Academic council meeting of Dr. YSR Horticultural University, VRGudem, Andhra Pradesh. on June 12, 2017

Dr. M. V. Prasad

- Guided Master of Arts (Applied Economics) student for his internship on "Trickling down of government assistance to oil palm growers for their socio-economic upliftment - A study in West Godavari Dt., Andhra Pradesh".
- Acted as External examiner for the Ph. D. student of Agricultural Extension, College of Agriculture, ANGRAU, Tirupati, Andhra Pradesh.

Dr. B.N.Rao

- Accredited as PG Teacher and to guide PG students of Dr. YSR Horticultural University, VRGudem, Andhra Pradesh.
- Guided one M.Sc (Hort.) student of Dr.YSR Horticultural University, VRGudem, Andhra Pradesh who submitted thesis on Irrigation management studies in oil palm.

Dr K Manorama

- Evaluated the M.Sc (Ag) thesis on"Performance of dual purpose sorghum (Sorghum bicolor (L.) Moench) varieties under varied crop geometry" from Acharya N G Ranga Agricultural University, Guntur.

Dr. K. Ramachandrudu

- Guided 15 students of Class XI and XII of Jawahar Navodaya Vidyalaya, Pedavegi, West Godavari Dt, Andhra Pradesh in their project work on Organic farming of oil palm: Recycling of oil palm waste in palm basins,

Microbial composting of palm oil mill waste and Preparation of bio-fertilizers/microbial decomposers during August-October 2017.

Dr. K.Sunilkumar

- Acted as External examiner for final examination of M. Sc (Hort.) including thesis evaluation and viva voice at Dept. of Plantation crops and spices, College of Agriculture, Vellayani on April 01, 2017.
- Acted as External examiner for qualifying examination for 4 PG students in Horticulture at Dept. of Plantation crops and spices, College of Agriculture, Vellayani.
- Delivered Invited lecture in the ICAR short course "Breeding for resistance to pest and diseases in plantation crops" organised at CPCRI, RS, Kayamkulam during November 21-30, 2017.

Dr. B. Kalyana Babu

- Guided one M.Sc (Biotech.) student who submitted thesis to Adikavi Nannayya University, Rajamahendravaram, Andhra Pradesh.
- Guided one M.Sc (Hort.) student who submitted thesis to Dr. YSR Horticultural University, VRGudem, Andhra Pradesh.
- Acted as Expert team member for evaluation of students projects and exhibitions at Zonal level at Jawahar Navodaya Vidyalaya, Pedavegi

Training Programmes

Hands on experience in Oil Palm planting-Training programme Oil Palm Production Technology

Demonstrating collection of soil sample - Training Programme on Soil and Leaf Nutrient Analysis in Oil Palm

Farmers Training on oil palm cultivation practices

Demonstration of nursery management practices - Training Programme on Nursery Management in Oil Palm

Diagnostic field visit of Multi Purpose Extension Officers training programme on Oil Palm Production Technologies

Farmers training programme on cultivation practices of oil palm

Mera Gaon Mera Gaurav

An innovative initiative "Mera Gaon Mera Gaurav" programme of Government of India was launched at ICAR-Indian Institute of Oil Palm Research during 2015-16 and the activities continued during 2016-17. The programme is aimed to promote direct interface of scientists with the farmers and provide required information, knowledge and advisories on agriculture and allied subjects on regular basis. Scientists of selected villages are providing information to the farmers on technical and other related knowhow in a time frame through personal visits or telephone. Scientists are using All India Radio, local newspapers, mobile messages, exhibition and local media to disseminate technology to the farmers in their local language. They are creating awareness on good agricultural techniques for producing good quality agricultural products and creating awareness on Swachh Bharat Abhiyaan. In this initiative, 78,000 farm families are in touch with scientists of ICAR-IIOPR.

Multidisciplinary team of scientists have been formed at ICAR-IIOPR; each team of 3-4 scientists adopted 5 villages within a radius of 50-100 km from the institute. A total of 23 villages adopted, 20 villages in Andhra Pradesh and 3 villages in Kerala. Baseline information of selected villages consisting of farming situation, climate, social and economic conditions of the selected villages were collected and compiled. The database of mobile numbers was collected from the selected villages. Unique numbers have been identified to send mobile advisories on required technologies to the farmers.

Villages selected in Andhra Pradesh: Makkinavaarigudem, Bandivarigudem, Krishnapuram, Borrampalem, Kollivarigudem, Cahllachintalpudi, Medinaraopalem, RamaRao Gudem, Malakacherla, Gudigunta, Kuchimpudi, Nyayampalli, Pedavegi, Kavagunta, Vanguru, Nallajerla, Dubacherla, Pullalapadu, Ayyavaram, Musullagunta Villages selected in Kerala: Uzhamalackal, Peringamala, Nanniyode

During 2017-18, ICAR-IIOPR covered 36 villages within a radius of 50-100 km from the institute and the following activities were taken up in these villages:

S. No	Item	No./Area (ha)	Beneficiaries
1	Diagnostic visits (No.) made to suggest remedial measures for pest and disease management and offer technical guidance to the problems identified.	82	603
2	Demonstrations (Area/ha) conducted on collection of soil and leaf samples, vermicomposting, recycling of biomass, harvesting etc.	59	621
3	Farmers' meetings conducted (No.) on harvesting of oil palm FFB, vermi composting, pest and disease management, irrigation and nutrient management etc	9	246

Training on Cultivation of black pepper: One day training programme on "Cultivation of black pepper" was organized at IIOPR Research Centre, Palode, Kerala on December 5, 2017. Fifty farmers attended the programme. Dr Rajeev, PI, TSP project from IISR, Calicut delivered lecture on pepper varieties and cultivation practices. Rooted cuttings of pepper varieties Panniyoor II, III and IV were distributed to the farmers.

Farmers first programme

ICAR sponsored KVK scheme "Farmers FIRST Programme" entitled "Enhancing profitability of oil palm based cropping system through resource use efficient technologies with farmer-scientist and stakeholders interface" is being implemented at Challachintalapudi and Makkinavarigudem villages of West Godavari District of Andhra Pradesh. Then following technological interventions were implemented under Farmers FIRST Programme, for assessment and refinement:

S. No.	Module	Intervention	Villages covered	Area covered (ha)/ Animal (No.)	Number of Households covered
1	Crop based module	Weather based irrigation scheduling in oil palm	2	200	40
2	Crop based module	Integrated pest management of leaf eating caterpillar and bag worm in oil palm	2	635	217
3	Crop based module	Integrated disease management of Basal Stem Rot (*Ganoderma sps.*) in oil palm	2	80	55
4	Crop based module	Mechanization of harvesting of bunches in oil palm	2	50	80
5	Horticulture based module	Coconut and Oil Palm based cropping system	2	4	10
6	Livestock based module	Fodder grass for live stock	2	2	30
7	NRM Based module	Recycling of biomass obtained from oil palm plantation	2	567	149

Organised activities *viz.,* capacity building/ HRD interventions (trainings, visits, workshops, interfaces, extension activities etc.) for farmer-scientist interface in the two villages. Conducted skill / method demonstrations on management of pests /diseases, collection of soil and leaf samples for nutrient analysis, release of parasitoid and application of pesticide/bio agent against pests/diseases, demonstrated use of chaffcutter for biomass recycling and vermibeds for recycling of biomass from oil palm plantations.

Programmes organised at Challachintalapudi, Andhra Prdaesh

S. No.	Date	Programme	No. of participants
1	22.04.2017	Skill demonstration on collection of soil and leaf sample	40
2	22.05.2017	Skill demonstration on collection of soil and leaf sample for analysis to stakeholders at ICAR- IIOPR, Pedavegi	40
3	31.05.2017	Skill demonstration on collection of soil and leaf sample for analysis to stakeholders	40
4	1.06.2017	Demonstration of chaff cutter and Skill demonstration on collection of soil and leaf sample for analysis to stakeholders	12
5	29.08.2017	Demonstration on controlling of Rhinoceros beetle on Coconut and Oil Palm	10
6	01.09.2017	Demonstration on controlling of Rhinoceros beetle on Coconut and Oil Palm and distribution of pesticides to farmers	15
7	18.09.2017	Demonstration on controlling of Rhinoceros s beetle on Coconut and Oil Palm and distribution of pesticides to farmers	20
8	21.09.2017	Field visit on intercrops in Oil Palm and coconut with cocoa and fodder grass	15
9	26.09.2017	Field visit on intercrops in Oil Palm and coconut with cocoa and fodder grass	12
10	27.09.2017	Demonstration on vermi compost beds and coconut (Godavari Ganga) planting	10
11	29.09.2017	Demonstration on vermi compost beds and coconut (Godavari Ganga)	10
12	03.10.2017	Demonstration of Vermi compost bed preparation	10
13	04.10.2017	Demonstration of Vermi compost bed preparation	15
14	05.10.2017	Demonstration of Vermi compost bed preparation	10
15	16.10.2017	Group meetings on controlling of leaf web worm	10
16	18.10.2017	Demonstration on controlling of leaf web worm	10
17	20.10.2017	Demonstration on pesticide spraying to control leaf web worm	5
18	21.10.2017	Group meeting on controlling of leaf web worm	10
19	23.10.2017	Demonstration on pesticide spraying to control leaf web worm	10
20	24.10.2017	Demonstration and releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	12
21	25.10.2017	Group meeting on vermi compost collection and controlling of leaf web worm	20
22	27.10.2017	Group meeting on vermi compost collection and controlling of leaf web worm	10
23	28.10.2017	Awareness campaign on recycling of biomass waste from oil palm plantations and preparation of vermi compost	48
24	30.10.2017	Demonstration and releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	10

S. No.	Date	Programme	No. of participants
25	02.11.2017	Demonstration on application of *Metarhizium anaesopliae* against Rhinoceros beetle in coconut and oil palm	25
26	06.11.2017	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	20
27	09.11.2017	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	15
28	14.11.2017	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	50
29	01.12.2017	Demonstration on chaff cutter for recycling of biomass in coconut and oil palm	10
30	20.12.2017	Demonstration and releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	9
31	05.01.2018	Group meeting for implementing pole harvesting of oil palm FFB	15
32	09.01.2018	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	7
33	25.01.2018	Inter face meet on irrigation and nutrient management in oil palm plantations	73
34	27.01.2018	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	7
35	02.02.2018	Skill demonstration on collection of compost from vermi beds	21
36	16.02.2018	Skill demonstration on mobile based irrigation scheduling	32

Programmes organised at Makkinavarigudem, Andhra Pradesh

S. No.	Date	Programme	No. of participants
1	07.08.2017	Skill demonstration on Organic farming and recycling of biomass waste from oil palm plantations	30
2	18.08.2017	Demonstration on pole harvesting of oil palm FFB	15
3	31.08.2017	Demonstration on control of rhinoceros beetle damage on oil palm and coconut	10
4	22.09.2017	Field visit on intercropping in Oil Palm and coconut plantations with cocoa and fodder	10
5	17.10.2017	Group meeting on control of leaf web worm	10
6	27.10.2017	Group meeting on management of leaf web worm and discussion on pest and disease management	20
7	30.10.2017	Group meetings on disease management in oil palm	15
8	31.10.2017	Awareness campaign on pests and diseases on oil palm	80
9	22.11.2017	Demonstration on use of *Arbascular michorrhizha*	17
10	17.01.2018	Demonstration on releasing of egg parasitoids (*Trichogramma sps.*) against leaf web worm	10
11	16.02.2018	Skill demonstration on mobile based irrigation schedule	20

Swachh Bharat Activities

The Govt. of of India has launched the Swachh Bharat Mission on October 02, 2014 stating that "A clean India would be the best tribute India could pay to Mahatma Gandhi on his 150 birth anniversary in 2019". In line with the Swachh Bharat Mission and ICAR's instructions various cleanliness activities were undertaken at ICAR – IIOPR. Swachhta Pakhwara was celebrated during September 17 to October 03, 2017 and the following activities were taken up.

Cleanliness drive was initiated by cleaning the office campus including lawns, gardens, farm area, administrative blocks and laboratories. The residential quarters' surroundings and old campus were also cleaned. The scientists, staff and residents of quarters participated in the initiative.

Swachhta shapath was administered to all the staff members of ICAR-IIOPR. In this programme Dr K.Manorama, Nodal Officer explained the objectives and guidelines of mission and series of programmes chalked out for the entire fortnight. Dr R.K.Mathur, Director gave a brief note on importance of waste management in oil palm plantations and urged all the staff to give more emphasis on this aspect. Pledge was administered in English, Hindi and Telugu languages.

Awareness campaign on climate smart waste management in oil palm plantations through vermicomposting was conducted to farmers from Tadepalligudem and Eluru rural mandals at ICAR-IIOPR, Pedavegi. Composting of huge quantity of waste generated in oil palm plantations was demonstrated by using proper composting techniques. Benefits of intercropping in oil palm plantations were explained to utilize the interspaces more effectively for higher net benefits and efficient utilization of resources.

Waste management practices that could be adopted in oil palm plantations were demonstrated during farmers training programme at G Kothapalli village of West Godavari Dt., Andhra Pradesh. Scientists from ICAR-IIOPR demonstrated the use of chaff cutter to cut the fronds and spreading the same in palm basins. The benefits of composting waste material in terms of nutrient recycling, moisture conservation, environmental protection were explained.

Tree planting has been initiated at IIOPR campus on September 22, 2017 by QRT members.

Awareness campaign on "Swachh Bharat" cleanliness drive and avoiding open defecation was conducted in MRC colony village near IIOPR, Pedavegi. The importance of cleanliness to maintain good health and clean surroundings was explained to the villagers. Villagers and local ward member also participated in the programme.

Vanamahotsav at IIOPR campus was taken up and different tree species were planted by scientists and staff members at old and new campuses. It is expected that this would improve the air quality and micro climate of the campus.

With the objective of cleaning the tourist places, scientists and staff of ICAR-IIOPR cleaned the premises of Balayogi Science Park, district science museum in the town on the eve of World Tourism Day. The District Science Officer of science park, explained the activities of their institution and showed the exhibits present in the park. Competitions *viz.,* essay writing, drawing, debate and rangoli were conducted with swachh bharat theme. Essay writing competition has given a better roadmap for us to follow, wherein the views on improving the Institute with respect to Swachh Bharat initiative were expressed.

6. Awards and Recognitions

Dr. M. V. Prasad

- Received the Rytunestham foundation award and presented with Padmasree Dr. I. V. Subba Rao Rytunestham Purasakaram-2017 on October 3, 2017 by Hon'ble Vice president of India Sri. M. Venkaiah Naidu, at Atkur village, Krishna Dt., Andhra Pradesh.

- Received best research paper, oral presentation on "Voice Message Services ICT tool for dissemination of oil palm technologies" (by Prasad, M.V., Mary Rani, K.L., Sundera Rao, N. and Sowjanya, P.) in the National Conference on "Digital and engineering technologies for precision agriculture and value addition" organised by College of Agricultural Engineering, Bapatla, Guntur district, Andhra Pradesh during February 26-27, 2018.

- Received best research paper, poster presented on "Chipping bucket - A feasible approach for oil palm trunk disposal" (by Preethi, P., Vidhan Singh, T. V., Prasad, M. V., Ramajayam and Mathur, R.K.,) in International Symposium on Horticulture: Priorities & emerging trends, held during 5-8 September 2017 at ICAR-IIHR, Bengaluru, Karnataka.

Dr. B. Kalyana Babu

- Received Young Achiever Award from SADHNA Society, Palampur for the year 2017

Ms. H. P. Bhagya

- Won second prize in the long jump event at the Inter-zonal sports meet held at IARI, New Delhi during April, 2017.

Dr. R. K. Mathur

- Nominated as External Expert Committee member for scrutinizing applications and to recommend for awarding of stage-6 to the retired teachers under CAS, ANGRAU, Guntur and attended meetings during June 11-12, 2017 and on June 29, 2017.

Dr. K. Suresh

- Nominated as Editor for Journal of Environmental Management (Elsevier Publications).

Dr K Manorama

- Nominated as External Member of ICAR-CTRI, Rajahmundry Assessment Committee for considering merit promotion cases of Technical Personnel up to 29.01.2019.
- Nominated as expert member for screening and selection of candidates under Career Advancement Scheme (CAS) of Agronomy discipline on June 27, 2017 at Acharya N.G. Ranga Agricultural University, Guntur.
- Acted as expert member for the selection of Associate Professors in Agronomy Discipline, Acharya N.G. Ranga Agricultural University, Guntur on August 06, 2017.

Dr. K. Ramachandrudu

- Expert member, Screening Committee for screening of candidates under Career Advancement Scheme (CAS) of Horticulture discipline of Acharya N.G. Ranga Agricultural University, Guntur on June 28, 2017.
- Expert member, Selection Committee for conducting assessment and interview of Assistant Professor/Scientist to Associate Professor/Sr. Scientist of Dr.YSR Horticultural University, V.R. Gudem, West Godavari Dt., Andhra Pradesh on February 17, 2018.

Dr. G. Somasundaram

- Cleared the Domain Skill & Platform Skill Training under Training of Trainer Programme for the job role Seed Processing Worker, QP Code AGR/Q7102 and NSQF Level 3 held at Rajamata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh during December 11-13, 2017.

7. Linkages and Collaborations

ICAR-Indian Institute of Oil Palm Research, Pedavegi is maintaining linkages with the following National level Institutions for the promotion of oil palm research and development:

- ICAR-Central Plantation Crops Research Institute, Kasaragod
- ICAR-Indian Institute of Horticultural Research, Bangalore
- ICAR-National Bureau of Plant Genetic Resources, New Delhi
- ICAR- National Bureau of Soil Survey and Land Use Planning, Nagpur
- ICAR-Central Tobacco Research Institute, Rajahmundry
- Department of Science and Technology (DST)
- Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), Ministry of Agriculture & Farmers Welfare, Govt. of India
- State Departments of Agriculture/ Horticulture, Govt. of Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Goa, Gujarat, Chhattisgarh, Maharashtra, Odisha, Mizoram, Tripura, West Bengal
- State Agricultural/Horticultural Universities of oil palm growing states
- Entrepreneurs involved in oil palm development

DST funded project

- DST Startup fellowship on "Mapping QTLs for important physiological traits, oil yield related traits and construction of linkage maps in oil palm using genome wide microsatellites and SNP markers".

ICAR funded project

- Farmers first programme (under KVK scheme of ICAR) - Enhancing profitability of oil palm based cropping system through resource use efficient technologies with Farmer-Scientist and Stakeholders Interface.

Inter-Institute Collaborative Research Projects

- Delineation of potential areas for oil palm cultivation in India using remote sensing and GIS techniques (with NBSSLUP).
- Long term conservation of oil palm germplasm (with NBPGR).
- Investigations and various options for effective use of oil palm biomass waste (with CTRI).
- Evaluation of African oil palm germplasm (*Elaeis guineensis*) for cold tolerance (with CPCRI).

Oil Palm Development Programme

IIOPR is involved in various activities associated with oil palm development programme in the country.

National Mission on Oilseeds and Oil Palm (NMOOP): The Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India launched the 'National Mission on Oilseeds and Oil Palm (NMOOP)' to boost the production of vegetable oils sourced from oilseeds, oil palm and tree borne oilseeds. The following NMOOP funded projects were implemented at IIOPR:

- Utilization of oil palm biomass-as a source of various by-products.
- Dissemination of oil palm production technology through digital video films.
- Design and development of oil palm crop doctor for dissemination of technology Development of elite planting material for next generation seed gardens.

- Development of elite planting material for next generation seed gardens.
- Development of seed standards for existing oil palm seed gardens (Pedavegi, Palode and Rajamahendravaram).
- Strengthening of training on oil palm production technologies for stakeholders.

Technical guidance

IIOPR has been providing technical guidance to Department of Agriculture, Cooperation & Farmers Welfare and State Agriculture/Horticulture Departments of oil palm growing States on various aspects of oil palm cultivation.

Director, IIOPR or his representative is nominated as member of National Level monitoring team for the states of North East, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu for monitoring activities of National Mission on Oilseeds and Oil Palm (NMOOP), DACFW, Ministry of Agriculture, Govt. of India

Director, IIOPR is a member of the Project Management Committee (PMC) and FFB Price Fixation Committee (PFC) of the Oil Palm Development Programme (OPDP) implementing states.

8. AICRP/ Co-ordination Unit

The ICAR-Indian Institute of Oil Palm Research is offering the required technical support for the implementation of research programmes of the All India Coordinated Research Project on Palms at six centres namely: Pattukottai (Tamil Nadu), Gangavathi (Karnataka), Madhopur (Bihar), Mulde (Maharahstra), Pasighat (Arunachal Pradesh) and Vijayarai (Andhra Pradesh)

Dr.R.K.Mathur, Director, Dr.B.N.Rao and Dr. K. Manorama Principal Scientists participated in the 26th Annual group meeting of AICRP (Palms) held at AICRP on Palms Centre, UHS, Bagalkot, Karnataka during July 25-28, 2017. Dr. R. K. Mathur chaired the crop improvement and germplasm management session and offered technical suggestions.

Dr. P. Naveen Kumar and Dr.B.N.Rao visited AICRP (Palms), Oil palm centres, Mulde, Maharashtra and Pattukottai, Tamil Nadu and reviewed the progress made in the implementation of oil palm research projects allotted to the Centres

Dr K Manorama visited HRS, Vijayarai, Andhra Pradesh on October 12, 2017 along with Project Co-ordinator (Palms) for monitoring of AICRP trials being conducted at the centre.

Dr.R.K.Mathur and Dr.B.N.Rao visited the AICRP (Palms), Oil palm Centre, Madhopur, Bihar on February 8, 2018 and reviewed the research work on oil palm and advised on implementation of the technical programme.

9. Publications

Research Papers

- Chandra Surya Rao, M., Rao, B. N., Vijaya Bhaskar, V., Suresh, K. and R. Kalpana. 2018. Influence of different methods and levels of irrigation on photosynthetic pigments in relation to yield of oil palm (*Elaeis guineensis* Jacq.). 2018. *Int. J. Curr. Microbiol. App. Sci.* 7(2): 26-35. https://doi.org/10.20546/ijcmas.2018.702.005
- Kalayan Babu, B. and R.K. Mathur. 2017. Molecular breeding in oil palm (*Elaeis guineensis*): Status and Future perspectives. *Progressive Horticulture* 48 (2) 123-131.
- Naveen Kumar, P., Mathur, R. K., Murugesan, P. Reddy, A. G. K., Sunilkumar, K. Ramajayam, D. and Ravichandran, G. 2017. Seasonal variation in fresh fruit bunch production in dura oil palm, *Ind. J. Agric. Sci.* 87 (9): 1184–9.
- Sanjib K. Behera, Ravi K. Mathur, Arvind K. Shukla, K. Suresh and Chandra Prakash. 2018. Spatial variability of soil properties and delineation of soil management zones of oil palm plantations grown in a hot and humid tropical region of southern India. *Catena* 165: 251-259.
- Sunilkumar K., Mathur R. K. and Sparjan Babu D.S. 2017. Differential pollen longevity in Dura and Pisifera oil palm fruit types (*Elaeis guineensis* Jacq.) at storage temperatures, *Ind. J. Agric. Sci.* 87 (7):893-8.

Popular articles

- B. Narsimha Rao, M. Chandra Surya Rao, K. Manorama and S. Naresh. 2017. Oil palm saagulo neeti yajamanyam - Rytulaku Soochanalu - Telugu (Water management in oil palm - suggestions to farmers). Annadata 49(3):26-28.
- P.Preethi, D.Ramajayam, G.Ravichandran and L.Saravanan. 2017. Pamail marathin palakulaikal aruvadai seivathin thozhilnudpanga muraigal - Tamil. Naveena Velanmai. April, 2017. 44-48.
- P.Preethi, G.Ravichandran and L.Saravanan. 2017. Ennaipanai peralum kalanillai mattathirukku etta melanmai muraigal - Tamil. Naveena Velanmai. August, 2017. 48-50.
- Prasad, M. V., Sanjib Kumar Behera, Suresh, K., Vishala, S. and Bhanusri, A. 2017. Oil palm lo eruvula yajamanyam-Telugu (Fertilizer management in oil palm). Vyavasayam. April, 2017. 18-23.
- Prasad, M. V., Vidhan Singh, T., Preethi, P. and Vishala, S. (2017). Oil Palm lo gela pakvaniki pramanalu mariyu gelala kota - Telugu (Maturity standards in oil palm and harvesting of bunches). Vyavasayam. May, 2017. 28-29.
- Prasad, M. V., Ramachandrudu, K., Sunder Rao, N. and Sowjanya, P. 2017. Oil palm lo antara pantala sagu yajamanyam lo teesukovalasina jagrattalu - Telugu (Precautions to be taken in intercropping in oil palm). Vyavasayam. October, 2017. 29-31.
- Prasad, M. V., Ramachandrudu, K., Sowjanya and Sunder Rao, N. 2018. Oil palm lo antara pantala sagu-cheyavalasinavi-cheyagudanivi - Telugu (Do's and Don'ts in intercropping in oil palm). Rytunestham 13 (6): 53-54.

Technical publications

- Narsimha Rao, B., Suresh, K., Behera, S. K., Ramachandrudu, K. and Manoram, K. 2017. Nutrient Management in Oil Palm (Revised edition). ICAR- Indian Institute of Oil Palm Research, Pedavegi. Pp 28.
- Narasimha Rao, B., Suresh, K., Behera, S. K., Ramachandrudu, K. and Manorama, K. 2017. Irrigation Management in Oil Palm (Revised

edition). ICAR- Indian Institute of Oil Palm Research, Pedavegi. Pp 20.

- Prasad,M.V., Kalidas,P. Narsimha Rao,B., Suresh,K., Ramachandrudu,K., Praveena Depti,K, Mary Rani,K.L., Saravanan,L., Ravichandran,G., Ramajayam,D., Preethi,P. and Vishala,S. 2017. Ennai panai sagubadi-Tamil (Oil palm cultivation). ICAR-Indian Institute of Oil Palm Research, Pedavegi. Pp 68.
- Prasad, M. V., Kalidas, P., Rao, B. N., Suresh, K., Ramachandrudu, K., Preethi, K. P., Mary Rani, K. L. co-edited by Sunilkumar, K., Rahana, S. N., Sabu, A. S., and Aswathi, G. M. 2018. Enna pana krishi - Malayalam (Oil palm cultivation). ICAR-Indian Institute of Oil Palm Research, Pedavegi. Pp 57.
- Prasad, M.V., Suresh, K., Mary rani, K. L., Mathur, R. K., Sowjanya. P., Bhanusri, A., and Sundera Rao, N. 2018. Oil palm crop calendar (English). ICAR-Indian Institute of Oil Palm Research, Pedavegi. P-3.
- Prasad, M.V., Suresh, K., Mary rani, K. L., Mathur, R. K., Sowjanya. P., Bhanusri, A., and Sundera Rao, N. 2018. Oil palm crop calendar (Telugu). ICAR-Indian Institute of Oil Palm Research, Pedavegi. P-3.
- Prasad, M. V., Suresh, K., Sowjanya. P. and Sundera Rao, N. 2018. Folder on Oil palm cultivation. ICAR-Indian Institute of Oil Palm Research, Pedavegi. P-2.
- Prasad, M. V., Suresh, K., Sowjanya. P. and Sundera Rao, N. (2018) Folder on Oil palm sagu-Telugu (Oil Palm cultivation). ICAR-Indian Institute of Oil Palm Research, Pedavegi. P-2.
- R. K. Mathur, K. Suresh, A.Bhanusri, P. Naveen Kumar, M.V.Prasad, B.N.Rao and P. Kalidas. 2017. Research Highlights 2011-15. ICAR-Indian Institute of Oil palm Research, Pedavegi. Pp 58.
- R.K. Mathur, G. Ravichandran, K. Sunil Kumar, Ranvir Singh, B. Kalyana Babu, Anitha, P and H.P. Bhagya, 2017. Proceedings of 12th National oil palm seed meet. Published by Department of Agriculture and Cooperation & Farmers welfare and ICAR-Indian Institute of Oil palm Research, Pedavegi. Pp
- Ramachandrudu, K., Suneetha, V., Suresh, K., Rao, B. N. and K. Manorama 2018. Systems approach in oil palm for higher productivity and profitability. ICAR- Indian Institute of Oil Palm Research, Pedavegi. Pp 50.

Book chapters

- B.K. Babu and R.K. Mathur. 2017. Biodiversity and Genomics of Oil Palm. In: Biodiversity in Horticultural Crops. Astral Publications. Vol 6. pp 319-336.
- Suresh,K., Behera,S.K., Manorama,K. and Rao, B.N. 2017. Oil Palm. In: Impact of climate change in plantation crops. Eds: Drs. K.B. Hebbar, S. Naresh Kumar & P. Chowdappa. Astral International Pvt. Ltd., New Delhi. pp 101-122.

Training Manual

- Somasundaram. G. and K. Sunilkumar. 2018. Training Manual on Basic Knowledge in Computers. ICAR-Indian Institute of Oil Palm Research, Research Centre, Palode.
- Sunilkumar, K. and G. Somasundaram. 2018. Training Manual on Farm Management. ICAR-Indian Institute of Oil Palm Research, Research Centre, Palode.
- Somasundaram. G., K. Sunilkumar, G. Ravichandran and R.K. Mathur. 2018. Training Manual cum Handbook on Seed Processing Worker. ICAR-Indian Institute of Oil Palm Research, Research Centre, Palode.

E-Publications (Video films)

- Prasad, M.V., Suresh, K., Mathur, R.K., Kalidas, P., Rao, B.N., Ramachandrudu, K., Preethi, P. 2018. The Golden Palm – A digital video film on oil palm cultivation practices. 30 min. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Prasad, M. V., Suresh, K., Mathur, R. K.,

Sunilkumar, K. 2018. ICAR-IIOPR Marching Ahead (English and Hindi). A digital video film on activities of ICAR – IIOPR. 12 minutes. ICAR-Indian Institute of Oil Palm Research, Pedavegi.

E-Publications (Short videos)

Developed short video films on management practices in oil palm cultivation *viz.,* irrigation, fertilizer, mulching, green manure and cover crops, intercropping, nutrient management, pest management, disease management.

- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Rao, B. N. 2018. Irrigation Management in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Rao, B. N. 2018. Fertilizer Management in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Rao, B. N. 2018. Mulching in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Rao, B. N. 2018. Green Manuring and Cover Crops in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Ramachandrudu, K. 2018. Intercrops in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K., Rao, B. N. and Suresh, K. 2018. Management of Nutrient Deficiencies in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Kalidas, P. 2018. Pest Management in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.
- Mary Rani, K. L., Prasad, M. V., Mathur, R. K. and Praveena Deepthi, K. 2018. Disease Management in Oil Palm. ICAR-Indian Institute of Oil Palm Research, Pedavegi.

10. Training and Capacity Building

HRD Physical targets and achievements

S. No.	Category	Total No. of Employees	Trainings planned during 2017-18 as per ATP	Employees trained during April-Sept. 2017	Employees trained during Oct 2017- March 2018	Employees trained during 2017 - 2018	% Realization of trainings planned
1	Scientist	18	5*	0	4	4	80
2	Technical	15	9	2	7	9	100
3	Administrative & Finance	9	7	5	1	6	85.7
4	SSS	15	10	0	10	10	100
Total		57	31	7	22	29	91.425

* 4 training programmes could not be completed due to transfer of 4 scientists (Distortion in cadre strength)

HRD Financial targets and achievements

RE (Rs in lakhs)	Actual Expenditure (Rs in lakhs)	% Utilization
1.00	1.00	100

Category-wise trainings attended by employees during 2017-18

S.No.	Name of employee	Designation	Discipline/Section	Name of training programme attended
Scientists				
1	K. Ramachandrudu	Principal Scientist	Horiculture	MDP on Leadership Development during December 12-23, 2017 at NAARM, Hyderabad
2	H. P. Bhagya	Scientist	Plantation, Spices, Medicinal and Aromatic plants	Training programme on Multivariate data analysis during December 14-20, 2017 at NAARM, Hyderabad
3	R. K. Mathur	Director	Director	Training programme on The Art of successful leadership and management during November 1-3, 2017 at MDI, Gurgaon
4	K. Suresh	Principal Scientist	Plant Physiology	Competency enhancement programme for effective implementation of training functions by HRD Nodal officers of ICAR during February 15-17, 2018 at NAARM, Hyderabad
Technical staff				
1	Mr. N. V. Ganesh	Senior Tech. Officer	Field/Farm	Training programme on "ICAR-ERP" at IASRI, New Delhi during July 17-22, 2017
2	Mr. VVS Krishna Murthy	Senior Tech. Asst.	Library	Training programme on "ICAR-ERP" at IASRI, New Delhi during July 17-22, 2017 Training programme on KOHA for Library staff of ICAR uring Feb5-9, 2018 at NAARM, Hyderabad

S.No.	Name of employee	Designation	Discipline/Section	Name of training programme attended
3	M. Rambabu	Technical Assistant	Farm	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme onSpoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
4	K. Ananda Rao	Senior Technician	Crop Improvement	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme onSpoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
5	A. Papa Rao	Senior Technical Assistant	Farm (Tractor Driver)	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme onSpoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
6	A. S. Sabu	Chief Technical Officer	Farm	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi
7	B.Muralidharan Pillai	Technical Assistant	Farm	Inhouse training programme onSpoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
8	V. Sunil Dutt	Technical Officer	Farm	Inhouse training programme on Farm Management during March 6-7 2018 at IIOPR, RC, Palode
9	P. Anil Kumar	Senior Technician	Farm	Inhouse training programme on Farm Management during March 6-7 2018 at IIOPR, RC, Palode
10	P. Ramalingeswara Rao	Senior Technical Assistant	Driver	Automobile maintenance, Road safety and Behavioral skills at CIAE, Bhopal during 27-11-2017 to 01-12-2017
Administrative staff				
1	Mr. Asif Mohammad	Asst. Finance and Accounts Officer	Audit and Accounts	Training programmes on Goods & Service Tax ISTM, New Delhi on 18-08-2017
	Mr. Asif Mohammad	Asst. Finance and Accounts Officer	Audit and Accounts	General Financial Rules-2017 at ISTM, New Delhi during August 21-23, 2017
2	Mr. Nasir Hussain	Asst. Administrative Officer	Administration	Workshop on e-procurement at ISTM, New Delhi uring August 21-22, 2017
3	Mr. P. Gowri Shankar.	Asst. Administrative Officer	Administration	Training programme on PFMS" at NAARM, Hyderabad on 13-09-2017
4	Mr. P. Saikishore,	Personal Assistant	Audit and Accounts	Training programme on PFMS" at NAARM, Hyderabad on 13-09-2017
5	S. Sivaramakrishna	Personal Assistant	Administration	Training programme on PFMS" at NAARM, Hyderabad on 13-09-2017

S.No.	Name of employee	Designation	Discipline/Section	Name of training programme attended
6	T.V. Ramakrishna	Private Secretary	Direcyor's Cell	Training programme on Enhancing efficiency and behavioural skills during October 25-31, 2017 at NAARM, Hyderabad
Skilled Supporting Staff				
1	G. Raju	Skilled Support Staff	Plant Pathology	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
2	A. Dhana raju	Skilled Support Staff	Director Cell	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
3	U. Rama Rao	Skilled Support Staff	Farm	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
4	A. Ganga Raju	Skilled Support Staff	Farm	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
5	K. Satyanarayanaa	Skilled Support Staff	Farm	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
6	Ch. V. Durga Rao	Skilled Support Staff	Crop Improvement	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
7	M. Appa Rao	Skilled Support Staff	Crop Production	Inhouse training programme on ICAR-ERP system during December 6-7, 2017 at IIOPR, Pedavegi

S.No.	Name of employee	Designation	Discipline/Section	Name of training programme attended
				Inhouse training programme on Spoken English including letter drafting and routine administrative procedures during February 20-21, 2018 at IIOPR, Pedavegi
8	P. K. Rethnakaran	Skilled Support Staff	Farm	Inhouse training programme on Basic Knowledge in Computers during February 27-28, 2018 at IIOPR, RC, Palode
9	P. Rema	Skilled Support Staff	Farm	Inhouse training programme on Basic Knowledge in Computers during February 27-28, 2018 at IIOPR, RC, Palode
10	C. Ravi	Skilled Support Staff	Farm	Inhouse training programme on Basic Knowledge in Computers during February 27-28, 2018 at IIOPR, RC, Palode

Inhouse training programmes organized

Area of training	Place	Date	Coordinator
ICAR-ERP system	IIOPR, Pedavegi	December 6-7, 2017	Dr. K. L. Mary Rani
Spoken English including letter drafting and routine administrative procedures	IIOPR, Pedavegi	February 20-21, 2018	Ms. A. Bhanusri Dr. K. Suresh
Basic Knowledge in Computers	IIOPR, Palode	February 27-28, 2018	Dr. G. Somasundaram
Farm Management	IIOPR, Palode	March 6-7, 2018	Dr. K. Sunilkumar

11. Participation in Conferences, Seminars, Symposia etc.

Dr. R.K. Mathur

- Meeting with Director of Agriculture, Assam & Nodal Officer, Oil Palm at Guwahati, Assam on April 23, 2017.
- Meeting with Director of Agriculture, Govt. of Mizoram at Aizawl on to discuss about the status of oil palm in Mizoram.
- Visit to Tissue culture laboratory and discussions with Director and Scientists on water efficient technologies at ICAR-CAZRI, Jodhpur during May 6-9, 2017.
- Meeting on EFC (2017-2020) with DDG (HS), ICAR at New Delhi during May 10-13, 2017
- Meeting for finalization of report on "Oilseed production to meet demand and reduce imports" at ICAR-IIOR, Hyderabad on May 29, 2017.
- Cabinet Committee meeting at New Delhi on July 20, 2017 and made a presentation on impact of customs duty on palm oil imports
- Meeting under the Chairmanship of Director General, ICAR on "Prospects of oil palm Tissue culture technology" at New Delhi during August 9-11, 2017
- Meeting on Review of EFC under the chairmanship of Director General, ICAR and was also attended by DDG (HS), FA and other officials at Krishi Bhawan, New Delhi during August 28-30, 2017.
- First meeting of "Cost of cultivation of oil palm" convened by CACP at Krishi Bhavan, New Delhi on September 15-16, 2017; the meeting was attended by Joint Secretary (Oilseeds), DACFW, officials from DACFW and CACP, Commissioner of Horticulture, Govt. of A.P. and representatives of oil palm processors, farmers etc.
- Brainstorming session cum Workshop on "Strategies for area expansion….in oil palm" at Hyderabad on September 25-27, 2017.
- Global Rajasthan Agritech Meet 2017 at Udaipur, Rajasthan during November 5-8, 2017.
- Andhra Pradesh AgSummit, 2017 at Visakhapatnam during November 15-16, 2017
- Standing Committee meeting of PLACROSYM-23 at ICAR-CPCRI, Kasaragod during February 20-23, 2018
- First meeting of the "Committee for monitoring of action points for increasing oilseeds production" at Krishi Bhawan, New Delhi on February 25-27, 2018
- Directors' Conference at New Delhi during March 08-09, 2018
- Meeting with Vice President of India at ICAR-IIRR, Hyderabad on "Doubling Farmers' income" during March 30-31, 2018

Dr. R. K. Mathur and Dr. K. Sunilkumar

- Divisional meeting for monitoring and reviewing of progress of foreign aided projects of Horticultural Science Division, ICAR, New Delhi on November 20, 2017 and presented proposal for extension of International collaborative research project involving exchange of oil palm germplasm between India (ICAR- Indian Institute of Oil Palm Research) and Malaysia (Malaysian Palm Oil Board).

Dr. P. Kalidas

- Review of the performance of turbo sprayers of Aspee and Gulshuk companies of Mumbai and Ludhiana on August 31 and September 01, 2017

- National Workshop on "Bio-suppression of Rugose Spiralling Whitefly, *Aleurodicus rugioperculatus* Martin on January 06, 2018 at CPCRI, Kasargod, Kerala and presented a paper on "Rugose spiralling whitefly on oil palm in Andhra Pradesh".
- CACP meeting on price fixation of oil palm FFB for Telangana state on January 29, 2018.
- Scientific Advisory Committee (SAC) meeting of KVK, Undi on February 22, 2018

Dr. M. V. Prasad

- Meeting of state level coordination committee (SCC) for Andhra Pradesh for Doubling Farm Income at A. P. Secretariat, Velagapudi, Andhra Pradesh on April 7, 2017.
- Mizoram oil palm advisory committee meeting held at Department of Agriculture, Aizawl on July 18, 2017.

Dr. M. V. Prasad and Dr. K. Suresh

- Training cum workshop on "Methodological framework for implementation of Farmers First Project" held at Dehradun, Uttarakhand during November 6-9, 2017.

Dr. M.V.Prasad and Dr. K. L. Mary Rani

- National Conference on Digital and Engineering Technologies for Precision Agriculture and Value Addition & Farm Engineering Expo-2018 organized by College of Agricultural Engineering, Bapatla, Andhra Pradesh during February 26-27, 2018 and presented a paper (oral) entitled "Voice Message Services – ICT tool for dissemination of oil palm technologies".

Dr. B. N. Rao

- IIM workshop on "Scope Exploration for IIPM in Vijayawada" organized by IIM, Bengaluru at Vijayawada, Andhra Pradesh on May 23, 2017
- ASRB interface meeting at ICAR-NAARM, Hyderabad during November 01-02, 2017
- Workshop on Oil Palm Development Programme organized by Department of Horticulture, Govt. of Andhra Pradesh on December 13, 2017.

Dr K Manorama, Dr. K. Sunikumar, Dr. G. Ravichandran, Dr. K. L. Mary Rani, B. Kalyana Babu, H.P. Bhagya attended International Symposium on Horticulture: Priorities & Emerging Trends during September 04-08, 2017 organized by ICAR-IIHR, Bangalore at IISc campus, Bengaluru and presented the following research papers:

- Prasad, M.V. and Mary Rani, K.L. 2017. ICT – A way forward to disseminate oil palm technology.
- Manorama, K., Chandran, K.P., Ravi Kumar Mathur, Sanjib Kumar Behera, Suresh Kancherla, Ramachandrudu Kummari and Narsimha Rao Bezwada. 2017. Efficient plot size for oil palm (*Elaeis guineensis* Jacq.) field experiments.
- Sunilkumar, K., Vilash, V., Ravichandran, G. and Mathur, R.K 2017. Breeding or high yield in oil palm: early performance of advanced breeding lines.
- Ravichandran, G., P.Murugesan, R.K.Mathur, B.Kalyana Babu, D.Ramajayam, P.Naveen Kumar, K.Sunil Kumar and H.P.Bhagya. 2017. A method to protect the plumule and radicle of oil palm (*Elaeis guineensis* Jacq.) germinated seeds during transport.
- Bhagya, H.P., B. Kalyana Babu, D. Ramajayam, R.K. Mathur, P. Murugesan, K. Sunil Kumar, P. Naveen Kumar, G. Ravichandran and M.V.B. Venu. 2017. Identification of polymorphic SSR markers for genetic diversity and mapping studies in oil palm (*Elaeis guineensis* Jacq.).
- Kalyana Babu, B., R.K. Mathur, P. Naveen Kumar, K. Suresh, G. Ravichandran, H.P. Bhagya and M.V.B. Venu. 2017. Genome-wide association study (GWAS) of oil-yield related traits in oil palm (*Elaeis guineensis* jacq.) using SNPs and SSR markers.

Dr K Manorama

- DST sponsored Stake holders consultation workshop of GTWG (Global Technology Watch Group) on Sustainable agriculture held at ICAR-NAARM, Hyderabad on July 13, 2017.
- 38th Asian Conference on Remote Sensing held at New Delhi during October 23-26, 2017 and presented a paper (oral) on "Remote sensing and GIS techniques in agroecological zoning and potential area identification".
- Workshop on Commodity futures and price risk management organised by IIPM, Bengaluru and Government of Andhra Pradesh at Vijayawada on February 06, 2018.

Dr. K. Ramachandrudu

- National Workshop on Farmers' Feedback on Doubling Farm Income by 2022 organized by Ministry of Agriculture and Farmers Welfare, Govt. of India at ICAR-NAARM, Hyderabad during December 22-23, 2017.
- International Symposium on Biodiversity of Medicinal Plants and Orchids: Emerging Trends and Challenges at Acharya Nagarjuna University, Guntur, Andhra Pradesh during February 09-11, 2018 and presented a paper entitled Long pepper: As an inter crop in oil palm gardens.

Dr. K. Sunikumar

- As member of Expert committee to study market expansion of oil palm attended meeting chaired by Principal Secretary (Agri.) and Agriculture Production Commissioner at Agriculture Department, Govt. Secretariat, Kerala on July 29, 2017.
- Acted as Expert member for preparation of farm plan 2017-18 of Peringammala, Krishi Bhavan.
- Midterm review meeting of the ICAR Regional committee No. II held at ICAR-CIFRI, Barrackpore on November 13, 2017
- Tuber crops technology conclave and Agri-start up meet-2017 organised by CTCRI during October 27-28, 2017.
- Centre State Interface meet to enhance productivity of rice and horticultural crops organized at ICAR-CTCRI, Trivandrum on October 28, 2017.
- Indian Palm Oil Sustainability (IPOS) Framework meeting organized by Solidaridad in association with SEA, IIOPR and SOPOPRAD at Pachmarhi, Bhopal, Madhya Pradesh during July 20-22, 2017 and prepared draft guidelines.
- Foreign aided projects review meeting at SMD, ICAR, New Delhi on February 21, 2018 and presented International Collaborative Research Project Involving exchange of Oil Palm Germplasm between India (ICAR- Indian Institute of Oil Palm Research) and Malaysia (Malaysian Palm Oil Board).

Dr. K. L. Mary Rani

- National Symposium on "NSM Grid over NKN" during October 09-10, 2017 at Bangalore.

Dr. B. Kalyana Babu

- National Seminar on "Futuristic Agriculture for Sustainable Food Security" held at S.V. Agricultural College, Tirupati during February 21-23, 2018 and presented the paper: B. Kalyana Babu, K.L. Mary Rani, R.K. Mathur, Sarika sahu, G. Ravichandran, H.P. Bhagya and P. Anita. 2018. Development, and validation of genic and whole genome wide Microsatellite markers for large scale genotyping Applications in oil palm (*Elaeis guineensis* Jacq.). Theme IV – Crop Improvement for Food and Nutritional Security.

12. Ongoing Projects

S. No	Project No.	Title of the Project	Project Leader and Associates
I	1000761001	Collection, conservation, cataloguing and e valuation of oil palm germplasm	K. Sunilkumar, K.L.Mary Rani, G. Ravichandran, H. P. Bhagya, G. Somasundaram, P. Anitha
II	1000761002	Genetic enhancement in oil palm	G. Ravichandran, K. Sunilkumar, K. Suresh, K.L.Mary Rani, B. Kalyana Babu, , H. P. Bhagya, G. Somasundaram, P. Anitha
III	1000761003	Biotechnological studies in oil palm	B. Kalyana Babu, R. K. Mathur, K. Suresh, G. Ravichandran, K.L.Mary Rani , H. P. Bhagya
IV	1000763001	Production system management	B.N. Rao, K. Ramachandrudu, K. Suresh, K. Manorama, K.P.Deepthi
V	1000766001	Physiological and biochemical basis for growth and yield in oil palm	K. Suresh, K. Manorama, P. Anitha
VI	1000767001	Development of labour saving tools and machineries for oil palm cultivation	M.V. Prasad
VII	1000765001	Integrated pest management	P. Kalidas
VIII	1000765002	Integrated disease management	K. Praveena Deepthi, H. P. Bhagya
IX	1000769001	Dissemination of technology & ICT applications in oil palm sector	M.V. Prasad, K.L. Mary Rani, P. Kalidas, B.N.Rao, K. Sunilkumar, K. Suresh, K. Manorama, G. Ravichandran, K. Ramachandrudu, K.P.Deepthi, B.Kalyana Babu, H. P. Bhagya, G. Somasundaram, P. Anitha

13. Consultancy, Patents and Commercialization of Technology

1. Training programmes (National and International)

- Oil palm nursery management
- Oil palm production and processing technology
- Harvesting of oil palm FFB
- Oil palm hybrid seed production
- Plant protection in oil palm
- Soil and leaf nutrient analysis in oil palm

2. Consultancy services

- Oil palm hybrid seed production
- Production of quality planting material
- Oil palm tissue culture
- Setting up of oil palm nurseries and their management
- Designing of experiments and data analysis
- Oil palm crop feasibility studies/surveys
- Techno - advisory services
- Project preparation, evaluation and management
- General consultancy for oil palm development
- Agronomic aspects of plantation management
- Intercropping in oil palm plantations
- Soil and nutrient management
- Assessment of soil fertility status and advisory services on nutrient disorders
- Plant health centre for pest & disease management
- Molecular and biochemical characterization of plants, fungi, bacteria
- PCR based detection of oil palm diseases
- Pollinating weevils
- Maturity, harvest, post harvest management
- Oil palm processing
- Oil quality analysis
- Value addition of palm oil and EFB fibre
- Management of oil palm plantation and mill wastes
- Impact studies, socio economic studies, SWOT analysis, case studies, diffusion studies, constraint analysis in oil palm

3. Contract Research

- Testing of Agro-chemicals, Fertilizers, Bio-Fertilizers, Bio-Pesticides and Growth regulators suitable for oil palm
- Projects on all aspects of Water, Nutrient, Pest and Disease Management in oil palm /oil palm based cropping system

4. Contract services

- Analysis of water and soil to test the suitability for oil palm
- Leaf nutrient analysis
- Lab and field evaluation of fertilizers, herbicides, agro-chemicals/plant protection against fungi, bacteria and insect pests of oil palm
- Diagnosis of damages caused by insect pests and diseases in oil palm plantations and suggest control measures
- Oil analysis
- Bunch analysis

Consultancy projects

- Production of quality oil palm hybrid seeds and management of seed garden at Rajahmundry, Andhra Pradesh

INSTITUTE TECHNOLOGY MANAGEMENT UNIT

The Institute Technology Management Unit (ITMU) of IIOPR submits the monthly reports on success stories, transfer of technology/ commercialization of technologies and other related aspects at the Institute level to ZTMC-BPD, South zone. The technologies developed at IIOPR were documented.

Patents filed and present status

1. "Design and development of oil palm ablation tool" Indian Patent Application Number: 3937/ CHE/2014 – Publication date: 22-08-2014 (Application awaiting Examination)
2. "A process and kit for insect facilitated controlled pollination in oil palm" Indian Patent Application Number: 201641044994 – Publication date: 17-02-2017 (Application awaiting Examination)

14. QRT, RAC, IRC and IMC Meetings

Quinquennial Review Team (QRT)

The Indian Council of Agricultural Research vide office order F. No. HS-1(4)/2016-IA.V dated 31-03-2017 constituted a Quinquennial Review Team to review the work of Indian Institute of Oil Palm Research during 01-04-2011 to 31-03-2017. The QRT comprises the following Experts:

1. Dr. B.M.C. Reddy Chairman
Ex. Vice Chancellor,
Dr. Y.S.R. Horticultural University,
V.R.Gudem, Andhra Pradesh

2. Dr. S. Arulraj Member
Ex. Director, ICAR-IIOPR, Pedavegi
ANE Salai, Ayyappanthangal, Chennai

3. Dr. N. Subhash Member
Retd. Professor & Head, Tissue Culture laboratory,
Anand Agricultural University, Anand, Gujarat

4. Dr. S. K. Sharma Member
Ex. Director, ICAR-CIAH, Bikaner,
Consultant, Horticulture and Forestry Education,
Rani Laxmi Bai CAU, Gwalior Road, Jhansi

5. Dr. A. S. Dhatt Member
National Advisor - Tata Agriculture Research & Development Trust
Ludhiana, Punjab

6. Dr. R. Vikraman Nair Member
Retd. Professor of Agronomy,
Kerala Agricultural University,
Thiruvananthapuram, Kerala

7. Dr. K. Suresh Member Secretary
Principal Scientist (Plant Physiology),
ICAR- Indian Institute of Oil Palm Research,
Pedavegi, Andhra Pradesh

The Preliminary Meeting of QRT was held on 21-04-2017 at Horticultural Science Division, ICAR, New Delhi. The Chairman and members of the QRT along with Director, ICAR-IIOPR attended the meeting. The time line for the QRT visits was finalised in the meeting. The QRT during their visit to ICAR-IIOPR, Pedavegi, Andhra Pradesh visited the experimental fields, laboratories and interacted with the scientists. Detailed presentations were made by Project Leaders. QRT members critically reviewed the projects and offered valuable observations and suggestions. The Team visited oil palm processing industry, Andhra Pradesh State Oilseed Growers Federation (AP Oil Fed), Pedavegi, Andhra Pradesh and discussed with the Manager regarding the issues related to oil palm processing

sector and functioning of the mill. The Team also met administrative, technical and skilled supporting staff of the Institute to elicit their views. Discussions were also held with IJSC members, Farm and Library section staff of ICAR-IIOPR. The Team visited experimental blocks at ICAR-IIOPR, Research Centre (RC), Palode, Kerala and held discussions with scientists and staff members of the Centre.

The Team visited Oil Palm India Limited (OPIL) seed garden, Thodupuzha, Kerala to oversee the seed production activity and also observed the palms belonging to first generation planting material in India. Performance of African germplasm at oil palm germplasm block, Plantation Corporation Kerala Limited (PCKL), Athirapally, Kerala was also examined. The Team reviewed the oil palm experiments currently undertaken at AICRP on Palms Centre, Pattukottai,

Tamil Nadu Agricultural University, Tamil Nadu. The QRT members visited oil palm seed garden and Block Demonstration plots in Mizoram and reviewed the progress of activities undertaken in the State. An interaction meeting with the oil palm stakeholders at Mizoram gave an insight into the oil palm scenario in the State. Later the Team had a meeting with Director of Agriculture, Govt. of Mizoram along with other officials for an in-depth discussion on the progress of oil palm development in Mizoram.

The Interaction Meeting with oil palm stakeholders in the major oil palm growing State, Andhra Pradesh, resulted in understanding the progress along with constraints faced by them in oil palm cultivation and development. The performance of the Institute has been rated as **Outstanding** for the above period. The consolidated recommendations of QRT are as follows:

Technical

1. The present germplasm collection at ICAR-IIOPR consists of 128 collections from Tanzania, Zambia, Cameroon, Sierra Leone, Senegal, Guinea Bissau, etc. Looking at the narrow genetic base of oil palm, germplasm resources should be further strengthened and enriched from the Centres of Origin *viz*., Benin, Ghana, Nigeria, Ivory Coast, etc.

2. The first and second generation planting material developed by IIOPR has yield potential of 25 and 30 t FFB/ha/Y respectively. The third generation planting material developed with a targeted yield potential of 40 t FFB/ha/Y (8 t oil/ha/Y) are to be further tested in AICRP/farmers fields before release.

3. The present production of planting material from the established five seed gardens is approximately 4.00 million germinated seeds/ sprouts per annum. Also the recently established four seed gardens will have an additional capacity of 2.50 million germinated seeds/ sprouts per annum by 2024. In this context, efforts should also be made to ensure self sufficiency of planting material through seed gardens and Tissue culture, as indicated in the Oil Palm Crop Improvement Plan – Vision 2050 of IIOPR.

4. Concerted efforts should be made for standardization/refinement of tissue culture protocol for mass multiplication of elite palms.

5. Basic studies on root spread, light infiltration and return of residues have been done and these studies have bearing on recommendations on nutrient supplementation, irrigation and intercropping and would be useful in designing field experiments on these three aspects. Further basic work on light infiltration through oil palm canopies in farmers fields and identifying factors significantly related to it (like age, spacing and canopy density) may be useful in predicting light infiltration and in selecting crops suitable as intercrops for different situations.

6. Classifying the possible intercrops as shade loving, tolerant, intolerant and sensitive may also be useful in choosing for different shade levels. It may be done tentatively using experience (Eg. Cocoa) and available research results. Further work on shade response of new intercrops (Eg. Heliconia, Red Ginger, Long Pepper, etc) may also be worthwhile taking up.

7. With the available experimental data, reported information on crop coefficients of related crops (Eg. Coconut and Date palm), basic data on moisture retention properties of oil palm soils, climate data on evaporation demand (Eg. Pan Evaporation) and root spread and width, recommendations on irrigation scheduling may be made (quantities of which to be used and the frequency) as is now done for coconut. These may be made for different textural class of soils and for different climates (Potential Evaporation of 3, 4 & 5 mm). As irrigation is one of most critical inputs for successful growth of oil palm under Indian Scenario, efforts need to further strengthened to maximize water use efficiency.

8. Collection of crop residues, their processing (shredding and composting) and application

to the basins is now being recommended. This may become too expensive an operation when the wages go high. *In situ* composting of residues in basin area and methods of alleviating problems related to the practice (Eg. inconvenience in placement of fertilizers, gaseous losses of surface applied Nitrogen fertilizers and delay in decomposition) may be addressed through management methods like modified fertilizer placement, priming of urea and enhanced residue decomposition through microbial means.

9. At present, chisels are used for harvesting till the palms reach a height of 2 m. Further, sickles and motorized sickles are used for medium tall palms. Harvesting in tall plantations could be done by recently developed hydraulic lift platforms, with few limitations. Efforts should be further undertaken to strengthen mechanization of harvesting, waste management and by product utilization.

10. *Ganoderma boninense* causes both basal stem rot (BSR) and upper stem rot (USR) and is becoming the most devastating disease in older oil palm plantations in the recent years. The reported incidence in Andhra Pradesh varied from 2.90 to 52.85 per cent. In this context, intensive research efforts on management of this disease are needed to address the problem.

11. North East Region has immense potential for the development of oil palm as it could play a significant role in improving the income of farming community and could help in raising the standard of living of a large number of people to be engaged in various activities related to oil palm sector. In this context, Capacity Building Programmes for farmers and development personnel needs to be further strengthened.

Policy

12. Scientist (Farm Machinery & Power) should be allotted to ICAR-IIOPR on priority for undertaking research on harvesting tools and mechanization of different field operations along with Oil Extraction Ratio (OER) studies.

13. Scientist (Agril. Economics) is very much essential for economic analysis of impact of oil palm technologies, cost of cultivation studies and policy research on production, processing, marketing, investments and domestic & international trade in oil palm.

14. The Institute budget for the years 2017-20 has been fixed at Rs. 512.00 lakhs of which, a meagre amount of Rs. 16.50 lakhs has been earmarked for works and equipments. Sufficient amount (Rs. 150.00 lakhs) may be sanctioned for infrastructure development.

15. At present, land for undertaking further experiments is a constraint at the centre. Being a perennial crop, atleast 100 ha of additional land is required for undertaking research particularly on germplasm evaluation, progeny trials and irrigation management.

General

16. As oil palm is an introduced crop, exposure visits of IIOPR scientists to major oil palm producing countries like Costa Rica, Malaysia and Indonesia would aid them in updating their knowledge and skills.

17. Financial assistance to scientists in attending International Oil Palm Conferences (International Palm Oil Congress and Exhibition, PIPOC, Malaysia; Indonesian International Palm Oil Conference, IIPOC, Indonesia) would help in better understanding of the crop and more interactions with scientists of other countries.

Research Advisory Committee (RAC)

The XVIII Research Advisory Committee meeting of the ICAR-Indian Institute of Oil Palm Research, Pedavegi was held on August 17, 2017 at Pedavegi. The meeting was chaired by Dr. D. P. Ray, Former Vice Chancellor, Orissa University of Agriculture and Technology, Bhubaneswar. The following members attended the meeting.

- Dr. W.S. Dhillon, Assistant Director General (HS-1), Division of Horticultural Science, ICAR, New Delhi

- Dr. S.R.Bhat, Emeritus Scientist, ICAR-National Research Centre on Plant Biotechnology, New Delhi
- Sri Y.S.Ranganaikulu, CEO, Shivasis Oil Palm Pvt. Ltd., Hyderabad
- Dr. R.K.Mathur, Director, ICAR-Indian Institute of Oil Palm Research, Pedavegi
- Dr. B.N.Rao, Principal Scientist, ICAR-IIOPR, Pedavegi & Member Secretary

The following recommendations and general suggestions were made by the committee:

- As per the need of the institute posting of scientists in Farm Machinery, Tissue Culture, Post Harvest Technology, Agricultural Economics and Plant Breeding are recommended to meet the immediate requirement on priority.
- As large scale planting material is needed in oil palm, research on tissue culture in oil palm should be strengthened.
- The technologies developed by the institute on oil palm based cropping system needs to be revalidated in different agro-climatic regions as per the suitability and market demand.
- Good number of success stories should be published on the achievements made by the institute.
- Institute should develop linkages with KVKs of oil palm growing districts in conducting demonstrations and training programmes for the benefit of the farming community.

Institute Research Committee (IRC)

The Mid-term Institute Research Committee-2017 meeting was conducted on September 25, 2017 for reviewing and finalization of the technical programme of nine institute projects.

The twenty-first Institute Research Committee meeting of ICAR-Indian Institute of Oil Palm Research was held during March 14-15, 2018 at IIOPR, Pedavegi. The progress made in the implementation of research programmes during 2017-18 was reviewed. Nine projects were presented during the Technical Sessions. Project Leaders and Sub-Project Leaders presented the progress of ongoing research programmes and achievements. Technical Programme of the nine projects for the year 2018-19 was finalized and brought out in the form of proceedings.

Institute Management Committee (IMC)

Institute Management Committee meeting was held on September 20, 2017 at IIOPR, Pedavegi.

15. Workshops, Seminars, Summer Institutes, Farmers' Day and other Meetings Organised

International Day of Yoga was celebrated at ICAR-IIOPR, Pedavegi on June 21, 2017. Yoga and meditation experts were invited to the Institute and sessions were organized for the benefit of staff members. All the staff members participated in the programme and practised meditation.

National Oil palm Seed meet was conducted on July 19, 2017 to assess the demand of oil palm germinated seeds from indigenous sources and preparation of supply schedule of germinated seeds during 2017-18 from various oil palm seed gardens.

Parthenium Awareness Programme was organized in the campus and the staff of ICAR-IIOPR actively participated in removal of parthenium weed to make the campus parthenium free on August 24, 2017.

Vigilance Awareness Week was celebrated during October 30 to November 4, 2017. Competitions were conducted to school and college students and prizes were distributed.

Constitution Day was celebrated at ICAR-IIOPR, Pedavegi on November 26, 2017. A staff meeting was organized and the Preamble of the Constitution was read on this occasion.

Agricultural Education Day was celebrated on December 4, 2017. Essay writing and quiz competitions were conducted to school students.

World soil day was celebrated on December 5, 2017 at ICAR-IIOPR, Pedavegi. Soil Health Cards (68 nos.) were distributed to oil palm growers of West

Godavari and Krishna Districts with advisory for oil palm nutrient management. Dr. B. N. Rao delivered talk on "Role of fertigation and irrigation management in oil palm", Dr. K.Manorama gave a talk on "Importance of soil health management" and Dr. K. Ramachandrudu delivered talk on "Inter crops in soil health management in oil palm gardens". Discussions were held on various aspects

of oil palm cultivation in which all the scientists of ICAR-IIOPR participated.

Workshop on Oil palm development programme was organized by Department of Horticulture, Government of Andhra Pradesh at ICAR-IIOPR, Pedavegi on December 13, 2017 under the chairmanship of Sri. Chiranjiv Choudhary, Commissioner of Horticulture, Govt. of Andhra Pradesh. Scientists from IIOPR participated in the workshop.

Review meeting of R & D projects under NMOOP was organized at ICAR-IIOPR, Pedavegi on January 19, 2018 under the chairmanship of Dr. S. K. Malhotra, Agricultural Commissioner, DAC&FW, New Delhi. Scientists from ICAR and State Agricultural Universities and Officers from DAC&FW and State Agri./Hort. Departments participated in the meeting.

Brainstorming session on Development of seed standards for oil palm seed gardens was organised at ICAR-IIOPR, Pedavegi on January 24, 2018. Dr. Vilas A. Tonapi, Director, IIMR, Hyderabad acted as facilitator of the session. He stressed the need of oil plam seed standards in view of seed certification. Dr. A. Vishnu Vardhan Reddy, Director,

ICAR-IIOR, Hyderabad; Dr. B. Gurudev Singh, Retd. Scientist G & Head IFGTB, Coimbatore; Dr. K. Keshavulu, Director, TSSCA, Hyderabad; Dr. P. K. Chandrasekhara Pillai, Scientist-in-Charge, KFRI, Peechi, Kerala are the other committee members present during the meeting. The draft for "Indian minimum seed certification standards" was presented and discussed. The committee also suggested few researchable issues for further strengthening of seed standards in oil palm.

Workshop on Enhancing farmers' income through resource use efficiency and technological interventions in oil palm was organized at ICAR-IIOPR, Pedavegi on February 19, 2018, on the occasion of foundation day of the Institute. Sri. Chiranjiv Choudhary, Commissioner of Horticulture, Govt. of Andhra Pradesh was the chief guest. Oil palm farmers, entrepreneurs, officres from State Dept. of Horticulture, scientists and staff of IIOPR participated in the workshop. Soil health cards were distributed to the farmers. Dr K Manorama delivered a talk on "New interventions in fertiliser and irrigation management" and Dr. K. Ramachandrudu delivered a talk on inter crops in oil palm and recycling of oil palm waste in oil palm gardens.

General Activities

Independence day

New Year celebrations

Republic day

Demonstration of Fertigation technology

Participation in exhibition

Skill development programme on Seed processing worker

16. Official Language Implementation Activities

At ICAR-IIOPR, Pedavegi, a good number of file notings were written in Hindi. Letters received in Hindi were replied in Hindi. Institute's name boards, routine formas, ID cards etc., are bilingual.

ICAR-IIOPR, Pedavegi received 2nd prize in Rajbasha (Hindi) implementation from Town Official Language Implementation Committee (TOLIC), West Godavari Dt., Andhra Pradesh. Award was received from general manager, BSNL, Eluru during June 2017.

Hindi Pakhwada was celebrated at ICAR-IIOPR, Pedavegi from September 14-28, 2017. Different competitions were conducted for the staff and students in Hindi language implementation and prizes were distributed.

Mr. Nasir Hussain, AAO attended seminar and Workshop conducted by Rajbasha Sansthan, New Delhi during November1-3, 2017. Further he received Karyalai Deep Smruthi Chihn award during the Programme.

At IIOPR, RC, Palode Hindi day was celebrated on September 27, 2017 by organising various competitions for high school students from three schools and also to the Institute staff.

17. Distinguished Visitors

The following dignitaries visited ICAR-IIOPR, Pedavegi during 2017-18:

July 21, 2017

- Dr. B.M.C. Reddy, Ex. Vice Chancellor, Dr. Y.S.R. Horticultural University, V.R.Gudem, Andhra Pradesh and Chairman, QRT
- Dr. S. Arulraj, Ex. Director, ICAR-IIOPR, Pedavegi, Andhra Pradesh and Member, QRT
- Dr. N. Subhash, Retd. Professor & Head, Tissue Culture laboratory, Anand Agricultural University, Anand, Gujarat and Member, QRT
- Dr. S. K. Sharma, Ex. Director, ICAR-CIAH, Bikaner, Rajasthan and Member, QRT
- Dr. A. S. Dhatt, National Advisor - Tata Agriculture Research & Development Trust, Ludhiana , Punjab and Member, QRT
- Dr. R. Vikraman Nair, Retd. Professor of Agronomy, Kerala Agricultural University, Thrissur, Kerala and Member, QRT

August 17, 2017

- Dr. W.S.Dhillon, Assistant Director General (HS-1), ICAR, New Delhi and Member, RAC
- Dr. S.R.Bhat, Emeritus Scientist, ICAR-NRC on Plant Biotechnology, New Delhi and Member, RAC

October 11, 2017

- Prof. Vijay Paul Sharma, Chairman, Commission for Agricultural Costs & Prices, New Delhi
- Dr. Shailja Sharma, Member Secretary, Commission for Agricultural Costs & Prices, New Delhi
- Dr. B. Rajender, Joint Secretary (Oilseeds), DAC & FW, New Delhi
- Dr. V. Praveen Rao, Vice Chancellor, Prof. Jayashankar Telangana State Agril. University, Hyderabad

December 13, 2017

- Sri. Chiranjiv Choudhary, Commissioner of Horticulture, Govt. of Andhra Pradesh

January 19, 2018

- Dr. S. K. Malhotra, Agriculture Commissioner, DAC & FW, New Delhi

January 23, 2018

- Dr. V. Damodara Naidu, Vice Chancellor, Acharya N.G.Ranga Agricultural University, Guntur

January 24, 2018

- Dr. Vilas. A. Tonapi, Director, ICAR-Indian Institute of Millets Research, Hyderabad
- Dr. A. Vishnu Vardhan Reddy, Director, ICAR-Indian Institute of Oilseeds Research, Hyderabad
- Dr. B. Gurudev Singh, Retd. Scientist G, Head (Genetics & Tree Breeding), Institute for Forest Genetics and Tree Breeding, Coimbatore
- Dr. K. Keshavulu, Director, Telangana State Seed Certification Agency, Hyderabad
- Dr. P. K. Chandrasekhara Pillai, Scientist-in-Charge, Kerala Forest Seed Centre, Kerala Forest Research Institute, Peechi, Kerala

Palode

- Justice M.R. Hariharan Nair, Former Judge, High Court of Kerala & Chairman, University Ethics Committee, Kerala University of Health Sciences, Thrissur on May 09, 2017.
- The QRT Chairman Dr.B.M.C. Reddy and members Dr.S.Arulraj, Dr.N.Subhash, Dr.S.K.Sharma, Dr.A.S.Dhatt and Dr.R.Vikraman Nair visited the experimental plots and laboratories at IIOPR, RC, Palode on August 21, 2017 and Interacted with scientists and staff.
- Dr. A.G. Pandurangan, Director, JNTBGRI, Palode visited on March 08, 2018 and inaugurated ASCI Sponsored Skill Development Programme on "Seed Processing Worker".
- Dr. D. Sajit Babu IAS, CEO, Additional Skill Acquisition Programme (ASAP), Govt. of Kerala visited on March 31, 2018 and was the Chief Guest for valedictory function of ASCI Sponsored Skill Development Programme on "Seed Processing Worker".
- Dr. S. Babu, Director, IAH&VB, Palode visited on March 31, 2018 2018 and was the Guest of Honour for valedictory function of ASCI Sponsored Skill Development Programme on "Seed Processing Worker".

18. Personnel

RMP

Dr. R. K. Mathur, Director

STAFF POSITION AT HEAD QUARTERS, PEDAVEGI

Scientific Staff

Dr. P. Kalidas	Principal Scientist (Agril. Entomology)
Dr. M. V. Prasad	Principal Scientist (Agril. Extension)
Dr. B. Narsimha Rao	Principal Scientist (Horticulture)
Dr. K. Suresh	Principal Scientist (Plant Physiology)
Dr. K. Manorama	Principal Scientist (Agronomy)
Dr. K. Ramachandrudu	Principal Scientist (Horticulture)
Dr. P. Naveen Kumar	Principal Scientist (Horticulture) transferred to ICAR-DFR, Pune on 31-05-2017
Dr. G. Ravichandran	Principal Scientist (Seed Technology)
Dr. K. L. Mary Rani	Principal Scientist (Computer Applications)
Dr. Sanjib Kumar Behera	Senior Scientist (Soil Science) transferred to ICAR-IISS, Bhopal on 24-06-2017
Dr. L. Saravanan	Scientist (Agril. Entomology) transferred to ICAR-SBI, Coimbatore on 31-05-2017
Dr. B. Kalyana Babu	Senior Scientist (Agril. Biotechnology)
Dr. K. Praveena Deepthi	Scientist (Plant Pathology)
Dr. P. Anitha	Scientist (Plant Breeding) joined on 03-07-2017 from ICAR-NBPGR, New Delhi
Dr. Preethi.P	Scientist (Fruit science) transferred to ICAR-DCR, Puttur on 31-05-2017
Ms. Bhagya H.P.	Scientist (Plantation, Spices, Medicinal & Aromatic Plants)

Administrative Staff

Mr. P. Gowri Shankar	Asst. Admn. Officer
Mr. Nasir Hussain	Asst. Admn. Officer (relieved on 28-02-2018)
Mr. T. V. Rama Krishna	PS to Director
Mr. Asif Mohammed	Asst. Finance & Accounts Officer
Mr. P. Sai Kishore	Personal Assistant
Mr. S. Sivarama Krishna	Personal Assistant (relieved on 28-02-2018)
Mr. Y.J.E. Samuel	Upper Division Clerk (passed away on 11-02-2018)
Mr. G.S.N. Babu	Lower Division Clerk

Technical Staff

Mrs. A. Bhanusri	Senior Technical Officer
Mr. N. V. Ganesh	Senior Technical Officer
Mr. J. Mohan Rao	Technical Officer (retired on superannuation on 31-05-2017
Mr. M. Ananda Rao	Technical Officer
Mr. P. R. L. Rao	Senior Technical Assistant (Driver)
Mr. E. Perayya	Senior Technical Assistant (Driver)
Mr. V. V. S. Krishna Murthy	Senior Technical Assistant (Library)
Mr. Ch. Subba Raju	Senior Technical Assistant (Driver)
Mr. A. Papa Rao	Senior Technical Assistant (Tractor Driver)
Mr. M. Rambabu	Technical Assistant
Mr. K. Ananda Rao	Senior Technician

Skilled Support Staff

Mr. G. Raju	SSS
Mr. G. Venkateswara Rao	SSS
Mr. A. Dhana Raju	SSS
Mr. U. Rama Rao	SSS
Mr. A. Ganga Raju	SSS
Mrs. Y. Chaitanya	SSS
Mrs. N. V. V. S. Lakshmi	SSS
Mr. K. Satyanarayana	SSS
Mr. Ch. Venkata Durga Rao	SSS
Mr. M. Appa Rao	SSS
Mr. B. Gopalakrishna	SSS

STAFF POSITION AT RESEARCH CENTRE, PALODE

Scientific Staff

Dr. K. Sunil Kumar	Senior Scientist (Horticulture) & SIC
Dr. P. Murugesan	Principal Scientist (Horticulture) transferred to ICAR-CTCRI, Trivandrum on 30-06-2017
Dr. G. Somasundaram	Scientist (Seed Technology) joined on 12-07-2017 from ICAR-IISS, Mau
Mrs. S. N. Rahana	Scientist (Plant Breeding) on study leave

Administrative Staff

Mr. K. Ravindran	Assistant

Technical Staff

Mr. A.S. Sabu	Chief Technical Officer
Mr. V. Sunilduth	Senior Technical Assistant

Mr. B. Muralidharan Pillai	Senior Technician
Mr. P. Anil Kumar	Senior Technician

Skilled Support Staff

Mr. P. K. Rethnakaran	SSS
Mr. S. Sudhakaran Nair	SSS (retired on superannuation on 31-10-2017)
Mrs. P. Rema	SSS
Mr. C. Ravi	SSS

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