RESEARCH HIGHLIGHTS 2020

Directorate of Research
Status of Research Activities & Achievements
(2019-2020)

Dr. K.S. Subramanian
Director of Research
TNAU, Coimbatore

The Tamil Nadu Agricultural University, Coimbatore, is a symbol of excellence in education, research and extension. The university is known for its innovation, advancement in research and development activities besides new initiatives to transform agriculture from conventional to precision farming. The TNAU's stand in the global arena is based on newer technologies such as nanotechnology, biotechnology, bioinformatics, geo-informatics, improved package of practices, natural resource management, drip-fertigation system, management of invasive pests and diseases and ICT in extension. In horticulture, improved varieties, high density planting, grafting techniques and production of quality planting materials are the emerging areas of interest. Agricultural engineers are developing prototypes and design & fabrication of machines to suit Indian agriculture to achieve total mechanization in farming to overcome acute labour shortage. The Faculty of Community Science has brought out a wide array of innovative value added products such as rice analogue, millet drink, beverages and heath drinks besides immune boosters against COVID 19. The Faculty of Forestry has a wide spectrum of activities such as conservation of genetic resources, agro-forestry, silviculture, forestry products, multi-functional agro-forestry models and biodiversity of wild animals etc.

The Scientific Workers Conference (SWC) is Chaired by the Agricultural Production Commissioner & Principal Secretary to Govt. of Tamil Nadu and the Vice Chancellor of Tamil Nadu Agricultural University, Coimbatore, and the Director of Research will serve as the Member Secretary. The SWC is organized once in year wherein varieties and technologies developed by the University are presented to the State Department, HODs, JDAs, and other officials to forward them for adoption. The SWC is conducted once in a year which succeeds Annual Crop Scientists Meets of the university.

Research Priorities

The TNAU sets the research priorities to derive solution to unresolved field problems with respect to the State of Tamil Nadu besides addressing global challenges

- Evolve high yielding varieties / hybrids to tackle abiotic and biotic stress conditions through classic and molecular breeding approaches
- Develop climate resilient agricultural practices to sustain the agricultural

productivity

- Manage invasive pests and diseases through technology capsule
- Design and fabrication of customized miniaturized machines to achieve complete mechanization to overcome labour shortage
- Infuse innovative technological options such as nano-biotechnology, sensors, artificial intelligence, drones and robotics in agriculture to promote smart farming

Research Agenda

- Once in five years based on the holistic dissection of the outcome from Research Council Meeting, Annual Crop Scientists' Meet and Scientific Workers' Conference.

- These three events have bidirectional flow of information for shaping up the Research agenda, setting up the time line and technical program for rolling out the fine tuned technologies to the State Department officials for its widespread adoption by the farmers. The details of research agenda for period of 2014-2018 and 2019-2023 are furnished in the website.

Research Council (RC)

- Policy making body on Research in the Faculties and Research Stations of the University. It consists of the officials as members besides Vice Chancellor as the Chairman and Director of Research as the Member Secretary.

- It advises research policy, taking a leadership role to create an enabling environment and value the scholarly activities. The annual meeting of RC is conducted during February-March of every year to finalize the new research agenda, mid-term corrections, if any, of current agenda and evaluate the progress of ongoing research.

Annual Crop Scientists Meets (CSMs)

- The CSMs are conducted during April/May to review the annual progress of research work done by each of the scientist based on pre-review conducted by the respective Technical Directors during November - December which coincides with half yearly completion of the research projects.
- There are 13 CSMs encompassing Rice, Millets, Pulses, Oilseeds, Cotton, Sugarcane, Horticulture, Forestry, Sericulture, Agricultural Engineering, Social Research, Non-crop specific projects, Community Sciences and Production Oriented Projects.

- The meets include presentation by the Director of Research, action taken reports by lead centers, proposed action plan by the Technical Directors. This process scouts for the varieties, technologies and farm implements for adoption, on-farm testing and information. Due to COVID pandemic lockdown, CSMs were conducted on-line mode in 2020 and proceedings were sent to the concerned for further action.

Crop Scientists Meet 2020 – Programme schedule

S. No.	Name of the meet	Office in-charge & Name of the Lead centre	Review Date of Vice-Chancellor
1.	39th Rice Scientists Meet	Director, TRRI, Aduthurai	20.05.2020 (Wednesday; 9:30 AM- 1.00 PM)
2.	38th Millets & Forages Scientists Meet	P&H, Dept. of Millets, P&H, Forages, CBE	21.05.2020 (Thursday; 9:30 AM- 1.00 PM)
3.	38th Pulses Scientists Meet	P&H, NPRC, Vamban	22.05.2020 (Friday; 9:30 AM- 1.00 PM)
4.	56th Oilseeds Scientists Meet	P&H, RRS, Vridhachalam	23.05.2020 (Tuesday; 9:30 AM- 1.00 PM)
5.	36th Horticultural crops Scientists Meet	Dean, Hort., CBE	26.05.2020 (Tuesday; 9:30 AM- 1.00 PM 2.30 PM – 4.30 PM)
6.	38th Cotton & Other fibre crops Scientists Meet	P&H, Dept of Cotton, CBE	27.05.2020 (Wednesday; 9:30 - 11.30 PM)
6.	28th Sugarcane Scientists Meet	P&H, SRS, Cuddalore	27.05.2020 (Wednesday; 11:30 - 1.00 PM)
7.	8th Agrl. Engineering Scientists Meet	Dean, Engg. CBE	01.06.2020 (Monday; 9:30 AM- 1.00 PM)
8.	7th Scientist Meet on Community Science	Dean, CSC&RI, Madurai	01.06.2020 (Monday; 2.30 PM–5.30 PM)
9.	8th Scientists Meet on Non crop specific projects. (Projects not covered under Crop specific Meets)*	Technical Director/ Dean for the disciplines under their control	02.06.2020 (Tuesday; 9:30 AM- 1.00 PM)
10.	30th Forestry and 11th Sericulture Scientists Meet	Dean, FC&RI, MTP	02.06.2020 (Tuesday; 2:30 AM- 5.30 PM)
11.	8th Social Sciences Scientists Meet	Director, CARDS,CBE	10.06.2020 (Wednesday; 9:30 AM- 1.00 PM)
13.	3rd Scientists Meet on Production oriented projects (All VCS & RF and other Prodn. oriented projects)	Director, ABD	10.06.2020 (Wednesday; 2:30 PM- 5.00 PM)

Scientific Workers Conference (SWC)

- The SWC is conducted to evolve policy decisions on the introduction of varieties and technologies. The SWC is convened under the Chairmanship of the Vice Chancellor and the Agricultural Production Commissioner & Principal Secretary to the Government of Tamil Nadu.

- The Director of Research organizes the event involving Director of Agriculture, Director of Horticulture & Plantation Crops, Commissioner of Agricultural Marketing & Agri-Business, Commissioner of Sugars, Director of Seed Certification, Director of Sericulture, Chief Conservator of Forest and Chief Engineer. The action taken report is presented by the Director of Research and the field problems are discussed with Department officials and Technical Directors.

- Since 2019, the SWC is conducted with a focus on field problems raised by Department officials and addressed by the scientists of TNAU. The interim review meetings are scheduled in every quarter to ensure follow up action taken on the suggestions made. .

84th SWC and Follow Up Meets

S. No.	Name of the Event	Location	Date Conducted
1	84th SWC – 2019	TNAU, Coimbatore	19.08.2019
2	84th SWC – 2019 Ist Interim Action Taken Review Meeting	Conference Hall, Secretariat, Chennai	26.11.2019
3	84th SWC – 2019 IInd Interim Action Taken Review Meeting	Conference Hall, Secretariat, Chennai	11.03.2020
4	84th SWC – 2019 Follow up Review Meeting (online)	TNAU, Coimbatore	25.06.2020

University Variety and Technology Release Screening Committee (UVTRSC)

- The outcome from a project (a culture / technology / farm implement) recommended during CSMs and SWC is rigorously scrutinized by the UVTRSC as per the guidelines stipulated under the Chairmanship of Vice Chancellor and the Director of Research as the Member Secretary. The UVTRSC scheduled meet during the last week of every calendar year. The University Variety and Technology Release Committee (UVTRSC) meeting was conducted on 23.01.2019 under the Chairmanship of Dr. N. Kumar, Vice Chancellor, TNAU, Coimbatore to scrutinize the proposals received from TNAU scientists. A total of 42 proposals (19 under crop varieties, 19 under technologies and 4 under implements) were received by the Directorate of Research. The outcome of the Crop Scientists' Meets and Scientific Workers' Conference were duly considered for the evaluation of the proposals. A total of 13 varieties, one implement & 19 technologies have been approved by the UVTRSC.

State Variety Release Committee (SVRC)

- The varieties recommended by the UVTRSC is presented to SVRC chaired by the Agricultural Production Commissioner and Principal Secretary, Government of Tamil Nadu and SVRC approved cultures are released as varieties during the first week of January every year as a "Pongal Gift" to farmers of Tamil Nadu.

List of Varieties Released during 2019-2020

S.No.	2019	2020
1.	Rice VGD 1	Rice CO 53
2.	Rice ADT 53	Rice ADT 54
3.	Little millet ATL 1	Sugarcane COC 13339
4.	Greengram VBN 4	Cotton CO 17
5.	Groundnut BSR 2	Blackgram VBN 11
6.	Castor YTP 1	Sorghum CO 32
7.	Kadam MTP1	Tenai ATL 1
8.	Bottlegourd PLR 2	Banana CO.2
9.	Kufri Sahyadri	Tomato Hybrid CO 4
10.	Garlic Ooty 2	Onion Variety CO 6
11.	Kaveri Saba	Yethapur 2 (YTP 2)
12.	Kaveri Kalki (Namwa Khom)	PKM (MT) - 02
13.	Kaveri Sugantham	CO.1 Manathakkaali

List of Implement Released

S.No.	2019	2020
1.	-	Turmeric Value Chain Machinery

Crop Production Guide (CPG)

The varieties and technologies that are recommended for adoption are incorporated in to the **Crop Production Guide (Agriculture & Horticulture)** and released as technology package as a policy document to the Department of Agriculture, Government of Tamil Nadu. The updated CPGs were released on 9th January 2020 at the Secretariat, Chennai and it is decided to revise periodically in line with progressive development.

Research Programs

University Research Projects (URPs)

The URPs are proposed by the scientists to meet the requirement of the regional researchable issues generated from the CSM, SWC, RC or specific problem felt by the university / government to be addressed immediately. It is mandatory that each scientist should have at least one URP to meet the requirement of local needs. The proposed URPs are screened by the RPAC (Research Project Approval Committee) constituted by the Technical Directors and the final approval by the Director of Research. In order to meet the challenging field problems in the State of Tamil Nadu, the Agricultural Production Commissioner has sanctioned **Rs. 5.0 Crores** as a special grants to support **191 core projects** that are being implemented in TNAU during 2018-2020. This helped us to develop medicinal rice, identify microbes to enhance host plant drought tolerance, seed encapsulation of nano-fibres for input delivery, development of technology capsule for fall army worm, artificial intelligence to monitor pests, biofortification of rice and millets etc.

University Research Projects (On-going)

Sl. No.	Directorate	URP (as on 17.07.2020)
1	CPBG	206
2	CPMB	19
3	CPPS	198
4	DCM	103
5	NRM	151
6	Seed	59
7	WTC	6
8	Agrl. Engg.	36
9	CARDS	85
10	HC&RI	169
11	CSC&RI	16
12	FC&RI	12
	Total	**1060**

Core Projects for research activities at Colleges and Research Stations of TNAU - 2019

Sl. No.	Directorate	Phase I		Phase II		Phase III	Phase IV	
		No. of Projects	Amount in Rs.	No. of Projects	Amount in Rs.	Amount in Rs.	No. of Projects	Amount in Rs.
1.	AEC&RI	10	16,00,000	4	8,20,000	12 Post Doctoral Fellows	5	9,50,000
2.	CARDS	-	-	6	26,00,000		7	14,75,000
3.	CPBG	7	17,50,000	4	10,00,000		10	18,00,000
4.	CPMB	6	18,00,000	3	3,00,000		2	3,50,000
5.	CPPS	7	18,20,000	10	15,30,000		9	19,25,000
6.	CSC&RI	-	-	2	3,00,000		-	-
7.	DCM	6	15,70,000	10	21,00,000		10	11,85,000
8.	FC&RI	4	4,00,000	4	6,00,000		1	2,00,000
9.	HC&RI	8	21,00,000	13	18,75,000		7	16,75,000
10.	NRM	5	17,00,000	6	19,00,000		5	15,00,000
11.	Seed Centre	2	3,00,000	3	4,25,000		2	4,50,000
	Total	**55**	**1,30,40,000 (130.40 lakhs)**	**65**	**1,34,50,000 (134.50 lakhs)**	**1,20,00,000 (120.00 lakhs)**	**58**	**1,15,10,000 (115.10 lakhs)**

Grand total – 500.00 lakhs

All India Coordinated Research Projects (AICRPs)

The TNAU has the highest number of **62 AICRPs** among the SAUs with an annual budget outlay of **Rs. 65 Crores** supporting 192 scientists and 254 supporting staff. The AICRP Centers include Plant Breeding & Genetics (23), Crop Management (4), Natural Resource Management (5), Water Technology Center (1), Centre for Plant Protection Studies (6), Horticulture (14), Seed Center (2), Agricultural Engineering (4), Forestry (2), Community Science (1). During the year 2019, TNAU has received **5 Best Performing Centers Awards** for Millets, Sorghum, Forages, Vegetables and Bees. This is a network research programs giving opportunity for the TNAU researchers to portrait their technologies at the national level. The Director of Research and Technical Directors closely monitors the activities and achievements of each Center while they go for the Annual Group Meets scheduled every year.

All India Coordinated Research Projects

No.	Directorate	Centres	Technical	Non-Technical
1	CPBG	22	77	71
2	Horticulture	15	38	55
3	DNRM	5	12	13
4	Crop Management	4	15	28
5	Seeds	2	5	9
6	Agrl. Engineering	4	22	52
7	CPPS	8	10	9
8	WTC	1	5	13
9	Community Science	1	5	0
10	Forestry	2	3	4
	TOTAL	**62**	**192**	**254**

Externally Funded Schemes

The TNAU scientists receive bountiful of **competitive research grants** from the national external funding agencies such as ICAR, BRNS, DBT, DST, MoEF, MoES, DRDO, DST Nano Mission and BIRAC. The projects are presented to the Technical Directors and the Director of Research prior to submission to the funding agencies. In order to promote grantsmanships, workshops are conducted on a regular basis to assist young scientists to get equipped to get competitive research grants. During 2019-20, five **Grantsmanship Workshops** were conducted to benefit **181 scientists** of TNAU. Indeed, this helped our scientists to get motivated to propose fundable projects. The number of Externally Funded Projects obtained in 2019-20 was **86** with a budget outlay of **Rs. 48.91 Crores**. Scientists who received external funded projects were given with merit certificate besides shield and medals for those who get more than **a Crore** research grants and more than **Rs. 10 lakhs** will receive a recognition certificate.

Grantsmanship Workshop – Externally Funded Projects

S. No.	Workshop	Date of Conduct	No. of Participants	Projects Prepared	Short-listed / Sanctioned
1	Coimbatore	19.03.19 – 21.03.19	28	28	14
2	Coimbatore	29.03.19 – 30.03.19	27	27	12
3	Coimbatore (CPPS)	10.06.19 – 12.06.19	34	34	6
4	Coimbatore, MDU	11.11.19 – 13.11.19	41	41	11
5	AC&RI, KKM	02.01.20 – 04.01.20	51	51	15
6	ADAC & RI, HC & RI (W),TRY AEC & RI, KUM IOA, KUM	9.08.2020 to 11.08.2020	60	60	In Progress
TOTAL			**241**	**241**	**58**

Externally Funded Projects obtained with Budget outlay (ASO's given)

S.No.	Year	Nos.	Budget (Rs. In Cr.)
1	2018 – 2019	124	31.96
2	2019 – 2020	86	48.91

Externally Funded Projects - Proposed

S.No.	Year	Nos.
1	2018	57
2	2019	180
3	2020 (upto June 2020)	28
TOTAL		**265**

Research Support from Foreign Sources

The TNAU scientists collaborate with researchers across the globe in foreign Universities and CGIAR centers such as IRRI, ICRISAT and IFPRI, Global Affairs Canada (GAC), International Development Research Center (IDRC), Canada for research support. These projects require MoU between TNAU and respective funding institutes. For entering into MoU/ MoA/Letter of Agreement (LoA), proposal initiated by the individual scientist will be scrutinized at the respective Technical Directorates and then at the Directorate of Research and vetted by the Law section and Trade and Intellectual Property Section before getting approved. Such approved binding documents are signed by the Registrar, TNAU on behalf of the University. The other source of funding is from **philanthropic agencies** such as Ford, Bill and Melinda Gates and Rockefeller Foundations. The Rockefeller Foundation's International Rice Biotechnology Programs made a marvelous impact in transforming TNAU research agenda in rice research.

Foreign Research Collaborations Made (2019-2020)

S.No.	Name of the Scientists & Country	Meeting Date with the Foreign Scientist
1	Dr. Daniel Atlin, University of Guelph, Canada	07.02.2019
2	Dr. Tri D Setiyono, IRRI, Philippines	07.03.2019
3	Dr. Reynalds Lemke	28.01.2020
4	Ms. Dana Kursh, Israel	29.01.2020

Product Testing

Private companies approach TNAU for testing their new products / molecules for their efficacy and field performance. The products include pesticides, fertilizer formulations, growth regulators, varieties and hybrids and are tested on cost basis. Some of these companies are approaching TNAU for specific reasons such as registration of their products. Since, these projects are mere evaluation, the TNAU insisted that there should be a basic research component in order to gain insights while providing field data to the companies.

Bio Efficacy Projects (Directorate wise) 2019-2020

S. No.	Directorate	Number of Projects
1	CPBG	-
2	Horticulture	1
3	DNRM	3
4	Crop Management	8
5	Seeds	1
6	Agrl. Engineering	-
7	CPPS	20
8	WTC	-
9	Community Science	-
10	Forestry	-
	TOTAL	**33**

Total Budget Rs.3.95 Crores

Extension Projects Funded by Government

There are number of research projects being supported under NADP (National Agricultural Demonstration Project) by GOI, TN-IAMP (TN-Irrigated Agriculture Modernization Project) by the World Bank and National Seed Production programs. The main purpose of these projects is to reach the farmers with the latest technologies and to promote rural livelihood.

State Plan Schemes

More than **78%** of the State budget to the university goes for the salary and hardly funds are available to meet the research expenditure. Considering the special needs and emerging invasive pests and diseases, State Government began to fund project under varous programs such as TANII (Tamil Nadu Innovative Initiatives), State Balanced Growth Fund, Tamil Nadu State Land Use Research Board (TNSLURB) and Special Area Development Program (SADP) etc.

Funding Agencies	On-Going R&D schemes	Expenditure (Rs. Lakhs)		
		2016-17	2017-18	2018-19
State Grant	**Non plan**	35099.19	36672.96	42355.84
	Plan	8386.86	7595.32	13870.12
	Sub-total	**43486.05**	**44268.28**	**56225.96**
ICAR	**Partly**	3798.42	3921.06	3677.63
	Fully	2722.64	2378.34	2639.99
	Dev. Grant	2.86	639.16	535.23
	Sub-total	6523.92	6938.56	6852.85
GOI		1617.87	1805.79	1691.07
NADP		3064	2060.34	472.23
Others		1122.78	910.86	971.92
Total		**55814.62**	**55983.83**	**66214.03**

I. AGRICULTURE
A. CROP IMPROVEMENT

Dr. S. Geetha
Director, Centre for Plant Breeding and Genetics
TNAU, Coimbatore

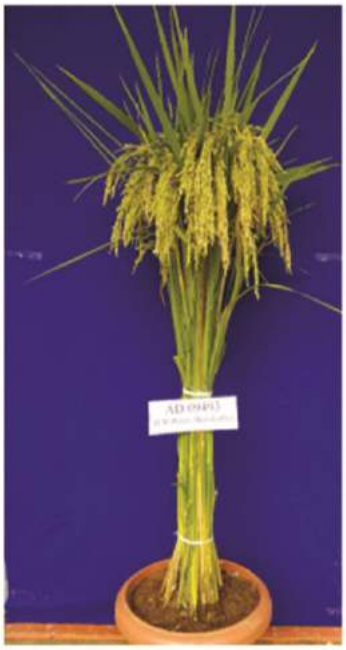
I. Rice

I. 1. For Adoption (Varieties approved by SVRC - 2020)

I. 1. (a) ADT 54 (AD 09493)

Parentage	:	I. W. Ponni / Bansakthi
Duration	:	130 – 135 days
Season	:	Late Samba / Thaladi
Average yield	:	6307 kg / ha
Yield increase over check	:	8.28% (Check: ADT 49) 11.21% (Check: BPT 5204)
Special features	:	• High yielding, Medium tall erect variety • Medium slender rice with high milling outturn (72.3%) and Head Rice Recovery (63.1%). • Cooked rice is white with intermediate amylase and soft GC • Resistant to blast, leaf folder and to stem borer

Grain, Parboiled and Cooked Rice



Single Plant

I. 1. (b). CO 53 (CB 06803)

Parentage	:	PMK (R) 3 /Norungan
Duration	:	115-120 days
Average yield	:	3784kg/ ha under rainfed condition
Yield increase over check	:	Dry condition – 12.19% (Check: TKM (R) 12) and 14.08% (Check: Anna 4) Semi dry condition – 18.40 % (Check: TKM (R) 12) and 8.67% (Check: Anna 4)
Special features	:	• Drought tolerance • Moderately resistant to Multiple diseases • White short bold rice with high milling(70%), HRR(60%)

I. 2. i. Cultures Recommended for the conduct of OFT during 2020-21

To critically evaluate two pre release short duration cultures *viz*., CB 12558, and AD 09219 with earliness and quality traits, it is planned to raise these two cultures in larger area along with TNAU check varieties *viz*., ADT 53 and CO 51 and market variety RNR 15048 at Aduthurai, Coimbatore, Ambasamudram and Tirur stations. Based on the competitive performance and unique traits and with overall consensus, the best culture in terms of yield, quality and other features will be proposed**.**

I. 2. i. Cultures Recommended for the conduct of OFT during 2020-21

Short Duration	
Super fine	**Test entries**: CB 15569, AD 16052. Check : ADT 53 **Districts**: Thiruvallur, Erode. Trichy, Villupuram, Salem, Thanjavur, Thiruvarur, Kancheepuram and Cuddakur **Season:** Kuruvai
Rainfed Early	**Test entry**: TM 12077 **Semi dry condition:** 3.8 and 16.6 % over check Anna (R) 4 & IR 64 **Dry condition:** 31.9 and 24.1 % over check Anna (R) 4 and IR 64 **Districts**: Sivagangai, Ramanathapuram and Thiruvallur
Transplanted - Mid Early	**Test entry** :AD 12132 -19.4 % increase over yield (Check : ADT 39) **Test entry** :TP 08053 - 16.3 % increase over yield (Check : ADT 39)
Hybrid Rice- Mid Early	**Test entry** :TNTRH 55 - 15.3% increase over yield (Check : ADT 39)
Medium Duration	
Transplanted	**Test entry** : CB12132 - 15.2% higher yield over BPT 5204 and 10.5 % over ADT 49.

Hybrid Rice- Mid Early - TNTRH 55

I. 3. Cultures Recommended for Adaptive Research Trials (2020-21)

Parentage and checks	Yield and Duration	Special attributes	Location
Rice 4/2020-21: Transplanted (Oct 25 – Nov 10, 110 to 125 days)			
AS 15024* (ASD 16 /Manjalsaradai) Check: TPS 5 & TKM 13	6306 kg/ha in 119 days 14.95 per cent higher yield than CO 51 and 5.50 per cent higher than TPS 5	Medium bold MR to Leaf Folder and Stemborer	All districts except Virudhunagar, Ramnad, Sivagangai, and The Nilgiris

II. Millets

II. 1. For Adoption (Varieties approved by SVRC - 2020)

II. 1. i. Sorghum

II. 1. i. (a) CO 32 (TNS 648)

Parentage	:	Hybrid derivative of the cross APK 1 x M35-1
Duration	:	105 – 110 days
Season	:	Adi pattam (Jun-Jul) Purattasi pattam (Sep – Oct)
Average yield	:	Grain yield - Irrigated 2910 Kg/ha, Rainfed 2445 kg/ha Dry fodder yield Irrigated 11,710 Kg/ha, Rainfed 6490 kg/ha
Percentage increase over check	:	**Rainfed:** Grain – 10.3% (Check: CO 30) 9.17% (Check: K 12) Dry fodder -10% (Check: CO 30)13 % (Check:K12) **Irrigated:** Grain – 12% (Check: CO 30) 11.32 % (Check: K12) Dry fodder -10% (Check: CO 30)14 % (Check:K12)
Special features	:	• Dual purpose variety. • Yellow white grains. • Stover quality is with 6.15% protein and IVDMD of 54 – 58%. • Moderately resistant to shoot fly and stem borer, downy mildew and grain mould

Field view of Sorghum CO 32

II. 1. ii. Tenai

II. 1. ii. (a) ATL 1 (TNSi 331)

Parentage	:	Hybrid derivative of PS 4 x Ise 198
Duration	:	80-85 days
Season	:	Adi pattam (Jun-Aug) Purattasi pattam (Sep – Oct) Masi pattam (Feb- Mar)
Average yield	:	Rainfed – 2117 kg/ha
Percentage increase over check (CO Te 7)	:	10% (Grain) 15% (Straw)
Special features	:	• Drought tolerant. • Non lodging and uniform maturity. • Suitable for mechanical harvesting • Palatable and nutritious straw • Field Tolerant to shoot fly incidence, blast and rust

Field view

Panicle at flowering

Panicle at maturity

II. 2. Cultures identified for variety release (2020-2021)

II. 2. i. Ragi

Culture	Pedigree	Duration (days)	Seed yield (kg/ha)	Yield increase over check CO 15 (%)	Special features
TNEc 1285	TNAU 900 x CO (Ra) 14	110	2256	12.5	Large panicle Bold seeds

II. 2. ii. Varagu

Culture	Pedigree	Duration (days)	Seed yield (kg/ha)	Yield increase over check		Special features
				CO 3	TNAU 86	
TN*Psc* 176	Selection from DPS 63	110	2956	21.8%	16.9%	Short duration, Non lodging Moderately resistant to shootfly and grain smut

III. 3. On Farm Trials

III. 3. i. Sorghum

S.No.	Crop / Culture	Parentage	Duration (days)	Grain yield Kg/ha)	Special attributes
1.	TKSV 1036 (R)	ICSB 518x SPV 1489	100	2102	• Dual purpose • Suited to rainfed conditions
Checks : CO 32 and K 12					
Season: Rainfed - Kharif' **Districts:** Salem, Tiruppur and Erode					

III. 3. ii. Pearl Millet: OFT

S.No.	Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Special attributes
1.	TNBH 1619	ICMA 10444 A x PT 6679	90	3564	High grain yield, Bold, Compact and DM resistance
Checks: CO 9 hybrid and private hybrid					
Season: *Kharif*	June-July	**Districts:** Villupuram, Vellore, Tiruvannamalai, Cuddalore, Dharmapuri, Salem, Namakkal, Erode, Coimbatore, Tiruchirapalli, Perambalur, Karur, Pudukkottai, Madurai			
Rabi	Sept-Oct	Theni, Dindigul, Virudhunagar, Sivagangai, Thoothukudi and Tirunelveli			

III. 3. iii. (a) Maize (Irrigated): OFT

S. No.	Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Special attributes
1.	CMH 12-686	UMI N09153-1-2 x N148	100-110	10269	High yielding Orange kernels MR to charcoal rot (3.6)
	Checks: CO 6, COH(M) 8 and NK 6240				
Season: *Kharif*	June – July/ Jan-Feb	**Districts:** Coimbatore, Tiruppur, Salem, Namakkal, Erode, Perambalur, Madurai, Theni, Dharmapuri, Krishnagiri, Karur, Cuddalore, Villupuram			

III. 3. iii. (b) Maize (Rainfed): OFT

S.No.	Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Special attributes
1.	CMH 15-005	UMI 1220 x UMI 1210	105	5276	High yielding, drought tolerant suited for rainfed situations
2.	VaMH 12013	UMI 1200 x VIM 419	100	5009	Suitable for rainfed condition, Orange yellow dent kernels, Moderately resistant to TLB (3.0)
	Checks: CO 6, NK 6240				
Rabi - Rainfed (25)		September – October			Dindigul, Madurai, Thoothukudi, Virudhunagar, Thirunelvelli

II. 4. Adaptive research trials

II. 4. i. Sorghum (Rainfed)

Crop / Culture	Parentage	Duration (days)	Grain yield Kg/ha)	Yield increase over check CO 30	Special attributes
TNS 661	TNS 603 x IS 18551	100	3016	11%	Pearly white grain, Moderately resistant to shoot fly

Season	***Kharif* (Jun-Jul)**	***Rabi* (Sep-Oct)**	***Summer* (Feb- March)**
Districts	20 districts, 52 locations Villupuram(2), Vellore (4) Tiruvallur(2), Thiruvannamalai (4), Cuddalore(2), Dharmapuri(2), Krishnagiri(2), Salem (2) Namakkal (2), Coimbatore(4) Tirupur (4), Erode (2), Trichy(2), Perambalur(2), Pudukkottai,(2) Madurai(2), Theni(2), Dindigul(2), Virudhunagar (4)	7 districts, 28 locations Madurai, Dindigul, Virudhunagar, Ramnad, Sivagangai , Thoothukudi and Thirunelveli	14 districts, 52 locations Dharmapuri, Krishnagiri, Salem Namakkal, Coimbatore Tirupur , Trichy, Perambalur, Karur, Pudukkottai, Madurai, Theni, Dindigul, Virudhunagar

KVK	8 KVKs, 16 trials, 2 trials/KVK Pudukottai, Perambalur, Cuddalore, Trichy, Vellore, Villupuram, Salem, Madurai	8 KVKs, 16 trials, 2 trials/KVK Pudukottai, Cuddalore, Virudunagar, Trichy, Vellore, Aruppukottai, Villupuram, Madurai	9 KVKs, 18 trials, 2 trials/KVK Pudukottai, Cuddalore, , Trichy, Vellore, Thiruvallur, Villupuram, Salem, Madurai, Dharmapuri,

II. 4 . ii. Tenai

Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Yield increase over check		Special attributes
				CO 7	ATL 1	
TN*Si* 337	CO 6 x ISe 19	90	1765	18.3%	14.2%	High tillering Absence of tip sterility Field tolerance for blast
Districts	Villupuram, Vellore, Cuddalore, Dharmapuri, Salem, Namakkal, Madurai, Virudhunagar, Thoothukudi, Thirunelveli (Each district 5 locations) (10 districts, 50 locations)					

II. 4. iii. Panivaragu

Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Yield increase over check CO (PV) 5	Special attributes
TN*Pm* 247	PV1403 x PV 1673	70-75	1365	5.15%	Long panicles Bold seeds
Districts	Villupuram, Vellore, Thiruvanamalai, Salem, Namakkal, Madurai, Theni, Virudhunagar, Thoothukudi, Tirunelveli (Each district 5 locations)(10 districts, 50 locations)				

III. Pulses

III. 1. For Adoption(Varieties approved by SVRC – 2020)

III. 1. i. Blackgram

III. 1. i. (a) VBN 11 (VBG 12 - 062)

Parentage : PU 31 X CO 6

Duration : 70-75 days

Season	:	Adi pattam (Jun-Jul) Purattasi pattam (Sep – Oct) Markazhi / Thai pattam (Dec - Jan) Chithirai pattam (Apr - may)
Average yield	:	Rainfed – 865 kg/ha; Irrigated – 940 kg/ha
Yield increase over check	:	Rainfed - 11.4% (VBN 6) and 11.6% (VBN 8) Irrigated - 18.7 % (VBN 6) and 12.0% (VBN 8)
Special features	:	Resistant to Mungbean Yellow Mosaic Virus and moderately resistant to powdery mildew diseases.

III. 2. Cultures identified for variety release (2020-21)

III. 2. i. Blackgram

Culture	**COBG 10-05**	**AD(TR) BG 14003**
Parentage	VBN (Bg) 5 x *V.mungo var. silvestris* (22/10)	Mutant of ADT 3
Duration	60-65days	65-70days
Average yield	880 kg/ha	735 kg/ha
Yield increase over check	11.4% (CO 6) , 12.1% (VBN 6) and 14.3% (VBN 8)	22.1%(ADT 6) and 18.0 (VBN 9)
Special features	Determinate plant type with synchronized maturity. Resistant to Mungbean Yellow Mosaic disease (MYMV) and moderately resistant to leaf crinkle, stem necrosis diseases	Suitable for rice fallow. Moderately resistant to MYMV and Powdery mildew diseases

III. 3. On Farm Trials

III. 3. i. Blackgram (Rabi)

III. 3. i. (a) COBG 13-04

Parentage	T 9 x ADT 5
Duration	60-65days
Average yield	908 kg/ha
Yield increase over check	16.7% (VBN 8)
Special features	MYMV disease resistant

III. 3. ii. Greengram (Kharif and Rabi)

III. 3. ii. (a) COGG 13-19

Parentage	CO 6 x COGG 912
Duration	60-65days
Average yield	785 kg/ha
Yield increase over check	4.0% (VBN 3)
Special features	Resistant to MYMV disease

III. 3. iii. Greengram (Rabi season)

III. 3. iii. (a) VGG 15-013

Parentage	VBN(Gg) 2 x ML 1451
Duration	70-75days
Average yield	977 kg/ha
Yield increase over check	16.2% (VBN 3)
Special features	Moderately resistant to MYMV

III. 4. Cultures in Adaptive research trials

III. 4. i. Blackgram (Rice fallow)

III. 4. i. (a) VBG 13003

Parentage	KU 2016 x VBN 3
Duration	65-70 days
Average yield	742 kg/ha
Yield increase over check (ADT 6)	16.9%
Districts	Cuddalore, Thiruvarur, Nagapattinam, Mayiladuthurai and Thanjavur (125 trials@ 25 locations per district)

III. 4. ii. Greengram (Rice Fallow)

Culture	**COGG 13-39**	**VGG 15-029**	**VGG 15-030 V**
Parentage	CO 6 x SML 668	VBN(Gg) 2 x IPM 409-4	VBN(Gg) 2 x IPM 409-4
Duration	60-65days	65-70days	65-70days
Average yield	744 kg/ha	711 kg/ha	718 kg/ha
Yield increase over check (ADT 3)	31.1%	20.4%	21.5%
Districts	Cuddalore, Thiruvarur, Nagapattinam, Mayiladuthurai and Thanjavur (125 trials@ 25 locations per district)		

III. 4. iii . Greengram (Bold seed for sprouts)

III. 4. iii. (a) VGG 18-002

Parentage	EC 496839 x IPM 409-4
Duration	55-60 days
Average yield	949 kg/ha
Yield increase over check	1.5% (CO 7), 30.2% (CO 8) and 1.5% (VBN4)
Special features	Short duration Bold seeded (5.8-6.0 g/100 seed) High Vit C content (19.60 mg/100g) in sprouts Good acceptability for sprouts
Season	Kharif, Rabi
Districts	Villupuram, Vellore, Kanchipuram, Tiruvallur, Thiruvannamalai, Cuddalore, Dharmapuri, Krishnagiri, Salem, Namakkal, Coimbatore, Tirupur, Erode, Trichy, Perambalur, Ariyalur, Karur, Pudukkottai, Madurai, Theni, Dindigul, Virudhunagar, Sivagangai, Thanjavur, Tiruvarur, Nagapattinam, Thoothukudi, Kallakurichi, Tenkasi, Chengalpattu, Tirupathur, Ranipet, Mayiladuthurai and Thirunelveli (170 Trials – five trials in each district)

III. 4. iv. Cowpea

III. 4. iv. (a) VCP 14-001

Parentage	Vamban 1 x VCP 10- 001
Duration	70-75 days
Average yield	995 kg/ha
Yield increase over check	16.9% (VBN 3)
Season	Kharif, Rabi
Districts	Villupuram, Vellore, Kanchipuram, Tiruvallur, Thiruvannamalai, Cuddalore, Dharmapuri, Krishnagiri, Salem, Namakkal, Coimbatore, Tirupur, Erode, Trichy, Perambalur, Ariyalur, Karur, Pudukkottai, Madurai, Theni, Dindigul, Virudhunagar, Sivagangai, Thanjavur, Tiruvarur, Nagapattinam, Thoothukudi Kallakurichi, Tenkasi, Chengalpattu, Tirupathur, Ranipet, Mayiladuthurai and Thirunelveli (170 Trials – five trials in each district)

III. 4. v. Chickpea

III. 4. V. (a) ICGV 181674

Parentage	(Genesis 836 x GG 2) X (ICC 4958 TM x JG 11)
Duration	75-80 days
Average yield	1346 kg/ha
Yield increase over check	13.3% (CO 4) and 13.4% (JG 11)
Season	Rabi
Districts	Coimbatore, Thiruppur, Dharmapuri, Salem, Erode, Virudhunagar, Perambalur and Thoothukudi (40 Trials – five trials in each district)

IV. Oilseeds

IV. 1. Cultures identified for variety release (2020-21)

IV. 1. i. Groundnut

The Spanish bunch culture VG 13163 has been identified and recommended for release. The culture matures in 105-110 days. It recorded a mean pod yield of 2509 kg and 2929 kg/ha respectively under *Kharif* and *Rabi*/Summer seasons, which is 5.01 per cent and 18.0 *per cent* superior over the best check varieties *viz*., BSR 2 and VRI 8. The newly evolved culture registered a mean shelling outturn of 70.0 per cent and a mean hundred kernel weight of 44 g. The oil content is 51 *per cent* with a O/L ratio (1.87). It is moderately resistant to late leaf spot and rust diseases

IV. 2. Cultures identified for the evaluation under OFT :2020-21

IV. 2. i. Groundnut

IV. 2. i. (a) Spanish Bunch [Short Duration (90 days)]

Special MLT has been conducted at eight centres during *Rabi*/Summer 2019-20 as per the action plan and the entry VG 17008 recorded highest mean pod yield of

2446kg/ha which is 39.2% over the best check VRI 3 (1757kg/ha). Seed multiplication will be done during *Kharif* 2020. The entry VG 17008 along with check varieties GG 7/GG10 and K 6 will be evaluated under OFT (10cents/entry)/ Farmers participatory appraisal (25cents/entry) in selected districts during *Rabi*/summer 2020-21.

Districts : Cuddalore, Villupuram, Thiruvannamalai, Vellore, Kancheepuram (12 locations/ districts; total trials=60)

IV. 2. i. (b) Virginia Bunch [Duration (120-125 days)]

The groundnut entries ICGV 07247 and ICGV 07245 recorded highest mean pod yield of 1776 and 1700 kg/ha in the Farmers Participatory Selection under farmers holdings of selected districts of Salem, Namakkal, Erode, Dharmapuri and Perambalur districts. The yield increase over checks VRI Gn 7 and CO 6 for ICGV 07247 is 39.62% and 33.96% and that of ICGV 07245 is 21.81 % and 16.87%

The semi spreading entry ICGV 07247 with the average yield potential of 1776kg/ha (33.96% increase over CO 6) along with check variety CO6 are being evaluated though OFT during *Kharif* 2020. Ten trials have been laid out in the farmers' holdings in Salem and Namakkal districts and the farmers have taken up the sowing during July 2020.

IV. 3. Adaptive research trials

IV. 3. i. Groundnut

IV. 3. i. (a) Spanish Bunch [Duration (105-110 days)]

The Spanish bunch culture COG 0537 is a cross derivative of CO 7 x ICGV 03042 and matures in 105-110 days. It produced a mean pod yield of 2883 kg/ha which is 39 *per cent* increased pod yield over the best check variety GG 7 (2075 kg/ha). The newly evolved short duration culture registered a mean shelling outturn of 71.5 *per cent* and a mean hundred kernel weight of 48.5 g. The oil content is 51 *per cent* and moderately resistant to foliar diseases and sucking pests.

Season : Rabi / Summer

Districts : Thiruvallur, Kancheepuram, Villupuram, Vellore, Thiruvannamalai, Cuddalore, Salem, Namakkal, Erode, Coimbatore, Thiruchirappalli, Perambalur, Karur, Pudukkottai, Tanjore, Madurai, Theni, Virudhunagar, Sivagangai, Thirunelveli, (2 trials in each districts.

IV. 3. ii.Sesame

Sl. No	Entries/ Checks	Pedigree	Duration (Days)	Pod yield (kg/ha)	Yield increase Over TMV 7	Special attributes
1	VS 13-006	VRI (Sv) 2 x GT 10	80-85	719	10.62 %	Moderately resistant to root rot and phyllody

						diseases
Season	Rabi / Summer					
Districts	Villupuram, Vellore, Kanchipuram, Tiruvallur, Thiruvannamalai, Cuddalore, Dharmapuri, Krishnagiri, Salem, Namakkal, Coimbatore, Tirupur, Erode, Trichy, Perambalur, Ariyalur, Karur, Pudukkottai, Madurai, Theni, Dindigul, Virudhunagar, Sivagangai, Thanjavur, Tiruvarur, Nagapattinam, Thoothukudi, Kallakurichi, Tenkasi, Chengalpattu, Tirupathur, Ranipet, Mayiladuthurai and Thirunelveli (170 Trials – five trials in each district)					

IV. 3. iii. Sunflower

Sl. No	Cultures	Pedigree	Duration (days)	Seed yield (kg/ha)	Yield increase over check (COH 3)	Special features
1	CSFH 15020 (R)	COSF12A x IR 6	85-90	1893	11.3 %	Moderately resistant to powdery mildew and *Alternaria*
Season	Kharif/ Rabi					
Districts	Villupuram, Vellore, Kanchipuram, Tiruvallur, Thiruvannamalai, Dharmapuri, Salem, Namakkal, Coimbatore, Tirupur, Erode, Trichy, Perambalur, Ariyalur, Karur, Madurai, Theni, Dindigul, Virudhunagar, Thanjavur and Thoothukudi, (105 Trials – five trials in each district)					

IV. 3. iv. Castor

Sl. No	Entries/ Checks	Pedigree	Duration (Days)	Seed yield (kg/ha)	Yield increase over check (YRCH 2)	Special attributes
1	YRCH 16108	DPC 17 x YRCS 1904	180	2150	15%	Semi-dwarf; wilt Resistant; basal branching, early (90 DAS) first harvesting;
Season	Kharif					
Districts	Dharmapuri, Salem, Namakkal, Erode (10 Trials in each district)					

V. Cotton

V. 1. For Adoption (Varieties approved by SVRC - 2020)

V. 1. (a) CO 17 (TCH 1819)

Parentage	:	Khandwa 2 x LH 2220
Duration	:	125 - 135 days
Season	:	Adi pattam (Jun-Jul) Purattasi pattam (Sep – Oct) Markazhi / Thai pattam (Dec - Jan) Chithirai pattam (Apr - may)
Average yield	:	2361 kg/ha
Yield increase over check	:	18.9% (Suraj)
Special features	:	• Early maturing. • Compact and erect plant type. • Zero monopodia. • Suitable for High Density Planting System • Synchronized boll maturity. • Suitable for mechanical harvest • Medium long staple fibre. • Moderately resistant to root rot and *Alternaria* leaf blight

V. 2. Adaptive Research trials

V. 2. i. Cultures nominated for *G. hirsutum* types

S. No	Culture	Duration (days)	Seed cotton yield (kg/ha)	Yield increase Over CO 14 /SVPR 6	Special features
1	TSH 357 (N)	150	2232	13.6 per cent increase over SVPR 6	Long staple Moderately resistant to leaf hopper
2	TCH 1828 (Second year of testing)	150	1825	17.0 per cent increase over CO 14	Long staple Boll weight : 4.3 g
Season	Winter Irrigated			Summer Irrigated	
Districts	Coimbatore, Theni ,Salem, Dharmapuri, Erode, Villupuram, Kallakurchi, Namakkal, Tiruppur, Trichy and Dindigul			Theni, Salem, Tuticorin, Virudhunagar, Tirunelveli, Thenkasi, Madurai, Dindigul, Thanjavur, Trichy and Thiruvarur	

V. 2. ii. Cultures nominated for compact types

Culture	Parentage	Duration	Seed cotton yield (kg/ha)	Yield increase over Suraj	Special features
TCH 1897 (N)	Selection from BPCH 1101-5	125-135 days	2079	18 %	Long staple
Season	**Winter Irrigated**			**Summer Irrigated**	
Districts	Coimbatore, Theni ,Salem, Dharmapuri, Erode, Villupuram, Kallakurchi, Namakkal, Tiruppur, Trichy and Dindigul			Theni, Salem, Tuticorin, Virudhunagar, Tirunelveli, Thenkasi, Madurai, Dindigul, Thanjavur, Trichy and Thiruvarur	

V. 2. iii.Cultures nominated for rainfed cotton

S.No	Culture	Duration (Days)	Seed cotton yield (Kg/ha)	Yield increase over		Special features
				SVPR 4	KC 3	
1.	TKH 1197 (Second year of testing)	140	1081	16.7%	10.6%	Long staple Highly resistant to leaf hopper and tolerant to drought
2.	TKH 1185 (Second year of testing)	140	1033	17.9%	14.9%	Long staple Drought tolerant

Districts	Tuticorin, Virudhunagar, Tirunelveli, Tenkasi, Ramanathapuram, Madurai and Perambalur

VI. Sugarcane

VI. 1. Adaptive Research Trial

- The clones *viz.,* Co 15007, Co 14016, C 30010, Si 10-12 and check varieties *viz.,* CoG 6, CoSi 8, CoC 25, Co 86032 and Co 11015 were planted (first plant crop)during 2020-21
- Yield increase for Co 14016 is 12.8% and C 30010 is 12.9% over check CoSi 8 and for Co 14016 is 19.7% and C 30010 is 19.7% over check Co 86032
- The same set of clones and standards will be planted as second plant crop during 2021-22 and the ratoon study of first plant also carried out during 2021-22 after its harvest
- The ARTs 2020-21 were planted in 25 identified sugar mills by scientists of SRS, Cuddalore, Sirugamani, Melalathur and ICAR-SBI, Coimbatore with support of respective sugarmills. The age of the crop is 8 months.

VII. Forage crops

VII. 1. Culture identified for OFT

VII. 1. i. Fodder Maize (continued)

Entry	Parentage	Duration (Days)	Green fodder yield (t/ha)	Yield increase over check (African Tall)	Special features
TNFM 131-9	Composite of five inbreds	65	45.0	7.6	10 days earlier than African Tall. White grain. More palatability.

VII. 1. ii. Forage sorghum

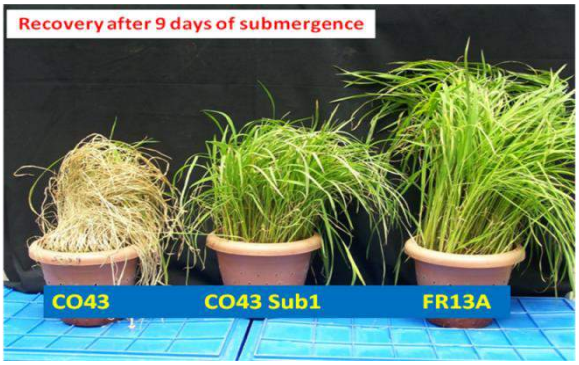
S. No.	Crop / Culture	Parentage	DFF (days)	GFY (t/ha)	Special attributes
1.	TNFS 220	BMR 211 X CSV 24SS	60	31.97	Plant Height -270 cm; Brix-12 %; TSS-9.74%
Checks : CO 27 and K 11 Few trials to be laid out as per farmers practice (Broadcasting)					

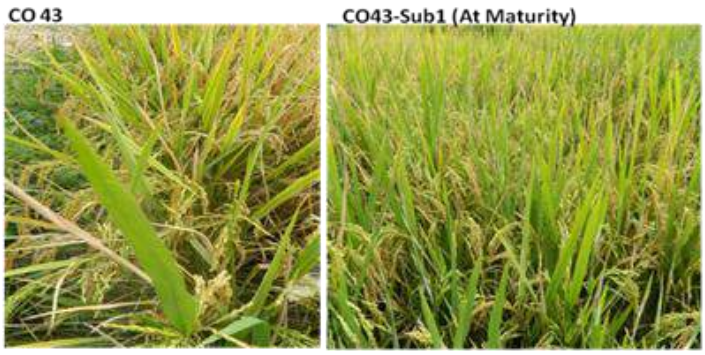
Dr. S. Mohankumar
Director, Centre for Plant Molecular Biology & Biotechnology
TNAU, Coimbatore

FOR ADOPTION:

CO43-Sub1, a submergence tolerant rice

Submergence tolerant version of a popular rice variety CO43 was developedthrough Marker Assisted Backcross Breeding approach. CO43 *Sub1* exhibited on-par performance against its recurrent parent CO 43 (with an average of 4% increased yield) under normal conditions. It out yielded CO43 by recording 23.5% increased yield under submergence. It recorded 58.8% increased yield over the best check, Swarna*Sub-1* under submergence.

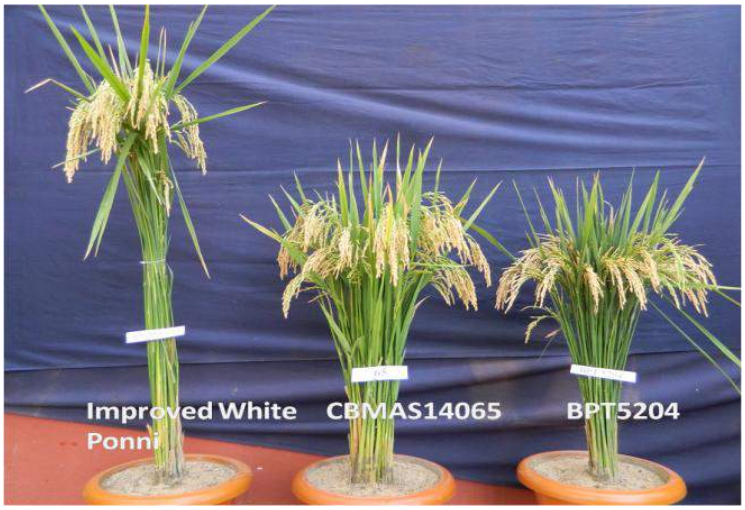




FOR ON-FARM TESTING (2019-20)

CBMAS 14065 (Improved White Ponni x Apo), a medium duration fine grain rice

CBMAS14065 is a medium duration (130-135 days) culture with short slender grain (L = 5.4 mm; B = 2 mm and L/B ratio 2.6), yield potential of >5 t/ha, better head rice recovery (62%) and good cooking quality. This performed better than the checks, TKM 13 and BPT 5204 under MLT and ART. Having potential to withstand moderate drought due to possession of drought tolerant QTLs.Recommended for evaluation under OFT.

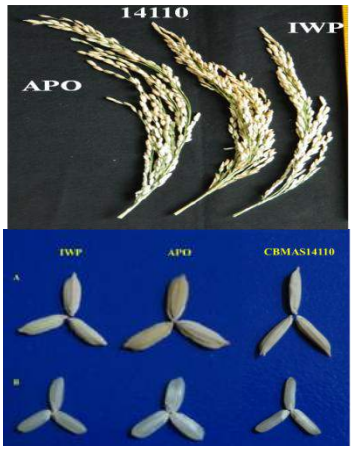


AD (Bio) 09518 (ADT 43 x IRBB 60-5-1) – a bacterial blight resistant rice culture

A short duration (115-120 days) rice culture, AD (Bio) 09518 (ADT 43 x IRBB60-5-1) with the yield potential of 5767 kg/ha and high resistance to bacterial blight has been developed through marker-assisted pedigree breeding. It has medium slender grains with high head rice recovery (80.6%). This culture was tested under adaptive research trial (ART-Rice 14/2015-16, 2016-17, Special transplanted Early (May-June sowing) for the two consecutive years.

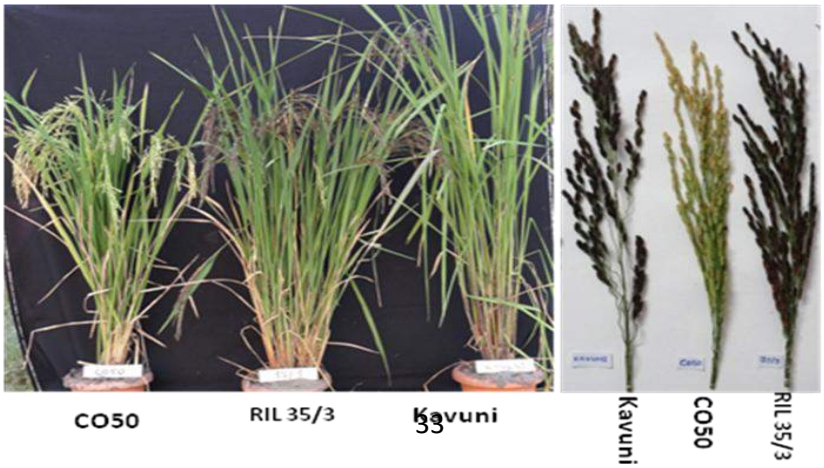
FOR INFORMATION (ART/MLT)

CBMAS 14110, a high yielding (6t/ha) and short duration (110 – 115 days) rice culture possessing fine grainsdeveloped through marker-assisted pedigree breeding. t is a medium tall genotype with dark green leaves. Possess very high grain number per panicle (300 – 350 grains per panicle). It harbours 3 mega effect QTLs of Apo contributing for grain yield under drought. The culture was evaluated under MLT for two years (2018-19 and 2019-20). Now recommended for evaluation at Paramakudi for testing its suitability under drought prone environments.



High yielding versions of a therapeutic rice Kavuni

A traditional therapeutic rice "Kavuni" is characterized for biochemical and medicinal properties. Kavuni was found to contain therapeutic properties to circumvent diabetes and age related macular degeneration (ARMD). Through innovative breeding, high yielding (3 – 3.5 t/ha) and photo-insensitive versions of Kavuni possessing all major therapeutic clues have been developed and nominated for special MLT. Now, it is recommended for OFT.

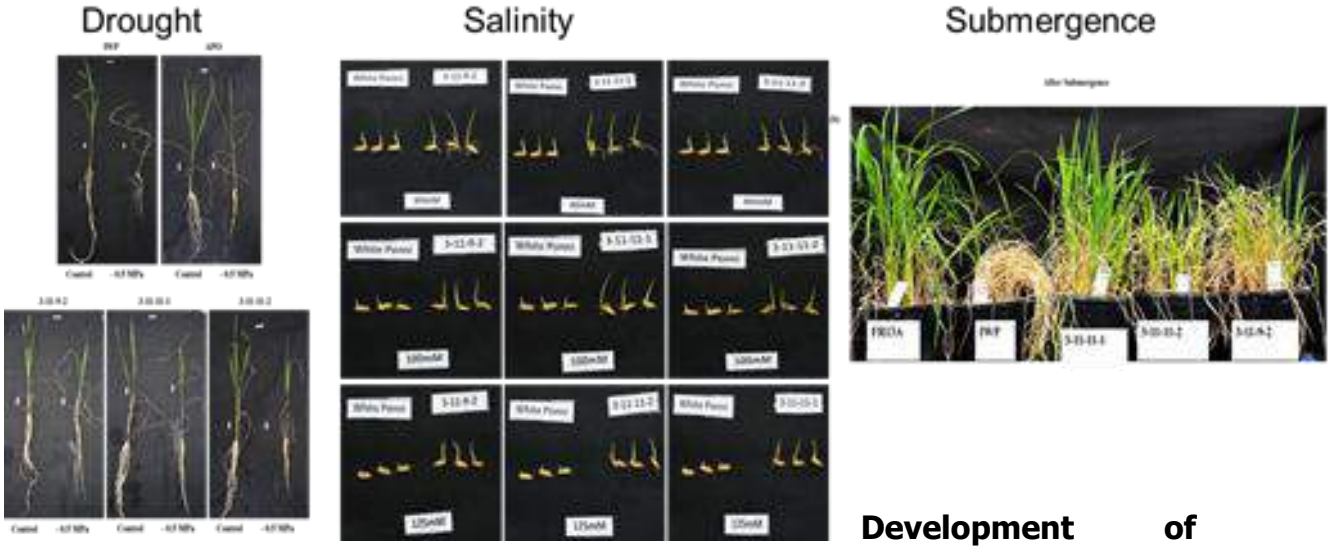


Maize hybrid in MLT

The Maize hybrid ACM M15009 (UMI1200β x UMI1230 β) is nominated for MLT during 2018-19 with CO 6 as a check. The hybrid is having high yield potential of 10730 kg/ha which is 11.3 % increase yield over the existing hybrid CO6 with the β carotene content of 9.60 µg/g.

Triple trouble (drought, salinity and submergence) tolerant rice:

Advanced backcross progenies of White Ponni pyramided with drought, salinity and submergence tolerant QTLs have been developed through MABB. Superior NILs have been identified and are under multiplication.

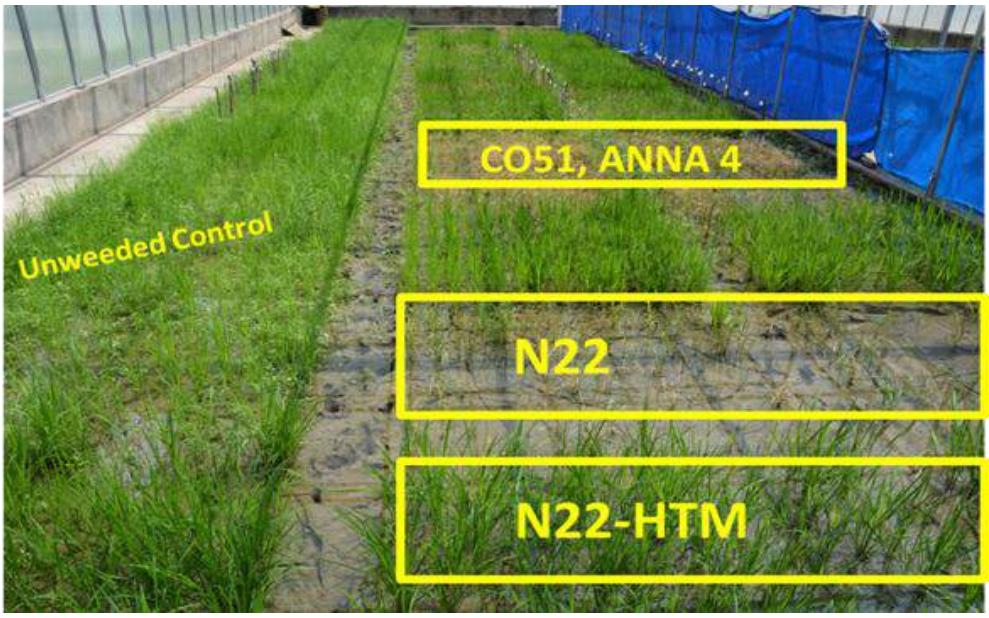


Development of multiple stress tolerant rice through QTL pyramiding

Advanced back cross progenies of CBMAS14065 harboring 8-9 QTLs conferring tolerance against drought, salinity, submergence, BLB, Blast and BPH have been developed. In CO1 genetic background, F2 progenies derived through inter-mating of back cross progenies of CO51 harbouring 9 QTLs (5 progenies with 83-92% RPG recovery), 8 QTLs (12 progenies with 76-92% RPG recovery) and 7 QTLs (27 progenies with 76-92% RPG recovery) were developed.

Herbicide tolerant rice paving way for water and labour saving rice cultivation

DPB, CPMB&B in collaboration with Dept. of Rice has developed herbicide tolerant versions (Imazethapyr resistant) of CO 51, Anna 4, ADT 43 and CBMAS 14110. Efficacy of rice herbicide tolerance trait was tested under direct seeded cultivation. Advanced back cross progenies (BC3F1) of CO51 harboring herbicide tolerance loci have been developed. This technology will allow us to test water and labour saving direct seeded rice cultivation in Tamil Nadu.



Early morning flowering version of CO51 to mitigate heat induced spikelet sterility

- Popular rice variety CO 51 is improved for its tolerance against high temperature stress. A QTL qEMF3 controlling anthesis time in rice has been mobilized into CO51 through MABB. NILs of CO51 harboring qENF3 with 1 to 1 ½ hrs earlier anthesis have been developed.

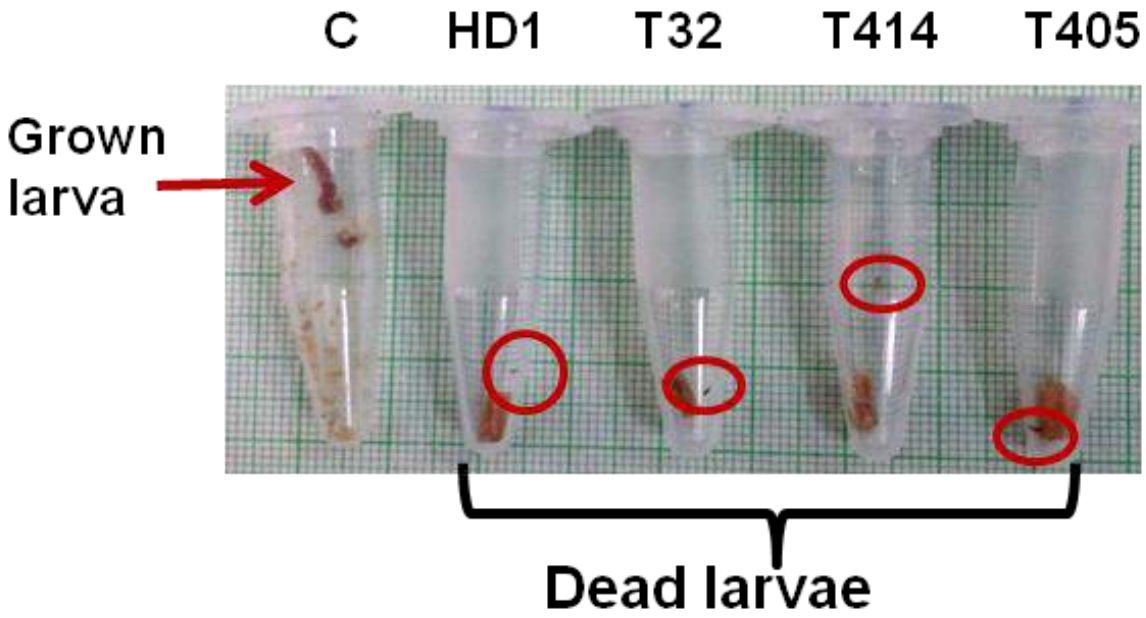
Transgenic plants developed for biotic stress tolerance in Rice and Banana

- Transgenic rice plants producing siRNA for suppressing the expression of *Chitin synthase 1* of *Nilaparvatha lugens* were developed. Bio-assay studies identified few moderately resistant events were identified

- Transgenic banana (Rasthali) exhibiting resistance against BBTV has been developed through RNAi technology.

Exploring native Bt diversity for novel insecticidal toxins

- DPB is involved in Bt research for the past 20 years. Scientists of DPB have invented novel Bt toxins and flied 3 patents so far. In this series, recent exploration has led to the identification of novel Bt isolates exhibiting toxicity against maize Fall Army Worm ***Spodoptera frugiperda.***



B. CROP MANAGEMENT

Dr. V. Geethalakshmi
Director, Crop Management
TNAU, Coimbatore

I. Department of Agronomy

1. RICE

FOR ADOPTION:

1. Cost effective weed management in direct seeded rice under puddled low land condition

Application of pre and early post emergence herbicide augmented broad spectrum weed control in puddled direct seeded rice. Pre emergence herbicide application of Pyrazosulfuron ethyl 10% WP @ 20 g ha^{-1} at 3 DAS + Early post emergence application of Bispyribac sodium 10% SC @ 25 g ha^{-1} at 2-3 leaf stage (20-25 DAS) effectively control the weeds and resulted higher weed control efficiency.

2. Alternative crops for *Kuruvai* season a contingent plan in Canal irrigated limited water situation

Pre-monsoon sowing of Greengram (Co 8) for canal irrigated (Vaigai canal) area where water is not released for irrigation for first season as contingent plan. It recorded higher yield, B:C ratio and higher water productivity in pre-monsoon sowing.

FOR INFORMATION:

1. Cost effective agronomic management to enhance the productivity of wet DSR

Drum seeding with pre germinated seed had close contact in soil resulted better germination and better yield.

2. Long term trial on weed dynamics under different establishment methods

Unpuddled direct seeding method resulted higher grassy weeds (*Leptochloa chinensis*) population. Machine transplanting with mechanical weeding recorded lesser weed density and higher grain yield.

3. Mitigation of methane emission from rice

SRI, MSRI and AWD irrigation are effective in reducing CH_4 and CO_2-eq emissions (40, 49 and 52% respectively compared to conventional method). Saving of irrigation water 26, 27 and 28% respectively for SRI, MSRI and AWD compared to conventional method without affecting rice grain yield.

FOR OFT:

Reducing methane emission from rice ecosystem

Modified SRI (15 days old seedlings, machine planting at 30 x 12 cm, AWD irrigation at 15 cm depletion of water in clay loam soil and 10 cm in sandy loam

soil, cono-weeding starting from15 DAT at 10 days interval and LCC based N application)

Evaluation of response of different rice varieties suitable for organic farming

To demonstrate the rice varieties suitable for organic farming in different locations.
Treatment details:

T1 - Improved White Ponni
T2 - CO (R) 48
T3 - Mappillai Samba
T4 - Standard check (Best performing variety of the region)

2. MAIZE

FOR INFORMATION:

Delayed sowing of maize, preferably during August 15th has produced higher grain yield of maize, compared to the other two sowing dates (June 15th & July 15th), might be due to less FAW infestation as per the pest scoring value. Among the intercrops tested, maize with soybean has produced higher grain yield with less FAW infestation than the other intercrops and control.

The sweet corn hybrid H2 (MISTHI) recorded higher green cob yield (15728 kg ha^{-1}), net return (Rs. 61243/ha) and BC ratio (2.38) under 60 x 15 cm with 100% RDF (120:60:45 NPK kg/ha). Whereas, H1 (CSCH-15001) recorded lower green cob yield (15134 kg ha^{-1}), net return (Rs. 58180/ha) and BC ratio (2.31) under 60 x 15 cm with 100% RDF.

Maize hybrid COH (M) 6 sown during 39th standard meteorological week was found to give higher growth parameters yield attributes and yield of maize under rainfed vertisol condition.

FOR OFT:

Application of Atrazine at 1kg/ha as pre emergence fb Topramezone at 25.2 g/ha on 25 DAS as post emergence recorded higher grain yield (7586 kg ha-1), net return (Rs. 70,928 ha-1) and B:C ratio (2.28) in maize

3. CUMBU

FOR INFORMATION:

Integrated nutrient management practices, comprising of 100 per cent recommended dose of nitrogen (80 kg N ha-1) through vermicompost and biomix (Azospirillum +PSB + Mycorrhizae) recorded higher plant height, productive tillers, yield parameters, grain and dry fodder yield of pearl millet under rainfed condition

The highest grain yield of 1896 kg/ha was recorded in plots treated with 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic manures in pearl millet. The benefit cost ratio was maximum (2.15) in 100% inorganic management practices (RDF alone) applied plots followed by 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic management practiced plots (1.82).

4. SORGHUM

FOR OFT:

For pre monsoon sowing (39th standard meteorological week), sorghum variety CO 30 (2141 kg ha-1) followed by K8 variety (1628 kg ha-1) were found to give higher yield even with high morning relative humidity under rainfed vertisol condition. For monsoon sowing (41st standard meteorological week), sorghum variety K 8 (580 kg ha-1) was found to give higher yield of under rainfed vertisol condition

5. RAGI

FOR INFORMATION:

The variety, Co (Ra) 15 has recorded the highest grain yield of 3601 kg ha-1. Among the irrigation regimes, the IW/CPE ratio of 0.8 has recorded the highest grain yield of 3771 kg ha-1. Among the interactions, the variety, Co(Ra)15 with IW/CPE ratio of 0.7 and IW/CPE ratio of 0.8 has recorded significantly the highest grain yield and on par

Application of enriched vermicompost @ 1t/ha applied in two splits on 25 and 40 DAT along with foliar application of egg amino acid @ 5% on 30 and 45 DAT was found to be the best nutrient management package for organic finger millet based on the grain yield (2746 kg/ha). However, the maximum net return (Rs. 31,477) and BCR of 1.94 was recorded under basal application of EFYM @ 750 kg/ha along with foliar spraying of EM @ 5% on 30 and 45 DAT thus proving as an economically viable package for organic finger millet production

FOR OFT:

Experiments conducted during kharif, 2018 and kharif, 2019 revealed that SFI +Two hand weeding at 15 and 30 DAS and SFI + One hand weeding at 15 DAS and mechanical weeding at 30 DAS recorded significantly higher growth and yield attributes and yield in rainfed ragi

6. BARNYARD MILLET

FOR INFORMATION:

The plants grown under state recommended management practices registered the maximum grain yield of 1982 kg/ha followed by plants grown under 75% organic + innovative organic practice (3% Panchagavya + Azophos @ 2kg/ha) with the yield of 1786 kg/ha in barnyard millet.

7. VARAGU

FOR OFT:

Sole varagu intercropped with blackgram in 1:1 ratio recorded higher grain yield and straw yield of 1880 kg / ha and 4347 kg / ha under irrigated and 1613 kg / ha and 4938 kg / ha under rainfed condition followed by Sole varagu intercropped with greengram 1:1 ratio.

8. BLACKGRAM

FOR ADOPTION:

Piloting pulse produce support system through ICT enabled services

University Research Project on "Piloting pulse produce support system through ICT enabled services" carried out in blackgram during 2019 – 20 in three different eco systems viz., irrigated (ACRC, Coimbatore), rice fallow (TRRI, Aduthurai) and rainfed (ARS, Kovilpatti) indicated that the registered farmers had received 10 -12 timely advisories during the crop period 3 - 5 days in advance thro' their mobile to plan their farm activities and realized an increased return ranging from Rs.1900 to Rs.2800 through yield increase and cost reduction, while the non registered farmers could react only after the occurrence of extreme weather events. Hence, the "TNAU – AAS web cum Mobile App" may be recommended for adoption and may be popularized among the farming community to manage weather based risks and to maintain sustainability in crop production during aberrant weather.

FOR INFORMATION:

Field experiment was conducted during the summer and *kharif* 2019 to evaluate the different methods of application of seaweed extract in blackgram and its impact on growth and yield of blackgram. Basal application of seaweed extract granules and foliar spray of sea weed extract are two methods of application.

Foliar spray of seaweed extract (0.25%) during flowering and pod formation stage along with RDF (25:50:25 kg NPK ha^{-1}) recorded higher seed yield of blackgram (660 kg /ha). The yield increment was 20 per cent as compared to RDF alone. Foliar application of seaweed extract along with RDF to blackgram found advantageous as it produced higher net return (Rs. 37960 / ha) and benefit cost ratio (2.21).

FOR OFT:

OFT 1. Agro technologies for rice fallow pulses

Trials may be conducted at farmer's field with following practices (T1): Varieties	Blackgram ADT 6/ VBN 9 / & Greengram ADT 3
Time of sowing	2-4 days before mechanical rice harvest or 7-8 days prior to manual harvest in waxy soil moisture condition
Seed rate	30 kg ha-1
Seed treatment	Imidacloprid (1.5 ml kg-1) + Bacillus subtilis (10 g kg-1) + Rhizobium and Phosphobacteria (30 g kg-1)
Herbicide	Tank mix application of Quizalofop-ethyl 50 g ha-1 and Imazethapyr 50 g ha-1 at 15- 20 DAS Normally, no herbicide will be used for weed control in rice fallow as the weeds do not emerge under such condition.
Foliar spray	TNAU Pulse wonder @ 5 kg ha-1 at flower initiation
Stress mitigation	Mobile sprinkler irrigation at critical stages using harvested rain water from farm pond

	PPFM spray to mitigate the drought
Plant protection measures	Monitoring of pests and diseases throughout the crop period and practicing need based IPM

OFT 2. Mechanization in sowing of pulses

Treatments:

T1 - Sowing with Precision pulse seeder

T2 - Sowing with Turbo seeder

T3 - Farmers's practice

Season: Kharif 2020 Variety: VBN 8

OFT 3. Enhancing productivity of blackgram through Sea Weed Extract

Treatments:

T1 – RDF + Foliar spray of Sea weed extract (2.5ml /lit)

T2 – RDF + Basal application of Sea weed granule @ 10kg /ha

T3 – RDF alone

Season: Kharif 2020 Variety: VBN8

OFT 4: Mitigation of water stress by hydrophilic polymer seed coating in blackgram

Treatments

T1 - No seed treatment + Recommended package of practices

T2 - No seed treatment + Imposing water stress up to 20 days after life irrigation

T3 - Seed treatment with Xanthan Gum + Carrageenan + Agar (4:1:1) @ 20 g /kg of seeds + Recommended package of practices

T4 - Seed treatment with Xanthan Gum+ Carrageenan + Agar (4:1:1) @ 20 g /kg of seeds + Imposing water stress up to 20 days after life irrigation

9. GREENGRAM

FOR OFT:

OFT 1. Effect of growth regulating substances in improving crop establishment and Harvest Index in greengram under sodicity

Treatments:

T1: Control (without any seed treatment)

T2: Seed treatment with cowpea sprouts extract (2 %) + foliar spray of Panchagavya (3%) at flower initiation and pod initiation stages

Season: Kharif 2020 Variety: Greengram - VBN (Gg) 2

10. HORSEGRAM

FOR OFT:

OFT 1. Influence of nipping on the productivity of rainfed horsegram under altered

Treatments

T1 - Broadcast method of sowing + chlormequat chloride 250 ppm at tendril initiation
stage
T2 - Broad cast method of sowing + manual nipping at tendril initiation stage
T3 - Farmers practice
Season: Rabi 2020 Variety: Paiyur 2

OFT 2. Impact of TNAU Horsegram Wonder on yield improvement in horsegram
under rainfed condition

Treatments
T1 - Foliar spray of DAP (2%) spray
T2 - Foliar spray of TNAU Pulse Wonder @ 2 kg / acre
T3 - Foliar spray of TNAU Horsegram Wonder @ 2 kg / acre
Season : Rabi Variety : Paiyur 2

11. MOTH BEAN

FOR OFT:

OFT 1. Evaluation of drought tolerant rhizobial strains in Moth bean (Vigna aconitifolia)

Treatments
T1-100%NPK
T2- Rhizobium (MB-1) + 75% N + 100 % PK
T3- Rhizobium (MB-1) + PSB + KRB-9 + 75 % NPK

12. RED GRAM

FOR INFORMATION:

Evaluation of post emergence herbicides inredram

Application of PE pendimethalin 3 DAS followed by Imazethapry + Imazamox on 25 DAS and one intercultural operation on 50 DAS recorded higher weed control efficiency (91 %), seed yield (1228 kg /ha), net income (Rs.36240/ha) and BCR (1.81) in redgram.

FOR OFT:

OFT 1. Redgram based crop intensification under rainfed ecosystem

Treatments
T1 - Redgram + Cotton (4:4)
T2 - Redgram (Sole crop)
Season: Kharif 2020 Variety: Redgram (Co8) and Cotton (Co 14)


13. GROUNDNUT

FOR OFT:

1. Crop establishment and suitable intercrop for semi-spreading groundnut under rainfed condition

Groundnut + cowpea @ 4:1 ratio under seed drill sowing with raised bed (120 cm) recorded higher GEY (1601 kg/ha), RUE (1.89 kg ha-mm-1) and BCR (2.05).

2. Identification of remunerative groundnut based cropping system under rainfed situation

Treatments

T1-Groundnut + Maize (4:1)

T2- Groundnut + SD Redgram (4:1)

Season :Kharif 2020

14. GINGELLY

FOR OFT:

1. Effect of sulphur oxidizing bacteria on yield of sesame

Treatments

T1 -100 % RDN + Gypsum

T2- 75 % RDN + Seed treatment with Azospirillum + Gypsum

T3-75 % RDN + Seed treatment with Azospirillum & SOB +soil application of SOB on 45 DAS

Season : Rabi/Summer 2020-21

15. SUNFLOWER

FOR INFORMATION:

1. Weed management in sunflower under modified spacing

Weed free environment resulted in producing significantly higher seed yield of 2212 kg/ha and it was on par with Pre emergence application of Pendimethalin fb hand weeding or power weeded at 30 DAS and all Pendimethalin as PE at seed row + power weeder at 15 & 30 DAS except Pendimethalin (30 EC) @ 1.0 kg ai/ha as PE at seed row (Before irrigation) + power weeder at 15 & 30 DAS. Highest net returns of Rs. 18,581 /- and benefit cost ratio of 1.34 was observed in Pendimethalin (38.7 CS) @ 1.0 kg ai/ha as PE at seed row (After irrigation) + power weeder at 15 & 30 DAS.

Hence, to control weeds effectively and economically in sunflower is application of Pendimethalin (38.7 CS) @ 1.0 kg ai/ha as PE at seed row (After irrigation) + power weeder at 15 & 30 DAS.

2. Good agricultural practices for sustainable productivity of cropping systems involving sunflower

Demonstration was conducted in the station with full improved package of practices from seed to seed with groundnut – sunflower cropping system. The results shown that the sunflower yield of 2395 kg/ha was realized due to adoption of all the improved practices with BCR of 1.50. Yield increased over farmers' practices is 22 per cent.

3. Technology Validation- Integrated weed management

Pendimethalin @ 1.0 kg ai/ha as PE + power weeder at 30 DAS resulted in producing significantly higher seed yield of 2125 kg/ha. Economics wise Pre emergence application of Pendimethalin@ 1.0 kg ai/ha fb power weeded at 30 DAS is the best and record higher net return of Rs. 19,224 with higher BCR of 1.36.

4. Response of sunflower to varying planting geometry and fertilizer levels under different land configurations under rainfed conditions

The entire period of cropping period received the adequate rainfall for the growth and development. The rainfall received during the cropping period was 475.1 mm with 30 rainy days. The results revealed that the growth parameters, yield attributes and yield parameters of sunflower were significantly influenced by land configurations and graded level of fertilizers. Among the land configuration ridges and furrow sowing recorded significantly higher growth parameters, yield attributes and yield (1259 kg/ha) and it was followed by flat bed. Among the fertilizer levels, 125 % RDF recorded significantly higher growth parameters, yield attributes and yield (1159 kg/ha) over 75 % RDF but 125% RDF was comparable with 100% RDF. The economics revealed that among the land configuration ridges and furrow sowing recorded higher net return (Rs. 8,517) and BCR (1.25).

5. Optimizing spacing and nutrient levels for prerelease sunflower hybrid

The results revealed that the plant height was not significantly influenced by intra row spacing, but nutrient level was significantly influence on sunflower plant height. Among the different level of fertilizer application higher dose of fertilizer application recorded taller plant. Days to 50 % flowering was not significantly influenced by intra row spacing and different level of fertilizer application. Number of grains per plant and yield of sunflower were significantly influenced by intra row spacing and different level of fertilizer application. 60 x 35 cm spacing recorded significantly higher number of grains per plant and it was on par with the 60 x 30 cm spacing. 60 x 25 cm spacing recorded significantly higher sunflower yield and it was on par with the 60 x 30 cm spacing. With respect to level of fertilizer application number of grains per plant and yield of sunflower were increasing with increasing levels upto 110 % STCR and there after they were decreasing. Among the different level of fertilizer application, application of fertilize at 110 % STCR recorded significantly higher yield attributes (1099 nos. of grains per plant) and yield (2080 kg / ha). The economics revealed that among the different plant spacing, 60 x 25 cm recorded higher net return (Rs. 34678) and 60 x 25 cm and 60 x 30 cm both recorded higher BCR (1.88). With respect to fertilizer level, 110 percent STCR level

recorded higher net return (Rs. 35380) and 110 percent STCR and 100 percent STCR both recorded higher BCR (1.90).

16. CASTOR

Optimizing nipping practices for newly released perennial castor variety YTP 1

The results of the experimental trials revealed that nipping (N1) of primary branch at 8th node produced significantly shorter plant (106.0 cm) followed by nipping at 10th node and nipping at 12th node (134.8 & 145.6 cm, respectively). While higher plant height of 180.9 cm was noticed under unnipped plant. However, higher number of branches per plant was recorded under nipping at 12th node (12.47). The next best treatment was nipping at 10th node (9.50). Similar to this character, No. of effective spike per plant was also higher under nipping at 12th node followed by 10th node (9.30 & 8.10, respectively). In contrast to this, the highest spike length (54.43 cm) was observed with unnipped treatment over other three nipped plot at 8th, 10th and 12th node (45.33, 43.90 & 42.90 cm, respectively). Likewise, No. of capsules per spike were also higher with unnipped plot over rest of the treatment. However, the parameters like shelling percent, test weight and oil content did not significantly influenced by nipping practice. With respect to seed yield, nipping primary branch at 12th node recorded significantly higher grain yield of 2254 kg /ha which was observed to be on par with nipping at 10th node (2058 kg/ha). The lowest seed yield of 1080 was recorded under unnipped plot (1080 kg/ha). With regard to intercropping, the highest castor equivalent yield (CEY) was recorded with groundnut over fodder cowpea and higher inter crop yield and CEY (1231 kg/ha) were recorded under unnipped plot as compared to nipped plot. Regarding economics, higher net returns of Rs.100762/ha with BCR of 3.23 were registered under nipping at 12th node followed by nipping at 10th node with net returns of Rs.90651/ha and BCR of 3.02. The lowest values of these parameters were recorded under unnipped treatment.

17. COTTON

FOR ADOPTION:

Growth retardant for cotton variety Co 17

Foliar application of Mepiquat chloride @ 100 ppm (Commercial product: one litre/ha) at square formation and boll development stages for higher seed cotton yield and net return in cotton variety Co 17 under high density planting.

FOR INFORMATION:

1. Labour saving techniques in Cotton cultivation

Result revealed that the treatment combination including application of herbicides (PE and POE) along with intercultural operation using tractor drawn implements and drip fertigation recorded a yield of 2761 kg /ha which was comparable with mechanized land shaping (2569 kg/ha) and Drip fertigation + Poly mulch (2482 kg/ha).

2. Technology for organic cotton production

Combination of seed treatment and soil application of azospirillum @ 2 kg/ha and foliar application of PPFM, Neem cake 250 kg/ha and raising of sunhemp between rows and incorporated before flowering recorded higher yield (1703 kg /ha).

FOR OFT:

1. Nutrient management for cotton under high density planting system (HDPS)

Treatments:

T1 - RDF 100 % (80:40:40 kg NPK/ ha)

T2 - RDF 125 % (100:50:50 kg NPK/ ha)

T3 - STCR based (100 % RDF & 2.5 t/ha target yield)

*Along with the above treatments straight and water soluble fertilizer may be tested

Variety/Cultures : CO 17

Spacing : 100 x 10 cm

Season: Rabi

2. Labour saving techniques in cotton cultivation

Treatments:

T1 -Land shaping by machine

T2-Pre and post emergence application

T3 - T1 + T2 + Drip fertigation + Boom sprayer /Others sprayers

Variety/Cultures : CO 17

Spacing : 90 x 45 cm

Season: Rabi

18. FORAGE CROPS

FOR ADOPTION:

1. Assessing the suitability of single budded setts in Cumbu Napier hybrid grass

Horizontal planting of single budded setts with sett treatment registered higher establishment percentage (92.4%), number of tillers (19.25) and green fodder yield (79.1 t/ha/cut). Hence, it was found to be a viable option for reducing the sett requirement (50%) and cost of cultivation.



FOR INFORMATION:

1. Studies on carbon sequestration in perennial grass based cropping systems (2015 -2020)

Cumbu Napier hybrid grass in paired rows (60/120 cm) + *S. grandiflora* (1 row) sequestered significantly higher total carbon of 165.7 t/ha/ 3years. Lowest carbon sequestration of 123.8 t/ha/ 3 years cuts was recorded in guinea grass alone planted in recommended spacing.


2. Studies on performance top feeds under varied planting geometry with and without intercrop (2017 -2021)

Agathi (*S. grandiflora*) planted in 2.0 m X 0.5 m distance with one row of Cumbu Napier hybrid grass CO (BN)5 as inter crop was found to be a suitable combination for achieving higher green fodder yield with crude protein


19. WEED MANAGEMENT
FOR INFORMATION:

1. **Documentation of weed biology and assessing the impact of crop weed competition in direct seeded rice ecosystem**

Field experiments were carried out at Department of Agronomy, Coimbatore Tamil Nadu Rice Research Institute, Aduthurai, Department of Agronomy, AC &RI, Madurai, ARS, Bhavanisagar and AC & RI, Killikulam during *Kharif* season 2019. with an objectives of documentation of weeds biology and assess the impact of crop weed interference period in puddled and unpuddled DSR. The predominant weed flora were *Echinochloa colonum, Leptochloa chinensis* in grasses *Cyperus iria, Fimbristylis miliacea* in sedges and *Ludwigia parviflora, Marsilea quadrifoliata* in broad leaved weeds.

From the experiments conducted at five stations, it could be concluded that, the critical period for crop weed competition ranges between 30 to 45 DAS which contributed to records higher grain yield under puddled condition than unpuddled condition. Hence, in the DSR method of cultivation, the field should be free from weeds upto 45 DAS either in puddled nor unpuddled condition in order to obtain higher grain yield.

2. Ecofriendly sustainable *Parthenium* management

Experiments conducted at laboratory, Poly house and field condition, to management the Parthenium weed with different plants extracts along with two concentration of lime extracts during 2019. The revealed that, application of different plant parts extracts influenced the germination of the Parthenium seeds. There was inhibitory effect of plant extract viz., *Terminalia chebula pods*+ 50% acid lime extract and *Terminalia Chebula pods* + 25% acid lime extracts on the Parthenium seed germination while inhibitory effect on germination of Parthenium by the rest of the plant extracts also comparatively higher.

Application of *Terminalia chebula pods +* 50% and 25 % acid lime extract on Parthenium recorded lowest Plant height, root length and dry weight of Parthenium. Parthenium control efficiency was higher in *Terminalia chebula pods*+ 50% acid lime or 25% acid lime extract on 20 DAS recorded higher parthenium control efficiency

From the experiments conducted at three different levels, it could be concluded that, pre emergence or post emergence application of *Terminalia chebula pods*extracts + acid lime extract either with 25 or 50% resulted reduced Parthenium seed germination, dry weight and higher Parthenium control efficiency.

Hence, *Terminalia chebula pods*+ acid lime extract may be recommended to control Parthenium as eco friendly way of management in non cropped areas.

3. Weed management in maize–sunflower–dhaincha (*Sesbania aculeata*) based conservation agriculture system

Field experiments were carried out from 2015 on weed management in maize – sunflower – dhaincha based conservation agriculture system to monitor weed dynamics, crop productivity and herbicide residue under long term tillage and residue management practices.

The results revealed that, maize – sunflower cropping system of conservation agriculture, the predominant among broad leaved weeds were *Amaranthus viridis, Cleome viscosa* and *Parthenium hysterophorus*. Among the grass weeds, *Cynodon dactylon, Setaria verticiliata* and *Chloris barbata* were the dominant ones. *Cyperus rotundus* was the only sedge weed present in the experimental fieldsignificantly recorded higher grain yield and economics were recorded in zero tillage with previous crop residue and in pre emergence application of pendimethalin at 1.0 kg/ha with hand weeding on 45 DAS in sunflower. Whereas, in maize zero tillage followed by zero tillage with residue system and pre emergence application of atrazine at 0.5 kg./ha along with hand weeding on 45 DAS recorded higher productivity as well as high income.

4. Long term herbicide trial in transplanted lowland rice-rice cropping system

Field experiments were conducted during *Khairf 2019* and *Rabi2018* seasons with an objective of study the influence of continuous application of herbicides on weed shift, productivity and economics in transplanted rice-rice cropping system

The results are revealed that grasses, *Echinocloa crusgalli* and *Leptochloa chinensis* are predominant and *Ludwigia parviflora* were dominant species in broad leaved weeds. Among the different herbicide combination, significantly higher grain yield and income was obtained with PE bensulfuron methyl (0.6%) + pretilachlor (6.6%) followed by hand weeding *Rabi.* Where as significantly higher grain yield and income was obtained with PE pyrasosulfuron ethyl (10% WP) fb hand weeding during *Kharif*

Residues of all the studied herbicides in soil and rice grain at harvest from both *Rabi* and *Kharif* were found below the detection limit of 0.01 mg/kg. Soil nutrients status was also unaffected significantly by the herbicidal weed management practices.

5. Mitigation of pendimethalin in the soil grown with greengram

Pot culture experiments were conducted during 2018 with soil samples collected from the field and treatments were imposed 3 days before sowing of greengram (Co 8). On 3rd day after greengram sowing to study the mitigation of long persisting Pendimethalin herbicide in the soil.

The results found that lowest half life of 8.32 days was observed in FYM treatment and irrespective of mitigation measures followed, the Pendimethalin persisted up to 45 DAS. Application of FYM @ 10 t /ha or vermicompost @ 5/ha or biochar @ 5 t/ha is efficient in reducing the residual concentration of pendimethalin in greengram grown soil.

20. INTEGRATED FARMING SYSTEM
FOR INFORMATION:

Experiment 1 (1a): Identification of cropping systems module for different farming systems

Maize - Chillies - Radish system recorded the highest maize equivalent yield (30.45 t/ha), system productivity (83.4 kg/ha/day), water productivity (23.42 kg/ha.mm), net return (Rs. 4,31,197) and B:C ratio (3.65) followed by Onion - Cotton- Maize system.Vegetable based cropping systems are nutritionally and economically viable.

Experiment 2: Sustainable resource management for climate smart IFS

Integrated farming system adopted in 1.0 ha irrigated dry land by involving crop + dairy (2+2) + goat (10+1) + poultry (150 nos.) + horticulture + kitchen garden + boundary planting + vermicompost as components under Western zone of Tamil Nadu recorded higher net income of Rs. 3,63,122/- with a B:C ratio of 1.59 and generated an employment of 551 man days. By residue recycling the total quantity of nutrients added was 201 kg N, 87 kg P and 131 kg K.

Overview of 1a experiment

Cropping system
Integrated farming system for irrigated dryland

Goat rearing (Salem Black)

Dairy Unit

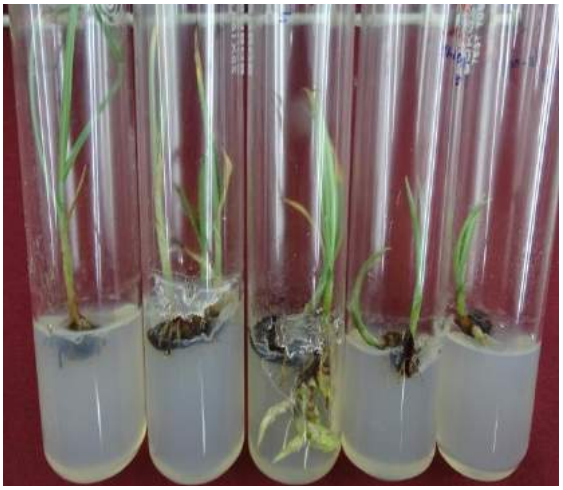
Poultry Unit

21. CORE PROJECT :

FOR INFORMATION:

Core Project 1. In vitro* establishment and improving the absorption and translocation of foliar applied herbicide in *cyperus rotundus

- Sterilization of explants and suitable medium composition for *in vitro* establishment of *Cyperus rotundus* has been standardized.
- Medium for tuberization of *Cyperus rotundus*has been standardized.
- Higher concentration of glyphosate (800 to 1000 ppm) effectively controlled the *Cyperus rotundus*
- Chemical method of synthesizing nanoparticles Fe_2O_3, ZnO, Ag were standardized



In vitro establishment of *Cyperus rotundus*

Glyphosate @ 500 ppm **Glyphosate @ 1000 ppm**

Core Project 2. Nutrient management for transplanted ELS cotton

The experimental results revealed that the survival of plants was recorded (86.77) 5.57 percentage higher in seedling transplanting than seeding methods (82.22) during summer and 8.29 percentage during winter2019.The cotton growth as measured by plant height, DMP and yield attributes as shown by number of sympodial branches, no. of bolls/plant, single boll weight and similarly the

physiology of cotton as indicated by LAI were all favored by intercropping green gram, black gram and onion in cotton as compared to sole cotton as seeding and also seedling transplanting.

Cotton seedlings was transplanted (18 days old) with wide spacing of 120 x 60 cm. In-between the wide spacing two rows of pulses such as synchronized maturing black gram or green ram could be raised for suppression of weed at early stage and additional income with 125 % of RDF or STCR based fertilizer application was found economical.





Core Project 3. **Influence of nipping on the productivity of rainfed horsegram under altered crop geometry**

In Horsegram, increased yield of 19.8% in manual nipping and 12.6 to 26.2% in chemical nipping *viz.*, chlormequat chloride & mepiquat chloride with 125 & 250 ppm spray @ tendril initiation over no nipping (672 kg/ha). Broadcasting of horsegram and nipping by spraying chlormequat chloride 250 ppm @ tendril initiation stage is economical (Grain yield: 949 kg /ha; B:C 1.87; net return: Rs.14,991/ha than no nipping (Grain yield: 669 kg /ha; B:C 1.38; net return: Rs.6041 /ha).


Core Project 4. **Ecofriendly sustainable *parthenium* management**

From the experiments conducted at three different levels, it could be concluded that, pre emergence or post emergence application of *Terminalia chebula pod* extracts + acid lime extract either with 25 or 50% resulted reduced Parthenium seed germination, dry weight and higher Parthenium control efficiency.

Hence, *Terminalia chebula pods*+ acid lime extract may be recommended to control Parthenium as eco friendly way of management in non cropped areas.

Core Project 5. **Integration of rice + duck farming system in irrigated transplanted rice under organic farming**

Based on the results of two seasons (*Navarai* 2018-19 and 2019-20), the following results were obtained.

Integration of ducks with rice, increased the rice yield (5.0 to 31%) compared to conventional cultivation. Rice + duck @ 400 Nos./m^2 released from10 or 20 or 30 DAT recorded significantly higher yield of rice compared to other duck introduced treatments. Integration of duck in transplanted rice @ 400/ha from 10 DAT increased the duck yield compared to others. Due to better rice yield and duck weight, gross return, net return and B:C ratio were also increased in integration of rice duck @ 400/ha released from 10 DAT in both the years of the study.

Core Project 6. **Developing low cost agronomic management strategies in irrigated maize for the control of fall army worm (*Spodoptera frugiperda*) in western agro- climatic zone of Tamil Nadu**

During *Kharif*, 2019 season, delayed sowing of maize, preferably during August 15th has produced higher grain yield of maize, compared to the other two sowing dates (June15th & July 15th), might be due to less FAW infestation as per the pest scoring value. Among the intercrops tested, maize with soybean has produced higher grain yield with less FAW infestation than the other intercrops and control.

Research Field Overview

Maize + Cowpea Intercropping

Maize + Sunnhemp Intercropping

Sole Maize

22. IFFCO Project on "Effect of seaweed extract on growth, productivity and profitability of greengram (*Vigna radiata* (L) Wilczek)"

FOR INFORMATION:

- The present investigation revealed that the combined use of seaweed extract through seed treatment and foliar application increased the growth and yield parameters and yield of *kharif* greengram under irrigated condition.
- Irrespective of nutrient sources used in seed treatment, the foliar application of seaweed extract at low concentration on 25 DAS and 35 DAS had shown superior performance in all growth, yield and quality traits of greengram.
- From the study it was concluded that application of RDF + seed soaking in SWE (0.1%) for 30 minutes and ST with *Rhizobium* + foliar spray with SWE (0.25%) on 25 DAS and 35 DAS is a viable nutrient management package for getting higher yield and returns in *kharif* irrigated greengram.
- Application of 100% RDF integrated with seed soaking in (0.1%) SWE followed by seed treatment with *Rhizobium* and foliar application of SWE (0.25%) on 25 and 35 DAS has been found to be beneficial in increasing the growth characters, yield attributes, yield (1248 kg/ha) and B:C ratio of irrigated greengram.

II. Agro Climate Research Centre

A. TNAU AAS - Web Cum Mobile App

An important outcome of research from the ACRC is, "TNAU AAS – Web cum Mobile APP" to disseminate farmers specific, crop specific, stage specific, weather based agro advisories directly to the farmers' mobile with zero human intervention which was launched during 2018. Timely and specific messages ensured climate resilient farming. The AAS - Mobile App has saved the cost of SMS for agro advisory dissemination. Available in http://aas.tnau.ac.in and Google play store. The agro advisory using the weather information thro' app is in the phase of up scaling to

other states for the betterment of farming community. Recently, the app has been linked to TN Govt. Uzhavan App for wider utility.

B. TNAU Medium Range Weather Forecast

Since 2011, ACRC is issuing medium range weather forecast for Rainfall, Temperature, Relative Humidity, Wind Speed with a lead time of six days and updating daily in public domain http://tawn.tnau.ac.in. With the continuous research, our MRW forecast has reached the accuracy of 70 – 85%, varying with seasons. TNAU has been the pioneer in providing block level weather forecast to the farming community. In addition to farmers, the government officials, general public are also using TNAU's MRW forecast. Recently, TNEB has requested to share ACRC's forecast directly to their server and using for their grid maintenance.

C. TNAU Seasonal Forecast

The seasonal Climate forecast for South West Monsoon and North East Monsoon are being disseminated during last week of May and September, respectively since 2014. During 2017-19, research had been made toimprove the accuracy of TNAU's seasonal forecast by including Indian Ocean Dipole Index, El Nino Southern Oscillation (ENSO) index and SST. The NEM 2019 forecast from ACRC perfectly matched with the observed values for most of the districts in Tamil Nadu. TNAU is the only SAU, issuing district level seasonalrainfall prediction for the entire state. Research is in progress for further improvement in accuracy, spatial resolution from "district to block" and temporal scale from "seasonal to monthly".

D. Climate change and crop weather relationship

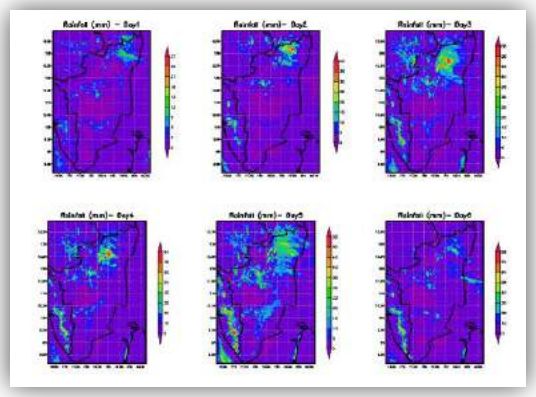
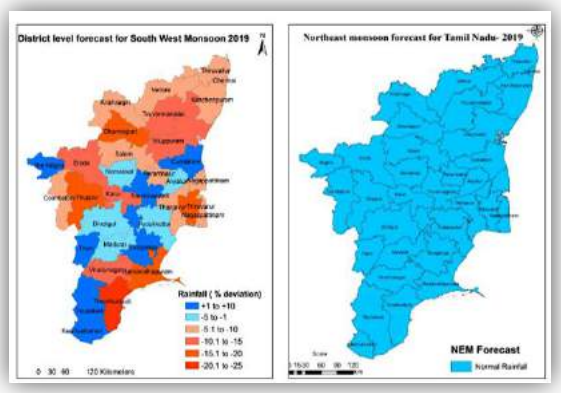
With new infrastructural establishments such as SPAR, Climate Control Champers, and Temperature Gradient Tunnel, ACRC faculties and students are continuously doing crop – weather relationship, drought and climate change on food crops. Using ensemble models on both climate and crop weather model, the impact of projected decadal climate change from 2030 to 2100 have been studied for rice, maize, groundnut, sugarcane and cattle and necessary management options have been developed to mitigate the impact.

E. Astrometeorology forecast

TNAU is pioneering in astrometeorology since 2011and identified astromet rules for hourly rainfall forecast (2017), wind speed influencing planets' positions (2018) and cyclone producing planet positions (2019). ACRC has also developed a planet activeness chart for rainfall and wind speed.

F. Crop Efficient Zonation

Studies were undertaken since 2016 for identifying the efficient cropping zones for rice, maize, cumbu, sorghum, groundnut, redgram, blackgram, Greengram, sugarcane and cotton. The findings facilitate policy makers in implementation of new developmental and insurance schemes. It helps to identify the lacuna in technologies or extension and to select the alternate efficient crops for the district.

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Automated Agro Advisory Service – Web cum Mobile App</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Medium Range Weather Forecast</td><td>Seasonal Forecast</td></tr>
</table>

III. Department of Sustainable Organic Agriculture

I. Network Project on Organic Farming

1. Evaluation of organic, inorganic and integrated production systems in vegetable crops (Brinjal, Tomato and Chillies)

- The brinjal yield was more (24,556 kg/ha) in nutrients supplied as per state recommendation of FYM @ 25 t/ha + Azophos @ 2 kg/ha + recommended doses of NPK fertilizers.
- The yield of chilli was the highest (13,052 kg/ha) in 50% organic manures (FYM + vermicompost) and 50% inorganic fertilizers applied treatment.
- The tomato yield was more (13914 kg/ha) under 75% organic and 25% inorganic sources of NPK nutrients.
- In brinjal, the net return was more in 75% organic (FYM + vermicompost) followed by foliar spray of *Panchagavya* @ 3% as foliar spray whereas the benefit cost ratio was more in 100% organic manures (FYM + vermicompost) applied plot.
- In both chilli and tomato the net return and benefit cost ratio was more in 75% organic manures (equally as FYM + vermicompost) and 25% inorganic fertilizers applied treatment.
- The quality parameters are better under 100% organically managed crops.

2. Evaluation of organic, inorganic and integrated production systems in barnyard millet

- The plants grown under state recommended management practices registered the maximum grain yield (1982 kg/ha) followed by plants grown under 75% organic + innovative organic practice (3% Panchagavya + Azophos @ 2kg/ha) with the yield (1786 kg/ha).
- Among the different management practices, 75% organic + innovative organic (3% Panchagavya + Azophos @ 2kg/ha) management practices followed plots has fetched the maximum net return per hectare (Rs.21,262) followed by 100% organic management practices applied plots (Rs. 18,998).
- Plots maintained under 75% organic + innovative organic practice (3% Panchagavya + Azophos @ 2kg/ha) showed the highest BCR of 2.08 followed by plots maintained under 100% inorganic management practices.

3. Evaluation of organic, inorganic and integrated production systems in finger millet

- The plots that treated with 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic fertilizers registered the maximum yield of 2905 kg/ha.
- The highest straw yield of 9168 kg/ha was recorded under RDF alone, which is followed by state recommended practices (8472 kg/ha).
- The plots applied with 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic management practices fetched maximum net return of Rs.40,764/ha followed by 75% organic + innovative organic practice (3% Panchagavya + Azophos @ 2kg/ha) applied plots (Rs. 39,983).
- BCR was higher (2.59) in plots maintained under recommended dose of fertilizers alone.

4. Evaluation of organic, inorganic and integrated production systems in pearl millet

- The highest grain yield of 1896kg/ha was recorded in plots treated with 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic manures.
- The treatments that received 50% organic (50 % FYM + 50 % vermicompost) + 50% inorganic fertilizers recorded the highest straw yield of 6650kg/ha.
- The highest net returns of Rs.20,334/- was realized in plots treated with 100% inorganic fertilizers management practices.
- The benefit cost ratio was maximum (2.15) in 100% inorganic management practices (RDF alone) applied plots followed by 75% organic (50 % FYM + 50 % vermicompost) + 25% inorganic management practiced plots (1.82).

5. Evaluation of response of different rice varieties suitable for organic farming

- Among the twelve rice varieties evaluated for their performance under organic production system, the rice variety CO (R) 48 had recorded the highest grain yield (4898 kg/ha) followed by improved white ponni (4762 kg/ha), CB05022 (4708 kg/ha), mappillai samba (4385 kg/ha) and bhavani (4161 kg/ha)

- The straw yield was higher in mappillai samba (10833 kg/ha) followed by CB 05022 (9349 kg/ha), CO (R) 48 (8884 kg/ha) and improved white ponni (8749 kg/ha).
- The traditional variety improved white ponni has fetched the highest net returns (Rs.58, 286 /ha) followed by mappillai samba (Rs.56, 245/ha), CO 48 (Rs.42, 803/ha), CB 05022 (Rs.41, 128/ha) and seeraga samba (Rs.34993/ha).
- Highest benefit cost ratio was also realized only from traditional varieties white ponni (2.10) and mappillai samba (2.06), followed by CO 48 (1.81), CB 05022 (1.78) and seeraga samba (1.66).

6. Development of Integrated Organic Farming System (IOFS) Model

- The IOFS model comprising of crop, livestock, fodder, perennial horticultural plantations, composting units, agro forestry, pest repellent cafeteria and bee keeping is the most suitable and efficient farming system model giving the highest system productivity for irrigated agro-ecosystem of Tamil Nadu.
- It has considerable potential to provide food security, nutritional benefits, employment generation and providing additional income to resource poor small farmers. The present study has provided the net income of Rs.74220 per annum with BCR of 2.17 generating an average of 557 man days per year.
- It was also known that the addition of organic residues in the form of animal and plant wastes help in improving the soil health and thereby productivity over the period of seven years with increased profit margin.
- The nutritional requirement of the system was self-sustained through resource recycling which curtails the cost of cultivation and increases profit margins and employment.
- Therefore, it is imperative to state that to sustain food and nutritional security, the IOFS approach is promising and will conserve the resource base through efficient recycling of residues and wastes within the system.
- It is an efficient way of using the same land resource to produce both carbohydrate and animal protein concurrently or serially as well as meeting the vitamins and mineral requirement through cultivation of vegetables and fruits on dykes and bunds, thus providing balanced diet to farm family, reducing malnutrition of the small and marginal farmers.

7. Geo-referenced characterization of organic and SPNF farmers

- Dindigul district is popularly referred as city of locks and tanneries. Diversified climate situation of the district favoured the farmers to cultivate high value crops such as onion, bhendi, tomato and brinjal, flowers and fruits.
- Majority of the organic farmers (80 %) are adopting diversified crops *viz*., vegetables cultivation (60 %) flowers (60 %) and fruits trees (55 %) as evinced from field survey.
- About 80 per cent of the organic farmers are using FYM as basal application for nutrient management followed by three fourth (75 %) of the organic farmers spray panchagavya @ 3 % as both nutrients source and for pest management.

- About half of the organic farmers (65%) are using neem extract as pest repellents followed by jeevamurth (60 %).Majority of the organic farmers (80 %) were practicing organic cultivation without organic certification.
- Three fourth of the farmers (80 %) are selling their products though local merchant followed by local market (30 %) and few through online (10 %).
- Reasons for adoption of organic farming as evinced through interaction with farmers were, use of locally available farm wastes, less labour intensiveness, easy to manage, satisfaction in producing eco- safe food and service motto to save environment as expressed by 80 % of the organic farmers.
- Individual member of the groups involved in entrepreneurial activities and produces value added product such as moringa powder exported to Middle East countries.

8. Cluster based demonstration of Organic Farming Package under TSP

Name of the district	Nilgiris
Name of the village	Pariyur (Lower Kotagiri)
Number of ST farmers covered	25
Name of interventions	• Crop rotation • Nutrient Management • Weed Management • Seed treatment techniques Vermicomposting • Panchagavya production • Organic vegetable cultivation • Organic pest management • Mushroom cultivation • Apiculture • Organic certification and PGS
Net benefit to farmers (Rs/ha) after intervention	• Improved livelihood and proceeding to sustainable farming

9. Cluster based demonstration of Organic Farming Package under SCSP

- Conducted PRA approach and collected soil and water samples in Cuddalore district
- Carried out demonstrations on seed treatment with bio-fertilizers, Panchagavya preparation, Jeevamirtham production and vermicomposting techniques.
- Conducted capacity building on organic nutrient and weed management
- Conducted capacity building on organic pest and disease management
- Distributed organic inputs such as paddy seeds, vermicompost, bio-fertilizers, bio-control agents and hand book in Tamil on 'Organic Agriculture for organic paddy cultivation'
- Provided continued support from sowing to sale of produce.

II. TANII Project on "Organic Inputs and Bio-Inputs Characterization for Sustainable Organic Agriculture"

- ✓ Created awareness on organic farming and different organic bio-inputs preparations to the farmers
- ✓ Promoted organic certification and marketing of produces
- ✓ Training has been given to the urban farmers and entrepreneurs on organic farming
- ✓ Selected 25 Tribal organic farm families in each districts of Tamil Nadu (1. Guziliamparai, Dindigul 2. Lower Kothagiri (Paaviyur), Nilgiris and 3. Karmangudi, Cuddalore districts) and demonstrated organic input preparation in last two years
- ✓ Regular trainings were given (Totally 553 numbers) to the farmers on organic input preparation during scheme period
- ✓ Visitors were engaged (356 numbers of farmers, students and VIP's) and organic bio-inputs preparation was demonstrated during scheme period
- ✓ Jeevamirtham and 5 leaf extract products were distributed to 500 contact farmers and also to the farmers during the field days
- ✓ Training programme was conducted on organic farming at UHTC, Chennai center on 22.11.2019 (around 80 farmers and entrepreneurs participated in the training)
- ✓ In general the cow urine based five leaf extracts (neem, notchi, Adathoda, Ailanthus and Jatropha) and 3G extracts (ginger, garlic and green chilli) showed comparable nympal mortality and adult emergence in white backed plant hoppers in rice.
- ✓ Benzene-1-ethoxy-4-methyl, Tetracosane, Diallyl disulphide were identified as the major bio-active compounds in cow urine based 3G extract analyzed through GCMS.
- ✓ Application of Jeevamirtham improved the soil organic carbon status
- ✓ Application of vermiwash, Fish amino acid, Egg amino acid and EEM enhanced the yield of rice and vegetables in farmers field
- ✓ In viral disease management the buttermilk with *Pesudomonas* and Arappu buttermilk karaisal performed well in gourds (vegetables)

III. Core Project - Zero Budget Natural Farming

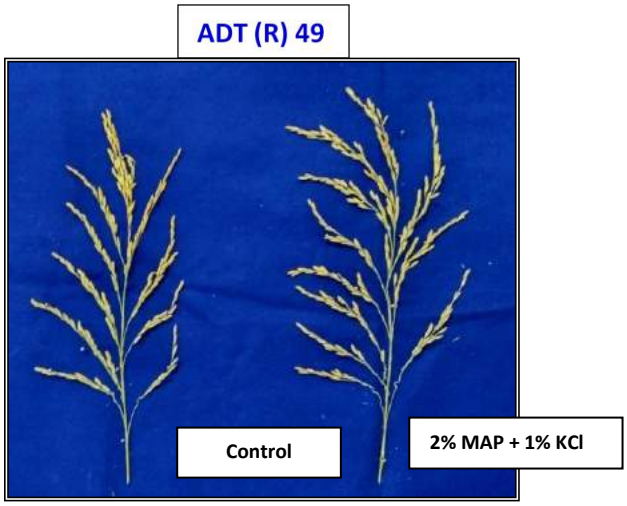
- ✓ Evaluation of in-situ composting experiments were carried out. Among the different treatments, compost maturity and nutrient status was found. Application of waste decomposer followed by TNAU bio-mineralizer are effectively composted the crop residues than the other inputs application.
- ✓ ZBNF scientific validation was carried out during 2019-20 at Eastern block, TNAU, Coimbatore along with sorghum + cowpea as intercrop
- ✓ Cowpea crop was performed poor due to high EC content of soil and irrigation water and yield was not obtained.
- ✓ Compare to other treatments the ZBNF treatment gave 60 % of the grain yield in sorghum crop due to application of organic sources
- ✓ ZBNF scientific validation work is in under progress as confirmation trial in the same field along with cotton + green gram

Field Trials of Network Project on Organic Farming

IV. Department of Crop Physiology

1. Improvement of grain filling in rice by foliar spray of nutrients and growth promoters

- Foliar application of 2% Mono Ammonium Phosphate (MAP) + 1% KCl at heading and grain filling stages increased the grain filling duration (26 to 30 days) and grain filling rate (1.01 to 1.18) mg grain^{-1} day^{-1} in three varieties (ADT 46, ADT 49 and CO 52). The grain yield increased up to 19 % over control.

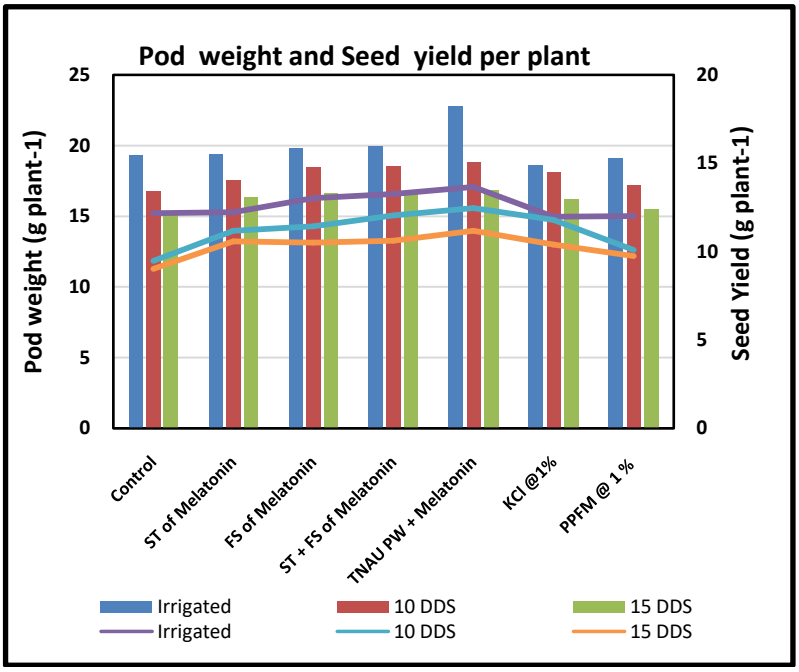


2. Rice varietal variation in flowering response to temperature

- The physiological basis for heat avoidance in IR 64 EMF was correlated with early first spikelet opening time i.e before 7.00 AM, lower panicle temperature and transpirational cooling at the time of anthesis. The heat tolerant donor, N22 showed advancement in time of flower opening and reached peak anthesis before 10:45 am, while peak anthesis of IR 64 and IR 52 were after 11.30 am affecting spikelet fertility and yield.

3. Drought Management in Pulses

- Foliar application of Melatonin @ 40 µM tank mixed with Pulse wonder (2%) has significantly increased relative water content, photosynthetic pigments, stomatal conductance and photosynthetic rate in green gram under drought stress condition. Further improved the yield of green gram both under irrigated (23.21%) and drought (30.81%) conditions.



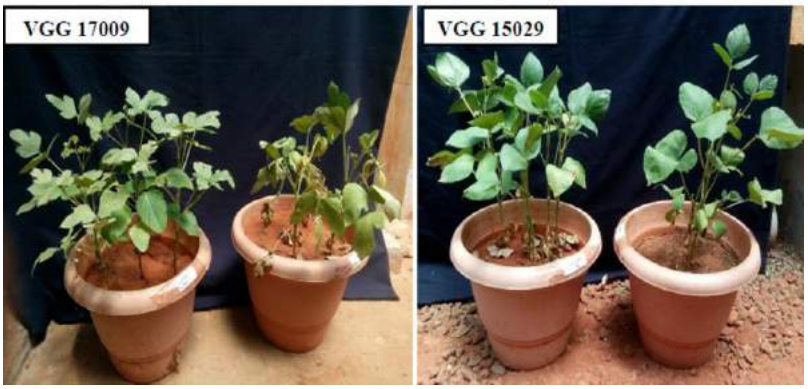
- Foliar application of nanocerium @ 100 µg g^{-1} under both irrigated and drought stress has improved pod weight (11 and 29%, respectively) and seed yield m^{-2} (10 and 22%, respectively) in green gram.

Irrigated - Ce @ 100 ppm

Drought- Ce @ 100 ppm

4. Screening greengram germplasm lines for drought and high temperature stress tolerance

- The greengram genotypes viz., COGG 1332, VGG 15029, VGG 16069, VGG 17003, VGG 17004, VGG 17009 and VGG 17019 were found tolerant to drought and high temperature stress at seedling, vegetative and reproductive stage. These genotypes showed higher proline content, chlorophyll stability index, relative water content and antioxidant enzyme activity.



5. Crop specific foliar formulations for yield enhancement in redgram

Foliar application of Nutrient consortia to the redgram variety, Co (Rg) 7, has enhanced the growth, physiological and biochemical parameters and significantly enhanced the seed yield (12 %) under normal condition.

Dr. R. Shanthi
Director, Natural Resource Management
TNAU, Coimbatore

(i). Department of Soil Science and Agricultural Chemistry

A. For Adoption

Evaluation of new chelated zinc and iron formulations for Maize

- In Zn and Fe deficient soils, foliar spraying of 0.5% Zn citrate (9% Zn) + 1.0 % Ferric citrate (10.9% Fe) thrice at 30, 40 and 50 DAS along with STCR based NPK registered 7.4 % higher mean grain yield (9458 kg ha^{-1}) than the existing recommendation of foliar spraying with 0.5% $ZnSO_4$ + 1% $FeSO_4$ + 0.1% citric acid (8806 kg ha^{-1}) besides higher grain Zn and Fe content, net income and B: C ratio.

Ferric citrate -10.9 % Fe

Zn Citrate-9% Zn

B. For Information

(i). Rice

Demonstration of STCR-IPNS based fertilizer prescription for rice in Cauvery Delta Zone

The demonstrations conducted at KVK, Needamangalam on Kalathur soil series for two seasons (Kuruvai and Thaladi) revealed that the highest grain yield was recorded with STCR-IPNS technology for 7 t ha^{-1} during kuruvai (6.86 t ha^{-1}) and thaladi seasons (6.60 t ha^{-1}) along with the highest response ratio (fertilizer use efficiency) of 11.58 and 9.73 kg kg^{-1}. The yield increase in STCR-IPNS treatment was 21.6 and 34.5 per cent and 20.6 and 38.9 per cent respectively over blanket and Farmer's fertilisation practice besides maintenance / built up in the post-harvest soil fertility status. Through these field demonstrations and farmer-scientist interaction, the benefit of adoption of STCR-IPNS technology in rice was highlighted to farmers of this region.

Field view-KVK, Needamangalam farm

Farmer- Scientist Interaction

Long term STCR-IPNS Experiment with rice-rice sequence on Alfisol

The highest mean yield (22 crops/ season) of 6.84 and 6.06 t ha^{-1} was recorded in kharif and rabi seasons along with highest average Response ratio (Fertilizer Use Efficiency) of 16.96 and 18.08 kg kg^{-1} respectively. The increase in yield was by 25.9 % and 23.7 % in kharif and rabi seasons respectively. After 21 years of cropping with STCR-IPNS technology there is maintenance of available N (280 to 266 kg ha^{-1}); built up in OC (4.6 to 8.4 g kg^{-1}) and available P (20.2 to 29.6 kg ha^{-1}); lesser magnitude of decline in available K (670 to 580 kg ha^{-1}). Hence, Soil test and yield target based fertiliser prescriptions under IPNS (STCR-IPNS) can be recommended for rice-rice sequence on Noyyal soil series (Typic Haplustalf) and allied soil series of Tamil Nadu for achieving higher yield, fertilizer use efficiency and soil fertility maintenance.

Field view
Wetland farms, TNAU

STCR-IPNS 7 t ha^{-1}

Decision Support System for integrated Fertiliser Recommendation (DSSIFER 2020)

The DSSIFER software, a computer based decision support system utilises the crop and location specific fertiliser prescriptions evolved through Soil Test Crop Response based Integrated Plant Nutrition System (STCR-IPNS) developed by the ICAR-AICRP-STCR, Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore and Mitscherlich-Bray percentage sufficiency recommendations developed by the Soil Testing Wing of the State Department of Agriculture, Tamil Nadu to generate crop and location specific balanced fertiliser prescriptions. If both are not available for a particularsoil - crop situation, the software can generate prescriptions using blanket fertilizerdoses but based on soil test values. The software has been upgraded as "DSSIFER 2020" and using the improved versionfertiliser doses can be prescribed for about 2235soil-crop situations and for 190 agricultural and horticultural crops along with fertilisation schedule. Besides, farmers' resource based fertiliser prescriptions can also be arrived at.In addition, the software provides reclamation measures for problem soils *viz.*, salinity, alkalinity or sodicity, acidity *etc*and irrigation water quality appraisal. The software is useful to all the Soil Testing Laboratories run by various organisations, progressive farmers, scientists, students and research scholars.

Permanent Manurial Experiment in Rice - Rice sequence

Madurai centre: After 45 years of cropping - higher yield in *rabi* season: 150:50:50 kg NPK + GLM @ 6.25 t ha^{-1} (5675 kg ha^{-1}), negative balance of N (-24 to -69 kg ha^{-1}), positive balance of P (+1.60 to 29.8 kg ha^{-1}), K (+3 to 41 kg ha^{-1})

and organic carbon (+1.10 to 4.80 g kg^{-1}); higher urease, dehydrogenase activity and microbial population in GLM + NP, NK & NPK treatments was observed.

Aduthurai centre: After 28 years of cropping - higher yield in *Kuruvai* season: 125:50:50 kg NPK + GM @ 6.25 t ha^{-1} (5901 kg ha^{-1}); *Thaladi* season: 150:60:60 kg NPK +12.5 t FYM ha^{-1} (6326 kg ha^{-1}), higher organic carbon (13.84 g kg^{-1}), available N, P & K - Positive balance - and built up was higher in INM.

STCR based Fertilizer Prescriptions for Rice under Sodic Soil

Fertiliser prescription Equations (FPEs) for rice on sodic soil have been developed and ready reckoner of fertiliser doses were computed for desired yield target of rice. Application of FYM @ 12.5 t ha^{-1} with a manurial composition of N: 0.60 %, P: 0.30 %, K: 0.50 % and moisture: 30% contributed 42:18:32 kg ha^{-1} of fertilizer N, P_2O_5 and K_2O and could be substituted from the recommended dose of fertilisers based on soil test values.

STCR-NPK alone			STCR-IPNS (NPK+FYM)		
FN	=	6.08 T - 0.72 SN	FN	=	6.08 T- 0.72 SN - 0.80 ON
FP_2O_5	=	1.64 T – 1.55 SP	F P_2O_5	=	1.64 T -1.55 SP - 0.69 OP
FK_2O	=	2.96 T – 0.39 SK	FK_2O	=	2.96 T -0.39 SK – 0.73 OK

where, FN, FP_2O_5 and FK_2O are fertiliser N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the grain yield target in q ha^{-1} and SN, SP and SK respectively are alkaline $KMnO_4$–N, Olsen–P and NH_4OAc –K in kg ha^{-1}; ON, OP and OK are quantities of N, P and K in kg ha^{-1} supplied through FYM.



Technology for improving the productivity of rice in Sodic Soil under water scarcity

Incorporation of Daincha (6.25 t ha^{-1}) + rice wet seeding + foliar spraying of antioxidant microbial consortia (1.5%) during boot leaf and panicle initiation stages with 100 % soil test based NPK significantly lowered the ESP (48.8%) and increased phosphatase activity in soil and proline content and higher grain yield in rice.

Reclamation of sodic soil with Organic and industrial amendments

Vermicomposting of Partially Decomposed Cowdung (PDC) + FA @ 3:1 resulted in reduction in C:N ratio from 31.63 to 11.07 (65%), increase in total N (0.784 - 0.96%), P (0.150 - 0.27 %), K (2.43 -2.98%) and Ca (11.40 -14.40 %) after 42 days of composting. Four of the five silica solubilising microbes isolated from sodic soil were used for microbial consortia preparation for *insitu* decomposition of paddy stubbles.

Effect of value added products from sugar and distillery industrial wastes on soil properties and performance of rice in calcareous sodic soil

Application of 75% STCR-K as value added products (VAP) from sugar and distillery industrial wastes with 100% STCR-N and P as inorganic sources was the best for increasing the grain yield of rice, agronomic efficiency and apparent nutrient recovery, carbon stock (15.31 Mg ha^{-1}) and humus stability index (2.35%).

Evaluation of Organic and Inorganic sources of nutrients under safe AWDI for transplanted rice

Under safe Alternate Wetting and Drying Irrigation (AWDI), application of recommended NPK + 12.5 t FYM ha^{-1} recorded the highest grain yield which was on par with recommended NPK + 6.25 t GM and STCR-IPNS + 6.25 t GM ha^{-1}. STCR - IPNS treatment sustained the soil fertility by saving 13:29 kg of fertiliser N and P_2O_5 ha^{-1} respectively.

Nitrogen management strategies for direct seeded rice in Kuruvai and Samba seasons

- **Aduthurai centre**: In Old Cauvery delta (Vertisol - Kalathur series) - High response was recorded for added N up to 125 kg ha^{-1} in terms of grain yield and N availability and was on par with N applied @150 kg ha^{-1} in both *Kuruvai* and *Samba* seasons.
- **Thanjavur centre**: In New Cauvery delta (Alfisol - Madukkur series) - higher response was recorded for the added N @150 kg ha^{-1} during Kuruvai season and 125 kg ha^{-1} during *Samba* season.

Nitrogen Use Efficiency of rice varieties and fertiliser management for sustainable production in Tamiraparani command area of Tamil Nadu

Among the 32 rice varieties tested with four levels of recommended N (0, 50%, 100%, and 150% RDF), the screened genotypes were grouped as : (i)Efficient and responsive (ER): ADT39, ADT45, TPS5, ACK14001, AD09206, CB06803, TM10085, TM12077, PM12009 and EC725224; (ii)Non-efficient and non-responsive : ADT 43, CO 51, MDU 5, ANNA 4, ACK 14004, AD 10034,CB 08702,TR 09027, TR 13069, TR 13083, TR 13007, TM 07335 and TM 12061. Application of either 100% N as Neem coated or 150 % N as gypsum coated urea recorded higher N use efficiency.

(ii). Millets

Permanent manurial experiment with maize - sunflower sequence on yield and soil health

In the 111 years old Permanent Manurial Experiment of TNAU, Coimbatore on red sandy loam soil (*Typic Haplustalf*), application of STCR-IPNS based fertilization recorded the highest grain yield of 8213 kg ha^{-1} followed by 100% NPK + FYM (7618 kg ha^{-1}) in hybrid maize. In sunflower, application of 100% NPK+FYM recorded the highest grain yield of 2346 kg ha^{-1}followed by STCR - IPNS (2143 kg ha^{-1}) besides sustained yield over years. Combined application of 100% NPK + FYM accumulated more carbon (83.8 kg ha^{-1} yr^{-1}) followed by STCR-IPNS (82.9 kg ha^{-1} yr^{-1}) and the same treatments maintained the positive balance of NPK in soil.

Addition of 100% NPK+12.5 t FYM ha^{-1} had increased microbial biomass carbon by 27.9% and microbial biomass nitrogen by 34%. The same treatment recorded 68, 34, 49.7 and 70% higher acid phosphatase, alkaline phosphatase,dehydrogenase and urease activities over 100% NPK, respectively. This

was closely followed by STCR-IPNS treatment in increasing the microbial biomass carbon, Nitrogen and enzyme activities over 100% NPK.


Economizing Phosphorus Use in Maize - Groundnut Production

In maize-groundnut sequence, application of 75% RDP as chitosan coated DAP to maize and 100% RDP to groundnut as SSP resulted in higher yield (6547 kg ha^{-1} – maize; 3197 kg ha^{-1} - groundnut), total P uptake (32.84 kg ha^{-1}), available P status of soil (25.6 kg ha^{-1}) and benefit – cost ratio (2.27).

STCR-IPNS technology for Little Millet

Fertilizer prescription equations validated for little millet (*var.*CO 4) revealed that the highest mean grain yield was recorded in STCR-IPNS-2 t ha^{-1} (2025 kg ha^{-1}) followed by STCR-NPK alone 2 t ha^{-1} (1945 kg ha^{-1}) and STCR-IPNS-1.75 t ha^{-1} (1805 kg ha^{-1}). The highest RR was observed in STCR-IPNS-2 t ha^{-1} (9.47 kg kg^{-1}) followed by STCR-IPNS-1.75 t ha^{-1} (8.69 kg kg^{-1}). The mean increase in grain yield due to STCR-IPNS-2.0 t ha^{-1} was 41.6% and 1.75 t ha^{-1} was 26.2% over blanket (44:22:0) + FYM.


Long Term Fertilizer Experiments (LTFE) on mixed black calcareous sandy clay loam soil

In the 48 years old long term experiment on mixed black calcareous sandy clay loam soil, application of 100% NPK+FYM @ 10 t ha^{-1} recorded 18.37 % yield increase in finger millet and 15.22 % yield increase in maize over 100 % NPK. Continuous addition of N fertilizer alone drastically declined yield of both the crops. Positive balance of N, P and K was observed in INM followed by 150 % NPK and 100% NPK + Zn. SOC stock and SOC sequestration was more in 100 % NPK+FYM (133 Mg ha^{-1} yr^{-1} & 6342 kg ha^{-1}) over 100% NPK (68 Mg ha^{-1} yr^{-1} & 4617 kg ha^{-1}).

Evaluation of Sorghum varieties for their tolerance to sodicity

The different sorghum varieties screened for sodicity indicated that *var.* CO 30 can be cultivated in soil having ESP up to 32% whereas the cultivar K12 can be cultivated only up to ESP of 24% for achieving 50% yield.

Yield maximization through optimization of nutrients for dual sorghum (K12) in different land configurations of dry land Vertisols

Cultivating dual sorghum (K12) in tied ridges recorded the highest grain yield (1772 kg ha^{-1}) followed by ridges and furrows (1654 kg ha^{-1}). Application of fertilizer as per STCR-IPNS recommendation recorded higher grain yield (2010 kg ha^{-1}) followed by 100% RDF (40:20:20 kg NPK ha^{-1}) with foliar application of 1% $FeSO_4$ + 0.10% citric acid + 0.50% $ZnSO_4$ ha^{-1} (1614 kg ha^{-1}). Higher Rain Water Use Efficiency of 4.08 and 4.72 kg ha^{-1}-mm was recorded in tied ridges method of land configuration and 100% NPK as per STCR-IPNS recommendation respectively.

Optimization of N, P and K requirement for Barnyard millet in black and red soils

For black soil, soil application of 40:15:15 kg of NPK ha^{-1} to Barnyard millet (MDU1) resulted in higher grain yield (2514 kg ha^{-1}) and 41.2% yield increase with the higher response ratio (14.8 kg kg^{-1})and B:C ratio (2.31). For red soil, soil application of 50:15:15 kg of NPK ha^{-1} resulted in higher yield (2413 kgha^{-1}) and per cent yield increase (41.5) with higher Response Ratio (12.5 kg kg^{-1}) and B:C ratio (2.20).

(iii). Oilseeds

Multi-micronutrients foliar formulation for alleviating the micronutrient deficiencies in groundnut

Foliar spraying of micronutrient Grade IV formulation (14 kg ha^{-1}) twice at vegetative and flowering stages increased the pod yield (2806 kg ha^{-1}) (17.1% over NPK alone) and BCR (2.54).

Iron efficient groundnut genotypes and microbial siderophores for calcareous soil

The screening of twenty groundnut genotypes for their iron efficiency under calcareous condition showed that the genotypes identified as iron efficient (CO7, TMV 1, VRI 8, TAG 24, JL 24and TMV 2) based on morpho physiological parameters under sand culture (45 DAS) and pot culture (45 DAS) are in close agreement with majority of the genotypes identified based on pod yield under field condition. Hence, sand or pot culture for a duration of 45 days and root volume and active iron as predictors can be used for selecting Fe efficient groundnut genotypes for calcareous soil. Four promising siderophore producing bacteria specific to calcareous soils was identified.

View of the Experiments Conducted for Screening of Groundnut Genotypes for Iron Efficiency

Efficient groundnut cultivars for zinc deficient soils

Among 20 groundnut genotypes, kernel yield Zn efficiency index ranged from 0.77 (TCGS 1157) to 1.10 (TMV 13). The genotypes CO 5, ALR 2, VRI 8, TMV 1, TMV 2, TMV 13, TAG 24, JL 24, Abhaya, Dharani and K6 recorded GYEI of more than 1 and were categorized as efficient Zn users. The genotypes CO 2, CO 3, CO 4, CO 7, ALR 3, VRI 8, TMV 7, Narayani and TCGS 1157 with GYEI of less than one but more than 0.5 were categorized as moderately efficient Zn users.

Permanent Manurial Experiment (PME) on Rainfed Groundnut and Cold weather Gingelly

The results of the Permanent Manurial Experiment (PME) on Rainfed Groundnut (58 thcrop) and Cold weather Gingelly (59th crop) showed that in both the crops, application of 100% NPK+FYM @ 12.5 tha^{-1} + herbicide (pendimethalin @ 3 L ha^{-1} for groundnut / alachlor @ 1 kg a.i ha^{-1} for sesame) recorded higher yield and available nutrients (N, P and K) in the post harvest soil. The treatments 100% N + Enriched FYM with optimum P and K and 100% NPK+FYM @ 12.5 t ha^{-1} recorded comparable yield with 100% NPK+FYM @ 12.5t ha $^{-1}$ + herbicide application.

(iv). Pulses

N utilization potential of prominent black gram varieties of TNAU

Results of the field experiments from Coimbatore, Madurai and Paiyur on evaluation of N utilization potential of prominent blackgram varieties of TNAU showed that of the four blackgram varieties tested, CO 6 registered the highest seed yield of 667 kg ha^{-1}which was on par with VBN8 and ADT 6 under irrigated conditions. The response of the varieties to the application of 100 % N and 125 % RDN was comparable. At all levels of N application, CO 6 recorded higher Nitrogen Use Efficiency (31.0 kg kg^{-1}) and Agronomic Efficiency of N (6.16 kg kg^{-1}).

Effect of zinc solubilizing bacteria on the zinc availability in alkaline soil and yield enhancement in black gram

In irrigated blackgram, under alkaline soil condition, combined application of recommended dose of NPK along with zinc through micronutrient mixture @ 5 kg ha^{-1}, Pulse wonder @ 5 kg ha^{-1} and zinc solubilising bacteria @ 4 kg ha^{-1} improved the growth and yield attributes and recorded the highest seed yield of 909 kg ha^{-1}.

Multi nutrient foliar fertilization for irrigated greengram

Foliar application of TNAU WSF 2 % + Liquid multi micronutrient 1% + HA 1% at vegetative and flowering stages along with recommended dose of NPK recorded the highest seed yield of 770 kg ha^{-1} of green gram (*var.* VBN 4) under irrigated condition with 34.0 per cent increase in seed yield over untreated control.

Macro Nutrient Mixture to Boost Red Gram Yield

In redgram (CO Rg 7), soil test based application of NPK (25:50:30 kg NPK ha^{-1}) as macro nutrient mixture of CAN + DAP + SOP and Urea + DAP + SOP resulted in highest plant height and number of primary branches at 30, 60, 90 and 120 DAS. The treatments, CAN + DAP + SOP and Urea + DAP + SOP registered the maximum seed yield of 851 and 845 kg ha^{-1} which were 26.1 per cent and 25.2 per cent increase over control (675 kg ha^{-1}) respectively. The yield increase was 12.5 and 11.8 per cent over Urea+SSP+MOP. However, application of Urea + DAP + SOP gave higher benefit cost ratio of 3.75 followed by CAN + DAP + SOP (3.42).

(v). Cotton

Screening of cotton genotypes for magnesium efficiency

Field experiments conducted with 13 cotton genotypes to identify the magnesium efficiency with and without $MgSO_4$ fertilization (50 kg ha^{-1}) revealed that, the genotypes *viz*., MCU 5 VT, MCU 7 and K12 having higher yield efficiency (>90%) were grouped as Mg efficient genotypes. The genotypes SVPR 2, SVPR 4, SVPR 5, were categorized as Mg in-efficient genotypes with lesser yield efficiency (75.2 to 79.0%). Rest of the genotypes *viz*., KC3, MCU 5, Anjali, Suraj, Suvin and SVPR6 were grouped as moderately efficient genotypes with the yield efficiency of 80 to 90%.

Permanent manurial experiment on cotton under rainfed deep black soils

In Permanent manurial experiments on cotton under rainfed deep black soils, the highest seed cotton yield (1364 kg ha^{-1}), stalk yield (3410 kg ha^{-1}), net income (Rs.28102 ha $^{-1}$), B:C ratio (1.81) and RWUE (3.20 kg - ha mm $^{-1}$) was obtained with 100% RDF + 25 kg $ZnSO_4$ and was comparable with 50 % inorganic N + 50% organic N (FYM) + P (50%) + K (50%). Built up of soil available nitrogen (105 to145 kg ha^{-1}), available phosphorus (11.2 to 17.6 kg ha^{-1}) and available potassium (345 to 610 kg ha^{-1}) over the initial status (2011) was observed with 100% RDF + 25 kg Zn SO_4 ha^{-1} and was comparable with 50 % inorganic N+ 50 % organic N (crop residue/FYM) + P (50%) + K (50%)

Integrated plant nutrient supply on nitrogen fertilization for cotton under rainfed alfisols

In alfisols, highest seed cotton yield (1182 kg ha^{-1}), stalk yield (2955 kg ha^{-1}), net income (Rs.21157 ha^{-1}), B:Cratio (1.75) and RWUE (2.77 kg ha mm $^{-1}$) was obtained in STCR - IPNS (60:10:20 kg N P_2O_5 K_2O ha^{-1}) for rainfed cotton and it was comparable with 100 % RDF (40:20:40 NPK kg ha^{-1}) and 50 % N (inorganic) + 50% N as poultry manure.

(vi). Sugarcane

Foliar formulation of micronutrients for alleviating the multi-micronutrient deficiencies in sugarcane

Foliar spraying of micronutrient Grade IV formulation (15 kg ha^{-1}) twice at @ early tillering (60 DAP) and tillering stages (90 DAP) increased the cane yield and alleviated the micronutrient deficiencies in sugarcane with a yield increase of about 18% over NPK Control.

(vii). Horticulture crops

Fixing critical limit for Mg in crops and soils:

Field experiments conducted with different levels of $MgSO_4$ revealed that, soil application of 60 kg $MgSO_4$ ha^{-1} was found economical for increasing the tuber yield of Potato by 16.5 to 23.5%. However, the response to added fertilizer Mg varied with soil Mg availability hence the following recommendations can be adopted to increase the yield of potato:

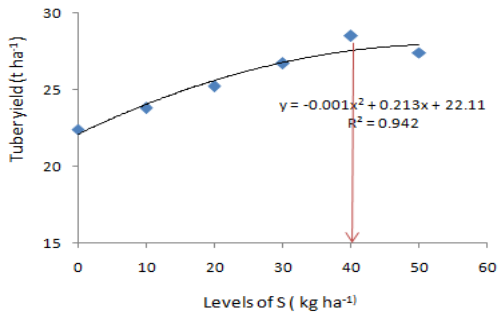
Soil Mg content (mg kg^{-1})	**Optimal rate of $MgSO_4$ (kg ha^{-1})**	**Response over NPK check (% increase)**
> 55	80.0	23.2 - 32.7

110 -175	60.0	28.5 - 30.4
> 280	40.0	20.6 - 21.0

Critical limit was fixed for Mg in acid soil (<42 mg kg^{-1}) and for potato plants (0.27%)to make fertilizer Mg recommendations.

Optimizing the sulphur requirement of carrot for increasing tuber yield and quality:

Seven field experiments conducted to optimize the rate of sulphur application for improving the yield and quality of carrot (*var.* zubera) revealed that, soil application of recommended NPK + 40 kg sulphur ha^{-1} was found optimal and economical for increasing the yield of carrot (28.5 t ha^{-1}) with the BCR of 4.64, besides improving the growth and yield attributes on sulphur deficient soils. Increasing levels of sulphur application increased the sulphur content and uptake by carrot besides improving the soil sulphur availability and quality attributes of carrot.



Optimizing the rate of $ZnSO_4$ application to aggregatum onion: Field experiments conducted in four different locations to optimize the rate of $ZnSO_4$ application for increasing the yield of aggregatum onion indicated that, soil application of 25 kg $ZnSO_4$ ha^{-1} was found optimal for obtaining higher yield with an average yield increase of 17.0% over NPK control. Increasing levels of $ZnSO_4$ application increased the plant Zn content, its uptake and soil Zn status and application of 50.0 kg $ZnSO_4$ ha^{-1} maintained the highest zinc uptake and availability in all the locations.

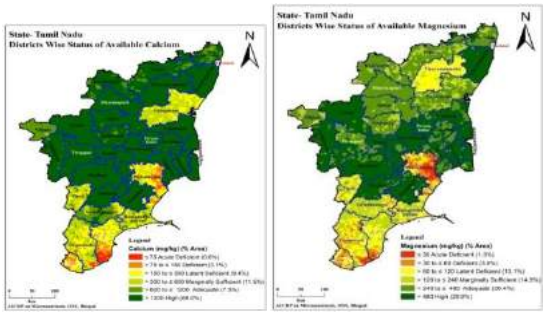
Optimizing the rate of Zn and Cu chelates for improving the yield and quality of hybrid tomato and small onion under drip fertigation

Two field experiments conducted each in tomato (hybrid Karishma) and small onion (var. CO 5 and Thuraiyur local) to optimize the rate of application of organo Zn and Cu chelates revealed that fertigation of 1.0 kg Zn glycinate ha^{-1} thrice at basal (50%), vegetative (25%) and flowering stages (25%) of the crop was found optimal and economical for increasing the fruit yield and quality of hybrid tomato by 20.7%. For small Onion, fertigation of 2.5 kg Cu citrate ha^{-1} twice at basal (50%) and on 30 DAP (50%) was the best and economical in increasing the bulb yield and quality of small onion (18.9%).

(viii). Non crop specific projects

Extent of Calcium and Magnesium deficiencies in soils of Tamil nadu

The overall calcium deficiency in Tamil Nadu soils was only 7.0%; however, the soils of few districts *viz.*, Kanyakumari (57.7%), Thoothukudi (54.9%) and Pudukkottai (46.3%) were having more than 40 % Ca deficiency. As regards Mg, the average deficiency was 10.8% ranging from 0.11 to 64.5% deficiency; the soils of Kanyakumari (66.6%), Pudukkottai (64.5%) and Thoothukudi (42.4%) districts were having very high Mg deficiency.

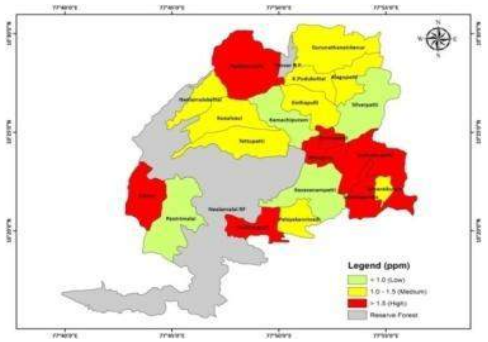


Irrigation water quality appraisal of various districts / blocks of Tamil Nadu

Ground water samples of Ramanthapuram district is characterized under good quality (10%), marginally saline (10%), saline (4%), marginally alkaline (1%), alkaline (10%), high SAR saline (46%), and high alkaline (19%) water.

Potential salinity exceeded the critical limit of 10 me L^{-1} in about 48% of the groundwater samples in Periyanaickenpalayam block. About 17 % of the groundwater samples were grouped under saline.

About 25% of the groundwater samples in Kundadam block and 32% of the samples in Reddiyarchatram block of Dindigul district is affected with fluoride (>1.5 mg L^{-1}).



Desalinisation of irrigation water

Capacitive deionization with zinc and iron electrodes was successful in reducing the electrical conductivity of irrigation water by 1 unit at < 4 V. Because at > 4 V, the water is unstable and electrodes also get ionized resulting in an increase in electrical conductivity of water.

Nutrient composition of seriwaste compost

Nitrogen, phosphorus, potassium, copper and zinc content of seriwaste compost were significantly higher in sericompost through EM (N - 2.78 %, P - 1.3%, K -1.7% Cu - 61.3 mg kg^{-1} and Zn - 95.2 mg kg^{-1}) followed by sericompost through earthworm (N - 2.41 %; P –0.8 %, K -1.1% , Cu - 55.8 mg kg^{-1} and Zn -90.3 mg kg^{-1}). Iron and manganese content was higher in sericompost through earthworms (1298 and 479.3 mg kg^{-1}) followed by EM (1190.2 and 463.1 mg kg^{-1}).

C. Proposals for on farm testing (OFT)

(i). Technology for improving the productivity of rice in sodic soil under water scarce condition

Objective: To improve the productivity of rice in sodic soil under water scarce condition.

Treatments:

T_1: Farmer's Practice

T_2: Daincha incorporation followed by rice wet seeding + anti oxidant microbial consortia (AOMC)+100% soil test based NPK

T_3: Daincha incorporation followed by rice wet seeding + anti oxidant microbial consortia (AOMC) +
125% soil test based NPK

AOMC application: Liquid Formulation foliar spray @ 1.5% at boot leaf and Panicle initiation stages

Observations to be recorded: Leaf microbial population, DPPH assay, Dry Matter production
Grain & Straw yield

Coordinating scientist: Dr. P. Janaki, Associate Professor (SS&AC) &Dr. J. Ejilane, Assistant Professor (AGM), ADAC&RI, Trichy

Centres and Scientists:

AC&RI, Killikulam : Dr. D. Lenin Raja, Assistant Professor (SS&AC) &Dr. K. G. Sabarinathan,, Assistant Professor (AGM)

RRS, Paiyur : Dr. M. Vijayakumar, Assistant Professor (SS&AC)

(ii). Optimization of N, P and K requirement for Barnyard millet (*var. MDU 1*) in *Red* and *Black* soils

Objective: To test verify the optimized dose of N, P and K requirement for barnyard millet in Red and black soils of Tamil Nadu

Treatments:

T_1 Blanket Recommendation (44:22:0 kg NPK ha^{-1})

T_2 40:15:15 kg NPK ha^{-1}

T_3 50:15:15 kg NPK ha^{-1}

Crop: Barnyard Millet-Var.MDU 1; Irrigated

Observations to be recorded

- ✓ Initial and Post harvest soil analysis for available N,P & K
- ✓ Dry matter production, plant nutrient content and uptake at harvest
- ✓ Yield attributes: Ear head length, number of productive tillers per plant, ear head weight per plant (g) and 1000 grain weight (g)
- ✓ Grain and straw yield
- ✓ Grain quality parameters *viz.,* protein content (%) and starch content (%)

Centres and Scientists

AC&RI, Coimbatore : Dr. S. Thiyageshwari, Professor (SS&AC), Dept. of SS&AC

AC&RI, Madurai : Dr. P.Kannan, Asst.Professor (SS&AC), Dept. of Soils &Env.

CoE for Millets, Athiyandal: Dr.K. Sivakami, Asst. Professor (Agronomy)

Coordinating scientist: Dr. S. Thiyageshwari, Professor, Dept. of SS&AC, TNAU, CBE-3

iii). Assessing the effect of mechanization on soil compaction in sugarcane and developing suitable management strategies

Objective : To study the effect of intensified mechanization in sugarcane cultvation on soil compaction

Treatment details:

T_{1-} Chisel ploughing at early stages of land preparation and farm yard manure @ 12.5 t/ha

T_{2-} Farmers practice

Observations to be recorded

Soil bulk density, particle density, hydraulic conductivity, Infiltration rate, Porosity

Soil texture at 3 different depth (20,40 & 60 cm), Growth and yield and quality parameters

Action: SRS, Cuddalore, SS&AC, TNAU, Coimbatore and SRS, Sirugamani

Scientist in-charge

1. Dr. M. Jayachandran, Professor & Head, SRS, Cuddalore
2. Dr. N. Chandrasekaran, Professor (SS&AC), TNAU, Coimbatore
3. Dr. R. Nageswari, Assistant Professor (Agronomy), SRS, Sirugamani

(iv). Developing multi micronutrient foliar formulation for alleviating the micronutrient deficiencies in sugarcane

Objective: Evaluation of micronutrient foliar mixture for the management of multi micronutrient deficiencies and increasing the productivity of Sugarcane

Treatment details:

T_1: Recommended NPK based on STCR-IPNS + water spray*

T_2: Recommended NPK based on STCR-IPNS + Foliar spray of Micronutrient mixture @15.0 kg ha^{-1} twice*

* Spray timings: Early tillering (60 DAP) and tillering (90 DAP) stages

Observations to be recorded:

Growth attributes, yield attributes & cane yield, quality parameters and BCR.

Action:

Coordinating centre & Scientist: Soil Science and Agricultural Chemistry, TNAU, Coimbatore:

Dr.D.Jegadeeswari, Assoc. Professor (SS&AC)

Centres & Scientist involved:

Scientist in-charge:

1. SRS, Cuddalore : Dr. G. Gayathry, Assistant Professor (Ag.Microbiology)
2. AEC&RI, Kumulur : Dr. M.Baskar, Associate Professor (SS&AC),

(v). Response of crops to applied amendments under fluoride stress condition

Objective : To study the response of crops to applied amendments under fluoride stress condition

Treatments

T_1-Control (RDF alone) ; T_2- RDF + FYM @ 12.5 t ha^{-1} ; T_3-RDF + Gypsum @ 2 t ha^{-1}

*RDF: As per STCR

Crop: Maize (CO 6); Irrigated

Observations to be recorded:

- Growth and yield parameters (Grain & Stover)
- Fluoride content in the soil and plant samples
- Soil pH, EC and organic carbon content

Co-ordinating Centre & Scientist :

Dept. of SS&AC & WTC, TNAU, Coimbatore; Dr. M. Elayarajan, Assoc.Professor (SS&AC)

Centres involved & Scientists

WTC, TNAU, Coimbatore : Dr. M. Elayarajan, Assoc.Professor (SS&AC)

RRS, Paiyur : Dr.M.Vijayakumar, Assistant Professor (SS&AC)

MRS, Vagarai : Dr. M. Mohamed Amanullah, Professor (Agronomy)

(ii). Department of Agricultural Microbiology

B. For information:

Rice:

Popularization of stage-specific inoculant for rice in Tamil Nadu

Application of specific inoculants at different growth stages of the rice crop ensures yield maximization. Six biofertilizer production units of TNAU have been upgraded for Stage-specific inoculant production. Total of 120 front-line demonstrations and field days; 60 trainings to the farmers; 24 trainings to the extension officials conducted for popularization of Stage-specific inoculants.

***Bacillus altitudinis* FD48 induces systemic tolerance in rice against moisture stress**

Bacillus altitudinus FD48 under induced moisture stress triggered the antioxidant defense enzymes *viz*., catalase, peroxidase and superoxide dismutase, ascorbate peroxidase, and proline that aids in drought resilience of rice cultivars (CO51 and IR64). Yield and yield attributing components were superior in *B. altitudinis* FD48 inoculated plants under drought stress. It induces drought-responsive genes of rice for drought mitigation. It also induces root metabolome (d-mannitol, benzoic acid, squalene, β-D-glucopyranoside, cis-vaccenic acid, acetyl syringic acid, coumarins, and l-(+)-ascorbic acid), conferring drought tolerance in rice.

Rhizosphere and Phyllosphere yeasts to improve rice growth, drought mitigation and soil aggregation

Yeast strains isolated from rhizosphere of rice and other crops have multi-functional beneficial role in plant growth promotion (mineral solubilization, growth
hormone and siderophore production) and also improve soil aggregation. Foliar spray of yeast cell lysate (0.2%) significantly triggered rhizosphere colonizing ability of PGPR strain in rice. It modulates rice and changed the chemical composition of root exudates. The change in root exudation favored rhizosphere biological properties and chemotactic motility of PGPR and hence improved the plant and soil health. Spraying yeast lysate favored rice plant for drought mitigation, which in turn recovered from drought (at 50% field capacity) and ensured yield under field conditions.

P solubilizing ability of yeast strains

New Promising inoculants for growth and drought mitigation of rice

New promising inoculants are *Bacillus megaterium* PB50, *Bacillus altitudinis* PB46, *Sphingobium yanoikuyae* MH394206 that possess multifaceted plant growth promoting traits, drought mitigation in rice and capable to colonize internal tissues of rice.

Multifaceted *Azotobacter* as inoculant for rice

Azotobacter vinelandii MAZO 36 and *A. salinestris* MAZO 13 from rice rhizosphere showed enhanced plant-growth promoting activities *viz*., N fixation, P and Zn solubilization, IAA and siderophore production. Seed coating of *Azotobacter vinelandii* MAZO 36 with A*rbuscular mycorrhiza* significantly increased the grain and straw yield (17.8 & 19.2% over control) of direct-sown rice (CO51). This technology can be an alternative to present inoculants (*Azospirillum* + PSB) for direct-sown rice.

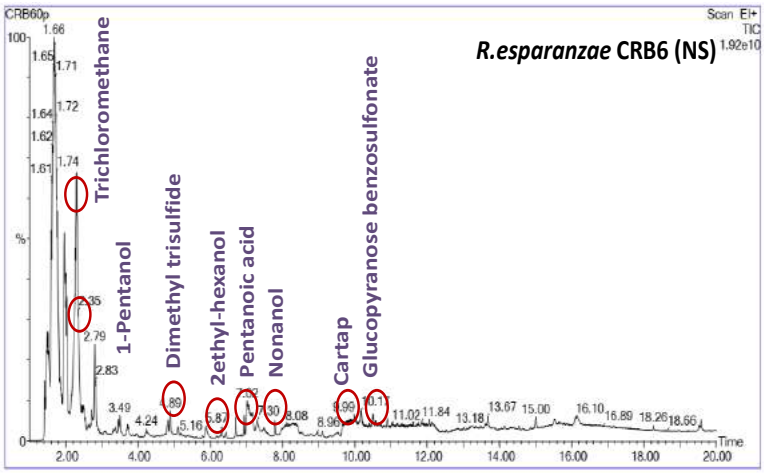
Plant Growth promoting and drought-tolerant bacterial isolate S2 for little Millet:

Endophytic bacterial strain S2 was screened with maximum drought tolerance (-6.25 MPa) and PGP traits. Seed endophytic bacterial strains tolerated upto -4.5 MPa and possess maximum nutrient solubilization efficiencies. Fumaric acid, oleic acid, hexadecanoic acid, 1-octanol, 2-butyl, L-ascorbic acid, and sitosterol are the metabolites responsible for drought tolerance during seed germination. Apoplast metabolome profile revealed that the cultivar CO 4 is more drought tolerant than ATL1.

A multi-functional plant probiotic, *Rhizobium esperanzae* CRB6 for finger millet :

R. esperanzae CRB6 possess plant growth-promoting traits such as nutrient solubilization, Acc deaminase, siderophore and phytohormones. Seed biotization with CRB6 in nanoemulsion improved the germination percent (66 to 74%) under induced drought deficit condition.

Pulses



Multilocation testing of *Rhizobium* strains for blackgram

In Blackgram MLT, *Rhizobium* isolate - GUR 5 (Kalaburagi) recorded more number of nodules/plant (31.7/plant) whereas *Rhizobium* isolate -VUC (Vamban) recorded the higher yield of 1271 kg/ha followed by PUR 34 (Pantnagar Ch.strain) - 1142 kg/ha).

Non-rhizobial endophytic yeast (NREY), *Candida tropicalis* VYW1, and *Rhizobium* sp. VRE1 for crop health, drought protection, and sustainable productivity of blackgram

Rhizobium and yeast interactions help balck gram growth and yield

The interaction of *Rhizobium* sp. VRE1 and *Candidatropicalis* VYW1 isolated from black gram nodule, exhibited significantly enhanced plant growth-promoting traits (IAA), nutrient acquisition (P, K and Zn), and ACC deaminase activities under induced moisture stress. Metabolites, D-galactopyranoside produced due to these interactions, activate the lectin complement pathway and facilitates nodulation by *Rhizobium.*

Validation of stability of *Rhizobium* mutant VM -1

In blackgram, both *Rhizobium* mutant (VM1) and *Rhizobium* wild (native) recorded more nodulation & nodule dry weight in combined application with 75% RDF as 14.07 & 13.57 nodules/plant. Whereas, the survival of *Rhizobium* mutant (VM1) under field condition was comparatively lesser to *Rhizobium* wild.

Multilocation testing of *Rhizobium* strains for greengram

In Greengram MLT, Vamban *Rhizobium* isolates *viz.,*VMF and VMC recorded more nodules /plant (53.4 and 42.0) and yield (1135 kg/ha & 1096 kg/ha) respectively.

Isolation and screening of efficient rhizobial strains and evaluation of their efficiency in Moth bean

A new rhizobial culture MB-1 was isolated from moth bean under **drought stress region** and identified as ***Rhizobium skierniewicense*** by 16SrRNA sequencing techniques. MB-1 *Rhizobium skierniewicense* recorded higher nodulation, biometrics and yield compared to standard rhizobial isolates in pot culture and in field studies. The moth bean *Rhizobium* MB-1 was found to possess drought tolerant trait and was found to be compatible with phosphobacteria (PSB) and potash releasing bacteria (KRB-9).

Gamma irradiated mutants of *Bacillus* spp. and *Actinobacteria* consortium to control the wilt and root rot diseases of Pulses

The efficient *Bacillus* spp. and actinobacteria *viz*, *Bacillus subtilis* BRBac4-1, *Bacillus siamensis* BRBac21-1, *Bacillus subtilis* BRBac24-2, *Bacillus subtilis* BRBac16-2, *Streptomyces* sp. BRAcB10-2 and *Streptomyces* sp. BRAcB11-1 were screened through dual culture assay and characterized based on 16S rRNA gene sequence analysis. All the four *Bacillus* isolates were positive for presence of surfactin and iturin in their extracellular supernatant. Gamma irradiated *Bacillus* spp. and actinobacteria showed higher inhibition against pathogens.

Oilseeds

Salt tolerant rhizobia for growth promotion and yield of groundnut in saline soils

Molecular characterization of nodule showed three rhizobial species - *Rhizobium phaseoli*, *Rhizobium pusense* and *Rhizobium mayense*. Non-rhizobial endophytes *viz*., *Dyella*, *Burkholderia*, *Enterobacter*, *Bacillus*, *Brevibacillus*, *Klebsiella*, *Massilia* and *Inquilinus* were also found. Salt tolerant bacteria viz., *Rhizobium phaseoli* S18, *Rhizobium pusense* S6R2, *Pantoeadispersa*YBB19B, and *Bacillus tequilensis*NBB13 possessed the multiple plant growth-promoting traits. Co-inoculation of *Rhizobium pusense* S6R2 plus *Pantoeadispersa*YBB19B, (or) *Rhizobium pusense* S6R2 plus *Bacillus tequilensis*NBB13 significantly improved the groundnut growth under saline condition.

Enhancing the productivity of sesame using microbial inoculants

Co-inoculated plants with *Azospirillum* and Sulphur Oxidizing Bacteria (SOB) both by seed treatment (600 g ha^{-1} of seed) and soil application (2 kg ha^{-1} each) integrated with 75 % RDN has recorded higher sesame seed yield (790 kg ha^{-1}) and B:C ratio (3.02). *Azospirillum* was found to be effective in sesame than *Azospirillum, Azotobacter* and SOB were found to compatible in rabi/ summer sesame.

Non Crop

Recombinant xylose reductase (XR) was cloned and over produced in *E. coli* up to 5mg/100 ml with specific activity of 270 U/mg. Besides, BC Projelly and spray powdered products were also produced.

BC nanofibre was fabricated and immobilized with *Lactobacillus acidophilus* 016. Spray dried probiotic BC powder improved viability of the encapsulated cells.

Maximum lipid content of 48.59 % produced by yeast was used as feedstock for biodiesel production. Besides, COD, BOD and cyanide content were reduced to 83.52%, 92.11%, and 78.93%, respectively. Lipid yield under shake culture condition was 1.21g/L and under Air Lift Bioreactor, the lipid yield is 2.68g/L .

Thermophilic bacteria *viz., Brevibacillus borstelensis* & *Bacillus subtilis* with pH (3-9) & temperature tolerance (50°C) was isolated from from Himachal Pradesh (Manikkaran) and has higher the ability to produce cellulase, protease, lipase, esterase, amylase & laccase.

Among the 11 phyllosphere yeasts, *Rhodotorula* showed maximum inhibition against *H. oryzae*(50.80 %)*,P. oryzae*(46.69 %) and *S.* o*ryzae*(40.26 %). Further, *Rhodotorula*+ *Dirkemia* + *Pseudozyma* +75% RDF increased the grain yield of rice (ASD 16) by 12% under pot culture conditions.

c. On Farm Trial proposed for 2020-2021

Pulses

Evaluation of drought tolerant rhizobial strain in Moth bean

Treatments

T_1- 100 % NPK

T_2- *Rhizobium* (MB-1) + 75% N + 100 % PK

T_3- *Rhizobium* (MB-1)+PSB + KRB-9 + 75 % NPK

Season: *Rabi* **Variety** : MD 1

Observation to be recorded

Plant height, No. of root nodules / plant, seed yield, total chlorophyll and proline content.

Soil nutrient status – Initial and post-harvest.

Centres & Scientist incharge:

Coordinating centre: ORS, Tindivanam Dr. R. Brindavathy, Assoc.Prof.(AGM)

AC&RI, Madurai: Dr. K. Kumutha, Professor & Head (AGM)

CEM, Athiyandal:Dr. K. Ananthi, Asst.Prof (CRP)

Oilseeds

Effect of sulphur oxidizing bacteria on yield of sesame

Treatments

T_1 -100 % RDN + Sulfur@40 kg /ha

T_2- 75 % RDN + Seed treatment with *Azospirillum* + Sulfur@40 kg /ha

T_3-75 % RDN + Seed treatment with *Azospirillum*& SOB +soil application of SOB on 45 DAS+ Sulfur@40 kg /ha

Coordinating Centre:

ORS, Tindivanam : Dr.R. Brindavathy, Assoc. Prof. (Agricultural Microbiology)

Centers : RRS, Vridhachalam : Dr. C.Harisudan, Asst. Prof.(Agronomy)

Dept. of Oilseeds : Dr.T.Selvakumar, Asst. Prof. (Agronomy)
Dr.R.Anandham, Asst. Prof. (Agrl. Microbiology)

Season : Rabi/Summer 2020-2021

Observations to be recorded

- Growth parameters
- Yield attributes and seed yield (kg/ha)
- Microbial population
- Nutrient Status
- Economics

(iii). Department of Environmental Sciences

A. FOR ADOPTION

Development of Elite Microbial Consortium for Degradation of Ligno cellulosic Wastes

For improving the efficiency of existing microbial consortium to degrade the ligno cellulosic wastes, few bacterial and fungal cultures were isolated, characterized and included in the "TNAU biomineralizer " which is given for technology commercialization. It is recommended @ 2kg per tonne of biodegradable waste for composting and the clientele are farmers, entrepreneurs, municipalities, panchayats and State Departments.

Biosorbent for Sequestration of Heavy metals

Optimized the water hyacinth biochar for maximum chromium (Cr) adsorption (Size 0.2 mm; dosage: 2.5% and contact time of 12 hours for Cr (III) and 36 hours for Cr (VI).)

The efficiency of the desorbing agents to recover Cr were in the order of 0.1M HCl > 0.5M HCl > 0.1M H2SO4 > 0.5M H2SO4. Hence Water hyacinth biochar @ 2.5% for chromium removal from tannery effluent and 0.1M HCl for higher desorption of Cr from Cr adsorbed biochar for recycling in tanneries for chrome tanning process is recommended.

Odour Management in Sewage through Biofloating Technique

Biofloating technique with *Terminalia arjuna, Millingtonia hortensis, Hibiscus tiliaceus and Melia dubia* and two microbial consortium viz., *Acidithiobacillus ferrooxidans, Acidithiobacillus thiooxidans* @0.5%v/v ($x10^4$ CFU ml^{-1}) along with two reed plants like *Brachiaria mutica* and *Phragmites sp* were found to reduce odour in sewage under open lagoon system. This can be adopted by civic bodies and private consultants adopting sewage treatment through open lagoon system / oxidation ponds.

Phytoremediation for Salt Affected Soils

The plant, *Sesuvium portulacastrum* with a spacing of 10 cm x 20 cm which produced a biomass of 15 t ha^{-1} in 90 days with a total salt removal upto 1.7 tons and reduced the soil ESP from 32 to 27.7 and EC from 6.12 to 4.95 dS m^{-1} can be recommended for phytoremediation of salt affected soil, which can be adopted by farmers / industries.

Recycling of Coir Industry Wastewater through Phytoremediation

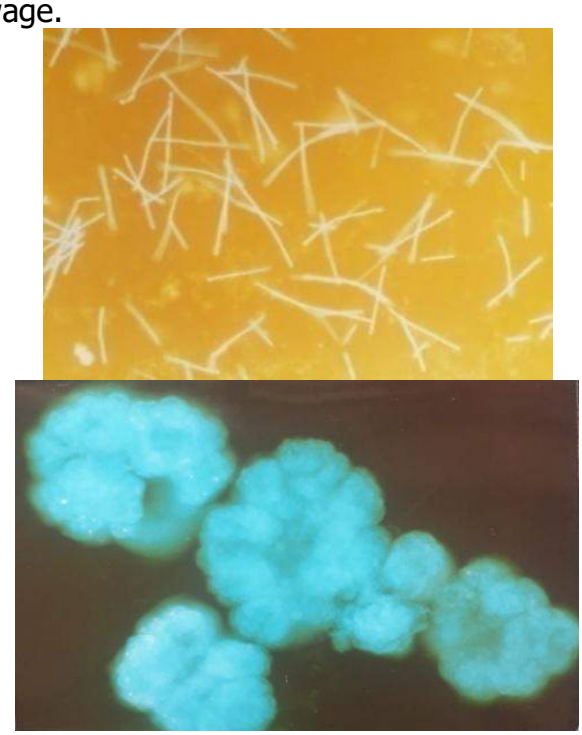
Low cost constructed wetland system with vetiver grass achieved a reduction of BOD (44.47%), COD (47.23%), TDS (57.07%) and polyphenols (40%) in the coir industry wastewater. Therefore, coir industry wastewater treated through constructed wetland system can be utilized by coir Industries along with farm yard manure @ 12.5 t ha^{-1} and recommended fertilizer dose (1.3 kg of Urea, 2 kg of SSP, 3.5 kg of MOP and 1 kg of TNAU micronutrient mixture per palm) for coconut.

B. FOR INFORMATION

Sewage Treatment and Energy Production

Sewage inoculated with Sulphate Reducing Bacteria (SRB) @ 10 ml L^{-1} reduced the population of coli form in sewage to the tune of 58 per cent. Anaerobic microbial consortium containing *Clostridium* sp, *Bacteroides* sp,

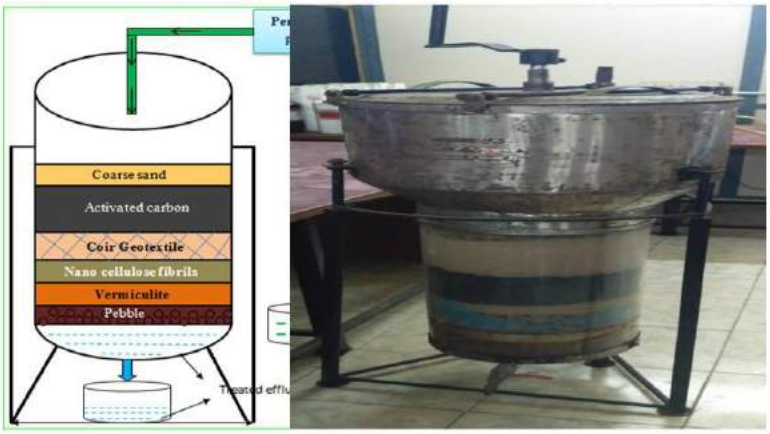
Methanobacterium sp and *Methanosarcina* sp showed the highest reduction of volatile solids (64 %) coupled with higher biogas and methane content (59 %) from sewage.



Wastewater Treatment using Coconut shell based Activated Carbon

Activated carbon prepared from coconut shell improved its efficiency through chemical activation. The yield of activated carbon with zinc chloride, calcium carbonate, sulphuric acid, hydrogen peroxide and phosphoric acid activated samples were found to be 51.4 %, 47.2 %, 49.6 %, 47.5% and 39.8% respectively.

Filtration system with zinc chloride impregnated activated carbon with nitrogen flow along with coir geotextile, nano cellulose fibrils resins and vermiculite for effective pollutant removal in wastewater was designed. Upscaling and process modification like design parameters, flow rate, flow pattern to suite specific site have been optimized



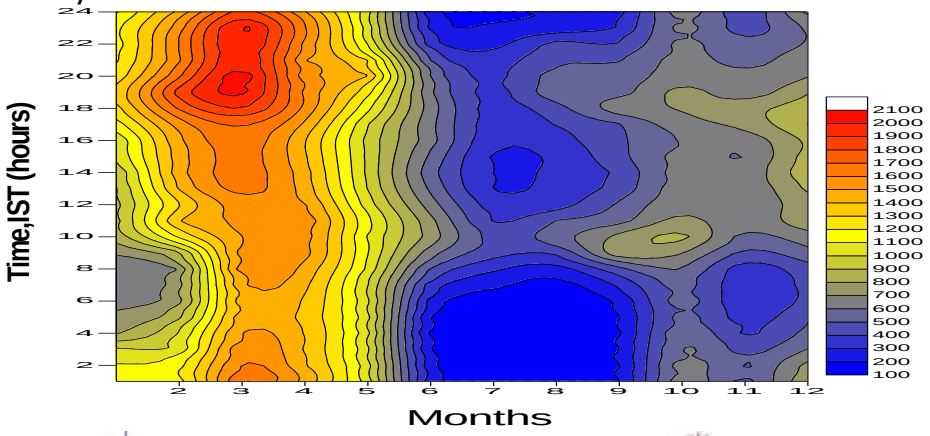
Impact of Paper mill Effluents on Soil, Ground water and Crops

Studies on assessing the long-term impact of paper and pulp mill effluent and paper and board effluent on soil, groundwater and crops were taken

up with four industries viz., TNPL unit-I at Karur, TNPL unit-II at Trichy, ITC at Thekkampatty and SPB at Erode. Periodical monitoring of treated waste water showed that the quality of wastewater was found to be within the limits as prescribed by TNPCB (pH of 6.8 -7.2, EC of <2 dS m-1, 1BOD of <100 mg/l, COD of <250 mg/l). Due to continuous application of paper board mill effluent soil salinity is observed (TNPL area), for which a phytoremediation technique is recommended.

Aerosol Characteristics Over High Altitude In Southern India

Diurnal variations of aerosol black carbon (BC) revealed an evening peak (during 17:00 to 22:00 h) during Feb to May, which decrease gradually towards morning and become lowest during the early morning hours (05:00 h). Annual averaged Aerosol Radiative Forcing values (SBDART model) were -11.47 Wm-2,-35 36.23 Wm-2 and 22.34 Wm-2 at the top of the atmosphere and earth's surface and within the atmosphere, respectively.



Impact of Troposphere Ozone on Crops, Tamil Nadu

Fifteen short duration rice cultivars obtained from various rice research stations of TNAU were screened for elevated tropospheric ozone tolerance (100 ppb) in open top chamber (OTC). Based on the Principle Component Analysis (16 traits), the chosen 15 rice cultivars were grouped into four categories: sensitive, moderately sensitive, moderately tolerant and tolerant. Rice TPS5, Anna(R)4 and PMK(R)3 exhibited more tolerance to eO3. Eight black gram varieties (CO 6, VBN 1, VBN 2, VBN 3, VBN 5, VBN 6, VBN 7,VBN 8) screened for elevated tropospheric ozone tolerance (50 ppb) in open top chamber (OTC) showed that VBN3 was found to be sensitive and VBN 8, VBN 5 were found to be tolerant

Carbon Sequestration by Oil Palm

The fronds and empty fruit bunches of oil palm recorded phytolith contents of about 59 and 5.7 mg g^{-1} respectively. Among the age groups (4, 8 and 15 years), the eight year old oil palm recorded the highest soil carbon (17.11 Mg C ha-1) at 0-20 cm depth of frond pile zone which was 69% higher than the four year old oil palm plantations.

Activated Hydrochar from Paper Board Mill (PBM) Sludge for Pollutant Removal

The hydrothermal temperature of 200°C and residence time of 10 h were optimized process parameters for hydrochar production from PBM-ETP sludge. The higher heating value of PBM-ETPS derived hydrochar was 18.39 MJ kg^{-1} with an energy densification quotient of 1.07 and energy yield of 75.03% and it was holding the BET surface area of 3.74 m^2 g^{-1}, particle size of 104.7 nm with the zeta potential of -17.1 mV and it showed the cation exchange capacity of 12 cmol [p+] kg^{-1} with the point of zero charge as 7.6. The post activated PBM-ETP sludge derived hydrochar achieved a higher removal percentage of 66.48% at pH 8 with initial diclofenac concentration of 10 mg L^{-1} after 15 h. The highest removal of 72 % was obtained at pH 5 with initial orthophosphate concentration of 100 mg L^{-1} after 24 h by post activated PBM-ETP sludge derived hydrochar with predicted response of 59.70 % at pH 8.

C. FOR ON FARM TRIAL

Sustainable Management of Textile and Tannery Effluent Contaminated Soil and Water using Castor Priming with AM fungi

Treatments

i. Recommended dose of fertilizer (90:45:45 NPK kg ha-1).

ii. RD of N and K and 50% of recommended P + AM fungi @ 50 kg ha^{-1} vermicompost @ 5t ha^{-1}

iii. RD of N and K and 50% of recommended P + AM fungi @ 50 kg ha^{-1} + composted poultry manure @ 5t ha^{-1}

Parameters to be recorded

Growth parameters : Biometrics, yield attributes and seed yield

Soil parameters : pH, EC, OC, nutrients, heavy metals and biological properties

Duration : One year (2020-2021)

Locations:

Textile effluent contaminated site : Tiruppur and Erode Districts

Tannery effluent contaminated site : Vellore and Erode Districts

Scientists in- charge: Dr.P.Kalaiselvi, Assistant Professor (ENS), Dr.S.Anandha Raja, Assoc.Professor (Ag.Extension) & Programme Coordinator, KVK, Tiruppur and Dr.P.Veeramani, Asst.Professor (Agr.), KVK,Virinjipuram.

(iv). Department of Nano Science and Technology

A. For Adoption

Nano seed invigorant for improved germination, growth and yield

Seeds coated with nano seed invigorant (IAA nano emulsion) at 15 ml per kg of seeds along with other recommended package of practices recorded higher mean pod yield of 2186 kg ha^{-1} in groundnut and mean grain yield of 902 kg ha^{-1} in black gram. The yield increase in groundnut was 14.1 and 8.4 per cent over control (1916 kg ha^{-1}) and existing $CaCl_2$ soaking respectively. In blackgram, the yield increase was 19.6 and 10.1 per cent than control (754 kg ha^{-1}) and $ZnSO_4$ soaking (819 kg ha^{-1}) respectively. In both the crops income generated and BCR were also found to be higher as compared to control and existing recommended seed invigoration treatments.

Nano fiber coated groundnut seeds

Chitosan nanoemulsion as an anti transparent for managing the impact of drought in crops

Foliar application of chitosan nanoemulsion @ 1000 ppm induced stomatal closure and reduced stomatal conductance in Maize and Pearl Millet. Field level studies demonstrated that foliar application of chitosan nanoemulsion @ 1000 ppm as an antitranspirant in maize after anthesis, recorded the yield advantage of 300 – 700 kg ha^{-1} under moisture deficit conditions with additional returns of ₹ 2500 to 7800 ha^{-1}. Thus, the foliar application of chitosan nanoemulsion in crop is recommended as short-term drought management strategy.

Nano hydrogel

TNAU Nano hand sanitizer for prolonged hand hygiene

TNAU Nano hand sanitizer consists of ICMR approved ingredients that are embedded in **polymeric Nano systems** for the sustained release of disinfectants to ensure prolonged hand hygiene. The hand hygiene is ensured between **15 and 30 minutes** based on the post application activities of the individual

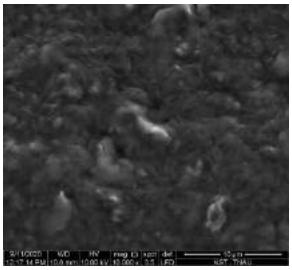
B. For Information

Carbon dots in water disinfection

Carbon dots were synthesized in filtration method with high reproducibility .Carbon dots synthesized through hydrothermal carbonization method produced small sized dots less than 10 nm compared to microwave method. These carbon dots can be employed for disinfecting water after validation.

TNAU Rhizo boost

TNAU Rhizo boost is a fortified plant growth booster contains probiotic microbial consortium and bio polymer based hydrogel embedded in humic- fulvic complex. TNAU Rhizo Boost creates an effective Rhizosphere and aids in enhanced nutrient transformation and also confers disease resistance. The hydrogel helps in enhancing the use efficiency of water and creates a favourable micro climate in the rhizosphere for the enhanced activity of probiotic microbial communities and also aids in better root proliferation. This technology is available in liquid and solid formulation and being field validated.



EDAX and SEM picture of Rhizoboost liquid formulation, confirming the presence of probiotic organism impregnated in humic-fulvic complex

C. OFT
Nano Capsule / Pellet Technology for pulses

Treatments
T1: Absolute Control
T2: Conventional fertilization (as per STCR)
T3: Fertilization through Nano capsule / pellet
(Note: for T_3, the doses as per STCR will be packed in the capsule/pellet)
Crop : Greengram Soil: Red
All the other package of practices will be followed as per CPG 2020.

Centers and Scientists:

Co-coordinating Centre	**:**	Department of Nano Science & Technology, TNAU, Coimbatore Dr. K.S. Subramanian, Director of Research Dr. S. Marimuthu, Assistant Professor (Agron.) (Farmer's field at Coimbatore Dt.)
Sub Centers	**:**	NPRC, Vamban Dr. R. Parimala Devi, Asst.Prof. (AGM) ARS, Bhavanisagar Dr. N. Satheesh Kumar, Assistant Professor (Agron.)

Chitosan Nano formulation as an alternate to toxic sulphur for the safe preservation of coconut copra

Treatment
T1: Conventional method (Sulphur fumigation)
T2: Chitosan nano formulation spraying

Centre and Scientists:

Centre	**:**	Department of Nano Science & Technology, TNAU, Coimbatore Dr. A. Lakshmanan, Professor & Head, DNST, TNAU, Coimbatore Dr. R. Sharmila Rahale Assistant Professor (SS &AC), DNST, Coimbatore

The technology will be validated in coordination with Copra units at Pollachi and Udumalpet and others stakeholders (Oil mills).

Biocatalytic Microbes Infused Nano-Hybrid System for the effective deodorization and decomposition of wastes
Treatment
T1: Control
T2: Biocatalytic microbes infused nano-hybrid system (MOF)

Centre and Scientists:

Centre	:	Department of Nano Science & Technology, TNAU, Coimbatore Dr. A. Lakshmanan, Professor & Head, DNST, TNAU, Coimbatore Dr. R. Sharmila Rahale,Assistant Professor (SS &AC), DNST, Coimbatore. Dr.P.Kalaiselvi, Assistant Professor (ENS), Dept. of ENS, TNAU, Coimbatore.

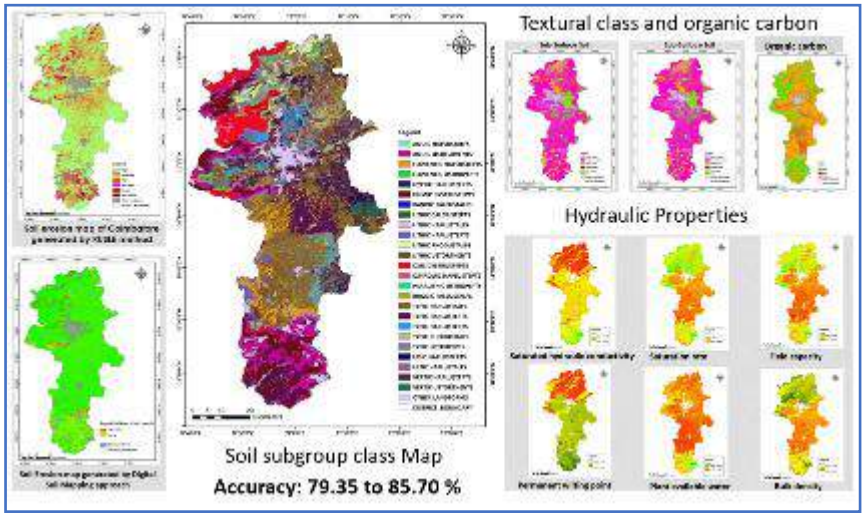
Technology validation in coordination with stakeholders like civic bodies, corporation and NGO's involved in waste handling.

(v). Department of Remote Sensing &GIS

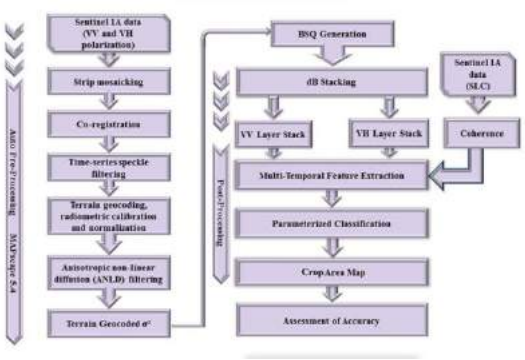
A. <u>For Adoption:</u>

Digital Soil Mapping using Machine Learning techniques

The Department of Remote Sensing has introduced the concept of Digital Soil Mapping using artificial intelligence and machine learning tools to generate digital database of soil class and properties *viz*., soil organic carbon, texture, erosion, and 32 environmental covariates at pixel level spatially. The digital soil maps will lead to developing AI based precision agriculture technologies.



Remote Sensing Technology for Crop Mapping



TNAU remote sensing technology for crop mapping and monitoring was developed integrating Sentinel 1A SAR data with ORYZA/DSSAT crop growth model with defined outputs of precise crop area in **Rice, Maize, Cotton, Groundnut, Sorghum and Blackgram**.

Products indicating start of season, leaf area index with crop signature and spatial yield estimates of

crops were generated. Methodology for mapping plantation crops was developed for **Mango, Cashew and Citrus**

Fig1: Methodology for satellite based Crop mapping

.

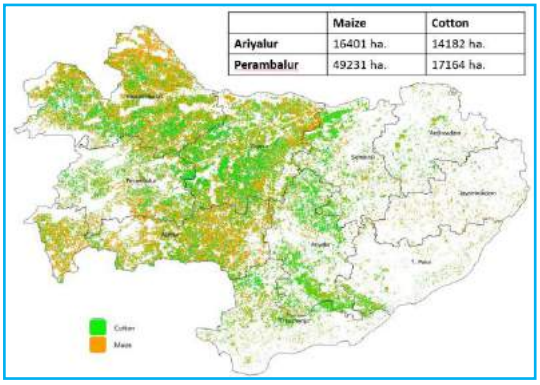


Fig2: Maize and Cotton area map of Perambalur and Ariyalur districts

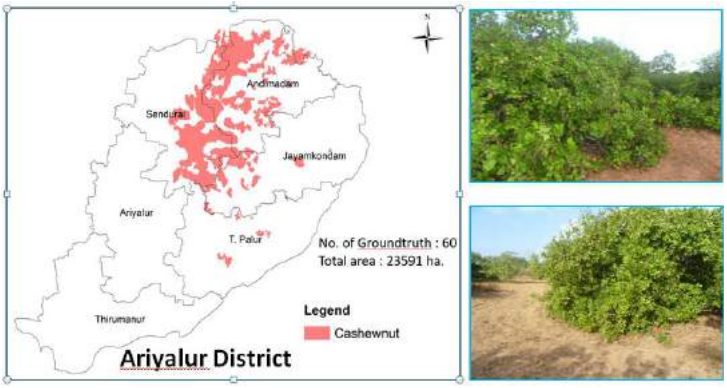


Fig3: Cashew area map of Ariyalur district

Remote Sensing Technology for Crop Insurances

Components:

1. Spectral signature showing crop growth, condition and failure if any.
2. Area under failed sowing / prevented sowing, Yield loss and total crop failure information
3. Cadastral level maps for farm verification
4. NDVI, NDWI and flood maps for crop stress assessment
5. **Smart sampling for optimizing crop cutting experiments**
6. **Two-Step yield estimation for specific areas and crops to reduce CCEs based on crop-health through weather data, satellite indices, etc.**

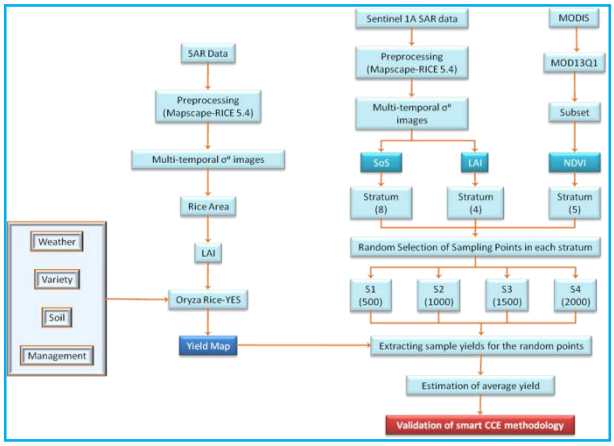


Fig. 4. Smart Sampling methodology for CCEs

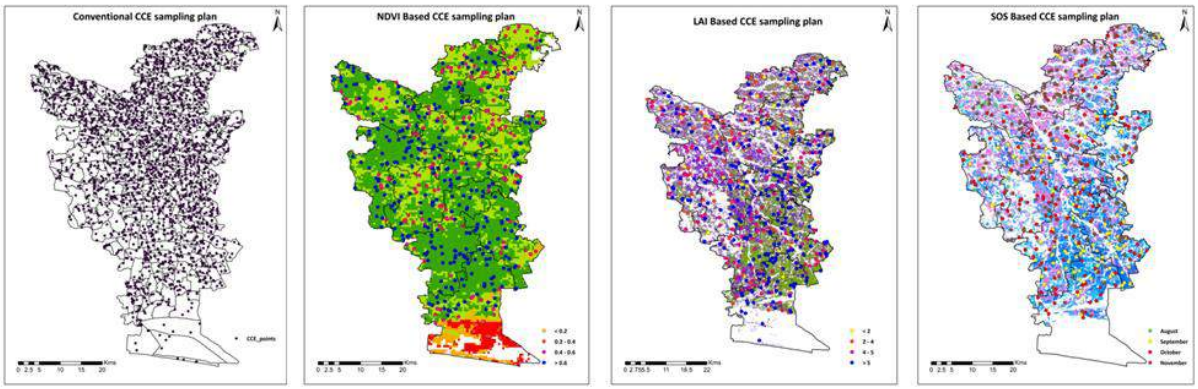
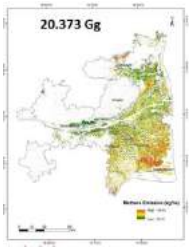


Fig. 5. Smart Sampling of CCEs using Start of the Season, LAI and NDVI

Spatial estimation of methane emission from paddy fields using remote sensing



A research study on 'Monitoring Methane Emission from Rice fields at regional scale through Remote sensing in Cauvery Delta Zone has been initiated to estimate methane emission spatially. Multi temporal Sentinel 1A satellite data at VH polarisation with 20 m spatial resolution was acquired from August, 2018 to January, 2019 at 12 days interval and processed using MAPscape-RICE software. The total methane emission for Cauvery Delta Zone was found to be 19.155 and 20.373Gg during 2017 and 2018 respectively.

B. For Information:

TN Soils – A Mobile based application

It is an initiative developed utilizing the soil and land resource maps generated by the Department of Remote Sensing and GIS to retrieve available soil information of Tamil Nadu state *viz.*, soil series, physical, chemical and nutrient properties for any location and prescribing soil and crop management practices besides navigation to TNAU centres for soil testing. For arriving STCR-IPNS based fertilizer recommendations, Decision Support System for Integrated Fertilizer Recommendation (DSSIFER) software is to be used.

Developing Drone based spraying techniques for foliar application of nutrients, Organics and Plant Protection chemicals

The advent of drones with high range, endurance and payloads, the drone applications in agriculture are increasing multifold leading to interdisciplinary research on mapping and monitoring field crops and plantations, natural resources, artificial intelligence, precision agriculture and spraying organics, nutrients, growth regulators and plant protection chemicals underlines the need for standardizing drone application and spraying techniques in Agriculture.

C. CROP PROTECTION

Dr. K. Prabakar
Director, Centre for Plant Protection Studies
TNAU, Coimbatore

a. Agricultural Entomology

Technology for Adoption

Rice

1. **Camphor oil for yellow stem borer management**

- Camphor oil at 1000 ml/ha is recommended for rice yellow stem borer management. Camphor oil 1000 ml/ha is cost effective and safe to predators and parasitoids in rice ecosystem; good alternate to azadirachtin 1% @ 1000 ml/ha

2. Mass trapping technology for rice stem borer

- Mass trapping with sex pheromone trap @ 25/ac had more attraction of yellow stem borer with the highest CB ratio. Mass trapping with sex pheromone traps, reduced the number of insecticide sprays. This technology is eco-friendly, supports natural enemies and good option in organic farming.

Pulses

1. IPM module for pod borer complex in red gram (Irrigated)

- IPM module (growing pod borer tolerant variety – CO 8, two rows of maize as border crop, pheromone traps @ 12/ha for monitoring *Helicoverpa armigera* , erecting bird perches @ 50/ha, application of azadirachtin 1% EC @ 500 ml /ha at vegetative phase and chlorantraniliprole 18.5 SC @ 150ml/ha at50 % bud initiation stageflubendiamide 480 SC @ 125ml/ha at flowering, and dimethoate 30 EC @ 1000ml/ha (pod maturation) resulted in maximum reduction of larval population and damage by pod borers with higher yield (1330 kg/ha and BCR (2.1) than non-IPM module.

2. **Management of spotted pod borer**

- Novaluron 10 EC (2 ml/lit) was effective in reducing the webbings of spotted pod borer in redgram and increasing yield to 880 kg/ha with BCR 1.28

Millets

1. Management of fall armyworm (*Spodoptera frugiperda*) in maize

- TNAU IPM technology Capsule *viz*., application of neem cake @ 250 kg/ha, seed treatment with *Beauveria bassiana* @ 10g/kg seed or thiamethoxam 30 FS @ 10 ml/kg seed , plant spacing of 60x25 cm, rogue spacing of 75 cm for every 10 rows, border cropping with cowpea & gingelly, intercropping with blackgram, Installation of pheromone traps @ 50/ha, solar light trap @ one /ha for monitoring FAW adults, spray of Azadirachtin @ 20ml/10 l or emamectin benzoate 5 SG @ 4 g/10 l or Thiodicarb @ 20 g/10 l at early whorl stage (20 DAS); spraying of *Metarhizium anisopliae* @ 80g/10l or spinetoram 12 SC @ 5 ml/10 l or Novaluron @ 15 ml/10 l or flubendiamide @ 4 ml/10 l or chlorantraniliprole @ 4 ml/10 l at late whorl stage (40 DAS) and at tasseling

and cob formation stage (60 DAS) on need basis is recommended for management of fall armyworm in maize.

2. Management of sorghum stem borer (*Chilo partellus*)

- The IPM module viz., Calcium silicate application @ 10 DAE (30 kg/ha), intercropping sorghum + cowpea (4:1), border cropping with cumbu napier, releasing egg parasitoid, *Trichogramma chilonis* at 20, 30 and 40 DAE, need based spraying of NSKE 5% at 45 DAE is recommended for the management of sorghum stem borer.

3. Management of rice weevil (*Sitophilus oryzae*)

- Seed treatment of *Acorus calamus* 6 EC TNAU formulation @ 10 ml/kg seed is recommended for the management of rice weevil, *Sitophilus oryzae* in maize.

Oil Seeds

1. Effect of border crop with organic amendment on insect pests of groundnut

- Combination of Groundnut + Pearl millet + Neem cake (250 kg/ha) recorded minimum population of thrips (3.3/plant), leafhopper (2.4/plant); damage by GLM (12.2%) and *Spodoptera litura* (6.8%); and increased natural enemies activity with more pod yield and BCR of 1:2.35.

2. Management of whitefly and thrips in castor

- Application of buprofezin 25 SC @ 0.8 ml/lit was more effective against whitefly (72.31%) and thrips (76.48%) with maximum yield (1531kg/ha) and BC ratio 1:2.85.

Sugarcane

Management of white grub in sugarcane

- Soil application of *Metarhizium anisopliae* 4 x 10^9 cfu/g @ 5 kg/ha was highly effective in reducing white grub population (66.66%) with highest cane yield of 103.03 t/ha and highest B:C ratio of 2.02

Horticultural Crops

Citrus

Integrated management of citrus leaf mite

- Application of three rounds of Citrulus fruit extract @ 5% at 15 days interval after noticing mite incidence in citrus was effective against leaf mite (64.36 % reduction) with the highest fruit yield.

Betelvine

Management of red spider mites in Betelvine

- Foliar application of azadirachtin 1% @ 1ml/litre followed by NSKE 5% after 15 days was more effective against red spider mite with BC ratio of 1:2.57.

Technology for OFT

Rice

OFT 1: Evaluation of sequential application of botanical and chemical insecticides against major pests of rice

Treatments:

1. Botanicals + Insecticide**:** Azadirachtin1% EC 1000ml/ha 25 DAT + Triflumezopyrim 10% SC 240ml/ha 45 DAT + Neem oil 2% 10 lit/ha 60 DAT
2. All botanicals**:** Azadirachtin1% EC 1000ml/ha 25 DAT+ Eucalyptus oil 1000ml/ha 45 DAT+ Neem oil 2% 10 lit/ha 60 DAT
3. All insecticides**:** Chlorantraniliprole 0.4G 10 kg/ha 25 DAT+ cartap

hydrochloride 50% SC 1.0 kg/ ha 50 DAT+ Triflumezopyrim 10% SC 240 ml/ha 65 DAT

4. Control (Untreated check)

Design : RBD
Replication : 5
Season : Rabi

Centres to be involved:

AC&RI, MDU [MS]* : Dr. G. Srinivasan, Assoc. Professor (Entomology)
AC&RI, KKM : Dr. N. Balakrishnan, Assoc. Professor (Entomology)
TRRI, ADT : Dr. P. Anandhi, Asst. Professor (Entomology)
TNAU, CBE : Dr. Sheela Venugopal, Asst. Professor (Entomology)
ADAC&RI, TRY : Dr. P. Yasotha, Asst. Professor (Entomology)

* MS-Monitoring Scientist

Observations:

- To be taken from 15 days after transplantation till pre-harvest stage at weekly interval on the existing pests and natural enemies as indicated below.

1. Thrips population per sweep and damage (leaf damage)
2. Stem borer adults per sweep and damage (DH/WE)
3. Leaffolder adults per sweep and damage (leaf damage)
4. Gall midge damage (silver shoot)
5. Number of leaf and plant hoppers /10 hills
6. Any other pests (if noticed)
7. Natural enemies such as coccinellids, rove beetles and spiders
8. Grain yield
9. CB Ratio

Note: Pre-treatments counts (PTC) should be recorded and per cent reduction over control should be calculated using PTC.

OFT 2: IPM technologies for major pests of rice

Treatments:

1. IPM package with:

a. High yielding variety - ADT51/ Co51
b. Raising blackgram ADT 6 as bund crop
c. Mass trapping of yellow stem borer with pheromone traps @ 20/ac
d. Release of the egg parasitoid, *Trichogramma japonicum* thrice (at weekly interval from 37 DAT) @ 1,00,000/ha each release (when stem borer moth activity is noticed)
e. Release *Trichogramma chilonis* thrice (at weekly interval from 30 DAT) @ 1,00,000/ha each (when leaf folder moth activity is noticed)
f. Azadirachtin 1% spray at 1000 ml/ha at 25 and 45 DAT
g. Need based application of chlorantraniliprole 18.5 SC @ 150 ml/ha

2. All chemical insecticides spraying:

a. Thiamethoxam 25 WG 100 g/ha - 25 DAT against thrips
b. Chlorantraniliprole 18.5 SC @ 150 ml/ha - 45 DAT against stem borer
c. Flubendiamide 39.35% M/M SC 50 g/ha- 60 DAT against leaf folder & stem

borer

d. Chlorantraniliprole 18.5 SC @ 150 ml/ha - 75 DAT against stem borer
3. Control (Untreated check)

Design : RBD (1 acre plot per treatment)
Replication : 12 locations within the plot
Season : Rabi

Centres to be involved:

AC&RI, MDU [MS]* : Dr. D. S. Rajavel, Professor (Entomology)
TNAU, CBE : Dr. Sheela Venugopal, Asst. Professor (Entomology)
HC&RI(W), TRY : Dr. R. P. Soundararajan, Assoc. Professor (Entomology)
TRRI, ADT : Dr. P. Anandhi, Asst. Professor (Entomology)
AC&RI, KKM : Dr. G. Preetha, Asst. Professor (Entomology)

* MS-Monitoring Scientist

Observations:

- To be taken from 15 days after transplantation till pre-harvest stage at weekly interval on the existing pests and natural enemies as indicated below

1. Thrips population per sweep and damage (leaf damage)
2. Stem borer adults per sweep and damage (DH/WE)
3. Leaffolder adults per sweep and damage (leaf damage)
4. Gall midge damage (silver shoot)
5. Number of leaf and plant hoppers /10 hills
6. Any other pests (if noticed)
7. Natural enemies such as coccinellids, rove beetles and spiders

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

Millets

OFT 1: Botanicals for the management of *Sitophilus oryzae* in sorghum

Treatments:

1. *Acorus calamus* TNAU formulation (Sweet flag 6%EC) @ 10 ml/kg of seed
2. *Azadirachta indica* (Neem) leaf powder 10 g/kg seed
3. *Vitex negundo* (Nochi) leaf powder 10 g/kg seed
4. Emamectin benzoate 5%SG 40 mg/kg seed
5. Untreated control

Design : CRD
Replication : 4
Season : Khariff & Rabi

Methodology:

Freshly harvested untreated sorghum seeds will be used for the study. Five hundred grams of sorghum seeds will be treated with respective products in four replicates. Treated seeds will be taken in one kg capacity plastic container and 20 pairs of newly emerged rice weevils (*S. oryzae*) will be released. Untreated control will be maintained. The experiment will be conducted under ambient conditions during two seasons.

Centres to be involved:

AC&RI, KKM [MS]	: **Dr. Abdul Razak, Professor (Entomology)**
AC&RI, VVNR	: Dr. Y. S. Johnson Thangaraj Edward, Professor (Entomology)
HC&RI(W), TRY	: Dr. V. R. Saminathan, Assoc. Professor (Entomology)
TNAU, CBE	: Dr. R. Arulprakash, Asst. Professor (Entomology)
AC&RI, MDU	: Dr. Zadda Kavitha, Asst. Professor (Entomology)

Observations:

- Mortality assessment will be made immediately after treatment on 3rd, 7th and 15th day after insect release and at monthly intervals for six months.
- Population of *S. oryzae* on 0,3, 7, 15 DAT and at monthly intervals for six months
- Per cent germination at monthly interval (PTC, 1,2,3,4,5,6 months)

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

Oilseeds

OFT 1: IPM capsule for leaf miner management in groundnut

Treatments:

1. IPM module:
    a. Application of neem cake @ 250 kg/ha;
    b. Cumbu as intercrop (6:1) and cowpea as border crop;
    c. Installation of light trap @1/ha;
    d. Monitoring with pheromone trap @12/ha;
    e. *Metarhizium rileyi* @ 4g/lit (CFU 108 / ml);
    f. Azadirachtin 1% @ 1.5 ml/lit; and
    g. Need based application of insecticide - Novaluron 10EC @ 2 ml / lit.
2. Farmers practice
3. Untreated control

Design	:	RBD
Replication	:	7
Season	:	Kharif
Variety	:	Popular variety
No. of trials	:	One each on campus and farmer's field

Centres to be involved:

AC&RI, VVNR [MS]*	: **Dr. S. Douressamy, Professor (Ento.) & Head**
AC&RI, KDM	: Dr. K. Chandramani, Professor (Entomology)
AC&RI, KKM	: Dr. G. Ravi, Professor (Entomology)
TCRS, YPR	: Dr. B. Geetha, Assoc. Professor (Entomology)
RRS, VRI	: Dr. C. Vijayaraghavan, Asst. Professor (Entomology)
CRS, ALR	: Dr. M. Alagar, Asst. Professor (Entomology)

* MS-Monitoring Scientist

Observations:

1. Population (Nos) of leaf miner and damage (%)
2. Population of entomophages in main and border crops

3. Pest defender ratio (PDR), occurrence ratio (OR), Preference ratio (PR)
4. Any other pests (if noticed)
5. Pod and kernel yield (kg/ha)
6. CB Ratio

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

OFT 2: Management of sesame pests through ecofeast border crops and organic amendments

Treatments:

1. Sesame + maize + vermicompost @ 2.5 t/ha
2. Sesame + maize+ neem cake @ 250 kg/ha
3. Sesame + sorghum+ vermicompost @ 2.5 t/ha
4. Sesame + sorghum+ neem cake @ 250 kg/ha
5. Untreated check -Sesame alone

Design	:	RBD
Replication	:	4
Season	:	Kharif & Rabi
Variety	:	VRI 2 or any popular variety in respective region

Centres to be involved:

AC&RI, ECK [MS]*	**:** Dr. A. Kalyanasundarm, Assoc. Professor
ADAC&RI, TRY	: Dr. Sheeba Joyce Roseleen, Asst. Professor (Entomology)
ARS, VRM	: Dr. P. Thilagam, Asst. Professor (Entomology)
RRS, VRI	: Dr. L. Allwin, Asst. Professor (Entomology)
IOA, KMR	: Dr. W. Baby Rani, Professor (Entomology)

* MS-Monitoring Scientist

Observations:

- To be taken from 15 days after sowing till pre-harvest stage at weekly interval on the existing pests and natural enemies as indicated below

1. Pest population, damage (%), phyllody incidence
2. Natural enemies population in main and border crop
3. Pest defender ratio (PDR), occurrence ratio (OR), Preference ratio (PR)
4. Yield
5. CB Ratio

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

Cotton

OFT 1: Management of sucking pests of cotton under high density planting system

Treatments:

1. Seed treatment with imidacloprid 70%WS@ 7ml/ kg of seed + spraying of diafenthiuron 50% WP @ 600 g/ha or thiamethoxam 25 % WG @ 100g/ha at 45 DAS and dinotefuran 20 % SG@ 150 g/ha or flonicamid 50% WG @ 150 g/ha at 60 DAS

2. Seed treatment with *Beaveria bassisana* @ 10 g/kg of seed + soil application of neem cake @ 250 kg/ha + yellow sticky trap @ 100 nos./ha + release of green lacewing @ 1 lakh eggs/ha at 30 DAS + need based spray of azadirachtin 1% EC @ 1000 ml/ha
3. Farmer practice (fipronil 5% SC@ 2000ml/ha on 25 DAS + imidacloprid 30.5 SC@ 75g/ha on 40 DAS + thiamethoxam 25 % WG @ 100g/ha on 55 DAS)
4. Control (untreated)

Design : RBD
Replication : 5
Season : Rabi

Centres to be involved:

TNAU, CBE [MS]* : **Dr. B. Vinothkumar, Asst. Professor (Ento.) Coimbatore Dt.**
CRS, SVPR : Dr. K. Premalatha, Asst. Professor (Entomology) Virudhunagar Dt.
TNAU, CBE : Dr. K. Senguttuvan, Asst. Professor (Entomology) Erode & Tiruppur Dt.
HC&RI(W), TRY : Dr. M. Chandrasekaran, Asst. Professor (Ento.) Trichy Dt.
CRS, VPM : Dr. V. G. Mathirajan, Asst. Professor (Entomology) Thiruvarur/ Mayiladuthurai Dt.
KVK, NDM : Dr. V. Radhakrishnan, Asst. Professor (Entomology) Thanjavur Dt.

* MS-Monitoring Scientist

Observations:

- To be taken from 15 days after sowing till crop duration end at weekly interval on the existing pests and natural enemies as indicated below.

1. Population of sucking pests (aphids, leafhopper, thrips, whitefly, mealybugs) as per standard protocol
2. Damage percentage (aphids, leafhopper, thrips, whitefly, mealybugs) and grade as per standard protocol
3. Any other pests including mite species (if noticed)
4. Natural enemies population as per standard protocol
5. Seed cotton yield
6. CB Ratio

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

OFT 2: Studies on the impact of ginger, garlic and green chilli(3Gs) extract for the management of insect pests in organic cotton

Treatments:

1. Need based application of fresh 3 G's extract (Ginger extract 5 % + Garlic extract 5 % + Green chilli extract 5% extracted with Cow urine)*
2. Need based application of Neem Seed Kernel Extract 5 % (standard check)
3. Control (Untreated)

Design : RBD

Replication : 7
Season : Rabi

* procedure for preparation of 3G extract will be provided by Monitoring Scientist

Centres to be involved:

TNAU, CBE [MS]* : Dr. M. Suganthy, Assoc. Professor (Entomology)
Coimbatore Dt.
ARS, BVSR : Dr. K. Ganesan, Asst. Professor (Entomology)
Erode Dt.
CRS, SVPR : Dr. K. Premalatha, Asst. Professor (Entomology)
Virudhunagar Dt.
ADAC&RI, TRY : Dr. Sheeba Joyce Roseleen, Asst. Professor (Entomology)
Trichy Dt.

* MS-Monitoring Scientist

Observations:

- To be taken from 15 days after transplantation till pre-harvest stage at weekly interval on the existing pests and natural enemies as indicated below

1. Population of sucking pests (aphids, leafhopper, thrips, whitefly, mealybugs) as per standard protocol
2. Damage percentage (aphids, leafhopper, thrips, whitefly, mealybugs) and grade as per standard protocol
3. Bollworm complex population pestwise as per standard protocol
   Damage percentage due to bollworm complex individually as per standard protocol
4. Any other pests including mite species (if noticed)
5. Natural enemies population as per standard protocol
6. Seed cotton yield
7. CB Ratio

Note: Pre-treatments counts (PTC) should be recorded without fail and per cent reduction over control should be calculated using PTC.

Horticultural Crops

OFT 1: Pollination of watermelon with *Apis cerana indica* for improved crop productivity

Treatments:

1. Two bee colonies / acre
2. Control (open pollination - no bee colonies)
3. Pollinator exclusion (sleeve cages for 20 flowers per replication)*

Design : RBD
Replication : 6 (20 tagged flowers per replication)
Season : Two seasons in the operational area

* Methodology for preparation and installation will be given by the Monitoring Scientist

Centres to be involved:

TNAU, CBE **[MS]*** : **Dr. P. A. Saravanan, Asst. Professor (Ento.)**
RRS, PYR : Dr. K. Govindan, Asst. Professor (Entomology)
AC&RI, MDU : Dr. Zadda Kavitha, Asst. Professor (Entomology)
HC&RI, PKM : P. Indiragandhi, Asst. Professor (Entomology)

RRS, VRI : Dr. S. Jayaprabhavathi, Asst. Professor (Entomology)
HRS, YCD : Dr. M. Senthilkumar, Asst. Professor (Entomology)

* MS-Monitoring Scientist

Observations:

1. No. of fruits/ plant
2. Fruit length (cm)
3. Fruit girth (cm)
4. Individual fruit weight
5. Bee visitation rate/5 inflorescence/tree/3 min.
6. Fruit yield /acre
7. Colony growth parameters namely brood area and honey store (cm2)
8. CB ratio

OFT 2: Evaluation of management modules of rugose spiralling whitefly in coconut

Treatments:

1. Module 1:
   Urea 1.3 kg; Super phosphate 2.0 kg; Muriate of potash 3.5 kg; Neem cake application @ 5 kg; organic manure (well rotten FYM) @ 50 kg; TNAU micronutrient mixture @1.0kg/tree/year; root feeding with TNAU coconut tonic @200ml/palm once in six months; setting up of yellow sticky traps/ sheets (8x1.5 ft) @ 10/acre to monitor and mass trap the RSW population; sowing sunhemp/cowpea @ 5 g/palm in the basin; stapling leaflets containing nymphs of RSW parasitised by *E. guadeloupae* on the under surface of the infested leaflets@100/ac; release of *Chrysoperla zastrowi sillemi* eggs @ 400/ac.
2. Module 2:
   TNAU micronutrient mixture @1.0kg/tree/year; root feeding with TNAU coconut tonic @200ml/palm once in six months; stapling leaflets containing nymphs of RSW (parasitised by *E. guadeloupae*) on the under surface of the infested leaflet; spraying of *Isaria fumosorosea* 2 x 108 CFU approximately 5-7 gram/litre of water) two sprays at 14 days interval at infestation index level 1.
3. Module 3:
   TNAU capsule (Release of *Encarsia guadeloupae* @ 100 parasitoids /ac (10 leafbits/ac); installation of yellow sticky traps (5 ft. x 1.5 ft.) smeared with castor oil @ 8/ ac; release of *Chrysoperla zastrowi sillemi* eggs @ 400/ac; neem oil 0.5%
4. Untreated control
   Note: Pretreatment count (PTC) should be taken and percent changes should be worked out based on the PTC.

   Design : RBD
   Replication : 5 (10 palms per module; each replication with 2 plants)
   Season : Year round

Centres to be involved:

TNAU, CBE **[MS]*** : **Dr. S. Jeyarajan Nelson, Professor (Entomology)**
Coimbatore Dt.

CRS, ALR : Dr. M. Alagar, Asst. Professor (Entomology)
Tiruppur and Erode Dts.
AC&RI, KKM : Dr. G. Preetha, Asst. Professor (Entomology)
Kanyakumari Dt.
CRS, VPM : Dr. V. G. Mathirajan, Asst. Professor (Entomology)
Thanjavur/Tiruvarur/Mayiladuthurai Dts. (3 locations)
HC&RI, PKM : P. Indiragandhi, Asst. Professor (Entomology),
Theni Dt.
RRS, VRI : Dr. S. Jayaprabhavathi, Asst. Professor (Entomology)
Cuddalore Dt.
HRS, YCD : Dr. M. Senthilkumar, Asst. Professor (Entomology)
Salem Dt.

* MS-Monitoring Scientist

Observations:

1. Per cent infestation by RSW;
2. Infestation index;
3. No. of RSW trapped in yellow sticky trap;
4. % Parasitisation by *Encarsia*;
5. Colonization by predator, *Chrysoperla*;
6. Other pests and natural enemies;
7. Percent infection by *Isaria* & laboratory confirmation;
8. Yield in terms of nuts/tree after one year
10. C B Ratio

Non – Crops

OFT 1: Pollination of moringa with *Apis cerana indica* for improved crop productivity

Treatments:

1. 4 bee colonies / acre
2. 2 bee colonies / acre
3. Control (open pollination - no bee colonies)
4. Pollinator exclusion (sleeve cages for 10 inflorescences per tree)

Note: For individual treatment minimum one km isolation distance should maintained

Design : RBD
Replication : 5 (One tree per replication)
Season : Khariff & Rabi

Centres to be involved:

TNAU, CBE **[MS]*** : **Dr. G. Umapathy, Professor (Entomology)**
Coimbatore Dt.
AC&RI, KKM : Dr. M. R. Srinivasan, Professor (Entomology) & Head
Tirunelveli/Tutucorin Dt.
TNAU, CBE : Dr. P. A. Saravanan, Asst. Professor (Entomology)
Dindigul Dt.
AC&RI, MDU : Dr. K. Suresh, Asst. Professor (Entomology)
Madurai Dt.
HRS TDK : Dr. S. Irulandi, Asst. Professor (Entomology)
Theni/Dindigul Dt.

KVK, SDR : Dr. Suganya Kanna , Asst. Professor (Entomology)
Salem Dt.

* MS-Monitoring Scientist

Observations:

1. No. of fruits/ tree
2. Fruit length (cm)
3. Fruit girth (cm)
4. Individual fruit weight
5. Total fruit weight
6. Bee visitation rate/5 inflorescence/tree/3 min.
7. Colony growth parameters namely brood area and honey store (cm^2)
8. Diversity of pollinators in moringa
9. C B Ratio

For Information

Rice

1. Resistant entries against major insect pests

Pests	Entries identified	Category
Stem borer	• RMLT 19-302, RMLT 19-501, • ART 1519-1, ART 1819-1, • KAUPTB 0627-2-11 and BK-35-155	Resistant
BPH	• RMLT 19-105	Moderately Resistant
	• ART 1519-2 • CB-16-512, CB-15-569,CB-16-570 • IR 7103315B, RP206818-3-5, PTB 33, 9-1-48, PTB41	Resistant
WBPH	• RMLT 19-105, RMLT 19-505 • ART 1519-2	Moderately Resistant
Leaf folder	• ACK 15001, AS 16004CB 16512, 144-2, 35-3, Anna (R) 4 and ADT 39	Resistant

2. Rice Stem borer Species Diversity:

- In *samba* season yellow stem borer was dominant in Trichy, Aduthurai & Coimbatore.

3. Pesticide residue monitoring:

- Rice grains collected from 11 locations in Tamil Nadu and analysed for residues, showed level below quantification for 39 insecticides tested

4. HIPV (Herbivore Induced plant Volatiles) in Pest management:

- HIPV *viz*., JA and MeSA affected the biological parameters of rice leaf folder *Cnaphalocrocis medinalis*, showing antibiosis activity after spraying at 5 mM and 100 mg L^{-1} respectively. JA and MeSA spraying resulted in release of volatiles (like Dodecane, Eicosane, Tetracontane & 2,4-Di-tert-butylphenol etc.,), which attract natural enemies

5. Outbreak of rice pests:

- Outbreaks of Rice Gall Midge, BPH and GLH were noticed in Cauvery Delta area, Trichy and parts of Erode (Bhavani) during December 2019. Field

surveys were conducted in the Cauvery delta areas of Thanjavur, Thiruvarur, Nagapattinam and Pudukkottai districts. Damage ranged from 16.58 % (Pillayarpatty, Thanjavur) to 85.64 (Melanambankurichi, Muthupettai block, Thiruvarur) with order of severity as Thiruvarur > Thanjavur > Pudukottai > Nagapattinam districts. Reasons for the outbreak is continuous cloudy or rainy weather, use of high tillering varieties, intensive management practices (high nitrogen and indiscriminate use of combination insecticides), low incidence of parasitoid *Platygaster oryzae*, dry season survival of pupal stage in the stubbles of harvested rice crop. Early sowing with CR1009 – escaped the attack; Late sowing of CR1009, ADT39, BPT5204, NLR34449, MTU 7029 resulted in severe incidence.

The management practices suggested include:

a. **Rice gall midge**:

- Following ETL (10% silver shoots) based control measures
- Immediately after crop harvest deep ploughing to remove stubbles
- Removal of alternate weed host plants
- Use of neem cake 250 kg /ha and optimum recommendation of potash fertilizer
- Setting up of light trap and infrared light trap on field bunds to attract and kill adult flies during early evening to night hours
- Collection and redistribution of *Platygaster oryzae* parasitised galls at the rate of one parasitized gall for every 10 m^2 area
- Conserving naturally occurring potent predators such as rove beetles, carabid beetles and spiders
- Spraying any one of the following insecticides during outbreak
    - Chlorpyriphos 20% EC 1250 ml/ha
    - Chlorpyriphos 10% G 10 kg/ha
    - Fipronil 5% SC 1000-1500 g/ha
    - Fipronil 0.3% GR 16-25 kg/ha
    - Thiamethoxam 25% WG 100 g/ha
- Avoidance of synthetic pyrethroids to prevent resurgence of brown plant hopper (BPH).

b. Brown plant hopper (BPH)

- Following the ETL of 1 hopper/ tiller in the absence of predatory spider and 2 hoppers / tiller when spider is present at 1/hill.
- Avoiding excessive use of nitrogen
- Controlling the irrigation by intermittent draining
- Set up light traps during night or yellow pan traps during day time
- Draining water before use of insecticides
- Direct spray towards the base of the plants.Spraying any one of the following insecticides during outbreak: Acephate 75 % SP 666-1000 g/ha
    - Acetamiprid 20% SP 50-100 g/ha
    - Azadirachtin 0.03% 1000 ml/ha
    - Neem oil 3% 15 lit/ha
    - Buprofezin 25% SC 800 ml/ha
    - Chlorantraniliprole 18.5% SC 150 g/ha
    - Chlorpyriphos 1.5% DP 25 kg/ha
    - Dinotefuran 20% SG 150-200g/ha

- Fipronil 5% SC 1000-1500 ml/ha
- Fipronil 0.3% GR 16.67-25 kg/ha
- Imidacloprid 17.8 SL 100-125 ml/ha
- Pymetrozine 50% WG 300g

c. Green leaf hopper (GLH)

- Following the ETL of 60 hoppers/25 net sweeps or 5 hoppers/hill at vegetative stage or 10 hoppers/hill at flowering or 2 hoppers/hill in tungro endemic area
- Setting up, light traps to attract and control the leafhoppers as well as to monitor the vector population.
- Destroying/ killing the leafhoppers attracted to light trap
- Spraying any one of the following insecticides twice, 15 and 30 days after transplanting per ha:
  - Phosphamidon 40% SL 1000 ml/ha
  - Buprofezin 25% SC 800 g/ha
  - Fipronil 5% SC 1000-1500 g/ha
  - Imidacloprid 17.8% SL 100 -125 ml/ha
  - Thiamethoxam 25% WG 100 g/ha
  - Spraying the vegetation on the bunds also with the insecticides.

Pulses

Identification of Resistant Sources against *Maruca vitrata*

- Eleven black gram AICRP entries (KUE 19-35, KUE 19-46, KUE 19-57, KUE 19-65, KUE 19-70, KUE 19-74, KUE 19-76, KUE 19-78, KUE 19-79, KUE 19-80 and KUE 19-81) were identified as resistant to *Maruca vitrata*
- Four green gram AICRP entries (KME 19-3, KME 19-10, KME 19-16 and KME 19-32) were identified as moderately resistant to *Maruca vitrata*
- Three red gram MLT entries (RL-K-19-02, RL-K-19-04 and AC 9060) were identified as resistant to *Helicoverpa armigera*

Development of poly-herbal based greengram seed protectant against pulse beetle *Callosobruchus maculatus*

- Seeds treated with poly-herbal formulation @ 10 ml/kg of seeds packed in polythene bag resulted in minimum number of bruchid eggs per 100 seeds, bruchid seed damage and higher germination than untreated seeds after six months of storage

Millets

- CO 8 maize hybrid recorded low infestation of FAW at early stages along with adequate population of parasitoids (*Chelonus* sp., *Goniozus* sp.) and predators (*Ropalidia* sp., Geocoris sp., Paederus sp.).
- Maize seeds treated with tetraniliprole 240 + Fipronil 240 FS @7.2 + 7.2 ml resulted in minimum whorl infestation (12.6%) as against control (52.0%) up to 30 DAS.
- Maize inter and border cropping systems with sunflower, sesame and brinjal registered maximum number of spiders, coccinellids, earwigs, rove beetles, dragonflies, Ichneumonid wasps and tachinids.

- Application of biocontrol agents *Trichogramma pretiosum* + *Beauveria bassiana* NBAIR -Bb 45 recorded 89.24% damage on 45 DAS as against insecticide treatments (59.57 %)
- Seed treatment with Chlorantraniliprole 625 g/L FS @ 5.60 ml/kg of seed significantly reduced the *Spodoptera frugiperda* population, leaf and whorl damage up to 28 days after sowing on maize
- Three time application of thiodicarb 75% WP at 750 g a.i/ha at 15 days interval reduced the population of fall armyworm and found safer to natural enemies

Oilseeds

Groundnut

- ❖ IPM capsule (Application of neem cake @ 250 kg/ha; Installation of light trap @1/ha; Monitoring with pheromone trap @12/ha; *Metarhizium rileyi* @ 4g/lit (CFU 10^8 / ml); Cumbu as intercrop (6:1) and Cow pea as border crop; Azadirachtin 1% @ 1.5 ml/lit ; Need based application of insecticide - Novaluron 10EC @ 2/ml) recorded minimum GLM damage (2.11 %) with high pod (1203kg/ha), fodder yield (2475kg/ha) and BC ratio of 1:2.05
- ❖ Leafminer & *S. litura* incidence was less in Pongamia oil derived formulation @ 3ml/lit and quinalphos 2ml/lit on 14 DAS
- ❖ Extract of basil leaf @ 5% was highly effective against spider mites on groundnut with 82.30% reduction and high cost benefit ratio of 1:2.45

Sesame

- ❖ Pongamia oil derived formulation @ 3ml/lit and azadirachtin 10000 ppm @ 1.5 ml/lit were on par with each other in reducing shoot webber damage & leafhopper population

Sugarcane

- Out of 48 clones screened for resistance, 18 were less susceptible to early shoot borer with less than 30 % incidence
- Army worm, *Spodoptera mauritia* damage was observed to a level of 12.25 % at Parayampattu village of Thiruvannamalai district and 14.50 to 20.00% at S. Kolathur, Kaduvanur village of Kallakuruchi district
- Buprestid leafminer damage (3.0 %) was recorded in ratoon crop of Co 86032 at the Farm Unit of Chengalpattu Co-operative sugar Mill, Padalam

Cotton

- Spinosad 45 % SC @ 250 ml/ha was effective against pink bollworm in both summer and winter cotton crops in terms of the highest seed cotton yield and the lowest per cent boll and locule damage.
- Six releases of *Trichogrammatoidea bactrae* @ 2cc/ac + pheromone traps (12/ha) resulted in minimum pink bollworm damage and was similar to insecticide (thiodicarb 75 WP 1kg/ha) treatment with high BC ratio of 1: 2.41.

Horticultural Crops

- Out of 55 entries tested, 9 entries *viz.,* IC 27821-A, IC 31850-A, IC 42531, IC 22237-C, IC 42485-B, IC 43743, IC 43746-D, IC 45728 and IC 45804 were identified as tolerant against bhendi fruit borer.
- Out of 440 farm gate vegetables analyzed, okra, capsicum, bitter gourd, chilli, brinjal, tomato and lab lab showed detectable level of cypermethrin, imidacloprid, clothianidin, chlorantraniliprole, flubendiamide, acetamiprid, thiacloprid, bifenthrin and 6- Chloronicotinic acid residues

- Population of *Encarsia guadeloupae* parasitized rugose spiralling whitefly nymphs was maximum in conservation treatment where no agents were applied (14.0 nos/leaflet) and foliar application of neem oil (0.5%) (14.0 nos./leaflet) compared to foliar application of *Isaria fumosorosea* (pfu-5) @ $1x10^8$ cfu/ml (10.0 nos./leaflet).
- In curry leaf, a total of 44 insect species belonging to 10 orders and comprising 17 species of herbivores, 15 species of predators, 4 species of parasitoids, 3 species of scavengers and 2 species of pollinators were documented. Among the insect pests, *Diaphorina citri* and among the natural enemies *Chrysoperla* sp. were the dominant fauna.
- In Aonla under Aruppukottai conditions, nimbecidine, lufenuron and 2-Phenoxy ethanol at 1000 ppm were effective against termites in bait stations (Dried cow dung and sorghum straw) with minimum number of termite galleries. Nimbecidine spray at 1ml/lit and vinca leaf powder at 50 gm/tree registered less number of galleries and less number of termites per gallery.

Non Crops

Pesticide dissipation and residue studies

- Dissipation of chlorantraniliprole residues with half-life period of 2.21, 1.62 and 1.26 days respectively in okra, chilli and tomato and safe waiting period of one day was suggested for consumption.
- Tamarind + lemon juice (2%) was the best decontaminant solution for removing chlorantranilirpole residue in okra, chilli and tomato fruits.
- Acetamiprid and imidacloprid residues recorded in both pollen (1 no./9) & honey (2 nos./11) and hence to be avoided in crops being managed with bee colonies during full bloom

Stingless bee biology and colony management

- The total developmental period of stingless bee queen of *Tetragonula iridipennis* is 59±3 days
- Among the different enemies of stingless bees, the pollen mite (62.6%) and phorid flies (49.32%) causes significant damage to stingless bee colonies

b. Plant Pathology

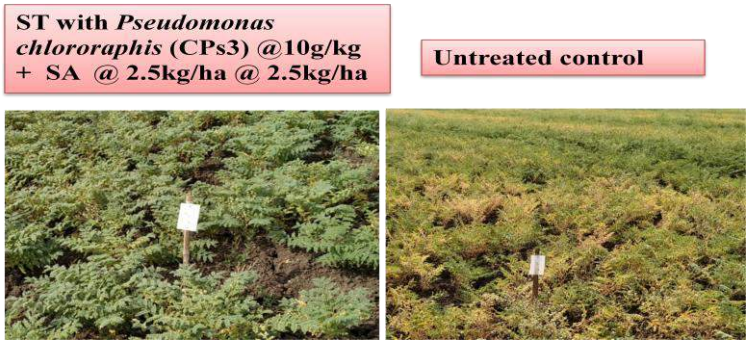
1. FOR ADOPTION

1. Management of leaf and neck blast of rice

Foliar spraying of azoxystrobin + difenoconazole @ 0.1 % (single spray) at the time of symptom appearance is recommended for the management of leaf and neck blast of rice.

2. **Biological management of chickpea wilt**

Application of *Pseudomonas chlororaphis* (CPs3) as seed treatment @ 10g / kg of seeds and soil application @ 2.5kg / ha is recommended for the management of wilt disease in chickpea.



3. Management of root rot and wilt diseases in redgram with biocontrol agents

Application of talc based formulation of *Bacillus subtilis* as seed treatment @ 10 g / kg of seeds and soil application @ 2.5 kg / ha is recommended for the management of wilt and root rot diseases of redgram.

4. Integrated disease management in groundnut

Seed treatment with tebuconazole @ 1.5 g / kg + basal soil application of *Trichoderma asperellum* @ 2.5 kg / ha mixed with 50 kg of FYM + application of *T. asperellum* @ 2.5 kg / ha mixed with 50 kg of FYM at 40 days after sowing + two sprays of tebuconazole @ 1 ml / l at initiation of foliar diseases and 15 days later was found to be effective in managing collar rot, root rot, stem rot, late leaf spot and rust diseases of groundnut besides increasing the pod yield.

5. Management of gummosis and die-back disease in mango

Removal of infected twigs and branches followed by three sprays of tebuconazole 25 EC @ 0.1% at 15 days interval was found to be effective in reducing the severity of gummosis and die-back disease of mango.

6. Integrated management of citrus greening disease

Soil application of 50 per cent more than recommended dose of phosphorus (600g) with zinc sulphate @ 200g + ferrous sulphate @ 200g per tree followed by two sprays of tetracycline hydrochloride @ 600 ppm at 45 days interval from initiation of disease was found to be effective in reducing the citrus greening disease.

7. Eco-friendly bioformulation for the management of chilli anthracnose disease

Foliar application of thyme oil 5 EC at the rate of 10 ml / l during flowering followed by two sprayings at 15 days interval significantly reduced the chilli anthracnose disease.


8. **Recyclable PP containers as an alternative to polypropylene bags for oyster mushroom cultivation**

Polypropylene containers can be used as an alternative to polypropylene bags for cultivation of oyster mushroom. Oyster mushroom cultivation in polypropylene container recorded yield on par with polypropylene bags with bioefficiency of 126.35 and 128.9%, respectively with a C:B ratio of 3.1.

2. FOR INFORMATION

1. **Development of loop-mediated isothermal amplification (LAMP) assay protocol for the detection of rice blast pathogen, *Magnaporthe oryzae***

The loop-mediated isothermal amplification (LAMP) assay is a rapid detection method to detect airborne inoculum of *Magnaporthe oryzae*. The detection and amplification occurs in a single step and suitable for *in situ* applications and suitable for quarantine applications.

2. **Identification of resistance sources for major diseases of rice**

The following are the resistance sources for the major diseases of rice.

Blast	Sheath Blight	BLB	Brown spot	Sheath rot
AD 13253	ACK 14026	AD13253	AD 17152	ACK14029
TNTRH 105	AD13253	CB 15138	AD 16028	PM16003
AD 16148	CB 15138	AD 15105	32-2	148-2
AD16124	AD 15105	AD16124	AS 13228	
32-2	AD16124	AD 15105	AS 16050	
IR 64 dt. QTL.	AD 15105	AD 16124	US 312, PM16003	

TM 12012	148-2	ACK14029	CB 16570	
35-3		PM16003	AS13203	
AD 16124		148-2	IR 64 dt. QTL	
			TM 14035	

3. ***Aspergillus flavus* and Aflatoxin in rice grains**

Out of 40 samples collected from farmers' field, 6 samples yielded *A. flavus* (15%) and aflatoxin (AFB1) was detected in 2 samples by Thin layer chromatography (5%). Out of 20 samples collected from warehouses, 10 samples yielded *A. flavus* (50%) and aflatoxin (AFB1) was detected in 3 samples (15%).

4. The redgram entries *viz*., ICP 6859, ICP 8602, Yelagiri local, Vathalmalai -1 and TTB 7 found to free from wilt incidence. The entries *viz*., IPA 9F, MAL 13 and BRG 4 were found to be resistant donors for sterility mosaic virus disease.
5. The blackgram entries *viz*., KUP 19-40, KUP 19 -59, KUP 19-61 and KUP 19-77 were free from yellow mosaic disease (YMD) during Kharif 2020 under field conditions. The entries *viz*., RUP 19-57, RUP 19 -58, RUP 19- 62 and RUP 19-66 were free from (YMD) under artificial condition through insect transmission during Rabi 2019-20.
6. The greengram entries *viz*., KMP 19-6, KMP19-13, KMP 19-14, KMP 19-36, KMP19-35 and KMP 19- 33 were free from YMD during Kharif 2020.
7. The land races sorghum *viz*., Vilathikulam local, Kalugumalai, Ammapatti local 2, Kalikkampatti local 1, Chittayan kottai local 1, Kalingamudaiyanpatti local 1, Kalingamudaiyanpatti local 2, Keezhakunampati local 1, Muthiyampalayam local1, Muthiyampalayam local 4, Tenkasi local, TNAU-R-0040-2448, TNAU-R-0040-4416 and PYR-(TV)-16-03 showed resistance to ergot, grain mould, anthracnose, rust and downy mildew diseases
8. Spraying tebuconazole 5.36 W/W @ 1ml / l recorded 9.99% ergot incidence with a maximum grain yield of 2009 kg / ha compared to control (75.57% ; 1278 kg/ha)
9. A 'T' shaped low cost and user friendly spore trap was devised to monitor the spore load of maydis and turcicum blight diseases in maize.
10. Application of farm yard manure @ 12 tons / ha + seed treatment with *Bacillus subtilis* @ 10g / kg + VAM @ 5g / plant at vegetative stage and soil application of *B. subtilis* + *Trichoderma viride* @ 2.5kg / ha at tasseling stage and milky stage effectively reduced the charcoal rot incidence.
11. A new mycoparasite *Sphaerellopsis paraphysata* on rust of pearlmillet was confirmed at molecular level
12. Basal soil application of *Trichoderma asperellum* (2.5kg / ha) enriched in FYM @ 100 kg applied and at 40 DAS significantly reduced the incidences of soil borne diseases of groundnut.

13. Seed treatment with *Trichoderma asperellum* @ 4g/kg of seed followed by spraying of carbendazim + mancozeb @ 0.1% on 30 DAS was effective in managing root rot, *Alternaria* leaf spot, powdery mildew and phyllody diseases of sesame with increased yield.

14. For the integrated management of root rot of sesame, soil application of *Trichoderma asperellum* @ 2.5 kg / ha mixed with FYM at the rate of 150 kg and VAM 10 kg / ha and applied as basal was found to be effective.

15. In sunflower, seed treatment with salicylic acid @ 100 ppm, foliar spraying with neem oil 3% at 30 DAS, foliar spray with zineb + hexaconazole @ 2.5g / l during 45 and 60 DAS showed no incidence of necrosis and lower severities of leaf spot and powdery mildew with higher yield and BC ratio of 1:1.9.

16. In castor, foliar spray of carbendazim @ 0.2% and profenophos 50 EC @ 0.025% at 45, 60 and 75 DAS was effective in managing grey mold disease and capsule borer.

17. A lower incidence of *Myrothecium* leaf spot in cotton was observed with seed treatment of *Bacillus subtilis* (10g / kg) + foliar spray (0.5%) on 30 and 45 days after sowing when compared to control.

18. Spraying copper oxychloride 50 WP @ 2.25g / l of water was found to reduce incidence of sooty mould in cotton.

19. Sett treatment with liquid formulated *Chaetomium globosum* @ 10 ml / l for 10 minutes + soil application with talc formulation @ 2.5 kg / ha at the time of planting recorded lowest incidence of sett rot disease in sugarcane with the higher germination per cent, tiller and shoot populations.

20. A rapid, highly sensitive, specific molecular detection method, loop-mediated isothermal amplification (LAMP) protocol has been validated for the early detection of grapevine mildew pathogens. The reliability of LAMP protocol in the detection of grapevine downy and powdery mildew pathogens was found to be 79.5 and 85 per cent, respectively.

21. **Management of fusarial wilt of banana**

The bacterial endophytes viz., *Brachybacterium paraconglomeratum, Bacillus subtilis, Bacillus tequilensis, B.elezensis, Strenotrophomonas maltophilia, Achromobacter xylosoxidans, Strenotropho monasmaltophilia* and B. amyloliquefaciens isolated from resistant banana plants (YKM 5) were found to be effective in the suppression of *Fusarium oxysporum* f.sp. *cubense* under *in vitro* condition.

22. **Management of sigatoka leaf spot of banana**

Banana Sigatoka leaf spot disease was effectively managed by three sprays of propiconazole @ 0.05% + mineral oil @ 1% at 25 days interval with the least disease severity index of 14.75 as compared to untreated control (30.45).

23. **Management of mango collar rot and root rot**

Mango collar rot caused by *Sclerotium rolfsii* in nurseries was effectively managed by treating the mango stones with *Trichoderma asperellum* @ 2% and soil treatment with *T. asperellum* @ 10g + VAM @ 15g + vermicompost @ 250g /m2 . Mango root rot caused by *Macrophomina phaseolina* in seedlings was also effectively managed by the application of *T. asperellum* @ 10g +VAM @ 15g / graft in the pot mixture and increased the per cent root stock success.

24. **Management of black leaf spot of papaya**

Foliar spray of tebuconazole 50% + trifloxystrobin 25% WG @ 0.45g / l was found to be effective in managing black leaf spot of papaya followed by foliar spray of propiconazole 25% EC @ 1ml / l.

25. **Management of soil borne disease of tomato**

Application of *Bacillus subtilis* endospore based liquid bioformulation as seed treatment @ 10ml / kg, seedling dip @ 10ml / l, soil application @ 100ml / pot along with foliar spray @ 0.2% at 30 and 60 days after transplanting recorded the lowest soil borne disease incidence of 9.5 per cent as against 65.5 per cent in the inoculated control accounting for 85.5 per cent reduction over control in tomato.

26. **Management of virus disease complex in brinjal**

Spraying thiamethoxam @ 0.05% at 15 DAT, foliar spray of *Bacillus subtilis* @ 0.5% at 30 and 45 DAT and foliar spray of micronutrient mixture @ 0.2% at 60 DAT showed effective reduction in virus incidence in brinjal.

27. **Management of postharvest decay of carrot**

Freshly harvested carrots dipped in the boiled cinnamon bark extract @ 10% for 3 min was effectively inhibited (84.5%) the decay of carrot upto 10 days after dipping. This treatment did not affect any quality parameters of the carrot *viz*., taste, colour, firmness and cooking quality as per the sensory evaluation test.

28. **Management of cassava mosaic virus disease**

Sett treatment in hot water @ 51^0C for 20 minutes, sett treatment and foliar spray of *Bacillus subtilis* @ 0.2% and placing yellow sticky traps were found to record a low severity of cassava mosaic disease (grade 2.3) with higher tuber yield (34.92 t/ha)

29. **Development of RNAi constructs for cucumber mosaic virus**

RNAi constructs using fragments of coat protein and replicase genes of Cucumber mosaic virus (CMV) were developed to confer resistance against CMV.

30. **IDM for bacterial wilt of tomato**

Soil application of bleaching powder @ 15kg / ha before transplanting, soil amendment with lime depending upon pH of the soil to make soil neutral + seedling root dip with streptocycline @ 200ppm and drenching of copper oxychloride @ 0.3% thrice at 10 days interval started from 20 days after transplanting recorded lower bacterial wilt incidence in tomato with highest BC ratio of 3.91.

31. **Integrated management of bitter gourd virus diseases**

A minimum disease incidence of 7.65 PDI of mosaic was recorded in bitter gourd up on application of acephate @ 0.15% + neem oil @ 0.2% spray followed by spraying of pyriproxifen @ 0.1% at 10 days interval as against control (32.56 PDI) and recorded maximum fruit yield of 167.25 q/ha.

32. **Management of powdery mildew disease in coriander**

Foliar spraying of propiconazole 25 EC @ 0.1% at the time of initial appearance of disease followed by carbendazim + mancozeb @ 0.2% on 10 days after spray reduced the powdery mildew in coriander

33. **Management of root rot diseases of *Gloriosa***

Dipping tubers in talc based formulation of *Bacillus amyloliquifaciens* @ 1 % for 20 min + soil application of talc based formulation of *B. amyloliquifaciens* in FYM @100g / plant on 30 and 60 days after planting was found to be effective in reducing the *Sclerotium* incidence to 16% and *Macrophomina* incidence to 14% with a seed yield of 420 kg/ha.

34. **Bio-suppression of *Macrophomina* root rot of *Coleus***

Basal soil application of *Bacillus subtilis* (Bbv 57) @ 2.5kg / ha + dipping cuttings in 0.2% (Bbv 57) for 10 min + soil application of Bbv 57 on 30 and 45 DAP recorded maximum disease reduction over control (69%).

35. **Management of *Alternaria alternata* leaf blight disease in Gloriosa**

Foliar spray of tebuconazole + trifloxystrobin @ 0.05 % at 30, 45, 60 days after planting recorded maximum disease reduction over control.

36. Strain Vv-4 of paddy straw mushroom (*Volvariella volvacea)* was found suitable for out door cultivation.
37. The antiviral compound, squalene identified from solvent fractions of *Ganoderma lucidum* inhibited symptom development of Groundnut bud necrosis virus in tomato

3. FOR ON FARM TRIALS AND MULTILOCATION TRIALS

1. Management of rice grain discolouration through botanicals

Treatments

T1. Foliar spray of *Ocimum sanctum* leaf extract (10%) at 50% flowering stage followed by second spray 10 days later

T2. Foliar spray of neem oil @ 3 per cent at 50% flowering stage followed by second spray 10 days later

T3. Absolute control

2. Management of sheath rot and grain discolouration in rice

Treatments

T1. Seed treatment with Bacillus subtilis @ 10g/kg + one foliar spray with azoxystrobin @ 0.2% at 50 per cent flowering.

T2. Seed treatment with Bacillus subtilis @ 10g/kg + one foliar spray with carbendazim + thiram + mancozeb (1:1:1) @ 0.2% at 50 per cent flowering.

T3. Untreated control

3. Revalidation of IPM package for yellow mosaic disease and its vector in blackgram

Treatments

T1. IPM Module

- Seed soaking with borax @ 2g / kg + 10% nochi leaf extract @ 300ml/kg followed by seed treatment with imidacloprid 600FS @ 5g/kg

- Soil application of Bacillus subtilis (BS-1) @ 2.5kg / ha
- Border row planting of maize (2 rows)
- Rogue out virus infected plants upto 25 DAS
- Installing yellow sticky traps @ 12 no. / ha
- Foliar spray of borax @ 0.1% and nochi leaf extract 10% at 30DAS
- Need based spraying of acetamiprid 20 WP @ 250g / ha

T2. Farmers Practice

4. Biological management of root rot disease of sesame

Treatments

T1. Soil application of *Trichoderma asperellum* (2.5 kg/ha) mixed with FYM @150 kg and VAM 10 kg as basal application

T2: Soil drenching with carbendazim @ 1 g / l at 30 DAS

T3: Control

5.Management of cotton diseases

T2. Seed treatment with *Bacillus subtilis* @10g/kg + foliar spray 0.5% on 30 and 45 days after sowing

T3. Untreated control

6.Integrated disease management for viral and phytoplasma diseases of brinjal

Treatments

T1. Biointensive management - seed treatment with Bacillus subtilis @ 10 g/kg; nursery application of neem cake @ 1.0 kg/sq.m.; growing of maize as border crop, rouging out infected plants up to 30 DAT; installation of yellow sticky traps @ 12/ha; foliar spraying of neem oil formulation @ 3 ml/lit and need based application of insecticides spiromesifen 240 SC @ 1.0 ml/lit

T2. Farmers Practice

T3. Untreated check

7.IPDM strategy for the virus diseases management in snake gourd

Treatments

T1. Seed treatment @ 10 g/kg of seeds + soil application @ 2.5 kg/ha with *Bacillus subtilis* + basal soil application of micronutrient mixture @ 2.5 kg each of ferrous sulphate, zinc sulphate, copper sulphate, manganese sulphate and boric acid per hectare + foliar spraying of micronutrient mixture (0.2% concentration of each ferrous sulphate, zinc sulphate, copper sulphate, manganese sulphate and 0.1% boric acid) at 25 days after sowing + need based application of thiamethoxam 25 WG @ 0.5g/l.

T2 - Farmers Practice - Insecticide application for vector control (imidachloprid @ 0.5 ml /L)

T3 - Untreated check

8.Management of leaf blight disease of coconut Treatments

T1. Root feeding with tebuconazole @ 5 ml in 100 ml of water during Jan, April, July and October + 200g of *Bacillus subtilis* in 50kg of FYM. Additional application of potash 1kg over RDF.

T2. Farmers practice – Hexaconazole @ 2ml in 100ml of water.
T3. Control

9.Management of leaf blight (*Alternaria alternata*) in Gloriosa

Treatments

T1. Foliar spray of tebuconazole + trifloxystrobin @ 0.05 % on the onset of the disease followed by two sprays at 15 days interval
T2. Farmers Practice
T3.Untreated check

10. MLT MUSHROOM

1. Evaluation of milky mushroom CBE-TNAU-1523 at growers cropping house

c. Department of Nematology

FOR ADOPTION

1. Management of root knot nematode, *Meloidogyne enterolobii* in guava

Application of *Purpureocillium lilacinum* @ 75g mixed with FYM @ 2.5kg, Pressmud @ 2.5kg, Neem cake @ 125 g/tree with marigold around tree basin after pruning effectively reduced the root knot nematode, *Meloidogyne enterolobii* population in soil (14.4%) and enhanced the fruit yield (23.0%) with CB ratio of 1: 2.70.

2. Entomopathogenic Nematodes (EPNs) bacterial toxins against brinjal insect pests

Spraying of EPN bacterial (*Xenorhabdus*) toxin formulation @ 1 ml /lit of water at 30, 60 & 90 Days after transplanting significantly reduced the population of shoot and fruit borer (31.09%), *Epilachna* beetle (13.68%) and white fly (2.40%) but no significant difference was found in the population of thrips and green leaf hopper in brinjal.

3. Bio-management of root knot nematode, *Meloidogyne incognita* on tomato

Application of *Purpureocillium lilacinum* @ 2.5kg/ha mixed with FYM @ 250Kg/ha at the time of transplanting reduced root knot nematode, *M. incognita* population in soil (23.2%) and root (39.0%) and significantly increased the tomato yield by 16.32% with cost benefit ratio of 1: 3.4.

4. Overall package for the management of root knot nematode, *M. incognita* infesting cucumber under protected cultivation

- Removal of root biomass from previous crop
- Soil solarization of moistened soil using transparent polythene sheets 25 micron thickness for a period of 2-3 weeks during peak summer (May-June).
- Incorporation of bio enriched farm yard manure @ 1 ton per acre of polyhouse ($2x10^8$ for *Purpureocillium lilacinum*, *Pochonia chlamydosporia* and *T. asperellum*). The FYM heap has to be moistened, mixed with bioagents and kept for 3-4 weeks in shade (mixing and moistening once in a week).
- Application of liquid formulation of *Pochonia chlamydosporia* @ 0.25 ml/ m^2 through drip at the time of planting and repeated thrice at 30,60 and 90 days after planting.

FOR OFT

1. **Management of root knot nematode, *M. enterolobii* in guava by newer chemical Treatments**

T_1 - Basin application of Fluensulfone 2% GR @ 0.6 g a.i (60g of formulation) /plant twice at 3 months interval

T_2 - Farmers practice (Carbofuran 3G @ 60g/ plant twice at 3 months interval)

T_3 - Untreated control

Design: RBD, Replications: 7, Variety: L - 49

Observations to be recorded:

- Initial and final nematode population soil (200cc) and root (5g)
- No. of galls/ 5g root,
- Yield: Kg/tree and t/ha
- C:B ratio.

Coordinating centre: AC & RI, Coimbatore - Dr. P. Kalaiarasan, Asst. Prof. (Nem)

Participating centres:

AC & RI, Coimbatore - Dr. P.G.Kavitha, Asst. Prof. (Nem.)
AC &RI, Madurai - Dr. N. Seenivasan, Assoc. Professor (Nem.)
AC & RI, Vazhavachanur - Dr. P. Senthilkumar, Asst. Prof. (Nem.)
Dharmapuri/Tiruvannamalai
HC & RI, Periyakulam - Dr. S. Prabhu, Asst. Prof. (Nem.), **-** Dindigul
VRS, Palur - Dr. K. Senthamizh, Asst. Prof. (Nem.) - Panruti

2. **Validation of alginate beads of *Pasteuria penetrans* for the management of root knot nematode infestation in tomato**

Treatments Proposed

T_1 – Application of *P. penetrans* bead @1 / plant twice at the time of planting and 30 days after planting.

T_2 – Seed treatment with *B. subtilis* @ 10g/kg of seed and soil application with 2.5kg/ha at the time of planting

T_3 – Untreated control

Replications: 7 Design: RBD Plot size: 4 x 2 m Variety: Locally cultivated

Observations to be recorded:

- Soil (250g soil) and root (5g root) nematode population.
- Root-knot index
- Number of eggmasses / g of root
- Number of *P. penetrans* infested females / g of root
- Yield / plot (kg/plot) and (t/ha)

Coordinating Centre: AC & RI, Coimbatore (Dr. N. Swarnakumari, Asst. Prof. (Nem)

Participating Centres:

AC &RI, Coimbatore - Dr. G. Jothi, Assoc. Prof (Nem.) – Coimbatore
AC & RI, Coimbatore - Dr. P. Kalaiarasan, Asst. Prof. (Nem.) – Erode
VRS, Palur - Dr. K. Senthamizh, Asst. Prof. (Nem.)
ADAC & RI, Trichy - Dr. S. Jayakumar, Asst. Prof. (Nem.)
AC & RI, Vazhavachanur - Dr. P. Senthilkumar, Asst. Prof. (Nem.) Dharmapuri/Tiruvannamalai

FOR INFORMATION

1. **Biomanagement of root knot nematode, *Meloidogyne incognita* on brinjal**

Application of *Pochonia chlamydosporia* liquid formulation at the time of planting followed by 30 and 60 DAP showed 55.8% reduction in eggmass production of root knot nematode, *M. incognita* in brinjal.

2. **Bio-management of root knot nematode, *Meloidogyne incognita* on tomato**

Native isolates of nematophagous fungi viz., *Clonostachys rosea* and *Lecanicillium lecanii* inhibited the egg hatching, juvenile mortality and parasitism of eggs of root knot nematode, *M. incognita*.

II. HORTICULTURE

Dr. L. Pugalendhi
Dean, HC&RI, Coimbatore

FRUIT CROPS

I. Crop Improvement

For Adoption

1. Banana CO2

The hybrid is an outcome of hybridization programme involving Karpooravalli and a resistant diploid parent "Pisang Lilin". The average bunch weight is 9.97 kg as compared to 9.89 kg in Ney Poovan. The crop duration is 360 to 390 days. It has 8 to 9 hands per bunch. The number of fingers per bunch is higher (146) as compared to Ney Poovan (125). The TSS ranges from 22 to 26^0 Brix depending upon the stage of ripening. The hybrid shows field tolerance to nematode population while Ney Poovan was found susceptible. Because of this resistant attribute and acceptable yield, fruit quality traits similar to Ney Poovan this hybrid can be cultivated with minimum nematicide usage or can also be well fit in organic production system.

2. Manila Tamarind PKM 2

PKM 2 Manila Tamarind is an open pollinated seedling progeny from Viruthunagar Local. It is medium branching type. The growth habit is profuse. It has twisted pale yellow fruit with attractive red aril and yields about 87 kg/tree/year. TSS content is 19º Brix. This type is suitable for saline, alkaline soils and water logging conditions

For information

1. Banana - Pre-release culture H 96/7

High yielding banana culture H96/7 (ABB) is a cross between Karpooravalli and H201. The fruits are similar to Karpooravalli with good quality parameters with a TSS of 23 - 25^{o}Brix. The hybrid is tolerant to lesion nematodes with lesion index of 15.33% whereas Karpooravalli is highly susceptible (lesion index 42.28%). The culture recorded a pseudostem height of 260-270 cm, pseudostem girth of 75-80 cm with 13-14 leaves. It has recorded an average bunch weight of 22 kg / plant with 12-13 hands and 170 - 175 fingers /bunch. The total duration of the crop is 340-350 days. This culture can be recommended for areas where Karpooravalli is predominantly grown since the variety is highly tolerant to nematodes.

2. Papaya – Gynodioecious selection (C1-33)

A gynodioecious selection (Sel. C1-33) was made from progenies of C1 cross combination (CP-96 x CO.8). During the evaluation of F_6 generation, based on low disease severity, better fruit set and red pulp colour, four single plant selections were made. The yield of these selections ranged from 40-45 kg per plant and has been forwarded for further purification and evaluation in F_7 generation. The culture is proposed for MLT.

3. Wood apple – Pre release culture (FLV -03)

It is a clonal selection from Virudhunagar local and being evaluated at Horticultural College and Research Institute, Periyakulam. Trees are ever green with semi spreading habit. Fruits are round, greyish-white in colour. At full ripening, the pulp will be brown in colour, acidic with sweet taste. It yields 180 to 220 fruits/tree/year with individual fruit weight of 250 to 300 g. The pulp contains 4.05 mg of protein, 6.42 mg of ash, 7.30 g of dietary fibre, 68.0 mg of Calcium and 30.2 mg of Magnesium. The fruits are rich in pectin 3.15%, carotene 55.0 µg with TSS and acidity of 15.8° Brix and 1.62% respectively. It is suitable for preparing value added products *viz*., jelly, dry fruit powder, fruit bar and nectar. The pre-release culture is suitable for dry and wastelands of Tamil Nadu.

4. Jackfruit - Gumless Jack (AH10)

A gumless jack fruit genotype AH 10 was identified as promising at VRS Palur. The accession was collected from a farmer Pudukooraipettai, Vridhachalam. The fruits weigh 5kg each with 80 carpels (25g each) and have high TSS of 38^{o}Brix. The tree is 40 years old and high yielder with 250 fruits per year. After ripening the fruits have no latex in the rind and around the carpels which is an unique characteristic of this genotype. The scions of gumless (latex free) genotype AH 10 was grafted and a mother plant block was established at Vegetable Research Station, Palur.

II. Crop Management

For Information

1. Input use efficiency in banana

In Banana cv. Grand Naine, the inputs *viz*., Drip irrigation (80% ER at all stages) + Fertigation + Micronutrient foliar spray @ 2% spray at 3,4 and 5 MAP + Bunch spray of SOP (2%) (I spray after male bud removal and II spray – at 30 days after first spray) significantly recorded higher bunch weight (32.1 kg/plant), hands per bunches (12.0) and finger weight (231.2g) with a BC ratio of 3.6 as compared to control (soil application of RDF + flood irrigation). The yield increase of 18.9% was recorded with the above input combination when compared to control.

2. Fertigation scheduling for Guava cv. Lucknow 49 under high density planting system

Guava cv. Lucknow 49 planted at 3m × 1m spacing (3,333plants/ha) with tip pruning of current year shoots followed by fertigation dose of 75:75:75g NPK/plant/season was found to be the best practice to get higher productivity (50.63t/ha) as against 11.80t/ha (5 x 5 m). The best treatment recorded the highest Cost Benefit Ratio (1:2.85 as against 1:1.95 in control).

The fertigation scheduling for various growth stages is as follows

S.No	Stages	N (%)	P_2O_5 (%)	K_2O (%)
1	Vegetative phase (6 weeks)	60	50	30
2	Flowering to fruit set phase (3 weeks)	30	40	30
3	Fruit development to fruit maturity phase (12 weeks)	10	10	40

3. Pre-harvest application of water soluble fertilizers in grapes var. Muscat Hamburg

Pre-harvest dipping of grape bunches with solution containing Calcium Chloride @ 1 % + Sulphate of Potash @ 1 % at berry development and veraison stage was found superior for individual bunch weight (298.82 g), yield per vine (15.52 kg) and estimated yield per hectare (20.69 t ha^{-1}).The same treatment also registered superiority for quality parameters *viz*., TSS (23.53 °Brix), TSS: acid ratio (46.69), total sugars (16.70%), reducing sugars (16.10%) and shelf life (8.97 days). However, least berry cracking (3.27%) and physiological loss in weight (2.74%) was registered in bunches dipped in T_{10} (1% Calcium Nitrate + 1% Potassium Nitrate).

VEGETABLE CROPS

I. Crop Improvement

For Adoption

1. Tomato Hybrid CO4

Tomato Hybrid CO4 is an F_1 hybrid of LE 1226 X LE 1249. Fruits are flat round with thick pericarp (5.84 mm) and extended shelf life (10 days at room temperature). The fruits have green shoulder at breaker stage which turns to red at ripening. Fruits are borne in clusters of 5-6, with a mean fruit weight of 75.3 g. The hybrid has long harvesting period with 20-22 harvests in 150 days with an yield of 2.94 kg per plant and 92.3 t/ha (27.31 % increase over TNAU tomato hybrid CO3 and 40.91% over Lakshmi). The hybrid CTH 1 is moderately resistant to leaf curl virus (10.5 PDI).

2. Onion CO 6

Aggregatum onion variety CO 6 was developed by selection from germplasm. It has the ability of free flowering and seed setting throughout Tamil Nadu. The bulb and seed yield is 19.10 tonnes / ha and 250- 300 kg/ ha, respectively. It recorded 20.94 % increase over the check CO (On) 5. By switching over to cultivation of seed setting onion from the bulb propagated one, there is a saving of seed bulb to a tune of 1000 kg / ha. The bulbs are bolder in size with attractive pink in colour. Each clump has 5 - 7 bulbs and each clump weighs 90-100 g. For seed to bulb it takes 130 days and bulb to seed it takes 140 days duration. The bulb has a TSS of 15.4 ^{0} brix and ascorbic acid content of 10.8 mg/100 g.

3. YTP 2 Cassava

It is a selection from Thondamuthoor -1. Plants are erect, tall growing and branches at top. The inter nodal length is shorter and the leaf size is bigger. The tubers are long, cylindrical with pinkish white skin. The rind colour is also pink with creamy white. The flesh is white in colour. The mean tuber yield per plant is 6.28 kg with the starch content of 29.62% . It is a dual purpose cassava accession suitable for edible purpose and for industrial use. Cassava mosaic virus grade is one to two.

<u>For Information</u>

1. Brinjal hybrid derivative HD 10-6-5-3

Brinjal hybrid derivative (HD 10-6-5-3) was selected from a cross ACM SM 9 x Annamalai. This hybrid derivative is with a plant height of 85.16 cm and 22.17 branches/plant. Each plant bear 39.14 fruits and each weighing 47.50g. The fruit is white in colour with purple stripes which is locally called as Palgiri. The hybrid derivative showed 18.59 % and 36.64 % infestation by shoot and fruit borer respectively besides recording 18.45 % little leaf incidence and the yield increase over the check (CO2) was 30.4%.The culture is under ART.

2. Non-spiny brinjal VMB-16-10

The non-spiny brinjal (VMB-16-10) is a hybrid derivative. The plant height is 118.6 cm with 30.5 branches/plant. Each plant bear 95.5 fruits each weighing 120 g. The fruit is purple in colour with a potential yield of 2.3 kg /plant. It showed 18.3 % and 23.3 % infestation by shoot and fruit borer respectively besides recording no little leaf incidence. The yield increase over the check (VRM(Br1) was 25% .The culture is under ART.

3. Brinjal culture CBE –SM- 03

It is a hybrid derivative of CBE- SM - 13 X *Solanum viarum* cross combination. Fruits are long, light purple with white stripes, cluster bearing with 2-3 fruits per cluster. Each plant bears 33.2 fruits each weighing 80g with a potential yield of 2.80 Kg per plant in crop duration of 150 days. The yield increase over the check variety CO 2 is 21.7 per cent. It showed 12.06 and 15.37 % infestation respectively for shoot and fruit borer.

4. **Brinjal culture CBE- SM -06**

It is profuse bearing hybrid derivative of cross combination of CBE – SM- 31 X CBE-SM-8. Fruits are dark violet, oblong, cluster bearing with 3-4 fruits per cluster. Yields 35-36 tonnes/ha in a crop duration of 145-150 days. It showed 12.28 and 17.67% infestation respectively for shoot and fruit borer incidence. The yield increase over the check variety CO 2 is 34.5 per cent

5. Ridge gourd ACM LA 19-003

Ridge gourd culture ACM LA 19-003 is a hybrid derivative of the cross between LA M 3 x LA M 1. The average fruit weight is 309 g/fruit with 16.93 fruits per plant. The yield per plant is 5.26 kg/plant with 28.13% increase over check CO 1.

6. Ridge gourd RG 15-3-4

The ridge gourd 15-3-4 was developed as RIL's in F_6 of the cross CO1 X Kasi Kushi. It is a small fruited, cluster bearing type with hermaphrodite flowers. The fruits are 25-30cm long and single fruit weight is 150-160g. It bears 85-90 fruits with an yield of 14.50 kg per plant. It is an early bearer (35-38 days for first harvest). The total antioxidant activity is 93.8ug/100g with zinc (0.35 mg/100g), iron (1.4 mg/100g) and Calcium (31.89 mg/100g).

7. Elephant Foot Yam CBE AC 03

It is a clonal selection from the germplasm collected from Appakudal village in Erode District. It is an early maturing variety **(**244 days) with high corm yield of 53.47 t/ha. It has low acridity with the oxalic acid content of 93.00 mg/100 g. The per cent yield increase over the check variety Gajendra is 15.13.

8. Pole Type Lablab DbP 4 (2014-1-4)

It is a hybrid derivative of CBE LP (p) 17 x CBE LP(p)06. The pole type Lablab DbP 4 is a cluster bearing, photo insensitive type yielding 30-35 t/ha. The pods are 12cm long, flat, fleshy with high market preference. Suitable for round the year cultivation.

9. Bush Type Lablab Db (B) -12

It is a hybrid derivative of CBE LP (b)03 x CBE LP(b)36. It is a cluster bearing, photo insensitive type which is very early (60-65 days for first harvest) and yielding 15-18 t/ha. The pods are 12-15cm long, straight, flat, fleshy with high market preference. It has 25% total soluble protein, 4% total soluble sugars with 1.5% crude fibre content. Suitable for round the year cultivation.

10. Mundu Chilli PKMCA 32– 09-04 (Chatti Mundu Type)

It is a high yielding Mundu chilli type collected from Valanthavarai, Ramanathapuram Dt. The individual ripe fruit weight is 10.55 g. Fruit length (8.60 cm) and the fruit girth is 2.65 cm. Number of fruits per plant is 105.4. Dry fruit weight and dry fruit yield were 2.05 g and 215.3 g/plant respectively. Dry recovery is 25.4%. The capsaicin content and capsanthin content were 2284 SHU and 198.7 ASTA respectively.

11. Kuruvi pakal culture CBE MC 07

It is selection from local collection made from Theni. The individual fruit weight ranges from 35-45 g. The length and girth of the fruit is 8.5 and 9.8 cm respectively. The individual plant yield 40-45 fruits and recorded 1.75 kg/plant.

II. Crop Management

For Information

1. Weed management in Elephant Foot Yam

Mulching with black polythene mulch (25 µ) recorded highest corm yield per plant (3.00kg) with the yield of 45.8 t per hectare and benefit cost ratio of 2.70. Then, Pre-emergent herbicide Pendimethalin 30 % EC @ 1 kg ai/ha (1DAP) + Post emergence herbicide Glyphosate 41 % SL @ 1 kg ai/ha at 45 and 90 DAP recorded 2.86kg yield per plant and yield per hectare is 44.87 t with a BCR of 2.59

2. Critical limit for Magnesium in soils and crop (Potato)

Field experiments conducted with different levels of $MgSO_4$ revealed that, soil application of 60 kg $MgSO_4$ ha^{-1} was found economical for increasing the tuber yield of Potato from 16.5 to 30.4 %. The critical limit was fixed for Magnesium fertilizer recommendation and is < 42 as deficient , 42 to 83 medium and > 83 as high

3. Customized fertilizer for Bitter gourd

A Customized fertilizer (CFII) for soil application of nutrients with a combination of Urea, MAP,KNo_3+ Vegetable MN mixture was formulated and has recorded an yield increase of 15.20 per cent over the control. The fruit quality parameters *viz.*, ascorbic acid, iron and zinc were improved.

4. Effect of organic treatments on in brinjal, chilli and tomato

In brinjal the highest yield of 23.967 t/ha was obtained with (100% organic manures -50 % FYM +50 % vermicompost). The maximum net returns (Rs.1,86,767 /ha) and quality parameters (Ascorbic acid and titrable acidity) were better in 75% organic + 3% panchagavya). In chilli and tomato 75 % organic manures and 3% panchagavya had recorded the highest yield of 10.237 t/ha 10.332 t/ha respectively and the quality parameters were also enhanced.

Spices and Plantation Crops

I. Crop Improvement

For Information

1. Turmeric Culture BS 9 under ART/MLT

The special features of the culture are high fresh rhizome yield of 52 t/ha with a curcumin content of 4.38%. The culture is under ART

2. Coriander Culture CS 38

It is a selection from germplasm collection maintained at HC&RI, Coimbatore. The culture recorded a high leaf yield (4238 kg/ha) in a duration – 38 to 45 days. The yield increase over the check variety CO (CR) 4 is 23 %. The MLT and ART completed. The culture is under large scale demonstration.

Ginger

Evaluation of 14 ginger genotypes at HREC, Gudalur for high yield and resistance to soft rot disease revealed that ACC 578 recorded the highest fresh rhizome yield (10.80 kg/plot of 6 sq.m) with PDI of 9.00 against soft rot disease. Whereas, Maran recorded the minimum PDI of 3.00 against soft rot with the fresh rhizome yield of (4.00 kg/plot of 6 sq.m.).

4. Coconut

- A total of fifteen hybrids were evaluated for tender coconut. Among them, high volume of tender nut water was recorded by COD x CC hybrid (560 ml/nut). However, high content of TSS and reducing sugars were recorded in COD x KAP hybrid (5.9° brix & 3.6 g/100 ml tender nut water respectively).
- Of the location specific dwarf x tall coconut hybrids evaluated, KTD (Kenthali Dwarf) x ET (Etamozhi Tall) recorded the lowest palm height and proved its dwarf stature than COD x ET. The highest nut yield (64.7 nuts/palm) was recorded in KTD X ET followed by COD (Chowghat Orange Dwarf) X ET (57.5 nuts/palm) at the age of five years.
- Collection, conservation evaluation of location specific germplasm revealed that IC 599265 beared bigger sized dehusked nuts with high copra content (777.50 g/nut and 164.50 g/nut respectively)

5. Oil Palm

- Evaluation of ten *Tenera* hybrids for growth and yield revealed that the hybrid NRCOP 9 recorded the highest bunch weight per palm (15.75 Kg), FFB productivity (138.60 kg/palm) and FFB yield (19.82 t/ha)

II. Crop Management

For Information

1. Curry Leaf

- Standardization of grafting techniques in curry leaf for water deficit conditions - Among the four rootstocks *viz. Murraya koenigii* (wild type), *Aegle marmelos, Limonia acidisiima and Murraya paniculata* of Rutaceae family senkambu grafted on wild curry leaf (*Maurraya koenigii*) recorded a success percentage of 66.00. The performance evaluation is under progress.
- Studies on the effect of different combinations of organic manures and bio-stimulants in curry leaf revealed that application of 50% N as Vermicompost + 50% N as Neem cake + Panchakavya (3%) as foliar spray recorded the highest fresh leaf yield of 6.81 t/ha and 4.39 t/ha in the kharif and rabi seasons respectively as compared to the control which recorded leaf yield of 5.36 t/ha and 3.16 t/ha in the *kharif* and *rabi* seasons respectively

2. Cocoa

- Based on DRIS indices, leaf tissue concentration and soil nutrient status, the micronutrient requirement of cocoa was arrived at as FeSO4 – 100 g, MnSO4 – 25 g, ZnSO4 – 50 g, CuSO4 – 25 g and Borax – 10 g per plant per year along with liberal quantities of FYM.
- Cocoa is not a remunerative intercrop of coconut in calcareous soils with free $CaCO_3$ content > 8.0 %, due to very less productivity (<10 kg pods / plant / year) owing to multi –micronutrient deficiencies
- **Onfarm decomposting technology for cocoa leaf and pod waste (OFT):** On farm decomposition technology for cocoa leaf and pod conducted at three locations *viz.*, Thondamuthur, Vettaikaranpudur, and HRS, Thadiyankudisai revealed that the microbial culture *Phanerochaete chrysosporium* (1lit. of 5% solution per 100 kg of leaves / pod husk) was found to be effective in decomposing cocoa leaf waste and pod husk in all the three locations.
- **Evaluation of micronutrient mixtures for cocoa (OFT):** Four grades of micronutrient mixtures containing graded doses of Fe, Mn, Zn, Cu and B is being evaluated for cocoa under coconut ecosystem in three locations *viz.,* Farmers' fields of Aliyar Nagar (10.234^0 N and 77.763^0 E), Sethumadai (10.4852^0 N and 76.8898^0 E) Kaliyapuram (10.5536^0 N and 76.9249^0 E). Micronutrient mixtures were applied @ 100 g per plant, one month after the application of macronutrients. Application of Micronutrient Mixture Grade 3 @ 100 g per plant per year was beneficial in terms of pod and dry bean yield of

cocoa. The effect was on par with micronutrient mixture grade 4 across the three location

3. Cashew

- Studies on canopy management under ultra high density planting system of cashew at RRS, Vridhachalam revealed that medium level pruning during first fortnight of July performed better under 4mx2m spacing for growth and yield characteristics with the highest number of nuts/tree (800), nut weight (6.83g) and nut yield/tree (5.76kg).

FLORICULTURE AND LANDSCAPE ARCHITECTURE

I. Crop Improvement

For Information

1. Pre-release culture of Winter Jasmine (*Jasminum multiflorum)*

The culture Acc.Jm-1(KMD) of *J. multiflorum* can be a potential substitute for Local White Kakada. The characteristic features of the culture are year-round flowering, profuse flowering in winter, superior quality parameters, bold buds, attractive pink colour corolla, pink corolla tube with contrasting green tinge at the base, long corolla tube – suitable for easy harvesting and string making, longer shelf life (flower buds remain unopened for 10 hours under room temperature and 52 hrs under cold storage at 7-8^{0}C), higher fragrance level than Local White Kakada, attractive plant architecture (ideal as decorative ornamental also). The MLT and ART of the clonal selection Acc.Jm-1(KMD) of *J. multiflorum* were laid out in six locations. namely, HC&RI(W), Trichy; HC&RI, Periyakulam; AC & RI, Madurai; ARS, Bhavanisagar; FRS, Thovalai and RRS, Paiyur and 17 farmers' fields at Coimbatore, Erode, Karur, Trichy, Salem, Namakkal and Theni Districts.

Pre-release culture of Winter Jasmine (*Jasminum multiflorum)*

II. Crop Management

For Information

1. Foliar nutrition for Jasmine

Foliar application in *Jasminum sambac* variety Ramanathapuram Gundumalli with $MgSO_4$ (0.3%) + $FeSO_4$ (0.5%) + K_2SO_4 (0.5%) + Borax (0.3%) recorded the highest yield of 6.75t ha^{-1} with a yield increment of 27.6% over the control (5.29 t ha^{-1}) and a BC ratio of 3.29.

2. Protray technology for tuberose mass multiplication using bulblets

Treating tuberose bulblets with 200 ppm GA_3 recorded early sprouting (10.15 days), lesser time for 70% sprouting (20.49 days), higher sprouting percentage (97.25%), enhanced plant vigour, shoot:root dry weight ratio (0.54), plant height (27.13 cm), leaf area (22.92 cm) number of roots per clump (16.73) and number of leaves (10.80).

3. Anti-oxidant potential of Hibiscus

- A multi-whorled hibiscus accession rich in anthocyain (78.22 mg/L C 3 G eq), total phenol (75.296 mg/g Gallic acid eq) and total flavonoid (28.20 mg/g Quercetin eq) was identified from Hibiscus germplasm.
- The anti-oxidant potential of the multi whorled accession was also the highest with DPPH (108.51 µg/ml), ABTS (154.70 µg/ml), chelating potential (14.18 µg/ml), FRAP (179.80 µM Ascorbic acid equivalent) and CUPRAC (170.31 µM Ascorbic acid equivalent) assays.
- Tea infusions prepared using hibiscus petals and green tea petals (1:1) possessed high anti-oxidant potential and high consumer acceptability in organoleptic scoring.
- Processed products *viz*., mixed fruit jam and amla RTS coloured using hibiscus flower extract recorded good consumer acceptability.

MEDICINAL AND AROMATIC PLANTS

I. Crop Improvement

For Adoption

Manathakkali CO 1

It is selection from germplasm collection, seed propagated with a duration of 160-180 days. The green herbage yield is 30-35 t/ha and 19.05 % more than herbage yield of check. The total alkaloid content is 0.38 % and is rich in ascorbic acid (21.66 mg/g) and iron content (6.10 mg /100g).

For Information

1. Gymnema

In *Gymnema sylvestre*, two genotypes for high biomass yield (TNGsy 14 and TNGsy 28 (0.75kg and 0.72kg dry leaf / plant respectively) and two genotypes for high gymnemagenin content (TN*Gsy* 34 and TN*Gsy* 20 (1.54% and 1.30% respectively) were identified for multilocation trial.

Dr. T. Arumugam
Dean, HC&RI, Periyakulam

Fruit Science

Wood apple prerelease culture (FLV – 03)

It is a clonal selection from Virudhunagar local the tree is an evergreen and semi- spreading type. Leaves are dark green, leathery and alternate arrangement. Fruits are round and greyish-white in colour. At full ripen stage, the pulp is in brown colour, acidic (1.62%) with sweet taste (TSS – 15.8° Brix). It bears 200- 240 fruits/tree/year with individual fruit weight of 250 to 300 g. It yields 60-65 kg/tree/year (11.0 to 12.2 t/ha). The fruit contains 4.05 mg of protein, 6.42 mg of ash, 7.30 g of dietary fibre, 68.0 mg of Ca and 30.2 mg of Mg. Rich in pectin 3.15% and carotene 55.0 µg. Suitable for preparing value added products like Jelly, dry fruit powder, fruit bar and nectar. Highly suitable for dry and wastelands of Tamil Nadu

VEGETABLE SCIENCE

1. PKM MO 55 (Karumbu Murungai – Perennial Type)

PKM MO 55 is a selection from a Karumbu Murungai (perennial) type identified at a farmer's field near Devathanapatti, Periyakulam. It is a high yielding type with the total fruit yield of 50-55 kg/tree/ year, with a long fruiting period (February to September).The number of fruits recorded were 450 – 500 fruits per tree. The fruit length and fruit girth are 75 cm and 7.3 cm respectively. The percentage of flesh weight is 67.8. The fruit has crude fibre content of 23.5 %, with high Ascorbic acid (108.2 mg/100g) content. This type is suitable for propagation by air layering.

PKM MO 55 (KarumbuMurungai – Perennial type)

Mother tree identified at Devathanapatti

2. Mundu Chilli PKMCA 08 (ChattiMundu Type)

It is a purified type from the high yielding Mundu chilli type collected from Kathalampatti, Virudhunagar Dt. The individual ripe fruit weighs 11.0g. Fruit length is 1.90 cm and the fruit girth is 10.67cm. Number of fruits per plant is 98.3, dry fruit weight is 1.98 g, dry fruit yield 187.5 g/plant and dry recovery 26.4 %. Capsaicin content is 2973 SHU (286.2 ASTA).

3. MunduChilli PKMCA 32– 09-04 (OosiMundu Type)

It is a high yielding Mundu chilli type collected from Valanthavarai, Ramanathapuram Dt. The individual ripe fruit weight is 10.55 g. Fruit length is 8.60 cm and the fruit girth is 2.65 cm. Number of fruits per plant is 105.4. Dry fruit weight is 2.05 g & dry fruit yield 215.3 g/plant. Dry recovery is 25.4 %. Capsaicin content is 2284 SHU (198.7 ASTA).

SPICES AND PLANTATION CROPS

For OFT/ART/MLT – Curry leaf

In curry leaf, application of 50% N as Vermicompost + 50% N as Neem cake + Panchakavya (3%) as foliar application recorded the highest fresh leaf weight per plant (680.61 g and 438.74 g during kharif and rabi season respectively), leaf iron content (3.62%), leaf calcium content (950.37 mg/100 g) and essential oil content (0.186%).

For Information – Black turmeric

- Black turmeric single bud rhizome sprouts were grown in the media consisting of Cocopeat + Vermicompost + *Pseudomonas fluorescens* as best growing media for quality planting material production.
- The organic production technique of black turmeric including the application of 50% N (25% N as FYM + 25% N as Vermicompost) + 50% K (25% K as Potassium Schoenite + 25% K as Potassium humate) along with spraying of Panchagavya at 3 per cent and mulched with dry grass recorded the highest fresh rhizome yield ranging from 19.86 to 22.03 t/ha.
- For processing of black turmeric, the rhizomes were dipped in boiling water for 10 minutes and dried for 6 to 7 days recorded the highest dry recovery of 42.97%.

Dr. P. Paramaguru
Dean, HC&RI(W), Trichy

For Adoption

Vegetable Crops

1. Fifty genotypes of small fruited bitter gourd (Mithipakal) collected from different districts of Tamil Nadu were evaluated under the project "Collection, evaluation and screening of small fruited bitter gourd, *Momordica charantia* L. var. *muricata* (Willd.) Chakrav. (Mithipakal) for high yield and anti-diabetic compounds under salt affected soil". The studies indicated that the number of fruits per plant ranged from 30.17 to 45.83. The significantly higher number of fruits per plant was recorded in MCM 1 (45.83) which is on par with MCM 16 (45.06), MCM 14 (45.22), MCM 17 (43.78), MCM 33 (43.67), MCM 13 (43.56), MCM 12 (41.72), MCM 34 (41.39), MCM 21, MCM 32 (41.17), MCM 19 (40.89), MCM 15 (40.67) and MCM 10 (40.34). Identification of phytochemicals in bitter gourd fruits of accessions, MCM 1 and MCM 37 were done using GC-MS. The anti-diabetic compounds *viz*., stigmasterol and sitosterol were identified in MCM 1 and stigmasterol in MCM 37.

			
MCM 1	**MCM 10**	**MCM 13**	**MCM 15**
			
MCM 19	**MCM 24**	**MCM 27**	**MCM 29**
			
MCM 31	**MCM 34**	**MCM 46**	**MCM 48**
			
MCM 37	**MCM 41**	**MCM 45**	**MCM 11**

Variability in fruits of small fruited bitter gourd, *Momordica charantia* L. var. *muricata* (Willd.) Chakrav. (Mithipakal)

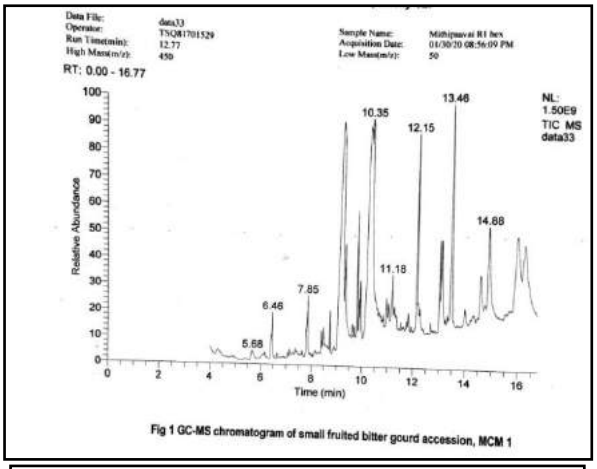


Fig 1 GC-MS chromatogram of small fruited bitter gourd accession, MCM 1

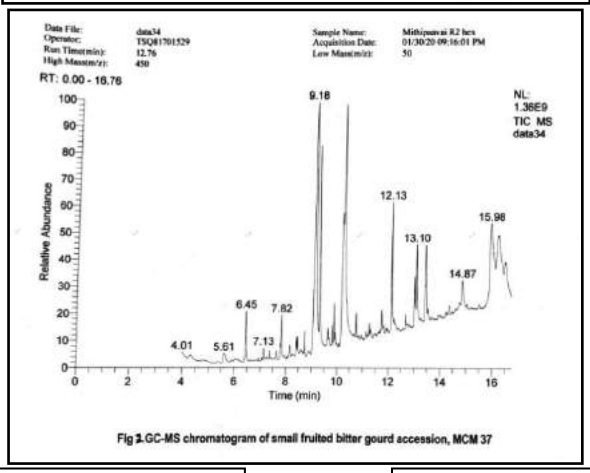


Fig 2 GC-MS chromatogram of small fruited bitter gourd accession, MCM 37

GC MS Chromotogram of MCM 1

GC MS Chromotogram of MCM 37

2. In the study on screening of bhendi entries / varieties and evaluation botanicals / newer insecticidal molecules for management of bhendi fruit borer complex, 55 bhendi entries were screened during 2016-20. The accessions *viz*., IC 27821-A, IC 42531, IC 22237-C, IC 42485-B,IC 43743, IC 43746-D, IC 45728 and IC 45804 were identified as moderately resistant source and these can be further utilized in breeding programmes to develop durable varieties with *Earias* sp. fruit borer resistance. The botanical Azadirachtin 300 ppm @ 3ml/l found to be good in reducing the *Earias* damage. Hence, it can be used for the management of *Earias* at early stage. The newer molecules Novaluron 10 EC @ 1.6ml/l and Chlorantraniliprole 20 SC @ 0.4 ml/l can be included as one of the component in IPM package in bhendi plant protection.

3. Sodicity is one of the major constraints in crop production. Phytoremediation is a biological approach proving the efficiency of plants to desalinise the soil. Soil phytodesalinisation is based on the capacity of some halophytes to accumulate enormous sodium quantities in their shoots. The study on the evaluation of three underutilized leafy vegetables along with amaranthus in salt affected soils for leaf yield and phytoremediation effect at HC&RI (W), Trichy revealed that all the leafy vegetables grown in sodic soil viz., *Portulaca, Chenopodium, Tetragonia* and *Amaranthus* performed well indicating the potential of growing these underutilized leafy vegetables in sodic soil. Among them, *Tetragonia* and *Chenopodium album*

recorded an estimated yield of 12.6 tonnes per ha in sodic soil condition. The reduction in pH and EC content of the soil in the *Portulaca* and *Chenopodium* grown field indicated their phytoremediation effect. Repeated cropping of these crops until the soil reaches acceptable levels will help the farmers to utilize their lands for regular crops.

Fruits Crops

1. The studies on standardization of fertigation schedule in high density planting of Guava cv. L-49 under alkaline soil indicated that Application of 50 % of the recommended dose of fertilizers (300:150:150g of N: P_2O_5 and K_2Og/plant/year – CISH recommendation) through fertigation was found to be the best in obtaining higher yield (10.22 tonnes/ha) in HDP of guava cv. L-49.

2. In the study on screening and evaluation of guava (*Psidium guajava*) germplasm for sodicity tolerance, 34 guava accessions were evaluated. The varieties viz., Nasik, Mirzapur Seedling, Surka Chitti Natputani, Allahabad Safed, Benaras, Panneer guava, Lalit, Chittidhar White, Surka Chitti, Chakkaiya Ruthumanagar, Hafsi and Lucknow 49 were identified as salinity tolerant varieties based on the yield and quality parameters.

3. Screening and evaluation work on Pomegranate (*Punica granatum*) accessions against sodicity tolerance taken up shown that Muscat and Bhagwa are the suitable genotype for commercial exploitation under sodicity soil conditions. The salinity tolerant varieties were identified based on the yield, quality parameters and physiological and sodicity tolerance traits. The tolerant varieties are Bhagwa, Muscat, Ruby, Daru, Daya, P-23, G-37 and Dholka. Hence, the two varieties (Muscat and Bhagwa) could be used as a root stock under sodic condition in future.

III. SEEDS

Dr. S. Sundareswaran
Director, Seed Centre,
TNAU, Coimbatore

For Information

1. Redefining ODV standards for certified class seeds of rice varieties

The permissible limit of ODV standard for certified class seeds of rice need to be revised as 30 No./kg instead of existing 20 No./kg, since higher number of ODV (28 No./kg) was observed in certified seed lots.

(Recommendation was given to Government of India for inclusion in the Indian Minimum Seed Certification Standards).

2. Integrated nutrient management for yield maximization in small millets

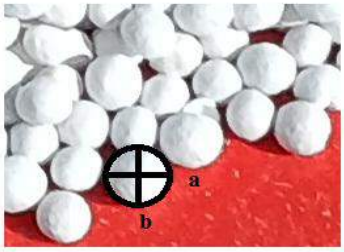
Seed priming with 20% liquid *Pseudomonas fluorescens,* soil *a*pplication of neem cake (125 kg) + vermicompost (1250 kg), each 50 kg Urea, SSP and MOP per ha and foliar spray of 2% boric acid at flower initiation stage is recommended for maximization of seed yield in foxtail, kodo and little millets.

Control

Treated

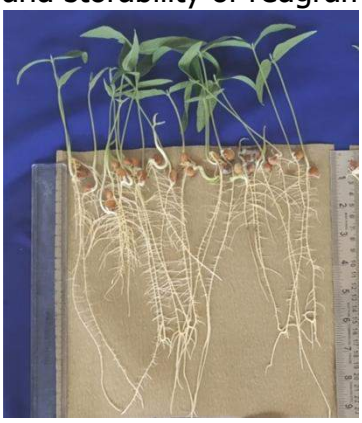
3. Seed pelleting for mechanized sowing in millets

Pelleted seeds of 3.5 mm size is recommended for air assisted seed drill sowing to reduce seed rate (about 25%) and to increase seed yield (about 10%) in varagu and tenai.




4. Nano seed treatment for quality improvement in redgram

Seed treatment with ZnO nano particle @ 500 mg/kg of seed enhanced the germination and storability of redgram seeds.


Control


ZnO @ 500 ppm

5. Crop management practices for yield improvement in annual moringa PKM 1

Pinching at the height of 60 cm and foliar spray of 0.2% boric acid before initiation of flowering is recommended for enhanced seed yield and quality in annual moringa.


6. Storage techniques for onion seeds

- Onion seeds with 6% moisture content, packed in aluminium foil pouch maintained 85% germination upto ten months under cold (10^0C) storage condition.
- Marginal seed lots with 70% germination could be improved to 84% by soaking the seeds in 0.05% Glutathione for 3 hrs.

Onion seed storage

Embryo anatomy of Glutathione (0.05%) treated seed

7. OFT on mitigation of water stress by hydrophilic polymer seed coating in blackgram (*Vigna mungo* L.)

Seeds treatment with Xanthangum : Carrageenan : Agar (4:1:1) @ 20 g/kg of seeds tolerated water stress up to 20 days after life irrigation and enhanced the seed yield (793 kg/ha) over control (520 kg/ha) in blackgram.

On Farm Trials are in progress at AC & RI, Kudumiyanmalai; AC & RI, Madurai; ARS, Bhavanisagar and ARS, Vaigai Dam.

Plant Population

Control

Treatment

Seed production achievements during 2019-20

Unit : q

S. No.	Crops	Foundation seed		Certified seed		TFL seed		Total	
		Target	Prodn.	Target	Prodn.	Target	Prodn.	Target	Prodn.
I	**Seeds**								
1.	Paddy	2825.50	5190.19	2103.00	532.02	3218.50	8692.45	8147.00	14414.66
2.	Millets	35.00	38.77	181.00	63.33	16.00	236.53	232.00	338.63
3.	Pulses	696.25	348.94	1761.00	447.80	21.00	355.27	2478.25	1152.01
4.	Oilseeds	100.00	257.04	2150.00	489.53	50.50	156.49	2300.50	903.06
5.	Cotton	-	-	-	-	6.50	13.19	6.50	13.19
6.	Forage crops	-	-	-	-	27.20	37.77	27.20	37.77
7.	Greenmanure	-	-	-	-	80.00	74.13	80.00	74.13
8.	Vegetable crops	1.40	0.29	1.35	0.08	9.45	89.76	12.20	90.13
	Total	**3658.15**	**5835.23**	**6196.35**	**1532.76**	**3429.15**	**9655.59**	**13283.65**	**17023.58**
II	**Vegetative propagules**								
1.	Turmeric	-	-	-	-	250.00	406.68	250.00	406.68
2.	Sugarcane	-	-	-	-	620.00	1180.00	620.00	1180.00
	Grand Total	**3658.15**	**5835.23**	**6196.35**	**1532.76**	**4299.15**	**11242.27**	**14153.65**	**18610.26**
III	**Planting materials (Nos. in lakhs)**	-	-	-	-	-	-	**19.745**	**23.814**

IV. AGRICULTURAL ENGINEERING

Dr. B. Shridar
Dean, AEC&RI, Coimbatore

ON FARM TRIALS

1. Corn Cob Harvester

A single row mini tractor operated corn cob harvester was developed for harvesting maize cobs and loading in box. The harvester consisted of snapping rollers, gathering chain, chain elevator with slots and cob collection box. The complete assembly was mounted to a mini tractor and can be lifted or lowered by a hydraulic system. The hydraulic system was also used for lifting the cob collection box sideways and unloading the collected cobs. The snapping roller pulled 100 per cent of plants from the field and out of which 94 per cent of cobs were removed from the plants. The actual field capacity of the harvester was 0.16 ha h^{-1}. Cost of the machine is Rs. 2.5 lakhs. Cost of operation is Rs. 5,000 / ha. The mechanical harvesting resulted in 65 per cent of saving in labour and 78 per cent of saving in time.


2. Tractor Operated High Clearance Weeder

A tractor operated high clearance weeder was developed. The weeder consisted of main frame and two extension foldable frames hinged to the main frame which facilitates to fold the extension frames during transportation of weeder in road condition. The height of the shovel with tynes was fixed as 700 mm based on the crop height during the 3rd stage of weeding. The tynes of fifteen numbers were clamped with the main frame for accomplishing the weeding operation in between standing rows of crops. The spacing between the tynes can be changed simply by slackening the bolts and sliding the braces to the desired position. The weeding efficiency was found to be 88 per cent. The field capacity and field efficiency were 0.65 ha h^{-1} and 87 per cent, respectively in cotton field at a row spacing of 750 mm. The cost of the machine is Rs.1.5 lakhs.


3. Size based grader for spherical fruits

Size based mechanical grader for spherical fruits (Guava, Tomato, Orange, Sapota, etc.) was designed and fabricated .The total length of the frame was fixed as 2630 mm and width of 610 mm. The height of the belt conveyor from the ground level was fixed as 730 mm for easy feeding of fruits and vegetables. Totally five collecting trays were fixed with 350 mm length converging to 200 mm and 100mm width. The thickness of the trays was 10 mm made from MS sheet. The inclination of collecting trays can also be adjusted so that we can use for all types of spherical fruits and vegetables with no damage. The unit is powered by 1 hp single phase electric motor. The length of the feeding section was 150 mm to ensure that each fruit comes in contact with the metering aperture. In the grading section 5 numbers of outlets were provided in order to separate the fruits and vegetables into 5 different grades. The length of the each metering aperture was 350 mm and the clearance was fixed as 40 mm. The length of the side rollers were 150 mm.

- Efficiency of size based grader : 95%
- Capacity of the size grader : 100 kg/h
- Cost of the unit : Rs.25,000
- Cost of operation : Rs.500 / tonne

4. Compound Parabolic Solar Dryer

- The compound parabolic collector ($2m^2$) consists of evacuated tubes surfaced with parabolic concentrators to produce hot air.
- Vertical drying chamber of 25 kg capacity is made up of polycarbonate collector.
- Drying chamber consists of 60 nos. of multi-stack trays of HDPE food-grade quality for drying high value products like jackfruit flakes, sapota bars, etc.,
- Maximum temperature of 65^oC is attained inside the chamber with collector thermal efficiency of 56.4 %.
- Temperature/RH controls are provided to maintain uniform set point temperature and RH inside the chamber.
- Compound Parabolic Solar Dryer (CPSD) cost is Rs. 2.5 lakhs with payback period of 6 months
- The quality of the products dried in CPSD is better than the commercially available products.

FOR INFORMATION

1. Remotely Operated Seeder for Pelletized Paddy

A remote controlled four row seeder for direct sowing of pelletized paddy seeds in lowland was developed to overcome the laborious operation of nursery raising and transplanting. On the other side, to eliminate the drudgery of manual pulling of drum seeder for direct sowing of paddy, the developed unit was designed to operate through telemetry controller. The foremost advantage of the unit is to ensure the row to row spacing and hill to hill spacing.

The seeder consisted of i) sowing unit ii) seed hopper iii) skid and traction wheel,
iv) steering system and drive v) drive for metering system vi) ground wheel and vii) electrical drives and controls. Two skids of 680 mm long and 120 mm wide were provided for floating of the seeder in soft puddle rice field. Propulsion was achieved by a single 30 W DC motor with spur gear reduction. The control of the propulsion, steering and seed metering were done by three separate motors and all the three motors were controlled through multi-channel telemetry. The ground speed was measured by an encoder wheel and the seed disc was driven at proportional speed. The seed metering can be switched on and off by the telemetry controller. Three paddy seeds were pelletized to make sure that there is no missing of plants. The actual field capacity of the developed rice seeder was 0.079 ha h^{-1}. The cost of sowing was found to be Rs.1,200 per hectare, whereas the cost of transplanting was Rs. 9,200 per hectare. The cost of the unit is Rs.30,000.

V. FORESTRY AND SERICULTURE

Dr. K. Parthiban
Dean, FC&RI, Mettupalayam

CROP IMPROVEMENT

FOR ADOPTION

1. Improved timber genetic resources –teak (T*ectona grandis*)

Promising seed sources
1) Syyaburry : MTPTK07
Volume : 0.2944 m^3
2) Nilambur : MTPTK21
Volume : 0.1600m^3
3) Chandrapur : MTPTK16
Volume : 0.1087 m^3
Wood density : 620-680 kg/m^3

2. Improved Red sander (P*terocarpus santalinus*) genetic resources

Salient Features:

Potential progeny : TNRS01
Volume : 0.3976 m^3
Density : 900-975 kg/m^3
Rotation : 15 years

3. Improved Casuarina high yielding clone

Salient Features:

Parentage : Hybrid between *C. equisetifolia* × *C. junghuhniana*
Clone Name : CJH27-01
Yield : 124 to 190 tons per hectare
Pulp Yield : 49.0 to 51.5 %
Rotation : Three Years

4. HYSR clone in Shisham (*Dalbergia sissoo)*

Salient Features:

Parentage : Clonal selection
HYSR Clone : MTPDS18

Yield (3 years) : 100-111 tons per hectare
Yield (6 years) : 200-225 tons per hectare
Basic density : 610 kg/m^3
Pulp yield : 49.4 %
Kappa number : 20.2
Holo cellulose : 73.6 %

5. Improved Subabul progeny for higher pulp yield

Salient Features:

Parentage : Progeny selection
Improved progeny : FCRILL15
Yield : 115 tons per hectare (Ht: 10.42m, DBH:5.94cm)
Rotation : Three Years
Basic density : 546 kg/m^3
Calorific Value : 3600-4200 kcal kg^{-1}
Pulp yield : 49.5 %
Kappa number : 20.7
Holo cellulose : 70.2 %

6. High pod yielder in Kapok

Clone : MTPCP 18
Pod yield : 400-500 pods/ tree
Floss yield : 4560 kg ha^{-1}

7. New Melia clone for face veneer

Salient Features:

Parentage	:	Clonal selection
Clone		MD44
Colour	:	Light Pink
Grain Pattern	:	Flowery
Look	:	Some are uniform but most of the veneers are having white patches of Sap wood
Hardness	:	Smooth surface but brittle
Density	:	450-550 kg/m^3
Shrinkage	:	6-7 %
Face Yield	:	12.00 %
Avg. Total Yield	:	55.00%
Thickness	:	Peeling below 0.50 mm thickness face veneer is difficult
Face Grading	:	A-150 %, B- 30%, C-33.5%, D-35%

FOR OFT/MLT

1. Annatto (*Bixa orellana)* – TNBi 003 and TNBi 009

S. No	Genotype	Parentage	Seed Yield (tonnes /acre)	Bixin Content (%)	Duration	% Increase over Population Mean (t/acre)	Special features
1	TNBi 003	Selection	0.91	3.16	Perennial	118.18	High yield High Bixin Wide adoption
2	TNBi 009	Selection	1.13	3.06	Perennial	146.75	

Farmers' Field

Farmers' field identified at Dahrapuram, Virudhunagar and Tirunelveli. Progenies raised in the nursery and planting will be taken during November 2020

Experimental Details

Spacing : 3 x 3m
Area : 1 acre

Observations to be recorded

a) Plant Height (m)
b) Basal diameter (cm)
c) No. of branches

d) Fruit weight (kg)
e) Seed Yield per tree (kg)

TNBi 009

TNBi 003

2. Acacia hybrid clone for pulp & plywood

Clone : AM 19
OFT Location : 3 Farmers field
Data to be recorded : All biometric attributes

3. New and alternate species for core veneer & splints

Species : *Sterculia alata*
Veneer recovery % : 64 %
Splints recovery : 17,000 splints/kg of wood
OFT Location : 3 Farmers field
Data to be recorded : All biometric attributes

4. New and alternate species for core veneer

Species	:	*Sweitenia macrophylla*
HYSR progeny	:	FCRISM20
Veneer	:	19.97 m^2
Veneer yield	:	57.01 %
Density	:	520-560 kg/m^3
OFT Location	:	3 Farmers field
Data to be recorded	:	All biometric attributes

5. New Eucalyptus clone with low bark content

Eucalyptus hybrid	:	EHLBT - 01
Bark thickness	:	4.25 mm (check > 6 mm)
Basic Density	:	542 kg/m^3
OFT Location	:	3 Farmers / industry field
Data to be recorded	:	All biometric attributes

6. Improved progeny in white teak (*Gmelina arborea*)

Best Progeny	:	FCRIGA 08
Density	:	515-580 kg/m^3
OFT Location	:	3 Farmers field
Data to be recorded	:	All biometric attributes

FOR INFORMATION

1. A new clone for essential oil

E.tereticornis × *E. camaldulensis* → Clone: EH 02

2. Improved genetic resources in Jatropha

Parentage	:	*Jatropha curcas* X *Jatropha integerima*
No. of hybrid clones	:	58
No. of elite clones identified	:	05
Promising Clones	:	CJH 13 & CJH 5

3. Technology commercialization (revenue: Rs. 12 lakhs) :

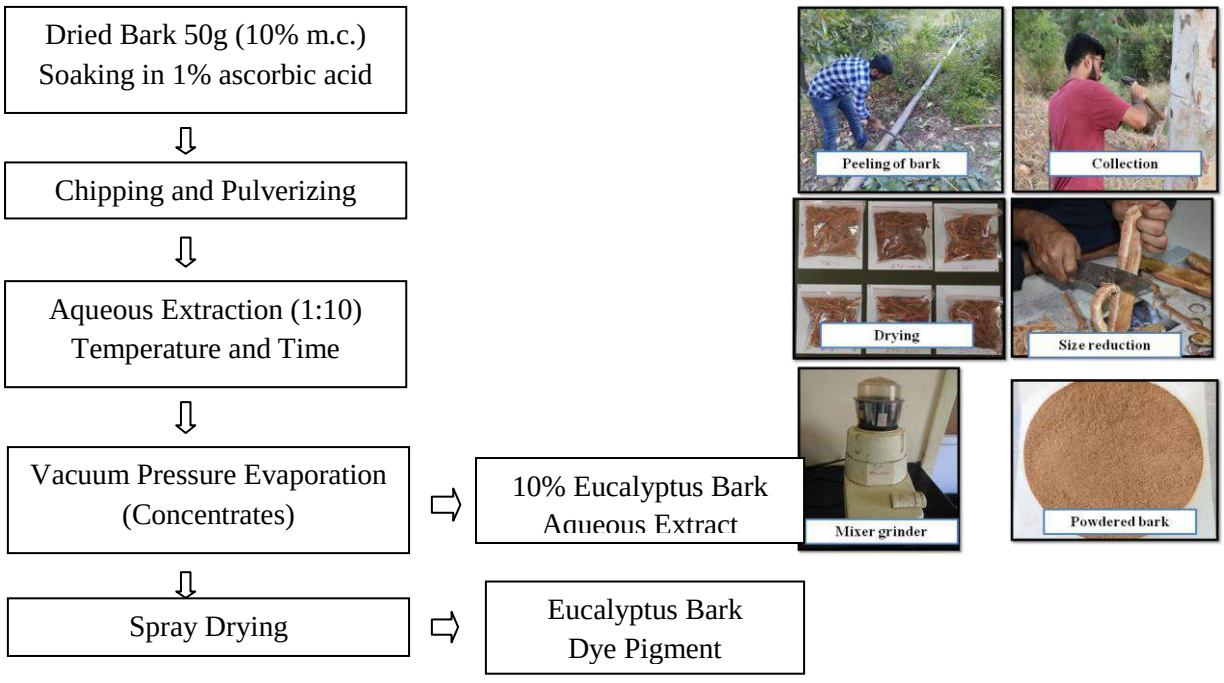
S. No.	Incubatee and Technology
1.	Kumar Hi-Tech Nursery, Annur ***Melia dubia* MTP-2**
2	National Associates, Sathyamanagalam ***Melia dubia* MTP-2**
3	Covai Gain Naturals, Coimbatore ***Melia dubia* MTP-2**
4	NewGen Nursery, Walajapet ***Melia dubia* MTP-2**
5	K3 Nursery, Thindivanam ***Melia dubia* MTP-2**

6	Maharastra Sandal Grower Farmers Producer Company Ltd., Latur, Maharastra ***Melia dubia* MTP-2**
7	Eccentric Organic's Limited, Trichy ***Melia dubia* MTP-2**
8	Enhanced Bio Fuels and Technologies India Ltd, Coimbatore ***Melia dubia* MTP-2**
9	La Farme De Peter, Thirunelveli ***Casuarina* MTP-2**
10	RPS Green Energy Limited, Batalgundu ***Melia dubia* MTP-2**
11	Tandulwadi Agro Produce Company Limited, Parbhani, Maharastra ***Melia dubia* MTP-2**
12	Tandulwadi Agro Produce Company Limited, Parbhani, Maharastra ***Casuarina* MTP-2**
13	La Farme De Peter, Thirunelveli ***Melia* MTP-2**

CROP MANAGEMENT

FOR ADOPTION

1. Protocol for Eucalyptus Bark Dye Extraction



Seed Cube Technology for Tree Species

S.No	Tree Species	Seed Cube Technology
1.	*Azadirachta indica*	Seed coating with TNAU formulation @ 4g / kg + Humid priming : 12 h soaking + 3 days humid incubation Seed cube media: soil (700 g), saw dust (130 g), bone meal (80 g), vermicompost (40 g), VAM (50 g)
2.	*Thespesia populne*	Seed coating with TNAU formulation @ 4g / kg + Humid priming : 24 h soaking + 3 days humid incubation Seed cube media: soil (700 g), saw dust (130 g), bone meal (80 g), vermicompost (40 g), VAM (50 g)
3.	*Pongamia pinnata*	Seed coating with TNAU formulation @ 3g / kg + Humid priming : 24 h soaking + 36 hours humid incubation Seed cube media: soil (700 g), saw dust (130 g), bone meal (80 g), vermicompost (40 g), VAM (50 g)
4.	*Tamarindus indicus*	Seed coating with TNAU formulation @ 3g / kg + Humid priming : 24 h soaking + 3 days humid incubation + Seed cube media: soil (700 g), saw dust (130 g), bone meal (80 g), vermicompost (40 g), VAM (50 g)
5.	*Albizzia lebbeck*	Seed coating with TNAU formulation @ 3g / kg + Humid priming : 24 h soaking + 3 days humid incubation + Seed cube media: soil (700 g), saw dust (130 g), bone meal (80 g), vermicompost (40 g), VAM (50 g)

3. Clonal multiplication technology for *Enterolobium cyclocarpum*

Rooting material : Coppice shoots
Rooting hormone : IBA 1000 ppm
Rooting percent : 80 %

4. Local yield table/model for farm grown *Albizia lebbeck*

Tree : Vagai (*Albizia lebbeck*)

Agroclimatic region : Western agro-climatic zone

1. Yield model and yield table for *Albizia lebbeck*

a. Yield model for standard stem timber

Y= (-1.212) + (-0.012* Age) + (6.506* Diameter)

` b. Yield model for standard stem small wood

Y= (-0.945) + (-0.045*Age) + (2.769*Diameter) + (0.262*No. of branches)

Yield table for *Albizia lebbeck*

AGE (years)	Diameter class																								
	0.10 (m)						0.20 (m)						0.30 (m)						0.40 (m)						
	Standard stem timber volume (m³/tree)	Standard stem small wood volume (m³/tree)					Standard stem timber volume (m³/tree)	Standard stem small wood volume (m³/tree)					Standard stem timber volume (m³/tree)	Standard stem small wood volume (m³/tree)					Standard stem timber volume (m³/tree)	Standard stem small wood volume (m³/tree)					
		Number of branches						Number of branches						Number of branches						Number of branches					
1-5	-0.501	1	2	3	4	5	0.149	1	2	3	4	5	0.800	1	2	3	4	5	1.450	1	2	3	4	5	
		-0.631	-0.369	-0.107	0.154	0.416		-0.354	-0.092	0.169	0.431	0.693		-0.077	0.184	0.446	0.708	0.970		0.199	0.461	0.723	0.985	1.247	
6-10	-0.441	2	3	4	5	6	0.209	2	3	4	5	6	0.860	2	3	4	5	6	1.510	2	3	4	5	6	
		-0.594	-0.332	-0.070	0.191	0.453		-0.317	-0.055	0.206	0.468	0.730		-0.040	0.221	0.483	0.745	1.007		0.236	0.498	0.760	1.022	1.284	
11-15	-0.381	3	4	5	6	7	0.269	3	4	5	6	7	0.920	3	4	5	6	7	1.570	3	4	5	6	7	
		-0.557	-0.295	-0.031	0.228	0.490		-0.280	-0.018	0.244	0.506	0.768		-0.003	0.259	0.521	0.783	1.045		0.274	0.536	0.798	1.060	1.322	
16-20	-0.321	5	6	7	8	9	0.329	5	6	7	8	9	0.980	5	6	7	8	9	1.630	5	6	7	8	9	
		-0.258	0.003	0.265	0.527	0.789		0.019	0.281	0.543	0.805	1.067		0.296	0.558	0.820	1.082	1.344		0.573	0.835	1.097	1.359	1.621	
21-25	-0.261	7	8	9	10	11	0.389	7	8	9	10	11	1.040	7	8	9	10	11	1.690	7	8	9	10	11	
		0.040	0.302	0.564	0.826	1.088		0.318	0.580	0.842	1.104	1.366		0.595	0.857	1.119	1.381	1.643		0.872	1.134	1.396	1.658	1.920	
26-30	-0.201	9	10	11	12	13	0.449	9	10	11	12	13	1.100	9	10	11	12	13	1.750	9	10	11	12	13	
		0.339	0.601	0.863	1.125	1.387		0.617	0.879	1.141	1.403	1.665		0.894	1.156	1.418	1.680	1.942		1.171	1.433	1.695	1.957	2.219	
31-35	-0.141	11	12	13	14	15	0.509	11	12	13	14	15	1.160	11	12	13	14	15	1.810	11	12	13	14	15	
		0.638	0.900	1.162	1.424	1.686		0.916	1.178	1.440	1.702	1.964		1.193	1.455	1.717	1.979	2.241		1.470	1.732	1.994	2.256	2.518	

5. Yield model and yield table for *Ailanthus excelsa*

Local yield models for farm grown *Ailanthus excelsa* trees

Agro climatic Zone	Yield model
Cauvery delta zone	Y= - 0.041 + (0.019*Age) + (0.083*Diameter)
Western zone	Y= - 0.071+ (0.005*Age) + (0.961*Diameter)
North western zone	Y= -0.058 + (0.006 *Age) + (0.833* Diameter)
Southern zone	Y= - 0.085+ (0.002*Age) + (1.163*Diameter)
North eastern zone	Y= - 0.047+ (0.017*Age) + (0.159*Diameter)

Yield table for *Ailanthus excelsa*

Cauvery delta zone

Age (Years)	Diameter (m)							
	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24
1		-	-	-	-	-	-	-
2		0.002	0.004	0.007	0.009	0.012	0.014	0.017
3	0.018	0.021	0.023	0.026	0.028	0.031	0.033	0.036
4	0.037	0.040	0.042	0.045	0.047	0.050	0.052	0.055
5	0.056	0.059	0.061	0.064	0.066	0.069	0.071	0.074
6	0.075	0.078	0.080	0.083	0.085	0.088	0.090	0.093
7	0.094	0.097	0.099	0.102	0.104	0.107	0.109	0.112
8	0.113	0.116	0.118	0.121	0.123	0.126	0.128	0.131
9	0.132	0.135	0.137	0.140	0.142	0.145	0.147	0.150
10	0.151	0.154	0.156	0.159	0.161	0.164	0.166	0.169

Southern zone

Age (Years)	Diameter (m)							
	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24
1	-	-	0.022	0.057	0.091	0.126	0.161	0.196
2	-	-	0.024	0.059	0.093	0.128	0.163	0.198
3	-	-	0.026	0.061	0.095	0.130	0.165	0.200
4	-	-	0.028	0.063	0.097	0.132	0.167	0.202
5	-	-	0.030	0.065	0.099	0.134	0.169	0.204
6	-	-	0.032	0.067	0.101	0.136	0.171	0.206
7	-	-	0.034	0.069	0.103	0.138	0.173	0.208
8	-	0.001	0.036	0.071	0.105	0.140	0.175	0.210
9	-	0.003	0.038	0.073	0.107	0.142	0.177	0.212
10	-	0.005	0.040	0.075	0.109	0.144	0.179	0.214

North eastern zone

Age (Years)	Diameter (m)							
	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24
1	-	-	-	-	-	-	0.003	0.008
2	-	-	0.001	0.006	0.011	0.016	0.020	0.025
3	0.009	0.014	0.018	0.023	0.028	0.033	0.037	0.042
4	0.026	0.031	0.035	0.040	0.045	0.050	0.054	0.059
5	0.043	0.048	0.052	0.057	0.062	0.067	0.071	0.076
6	0.060	0.065	0.069	0.074	0.079	0.084	0.088	0.093
7	0.077	0.082	0.086	0.091	0.096	0.101	0.105	0.110
8	0.094	0.099	0.103	0.108	0.113	0.118	0.122	0.127
9	0.111	0.116	0.120	0.125	0.130	0.135	0.139	0.144
10	0.128	0.133	0.137	0.142	0.147	0.152	0.156	0.161

North western zone

Age (Years)	Diameter (m)							
	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24
1	-	-	0.023	0.048	0.073	0.098	0.123	0.148
2	-	0.004	0.029	0.054	0.079	0.104	0.129	0.154
3	-	0.010	0.035	0.060	0.085	0.110	0.135	0.160
4	-	0.016	0.041	0.066	0.091	0.116	0.141	0.166
5	-	0.022	0.047	0.072	0.097	0.122	0.147	0.172
6	0.003	0.028	0.053	0.078	0.103	0.128	0.153	0.178
7	0.009	0.034	0.059	0.084	0.109	0.134	0.159	0.184
8	0.015	0.040	0.065	0.090	0.115	0.140	0.165	0.190
9	0.021	0.046	0.071	0.096	0.121	0.146	0.171	0.196
10	0.027	0.052	0.077	0.102	0.127	0.152	0.177	0.202

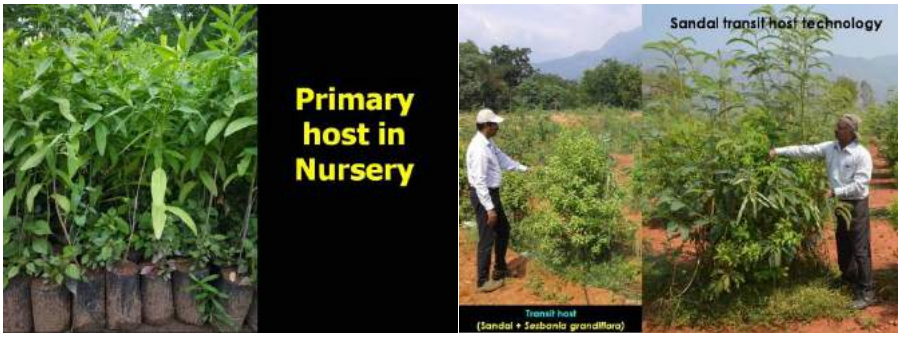
6. Irrigation schedule for red sanders

Age of trees (Years)	Water requirement @ 75 % Pan Evaporation
1	0.68 litres / day / tree
2	1.05 litres / day / tree
3	2.36 litres / day / tree

7. Sandal host technology

Primary host (Nursery) : *Altenanthera sessilis*

Transit host (Initial field establishment) : *Sesbania grandiflora*



8. Early flower induction under high density planting in tamarind

Canopy Management : Complete topping of canopy upto 6 feet

Florigen application : Foliar application of Cycocel @ 1500 ppm

Plantation details : High density planting (3 x 3 m)

Age of the crop : 3 to 4 years

9. Value addition technology

Species	:	*Lantana camera*
Technology	:	Briquetting / pelleting technology
Conversion	:	1.8 tonnes to 1.0 tonne
Calorific value	:	3600 - 3800 k cal/kg

10. Mini clonal technology for teak

Propagation material : Apical shoot
Rooting media : Coir pith
Rooting hormone : IBA @6000 ppm
Rooting percentage : 55.50 %

11. *Sterculia foetida* as alternate plywood

Veneer recovery : 60 %
Veneer shrinkage : 5.5%
Water absorption : 4.85%
Plywood density : 610 Kg m^{-3}

12. Kapok (*Ceiba pentandra*) as pulpwood

Pulp yield : 42.80 %

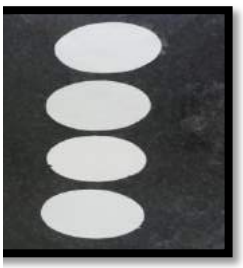
Kappa number : 23.00

Tensile index : 17.28 Nm/g

Tear index : 2.70 $mN.m^2g$

Burst index : 1.46 $kPa.m^2/g$

Opacity : 79.00%



30 % blending with Eucalyptus /Casuarina

FOR OFT/MLT

1. Clonal testing & precision silviculture techniques for *Enterolobium cyclocarpum*

Number of clones : 2

Locations

1. Western zone: FC&RI, Mettupalayam
2. Southern Zone: Farmers field, Thenkasi dist.
3. North-eastern Zone: Farmers field / AC&RI, Thiruvanamalai.

Experimental details

Treatments:

Main plot - 3

Sub plot - 3

Main plot: Irrigation water Levels

I_1 - 100 % PE (Pan Evaporation)

I_2 - 125 % PE

I_3 - 150 % PE

Sub plot: Fertilizers levels

F_1 - Humic acid (62.5 l ha^{-1})

F_2 - 150:100:100 kg N,P,K ha^{-1}

F_3 - Humic acid (62.5 l ha^{-1}) + 75: 50: 50 kg N,P,K ha^{-1}

Replications: 7

Design of experiment: Split plot Design

Observations to be recorded:

1. Biometric observations:
2. Soil nutrient analysis:
3. Testing pulp & plywood quality:
   (i) Estimation of important Physical parameters
   (ii) Estimation of important Chemical Parameters
   (iii) Estimation of strength properties

2. Host management in sandal

Locations

1. Western zone: FC&RI, Mettupalayam, Coimbatore District
2. Southern Zone: Farmers field, Thenkasi District.
3. North-eastern Zone: Farmers field, Tiruvallur District

Experimental details

Treatments: 6

1. Sandal + *Pongamia pinnata*
2. Sandal + *Casuarina equisetifolia*
3. Sandal + *Dalbergia sissoo*
4. Sandal + *Pterocarpus marsupium*
5. Sandal + *Enterolobium cyclocarpum*
6. Control

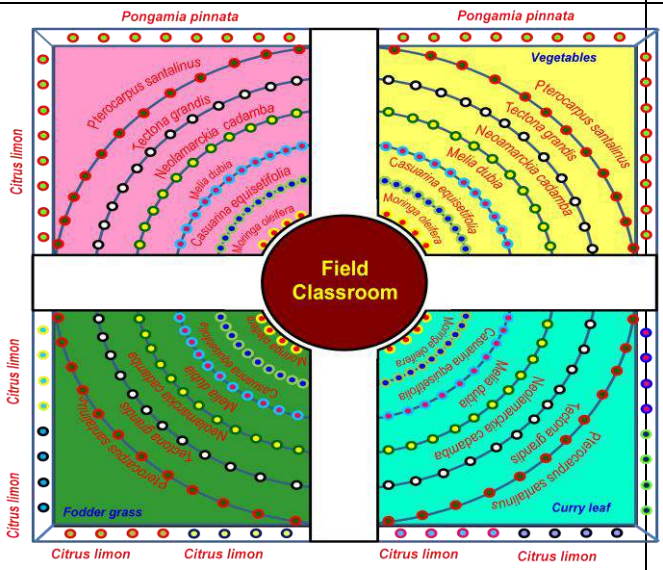
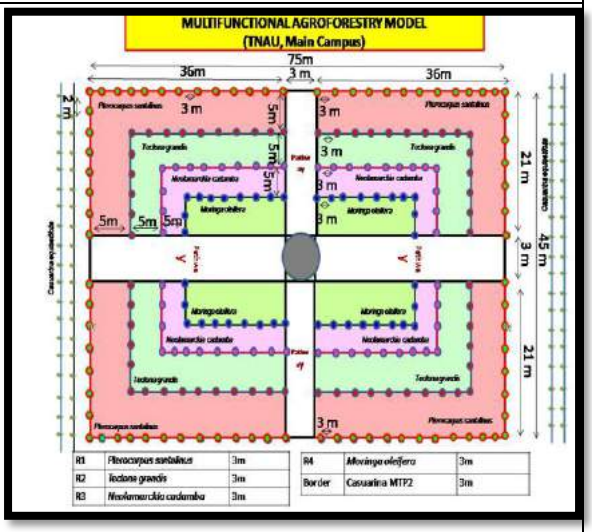
Replications: 4

Design of experiment: RBD

3. Profitable silvipasture model

- Melia + CO(BN)5 Grass + Hec Lucerne
- Fodder Yield - 101.3 tonnes / annum
- Income - Rs. 2,12,842 / ha / annum
- DFI – Farmers field at

Multifunctional agroforestry models

KVK VAMBAN	TNAU –MAIN CAMPUS
	

FOR INFORMATION

1. Dye Extraction Protocol for *Anogeissus latifolia (leaves)*

Leaf powder 5gram → 1: 3 (powder :water) → Natural Fermentation Filtration → in dark for 3 days




***Anogeissus* Leaves** **Leaf Powder** **30% Aqueous Dye Extract**

2. Dye Extraction Protocol for Roselle (*Hibiscus sabdariffa) Bracts*

Dried Bracts 5gram → 1: 5 (powder:water) → Heating and vacuum concentration → Filtration

Roselle Dried Bracts and Powder **Roselle Aqueous Dye Extracts**

3. Seed Enhancement protocol for Teak

- Mechanical Scarification (6 min) + Alternate soaking in water and drying for 7 days +Seed coating (8 g kg^{-1}) + Humid priming 250 ppm GA_3 (3 days) + Shade drying (1 day)
- Increased germination of 30.80% compared to that of control with 5.20%

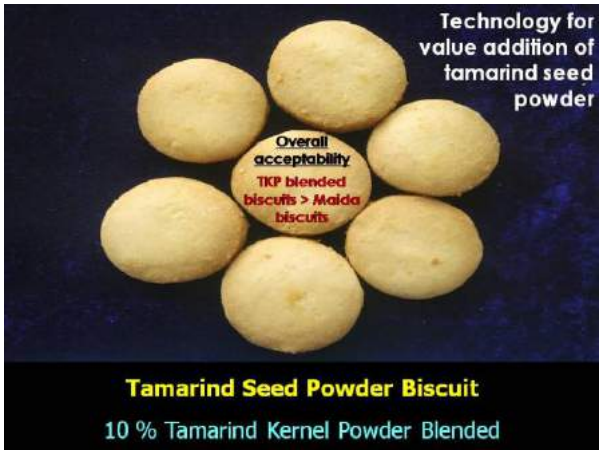
Intact Drupes

Scarified Drupes

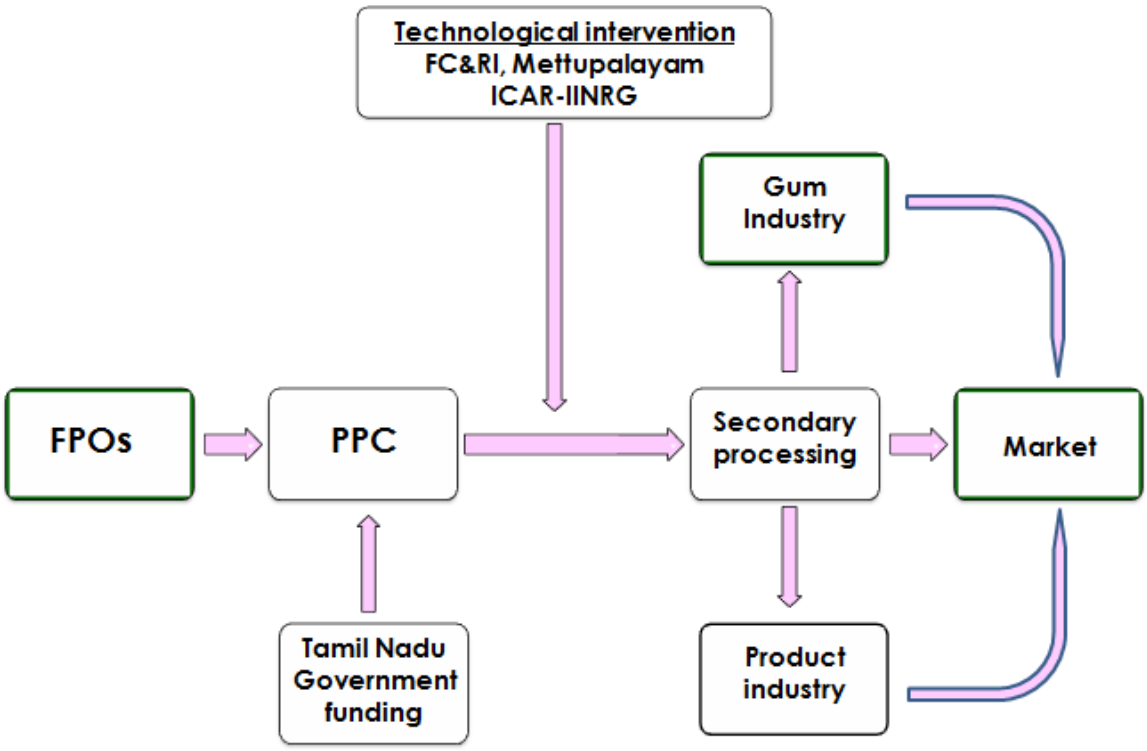
Germination (30.80%)

4. Value addition of tamarind seed powder

Tamarind biscuit and cake : Replacing 10 % maida with tamarind kernal powder

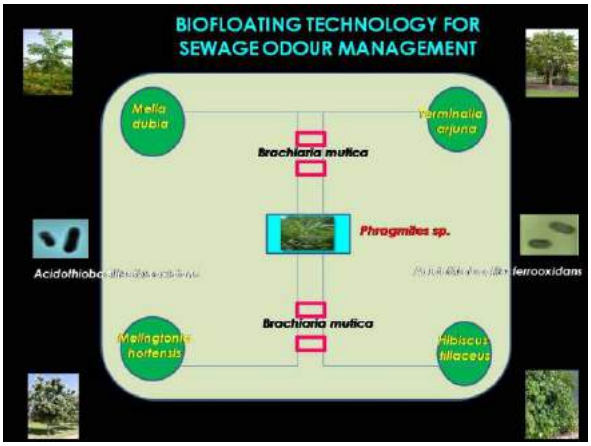


5. Improved value chain model in tamarind



6. Technology for sewage odour management

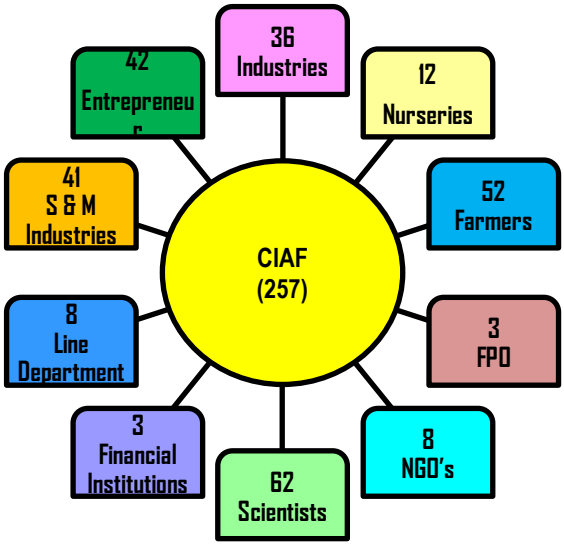
- Mixed microbial cultures: *Acidithiobacillus ferrooxidans* and *Acidithiobacillus thiooxidans* (@ 5 % v/v).
- Suitable trees for sewage odour: *Terminalia arjuna, Millingtonia hortensis, Hibiscus tiliaceus and Melia dubia*.
- Biofloaters for lagoon condition: Microbial cultures + Planting of trees + Biofloating mat of *Phragmites karka* and *Brachiaria mutica.*



7. Timber contract farming:

- Species: Teak, Mahogany, Subabul
- Price supportive system (Rs. 20,000 – 25,000 per MT)
- Fecilitation of felling and transportation
- Immediate adoption of improved genetic resources

8. Consortium of industrial agroforestry (CIAF):



Plantation developer – 5000ac/yr

Seedling production – 5 million

Harvesting – 1.25 lakh mt

9. In-situ chipper for forest residues

Species tested : Eucalyptus, Casuarina, Melia and Prosopis
Capacity : 2.5tons/hr
Size of the wood : 2 to 4 inches
Consortium Industry : Santhosh machineries

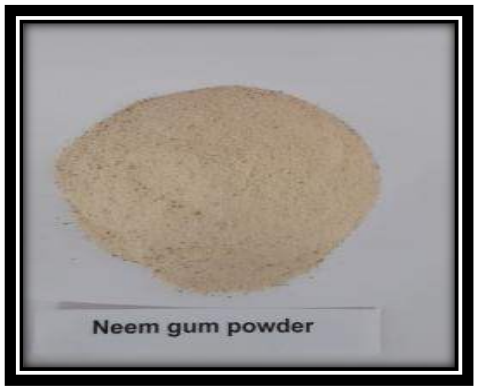
10. Agroforestry business incubator

Number of Incubatees : 41

Technologies for commercialization : Mini Clonal Technology
Briquetting Technology
Seasoning and preservation Technology
Activated Carbon

11. Identified tree gum powder (*Azadiracta indica, Ceiba pentandra and Acacia nilotica)* as hydrocolloid

- ✓ Solubility high for *Azadiracta indica* gum in hot water (84%)
- ✓ No toxic compounds
- ✓ Gum powder can be used as thickening agent



12. Standardized the extraction protocol for *Prosopis* and *Delonix* Seed Gum

Collection of seeds → Drying (8-9% M.C. (Wb) → Roasting (5,7 min at 105°C) → Decortication → Soaking in Water (30 min) → Milling (60 mesh sieve) →Vacuum Drying (6% M.C. (Wb)

13. Identified two elephant corridors and one tiger corridor for Sathyamangalam Tiger Reserve Elephant corridors:

Thengumaragada to Anaikatty (64 km)
Thengumaragada to Sigur to Mudhumalai (60 km)

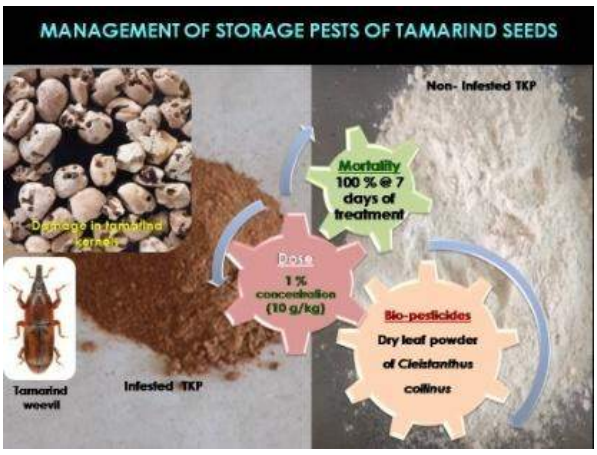
CROP PROTECTION

FOR ADOPTION

1. Management of storage pests of tamarind seeds

Pest : Tamarind seed weevil (*Sitophilus linearis*) and Bruchid (*Caryedon serratus*)

Recommendation : Oduvan (*Cleistanthus collinus*) leaf powder @ 10 g/kg (1%)



FOR OFT / MLT

1. Management of E*ligma narcissus* in *Ailanthus excelsa*

Treatment Details

T_1 - Swabbing the stem with grease
T_2 - Swabbing the stem with castor oil
T_3 - Swabbing the stem with coal tar
T_4 - Untreated control

Centres

- FC&RI, Mettupalayam (Location: Mettupalayam)
- KVK, Papparapatti (Location: Veppalampatti)
- ADAC&RI, Trichy (Location: Moovanoor)

Design: RBD

Replication: Five

Observations to be recorded:
Number of pupae per stem at 1, 3, 5, 7 and 14 days after treatment and percent reduction in pupation over control.

FOR INFORMATION

1. Management of termites in plantations

- Application of sand @ 1 kg/tree in the tree basin
- Application of wood chips @ 250 g/tree

SERICULTURE

FOR OFT

1. Effects of minerals on economic traits of cocoon

The fortification of mulberry leaves with minerals at different concentrations have positive impact on the protein content in silk gland & haemolymph, fibroin & sericin content and silk related traits in cocoon.

Mineral combination of Zinc at 100 ppm, Magnesium at 200 ppm and Potassium at 100 ppm had significantly increased the protein content in silk gland (61.50 mg/g), haemolymph (45.00 mg/ml), fibroin content (410 mg/shell) and sericin content (102 mg/shell), filament length (1458 m), filament weight (0.421 g), silk productivity (6.15 cg/day) and denier (2.60) which was found to be superior over the control.

Zinc sulphate @ 100 ppm + Magnesium sulphate @ 200 ppm + Potassium chloride @ 100 ppm

Control

2. Effect of silkworm excreta on mulberry and silkworm

Application of silkworm excreta @ 400g/plant recorded the highest mulberry growth and yield parameters *viz.,* shoot length (149.6 cm), number of branches per plant (12.8), number of leaves per branch (33.8), internodal length (6.72 cm), 100 leaves weight (440..3 g) and leaf yield (12608 kg/ha/year) and this was followed by silkworm excreta, 300g/plant.

In silkworms fed with mulberry leaves collected from field applied with excreta silkworm @ 400g/plant recorded the highest silkworm economic traits *viz.,* larval weight (4.70 g), cocoon weight (2.59 g), shell weight (0.25 g), shell ratio (26.36 %), and it was followed by silkworm excreta 300g/plant.

For Information

1. Effect of probiotics on the growth and development of silkworm, *Bombyx mori L.*

Application of probiotics *Lactobacillus rhamnosus* and *Saccharomyces boulardii* each at 3 per cent to double hybrid silkworm larvae significantly increased the commercial characteristics *viz.,* cocoon weight and pupal weight, shell weight and shell ratio.

- *Lactobacillus rhamnosus* 3.0 per cent recorded maximum cocoon weight (1.87 g), pupal weight (1.46 g), shell weight (0.43 g), shell ratio (22.99 %) and filament length (1296) followed by 2.5 per cent when compared to control which recorded less cocoon weight (1.68 g), pupal weight (1.35 g), shell weight (0.35 g), shell ratio (20.83 %) and filament length (1202 m)

- *Saccharomyces boulardii* @ 3.0 per cent recorded maximum cocoon weight (1.81 g), pupal weight (1.46 g), shell weight (0.37 g), shell ratio (20.44 %) and filament length (1256m) followed by 2.5 per cent when compared to control which recorded less cocoon weight (1. 65 g), pupal weight (1.37 g), shell weight (0.30 g) shell ratio (18.18 %) and filament length (1102 m)

2. Effect of oil cakes on mulberry and its impact on silkworm economic traits

- FYM @ 5 t/ha + Neem cake (0.5 mt/ha) + Pungam cake (0.5 mt/ha) + Mahua cake (0.5 mt/ha) recorded the highest mulberry growth and yield parameters *viz.,* shoot length (99.0 cm), number of branches per plant (9.5), number of leaves per branch (28.5), internodal length (3.85 cm), 100 leaves weight (450.35 g) and leaf yield (12,935.4 kg/ha/year) and was followed by FYM @ 5 t/ha + Neem cake (0.75 mt/ha) + 50% Pungam cake (0.75 mt/ha).

- FYM @ 5 t/ha + Neem cake (0.5 mt/ha) + Pungam cake (0.5 mt/ha) + Mahua cake (0.5 mt/ha) recorded the highest silkworm economic traits *viz.,* larval weight 2.80 (g), cocoon weight 1.26 (g), shell weight 0.20 (g), shell ratio 17.05 (%), and it was followed by FYM @ 5 t/ha + Neem cake (0.75 mt/ha) + Pungam cake (0.75 mt/ha).

3. Pharmaceutical properties of sericin

Sericin showed a significant increase in FBG (Fasting Blood Glucose) compared to standard drug treatment. SGOT (Serum glutamic oxaloacetic transaminase), triglycerides, cholesterol level of the Sericin treated group @ 800mg/kg was significantly decreased compared to the standard treatment group.

VI. COMMUNITY SCIENCE

Dr. S. Amutha
Dean, CSC&RI, Madurai

1. Ready to Serve soup from horsegram extract with potential hypolipidemic activity.

Ready to serve horse gram soup mix was developed from Payiur 2 variety. The process involved soaking horse gram (100g) in excess water for 12-18 hours (1:5), followed by cooking (60 min.) and draining the cooked water (horsegram extract). The horse gram extract was used for the preparation of the RTS soup. For the spice mixture for the soup, oil was heated and pepper, cumin, garlic, turmeric powder were added, sauteed, cooled and pulverized to fine powder. For preparation of horse gram soup, oil was heated and sautéed with mustard seeds, fenugreek seeds and cumin seeds. Chopped tomato and salt were added to the sautéed spices and cooked till done. To this was added the spice mixture and the horse gram extract and simmered on low flame for 10 min. The horse gram extract was packed in glass bottles, pasteurized and stored under refrigeration condition for shelf life study (3-5^{o}C). The sensory changes during storage and microbial load revealed that the product had an acceptability of 60 days on storage under refrigeration condition. The product had shelf life of 60 days under refrigerated condition. Cost: Rs. 90.0/Litre.

2. Texturized Vegetable Protein blending Mushroom and Underutilized Pulses

Three mushroom types viz; Oyster, Button and Milky mushroom with two underutilized crops such as horse gram and cowpea were utilized for preparation of Texturized Vegetable Protein (TVP). Mushroom was pretreated and processed into powder by cabinet and was incorporated with the pulse flour and extruded. Extrusion processing has been carried for development of mushroom analogues by

combining mushroom (oyster, milky mushroom) with underutilized pulses (horse gram, cowpea). The pulses (50-75%) and mushrooms (25-50%) formulation were made in different ratios. The formulation was extruded with feed moisture content 12%, extrusion temperature 120°C and screw speed 150rpm. The analogues formed were collected, dried in cabinet tray drier at 50°C for 30 minutes to achieve 3-5% moisture content in the final product. The average value of Water Absorption Index and Water Solubility Index varied from 3.25 - 5.28 (g/g) and 22.78 - 32.43 %. The expansion ratio values of analogues were in the range of 1.15 to 1.86. Increase in the mushroom flour concentration significantly increased the bulk density from 0.127-0.287 g/ml of sample. The flour and protein concentrate are good sources of protein. The protein content of flour ranged from 21.92 to 27.81g%. and 50.47% and 48.23%.in the concentrates. The protein concentrates showed higher emulsifying properties or gel formation which will improve the texture of the extruded product by forming 3D structure with higher water absorption. Incorporation of mushroom flour improved protein(24.56%), fiber content (7.78%)and antioxidant properties (11.91-12.46 mg GAE/g) of the analogues. The cost of the mushroom TVP is Rs.56/100g including the fixed, variable and total processing cost.

3. **Micronutrients (Iron and Zinc) enriched Kavuni rice with anti diabetic properties**

Parent varieties (Kavuni and CO 50) and 23 cultures were assessed for nutrient and therapeutic properties. The percentage of carbohydrate (64.00 g/ 100g), amylose content (23.12g/100g) and total soluble sugars (57.58 gm per 100gm) was found to be lowest in kavuni, which was on par with cultures having black colour genotypic traits. Based on the physicochemical characteristics, nutritional composition and therapeutic properties, the culture 145-3 have maximum scores when compared to other cultures. *In vitro* bioavailability results suggest that 145-3 rice lines having highest solubility of selected minerals and therapeutic compounds such as calcium(12.72 mg/g), iron (1.57ppm), zinc (3.28 mg/100g), total flavonoids (65.21 mg CAE/100g) and total anthocyanin (164 mg C3g/100g). The antioxidant property of culture 145-3 was similar to the kavuni parent. The inhibitory activity of alpha amylase was found to be 0.15 µg/ml in cultures - 144-1, 144-2, 144-3 and kavuni. Higher lutein content was presentin the order of 143-1

(294.60 µg/100g), 144 (235.10 µg/100g), kavuni (201.46 µg/100g) and 145-3 (149.20 µg/100g).Compared to white colour rice samples, black colour rice cultures had longer cooking time (50 minutes). Suitability of 145-3 rice line for traditional foods (pongal, pittu), extruded foods (idiappam and noodles) other breakfast foods (rice uppma, rice flakes) was found to be highly acceptable

Rice analogue

Flakes

Vermicelli

Noodles

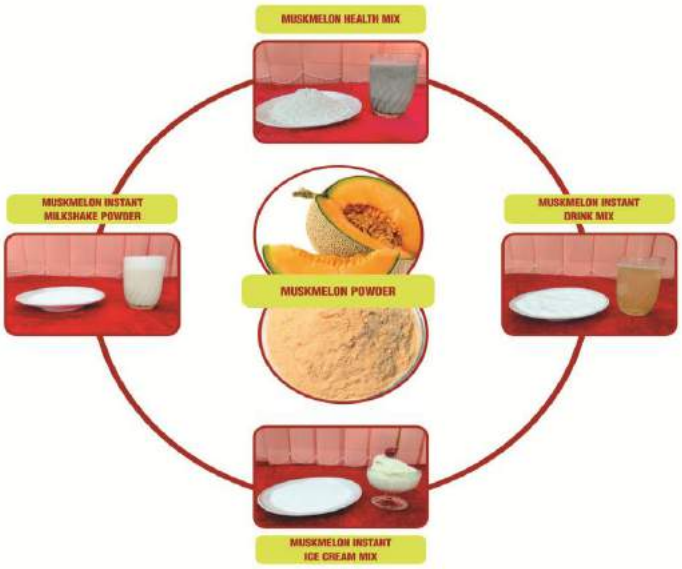
4. Development of Millet based Functional Milk Beverage

Millets are Gluten free, nutritional value , high in polyphenol and antioxidant properties. Bioavailability of the nutrients in the grain may be increased during germination process. Further removal of tannin during germination increases the iron absorption. Many value added products like millet rice, millet flour and millet flour based ready to eat snacks, convenient dry food mixes are marketed products but millet beverage is not available. So millet milk was developed suitable for all age groups which is nutrient dense and low in fat. Barnyard millet, kodo millet and little millet were cleaned to remove foreign substances and were steeped in excess water for 12 hours to achieve uniform moisture content. At the end of the steeping period, the grains were washed and the excess water was removed. Barnyard millet, kodo millet and little millet varieties were placed separately in muslin cloth, tied and allowed to germinate for with intermittent moistening to prevent dehydration. Germination was carried out at room temperature. To the malted grains water was added in the ratio of 1:7 and milk was extracted. Sugar 20 g and cardamom 2 g

were added as a flavoring substance. Total Soluble Solids were increased to 15°brix.Among the millets, the milk yield was comparatively maximum in malted millets and ranged between 450-500ml per 100 g of the millet. The milk extraction was better in kodo millet and barnyard millet followed by little millet. Malting reduces viscosity and sedimentation of particles in the beverage. The protein content of the milks ranged from 1.15 – 1.21 g%. Starch content was 5.21 -5.73g%, total sugars-3.12 – 3.58 g% and fat 1.15 – 1.38g% in the beverage. The calcium content was 2.6 mg in % in barnyard millet beverage and 1.63 in Kodo millet beverage. Among the malted millet milk, kodo millet scored highest organoleptic scores values in all aspects except colour. The millet milk had a shelf life up to three months.The Cost of the product was Rs. 25/ 200 ml. This beverage is a healthy alternate for soymilk and almond milk available in the market.

5. **Processing of fruit powde**r **from muskmelon and value addition**

Muskmelon fruit powder was prepared using spray drying at a temperature of 180°C with a TSS of 25°bx of the juice. The freshly processed muskmelon fruit powder contained moisture - 4.19 per cent, pH - 5.39, acidity - 0.1 per cent, TSS - 55^{o}brix, total sugar - 25.07, reducing sugar - 11.82 per cent, β - carotene - 988.99 µg/100g, ascorbic acid - 97.62 mg/100g and total antioxidant - 14.34 µg/g. The spray dried powder prepared at a temperature of 180^{0}C and TSS 25^{0} brix was found to be the maximum drying characteristics and also retention of nutrients than foam mat dried powder. The shelf life of muskmelon powder was 180 days. Instant drink mix, instant milk shake powder, instant ice cream mix and instant health mix was formulated by utilizing muskmelon fruit powder for commercialization.Muskmelon fruit powder was used for the preparation of ready to use mixes such as instant drink, milk shake powder, instant ice cream mix and instant health mix.



6. **Extraction of Nutraceuticals from grape wastes for utilization as bio food additives**

The grape skin, pulp and seed collectively called as pomace. The pomace is a rich source of pigments and polyphenolic compounds that are considered to be nutraceuticals. Pomace was collected and dried in a cabinet drier at 50 ^{0} C for 8 h. The dried pomace flakes were pulverized into powder. The dried powder contained 6.83 % moisture content. The anthocyanin was found to be 0.93 g/ Kg, with the crude fibre being 22.26 %.Hot extraction method was attempted for extraction of anthocyanin. 1 Kg of the pomace was made into a paste with addition of 1 l of water. It was then heated to 50°C for 5 h. it was filtered. The TSS of the filterate was found to 7 ^{0}bx and this was raised to 12^{0}bx by addition of malto dextrin. After addition of maltodextrin it was thoroughly mixed in a cyclone mixer for uniform consistency. It was then dried in a spray drier with the inlet temperature of 120 ^{0}c. The resultant spray dried powder is the anthocyanin powder from grape pomace. The powder contained 3.17% moisture content, -26.37 +38.60 and -18.05 colour value L* a* b*. The anthocyanin content was found 2.83 g/ Kg

7. Osmotic dehydration of cashew apple (*Anacardiumoccidentale* L.)

The process parameters for preparation of Osmotic dehydration of cashew apple (*Anacardiumoccidentale* L.) was optimized through RSM. The optimized conditions for osmotic dehydration of cashew apple slices in cane sugar at 50°C, 40% concentration and immersion time 2 hours. The optimized condition for osmotic dehydration of cashew apple slices in palm sugar syrup was temperature 50°C, 60% concentration and immersion time 2 hrs. The cashew apples (red and Yellow variety) were steam blanched for 2 min and soaked in 01.% potassium meta bi sulphate solution for 30 min. The TSS of the osmodried cashew apple ranged from 33-38°Brix, acidity 0.46 - 0.63 % and Vitamin C – 122.12 - 137.20 mg/100g. The retention of bioactive compounds was higher in cashew apples dehydrated using cane sugar and packed in HDPE. The products had a shelflife of 90 days.

8. **Protein enriched Papaya RTS**

Papaya fruits were cleaned, peeled, edible portions were cut and pulped. The juice was extracted from pulp. Sugar syrup (9°bx) 0.3g% acidity was prepared and mixed with the pulp. The juice was heated to 80°C and cooled to 60°C. Five per cent (milk and green gram protein) and 10 percent (soy protein) concentrates were blended separately in a small quantity of juice and added to the whole beverage. The 10 per cent soy protein isolate incorporated RTS was highly acceptable. The TSS of protein enriched RTS beverage was 14.7°bx, pH was 4.9, with 9.8 g of protein and 670μg of β carotene in 100 ml . The shelf life of the protein enriched papaya RTS is 60 days. The cost of 200ml of RTS is Rs16 / 200 ml.

Protein enriched Papaya RTS

9. Banana pseudostem RTS beverage

Banana pseudo stem (varvayalvazhai and muppattai) RTS was prepared with ginger as a flavouring agent. Thebanana pseudo stem was cleaned and washed thoroughly. Inner portion was cut into smaller pieces and blanched at 65°C for 3 mins. The juice was extracted mechanically by crushing and filtered using muslin cloth. Sugar and ginger extract for flavour was added separately. Then pseudo stem beverage was pasteurized at 71- 75°c for 5 mins and filled in sterilized glass bottles, corked and stored at refrigerated condition. The TSS of the beverage was 12°bx, acidity 0.34%, protein 3g, total sugar 14.75 g, reducing sugar- 8.20 g, starch22.41 g and phenols 52.04mg /100g. The pseudo stem beverage prepared with natural ginger flavour had high acceptability and had a shelf life of 45 days of storage in refrigeration with minimal changes in the quality attributes.

10. Thermal and non-thermal techniques to extend the shelf life of Palmyra Palm Tender Fruit Endosperm(PTFE)

The process parameters for thermal and non thermal processing of Palmyra palm Tender Fruit Endosperm (PTFE) for extending the shelf life was achieved through canning, retort pouch processing and freeze drying. For canning, the PTFE was pre cleaned by manual peeling of the skin and washing. The cleaned endosperm was placed in cans, filled with 60°bx sugar syrup and exhausted for 6 min. Then the cans were subjected to steaming and processing at 121°C for 25 minutes. The cans were immediately cooled, dried and stored. The canned PTFE had a shelflife of 5 months.

Retort packaging of nungu was standardized by packing the preclened PTEF along with 50°bx. The Fo value was 2.5min at 20 psi. Transparent retort pouches and Aluminum Retort Pouches were found to be suitable packaging material. Reduction in viscosity of syrup over the period of time was noted which may be due to increase in reducing sugars. The aroma of palmyrah palm was high in sugar syrup after thermal processing.Thermally processed PTFE in retort method showedgood shelf life for 7 months in room temperature.

The process of freeze drying of the endosperm involves freezing the precleaned endosperm at -20°C for 2 hrs at a pressure of 0.4 to 0.5m bar under vacuum of 40 mmand stored at -18°C. The freeze dried has less reduction in water activity.

Canning

PTFE in Retort Pouch

11. Antimicrobial Food Packaging Material: A Green Technology

Chitosan film was prepared at 1.0 and 1.5% concentration. For preparing film, 1 % chitosan solution was prepared by dissolving 1 g chitosan in 100 ml of 1% acetic acid solution. The resultant chitosan solution was filtered using Whatman No. 3 filter paper. The essential oil like Basil oil, Lemon grass oil and Thyme oil was added separately to the chitosan film forming solution at three different concentrations of 0.1, 0.2 and 0.3 % . Tween 80 (0.05 % v/v of the film forming solution) was used as an emulsifying agent and Glycerol was added at 0.1 % v/v as plasticizer. The solution (250 ml) was then homogenized using a magnetic stirrer before casting. Then the solutions were casted into a Teflon tray (9 x 12 cm) and were air dried for 48 h. The films are peeled off and conditioned in a Dessicator until further use. Biodegradable packaging material can be made using Chitosan@1% and 1.5% level. Biodegrable films incorporated with essential oil had good stability and strength suitable for packing fruits especially tomato.

Chitosan + PVA

12. Design and development of hand held fertilizer applicator

The hand held fertilizer application is a less weight simple and user friendly tool made of PVC pipe. The total height of the tool is 140 cm. The bottom portion of the applicatior has an invented 'T' shaped pipe to facilitate to press the applicator against the ground. During this action of pressing, required quantity of fertilizer is dropped near the plant during a single press . A hopper that is detachable is recommended since it can be used to facilitate the fertilizer filling activity. A hopper of diameter 6" to 12" with a height of 6 cm is designed. A vertical column made of PVC pipe of 2" diameter and length of 100 cm is used to fill the fertilizer. This vertical column can hold upto 1.5 kg of granular fertilizer. A rubberized grip of width 12 cm is provided on the outer side of the vertical column to enable holding the fertilizer applicator. A detectable fertilizer discharge tube of 40 cm is designed to discharge different quantities of the fertilizer such as 1 gm, 2 gm, 2.5 gm and 5 gm depending upon the requirement. This fertilizer discharge tube is also designed with a PVC pipe of 1.5" diameter and a (vent) is made to discharge the required quantity of fertilizer. The fertilizer is discharged through the vent.

The granular fertilizer namely Diammonium phosphate (DAP), Single superphosphate (SSP) or any other fertilizer needs to filled upto three fourth volume of the vertical column using the detachable hopper. On filling, the fertilizer applicator is pressed against the floor near the plant and the desired quantity of the fertilizer is discharged uniformly against each press. The user needs to hold the applicator in one hand over the grip over provided, and by walking, and pressing it near the plant the fertilizer is discharged.

The field capacity was 0.0432ha/h with 96 per centage of efficiency. The use of this fertilizer applicator device could help in saving fertilizer upto 18 per cent of fertilizer. There was a reduction in energy expenditure by 17 per cent when compared with the conventional method and savings in time by 26 percent.

Dr. K.R. Ashok
Director, Centre for Agriculture and Rural Development Studies
TNAU, Coimbatore

1.AGRICULTURAL ECONOMICS

1.1.Developing and Disseminating Market Intelligence for TN-IAMP Basin Crops

DEMIC has been giving pre-sowing and pre-harvest price forecasts for 14 major agricultural and horticultural crops of Tamil Nadu funded under TN-IAMP. During the reporting period (August'19 to August'20), DEMIC has given 17 pre-sowing market advisories and 16 pre-harvest market advisories with a validity of 92 per cent and 95 per cent respectively. The generated market advisories are disseminated through print and electronic media. viz., newspapers, magazines, FM radio, TV, SMS, e-mail, websites, Uzhavan App, etc. Policy inputs such as seed price policy for TANSEDA, demand and supply analysis for onion to TNSAMB, future price trend for oilseeds to TNSAMB for PDP schemes, copra price trend in Southern Indian markets to Dept.of Agriculture are given.

1.2. Causes and Consequences of e-National Agriculture Market on the Economic Development of Indian Agriculture - A Case Study

During the phase I of e-NAM movement, Government of India has approved 15 regulated Markets in Tamil Nadu. The commodities selected for the present study were paddy, cotton, maize, coconut, groundnut and turmeric. The commodities and reference markets for the study were selected based on their arrivals to the regulated markets. During the first year of the study, two commodities in each State *viz*., cotton and maize in Tamil Nadu, paddy and cotton in Telangana and potato and wheat in Haryana were selected for which data on arrivals and prices in the reference markets were collected. In the 23 e-NAM markets of Tamil Nadu, so far 15.65 Lakh Quintals of agricultural produce valued at Rs.277.24 crore was transacted through e-NAM platform and Rs.48.50 crore e-payment has been made to 12,511 farmers through e-NAM portal. The hardwares and softwares for the regulated markets, equipment's for grading and assaying, training to the staff are completed in most of the markets. Registration of farmers and traders under e-NAM plat form is picking up gradually.

1.3.Resource Use Planning for sustainable agriculture in Tamil Nadu

Resource use planning for sustainable agriculture in Tamil Nadu has been attempted through linear programming approach considering the major agricultural production constraints such as, crop season, availability of irrigated and rainfed land, human and hired labour, irrigation water and farm power use as constraints.The optimal plan revealed that the gross cropped area has declined from the existing area of 43.84 lakh ha to 38.39 lakh ha under scenario I (technologies such as SRI, SSI, Bt cotton and tissue culture banana) and 38.93 under scenario II (drip irrigation technology). Decline in area under cereals, pulses and oil seeds are replaced by commercial crop and vegetables.

Wider adoption of yield increasing and water saving technologies helps in increased income. Hence, technologies such as SRI, SSI, tissue culture banana, Bt cotton, micro irrigation are to be promoted in a larger scale. Efforts have to be taken to increase the productivity of pulses and oilseeds through water saving and yield enhancing technologies like sprinkler irrigation system. Use of more hybrid seed production and necessary technologies for protected vegetable cultivation of vegetable may be promoted.

1.4 Farmers' Knowledge, Perception and Intensity of Pesticide Use in Major Vegetables

A study was conducted in Namakkal, Salem and Dharmapuri districts of North western zone of Tamil Nadu since these districts have more area under onion, brinjal, bhendi and tomato crops.The vegetable growers use extremely toxic, highly toxic and less toxic chemicals to control pest, disease and weeds. In choice of pesticide selection, on an average 80 % of farmers considerthe quality in terms of its efficacy followed by ease of availability. Farmers are spraychemicals based on incidences. On an average, six to ten number of spraying per crop was done by the farmers. Pesticide spraying was taken at weekly interval in onion and three to five days' interval in bhendi and brinjal crops. In brinjal crop, even at the time of harvest,

farmers have the practice of spraying the chemicals. On an average, more than 70 per cent of farmers possess the good knowledge on selection and use of chemicals and on safety measures to be followed. Cost of chemicals, efficacy and ease of availability of the chemicals played a vital role in selection and use of chemicals.

1.5. Impact of Credit on Production Efficiency and Capital Formation in Farm Households

The study was conducted in Erode district. The average loan amount borrowed by short term borrowers was Rs.79918.18 per farm. Time lag between applying and sanctioning of loan ranged from 7days to 15 days. About 73.3 percent of farmers revealed that crop loan was inadequate. One-time settlement of credit is followed by all the farmers. Kisan credit card scheme norms was not fully followed. The average cost of credit was found to be Rs.631.25 for short term borrowing. The Cooperative bank was found to be the major source of credit (74 per cent) for the small and marginal borrowers.Inadequacy of loan amount, complex procedures, delay in sanctioning of loan amount and high cost of credit are the major problems faced by the sample borrower farmers.Reasons for not borrowing from the Institutional sources are easy access to the bank is not possible for small and marginal farmers, time consuming, high cost of credit, easy access for advance payment from jaggery traders and inadequate collateral security.

Suggestions for improving the credit delivery system includereduction in interest rate, simplification of procedures, timely disbursement of credit, banking related information should be publicized in the villages so that every farmer can access institutional agencies for borrowing. All the information relevant to farmers regarding eligibility, interest rate, scale of finance, subsidy, banking schemes may be given in local languages. Documentation of farm assets and financial details of the farmers will help to speed up the lending process.

1.6. Performances of Regulated Market in Tamil Nadu

The study was under taken in randomly selected 100 regulated markets being operated under ten Market Committees covering all the regions of Tamil Nadu. Farmers & traders stated that Warehouse capacity and drying yard facilities were not adequate during peak season. Many farmers and traders demanded solar drier for drying paddy grains. In few of the markets (about 25 per cent), poor infrastructure marketing facilities are available and none of the marketing functions was performed. Delay in sanctioning of pledge loan amount is the major problem.

Non-member farmers revealed that very high marketing cost viz.,loading and unloading charges and transportation cost is the main reason for not trading through regulated markets.Analysis on benefits of e- NAM linked Regulated Markets revealed that majority (70%) of the farmers and traders are aware of e Nam and trade practices. In all the e-Nam linked markets cash transaction is limited.Farmers revealed that it has been safely and quickly transacted to their bank accounts through e payment. Majority of farmers and traders revealed that fair and competitive price was obtained due to participation of large number of traders in one market after the implementation of e-NAM and there was transparency in price. They

get better price information through their mobile App. for making better trading decisions. Price, income, and IT knowledge among farmers and traders would increase the willingness to participate in e-Nam trading. Distance of the market from the farm has negative influence on accepting e-Nam trading.

Constraints in e NAM linked Regulated Markets are (i) Delayed payment (95%) was the major problem stated by farmers would receive payment from 3-10 days, and (ii) 93% of farmers lack computer skills and do not understand the e-NAM process flow completely. Farmers in the study area prefer immediate payment. About 85% of the farmers don't prefer e-payment, they prefer cash settlement. Due to server problems,58% of farmers reported that they don't receive SMS after bidding, so they are unable to know whether the lot has been traded or not and if the price is not remunerative, transaction cannot be cancelled (72%). Even though the implementation of e-NAM is meant to reduce the time taken for transaction, 82% farmers reported that there is delay in gate entry as only one staff is deployed for the same. 53% of farmers reported that the markets in study area lacked adequate storage facilities during rainy season and assaying facilities.

Majority of traders reported that the e-NAM markets lack adequate assaying facilities. Even after the implementation of e-NAM, traders are involved in physically verifying the produce and quote the price. Bidding time restriction also poses a problem, much concentration is needed by the traders and price once quoted cannot be edited (87%). One of the major constraints faced by the traders is decrease in crop arrivals (90%) after the implementation of eNAM in certain markets This may be attributed to delayed payment for the farmers. About 60% traders lack computer skills and cannot reap the full benefits of e-NAM. Participation in e-NAM is also limited by fear of taxation, as the transactions are now monitored.

It is suggested that (i) farmers get benefit from e-trading, and there is a need to create awareness among farmers and build their capacity in online trading, (ii) establishment of adequate assaying facilities for grading is important and (iii) uniform notification of commodities may be followed- If there is uniform notification of commodities in all markets, then farmers have the option to sell their produce in any markets where they receive better price under unified licensing. Compulsory trading through regulated markets may be insisted to all the farmers and traders.

1.7.Economic evaluation of solar powered pumping systems in Tamil Nadu

The study covers five agro climatic zones and eight districts viz., Coimbatore, Erode, Karur, Namakkal, Thanjavur, Theni, Thiruvallur and Vilupuram in Tamil Nadu covering 12 taluks across the sample districts**. Of the total sample 220 solar pump beneficiaries, 83% were male beneficiaries and 17% were female. Average**farm size was 2.79 ha.Nearly 20.30 per cent of marginal farmers, 38.61 per cent of small farmers, 28.22 per cent of medium farmers and 12.87 per cent of large farmers installed / availed solar powered pumpsets under subsidy programme.
*Solar pump Installation:*74% of the sample solar pumps were linked with Open well and 36 % with bore well with 5hp motor only. About 91% of the solar systems are functioning well whereas 9 % in non-working conditiondue to Gaja cyclone, damage

of solar panel by wind /damage of parts, due to declining water table / drought, etc. Reasons for installation of were availing subsidy from the government, low or nil maintenance of the solar system, alternate source of supply of water to manage power cut issue, saving of fuel cost, non-availability of electricity connection and eco-friendly technology.

*Cost and returns:*Operational cost of paddy cultivation using solar pumps is less expensive compared to oil engine pumps by Rs.9637.81. Gross margin (net income over operational cost) per ha under surface irrigation method was Rs.12083.52 higher in solar pumps over diesel engine whereas it was Rs.3097.54 lower than electric pumps. In sugarcane, solar pumps with drip irrigation is less expensive compared to solar pumps without drip irrigation. Gross margin under solar pumps was Rs..1.27 lakh per ha higher in using solar pumps with drip irrigation. Operational cost of sugarcane cultivation using solar pumps under without drip irrigation is very expensive compared to oil engine pumps.Gross margin was lower by Rs..9880.36 and Rs.24373.21for solar pumps over oil engine and electric pumps, respectively.

*Impact of solar pumps :*Net benefit of using solar pumps for irrigation was Rs.21733.09 per ha in paddy over oil engine and Electric pumps was Rs..8314.80. In sugarcane, net benefit overoil engine and electric pumps were Rs.47713.41 and Rs.3874.36 per ha. Solar pumping system was found to be the most efficient system than diesel and electric pump system due to its low maintenance cost and zero energy cost.

Financial Feasibility: by replacing the diesel pumps with solar pumping system, net present value was positive, benefit cost ratio was greater than one at 10% and 12% discount rate and IRR was found to be 14%which is more than the opportunity cost and with the subsidy component, the solar pumping system was found to be financially feasible.

*Benefits Sample farmers towards Solar pumps:*were continuous water supply throughout the year. In addition, low and nil maintenance of the system, no fuel requirement, long life for the system were the direct or private benefits whereas social benefits were saving of electricity to the government, no bad effects on the environment (pollution free).

*Constraints:*High capital cost as per small and marginal farmers; system working on only day time, no back up facility for storing electricity as well as water; no facility for repair of damaged partsand no service by company after installation even if it is under repair condition.

Policy Suggestions include installation of Quality panels with stand, provision of surface storage tank and poly ethylene sheet / aluminum sheet at the subsidized cost by the government, make necessary arrangement to service the system / follow up action at the end user level, periodical monitoring of the functioning of the solar pumping system, Training to benefiaciries by the SAUs on the servicing of the solar pumps, provision of higher motor efficiency (7.5 to 10hp) may be provided with subsidy, promotion of bank credit and Quadripartite arrangement model i.e.

government - Agrl. Enginnering department, Banking institutions and firms and farmer end users so as to promote the programme in a successful manner.

1.8. Documentation of GI Registration for RamnadMundu Chilli

RamnadMundu Chilli Producer Company Limited was identified as registered organization for filing of GI.To prove the uniqueness of the Chilly, in collaboration with the Horticulture Department the biochemical analysis of RamandMundu Chilli was found that the Capsaicin content is 0.1%, Oleoresin 14% and the colour value is 40.5. Cost benefit analysis revealed that farmers had received Rs.55,450 as net return and the BCR is 1.65. The cost of production of RamandMundu Chilli is Rs.48/kg and the net returns is Rs.32/kg.Value Chain Analysis of dry chilli revealed thatthe degree of value addition done by trader/wholesaler and retailer are 25% each.

1.9. Estimation of Production and Utilization Pattern of Milk and Milk Products in India
2020-21 (Budget: 12.4819 Lakh)

- The project is funded by ICAR – National Dairy Research institute (NDRI), Karnal.
- The project was initiated in consultation with "Avin District Co-operative Milk Producers Union"to identify withproducers, consumers, commercial producers, vendors and sweet makers to study the Production and Utilization Pattern of Milk and Milk Products in India.
- The secondary data on milk animals, milk production were collected for the southern state *viz.,* Tamil Nadu, Andhra Pradesh, Telangana, Karnataka, and Kerala. For instance, the population of cows in the country has risen by 18 per cent in the last seven years, while that of oxen dipped by 30 per cent, according to the latest census of livestock. The total number for livestock is 536 million. In terms of milk, the southern state such as Andhra Pradesh, Tamil Nadu, and Karnataka contributes 8%, 5%, & 4% respectively.

2.AGEICULTURAL EXTENSION AND RURAL SOCIOLOGY

2.1.Awareness, Knowledge and Attitude of B.Sc. (Ag.) students towards e-Learning

E–Learning is a learning /teaching tool in education and is now emerging as the advance paradigm for higher education. A study was conducted to assess the awareness, knowledge and attitude of students towards e–Learning and to suggest measures to improve e–Learning**.** Nearly two – thirds of the respondents were female, rural based, obtained more than 1070 marks. More than two third of the students had knowledge and experience in computer usage at moderate level. Majority of the students were not undergone computer special courses. More than half of the students had personal computer and internet access at their homes. Majority of the students expressed computer facility at college as good, computer accessibility in college as fully available and computer facility at hostel was poor. Majority of the students used internet every day. All the students were using internet in a week, but with different intervals. Little less than half of the students used

internet for entertainment and edutainment purposes. Two third of the students made mistakes rarely while using computer, were moderately satisfied with the computer usage and were comfortable with all media viz., Newspaper, Television and Internet. Majority of our students were having moderate level of knowledge, awareness and attitude towards e-Learning.The full integration of e-Learning into the curriculum, textbooks and tests and a strong program of training teachers to both use and teach with technologies are suggested as measures to improve e–Learning at higher education level.

2.2. Impact of Farmer to Farmer Extension approach under ATMA

Farmers Friends serve as a vital link between the Extension officials and farmers (91.00 per cent), involved in mobilization of the farmers (89.00 per cent), diffuse the technology very quickly among the farmers (87.00 per cent) and adopt the technology first in their farm (85.00 per cent). Due to the activities of Farmer Friends there is increase in adoption of specific technologies (83.00 per cent). Farmers had learnt specific skills in agriculture (78.00 per cent) and crop diversification (54.00 per cent) were identified as the other technological impacts. Increased contact with Extension officials (91.00 per cent) and increased training participation (85.00 per cent) were the major social impacts created by Farmer Friends. Increase in farm income due to adoption of new technologies (70.00 per cent),involvement in income generation activities (67.00 per cent) and increase in crop yield (62.00 per cent) were the major economic impacts created by Farmer Friends. Better interaction and information sharing with the other farmers (91.00 per cent) was the psychological impact created by the Farmer Friends. Direct contact with the farmers, serving as a motivational force for other farmers, increased trustworthiness, social proximity of extension service providers, more information flow were identified as the strengths of Farmer Friends. Retaining the information with themselves, sharing information only to their relatives and known farmers, some farmer friends are inactive and no interim evaluation on the performance were the weaknesses identified. Scope for appointing one Farmer Friend per village and developing evaluation criteria for assessing performance of Farmer Friends were the Opportunities. Appointing unemployed youth as Farmer Friend is the identified challenge.

'Farmer Friends' serve as role models for the fellow farmers and vital link between the extension officials and other farmers. Hence, it is suggested that one farmer friend per village need to be allotted and unemployed youth may be appointed as Farmer Friend. Evaluation on the performance of Farmer Friend is to be carried out and based on the evaluation, new Farmer Friend has to be positioned.

2.3. Present Extension System in Tamil Nadu

A study was conducted in Coimbatore, Salem, Tirunelveli, Madurai, Namakkal and Sivaganga districts to study the present extension system in Tamil Nadu, training needs of extension workers, SWOC analysis about the present pattern of extension system, constraints faced by the extension workers and their suggestions for further strengthening of extension system in Tamil Nadu .

The organizational structure set up from State, District, Block and revenue level with qualified man power in agriculture department as major strength. Farmers and Extension Personnel ratio is not properly matched. More man power needs to be deployed at needy places as one of the weaknesses in the system. Huge scope for implementation of various schemes and services in the diversified agro eco system for bridging the yielding gap in many crops is one of the major opportunities in this State. Major challenges in present extension system in Tamil Nadu include occurrence of frequent drought like situation in most of part of the State which affect the implementation of schemes and services and production of crops and unstable market price for most of the agricultural commodities.

Majority of the officers preferred to have demonstration cum hands on experience type of training programme followed by exhibition and discussion (success stories discussion). Majority of the officers preferred to attend three days training programme followed by One week and 10 days training programmes. Majority of the extension functionaries needs training on Integrated pests and diseases management, Integrated Weed Management Practices, Fertigation schedule for agricultural crops, Agricultural Exports, Process and Procedures, Organic Farming and Organic inputs preparation, Production of Parasites and Bio-control agents and Formation of FPOs – Process, establishment, management and sustainable issues. Availability of less time for technology dissemination due to overburden of other official works, expressed by 80 per cent of the officials expressed as one of the major constraints. Separate wing along with manpower may be created to take care of schemes and services related works (42 per cent of the officials expressed) as major suggestions for further strengthening of the extension system.

Key suggestions include(i)develop online Individual Farmer Database to provide farm specific agro advisory services and e-governance in agricultural sector, (ii) separate wing for distribution of schemes and services at Block Level, (iii) provide GPS enabled ICT tools to Extension officials for providing agro advisory services and to promote e-governance in agricultural sector, (iv)limit the in-person meeting with help of Virtual meeting tools, Virtual Extension Services, Block level Farmers Facilitation Centre, Mini Automatic Weather Station at Revenue Village level and (v) Empower FPOs as Para Extension Workers for implementation of schemes as major policy implication to the government for consideration.

2.4. Sustainable livelihood security and Marketing behaviour of Jasmine Vendors of Madurai

A study on jasmine vendors of Madurai district about their livelihood security and marketing behaviour revealed the following.

The average per day income from jasmine selling is Rs. 350 – 500. The package material used for jasmine is banana leaf. A Majority of the jasmine vendors (47 %)are using share autos for their transport to buy the flowers and to reach their selling place. An overwhelming majority of 60% of the respondents are selling jasmine by sitting in a temporary shop like structure. Most of the respondents are

travelling 5-10 kms daily to reach the flower market of Madurai. The place of selling includes market place (28%), around the temple zone (29%), bus stand zones (12%), and residential areas (19%) and along the road sides. Earning members of the family and the per day income earned through jasmine marketing are highly responsible for entrepreneurial behavior. The average amount spent on food per month per family is Rs. 13,500/- Problems faced by the respondents include price fluctuations during festival and non-festival season, climatic factors,and banana leaf as packing materials.

2.5. Cost and Returns and Marketing of Organic Vegetables in Tamil Nadu

Among the vegetables more remunerative vegetable is bhendi (1:2.88) followed by bitter gourd (1:2.55), tomato (1:2.52) and brinjal (1:2.45). Producer -Commission Agent - Wholesaler - Retailer- Consumer (Channel 1)is the predominant channel for marketing of the organic vegetables. Majority of the organic vegetable farmers (80%) were dependent on predominant marketing channel and less than one third (20 %) of the organic vegetable farmers are in the Paramparagat Krishi Vikas Yojna (PKVY)-Participatory Guarantee System (PGS) groups started own marketing out lets for marketing of their organic vegetables and other organic products.

Majority of the organic vegetable farmers preferred to market their produce through Channel 1 (producer-commission agent -whole seller -retailer-consumer) because the vegetables are highly perishable nature reaching the consumer through multi channel supply chain by producer, commission agent, wholesaler, retailer and consumer. The major constraints expressed by organic vegetable farmers in adoption of organic farming practices were bulk quantity of organic inputs requirements, inadequate organic inputs in time, lack of research support in providing scientific rationality of practices, non-availability of labour, insufficient of water for irrigation and drastic reduction in cattle population in the production side. Major constraints in marketing of organic products include lack of premium price for organic vegetables, high investment in the initial stage of organic farming, inadequate market facilities for sale of organic vegetables and lack of government supports for organic produces, higher premium charged by middlemen and lengthy organic certification procedure and high cost in the marketing side.

2.6.Identification and Documentation of ITKs among the Tribes of The Nilgiris.

The Indigenous technical knowledge of tribes of Nilgiris namely Todas, Irulas, Kurumbas and Kothas were indentified and documented. ITKs were indentified in Traditional Paddy varieties (Thondi, Vaalucha, Kuttivaliyan, Mannuvaliyan, Vilumbala, Jeera sara, Sanna, Punuja) – Kurumbas.Vaalucha, Thondi, Sanna, Jeera sara (scented), Seed storage through clay utensils, Bamboo basket (Komma)- Kothars and Todas.Traditional Weedicide/ herbicide preparation – Kurumbas and Kothars (Nochi, Neem, Keetha (Screw pine)

3. AGRICULTURAL AND RURAL MANAGEMENT

3.1. Developing Agribusiness Models Linking Farmer Groups and Farmer Producer Organizations to Markets through Value Chain management

The study on FPOs involved the sample size of 200 FPOs to whom capacity building programmes were conducted, buyer seller meets were organized to 1661 participants. The findings include small and marginal farmers were higher in proportion with the SFAC supported FPCs. Value addition, marketability through FPCs, quality input supply at a lower price and credit facilitation role of the FPCs significantly influenced the income improvement of the member farmers after joining the FPC. Majority of the FPCs were involved in procuring commodities from farmers and then marketed through the forward linkages established by the FPCs followed by the FPC's that provided advisory and technical services, whereas only half of the sample of FPC's were involved in value addition and processing of produce purchased from the farmers. About fifty per cent of FPC's were involved in supplying inputs, while warehousing facilities was provided by 22 of the FPCs.Backward and forward linkages are crucial for success of any business. Majority of the sample FPCs facilitated loans through banks to the farmer members followed by facilitation of pledge credit and only 15.00 per cent of the FPCs provided direct input credit. The market linkages was established by some of the FPCs for selling the produce with agribusiness firms like Marico, Sunlak, Rudhram export agency, NFPCL, Suguna industries, Nestle, Aavin, Supermarkets and exporters. FPCs may be awarded the status of Startups by the Government of India and extend all the provisions applicable.Resource Institutions: Consultancy services (Successful ACC/ABC/ Retired Senior officials from private sector with experience in agribusiness / agribusiness incubators could also be identified to be a RI.FPO company space resource: A common place (office / processing unit / marketing yard) for the FPO (company) does not exist and due to resource and operational constraints, these firms could not establish one.FPO – market support – market linkages*:* Market oriented agribusiness is vital for FPOs.Financial support for FPOs : The FPOs should be allowed to select the bank with which they would like to work with. Banks should be supported from NABARD so that these banks could fund the FPO as a Start-Up company.

3.2. Study on turmeric marketing system and its efficiency as a means to enhance the income of small and marginal farmers in Tamil Nadu

Study was conducted with the objectives of analysingthe price behavior of turmeric in major Indian markets, comparing the traditional and alternate marketing systems and its impact on farmer's income and analyzing the constraints faced by farmers in marketing and suggesting measure to improve the turmeric marketing system. Secondary data on turmeric price from Nizamabad, Erode and Sangliwas collected and analysed. Increasing price trend was observed in all the three markets. The study found that 77 per cent of the farmers reduced the area under turmeric from 4.25 acres in 2014 to 1.74 acres in 2018. The remaining 23 percent has switched over to other crops like banana and tapioca due to higher cost of production and lesser price for the produce. Except in Gobi cooperative society in all the trading

centres in Erode, selling of turmeric is done through e-auction. Among the turmeric trade centres in Erode, only in Farmers

Producers Organization the produce is graded into three grades mechanically and is repacked in gunny bags. Graded produce fetches more price compared to non-graded ones and reduced the wastage. GI tag has not induced any additional market demand and price for the Erode local variety. High labour cost, reduction in price of turmeric, low productivity and water scarcity was the major problems faced by turmeric farmers in Erode. Results suggested that to encourage the farmers to cultivate turmeric, Minimum Support Price could be used as a measure to compensate the increase in labour cost and reduction in price. Consumer awareness could be created about GI turmeric to get better price for Erode turmeric. Educating the farmers about the importance of grading at farm level could reduce the transaction cost and also increases the marketing efficiency. Curcumin content based pricing may be done to get better price for Tamil Nadu turmeric. Practical difficulties in trading of turmeric through e-NAM may be considered and procedures may be simplified to increase the trading of turmeric through eNAM in Tamil Nadu.

3.3. Business Processes and Performance of Edible oil Processing (Traditional) Firms in Tamil Nadu

The study was confined to western zone comprising four districts, Coimbatore, Tiruppur, Erode, Namakkal and Karur. The salient findings were, majority of edible oil processing units sourced the raw materials from the local traders. Three oils Viz., Coconut oil, Groundnut oil and Gingelly oils were traded by them. Among the value chains, Farmers – Wholesale Traders- Ghani Processors - Consumers was the common value chain in traditional edible oil. Edible oils were sold to the nearby customers (85 per cent). Most of the units operating for more than two years achieved the breakeven point.Place of sourcing of raw material, store location, Product availability in the store were the critical factors for the profitability of the units.

3.4. An economic analysis of *Meliadubia* across multiple use benefits in Western Tamil Nadu

For Ply wood purpose, *Meliadubia*(5X5m) provided net income was Rs.6,93,060 per ha. The benefit cost ratio@10% was 7.64.In pulp wood, the trees can be harvested from 2^{nd}, 4^{th} and 6^{th} year of cultivation. Net income from *Meliadubia* (2X2m was Rs.9,64,200 per ha. The benefit cost ratio@10% was 5.74.When the trees were used for both ply wood and pulp wood purposes thenthe net income was Rs.11,29,200 per ha. The benefit cost ratio@10% was 6.80.The main reasons for the farmers to prefer *Meliadubia* as an alternative crop is less maintenance and low labour cost.

Dr. M. Jawaharlal
Director of Extension Education
TNAU, Coimbatore

Krishi Vigyan Kendras (KVKs)

KVKs have been recognized as effective institutional links between Agricultural Research and Extension system in the country. KVKs are one of the effective and well-tested Frontline Extension System, which is exemplary and admired all over the world. At present, KVKs are the Frontier Frontline Extension System at the district level which functions with the mandate of "Technology assessment, refinement and demonstration of technology/products".

Tamil Nadu has a total of 30 KVKs of which 14 KVKs are under the control of TNAU, 4 KVKs under the control of TANUVAS, 2 KVKs with Deemed Universities and the remaining 10 KVKs are under the administrative control of NGOs.

The KVKs in Tamil Nadu are instrumental in transfer of technologies of National Agricultural Research System (NARS) including TNAU technologies and impacted in the adoption of frontier technologies in agriculture and allied sector.

The specific activities of KVKs:

- On-farm testing to identify the location specificity of agricultural technologies under various farming systems.
- Frontline demonstrations to establish its production potentials on the farmers' fields.
- Training of farmers to update their knowledge and skills in modern agricultural technologies, and training of extension personnel to orient them in the frontier areas of technology development.
- To work as resource and knowledge centre of agricultural technology for supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district.
- In order to create awareness about improved technology, a large number of extension activities will be taken up.
- The seeds and planting materials produced by the KVKs will also be made available to the farmers.
- Identifying the training needs of the farming community and organizing need based short term and long term training programmes for various target groups in the district.
- Developing and organizing non-formal educational programmes by way of field days, diagnostic field visits, farmers fair, radio talk, Farm Science clubs etc. as the follow up information support to training courses.

- Identifying the Farmer Teachers, Agripreneurs, Seed producers and IFS model farmers and recognizing them by using them as para extension professionals in the district.

The KVKs of TNAU are involved in demonstration of TNAU technologies through various interventions. The accomplishments of KVKs are given below:

Accomplishments of KVKs during (2019-20)

On Farm Testing (OFT)

On Farm Tastings' are conducted to find out new varieties and technologies emanated from research systems of State and Central Institutes/ stations which are suitable to the district concern. In order to facilitate the transfer and adoption of TNAU technologies a total of 97 OFTs were conducted in an area of 166 ha.

Front Line Demonstrations (FLDs)

The KVKs played a significant role in demonstration of varieties/ hybrids, management practices / crop production practices, plant protection technologies, Value addition and post harvest technologies, Agriculture engineering technologies. FLDs are conducted in the farmer's field to assess their performances. The successful technologies of the OFTs will be converted as FLDs. A total of 192 FLDs were organized in an area of 510 ha directly benefitting 1783 farmers in various districts of Tamil Nadu.

Skill Teaching by Trainings

To create awareness, knowledge, skill and adoption of TNAU technologies a total of 1102 trainings were organized benefitting 54059 farmers, 291 sponsored training programmes benefitting 12304 farmers. To develop farmers as entrepreneur's 157 Vocational training programmes were organized benefitting 3097 farmers.

Exhibitions / mela and other Extension activities

To create awareness and to popularize TNAU technologies, exhibitions, mela, field day, farmer's day and campaigns were organized by KVKs at the District and State level. A total of 430 programmes were organized benefitting 53943 farmers during the period 2019-2020.

Table 1: Accomplishments of TNAU KVKs (2019-2020)

S.No.	Year / Particulars	2019-20
On Farm Trial		
1	OFT (Nos.)	97
2	OFT (Area in ha)	165.74
3	OFT beneficiaries (Nos.)	818

Front Line Demonstration		
1	FLD (Nos.)	192
2	FLD (Area in ha)	510.34
3	FLD beneficiaries (Nos.)	1783
Trainings		
1	On Campus Training (Nos.)	552
2	No. Of farmers	23488
3	Off Campus Training (Nos.)	550
4	No. Of farmers	30571
5	Vocational Training (Nos.)	157
6	No. Of farmers	3097
7	Sponsored training (Nos.)	291
8	No. Of Beneficiaries (farmers) of sponsored training	12304
Exhibition/Farmers Day/Field day/ Mela		
1	Exhibition/Farmers Day/Field day/ Mela (Nos.)	430
2	No. Of farmers participated	53943

The TNAU Varieties /technologies demonstrated by KVKs for adoption by farmers during the period 2019-2020 are listed below.

Table 2 : **Demonstration of TNAU Varieties/Technologies by KVKs for Adoption**

The varieties demonstrated by KVKs during 2019-20 are given below:

Barnyard millet CO (KV) 2	Rice CO (R) 53, VGD 1, TRY 3	Bottle gourd – PLR 1
Barnyard Millet MDU1		Coriander Co (cr) 4
Bhendi Hybrid COBH 4	Rice ADT 53	
Black gram- ADT 6		Cowpea VBN 3
Blackgram MDU -1	Gingelly VRI 3	Ragi variety CO 15
Blackgram VBN 6 & Vamban 8	Groundnut VRI 8	Fodder cowpea- CO 9
Lablab (Bush type)-Co(GB)14	Greengram VBN 4 and CO-8	

Management technologies

- ✓ Fall Army Worm Management
- ✓ IPM in Cotton
- ✓ Management of Rugose White fly

Dr. S.D. Sivakumar
Director, Agribusiness Development
TNAU, Coimbatore

The Directorate of Agribusiness Development (DABD) was established in 2007 with the major mandate of supporting startup companies in agriculture and also commercializing the technologies developed by the University. The DABD strives to serve as a one stop solution to all the business needs of agribusiness firms and entrepreneurs who are interested in agriculture and allied activities. DABD encourages students, youth, farmers and women individually or in teams to make use of the services provided by this Directorate to realize their vision in life. People with inclination to innovate, start new agribusinesses, expand existing business could approach DABD for mentoring, support and business services. The journey of innovation and entrepreneurship requires persistence, networking, optimism and purpose. DABD facilitates clients to stay on target, offer handholding and grow with the clients.

Research Highlights (2019-2020)

a). Technologies commercialized

S No	Name of the technology	**Department from which the technology developed**	Name of the Firm	Duration	Tech.Tr. fee (Rs.)	Royalty (%)
1	TNAU-Liquid Bio – Pesticide- *Trichoderma viride*	Dept. of Plant Pathology, TNAU, Coimbatore	M/s. HIL (India) Limited	01.02.2019 to 31.01.2020	5,00,000/-	2
2	TNAU-Liquid Bio – Pesticide- *Pseudomonas fluorescens*	Dept. of Plant Pathology, TNAU, Coimbatore	M/s. HIL (India) Limited	01.02.2019 to 31.01.2020	5,00,000/-	2
3	TNAU Sweet Flag 6 % EC	Dept. of Entomology, TNAU, Coimbatore	M/s. Bhuvicare Private Ltd., Tirunelveli	03.03.2020 to 02.03.2025	25 lakhs (payment of Rs. 5 lakhs each year as upfront fee	2

b). Machineries commercialized

S No	Name of the technology	**Department from which the technology developed**	Name of the Firm	Duration	Tech.Tr. fee (Rs.)	Royalty (%)
1	Wetland Laser lever	Dept. of Farm Machinery and power Engineering	M/s. Farm Implements (India), Pvt. Ltd., Chennai	18.03.2020 to 17.03.2030	2 lakh	5

c). Hybrids Commercialized

S. No	**Name of the Crop & Hybrids**	**Department from which the technology developed**	**Name of the Firm**	**Duration**	**Amount (Rs.)**	**Royalty (%)**
1.	Rice- CO 4	Department of Rice, TNAU, Coimbatore.	M/S. Dinkar Seeds Pvt Ltd., Gujarat.	14.09.2017 to 13.09.2022	5,00,000/-	4
2.	Maize- COH(M) 9	Department of Millets, TNAU, Coimbatore.	M/S. Rasi Seeds Pvt Ltd., Attur, Salem.	27.05.2019 to 26.01.2024	5,00,000/-	4
3.	Maize- COH(M) 8	Department of Millets, TNAU, Coimbatore.	M/S. Proline Seeds Company (India) Pvt Ltd., New Delhi.	04.09.2019 to 03.09.2024	5,00,000/-	4

******