

TAMILNADU AGRICULTURAL UNIVERSITY

49th RESEARCH COUNCIL MEETING

Research Highlights 2015-17

CENTRE FOR PLANT BREEDING AND GENETICS

Varieties Released through State Variety Release Committee

Pearl Millet CO 10

A new high yielding, medium tall pearl millet composite UCC 32 was released as CO 10 to replace CO (Cu) 9 and ICMV 221 which were released more than 10 years before. The new composite was evolved through population improvement involving five agronomically superior inbred lines viz. PT6029, PT6033, PT6034, PT6039 and PT6047. This composite is



medium in stature (160 -180 cm) and matures in 85 – 90 days. The grains are bold and grey brown in colour. It is highly resistant to downy mildew and recorded a mean grain yield of 3526 kg/ha under irrigated condition, which is about 18 and 25 per cent increase over the checks CO (Cu) 9 and ICMV 221 respectively. The mean grain yield under rainfed conditions is 2923 kg/ha, which is 16 and 26 per cent increase over CO (Cu) 9 and ICMV 221 respectively. The protein content is 12.07 per cent).

Blackgram VBN 8

Blackgram VBN 8 is a cross derivative of VBN 3/VBN 04-008, maturing in 65-70 days and suitable for all the seasons. The average yield of VBN 8 is 900 kg/ha, which is 11.94 and 13.49 per cent more than TNAU VBN (Bg) 6 and TNAU CO (Bg) 6 respectively. The variety has synchronized maturity and high resistance to Mungbean Yellow Mosaic Virus (MYMV). It is also resistant to leaf crinkle and powdery mildew diseases. It



gives an average yield of 988 kg/ha under irrigated condition. Under rainfed conditions, it gives a yield of 871 kg/ha. The protein and content is 21.9 per cent and Arabinose content is 7.5 per cent. Grains are bold in nature with with good battering quality.

Groundnut VRI 8

VRI 8 is a hybrid derivative of ALR 3 /AK 303. The variety is a Spanish bunch type with medium bold pods and kernels with rose coloured testa. It matures in 105-110 days. The average dry pod yield under rainfed and irrigated conditions are 2127 and 2698 kg/ha respectively. The shelling outturn and oil content are 70.0 and 49.0 per cent respectively.



Cotton CO 14

CO 14 is an American cotton type with high yield and extra long staple lint. It is a cross derivative of (MCU 5/TCH 92-7)/MCU 5-1 with 150 days duration and suitable for winter irrigated tracts of Tamil Nadu. The average seed cotton yield is of 1768 kg/ha, which is 18.3 per cent higher than the yield of MCU 13. The variety can yield upto 3500 kg/ha under better management condition. It is having 34.8 per cent of ginning out turn and 6.0 g of boll weight. Regarding fibre qualities, it is having more than 35.0 mm of 2.5% span length and 22.7 g/tex of bundle strength as against 33.9 mm fibre length and 21.9 g/tex fibre strength of MCU 5.



Sugarcane CO 0212

This variety is released by Sugarcane Breeding Institute through SVRC. The mid-late maturing sugarcane clone CO 0212 is a high yielding and high quality variety suitable for Tamil Nadu and Puducherry. It was evolved through hybridization and selection involving two high yielding and high quality parents CO 7201 and ISH 106 at ICAR-Sugarcane Breeding Institute (SBI), Coimbatore. The variety gives an average yield of 150.56 t/ha with commercial cane sugar (CCS) percent of 14.76 and sugar yield of 23.04 t/ha. It is known for its tolerance to drought.



Fodder Cowpea CO 9

CO 9 fodder cowpea variety is a derivative of CO 5/Bundel Lobia 2 cross. It gives an average green fodder yield of 22.82 t/ha against the check CO (FC) 8 (19.27 t/ha). The seed yield of CO 9 is higher (745 kg/ha) as compared to CO (FC) 8 (610 kg/ha). CO 9 has a duration of 50-55 days. The crude protein content is 21.56 per cent. The variety has a dry matter yield of 3.85 t/ha. The reduced crude fibre content (19.9 %), Acid Detergent Fibre (ADF) content and Neutral Detergent Fiber (NDF) content in the fodder results in improved palatability, digestibility and intake.



Rice CO 52

CO 52 is a derivative of the cross BPT 5204/CO(R) 50. It matures in 130 – 135 days. The new rice variety with medium tall stature has efficient tillering capacity, long droopy panicles with a highly acceptable plant characters and is a good replacement for the rice variety BPT 5204 due to its high grain yield and superior grain quality. The variety recorded a mean grain yield of 6191 kg/ha, with 11.29 per cent increase over BPT 5204 and is moderately resistant to plant and leaf hoppers, blast, sheath rot, brown spot and sheath blight. It produces medium slender white rice with intermediate amylose, soft gel consistency and moderate gelatinization temperature.



Barnyard Millet MDU 1

MDU 1 is a pure line selection of barnyard millet identified from Arupukkottai region. It is a high yielder due to its high tillering capacity. It matures in 95-100 days and is suitable for *khari*, *rabi* and summer seasons of Tamil Nadu. The average grain yield under irrigated condition is 2284 kg/ha, which is 30 per cent more over CO(Kv)2. Under rainfed conditions, the grain yield range from 1500-1700 kg/ha. Fodder yield ranges from 3000-3300 kg/ha. The grains are yellowish grey in colour with good nutritional quality. The milling per cent is 70 per cent. The variety is resistant to shoot fly, stem borer and smut.



Redgram CO 8

CO 8 Redgram variety is a hybrid derivative from the cross combination APK 1/LRG 41. It matures in 170-180 days and gives a yield of 1800 kg/ha under irrigated and 1600 kg/ha under rainfed conditions. It is superior to the existing varieties viz. CO 6 and VBN 2. The seeds are bold with 23.0 per cent protein content. The variety is resistant to sterility mosaic virus (SMV) and root rot and moderately resistant to *Helicoverpa armigera* and *Maruca*.



Blackgram ADT 6

ADT 6 blackgram, a variety released for rice fallow conditions is a cross derivative of VBN 1/VBN 04-006. It matures in 65-70 days, by giving an average yield of 741 kg/ha, which is 13.8 per cent increased yield over ADT 3 (651 kg/ha). The culture possesses moderate resistance to Mungbean Yellow Mosaic Virus (MYMV), leaf crinkle and powdery mildew diseases. The seed protein and arabinose contents are 21.6 per cent and 5.7 per cent respectively.



Blackgram KKM 1

KKM 1 blackgram is another variety released for rice fallow conditions of Tamil Nadu. The variety having the parentage of COBG 643/VBN 3, gives an average yield of 607 kg/ha, which is 14.5 per cent over ADT 3 (530). It matures in 65-70 days. The variety is moderately resistant to Mungbean Yellow Mosaic Virus (MYMV), powdery mildew disease and pod borer. It is resistant to root knot nematode (*Meloidogyne javanica*). The arabinose content in the seed is 6.7 per cent.



Sesame VRI 3

VRI 3 is a hybrid derivative of SVPR 1/TKG 87 cross. The high yielding bold white seeded sesame matures in 75-80 days. The average yields are 995 and 1055 kg/ha under *rabi* and summer.



Castor YRCH 2

YRCH 2, the new castor hybrid having the parentage of M 619 -1/SKI 215 gives an average yield of 2089 kg/ha which is 18.4 per cent more than the yield of YRCH 1. The seed oil content is 49.0 per cent. The new hybrid is red stemmed, semispiny and comes under the triple bloom category. The plant type is non-lodging with basal branching and non-shattering capsules. The hybrid is specifically known for high proportion of female flowers which is more than 95 per cent. The hybrid is meant mainly for sole crop and is also suitable for intercrop cultivation. The hybrid YRCH 1116 is resistant to wilt. It is tolerant to insect pests *viz.* semilooper, *Spodoptera*, leafhopper and capsule borer.



Cotton K 12

K 12, a new *Karunganni* cotton (*Gossypium arboreum*) is a hybrid derivative of K 11/K 9. The variety is released for the rainfed vertisol tracts of Tamil Nadu. The variety is drought tolerant with superior medium staple cotton and gives an average seed cotton yield of 1193 kg/ha as against 1066 kg/ha of K 11. The variety is with higher boll weight (2.7 g) and superior fibre quality.



COC 25

COC 25 sugarcane is the derivative of CO 85002/HR 83-144. It gives a cane yield of 153.65 t/ha which was 12.20 per cent increase in over the check COC (Sc) 24. The sugar yield of the variety is 19.54 t/ha with 12.85 per cent commercial cane sugar (CCS). The plant type is tall with good rationing ability. The variety is moderately resistant to red rot.



Varieties Released through Central Variety Release Committee

Rice TM 07278 (IET 23216)

TM 07278 (IET 23216) is a hybrid derivative of WGL 32100 /Swarna with a duration of 125 days and has been identified and released for Eastern Zone by AICRP during 2016. It gives a yield of 5477 kg/ha and possesses moderate resistance to blast, RTD and brown spot. The plant type is semi-dwarf, erect with high tillering and non-lodging habit. Grains are medium slender and translucent with high milling (68.1 per cent) and HRR (62.4 per cent).



Multi-cut forage sorghum CSV 33MF (SPV2242 F)

A multi-cut forage sorghum CSV 33MF (SPV 2242 F) was identified for release by Variety Identification Committee and released during 2016 at national level. It was derived from EMS mutation of CO (FS) 29 (inter-specific cross of *Sorghum bicolor* x *Sorghum sudanense*). The variety has tall nature, thin stem, leafy and capable for multiple cuttings. First cut is on 65th day and subsequent cuts are at 45 days interval. It recorded green fodder yield of 1039.30 q/ha, in three cuttings and 16.23 per cent higher than SSG 59-3 (National check). Similarly, it recorded dry fodder yield of 280.93 q/ha, which is 13.10 per cent higher than SSG 59-3. It possesses higher green fodder yield per day (7.36 q/ha) and dry fodder yield per day (2.0 q/ha). This variety was identified for cultivation in Zone 1 (Haryana, Punjab, Uttarakhand, Uttar Pradesh, Gujarat and Rajasthan) and Zone II (Tamil Nadu, Karnataka and Maharashtra) during *kharif* season



Groundnut ALG 06-320

ALG 06-320, a Spanish bunch groundnut culture has been identified by the Variety Identification Committee of the AICRP and released for Zone III b, which includes Tamil Nadu, Andhra Pradesh and Karnataka. It is a derivative of (J 11/CG 52)/ICGV 86015 and matures in 115 days. It recorded a mean pod yield of 2741 kg/ha which is 33.0 per cent superior to the National Check TAG 24 (2060 kg/ha) and 29.0 per cent superior over the Zonal Check R 8808 (2124 kg/ha). The shelling outturn and oil content of the new genotype is 70



and 49.0 per cent respectively. The variety is resistant to rust and moderately resistant to late leaf spot diseases.

Fodder Cowpea TNFC 0926

Fodder Cowpea TNFC 0926 was identified for release in NEZ: Eastern Uttar Pradesh, West Bengal, Odisha, Assam and Jharkhand by CVRC during 2016. It is a cross derivative of CO 5/KBG 2. It gives an average green fodder yield of 25 t/ha against the national check UPC 5286 (22.50 t/ha). The crude protein yield over checks ranged from 2.41 to 14.46, with a genetic potential of 0.780 t/ha. The dry matter yield of TNFC 0926 is 4.94 t/ha.



Cultures in pipeline for release

Rice AD 09367

AD 09367 is the hybrid derivative of BPT5204 and Improved Whiteponni developed by the Tamil Nadu Rice Research Institute with a duration of 158 days and medium slender grains. The average yield of AD 09367 was 6720 kg/ha across 112 locations. This culture was found to be resistant to blast and bacterial leaf blight and moderately resistant to stemborer, leaffloder, brown planthopper, white backed planthopper and sheath blight based on the screening under controlled conditions.



Blackgram COBG 10-05

COBG 10-05 is a cross derivative of VBN 5 and *Vigna mungo* var. *silvestris* with a duration of 60-65 days. The average yield of the culture is 877 kg/ha, which is 10.20 and 12 per cent over the check varieties CO 6 and VBN 6 respectively. The culture is resistant to yellow mosaic virus (YMV).

Blackgram VBG 10-024

VBG10-024 is a selection from IPU 99-3 and gives an average yield of 1383 kg/ha with a duration of 65-70 days. In addition to high yield, it is highly resistant to YMV with synchronized maturity.

Greengram COGG 980

COGG 980 is a cross derivative of VBN (Gg) 2 and VC 6157B-70P and matures in 60-65 days. It recorded an average yield of 853 kg/ha, which is 11 per cent over the check variety CO (Gg)7. It possesses bold seeds with 100 grain weight of 5.5 g and is resistant to YMV with synchronous maturity.

Cowpea VCP 09 – 013

VCP 09 - 013 is a cross derivative of TLS 38 and VCP 16-1. The average yield is 915 kg/ha, which is 11.72 per cent increase over CO (Cp) 7 and 12.68 per cent over VBN 1. The duration is 70-75 days. It is bold and brown seeded with determinate plant type with synchronized maturity.

Cultures under evaluation in Adaptive Research Trials

Rice

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
Varieties				
AD 09219	ADT 45/ACK 03002	115	6147	Good cooking quality
CB 10553	BPT 5204/CB 05501	119	6099	Long slender grains
CB 11107	BPT 5204/CO 50	137	5188	moderate cooking quality
CB 12588	CB 04110/CB 05501	118	5955	Resistant to blast disease
TM 09135	Selection from IR82639-B-B-115-1	118	3848	Rainfed cultivation
TM 10085	ADT 43/CO 47	118	5961	Resistant to blast disease
TR 05031	ADT 39 /CO 45	135	5433	Salt tolerant
TR 09030	Mutant of TRY 2	108	3842	Salt tolerant
VG 09006	ADT43/ <i>Jeeragasamba</i>	127	4695	Short slender grain
TNTRH 40	TNAU95S/CB40	135	6321	Bold grains

Cumbu

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
TNBH 08804	ICMA 9955/PT6067	87	2415	Downy mildew resistance
TNBH 10885	ICMA 92777/PT 6069	92	2605	Downy mildew resistance

Pulses

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
Redgram CRG 10-12	Co (Rg) 7/BSMR 853	180	1880	Resistant to sterility mosaic disease and indeterminate
Blackgram VBG10-010	VBN 2/VBG 04-003	65	1095	Resistant to YMV
Blackgram COBG 11-02	VBN 4/V. <i>mungovarsilvestris</i>	65	748	Resistant to YMV
Blackgram VBG 11 – 016	VBN 3/VBG 04-001	69	1137	Resistant to YMV
Greengram VGG 05-009	VBN (Gg) 2/VRM (Gg) 1	75	882	Moderately resistant to YMV
Cowpea VCP 09 – 019	TY 860/CO(CP) 7	75	1370	Moderately resistant to YMV

Oilseeds

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
Groundnut ICGV 06146	ICGV 92069 x ICGV 93184)/ICGV 96246 x 92 R/75	110	2040	Spanish bunch type
Groundnut TVG 0856	VRI 6 x R 2001-2	103	2130	Spanish bunch type
Groundnut ICGV 07245	ICGV 92069/ICGV 93184)/SIL 4/(ICGS 44/ICGS 763	120	2170	Virginia bunch type
Groundnut ICGV 07247	ICGV 92069/ICGV 93184)/SIL 4/(ICGS 44/ICGS 763)	120	2133	Virginia bunch type
Sunflower CSFH 12205	COSF 6A/IR 6	90	2010	-

Cotton

Culture name	Seed cotton yield (kg/ha)	Duration (days)	Span length mm	Bundle strength g/tex
TCH 1819	2310	135	27.3	19.7
TCH 1822	2331	135	27.5	19.5
TSH 0499	1976	160	30.6	22.6

Sugarcane

Culture name	Cane Yield (t/ha)	CCS (%)	Sugar Yield (t/ha)
Early			
C 29 090	135.50	12.92	17.50
C 29 229	127.10	13.05	16.60
Si 2008 05	134.70	12.90	17.40
G 07 017	132.85	12.85	16.90
Mid late			
C 29442	134.00	12.91	17.30
Si 2008 06	132.00	12.87	17.00
07 G 023	132.50	12.90	17.10

NEW RESEARCH INITIATIVES

Establishment of Centre of Excellence in Molecular Breeding

The Centre of Excellence in Molecular Breeding is established with a financial outlay of 150 lakhs from the Government of Tamil Nadu with the objective of unraveling the genes controlling the traits of agronomic importance and speeding up the process of evolving ideal genotypes in selected crops by exploiting the potential of molecular marker technology in crop breeding. In the recent past, TNAU is exploiting the molecular tools in the evolution process of crop varieties and among the molecular tools, molecular marker technology and marker assisted breeding are major tools, augmenting the TNAU plant breeders to come with improved varieties in shorter period.



The high throughput genotyping platform viz. Fluidigm EP1 System installed in the Centre of Excellence in Molecular Breeding TNAU is expected to provide efficient SNP genotyping of major crops to facilitate marker assisted breeding.

Establishment of a Cryo-conservation facility for germplasm storage

The Department of Plant Genetic Resources, Centre for Plant Breeding and Genetics, TNAU was sanctioned with a budget of Rs. 196 lakhs from NADP for establishing a Cryo-conservation facility. This facility is meant for the conservation of 36,000 germplasm accessions of farmers' varieties and landraces of Tamil Nadu state for



posterity. Under this scheme, a cryo-conservation module with sophisticated equipments for safe and economical storage of seeds and vegetative propagules will be developed.

Revitalization of millets for nutritional security and enhanced productivity

The State Planning Commission has sanctioned a new scheme entitled Revitalization of millets for nutritional security and enhanced productivity during 2017 under Tamil Nadu Innovation Initiatives (TANII) with a budget of Rs 187.80 lakhs for three years. The principal objectives are promoting millet cultivation and utilization in Tamil Nadu by exploiting the already evolved high yielding millet varieties through better processing technologies, machineries and value addition methods. Formation of millet clusters at block level will be facilitated for sustained millet cultivation in order to have continuous supply of millets to the entrepreneurs/ consumers.



Scheme on Enhancing Cotton production

Under the ongoing scheme sanctioned by the Tamil Nadu Cotton Council during 2014-2015, compact plant types suitable for High Density Planting System are being evaluated. TCH 1819, one of the promising cotton genotypes is being evaluated under rice fallow situation in Cauvery Delta Zone.



An experiment to arrive at a holistic package for the High Density Planting System, suitable culture TCH 1819 is initiated. Evaluation of mechanized cotton cultivation from seed to seed is also in progress.

CROP MANAGEMENT

AGRONOMY

Rice

Performance of three rice varieties viz., Anna (R) 4, ADT (R) 45 and Norungan local varieties were evaluated with split application of N and K in semi dry cultivation. Among the varieties, Anna (R) 4 performed better with the recommended dose of NPK 75:25:37.5 kg/ha applied as full dose of P and 1/4th doses of N and K as basal and the remaining dose of N and K in three equal splits on 25, 45 and 60 days after sowing (DAS) and recorded 43 % increased grain yield over basal application of recommended dose of NPK.



Effect of chemical and non – chemical weed management practices viz., pre emergence application of pyrazosulfuron ethyl 10% WP @ 20 g a.i /ha on 3 DAS with and without cono weeding was studied in drum seeded rice under puddle condition. Pre emergence application of pyrazosulfuron ethyl at 20 g a.i /ha on 3 DAS followed by cono weeding on 25 DAS had higher weed control efficiency (94%), increased grain yield (6450 kg/ha) and B:C ratio (2.45). It was also found that cono weeding on 10 and 25 DAS is an alternative to chemical weed management.

Suitable pre and post emergence herbicides were evaluated in wet seeded rice during *kharif* and *rabi* season with varieties viz., CO (R) 51 and CO (R) 50. Among the herbicides, pre-emergence application of pendimethalin @ 1.0 kg a.i./ha at 3 DAS followed by post emergence application of biopyribac sodium 25 g/ha at 25 DAS along with one hand weeding at 45 DAS effectively reduced weed population, increased the grain yield (6039 kg/ha and 5937 kg/ha) with higher net return of Rs. 44,221/ha and 42,877 /ha during *kharif* and *rabi* respectively.

Performance of pre and post emergence herbicides were tried in transplanted rice during *kharif* and *rabi* season with rice varieties CO (R) 51 and CO (R) 50. Among the herbicides, pre emergence application of pretilachlor @ 750 g/ha at 3 day after transplanting (DAT) followed by post emergence application of chlorimuron and metsulfuron 4 g / ha at 25 DAT had higher weed control efficiency (97 % and 96 %), grain yield (6038 and 6044 kg/ha) and net return (Rs.47,001 /ha and 47,223 /ha) during *kharif* and *rabi* season respectively.

Sorghum

- Adoption of a spacing of 60 x 10 cm for grain sorghum instead of the recommended spacing of 45 x 15 cm will help to mechanize the operations of sowing with tractor drawn seed drill, weeding with power weeder and harvesting with reaper harvester and save labour and time without reduction in yield and economic returns.
- Considering the labour use and the need for the control of late emerging weeds from the point of view of field sanitation Atrazine 0.25 kg a.i./ha as PE with lay by application (spraying herbicide after first hand weeding) of pendimethalin at 0.5 kg a.i./ha can be highly recommended since it recorded the lowest weed density of 10.3 /m² and lowest weed DMP at harvest (16.2 g/m²) with a grain yield of 3101 kg/ha and net return of Rs.18023/ha.
- Application of FYM @ 10 t/ha + 125% N recorded the highest green fodder yield during first and second cut of fodder sorghum. Green forage yield obtained in this treatment was 19% higher over application of FYM @ 25 t/ha + 100% N for both first cut and second cut. The lowest HCN content was recorded by application of FYM @ 10 t/ha + 100% N and goat manure @ 5 t/ha + 100% N during first and second cut of fodder sorghum crop, respectively.

Pearl millet

- Fertilizer N application to different pearl millet varieties showed that the entries responded for the application of N upto 90 Kg/ha.
- Integrated nutrient management for pearl millet hybrids under optimum management, 75% RDF + PSB + *Azospirillum* + 5 t FYM has resulted in more growth and yield and this was closely followed by 50% RDF + PSB + *Azospirillum* + 7.5 t of FYM.
- Foliar application of iron @0.75% for pearl millet hybrids at tillering (25-30 days) resulted in more growth and yield and this was closely followed by 0.50% foliar application of iron. The economics worked out also indicated a similar trend on gross return, net return and B:C ratio.
- Sowing time of pearl millet was studied and it was found that July 20-25 showed significantly higher growth and yield parameters than the other date of sowing. Since the entries allotted for this study varied every year there was no scope for combined analysis.
- Among the four nutrient management tried RDF + FYM @ 5.0 t/ha + NPK foliar spray (19:19:19 Grade) @ 0.5% at 20-25 DAS had resulted in more growth and yield.

Maize

Maize hybrid COH(M) 7 under 60 x 20 cm and 50 x 20 cm with the RDF (250:75:75 NPK kg/ha) was found to give higher yield of 7324 kg/ha and 8062 kg/ha, with B:C ratio of 2.31 and 2.40 respectively.

Greengram and Blackgram

- In greengram, integrated weed management practices involving pre-emergence application of pendimethalin 30% EC + imazethapyr 2% EC (ready-mix) @ 1.0 kg a.i. ha⁻¹ at 3 DAS + one hand weeding at 30 DAS recorded the minimum weed count (3.99 Nos. m⁻²) and weed dry weight (34.2 kg ha⁻¹) and the maximum weed control efficiency (90.3%). Integrated weed management, practices also recorded higher number of pods plant⁻¹ (54.0), number of seeds pod⁻¹ (10.4), grain yield (1188 kg ha⁻¹), gross return (Rs. 71,280 ha⁻¹), net return (Rs. 39,612 ha⁻¹) and B: C ratio (2.25).
- In greengram, foliar nutrition by TNAU pulse wonder @ 5kg ha⁻¹ at flower initiation registered maximum number of pods plant⁻¹ (85), number of seeds pod⁻¹ (9.8), grain yield (1072kg ha⁻¹), gross return (Rs. 75,040 ha⁻¹), net return (Rs. 42,788ha⁻¹) B:C ratio (2.33).
- In blackgram, foliar nutrition by TNAU pulse wonder @ 5kg ha⁻¹ at flower initiation registered maximum number of pods plant⁻¹ (72), number of seeds pod⁻¹ (8.6), grain yield (879 kg ha⁻¹), gross return (Rs. 70,320 ha⁻¹), net return (Rs. 38,068 ha⁻¹) and B:C ratio (2.18).
- In irrigated blackgram, sequential application of pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ at 3DAS as pre-emergence herbicide followed by imazethapyr 10% SL @ 40g a.i. ha⁻¹ at 20 DAS as early post emergence herbicide registered the lower weed density (5.87 Nos. m⁻²) and weed dry weight (66.4kg ha⁻¹) and higher weed control efficiency (76.5%) at 60 days after sowing, and maximum grain yield (785 kg ha⁻¹), gross return (Rs.63,500 ha⁻¹), net return (Rs.33,972 ha⁻¹) and B:C ratio (2.15) than sole application of either pre-emergence herbicide (pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹) or early post emergence herbicide (imazethapyr 10% SL @ 40g a.i. ha⁻¹).
- TNAU (Blackgram) VBN 6, sown at normal date (June first week) recorded higher number of pods (73 plant⁻¹) and seeds (7.6 pod⁻¹) and registered maximum grain yield (937kg ha⁻¹), gross return (Rs. 74,960), net return (Rs.45,732) and B:C ratio (2.56) than 15 days delayed sowing. Among the time sowing and varieties tested, varieties sown at normal date registered higher number of yield attributes viz., pods (67.5 Nos. plant⁻¹), seeds (7.20 Nos. pod⁻¹), test weight (5.80g) and grain yield (911.5kg ha⁻¹) and also realized the maximum gross return (Rs. 72,920), net return (Rs. 43,692) and B:C ratio (2.50) than 15 days delayed sowing.
- In greengram, hand weeding twice at 15-20 and 35-40 DAS recorded minimum weed count (3.46 Nos. m⁻²), weed dry weight (14.3 kg ha⁻¹) and the maximum weed control efficiency (94.0%) at 30 DAS. Hand weeding twice, also registered higher number of pods plant⁻¹ (56.3), number of seeds pod⁻¹ (10.3), grain yield (831 kg ha⁻¹), gross return (Rs. 66,480 ha⁻¹), net return (Rs. 32,373 ha⁻¹), whereas the highest B: C ratio (1.98) was recorded in pre-emergence application of pendimethalin 30% EC + imazethapyr 2% EC (ready-mix) @ 1.0 kg a.i. ha⁻¹ at 3 DAS.

- In irrigated greengram, foliar nutrition by TNAU pulse wonder @ 5 kg ha⁻¹ at flower initiation registered maximum number of pods plant⁻¹ (77), number of seeds pod⁻¹ (9.8), grain yield (858 kg ha⁻¹), gross return (Rs. 68,640 ha⁻¹), net return (Rs. 35,938 ha⁻¹) and B:C ratio (2.10).
- In irrigated blackgram, foliar nutrition by TNAU pulse wonder @ 5kg ha⁻¹ at flower initiation registered maximum number of pods plant⁻¹ (72), number of seeds pod⁻¹ (8.6), grain yield (879 kg ha⁻¹), gross return (Rs.70,320 ha⁻¹), net return (Rs. 38,068 ha⁻¹) and B:C ratio (2.18).
- In irrigated blackgram, weed management practices which comprised of sequential application of pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ at 3DAS as pre-emergence herbicide followed by imazethapyr 10% SL @ 40 g a.i. ha⁻¹ at 20 DAS as early post emergence herbicide registered the lower weed density 7.10 (50.4 Nos. m⁻²) and weed dry weight (55.7 kg ha⁻¹) and higher weed control efficiency (73.5%) at 60 days after sowing, and the maximum grain yield (734 kg ha⁻¹), gross return (Rs. 61,160 ha⁻¹), net return (Rs. 30,062 ha⁻¹) and B:C ratio (1.97) than sole application of either pre-emergence herbicide (pendimethalin 30%EC @ 1.0 kg a.i. ha⁻¹) or early post emergence herbicide (imazethapyr 10% SL @ 40g a.i. ha⁻¹).

Redgram

Power weeding at 20 and 40 DAS with one hand weeding registered higher weed control efficiency (79.5%) and seed yield (922 kg/ha). Mulching with crop residue @ 5.0 t/ha reduced board leaved weeds and grassy weeds at all stages of crop growth.



Power weeding on 20 DAS



Crop residue mulching

Sunflower

- Blackgram was cultivated as preceding crop in *kharif*, 2015 and recorded a yield of 850 kg/ha. After harvesting of blackgram, crop residue (1.9 t/ha) was incorporated by using rotavator. STCR target yield NPK + S + 5t FYM/ha + Crop residue incorporation was significantly superior and recorded the highest yield of 2050 kg/ha which accounted for 18.5 per cent yield increase than control.
- Sunflower CO2 hybrid sown with spacing of 60 x 30 cm (55,555 plants/ha) along with the application FYM @ 5 t/ha and 125 % NPK (75:113:75 kg NPK/ha) recorded higher seed yield of 1976 kg/ha with net return of 31,927 and B:C ratio of 1.86.

- To control weeds effectively and economically in sunflower Pre emergence application of Pendimethalin @ 1kg ai/ha as pre emergence spray followed by one hand weeding at 30 DAS is the best practice.
- Weed free environment resulted in producing significantly higher seed yield of 2232 kg/ha and it was on par with twice hand weeding and pre emergence application of pendimethalin @ 1.0 kg a.i/ha as pre emergence spray followed by hand weeding or power weeded at 30 DAS. Highest net returns of Rs. 26,866 /- and B:C ratio of 1.67 was observed in Pendimethalin @ 1.0 kg ai/ha as pre emergence spray followed by power weeded at 30 DAS.

Soybean

- Recommended dose of fertilizer application with 2% foliar spray of 19:19:19 NPK at pod initiation recorded the maximum yield(1330 kg / ha), net return(Rs. 18060/ha) and B:C ratio(1.63) and it was comparable with 2% DAP (1304 kg/ha; Rs. 17175/ha and 1.60, respectively), whereas RDF registered soybean yield of 1029 kg /ha.
- Conventional tillage registered increased yield of 13.5% in soybean and 8.7% in maize crop compared to minimum tillage practice. Among the crops studied, maize recorded higher net return(Rs.31911/ha) and B:C ratio(1.97) compared to soybean (Rs.17148/ha and 1.63, respectively).
- Application of hydrogel @ 2.5 kg/ha immediately after sowing recorded 17.3 % higher soybean yield (1302 kg/ha) and B:C ratio (1.50) than without hydrogel application (1110 kg/ha and 1.40, respectively).
- In *kharif* season, 20 days late sown crop (19.7.2016) recorded 24.5 % decreased soybean yield than normal date of sowing(1205 kg/ha).

Cotton

- Genotype GSB 44 performed better than barbadense variety suvin as check with recommended spacing of 95x 45 cm with a blanket fertilizer recommendation of 80: 40: 40 kg NPK/ ha
- Genotype RHB-1014 performed better than barbadense hybrid as DCH - 12 as checkwith recommended spacing of 120 x 60 cm with a blanket fertilizer recommendation of 120: 60: 60 kg NPK/ ha
- Among the four genotypes HS - 292 performed better than check variety MCU 13 with recommended spacing of 75 x 30 cm with a blanket fertilizer recommendation of 80: 40: 40 kg NPK/ ha
- Genotype BGDHH-821 shows early maturity and genotype RHH 1007 recorded higher number of bolls compared to malliga hybrid as check with recommended spacing of 120 x 60 cm with a blanket fertilizer recommendation of 120: 60: 60 kg NPK/ ha.
- Genotype ARBC 1301 TCH1819 performed better than DSC 1302 with a spacing of 60 x 10 cm with a blanket fertilizer recommendation of 100: 50: 50 kg NPK/ ha.

- Biofertilizer application, neemcake@250 kg/ ha, biofertilizer seed treatment, intercropping with green manure and incorporation before flowering performed better.

Integrated Farming System

- The Integrated Farming System model for western zone of Tamil Nadu developed in TNAU, Coimbatore in 1.20 ha of land recorded a total net return of Rs. 2,92,702 (2011-16). A major share of 32.32% was contributed by crop component to the net return followed by dairy unit (31.43%), goat unit (22.68%), horticultural unit (0.07%) and other enterprises (13.65%)
- Saving of production cost, with recycled farm products was 27.6 % (Rs. 1,12,573) and farm labour engaged was 35.9 % (Rs. 1,46,531)
- Model generated an employment of 778 man days round the year with a B:C ratio of 1.96
- Nutrient addition through vermicompost and FYM was 191 kg N, 86 kg P and 112 kg K per year

Weed Management

- Conventional tillage (disc ploughing + two harrowing) with PE atrazine at 0.5 kg a.i./ha for maize and pendimethalin at 1.0 kg a.i./ha for sunflower + HW on 45 DAS can be recommended.
- Pre-emergence application of oxyfluorfen @ application of 250 g a.i./ha followed by Post-emergence application of imazethapyr @ 100 g a.i./ha + quizalofop ethyl @ 50 g a.i./ha on 15 DAS was found to be better for broad spectrum weed control in groundnut.
- Pre-emergence (PE) application of oxyfluorfen at 250 g a.i./ha on 3 DAS followed by twin wheel hoe weeder on 45 DAS can be recommended for broad spectrum weed control in onion.
- Pre-emergence application of atrazine at 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + Post-emergence application of 2,4-D Na salt 5g/L + urea 20g/L on 90 DAP followed by trash mulching at 5 t/ha on 120 days after planting (DAP) can be recommended to control striga in sugarcane
- Pre-emergence application of pretilachlor@750 g a.i./ on 3 DAS followed by Post-emergence application of chlorimuron + metsulfuron @ 4 g a.i./ha was found to be better for broad spectrum weed control and for higher grain yield in transplanted rice .
- Pre-emergence application of pendimethalin @ 1000 g a.i./ha followed by Post-emergence application of bispyribac sodium @ 25 g a.i./ha @ 20 DAS can be recommended for broad spectrum weed control and higher yield in directed rice.
- Neem cake @ 200 kg/ha at sowing followed by soil drenching of metalaxyl MZ @ 0.2% at 20 DAP reduced Orobanche shoot density with better weed control and higher tobacco leaf yield.

- Pre-emergence application of atrazine @ 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + Post-emergence application of 2,4-D Na salt 5g/l + urea 20g/l on 90 DAP followed by trash mulching at 5 t/ha on 120 DAP could be recommended for effective control of *Striga asiatica* in sugarcane and for higher productivity and profitability.
- Application of glyphosate at 1.5 kg/ha controlled *Cyperus rotundus* with no regeneration even after 60 days after herbicide application.
- In transfer of technology, about 6 On Farm Research on weed management in transplanted and wet seeded rice and five FLDs in tomato were carried out. Pre-emergence application of Pretilachlor 750 g/ha at 3 DAT + Post emergence application of chlorimuron and metsulfuron (Almix) 4 g/ha at 25 DAT was found better for broad spectrum weed control with higher seed yield and economic returns in transplanted rice. Pre-emergence application (PE) of pendimethalin 1.0 kg/ha followed by Post-emergence application of Bispyribac sodium 25 g /ha at 25 DAS followed by HW on 45 DAS can be recommended for broad spectrum weed control and higher seed yield and economic returns in wet seeded rice. Pre-emergence application of Pendimethalin 1000 g/ha on 3 DAS followed by Hand weeding on 30 DAS for broad spectrum weed control in tomato have been popularized.
- In maize – sunflower cropping system of conservation agriculture, significantly higher grain yield and economics were recorded in zero tillage in ZT-ZT+R system and in Pre-emergence application of pendimethalin 1.0 kg/ha + HW on 45 DAS in sunflower crop. Whereas, in maize, CT-CT system and in Pre-emergence application of atrazine @ 0.5 kg/ha + HW on 45 DAS recorded higher productivity as well as high income in maize crop.
- Application of crop residue mulching @ 5t/ha recorded significantly higher bhendi fruit and beet root tuber yields and higher income
- Pre-emergence application of bensulfuron methyl (0.6%) + pretilachlor (6.6%) 660 g/ha followed by hand weeding during *rabi* 2016, whereas, in *kharif* 2016 significantly higher grain yield and income was obtained with Pre-emergence application of pyrasosulfuron ethyl @ 20g/ha (10% WP) followed by hand weeding.
- The residues of atrazine and pendimethalin in soil and maize grain from different plots were below 0.01 mg/kg irrespective of tillage management practices adopted for weed control.
- Quizalofop-ethyl residues were below detectable level (0.01 mg/kg) in the harvest samples of onion plant, bulb and field-soil irrespective of doses of applications.
- Sorption and desorption of quizalofop ethyl was influenced significantly by the organic carbon content with the organic carbon normalized partition coefficient (K_{foc}) of 56.48 in the soil having OC % of 4.35 and pH of 5.2.
- Residues of quizalofop ethyl in soil declined sharply to the extent of 54.4 – 62.9% and >85% within the time period of 7 and 15 days after application, respectively with DT_{50} values of 4.1 and 5.6 days, respectively at 50 and 100 g /ha applied treatments.

- FYM @ 10 t /ha or vermicompost @ 5/ha or biochar @ 5 t/ha is efficient in reducing the residual concentration of atrazine than bioagents and crop residues application in calcareous sandy clay loam soil grown with maize.
- Residues of 2,4-D, atrazine and pendimethalin were below detectable limits in water, soil and maize grain samples collected from farmers' field.

NEW RESEARCH INITIATIVES

Rice

Nitrogen response trials on selected ART rice cultures under high and low input management.

- Yield maximization of rice under different sources of nutrients.
- Efficiency of neem-coated in transplanted rice.
- Evaluation of new herbicide product in transplanted rice.

Sorghum

- Priority inputs in *Kharif* sorghum
- Intercropping of sweet sorghum fodder with forage legumes under different nutrient management
- Effect of N levels on HCN content of multicut fodder sorghum
- Response of grain sorghum varieties to fertilizer levels
- Evaluation of mechanization in sorghum
- Evaluation of spacing and fertilizer doses for multi-cut forage sorghum

Pearl millet

- Performance of medium and late advance pearl millet hybrids to nitrogen levels.
- Performance of pearl millet medium and late advance hybrids to different dates sowing.
- Integrated nutrient management of pearl millet hybrids under optimum management
- Response of pearl millet hybrids to foliar application of Iron.
- Maximization in the pearl millet productivity under late sown situations.
- Performance of Iron and Zinc rich hybrids to different N levels

Maize

- Weed management in maize
- Effect of planting density and nutrient management practices on the performance of hybrids in *kharif-rabi* season
- Evaluation of new bio fertilizers in maize
- Performance of pre release medium and late maturity genotypes in *kharif-rabi* under varying planting density and nutrient levels.

Blackgram and Greengram

Herbicidal weed management in mungbean and its carry over effect on succeeding *rabi* crops.

- Foliar nutrition on blackgram and greengram productivity
- Effect of land configuration and weed management on urdbean productivity
- Validation of best management practices on yield maximization of urdbean

Cotton

- Optimization of spacing, fertilizer requirement for cotton compact culture TCH 1819 suitable for HDPS under rice fallow condition.
- Optimization of spacing for mechanized cotton cultivation.

Weed management

- Weed management in maize – sunflower – dhaincha (*Sesbania aculeata*) based conservation agriculture system
- Weed management in organic farming systems
- Non chemical weed management in organically grown okra + leaf coriander - maize + cowpea cropping system
- Non chemical weed management in organically grown green manure – beetroot - maize
- Long term herbicide trial in transplanted lowland rice - rice cropping system
- Herbicide residues – Monitoring and Mitigation in farmers and experimental fields

Integrated farming system

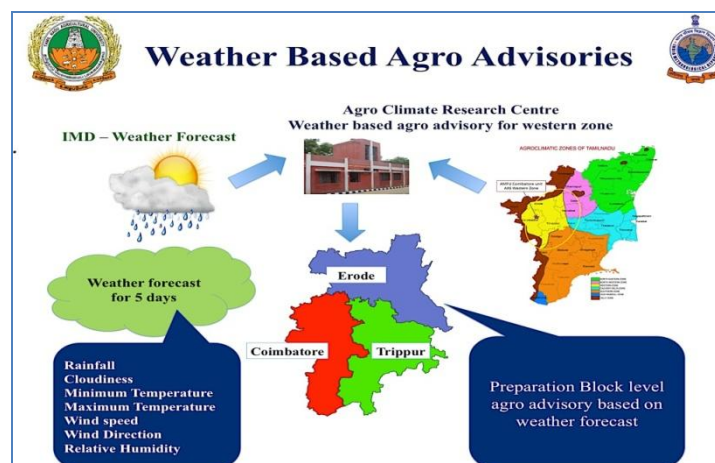
- Estimation of carbon sequestration and greenhouse gas emissions under existing IFS model.
- Identification of appropriate bio-intensive complementary cropping systems for the western zone of Tamil Nadu.
- Economic evaluation of intensive cultivation of fodder maize and its impact on soil health.
- Evaluation of different redgram based strip intercropping systems under rainfed condition.
- Relook on sowing time and sowing method for enhancing the winter pulses productivity in rainfed ecosystem.
- Altering crop geometry to suit mechanized weeding in sunflower.
- Evaluation of Best Management Practices (BMP) for greengram under irrigated conditions.
- Fodder preservation through silage making.

AGRO CLIMATE RESEARCH CENTRE

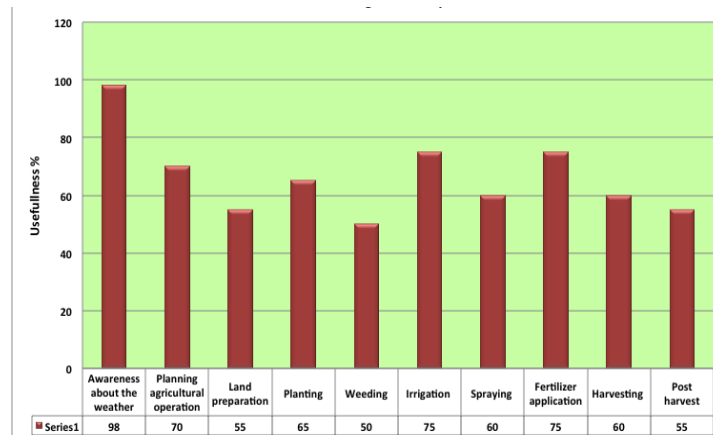
Seasonal Climate Forecast: Weather based farm decision making helps in reducing the production cost, climatic risks on crop production and improves yield and farm profit. Seasonal Climate Forecast (SCF) for South West Monsoon is given by last week of May and North East Monsoon is given by last week of September along with agro advisories on precautions and suitable crops. This could be utilized for modifying both on-farm as well as off-farm decisions with proper understanding and assessing its impact on crop production and income maximization. The same has been disseminated through Department of Agriculture, Pothigai TV, All India Radio and Newspapers.

Medium range weather forecast: Accurate block level weather forecast with nine parameters viz., Rainfall, maximum and minimum temperature, morning and evening relative humidity, wind speed and wind direction are being disseminated through public domain “tawn.tnau.ac.in”. This will help the farmer in timely planning of next three days operation. This will reduce the risk of loss in input and output. The forecast is being uploaded every day by 11.00AM for next six days.

Weather based agro advisory bulletins: Based on medium range weather forecast agro advisory bulletins in both Tamil and English are being prepared on every Tuesday and Friday and disseminated through Farmer portal, Department of Agriculture, TNAU Research Stations, KVK’s, Pothigai TV, All India Radio and Newspapers. Studies indicated that the bulletin created awareness on weather based agro advisory among the farmers and more than 75 per cent of farm operations are decided by using these agro advisories.



Method of weather based agro advisory preparation and dissemination



Farmers dependency on TNAU's weather based agro advisories

Weather based agro advisories as mobile SMS: Agro advisory in both Tamil and English language are being sent to 8.67 lakh farmers, twice in a week. Timely advisories help them in reducing risk and increasing input productivity.

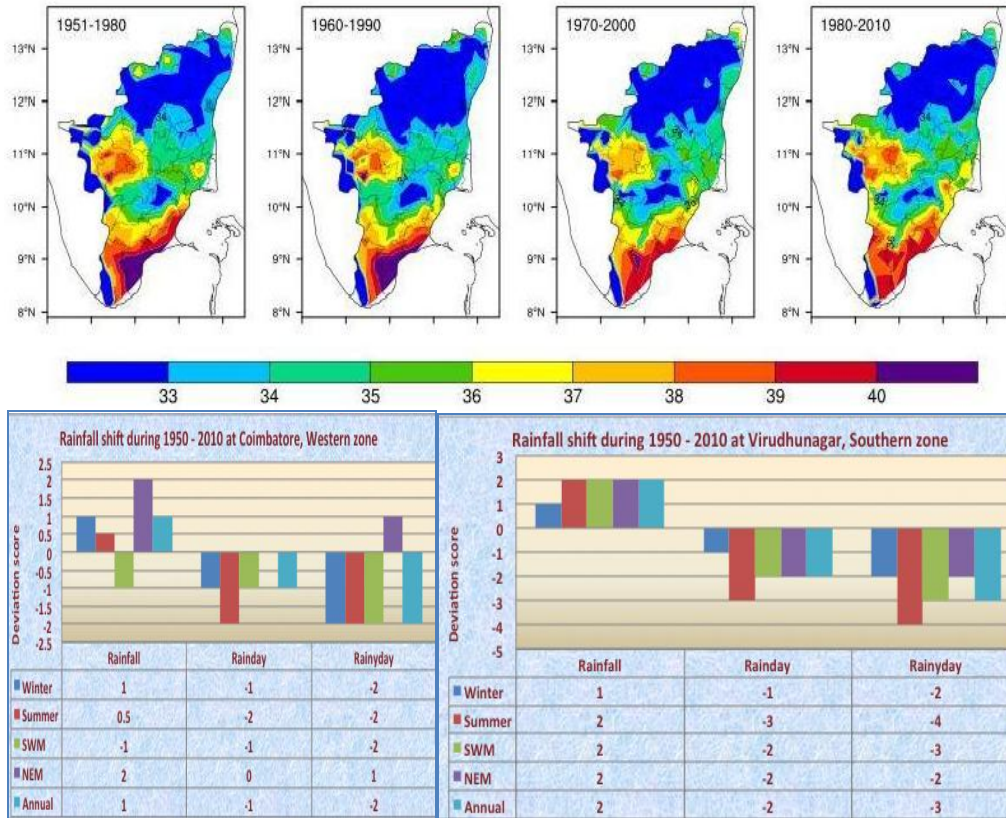
Rainfall Atlas: Rainfall events at block level viz., monsoon onset week, end week, wet week, pre monsoon sowing week, and Length of Growing Period were analysed over past 60 years and compiled as Rainfall Atlas. This will be very useful for researchers, extension officials as a reference book.



Rainfall Atlas with rainfall events like monsoon onset, LGP, quantity and rainy days

Impact of climate change on rainfall pattern, quantity and rainy days in Tamil Nadu

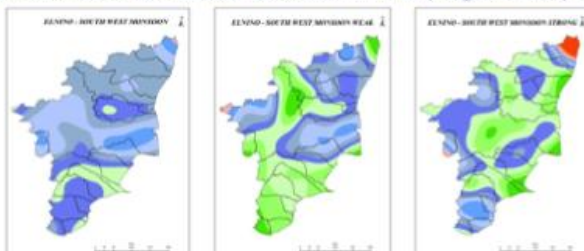
Results of the climate change impact study inferred that there is difference in the onset have been observed over these periods in Tamil Nadu and are more pronounced by an earlier onset in Southern districts and delayed along the Western Ghats, North Eastern and Coastal part of Tamil Nadu. There was decrease in rainy days at alarming level, poor distribution, increased RF intensity and reduction in LGP. Increasing intensity of rainfall may cause soil erosion, hence more emphasis should be given on soil moisture conservation research. There observed a sharp increasing trend in rainfall quantity & rainy days during NEM.



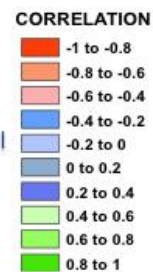
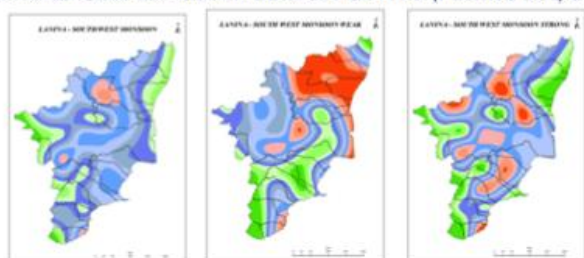
Impact of climate change on rainfall pattern, quantity and rainy day in Tamil Nadu

Impact of El Nino and La Nina on rainfall pattern of Tamil Nadu: El Niño/Southern Oscillation (ENSO) impacted the seasonal rainfall patterns over Tamil Nadu.

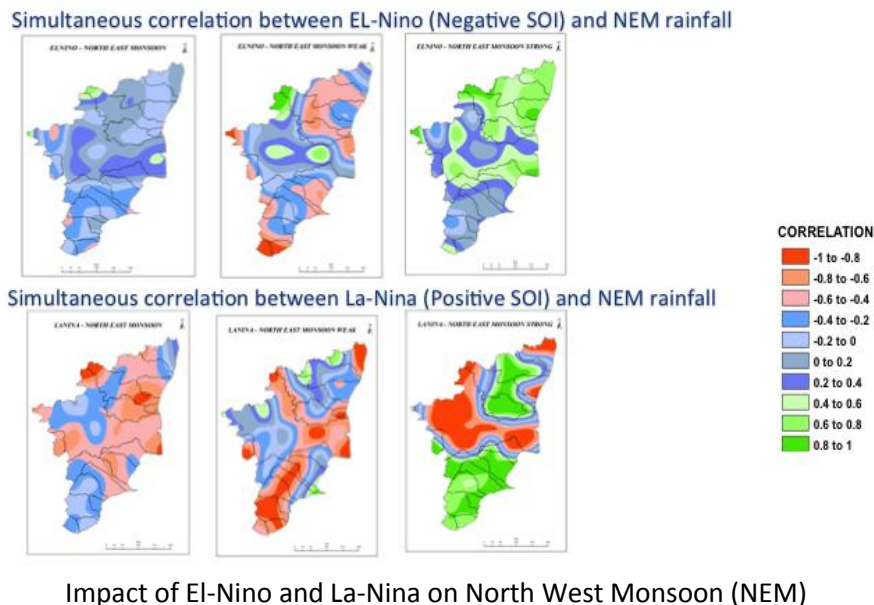
Simultaneous correlation between El-Nino (Negative SOI) and SWM rainfall



Simultaneous correlation between La-Nina (Positive SOI) and SWM rainfall



Impact of El-Nino and La-Nina on South West Monsoon (SWM)



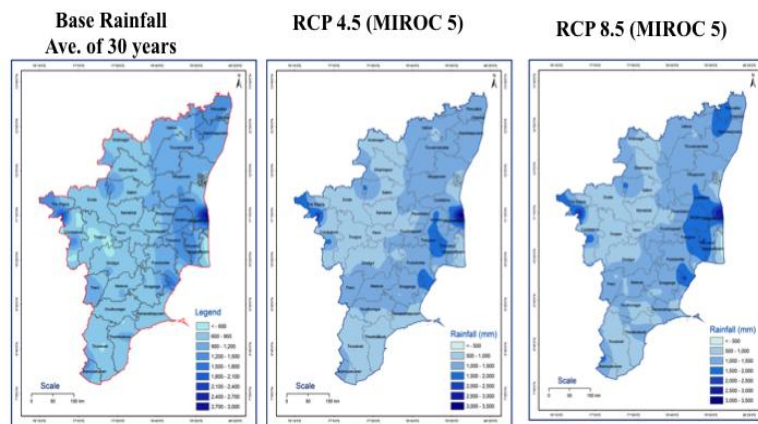
SWM and El-Nino: No relationship in all El-Nino years whereas weak years SOI had positive correlation with southern, central and northwestern parts of Tamil Nadu. In strong years the positive correlation extends to eastern and northeastern parts of Tamil Nadu covering most parts of eastern coast.

SWM and La-Nina: All La-Nina years had positive correlation over most parts of western ghats and northern coastal area. Weak years had positive correlation over southern parts of western ghats and central TN. Strong years had the positive relationship covering the whole western ghats and eastern coast

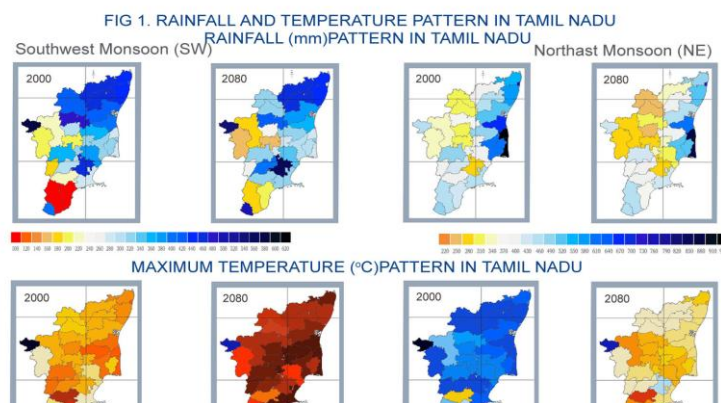
NEM and El-Nino: In all years only southern TN showed some correlation while all other parts had weak correlation. Weak years had good negative relationship over entire western ghats and east coast and northern pockets of TN. Strong years exhibits positive correlation with northern and central TN including eastern coast.

NEM and La-Nina: In all years northern and central TN showed negative relationship while in weak years the negative relationship extends to the total TN except few parts of western and northern TN. In strong years except Cauvery basin all other parts showed positive relationship.

- **Impact of climate change on rainfall projection during midcentury through climate models:** Models predicted that the annual rainfall quantity during midcentury is increased from current situation. The increment also higher at RCP 8.5 than RCP 4.5.
- **Impact of climate change on rice productivity in Tamil Nadu during 2050, 2080 and 2100:** The model study at RCP 4.5 indicated that, climate change will severely affect the rice productivity during 2050, 2080 and 2100. The reduction in yield was more in 2100 than 2050 and 2080.



Impact of climate change on rainfall pattern of Tamil Nadu during midcentury



Impact of climate change on rice productivity over Tamil Nadu (RCP4.5)

Regional Climate Change Projections across 20 GCMs in the Mid-century:

Study on RCP 8.5 during midcentury with 20 GCMs indicate increase in both maximum and minimum temperatures to the tune of 2.2 to 3⁰C. In Tamil Nadu, rainfall is expected to increase during the Northeast monsoon (October – December), the models agree on warmer future conditions.

System of Rice Intensification (SRI) is a climate change mitigation and adoption option:

Climate change mitigation and adaptation studies indicated that System of Rice Intensification is the management methodology during future climate scenarios. It reduces the water requirement of rice cultivation and also reduces the climate change factors like methane emission from rice fields. In the rabi season, water saving under SRI is 12.9 % over conventional cultivation. WUE in kg of grain yield/mm of water is 7.40 for SRI and 4.77 for conventional. It can be clearly seen that SRI is the best system for a farmer, the environment and a society as it saves water, reduces cost of inputs, reduces greenhouse gas emission and increases yield. Lower amount of input requirement and high productivity per unit area are the major reasons, heightening the SRI's performance in a sustainable way.



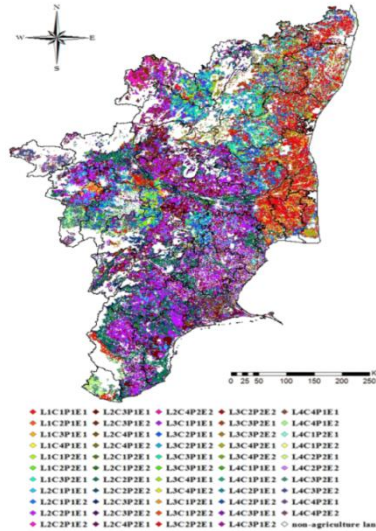
Fly ash and gypsum application is a climate change mitigation and adoption option:

Application of fly ash along with gypsum in rice fields as basal reduces the methane emitting bacterial population and increases the productivity in terms of both growth and yield parameters which resulted in increased yield. The results on grain yield showed that fly ash and gypsum in combination with Recommended Dose of Fertilizers (RDF) had increased grain yield significantly over control. The harvest index data across the treatments was also in favour of the treatments applied with soil amendments viz., fly ash and gypsum (Fig. 12). The role of methanogens and methanotrophs in methane emissions of rice fields has its uniqueness. It was found that application of fly ash and Silica Solubilizing Bacteria had higher rice production compared to other treatments studied. The application of fly ash with Silica Solubilizing Bacteria had reduced the Carbon di oxide emissions. But methane reduction was higher in Fly ash application followed by fly ash and Silica Solubilizing Bacteria combination. Whereas, Nitrous oxide reduction was by combination of fly ash with silica Solubilizing Bacteria followed by gypsum with Silica Solubilizing Bacteria application and fly ash application. The population of methanogens was higher in application of recommended dose of fertilizers alone and lowest in case of fly ash application. Methanotrophs however had higher population growths in fly ash amendment application. In considering all the benefits towards rice production and reduced greenhouse gases emissions, application of fly ash ($20 \text{ tonnes ha}^{-1}$) with silica solubilizing bacteria (12.5 kg ha^{-1}) added to recommended dose of fertilizers of NPK at $150:50:50 \text{ kg ha}^{-1}$ had performed best to increase rice production and decrease the greenhouse gases emissions through rice cultivation.



Application of fly ash is a climate change mitigation and adoption option

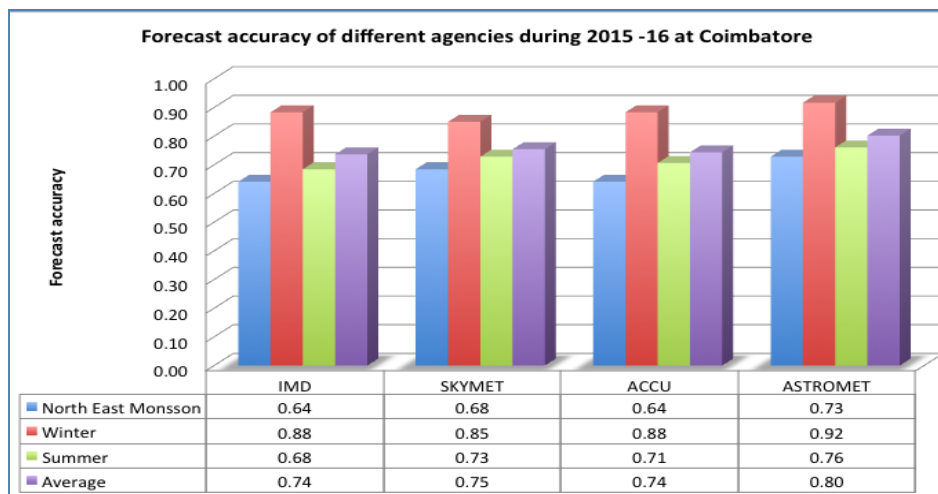
Development of micro ecological zones of Tamil Nadu: Using LGP, land cover, elevation, Land Capability classification and net primary productivity totally 54 agro micro meteorological zonation were identified in place of 7 agro climatic zones. This will help to develop location specific climate resilient technologies.



Micro ecological zones of Tamil Nadu

Increasing the accuracy of weather forecast through astrometeorology:

Astrometeorological forecast of daily rainfall had been developed for each one location of Seven Agro Climate zone of Tamil Nadu. Daily Astro rainfall forecast were developed and compared with daily rainfall forecast from WRF, private agencies and probability were used for comparing the effectiveness of astrometeorological forecast. Astrometeorological forecast has higher forecast accuracy than other agencies in all season. Astrometeorological forecast has higher Critical Success Indices than other agencies forecast except winter. Critical Success Indices of all the forecasting agencies was very less during winter and summer compared to NEM.



Astrometeorology is an option to increase forecast accuracy

Development of crop co-efficient for crop weather models: Genetic coefficient for rice and maize varieties were derived for using in the DSSAT model to generate yield prediction.

TNAU Weather soft: Weather database cum weather analysing tool for scientist and students. TNAU Weather soft is aVB .Net based MS Access DB windows application. Very simple and user friendly. Basic Windows working knowledge is enough. Developed for weather correlation studies. Store and retrieve multiple locations data. View and work with huge data, even for 100 years. It simply import input and export output as excel format. We can work with any specific range of available data store and retrieve 21 weather parameters. It calculate mean values for daily, standard weekly, monthly and annual, mean for any individual or all Parameter. It also list out date-wise extreme events, possibility of rainfall occurrence in particular day. It has modules to calculate initial and conditional probability, GDD and Heat units.

TNAU Energy soft: Developed to integrate energy data base with simplified energy efficient calculation methodology. It is a desktop application and user friendly. Like economic analysis viz., Benefit Cost ratio and net profit, with this TNAU energy soft, we could calculate Energy efficiency and net energy benefit. The TNAU Energy software can be used to identify the energy efficient agricultural technology and also useful to identify climate change mitigation technologies.



NEW RESEARCH INITIATIVES

- Medium range weather forecasting at village level
- Weather forecasting through Astrometerology
the impact of climate changes on the tolerance capacity of problematic weeds viz., *Cynodon dactylon*, *Cyperus rotundus* and *Trianthema portulacastrum*
- Effect of rainfall and throughfall on soil nutrient enrichment
- Methane emission from rice eco system and its management through different adaptation strategies
- Impact of climate change on pulse production

- Impact of climate change on pest population in pulses
- Assessment of climate change on Cauvery Delta and Kuttanad region through numerical weather prediction model
- Crop yield prediction through remote sensing tools
- Micro climate modification to manage climate variability in groundnut
- Impact of ENSO on climate variability in Tamil Nadu.
- Drought prediction near real time vegetative Index in numerical models

CROP PHYSIOLOGY

Rice

Validated SSR markers, RM431 linked to QTL qHTSF1.1 and RM5757 linked to QTL qHTSF4.1 in the back cross progenies developed between Improved White Ponni and N22. SSR genotyping of parents (N22, Improved White Ponni and CO 51) completed. QTL positive lines were found to exhibit improved spikelet fertility under high temperature stress.

Tomato

- Foliar spray of 0.5 ppm brassinolide at 20 and 40 days after transplanting overcomes the salinity effect and increase the yield up to 14.2 per cent under salinity (100 mM) compared to control
- Foliar spray of PPFM @ 2 per cent at 25 and 45 days after transplanting increased drought tolerant capacity through enhancement of RWC, CSI and NR activity.

Banana

- Grand Naine fruits of 25% ripening stage treated with 1-MCP @ 600 ppb for 16 hours at 17°C registered higher firmness (13.76 N), higher ascorbic acid content (49.36 mg g⁻¹) and total antioxidant activity (63.92 %).
- The 1-MCP treatment also resulted in delayed change of colour (chrome 'b' value: 37.0), greater peel thickness (4.61 mm), lesser physiological loss in weight (10.44 %) and reduced Pectin Methyl Esterase activity (8.54 meq of COOH g⁻¹min⁻¹).
- The shelf life of banana fruit was enhanced to 18 days by 1-MCP treatment while the control fruit had a shelf life of only seven days under cold storage conditions (17°C).

Mango

- Neelum fruits of 25% ripening stage treated with 1- MCP @ 900 ppb for 16 hours at 16°C registered higher firmness (7.68N), higher ascorbic acid content (23.42 mg g⁻¹) and total antioxidant activity (69.01%).

- 1-MCP application also resulted in delayed change of colour (chrome 'b' value: 32.3), greater peel thickness (4.71 mm), lesser physiological loss in weight (25 %) and reduced Pectin Methyl Esterase activity (7.83 meq of COOH g⁻¹min⁻¹).
- The shelf life of mango fruit was enhanced to 15 days by 1-MCP treatment while the control fruit had a shelf life of only 10 days under cold storage conditions (16°C).

NEW RESEARCH INITIATIVES

Rice

- Enhancing the grain filling rate in rice in the monsoon season
- Screening short duration rice genotypes for high grain Zn enrichment through mineral Zn fertilization

Greengram

- Best management practices for greengram under irrigated condition

Groundnut

- Integrated best management practices for enhancing the productivity of irrigated groundnut

Sesame

- Foliar nutrition for yield maximization in sesame

SUSTAINABLE ORGANIC AGRICULTURE

- For irrigated organic samai, application of FYM @ 12.5 tonnes / ha + EFYM @ 1 ton/ha + foliar spraying of Panchagavya @ 3 % twice (Pre and post flowering stages) is the best nutrient management practice to get higher grain yield (1.5 t /ha) with net income (Rs. 15,438/-) and B:C ratio (2.01).
- For rainfed organic horsegram, application of EFYM @ 1 ton/ha + foliar spraying of Panchagavya @ 3 % twice (Pre and post flowering stages) is the best nutrient management practice to get higher grain yield 960 kg ha⁻¹), net income (Rs. 14650/) and B:C ratio(2.29).
- Bengalgram under rainfed conditions, integrating the farmer's practice (12.5 t/ha) along with improved package of practices (EFYM @ 1 ton/ha and foliar spraying of Panchagavya @ 3 % twice at pre and post flowering stages) recorded the highest grain yield of 805 kg/ha, net income (Rs.18325 /-) and B:C ratio (1.71).

- Integrated use of organic (75%) and inorganic (25%) sources of nutrients in Green manure (daincha) – beetroot – maize cropping system recorded the highest cotton on an average yield of 7.3t ha⁻¹
- Organic rice culture CB 05022 registered higher grain yield 4.8 t ha⁻¹ followed by Mappillai samba 4.7 t ha⁻¹ and COR48 4.3 t ha⁻¹. Among the medicinal rice varieties both Jeeragasamba (3.0 t ha⁻¹) and red kuruvai (2.8 t ha⁻¹) produced comparable yields.
- Application of vermicompost in green manure incorporated field produced 31% more rice grain yield (3.75 t/ha) as compared to no green manure incorporation (2.5 t/ha).
- Application of 100% N through vermicompost + foliar application of Panchagavya @ 3% +3G extract recorded higher growth and yield parameters in Snake gourd with higher drymatter production, fruit weight, number of fruits/plant having higher B:C ratio of 4.1.
- Basal application of EFYM + Panchagavya @ 3 % + 3G Extract spray recorded higher yield(3250 kg/ha) with low incidence of cucurbit fruit fly (*Bactocera cucurbitae*) in bitter gourd
- In brinjal,application of corn flour @ 1 t ha⁻¹ followed by one hand weeding recorded lowered weed density of 17.82 No./m², weed dry weight of 24.30 gm⁻² with an increased yield of 32.9 q ha⁻¹

NEW RESEARCH INITIATIVES

Organic Inputs and Bio Inputs Characterization For Sustainable Organic Agriculture.

NATURAL RESOURCE MANAGEMENT

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Delineation and reassessment of secondary and micronutrient status in the soils of Tamil Nadu

- Totally 22 districts of Tamil Nadu has been delineated and re-assessed for micronutrient status in the soils (36,695 samples) and the results showed predominant deficiency of Zn (63.1 per cent) followed by Cu (30 per cent), Boron (18.7 per cent), Fe (10.5 per cent) and Mn (5.70 per cent).
- A comparative analysis on the emerging micronutrient deficiencies indicated a slight increase in average Zn deficiency (58.0 to 63.1 per cent) and a steep increase in Cu deficiency (6.0 to 30.0 per cent). There was a reduction in Fe and Mn status of the soils though it was very specific to few blocks in the districts.
- Fourteen districts have been delineated for various secondary nutrients viz., Ca, Mg, and S (23,237 samples) and the per cent deficiency varied from 1.92 to 55.40 per cent for Ca with the average of 24.3 per cent. Magnesium deficiency ranged between 1.33 to 64.50 per cent with an average of 19.20 per cent and sulphur deficiency ranged from 0.0 to 19.6 per cent with an average of 9.9 per cent.

Elements	Per cent sample deficiencies			
	1980-2006		2006- 2016	
	Range	Mean	Range	Mean
Zinc (Zn)	14.1-78.0	55.1	29.5 - 90.4	63.1
Iron (Fe)	0-39.0	17.1	0.30 - 49.9	11.4
Manganese (Mn)	0-19.0	6.3	0.10 – 34.0	6.0
Copper (Cu)	1.5-9.0	5.4	4.50 - 59.3	30.1
Boron (B)	16.0-66.0	7.7	0.00 - 42.5	18.8
Sulphur (S)	9.0-38.0	3.5	0.10 - 19.6	9.9
Calcium (Ca)	-	-	4.92 - 55.4	24.3
Magnesium (Mg)	-	-	3.31 - 64.5	19.2

Scenario of micro and secondary nutrient deficiencies in soils of Tamil Nadu

Soil Test Crop Response (STLR) Correlation Studies through IPNS for Glory Lily

- The fertilizer prescription equations developed for glory lily under IPNS in Palaviduthi series (red non calcareous soils), were validated with 6 test verification trials in Dindigul District and the following are the salient findings.
- The per cent achievement of the targeted yield was more than 90 per cent with STCR and STCR-IPNS treatment (6.5 q ha^{-1} during first year and 7.5 q ha^{-1} during second and third years) for proving the validity of the equations

developed for glory lily on Palaviduthi series (red non calcareous) (TypicRhodustalf).

- Application of FYM @ 12.5 t ha⁻¹ along with inorganic fertilizers based on STCR – IPNS test values recorded higher seed yield target of 6.5 q ha⁻¹ in the first year and 7.5 q ha⁻¹ in second and third year of cropping. The mean increase in seed yield due to STCR-IPNS(-6.5 q ha⁻¹) over blanket and farmer's practice was 34.9 and 43.1 per cent respectively. The increase in seed yield due to STCR-IPNS-(7.5 q ha⁻¹) over blanket and farmer's practice was 48.4 and 59.1 per cent and 45.0 and 61.1 per cent respectively during second and third year of cropping.

Bioremediation of degraded calcareous Sodic and Saline-Sodic soils

- Maize and Sunflower in calcareous sodic soils, Ragi and Maize in calcareous saline-sodic soils were having higher phyto-reclamation and native calcite dissolution potentials(25-30 per cent)
- *Bravibacterium halotolerans* in sodic soil and *Bacillus subtilis* in saline-sodic soils are identified as bio-inoculants for reclaiming the calcareous sodic and saline-sodic soils due to their improved soil reclamation potential and crop yield enhancement by 10 per cent.
- Application of either pressmud at 100 per cent Gypsum Requirement (GR) or elemental sulphur at 50 per cent GR were found equally effective as that of gypsum in reducing soil pH, exchangeable sodium and Exchangeable Sodium Percentage in both the soils.
- Better reclamation of saline-sodic and sodic soil were achieved by the integrated use of amendments (either gypsum+ pressmud at 100 per cent GR / Elemental sulphur + pressmud at 100 per cent GR), crops (maize and ragi) and with identified microbes.

AGRICULTURAL MICROBIOLOGY

Liquid formulations of biofertilizers

In recent past, biofertilizers were prepared as carrier based formulations and lignite is the most widely used carrier material. The improper sterilization of carrier material and handling methods during the blending of bacteria with carrier serve as source of contaminations. Because of these, the carrier based inoculant could not hold desired biofertilizer organism for long time which reduced the shelf-life of the biofertilizers. Further, the quality of the biofertilizer gets deteriorated. Because of these



reasons, biofertilizer application is not able to give consistent results in the fields. To avoid these constraints and to increase the quality and shelf-life of bio inoculants, liquid formulation of biofertilizer was developed. Liquid inoculants are available in broth culture in which the cells are suspended in a buffer with suitable cell

protectants. The protectants as additive in liquid formulations serve to overcome heat transfer, water retention property, absorption of bacterial toxins and protect enzyme system.

Method of application: Seed treatment – 500 ml each *Azospirillum* and Phosphobacteria per ha seeds; Seedling dip – 500 ml each *Azospirillum* and Phosphobacteria per ha seedlings; Soil application - 500 ml each *Azospirillum* and Phosphobacteria per ha seedlings; Tree crops – 100 ml each *Azospirillum* and Phosphobacteria per tree once in six months.

Biofertiligation: One ml per lit of water mix in the fertigation tank (Capacity: 60 lit) thrice at 30 days interval.

Pink-Pigmented Facultative Methylophils (PPFM) for mitigating drought

Methylobacteria are ubiquitous in nature and have been detected in soil, dust, freshwater, lake sediments, on leaf surfaces and nodules, air, hospital environments, as well as on other solid surfaces. They are aerobic, gram-negative bacteria and although they are able to grow on a wide range of multi-carbon substrates, they are characterized by the capability to grow on one carbon compounds such as formate, formaldehyde, methylamine and C_2 , C_3 , and C_4 compounds including the methanol emitted by the stomata of plants as the sole carbon and energy source. *Methylobacterium* is a facultative methylophil, meaning it has the ability to grow by reducing carbon compounds with one or more carbon atoms but no carbon-carbon bonds. Because of their distinctive pink pigmentation, they are also referred as PPFMs (pink-pigmented facultative methylophils). These PPFMs are especially abundant on leaves of field-grown crops averaged about 10^6 cfu of PPFMs per leaflet, and typically >80 per cent of the viable bacteria recovered from leaves were PPFMs.



- *Methylobacterium* strains have been localized as endosymbionts within plant cells. However, in some plants species, phyllosphere colonization also occurred via seeds. In addition to their ability to colonize the phyllosphere, members of *Methylobacterium* were also able to colonize the rhizosphere of plant species. Spraying on the aerial parts of plant, bacterial cells were localized in the grooves between the leaf epidermal cells which may give them protection and access to methanol.
- Method of application: Spraying of PPFM at 500 ml/ha with 500 litres of water thrice at active growth stage of crops with 15 days interval.

Multifunctional *Burkholderia* spp. for Groundnut

- Two species of *Burkholderia* viz., *B. vietnamensis* and *B.thailandensis* were obtained from rhizosphere soil. They were capable of Phosphate solubilization, possessed antagonistic property against *Macrophomina phaseolina* and *Rhizoctonia solani* and nitrogen fixation.
- *Burkholderia* species obtained were compatible with *Bacillus megaterium*, *Rhizobium* and Sulphur oxidizing bacterium
- Field experiments conducted at two different locations revealed that seed treatment of groundnut with soil bacterial consortium @1Kg/ha along with soil application @5Kg/ha on 45 DAS enhanced the nodulation, nodule dry weight, pod yield, 100 Kernel weight and registered the highest B:C ratio.

NEW RESEARCH INITIATIVES

- Development of stage-specific inoculants to improve the inoculant-derived benefits to the crops
- Development of Zinc solubilizing bacteria
- Development of DNA markers for fixing quality standards of biofertilizers
- Development of Seed Coating / Pelletization methods for microbial inoculants

ENVIRONMENTAL SCIENCES

Rhizoremediation of micropollutants (antimicrobials, pharmaceuticals and metals) in sewage contaminated soils

A study has been conducted to assess the pollution potential of sewage irrigation at Ukkadam, Coimbatore area. Greens samples and soil samples were collected from sewage irrigated areas of these regions and analyzed. From this, it was found that *Amaranthus dubius* (Araikeerai) contain high Chromium (Cr), *Amaranthus caudatus* (Thandukeerai) contain high Nickel (Ni) and *Trigonella foenum* (Vendhayakeerai) contain high Cadmium (Cd). All the metal concentrations were above the permissible limits of 1.5 mg/ kg. Apart from heavy metals, all greens and the soil are contaminated with pharmaceutical compounds and organic pollutants. They contain pharmaceuticals (Imidazoles and Cosanols), Hazardous Volatile Organics (Decene and Decanols), Antibacterials (Naphthalenedione) and Steroids (Stigmastanol, Cholestanol).

Post biomethanated distillery spentwash for soil and plant nutrition

- The possibility of using post biomethanated distillery spentwash as foliar spray was assessed by analyzing its biochemical constituents by GC-MS. The results showed that the PMDSW contains antimicrobial agents like 9,12,15-Octa deca tri enoic acid, Hexadecanoic acid, 1-Dodecanethiol, Octa methyl cyclo tetra silaxane and octadecane and anti-oxidants like Butylated hydroxyl toluene.

- The Post biomethanated Distillery Spentwash (PMDSW) is being applied to soil @ 100 KL per ha. per year as per the recommendation. A survey was conducted to identify the fields with two, three and five times PMDSW application. The soil organic matter status was assessed as influenced by the application of spentwash. The total organic carbon was found to increase in all the soil samples with two, three and five times PMDSW application. The per cent increase in organic carbon content of spentwash applied soils was compared with their respective control. The enhancement of organic carbon content was in the range of 1.67 to 12.61 per cent (two times), 2.25 to 25.90 per cent (three times) and 4.27 to 28.74 per cent (five times applied).

Effect of biomethanated spent wash on Lucerne as pre sown application

Field investigation was carried out to study the effect of Biomethanated spent wash application on Lucerne. The quantum of spent wash was applied for the nitrogen and potassium requirement @ 20KL/acre. Phosphorous was applied @ 120 kg/ha. The control field was maintained with recommended dose of fertilizer on 25:120:40 kg/ha. The field trail results revealed that there was an increase in Lucerne yield by 16%. The maximum Lucerne yield of 102 t/ ha was recorded in spent wash applied field, where as the yield was 88 t/ha under recommended dose of fertilizers. The crude protein content in the Lucerne grown in spent wash applied field was 22.2%, the crude fat content was 2.45%. The pre sown application of biomethanated spent wash application improved the quantity and quality of Lucerene.

Refuse derived fuel from municipal solid waste rejects

Municipal solid waste rejects (paper, plastics with exception of Polyvinyl chloride, textiles) were collected from municipal solid waste rejects and added with 20% saw dust to prepare Refuse Derived Fuel (RDF). Refuse derived fuel are good energy source for furnace in the place of coal. The physical properties of RDF showed that, it has the density of 1 kg cm^{-3} , moisture content was 8 % wt, ash content was 2.8% wt, and volatile mater had mean value of 83.1 % wt. The Calorific value was $6474.9 \text{ kcal kg}^{-1}$. The municipal solid waste rejects will be used as good energy source for furnaces.

Cocoa Intercropping in Coconut

A study was undertaken to evaluate the environmental impact of cocoa cultivation as an intercrop in coconut in comparison with coconut monoculture plantations besides understanding in influence of climatic variables on cocoa productivity. The health of soil in cocoa intercropped plantations was found to be improved in terms of nutrient status and enhanced soil carbon stock compared to coconut monoculture plantations. The average quantity of leaf litter accumulation ranged from 3 to 7.5 tonnes per ha per year in 2 to 10 years old cocoa plantations respectively. The total biomass carbon accumulated in the ten year old cocoa plantation was 4.39 t/ha indicating the fixation of 16.1 tonnes of carbon dioxide. Soil organic content increased with the age of cocoa intercropped coconut soils to a range of

22.24 to 24.72 per cent. The cocoa leaf litter is estimated to supply N, P, and K to a range of 80 to 160.3, 4.7 to 9.4 and 42.1 to 84.4 kg ha⁻¹, respectively in a year under one hectare of cocoa plantation. The increase in the soil available nitrogen, phosphorus and potassium ranged from 10.45 to 22.12, 10.76 to 21.92 and 4.21 to 7.55 per cent respectively over coconut monoculture plantations. The studies on the socio-economic impact of cocoa on the livelihood of farmers revealed that cocoa as an intercrop provides an additional income to the tune of Rs. 75,000 to 82,000 per hectare.

Assessment of heavy metal pollution in Coimbatore urban environment

A field survey and investigation were carried out in Coimbatore urban areas for soil and water pollution where large number of industries like textile, electroplating and foundries are located. Among all the heavy metals, Pb was found to be maximum in the Coimbatore urban environment, whose concentration in soils ranged between 24 and 356 mg kg⁻¹. In many places the Pb concentration was found exceeded the permissible limit of 100 mg kg⁻¹. In Tank waters the Pb concentration varied from 0.9 to 3.0 mg L⁻¹ which exceeded the maximum permissible limit (0.05 mg L⁻¹) prescribed for drinking water and the waters were found not fit for human and animal consumption. However, the concentrations were well within the permissible limit (5 mg L⁻¹) prescribed for irrigation water.

Reed bed system

The pollutant removal efficiency of the reed bed system was found to be 50% (BOD), 42.9% (COD), 40.3% (TDS), 50.8 % (TSS), 50% (Chromium and Nickel) during the early growth stage of aquatic plants like cattail (*Typha angustifolia*) and Signal grass (*Brachiaria humidicola*)

Salt tolerant species

Establishment of *Sesuvium portulacastrum* in dye and textile effluent contaminated soils (Andipalayam, Mangalam and Palayakottai villages) of Tirupur District was observed and the growth of the plant was good in contaminated soil. The electrical conductivity and sodium content were decreased in *Sesuvium* grown soil enriched with different concentrations of Na. There was 77.8% of Sodium removed from the soil. Among the four strains isolated APS1 showed highest growth in all the four concentration of NaCl and also exhibited increased salt removal capacity in the *in vitro* salt tolerance screening test. The Strain OPS2 has all the PGPR activities viz., IAA production, siderophore production and phosphate solubilization. The experimental results revealed that these bacterial strains having salt tolerant potential and also PGPR activities so this can be effectively utilized as a bioinoculant for better crop growth in the salt affected soils.

Development and evaluation of organic fertilizer product from poultry waste

- Two organic fertilizers viz., Phospho-Fertilizer granules (by blending poultry manure and rock phosphate (3%)) and Sulpho-Fertilizer granules (by blending poultry manure, rock phosphate (3%) and S° (2%)) were developed. Performance of Sulpho-Fertilizer was found better on tomato crop due to its affinity towards P and S nutrition. The uptake of N, P and K was found increased by 53.5, 36 and 43.5 percents, respectively, due to the Sulpho-Fertilizer than the NPK (chemical) fertilizers.
- Pot culture study was conducted with soil collected from Andipalayam village to assess the role of bioamendments and bioinoculants in enhancing the salt removal capacity of *Sesuvium portulacastrum*. Highest biomass production (600 g pot⁻¹) and salt removal (75%) was observed in the treatment that received vermicompost (@5t ha⁻¹) and salt tolerant plant growth promoting bacteria at 90 days after planting.
- An experiment was conducted at Amaravathy sugars factory and the maximum pod yield of 3,900 kg/ha, dry matter production of 12,728 kg ha⁻¹, crude fibre content(2.63%) and crude protein content (3.90%) were obtained in the treatment that received Post Methylated Distillery SpentWash @ 20.83kL⁻¹ha⁻¹ in case of cluster bean crop.
- Based on the experiment conducted at Bannari Amman sugars factory, application of biomethanated distillery spentwash @ 50 KL ha⁻¹ (T3) recorded the highest yield (46 t ha⁻¹) of Elephant foot yam (Gajendra)
- Available N and K status of soil was improved due to onetime controlled application of distillery spentwash to agricultural fields
pH and EC of both soil and water and other parameters such as ESP of the soil, TDS and nitrate of the ground water were within the critical limit
- As per the results of the experiment conducted at Seshasayee paper and Boards factory, Treated SPB effluent could be used for raising beet root crop. The variety Madur, when irrigated with treated effluent along with 75% RDF and 10 tons of Press mud recorded higher yield (23 tons ha⁻¹), as compared with that of well water (22.64 ha⁻¹).
- The quality attributes of beetroot viz; total soluble salts, total sugars, reducing sugars, carotene, lycopene, ascorbic acid were higher in 75% RDF and 10 tons press mud applied treatment as compared to similar treatment under well water irrigation.
- In chilly, effluent irrigation along with application of 75% RDF + 25% Pressmud compost + MLSS *Pseudomonas* has resulted in 13% higher growth compared to well water that received similar inputs. However, as compared to control, effluent irrigation resulted in 27.2% higher yield.
- The fruit weight of chilli also increased by 10.64% under effluent irrigation along with 75% RDF + 25% Pressmud compost + MLSS *Pseudomonas* as compared to similar well water irrigation.
- Brinjal can be grown using treated effluent with % RDF + 12.5% Pressmud compost and 12.5% MLSS. The yield of 30.8 t ha⁻¹ was 8% high compared to that of well water irrigation.

- The Tamil Nadu Newsprint and Papers Limited (TNPL) experiment revealed that the soils of TNPL Effluent Water Lift Irrigation Society (TEWLIS) area were found to be trending towards sodicity on continuous irrigation of treated effluent.
- The SSP and SAR of ground water samples of TEWLIS area were increasing on continuous irrigation of treated effluent.
- The drainage water was found to have high soluble salt content especially sodium compared to effluent water.
- TEWLIS area is dominated by coconut crop with (75%) followed by fodder grass (22.13%), Sugarcane (1.51%), fodder sorghum(0.70%).
- A new potting medium has been developed from different organic material, which is more suitable for terrace gardening being practiced in urban centers. The new potting medium has been named as “Nutrimix”. It is a light weight medium which has superior physical and chemical characters when compared to normal potting medium. Different vegetable crops were raised in this medium under terrace condition along with regular potting medium available in the market and the crops grown in Nutrimix recorded the maximum yield and higher quality parameters when compared to conventional medium. The other interesting feature is no additional nutrients are required for succeeding crop raised in the same Growbag and more moisture is conserved in the Nutrimix.
- Potassium was recovered from biometanated spent wash. The salt contains 30% Potassium in addition other nutrients. The recovered Potassium was evaluated under pot culture condition for substituting Potassium.

NEW RESEARCH INITIATIVES

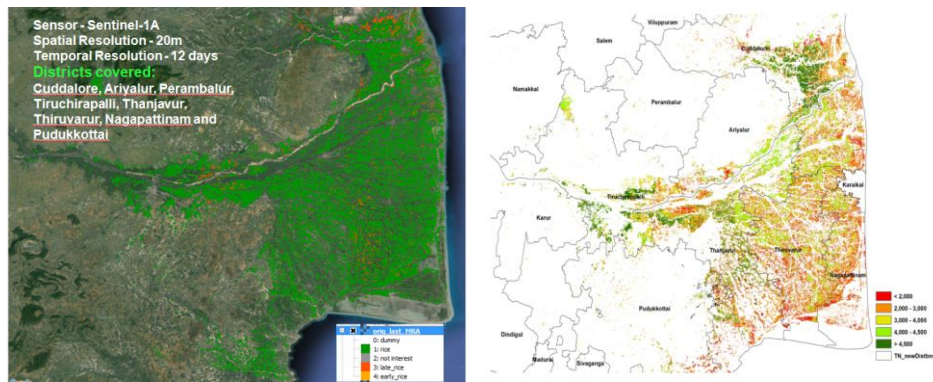
- Research work on preparation of nutrient rich flakes using spent wash and pressmud is initiated.
- Judicious use of treated paper mill wastewater after removal of recalcitrant organics by advanced oxidation processes (AOPs) for sustainable crop production (2015-16)”
- Green chemistry initiatives in molasses based Distillery and Pulp & Paper Industries.
- Remediation and Restoration of Historic Noyyal River, TamilNadu

DEPARTMENT OF REMOTE SENSING AND GIS

RIICE Technology for Remote Sensing Based Crop Monitoring and Yield Estimation

With latest advances in remote sensing and crop yield modeling, it is now possible to provide precise information on crop acreage, crop health, yields, damages and losses during floods and drought. Various maps viz. area map, seasonality map, seasonal map and phenology map were developed using Multi-year and seasonal Synthetic Aperture Radar (SAR) data viz., CosmoSkymed, TerraSAR-X and RISAT. The crop growth simulation model ORYZA was used to estimate yield involving remote sensing products in addition to the usual meteorological, soil, and

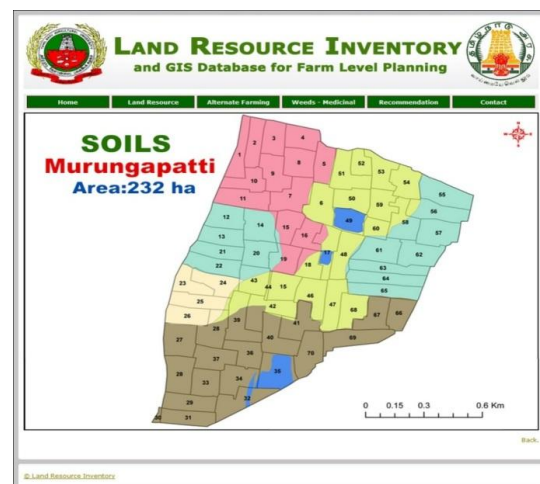
plant parameters. Early estimation of the yield by Remote Sensing Based Crop Monitoring is expected to facilitate the policy makers in the event of natural calamities without waiting for the data on Crop Cutting Experiments (CCEs).



Samba Rice area and yield map 2015-16

Web Based Fertilizer Recommendation System Using Cadastral Level Soil Maps

Detailed soil survey was made for more than 1,10,000 acres of entire Rasipuram, Valapadi and Veerapandi blocks soil for a period of three years. Based on various parameters obtained from the soil survey data, web based software was developed for fertilizer recommendation to the respective fields. A farmer by knowing his survey number in the mapping unit and can click on his survey number, the software will display the erosion detail of the survey number, colour, depth, pH, calcareousness details



and available macro and micro nutrient status of particular survey number of the farmer. It also shows the list of highly suitable crops, moderately and marginally suitable crops of the particular survey number. From the list farmer can select the crop and the details of area of cultivation is to be entered through the interface. The software will provide fertilizer recommendation for the selected crop. The fertilizer recommendation is based on its soil available nutrients status. It also explores the problem, viz., soil reclamation, soil conservation, and if the soils are problem in nature and the software also provides details about suitable crops for saline, alkaline and calcareous soil. This application is now available in all the primary Agriculture Co-operative Societies, Agricultural Extension centers of concerned three blocks and through the url: <https://sites.google.com/a/tnau.ac.in/rsgis/maps>.

NANO-SCIENCE AND TECHNOLOGY

- The Enhanced Freshness Formulation (EFF) technology has been released for adoption as a fruit preservative. Pre-harvest spray of 2% EFF twice (15 and 30 days before harvest) reduced the post-harvest losses by 10-15% in major varieties of mango. Fruits harvested from the sprayed trees had an extended shelf-life of 2-3 weeks under storage conditions besides retention of fruits on trees by another three weeks. Due to the delayed harvest and extended shelf-life, this technology helps the farmers to gain a lucrative price in the market due to the late arrival.
- The post-harvest dipping of fruits (mango and banana) and vegetables (cucumber and tomato) in 2% EFF extended shelf-life by 12-18 days under ambient storage conditions.
- Electrospun nano-fibre matrix fortified with hexanal (Sticker) and β cyclodextrin inclusion complex (Sachet) have been developed to minimize the post-harvest fruit damage during transport. The cost of technology hardly exceeds Rs. 5 per piece to protect the fruit box carrying 2-3 kgs.

NEW RESEARCH INITIATIVES

- Nano-packaging is being developed by fortifying biomolecules in the nano-fibre or metal organic frameworks
- Nano-capsules carrying macro and micronutrients are being tested for smart delivery of nutrients and balanced crop nutrition
- Electrospun nano-fibre loaded with hormones (IAA & GA₃) to enable seed invigoration
- Bi-walled encapsulation of herbicide to effectively control a parasitic weed (*Striga*) in sugarcane
- Encapsulation of Bt to manage pulses pod borer
- Computational screening of terpenoids (*Annosquamosin* derived from the seeds of custard apple) against cauliflower mosaic virus (CaMV) transmitting *Myzus persicae* stylet's cuticular protein (MpsCup)
- Standardized protocol for aqueous extraction and spray drying of *Cissus quadrangularis* extract that can be used for developing anti-microbial nano-films as edible coatings
- Sericine protein has been extracted from silkworm cocoon wastes and used successfully as an encapsulant for bioinoculants (eg. *Pseudomonas*).

CENTRE FOR PLANT PROTECTION STUDIES

AGRICULTURAL ENTOMOLOGY

Insect Biosystematics

- During 2015-16, insects and mites have been collected from ten districts of Tamil Nadu, curated and documented, which includes Lepidoptera (3955), Coleoptera (1988), Hemiptera (294), Hymenoptera (238), Trichoptera (352), Orthoptera (186), Odonata (93), Neuroptera (76) and Acari (15).
- Taxonomic studies were undertaken for Erebidae: Arctiinae (5 nos.), Noctuidae (1 no.), Limacodidae (1 no.) and Nolidae (1 no.) and Lycaenidae (12 nos).
- Development of bioinformatic tools/ inventories of insect biodiversity associated with major cropping systems on Erebidae : Lymantriinae (220 species), Cicadidae (100 species), Limacodidae (92 species) and Mantidae of Tamil Nadu (60 species) were completed.
- Visuals (around 500 nos.) of insects and their damage symptoms were collected and documented from different parts of Tamil Nadu.
- During 2016-17, insect survey and collection undertaken in 10 districts and Lepidoptera was predominant in all the places.
- Taxonomic studies of Lepidoptera undertaken for 25 species under the families of Erebidae, Noctuidae, Crambidae and Pieridae.
- Checklisting of Indian Crambidae and Eupterotidae completed.
- Visuals of insects around 150 documented.
- Post graduate students of the Department were imparted hands on training on insect Taxonomy under Dr.Kumar Ghorpade and Dr.V.V.Ramamurthy.

Biological control

- Egg parasitoid, *Telenomus* sp. is continued to be predominant on rice stem borer.
- Field experiments carried out against onion, chilli and tomato thrips with Bb 112 isolate of *Beauveria bassiana* at 10^8 spores ml^{-1} could cause the highest cumulative per cent reduction of thrips next to imidacloprid.
- Biological suppression of budworm (*Hendecasis* sp) and blossom midge (*Contarinia* sp.) in jasmine - Six releases of *Trichogramma chilonis* (1 lakh /ha) at 15 days interval from the bud initiation along with three sprays of *Beauveria bassiana* (5g/l) at 10 days interval resulted in 80.3 per cent reduction of bud worm damage and 65.2 per cent reduction of blossom midge damage. This treatment was superior to carbofuran application at 20g/plant.
- Bio-intensive IPM module against major pests of curryleaf - Using the egg parasitoid *Trichogramma chilonis* (1 lakh /ha) and larval parasitoid *Goniozus nephantidis* as inoculative release (250 adults /ha) and *Chrysoperla* 10000 eggs /ha effectively reduced the population of leaf roller (81.7 percent) and

psyllid (75.3 per cent) as compared to farmer's practice with two insecticide sprays with respective population reduction of 51.6 and 60.4 per cent against the leaf roller and psyllid.

Chemical control

Bioefficacy of the insecticides undertaken at this department and their effective performance against the target pests are furnished below.

S. No	Insecticides tested	Crop and Dose	Target pests
1	Cypermethrin 5% + ethion 40%	Chilli @1500ml/ha (75.0+600 g a.i./ha)	Mites, thrips, and fruit borer
2	Flubendiamide 20WG	Sugarcane @50 - 75 g a.i./ha	Early shoot borer
3	Flubendiamide 24% + thiacloprid 24%	Blackgram @60+60 g.a.i/ha Rice@60+60 g.a.i/ha	Pod borer, whiteflies, leaf hoppers and thrips in blackgram, stem borer, Leaf folder, thrips, earhead bug and gall midge
		Cardamom@7.2+7.2 g.a.i/ha	Shoot borer and thrips
		Brinjal @84+84 g.a.i/ha	Shoot and fruit borer, aphids, leaf hoppers and thrips in brinjal
4	Fenpyroximate 5% EC	Cotton@ 37.5 g a.i./ ha	Leaf hopper and mite
5	Buprofezin 70%DF	Rice@ 175 g a.i. ha ⁻¹	Brown Planthopper
6	Imidacloprid 17.8% SL	Cotton @50g.a.i/ha	Aphids, whiteflies, leaf hoppers and thrips in chilli, aphids, whiteflies, leaf hoppers and thrips
		Rice @60 g.a.i/ha	Plant and leaf hoppers
		Tomato @80g.a.i/ha	Whiteflies
		Grapes @80g.a.i/ha	Flea beetle
7	Imidacloprid 600 FS	Groundnut@1.2g.a.i/kg seed	Termites, leaf hoppers, thrips and aphids
8	Fipronil 200 SC	Chilli@50 g.a.i/ha	Fruit borer, thrips and aphids
9	Betacyfluthrin 9% + imidacloprid 21%	Cotton @18+42 g.a.i/ha	Whiteflies, mirids and leaf hoppers
		Citrus @ 0.63+1.47g.a.i / 10 lit water	Whiteflies, scales, psylla and leaf miner
10	Thiacloprid 240 SC	Pomegranate@0.36 g.a.i/lit water	Thrips

11	Spirotetramat 15% OD	Cotton@105 g.a.i/ha	Aphids, whiteflies, mites and thrips
		Grapes @105 g.a.i/ha	Mealybugs and mites
		Citrus@0.9g.a.i/10 lit water	Mites, scales, whiteflies and psylla
12	Flupyradifurone 200 SL	Brinjal@175 g.a.i	Whiteflies and leaf hoppers
13	Carbosulfan 25EC	Cotton@ 375 g.a.i	Aphids and thrips
		Brinjal@ 375 g.a.i	Shoot and fruit borer

Botanicals

- Sweet flag 20EC as petroleum ether extract effected 100 per cent mortality of pulse beetle while hexane extract (94.44 %) also produced similar effect on second day after treatment at 3 per cent concentration under filter paper impregnation method.
- Sweet flag 6 EC possessed anti- feedant effect ranging from 45.77 to 62.41 per cent at different concentrations viz., 0.5, 1.0, 1.5 and 2.0 per cent against diamond back moth
- Hexane extract of sweet flag rhizome had maximum amount of β -asarone content (72.21%) than the other extracts

Integrated Pest Management

An Integrated Pest and Disease Management (IPDM) package for cotton is approved for adoption in Cotton in the Cotton Scientist Meet 2015 (Cotton). The technology includes Seed treatment with imidacloprid 70WS 10ml/kg, soil drenching of chlorpyrifos 20EC (1.25 lit/ha) on 25 DAS, soil drenching chlorpyrifos + foliar application of *Bacillus subtilis* (BSC5) 0.1% (10g/ lit) on 30, 60, 120 DAS, yellow sticky traps (12/ha), pheromone traps (Spodoptera) (12/ha), one round of imidacloprid 17.8 SL 100ml/ha 35DAS, one round of trifloxystrobin 25 (0.1%) & tebuconazole 50 WG (0.1%) and trap crop of castor and maize along bunds.

Pesticide Residue

- The initial deposit of quinalphos on tomato fruit was 0.79 mg/kg and reached below detectable level of 0.05 mg/kg within 7 days of spraying. The half-life worked out was 1.36 days.
- Residues of imidacloprid 17.8 SL, quinalphos 20EC, chlorpyrifos 20EC and triazophos 40 EC on bittergourd sprayed at recommended dose reached BDL within seven days after the second spray while the half-life worked out was 1.45, 1.40, 1.20 and 1.62 days respectively.
- Chilli field sprayed with lamdacyhalothrin 5EC and bifenthrin 10EC at recommended dose had detectable residues up to three days and the half life values were 1.94 and 1.01 days, respectively.
- In curry leaves, ethion 50EC was detected up to 20 days with a half life of 3.14 days while profenophos up to 30 days with a half life of 7.92 days.

- In cauliflower, chlorpyrifos 20EC persisted up to 10 days while triazophos 20 EC 15days, ethion 50 EC 25 days, quinalphos 25EC 10 days and carbendazim 50WP 10 days after spraying recommended dose possessing half life period of 2.79, 2.66, 4.18, 2.33 and 2.66 days, respectively.
- Decontamination studies in cauliflower showed that washing followed by cooking for 10 minutes was the most effective method to reduce the level of pesticides by more than 80 per cent.
- Decontamination of vegetables namely tomato, chilli, okra and brinjal sprayed with quinalphos, lamdacyhalothrin, chlorpyrifos, cypermethrin and ethion using veggiewash (provided by Kerala Agricultural University) showed that the efficacy of veggiewash was either on par with water or less.
- Out of 1280 market samples analysed, 399 (31.17%) samples contained detectable level of residues
- Two poly house and 73 farmgate vegetables had detectable level of residues
- None of the organic vegetables expressed detectable level of residues
- Maximum number of curry leaf samples possessed high level of insecticide residues followed by cardamom, red chilli and red chilli powder
- The MRL values (PFA/CODEX) exceeded in 36 market samples out of 1280 samples.
- During 2016-17, out of 967 samples analysed 210 samples showed detectable level of residues
- Samples with detectable residues include vegetables viz., chilli, capsicum and lab lab, fruits viz., grapes, spices viz., dry chilli, red chilli powder, cardamom and curry leaf.
- Residues of organophosphorous and synthetic pyrethroid insecticides were commonly detected.
- Cardamom showed the maximum number contaminated samples and high level of insecticide residues followed by curry leaf and red chilli powder.
- The MRL values (PFA/CODEX) exceeded in 34 samples.

Honeybees and Pollinators

- Field experiment with RCH 2 BG II cotton hybrid using nylon net cages revealed that *Apis cerana indica* confined treatment recorded maximum number of pollinators (3.68/ 5 flowers/ 10 min) followed by open pollinated treatment (3.22) and pollinator excluded plots (0.1). The seed cotton yield was 16.3 per cent higher in *A. cerana indica* pollinated plot of RCH 2 BG II followed by 15.2 per cent in open pollinated plots compared to pollinator exclusion plots.
- RT-PCR method was used to successfully detect AcSBV in infected Indian honey bee larvae, *A. cerana indica*

Acarology

- Eighty seven rice entries were screened for leaf mite, *Oligonychus oryzae* resistance both under field and glasshouse condition. Based on mean mite

population and leaf damage grade, PTB 33 was found to be resistant, ASD 16 was moderately resistant, ADT 43 was moderately susceptible and BPT 5204 was susceptible to rice leaf mite

- The highest population of 12.44 rice mites/ 10 cm in BPT 5204 and 4.33 mites/ 10 cm in PTB 33 at 40 DAT with the longest developmental period of 12.63 days of larva, protonymph, deutonymph and quiescent stage than the susceptible BPT 5204 (7.88 days) with higher fecundity(60.25 eggs/ female).
- Shortest pre-oviposition period and longest oviposition and post oviposition period was observed on the susceptible BPT 5204 of 0.88, 7.67 and 3.22 days, respectively while it was found to be 1.81, 5.40 and 2.09 days in resistant PTB 33.
- Trichome density and trichome length on upper and lower epidermis, leaf lamina and midrib thickness and leaf area were found to be negative and significantly correlated with mite population.
- During March, 2016, rice leaf mite incidence was 22-37 per cent in Villupuram and Cuddalore districts while at Aduthurai condition, CR1009 was highly susceptible during Oct-Nov.2016.
- Predator-prey ratio @1:10 was effective in controlling *Tetranychus urticae* population in bhendi to an extent of 55.05 per cent over control.
- Fenazaquin10 EC@ 2 ml was found to be effective in controlling all bio stages of the carnation two spotted mite.
- The species viz., *Tetranychus urticae* (KR870317), *Tetranychus macfarlanei* (KR870318), *Tetranychus turkestanii* (KR870319), *Tetranychus fijiensis* (KR870320) and *Oligonychus indicus* (KR870321) and *Oligonychus coffeae* (KR870322) have been submitted in NCBI with accession numbers.. Sequence submission process has been initiated for other species identified to be new and first records to India.

Storage Entomology

- A nationwide survey was carried out to assess the frequency of phosphine resistance in key stored grain insect pests.
- Frequency and distribution of phosphine resistance was measured using two discriminating doses viz., low and high concentrations of phosphine gas.
- The frequency of phosphine resistance have been confirmed through molecular genetic analysis
- Effective fumigation protocol was developed to reduce the phosphine resistance level
- Spatio-temporal activity of stored grain insect pests were measured at representative geographical locations
- Flight pattern of stored grain insect pests were recorded on in and around of storage structure
- Species specific microsatellite markers have been developed for *Sitophilus oryzae*
- Population genetic analysis was carried out and the rate of gene flow was recorded in key stored grain insect pests

- Indian National grain protection alliance was formed to deliver the output of the progress

Tamil Nadu Government Sponsored Schemes

- State Planning Commission, Govt. of Tamil Nadu sponsored Tamil Nadu Innovative Initiative Scheme entitled 'Large area impact demonstration of fruit flies trapping technology to minimize yield losses to horticulture farmers in Tamil Nadu' for three years (2015-18) with budget allocation of Rs. 245 lakhs.
- NADP – Strengthening of the Insect Museum sanctioned with budget allocation of Rs.110 lakhs.
- NADP - Implementation of food safety and quality Agri-Horti produces through NABL accredited laboratories with budget allocation of Rs. 600 lakhs.

PLANT PATHOLOGY

Rice

- During 2015-16, the false smut incidence was 16.50 and 15.0 per cent in the hybrid CORH 4 and the variety ADT 46 respectively at Bhavanisagar. At Needamangalam in Nagapattinam Dt., the variety CR 1009 sub 1 recorded the false smut incidence to the level of 18 per cent in the farmers field.
- The Bacterial leaf blight infection was recorded in most of the popularly grown paddy varieties like TRY 3, ADT 45, ADT 37, CO 43, and CO 50 which ranged from 5 to 48 per cent.
- During 2016-17, the false smut incidence was recorded in the varieties BPT 5204 and CO 43 in the farmers field at Gobichettipalayam in Erode District which ranged from 22 to 30 per cent and in ADT (R) 45 and CO 43 at Dharapuram in Tirupur District which ranged from 25-34 per cent. Few rice cultures from seed production plots at Guddalore in Ooty recorded the false smut incidence (35-40%) during the survey period. Application of endospore based bioformulation of *Bacillus* EBPBS4 through seed treatment (10ml/kg), seedling dip (500 ml/ha), soil application (1000ml/ha) along with foliar spray (500 ml/ha) reduced the incidence of sheath blight under field conditions (89 % reduction over control) and increased the yield.

Pearl Millet

- During 2015-16, the entries viz., HHB 197, GHB 732, Kaveri Super Boss, Pratap (MH 1642) and NBH 5767 were maintaining stability in downy mildew resistance.
- Seed treatment with anti-oomycetes fungicide Ametoctradin + Dimethomorph @ 0.4ml/500 ml of water recorded significantly lower downy mildew incidence of 3.18 per cent as against 7.81 per cent in control.

- During 2016-17, seed treatment with metalaxyl @ 6g/kg recorded a significantly lower downy mildew incidence (1.91 %) and higher grain (1298 kg/ha) and straw yield (2817 kg/ha).

Redgram

- During 2015-16, seed treatment with carbendazim + mancozeb @ 2.5 g/kg seed+ Soil application of *Trichoderma viride* @ 2.5 Kg in 500 kg FYM/ha was found to be effective in reducing the wilt in pigeonpea
- Two rounds of spraying with propargite @ 0.1% at 1st spray 25 and 2nd spray after 15 days of first spray recorded the lowest sterility mosaic disease incidence and highest disease reduction (84.3%).
- During 2016-17, a total of 80 AICRP entries were evaluated for their resistance against Sterility Mosaic Disease (SMD), root rot and leaf spot diseases. Among these, six entries viz., VRG 06-003, MA6, LRG 133-33, ICP 15084, ICP 15028 and IPA 9 F showed resistance to SMD, five entries viz., AKTE 12-02, MAL 13, IPA 16F, KPL 43 and KPL 44 exhibited resistance to root rot and eight entries viz., NTL 30, CRG 201-12, BDN 711, LRG 133-3, ICP 15084, ICP 15028, MA 6 and IPA 9F were resistant to leaf spot
- Out of 30 ICRIAT entries screened for their resistance against SMD, three entries viz., ICPWS 1617, ICPWS 1622 and ICP WS 1607 showed resistance to the disease
- Two rounds of spraying with fenpyroximate 5 EC @ 1st spray 25 DAS and 2nd spray after 15 days of first spray reduced the SMD incidence by 82.5 per cent
- High incidence of pigeonpea wilt was noticed in Vellore district and the severity of root rot and YMV was found to be more in Erode district. The highest incidence of SMD and leaf spot was recorded in Hosur of Krishnagiri district
- *Bacillus subtilis* strain CcB7 from pigeonpea rhizosphere was found effective against root rot and wilt pathogens *in vitro*.

Sunflower

- Seed priming with carbendazim @ 2g/kg + thiamethoxam @ 4 g/kg + foliar spray of propiconazole @ 0.1% + thiamethoxam @ 0.04% as soon as disease appears & 15 days later is effective for the management of important diseases (necrosis, leaf spot and powdery mildew).
- Seed treatment with *Pseudomonas fluorescens* (Pf1) @ 10g/kg seeds followed by spray of Hexaconazole @ 0.1% at 45 days and *Pseudomonas fluorescens* (Pf1) @ 1.0% at 60 DAS is effective for the management of *Alternaria* leaf spot.

Chrysanthemum

- Tomato spotted wilt virus was first reported from India on Chrysanthemum.
- The occurrence of western flower thrips, *Frankliniella occidentalis* was first reported from Tamil Nadu.
- The pathogens associated with leaf spot of chrysanthemum were caused by *Alternaria* spp. Comprising of *Alternaria alternata* (KX156941, KX156948,

KX156952, KX156954, KX156956, KU639594, KU668692), *A. longipes* (KX156939), *A. tenuissima* (KX156940, KX156944, KX156945, KX156946, KX156947, KX156951, KX156953, KU639595), *A. porri* (KX156943, KX156955), *A. arborescens* (KX156942), *A. solani* (KX156950), *Curvularialunata* (KU668693, KU668694) and *C. spicifera* (KU668695).

- Foliar application of liquid formulation of *B. subtilis* isolate BS4 at fortnightly intervals was highly effective in suppressing the *Alternaria* leaf blight under field conditions.
- Among the fungicides, Tebuconazole + Trifloxystrobin @ 0.1%, Flupyram + Tebuconazole @ 0.1% and Mancozeb @ 0.2% significantly reduced the disease incidence of *Alternaria*, *Curvularia* and mixed infection of *Alternaria* and *Curvularia* leaf blight of chrysanthemum under field conditions.

Medicinal Plants - *Gloriosa*

- In *Gloriosa superba*, spraying *Bacillus subtilis* 0.2% on 30 and 60 days after planting was effective in managing the leaf blight disease which recorded the lowest disease intensity of 17.9 per cent and maximum yield of 518.8 kg/ha.
- The root rot disease of *Gloriosa superba* was effectively managed by dipping tubers in *Bacillus subtilis* (0.2%) followed by drenching with *B. subtilis* (0.2%) on 30 days after planting with the lowest disease incidence of 14.8 per cent as against the highest root rot disease incidence of 26.4 per cent in the control.

Mushroom

- During 2015-16, survey seven milky mushroom isolates viz., CBE TNAU 1519, CBE TNAU 1520, CBE TNAU 1521, CBE TNAU 1522, CBE TNAU 1523, CBE TNAU 1524 and CBE TNAU 1525, and three new cultures representing *Ganoderma*, *Termitomyces* and *Pleurotus* species have been brought into pure culture. Twelve cultures have been deposited in the National repository at DMR, Solan, H.P.
- In the AVT1, out of the 8 strains of *Volvariella volvacea* evaluated for their performance, the strain Vv-15-06 was found to be significantly superior followed by VV-15-02. The strain Vv-15-06 gave an average yield of 17.01 kg of mushrooms / 100 kg of paddy straw on dry weight basis.
- In the evaluation trial on high yielding strains or varieties of oyster mushroom, PL-15- 03 gave significantly increased yield of 393.8 g / bed (300 g of paddy straw on dry weight basis) followed by strain PL-15-02 which gave an yield of 372.8 g / bed.
- During 2016-17, a total number of 5 wild edible mushrooms have been collected, which include 2 *Agaricus*, 2 *Calocybe* and One *Pleurotus* isolates.
- In the AVT 1 for paddystraw mushroom, out of 6 cultures VV 1602 alone produced fruiting bodies. A total yield of 1.325 kg per bed containing 6.5 kg of paddy straw was obtained.
- In AVT 1 for oyster mushroom, out of 4 cultures PL 1602 produced 875 g of mushroom per bed containing one kg of paddy straw substrate.

Chick pea

- Chickpea rhizospheric *Bacillus subtilis* strain CaB5 showed the highest growth inhibition of *Fusarium oxysporum* f. sp. *ciceris* and *Rhizoctonia bataticola* *in vitro*.
- The presence of lipopeptide antibiotic biosynthetic gene *viz.*, surfactin, iturin, fengycin and bacillomycin D and Quorum sensing genes *viz.*, ComQ, Com X, Com P and Com A, were detected both in CcB7 and CaB 5
- Talc based formulation of *B. subtilis* strain CaB5 was found to be effective in controlling the wilt and root rot diseases in chickpea under field condition.

Mung bean

- Seed treatment with *Streptomyces rameus* strain GgS 48 @ 10 g kg⁻¹ + basal application @ 2.5 kg ha⁻¹ reduced the mungbean root rot incidence by 61.91 per cent in the field.

Cotton

- In cotton, the Tobacco streak virus genome causing necrosis disease was completely sequenced.
- The involvement of parthenium pollen and thrips in transmission of Tobacco streak virus was confirmed, where the predominant population of *Scirtothrips dorsalis*, *Thrips palmi* in cotton were able to acquire TSV, but couldn't transmit the virus. But in the presence of TSV infected parthenium pollen, the thrips could be able to facilitate TSV transmission by feeding injuries.
- Studies on the impact of weather factors on the intensity of foliar and soil borne diseases starting from 45th week coinciding with rainfall in November, all the entries under study had infection moderately. The hybrid RCHBGII and varieties MCU13 and SVPR4 were moderately susceptible to *Alternaria* leaf blight (3.0 PDI). The cotton plants of hybrid RCHBGII was less susceptible to bacterial leaf blight as few plants were seen with the symptoms (2.0PDI). The hybrid RCHBGII was found to be susceptible to soil borne disease (root rot - 5.0%).
- Occurrence of viral diseases revealed that *Tobacco streak virus* disease incidence was not observed in all cotton growing tracts surveyed in Tamil Nadu. Generally, the incidence of TSV was found to be minimal in all the cotton growing tracts of Tamil Nadu. The incidence was maximum (10.0%) in Coimbatore and a very few places surveyed in Dindigul district showed minimal incidence of TSV.
- Serological assay by Direct Antigen Coating-Enzyme Linked Immuno Sorbent Assay (DAC-ELISA) revealed the presence of *Tobacco streak virus* (TSV), the causal agent of cotton necrosis in leaf, square, stem, root, petiole and pollen grains of both apparently healthy and infected samples of variety CO14. Similarly, the presence of TSV in different plant parts including root, stem, leaf, pollen grains and squares in both apparently healthy and diseased plants were confirmed through Reverse Transcriptase Polymerase Chain Reaction

(RT-PCR). All the samples collected from both apparently healthy and infected samples amplified the genomic product of ~929 bp pertaining to coat protein gene of TSV and thus confirmed the systemic nature of the virus. Since parthenium serves as a reservoir of TSV, attempts were also made to confirm the systemic nature of TSV in apparently healthy parthenium plants. DAC- ELISA and RT-PCR based detection tools confirmed the association of TSV in the apparently healthy leaf, stem and pollen grains.

- The phylogenetic analysis of TSV from different plant parts of apparently healthy cotton and parthenium had no variation among the TSV isolates.

Bhendi

- Nine bhendi entries *viz.*, 2012/OKYVRES-6 (1.8 %), 2012/OKYVRES-1(4.97 %), 2012/OKYVRES-2 (4.75 %), 2014/OKYV RES-5 (3.35 %), 2014/OKYV RES-9 (4.25 %), 2014/OKYV RES-10 (4.19 %), 2014/OKYV RES-11 (3.25 %), 2015/OKYV RES-3 (3.5 %) and 2015/OKYV RES-4 (4.5 %) were found to be resistant to Bhendi yellow vein mosaic virus when compared to Pusa sawani (75.6 %) and Arka Anamika (85.9 %).
- Bhendi Yellow vein mosaic resistant hybrid CO4 released during 2016.

Snake Gourd

- Foliar spraying of sodium bicarbonate (0.1%) with organic inputs (Basal application of EFYM @ 1 t/ha, foliar spraying of panchagavya @ 3% thrice at 60,90 and 120 days, foliar spraying of herbal leaf extract (5 leaf) @3% at 15,30th day as common practice) had lower incidence of downy mildew (5 PDI), wilt (less than 1%) and blight incidence.

Chow chow

- The new virus causing severe mosaic and enation in chow chow (Chayote) is identified as Chayote enation yellow mosaic virus (ChEYMV).
- The transmission of ChEYMV by the greenhouse whitefly, *Trialeurodes vaporariorum* was confirmed. Further, the seed transmission of Chayote enation yellow mosaic virus (ChEYMV) was confirmed by PCR and grow out tests. This is the fourth report of seed transmission of Begomovirus in the world.
- Tomato spotted wilt virus infecting chrysanthemum was completely characterized both by biological and molecular methods. The generation transfer of TSWV through stem cuttings was also confirmed.

Turmeric

- Forty five *Chaetomium* sp. were isolated from various locations of Tamil Nadu and characterized by cultural, morphological and molecular methods. *Chaetomium* isolate, TNAU Cg-6 displayed high antagonistic and mycoparasitic activity against *Pythium aphanidermatum*, synthesized antifungal antibiotics and possessed mycolytic genes *viz.*, chitinase (*Chi46* and *Chi56*) and glucanase, and cellulolytic

enzymes besides promoting plant growth. Application of liquid based formulation of *Chaetomium globosum* (TNAU-Cg6) as rhizome dip @ 10 ml/l for 10 minutes + soil drenching @ 10 ml/l during 1,3,5,7th month after planting effectively suppressed rhizome rot of turmeric (47 per cent reduction over control) under field conditions.

Lilium

- The pathogen associated with lilium leaf blight was confirmed as *Botrytis cinerea* through morphological and molecular tools. The sequences of the isolates have been deposited in the NCBI data base and assigned with the accession numbers including KU936079, KU936080, KU936081, KU936082, KU936083, KU936084, KU936085, KY490053, KY490054, KY490055, KY490056, KY490057, KY490058, KY490059 and KY490060.
- Genes associated with hyperparasitism including QID 74 protein, β -1,3 endo glucanase, serine threonine protein kinase, chitinase and check point like protein were identified during the hyper parasitic interaction of *B. cinerea* by *Trichoderma asperellum*, *T. asperelloides* and *T. harzianum*.
- Foliar application of picoxystrobin @1500 PPM at fortnightly intervals was effective in suppressing *Botrytis* blight to an extent of 70.3% over control with an average marketable stem yield of 43 stems/m² as against 23 stems/ m² over untreated control.
- Foliar application of *Bacillus amyloliquefaciens* strain (E2 and Ka1) @ 10⁸cfu/ml at fortnightly intervals recorded the minimum PDI of 10.86 as against 11.40 PDI in the untreated control with the average stem yield of 40 and 39 stems/ m² respectively as against 29 stems/m² in the untreated control.

Rose

- The pathogens causing blossom blight in hills was identified as *Botrytis cinerea* Pers. (KU528751, KU528752, KU528753, KU528754, KU528755, KU528756, KU528757, KU528758, KX025174, KX025175) and the pathogen in plains associated with leaf blight was identified as *Alternaria alternata* (Fr.) Keissl. (KX397348).
- Foliar application of *B. amyloliquefaciens* (VB2) @ 0.5% (5ml/litre) four times at weekly interval after symptom initiation was effective in reducing *Botrytis* blossom blight to an extent of 53 % over control.
- Foliar application of penflufen + tebuconazole 180 SC @ 0.1% (1ml/litre) four times at weekly interval after symptom initiation was effective in reducing *Botrytis* blossom blight to an extent of 64.59% over control.
- Foliar spray with propiconazole 13.9 % + difenoconazole 13.9 % @ 0.1% (1ml/litre) four times at 15 days interval after symptom initiation was effective in reducing blossom blight incited by *Alternaria alternata* to an extend of 75% over control.

NEW RESEARCH INITIATIVES

- Eco-friendly management of leaf blight disease of senna using bioagents was initiated.
- Screening *Gossypium barbadense* accessions for root and foliar diseases resistance and elucidating the mechanisms governing such resistance.
- Initiated research on vector transmission of plant viruses. Thrips and whitefly rearing facilities were established and TSWV transmission by *F.occidentalis* and CHEYMV transmission by whitefly *Bemisia tabaci* and *Trialeurodes vaporariorum*.
- Initiated research on assessing the occurrence and distribution of mycotoxins in rice
- Research work has been initiated to study the antagonistic potential of *Streptomyces* spp. against soil borne diseases of pulses.
- Efforts have been made to develop water soluble formulation of *Bacillus amyloliquefcians* for the management of soil borne diseases of cutflowers and Tobacco Streak Virus in cotton.
- New schemes have been proposed with EID parry to develop biocontrol agents for the management of Late Blight of potato and powdery mildew of grapes under public private partnership mode.
- Evaluation of artificial inoculation procedure of plant pathogens in the rice culture introgressed with blast and BLB disease resistant gene.
- Confirmation of critical growth stage of rice for infection and infective stage of false smut pathogen based on previous artificial inoculation studies.
- Monitoring of diseases under irrigated and direct sown rice.
- Studies on epidemiology of blast and false smut diseases.
- Identification of resistant sources through artificial inoculation studies.
- Management of postharvest decay of carrot through alternative strategies.

NEMATOLOGY

Root knot nematode in guava and pomegranate

- Root knot nematode in guava and pomegranate infestation was first reported from Tamil Nadu.
- Wide awareness was created across Tamil Nadu by conducting awareness campaigns and field melas, media coverage and using e-media.
- Soil application of *Pupureocillium lilacinum* or *Pochonia chlamydosporia* at 10 kg / ha in 100 kg FYM, moistened and applied once in a month for 3 months effectively managed root knot nematode in guava and pomegranate.



- Development of management strategies for wilt (*Fusarium oxysporum f. sp. ricini*) and reniform nematode *Rotylenchulus reniformis* in castor.
- *Pseudomonas fluorescens* Pf-1 as soil application @ 2.5 kg/ha was effective in the management of *Rotylenchulus reniformis* in castor var. YRCH-1 by giving 47.32% reduction in the soil population and 62.75% reduction in root population.

Management of root knot nematode *Meloidogyne hapla* in carrot (2016-17)

Application of *Purpureocillium lilacinum* as seed treatment @ 20g /kg of seed followed by soil application @ 2.5 kg/ha along with FYM @ 2.5 t/ha reduced the root knot nematode, *M.hapla* population in soil by 41.8% and root knot index by 38% and increased the carrot yield by 33.6%.

Venture Capital Scheme on bioagents (2016-17)

Two biocontrol fungi namely, *Purpureocillium lilacinum* and *Pochonia chlamydosporia* are commercially produced under venture capital scheme functioning at Department of Nematology, TNAU, Coimbatore and distributed to farmers of Coimbatore, Erode, Trichy and Dharmapuri districts to manage nematode problem in vegetables, polyhouses, tuberose and fruit crops like guava and pomegranate (totally 809 kgs during March to December 2016).

Guava tree var. L 49 at Karur showing revival symptoms after application of bioagent, *Purpureocillium lilacinum*



Pupureocillium lilacinum treated & untreated
tuberose plants



Carrots treated with bioagents devoid of
forking



NEW RESEARCH INITIATIVES

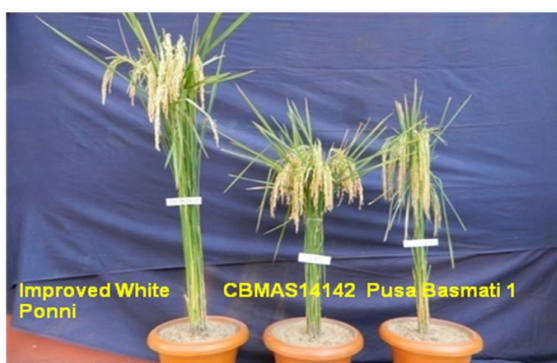
- Management of root knot nematode *Meloidogyne incognita* infesting tomato and cucumber under polyhouse conditions.
- Trials have been taken up in nematode infested polyhouses at Dharmapuri and Coimbatore districts to evaluate management of root knot nematode, *Meloidogyne incognita* in tomato and cucumber in polyhouse conditions under AICRP nematodes.
- Addressing the nematode problems in guava and pomegranate – disease complexes.
- Management trials have been laid in nematode-wilt sick farmers' field of guava and pomegranate at Dindigul and Coimbatore districts using bioagents viz., *Bacillus subtilis*, *Pseudomonas fluorescens*, *Trichoderma viride*, *Paecilomyces lilacinus* and their combination each @ 15 g/plant (cfu 2×10^6). Exploration of sources of resistant root stocks of guava and pomegranate and newer biomolecules to combat root knot nematode and fungal pathogen are undertaken through student works.
- Effect of AM fungi *Glomus intraradices*, *G.mossae*, *G.macrocarpum*, *Acaulospora levis* and *Gigaspora margarita*, against root knot nematodes.
- A university sub project has been undertaken to study the effect of AM fungi against *Meloidogyne incognita* in tomato and *Pratylenchus zeae* in maize.
- Ecofriendly approaches and newer molecules and biomanagement of rice root knot nematode *Meloidogyne graminicola* in paddy.

Field trials are being conducted to evaluate dazomet and soil solarisation at nursery and main field in comparison with carbofuran 3G against rice root knot nematode, *Meloidogyne graminicola* in paddy at RRS, Paiyur, Krishnagiri district.

CENTRE FOR PLANT MOLECULAR BIOLOGY & BIOTECHNOLOGY

Products under evaluation in Adaptive Research Trials

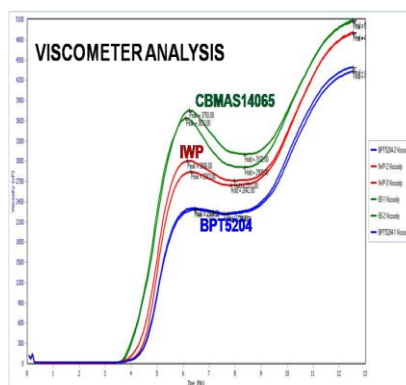
A short duration (115-120 days) rice culture, AD (Bio) 09518 (Parentage ADT 43 x IRBB 60-5-1) with the yield potential of 5767 kg/ha and resistant to bacterial leaf blight has been developed through marker-assisted breeding. It has medium slender grains with high head rice recovery (80.6%). This culture is under second year of adaptive research trial (ART-Rice 14/2016-17, Special transplanted Early (May-June sowing).



CBMAS 14142 is a short duration (115-120 days) culture, with long slender grain (Length = 7.3 mm; breadth = 1.9 mm and L/B ratio 3.8). This culture has yielded 4647 kg/ha under MLT (6.2% over PUSA Basmati). This culture has high head rice recovery of 61.8% and high linear elongation ratio after cooking. Currently, this culture is being evaluated under Adaptive Research Trial for the first year (ART-Rice 18/2016-17; Aromatic slender grain; Medium Transplanted (Sept.-Oct)).

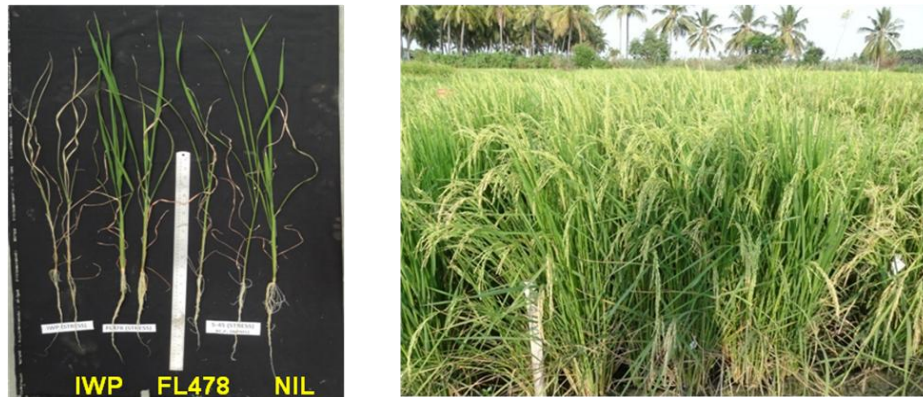
CBMAS 14065 (Parentage: Improved White Ponni x Apo), a medium duration fine grain rice CBMAS 14065 is a medium duration (130-135 days) culture with short slender grain (L = 5.4 mm; B = 2 mm and L/B ratio 2.6), yield potential of >5 t/ha, better head rice recovery (62%) and good cooking quality. This culture performed better than the checks, TKM 13 and BPT 5204 under MLT 2014 and 2015. Currently, this culture is being evaluated under Adaptive Research Trial for the first year (ART-Rice 15/2016-17, Special transplanted; 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 culture performed better than the checks, TKM 13 and BPT 5204 under MLT 2014 and 2015. Currently, this culture is being evaluated under Adaptive Research Trial for the first year (ART-Rice 15/2016-17, Special transplanted; Medium



IWP with Saltol

Salinity tolerant version of Improved White Ponni has been developed through marker assisted breeding by introgressing *saltol* QTL from FL478. IWP-*saltol* performed better under saline conditions and gave 20% higher yield than IWP in MLT. IWP-*saltol* has medium slender grains with good elongation of cooked rice (LER = 1.51; BER = 1.47), good volume expansion (VER 4.1) and soft gel. Currently, IWP-*saltol* is being evaluated under Adaptive Research Trial (ART-Rice 13/2016-17; Salt stress Medium (Sep sowing)).



Products in the pipeline for evaluation

Near-isogenic lines (NIL) having root trait QTLs have been developed through MAB by introgressing QTLs for deep root growth from Columbian rice, CT 9993 into IR 20. NILs were evaluated under drought in TPE during 2010-11, 2011-12, 2012-13, 2013-14, 2014-15 and 2015-16 rainfed cropping seasons. NILs with higher yield under drought in TPE have been identified.

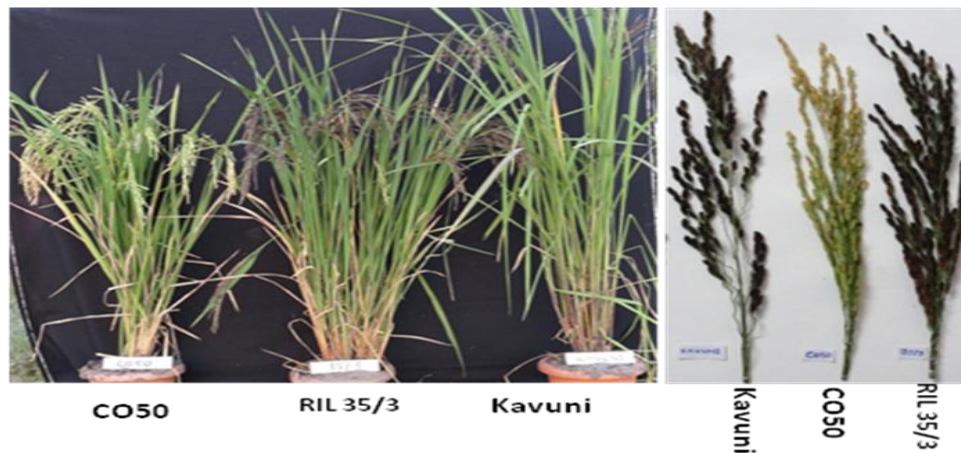


Two rice cultures, AD (Bio) 13042 (Parentage ADT 43/IRBB60), pyramided with three bacterial blight resistance genes viz., *xa5*, *Xa13*, *Xa21* and CB012015 pyramided with blast (*Pi 54*) and gall midge (*Gm1*,) resistance genes were developed through marker-assisted breeding and are in multi location testing.

High yielding rice lines with therapeutic properties

- A traditional therapeutic rice “Kavuni” is characterized for biochemical properties associated with anti-diabetes and age related muscular degeneration (ARMD). Using molecular markers, high yielding (3 – 3.5 t/ha)

and photo-insensitive versions of Kavuni possessing all major therapeutic clues have been identified and tested under PYT.

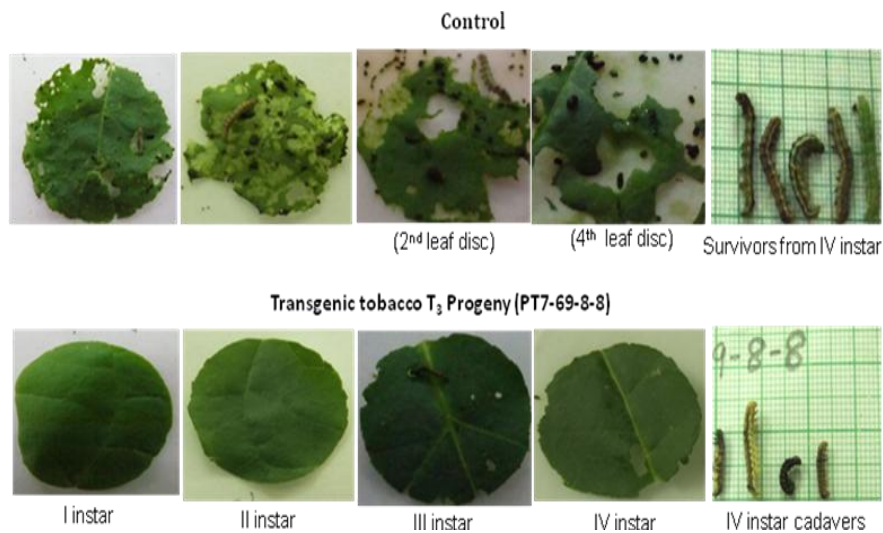


- Submergence tolerant version of a popular rice variety, CO 43 namely (CO 43 – Sub1) developed through MABB. This showed >90% RPG recovery and performed on-par with the recurrent parent under normal conditions.

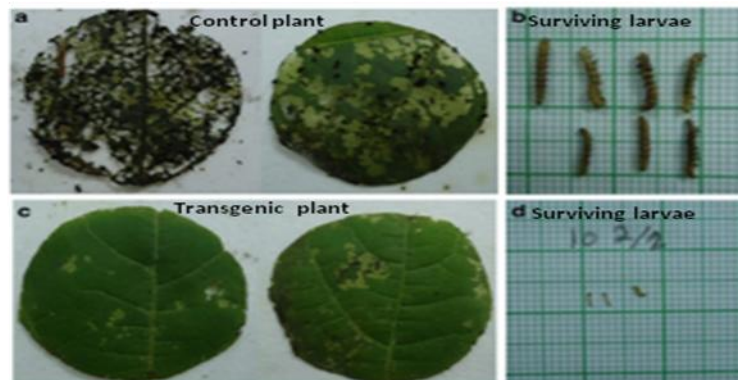


- A meta-QTL *qDTY6.1* spanning ~3.0 Mb between RM585 and RM217) on chromosome 6 mapped using a local rice landrace, Norungn was further fine mapped to 94.0 kb (0.36 cM) between markers RM2434 and RM6773 and deployed in MAB. Another meta-QTL, *qDTY1.1* for rice yield under drought in TPE was mapped on chromosome 1 using the landrace Nootripathu with an interval of about 3.8 cM between RM212-RM302-RM8085-RM3825 and is being fine mapped.
- MYMV resistant pre-breeding genetic stocks have been developed through interspecific hybridization (*V. mungo* x *V. umbellata*) and tested through laboratory screening procedures (Agroinoculation) and field evaluation. These pre-breeding genetic stocks are being used in mapping and functional genomics studies.
- Soybean varieties (CO3 and JS335) have been introgressed with *Phytophthora* and powdery mildew resistance genes, through marker assisted backcross breeding.

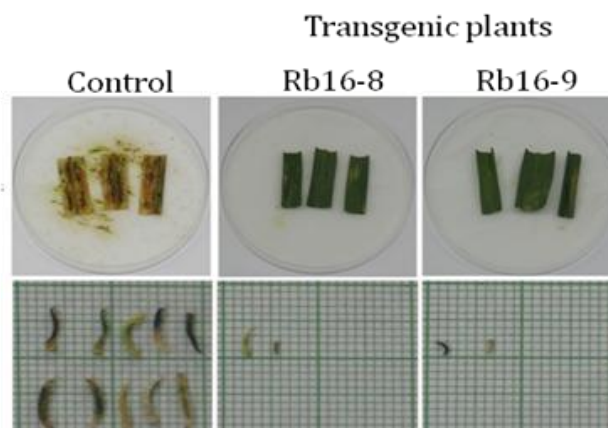
- Transgenic tobacco expressing Cry2AX1 protein (1.5 to 2 μg / g fresh leaf tissue) showed 100% mortality in 1st to 4th instar larvae of *Helicoverpa armigera* and about 90% mortality in neonates of *Spodoptera litura*.



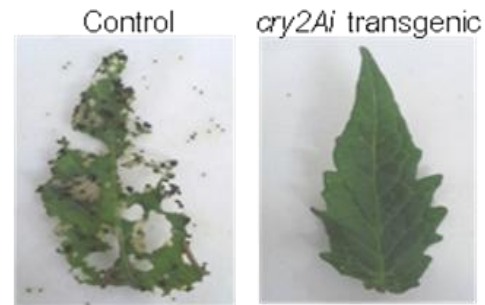
- A transgenic cotton event with single locus integration of *cry2AX1* gene showed expression of about 1.0 μg / g fresh leaf tissue and 80 to 90% mortality in neonates of *H. armigera*.



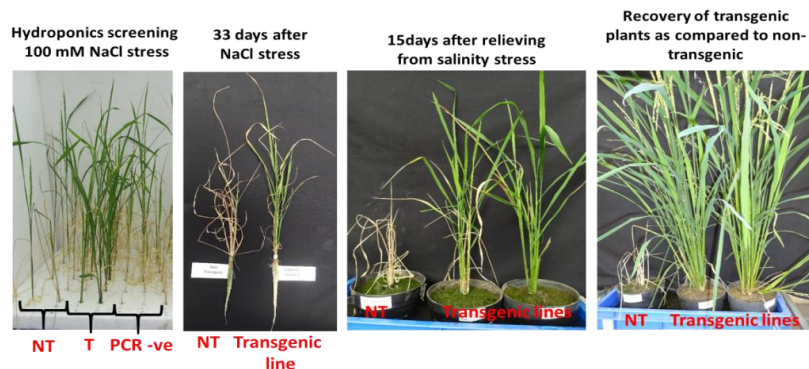
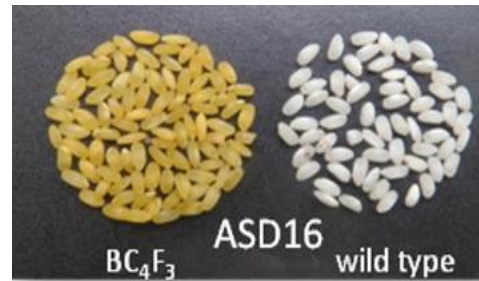
- Transgenic rice expressing 0.1 to 0.15 μg Cry2AX1 / g fresh leaf tissue showed about 80 per cent mortality in rice leaf folder larvae.



- A T₂ progeny of transgenic tomato event with single locus integration of novel *cry2A* gene showing 0.5 to 0.7 µg Cry2A/g fresh leaf tissue recoded 100% mortality in *Helicoverpa armigera*.



- Golden rice versions of local elite rice lines (ADT 43 and ASD16) developed.
- As a first step towards enhancing iron content in rice, genes involved in iron homeostasis such as IRT2 gene from barnyard millet, NAS2 gene from rice, ferritin gene from soybean were cloned and characterized.
- Genes for drought and salinity tolerance are isolated from diverse plant sources (drought tolerant rice, finger millet and resurrection plants) to improve abiotic stress tolerance in rice and other major crops.



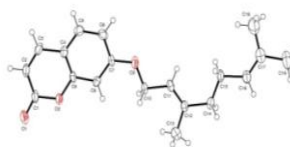
- High efficiency regeneration and transformation protocol in banana have been standardized for hill banana. With an aim of developing Bunchy Top Virus resistant banana, thirty five events of Rasthali harbouring RNAi construct targeting CP, MP and rep genes of BBTV have been generated.



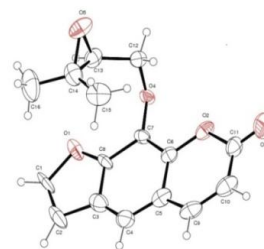
- With a view to develop doubled haploid lines in tomato and cocoa, anther culture studies are being carried out.
- Genes encoding chemosensory proteins in *Spodoptera litura* and *Nilaparvata lugens* were identified as molecular targets for their management and cloned. Silencing of *OR83b* and *CHSA* genes of *Spodoptera litura* resulted in reduced feeding and developmental deformities in larvae.
- Genetic analysis of phosphine resistance among storage pests revealed that *rph2* allele frequency varied in different storage pests and different food grain reserves. The frequency of resistance was above 50 per cent in most of the populations.
- Genetic diversity and phylogeography analyses of three species of honey bees, from 8 states of India were carried out. Different population clusters were recorded.
- Different coumarins viz., auraptene, imperatorin, heraclenin and umbelliferone were isolated from *Aegle marmelos correa* and osthole, phellopterin & imperatorin were isolated from *Angelica archangelica* Linn. Ritter Reaction was performed on the isolated compounds.



Aegle marmelos



ORTEP diagram of
Auraptene



ORTEP diagram of
Heraclenin

- Developing molecular databases for TNAU released varieties / hybrids of rice, millets and pulses.
- A comparative codon usage analysis tool was developed.
- Establishment of Millet DB: TNAU released Millet varieties with their morphological traits was developed

NEW RESEARCH INITIATIVES

Molecular breeding for improving agronomic traits in major crops

- Developing resilient rice varieties (stress tolerance, resource use efficiency) through genomics
- Molecular breeding for enhancing disease resistance in soy bean
- Molecular breeding for developing shoot fly resistant sorghum cultivars
- Developing rice lines enriched with protein and therapeutic clues to achieve nutritional security among rural people
- Molecular breeding for developing short slender grain rice with aroma

- Exploiting barn yard millet for biofortification – Towards identifying genes controlling Zn uptake and transport
- Understanding molecular basis of MYMV resistance through transcriptome sequencing in mung bean and rice bean
- Genetic engineering of False smut and BPH resistance in rice
- Identification and isolation of novel insecticidal genes from indigenous Bt strains
- Engineering resistance against pests and diseases in rice, tomato and cotton

Tissue culture

- Development of doubled haploid lines in tomato and cocoa
- Cell culture studies in *Anona muricata* for production of pharmaceutical products

Molecular ecology

- Diversity analysis in stored product pests of major cereals
- Molecular analysis of phosphine resistance in storage pests
- DNA barcoding of plants and their pollinators

Bioinformatics

- Whole genome sequencing of native rice varieties, black gram and minor millets (Italian millet, Little millet, Kodo millet etc.,) to identify and utilize the native genes

Biochemistry

- Bioprospecting for antimicrobial, insecticidal and pharmacological principles

Genome editing and Synthetic biology

- Genome editing for enhancing disease resistance and nutritional properties in rice
- Synthetic biology for antimicrobial, insecticidal and pharmacological compounds.

HORTICULTURE

Varieties Released through State Variety Release Committee Bhendi Hybrid CO 4

Bhendi Hybrid CO 4 is the product of BHD 9 and Karamadai local. Plants are tall and medium branched with dark green fruits. The average fruit length is 14 cm. Twenty two harvests can be made in a period of 110 days starting from 39 days after sowing. It recorded a yield of 25.6 t/ha which is 19.6 % over COBH 1 and 23.1 % over Sakthi. It can be grown successfully during May-June, February-March and September-October under irrigated condition in all the districts of Tamil Nadu except in hilly regions of Nilgiris and Dindigul districts.



Lime VRM-1

Lime VRM-1 is an introduction from Tahiti Islands in the year 1983. The plant is 4 to 6 metre tall with no thorns and wide spread branching habit. The fruit length and circumference range from 8 to 15 cm and 10 to 35 cm respectively. The average yield per plant per year is 62 kg. VRM 1 lime can be an ideal one for home gardens and fruits can be used for juice making.



Snakegourd Hybrid COH 1

Snakegourd COH 1 is the product of Kethanur Local and CO 2. The fruits of the hybrid culture is short (33.5cm), spindle shaped and dusty white with prominent white stripes. The average fruit weight is 380g. The hybrid yields 69.0 t/ha (in a period of six months 15-17 harvests) which is 44.4 % more than check BSS 694. The plants should be trained as a single stem till it reaches the bower. It can be successfully grown in June-July and January-February under irrigated conditions in the districts viz. Coimbatore, Tirupur, Cuddalore, Virudhunagar, Dindigul, Thiruvannamalai, Kancheepuram, Vellore, Villupuram, Theni, Erode, Madurai, Thoothukudi, Tiruchirapalli, Thirunelveli, Thanjavur, Namakkal and Pudukkottai.



Bottlegourd PLR1

PLR 1 is a selection from Siruvanthadu local types maintained by inbreeding. The selected line is long viny (5-6m) growth habit. The fruits are medium sized (35-40cm) possessing light green skin with mottles and tapering at the base with straight neck at the top. The variety comes to first harvest in 55 days after sowing and yields upto 32.4 t/ha in a period of 135 days. It is moderately resistant to powdery and downy mildew diseases and fruit fly.



French Bean Ooty 3

French bean Ooty 3 is a pure line selection from Thoothurmattam Local in the Nilgiris. It is pole type variety yielding 1,651.28g/plant. The pods are fleshy, long and straight without any curvature. The variety is resistant to powdery mildew and whitefly. The variety yields 39.8t/ha, which is 18.10 % higher than Ooty 1 in a duration of 90 days and is suitable for Ooty, Coonoor, Kotagiri and Gudalur block of the Nilgiris and other hilly areas in Tamil Nadu.



Technologies Developed

Rapid multiplication of turmeric using single bud rhizome sprouts in portrays



A portray based production of turmeric seedlings using single bud rhizomes was developed. This method requires only lesser quantum of planting materials (600–750 kg/ha). Since the planting materials are propagated in portrays there is good establishment of seedlings with better establishment capacity in a shorter period of time (30 days). The establishment of seedlings in the field is to the extent of 98-100 percent and is better than conventional method of planting.

Brinjal grafting

Brinjal grafting technology has been standardized, where the choice variety / hybrid is cleft grafted on the *Solanum torvum* rootstock to boost plant growth and development and yield by increasing the uptake of nutrients and also have resistance to dry root rot and nematode. The main crop can be maintained for 6 months followed by one or two ratoon crops. By adopting this technology, the brinjal plants are capable to yield 115 t/ha in 10 months duration. (One main and one ratoon crop).



FRUIT CROPS

Banana

Pre-release culture: H.212 is under MLT/ART

- Resembles the commercial cultivar 'Ney Poovan'
- Has tolerance to lesion nematodes and less susceptibility to sigatoka leaf spot disease
- The bunch weight ranges from 10-12 kg
- No. of fingers : 140-160/ bunch
- Average yield : 32 tonnes /ha

Integrated management of rhizome rot disease of banana (*Erwiniarot*)

- Soil Application with 4- 6g bleaching powder 5 times at monthly intervals upto 4 MAP+drenching with streptomycin 1-2 litres/plant(500ppm) at 1st MAP+ *Trichoderma viride* (50g/plant at 2nd, 4thMAP) + Growing cowpea / sunhemp in the interspaces till 5 MAP were found to be very effective in minimizing the rhizome rot incidence.

Management of sigatoka leaf spot disease

- Three sprays of Propiconazole (0.05%) with petroleum based mineral oil (1%) effectively controlled the Sigatoka leaf spot disease (12.8 PDI). Spraying with Propiconazole alone (1ml/lit) is also found equally effective (16.18 PDI).

Papaya

Integrated nutrient management

- In papaya, application of 100 per cent recommended dose of fertilizers + AM fungi(50g/plant) + Phosphate Solubilizing Bacteria (25g/plant) + *Azospirillum* (50g/plant) + *Trichoderma harzianum* (50g/plant) recorded the highest fruit yield of 38.34kg /tree and 73.27 kg/plant/year in Co.7 and Co.8 Papaya respectively.

Papaya Ring Spot Virus management

- Papaya Ring spot Virus could be managed by raising seedlings in insect proof net house, raising border crop maize around the field one month before planting of papaya and spraying of ZnSO₄ (0.5%), boron (0.1%) at 3rd and 7th month after planting recorded significantly higher yield as compared to control.

VEGETABLE CROPS

Cultures in pipeline for release

Onion Aca 15

Screening of small onion germplasm was done to identify a short duration seed propagated aggregatum onion. Over the three years of evaluation the Acc No. Aca 15, a selection from Puttarasal recorded the highest bulb yield of 19.12 t/ha which is 27.99 % increased yield over the check CO (On) 5. The bulbs of Aca 15 are bold pink coloured with 20.1 °brix TSS and 2.85 mg/ 100 g pyruvic acid. The duration of the crop is 65-70 days for bulb to bulb crop and 90 days for seed to bulb crop. Seed yield is 300 kg/ha.

BrinjalHD 1

It is a hybrid derivative of *Solanum melongena*(EP 65) x *Solanum viarum*. The yield of HD 1 is 3.20 kg/plant and single fruit weight is 53.07 g. Fruits are purple in colour with medium long in length and cluster bearing. Total number of fruits per plant is 61.62. Percentage of shoot and fruit borer incidence are 11.97 and 12.07 % respectively.

Tomato CTH 1

It is a F1 hybrid of LE 127 (Selection from Athani) x PKM 1 maintained in the germplasm of the Dept. of Vegetable Crops, Coimbatore. Fruits are green shoulder flat round with each fruit weigh about 75.3 g. The plant yields 32.1 fruits. The yield potential of the hybrid was 96.0 t/ha which is 22.6 % increased yield over COTH 3 & 26.3 % increased yield over Lakshmi. It is moderately resistant to leaf curl (10.5 PDI). The TSS of the fruit is 6.3 °brix and the ascorbic acid content is 30.43 mg/100 g.

Pre-release Culture of Garlic As 72

It is Selection from germplasm. Average bulb weight (40.89 g). bulb yield 17.32 t/ha Duration 120 -130 days. TSS content of bulb is 47°Brix. Poly phenol content and Allicin content is 3.514 mg/g and 3.06% respectively. It is suitable for cultivation in Nilgiris as a substitute of the existing local type grown.

SPICES AND PLANTATION CROPS

Crop Improvement

Turmeric

- Genotype ACC 48 recorded higher fresh rhizome yield (40.72 t/ha) with medium duration (210 days) over the check variety Prathiba during the germplasm evaluation studies (2013-14 to 2015-16). The genotype ACC 48

also recorded the highest curcumin content (5.50%) which was found superior than the existing turmeric cultivars *viz.*, CO 1 (3.2%), BSR 1 (3.5%) and CO 2 (4.3%).

Coriander

- A high leaf yielding coriander culture CS 38 has been forwarded to MLT to 15 centres during 2015-16. The results recorded from seven centres registered the highest leaf yield (5.88 t/ha) with 22.27% increase over the check variety CO (CR)-4 (4.57 t/ha). The ART is to be conducted during the rabi season of 2016.
- Among the 10 coriander leafy types evaluated for multiclipping at HC & RI, Coimbatore, the genotypes CO (CR) 4 and COR 76 identified as multiclipping types and recorded the highest leaf yield in first clipping (416.28 kg ha⁻¹ & 400.00 kg ha⁻¹ respectively) second clipping (308.11 kg ha⁻¹ & 293.33 kg ha⁻¹ respectively) and third clipping (140.94 kg ha⁻¹ & 90.00 kg ha⁻¹ respectively).

Crop Protection

Turmeric

- Field survey conducted in turmeric growing areas of Erode and Coimbatore districts revealed that, the leaf blotch intensity was maximum in Sathyamangalam (38.2 PDI) followed by Gobi (36.6 PDI). The maximum leaf spot intensity of 17.9 PDI was noticed at followed Kasipalayam (12.9 PDI) and Gobi (12.1 PDI).
- Among the 14 accessions screened for the foliar diseases in turmeric, CL 34 recorded minimum incidence of leaf spot and leaf blotch. The pooled mean of three years data indicated that the accession CL34 recorded minimum incidence of leaf spot (5.40 PDI) and leaf blotch (3.5 PDI) compared to BSR-2, which recorded 19.26 and 30.58 PDI respectively.

Coriander

- The field trial conducted to test the efficacy of new generation fungicides for the management of coriander powdery mildew indicated that, the plants sprayed with Propiconazole (0.1%) recorded minimum disease incidence of 4.26 PDI, while in control the incidence was 83.20 PDI.

Studies on insect pollinators of cocoa in India

- Studies on confirmation of entomophilous nature of cocoa revealed that caging of two cocoa entries *viz.* CCRP 1 and CCRP 2 with 100 kg of decomposed leaf litter as pollinator breeding substrate inside the cage resulted in the production of twenty seven matured pods in both the trees over a period of four months as against no pod set in the similar setup without pollinator breeding substrate.
- Regarding the breeding substrates for pollinators, banana pseudostem treated trees produced the maximum number of 24.3 harvestable pods per tree per season, followed by trees treated with cocoa leaf litter (21.9) as

against the minimum of 14.1 pods from the trees without pollinator breeding substrates. Regarding the bean yield parameters, the highest number of beans per pod was recorded in pods obtained from the trees treated with banana pseudostem (41.22) as against 33.00 beans per pod in untreated control. Weight of wet (141.41 g) and dry beans (44.12 g) per pod, dry bean yield per tree per season were recorded to be the maximum in the trees treated with banana pseudostem.

Crop Management

Standardization of vegetative propagation (Through budding and grafting)

Patch budding and soft wood grafting techniques have been standardized with 65-70% and 70-80% success respectively.

a. Budding

Bud wood preparation - Type of Shoot

Fan branches (Plagiotropic shoots)



Patch (2.5 cm length and 0.5 cm width) removed from rootstocks



Removal of Bud patch 2.5 cm length and 0.5 cm width from the bud wood and inserting it into the rootstock



Rootstocks

(8-10 month old cocoa seedlings)

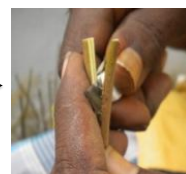


Budded portion tied with polythene tape

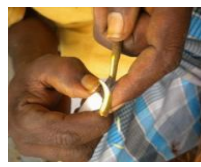


b. Softwood grafting

3 to 4 months old seedlings raised in polybags can be used as root stocks for grafting



Scion stick of 12-15 cm length with 3-4 buds from high yielding trees



Through cuttings

Single node semi hardwood cuttings treated with IBA in sand medium recorded significant effects on traits like rooting percentage (14 per cent), number of roots (14.00) length of roots (16.87 cm), number of leaves sprouted (5.37), length of sprout (7.70 cm), fresh weight of roots (0.42 g) and dry weight of roots (0.13 g). Similarly, in two node and long cuttings, two node cutting treated with IBA in sand medium influenced the sprouting, fresh weight and dry weight of roots. Even though the factors like media, growth regulator and type of cuttings had a role in increasing the rooting ability of cuttings, the success rate recorded in this study was far below and this can be applicable only for research purpose.



Standardization of potting media

Studies on efficacy of different pot mixtures on seedling establishment of cocoa revealed that Red Soil + Sand + FYM (2:1:1) + Super phosphate (5 kg/ton) was found to be the best treatment as adjudged by the seedling characters *i.e.* seedling height, number of leaves, leaf length, leaf breadth, root length and root fresh weight.

Standardization of Fertigation schedule

Application of 100 per cent RDF (100:40:140kg of N, P₂O₅ and K₂O) as WSF through fertigation by drip irrigation recorded the highest number of pods per tree (31.74 and 25.97, 32.41 and 26.18) during first and second season in 2012-13 and 2013-14 respectively. Fertigation with 100 per cent recommended dose of water soluble fertilizers recorded the highest dry bean yield per tree per year of 3433g and 3817g during first and second year which was on par with 75 per cent recommended dose of water soluble fertilizers. The cost benefit ratio was also highest in T₃ (4.56) over control (2.52).

Crop Protection

a. Standardization of management practices for pod rot

Application of *Pseudomonas fluorescens* liquid formulations @0.5% as soil and foliar spray recorded the minimum pod rot intensity of 20.12PDI with maximum number of fruits / tree (79.4) and the highest dry bean yield of 3.37 Kg /tree with the maximum C:B ratio of 1:3.52. This treatment was followed by T1 (*Pseudomonas fluorescens* talc formulation 100g / tree +2 kg of FYM+Foliar spray with Pf.1 @0.5% as pre monsoon spray) which recorded the pod rot incidence of 22.49 % with the maximum number of pods /tree (76.00) and dry bean yield of 2.87 kg /tree with

the C:B ratio of 1:3.12 as compared to untreated control (42.51PDI, 43.50, 1.82 kg /tree respectively).

c. Development of IPM module against sucking pest complex of cocoa

Efficacy of different pest management practices against sucking pest complex of cocoa revealed that the IPM module comprising of proper pruning and clean cultivation - erection of yellow sticky light traps @10 per ha – field release of *C. montrouzieri* @ 10 beetles per tree coinciding with the population build up of *Planococcus lilacinus* and *P. citri*- field release of *Acerophagus papayae* @ 100 per ha coinciding with the population build up of *Paracoccus marginatus* - foliar application of *Beauveria bassiana* (2×10^8 cfu / ml) @ 5 kg per ha coinciding with the population build up of tea mosquito bugs - foliar application of azadirachtin 10,000 ppm @ 500 ml per ha coinciding with peak flowering (to conserve pollinators) - foliar application of thiacloprid 21.7 % SC @ 750 ml per ha during pod formation stage, was significantly superior over farmer's practice and untreated control in checking the population of aphids, mealybugs and tea mosquito bug with the mean per cent reduction of 91.1, 94.0 and 84.4 over untreated control, respectively. Number of *C. montrouzieri*, *S. epeus*, syrphids and spiders recorded at 21 days after treatment were 5.7, 4.1, 2.1 and 1.7 per tree in IPM module as against 1.2, 0.5, 0 and 0.8 per tree in farmer's practice, respectively. Based on the results, IPM module was adjudged as the best treatment. Hence, adoption of IPM module is recommended not only to increase the productivity of cocoa, but also to conserve the natural enemies and pollinators in the cocoa ecosystem.

FLORICULTURE AND LANDSCAPING

Pre-release Culture

Jasminum nitidum Clone Acc.Jn-1 ()

Salient features of the variety

- Year-round flowering: flowers will be available throughout the year, including the lean season/off-season (Nov-Feb) of the commercial varieties
- Economic flower yield: Flower yield (of 3½ year old plants) is 1.87 kg/plant/year with an estimated flower yield of 6.25t/ha/year.
- Good keeping quality: Flower buds remain unopened for 12 hrs under room temperature and for 60 hrs under refrigeration)
- Attractive flower buds: Comparable with Jathimalli; buds are bright pink and open flowers are pure white
- Pleasant fragrance: open flowers possess a pleasant fragrance
- Good market preference: 93.33% of consumer preference owing to off-season flower production, similarity to Jathimalli (*J. grandiflorum*), potential to supplement Kakada (*J. multiflorum*)

Formulation of DUS testing guidelines for jasmine

- Formulation of DUS guidelines for the three commercial species, *J. sambac*, *J. auriculatum* and *J. multiflorum* has been completed.

S.No.	Jasmine species	Authentication
1.	<i>Jasminum auriculatum</i>	Published in the Plant Variety Journal of India, Vol. 08, No. 12 (December, 2014)
2.	<i>Jasminum sambac</i>	Published in the Plant Variety Journal of India, Vol. 10, No. 01 (January, 2016)
3.	<i>Jasminum multiflorum</i>	Submitted to PPV&FRA, New Delhi in December, 2015

- Formulation of guidelines for *J. grandiflorum* is in progress

Flower and filler crops for salt affected soils

The following flower crops are recommended for the salt affected soils. Flower crops : *Jasminumsambac*, *Jasminumauriculatum*, *Jasminumgrandiflorum*, *Nerium oleander*, *Ixoracoccinea* cv. *Native Red*, *Polianthestuberosa* var. *Prajwal* Foliage crops: *Chrysalidocarpuslutescens* (Areca palm), *Caryotaurens* (Fish Tail Palm), *Pritchardiathurstonii*, *Cyperusdiffusus* (Umbrella plant), *Dracaenas spp.* (Song of India, Song of Jamaica) and *Pandanusutilis* (Screw Pine).

Compatible interspecific crosses of jasmine

In interspecific hybridization of *Jasminum* species, 15 cross combinations (7 with *J. flexile* as female parent; 7 with *J. calophyllum* as female parent and 1 with *J. multiflorum* as female parent) resulted in fruit set. The percentage of fruit set among the interspecific crosses ranged from 0.05% (*J. multiflorum* x *J. grandiflorum*) to 88.00% (*J. calophyllum* x *J. flexile*).

Chrysanthemum varieties identified for loose flower and pot culture

Among loose flower varieties, Punjab Anuradha (114 flowers/plant) performed well under Coimbatore conditions and can be popularized for commercial cultivation. PusaAditya (66.00 flowers/plant) and PusaChitraksha (48.00 flowers/plant) performed well for pot culture.

Germplasm collections of Hibiscus, Celosia and Crossandra

- Sixteen Hibiscus types falling under 3 species namely, *Hibiscus rosa-sinensis* (13 genotypes), *Hibiscus schizopetalus*(1 genotype) and *Malvaviscusarboreus* (2 genotypes) have been collected and assembled.
- Twenty Celosia genotypes falling under 3 species namely, *Celosia cristata*(15 genotypes), *C. plumosa* (3 genotypes) and *C. argentea*(2 genotypes) have been collected and assembled.
- Sixteen accessions of Crossandra(*Crossandrainfundibuliformis*) have been collected and assembled.

Turf grasses for salinity tolerance

Among three grass species viz., *Zoysia* grass (*Zoysia japonica*), Bermuda grass (*Cynodondactylon* x *Cynodontransvaalensis*) and Seashore paspalum (*Paspalumvaginatum*) evaluated, Seashore Paspalum (*Paspalumvaginatum*) was

observed to possess higher salinity tolerance upto 15 d Sm^{-1} and Zoysia grass (*Zoysia japonica*) had acceptable turf quality for salinity treatment of 10 d Sm^{-1} .

Water saving in foliage plants using Pusa hydrogel

Incorporation of 40 g of hydrogel/5 kg potting media for *Schefflera arboricola* was found to be superior by reducing the frequency of irrigation (5.43 days) and the quantity of water required (11.42lit.) by saving 5.12 litre of irrigation water, when compared to control which required an irrigation level of 16.56 litre.

Fertigation for tuberose

Drip irrigation of tuberose (var. Prajwal) with 125% WR_c and fertigation with 75% WSF + 25% straight fertilizer along with foliar spray of 0.4% humic acid under black polythene mulching system recorded improved flower yield (19.06 t/ha & 653 g/ plant), bulb yield (14.4 Nos./clump), earliness in flower spike emergence (68.16 days), increase in flowering duration (26.16 days), rachis length (27.21 cm) and floret number/spike (55.6 Nos.). The BCR was the highest (3.08) in this treatment.

Standardization of bio-colourant extraction methods

Methods of bio-colourants extraction from hibiscus (*Hibiscus rosasinensis*), calendula (*Calendula officinalis*), celosia (*Celosia* spp.) and gomphrena (*Gomphrenaglobosa*) flowers were standardized. Flowers were oven dried (or) freeze dried and bio-colourants were extracted using solvent extraction. Lutein content quantified in calendula flowers was 43.44 mg/100g of dried flowers and the anthocyanin content in hibiscus flowers was 3.482 mg/100g of dried flowers.

MEDICINAL AND AROMATIC CROPS

Solanumnigrum

In *Solanumnigrum*, 46 germplasm collections were made from different parts of the country. Evaluation of genotypes for herbage yield and quality traits resulted in the identification of one promising genotype viz., Sn19 which recorded fresh herbage yield of 454.59g/plant. It is recommended for MLT.

Plumbagozeylanica

Forty three accessions of *Plumbagozeylanica* were collected from different parts of Tamil Nadu, Kerala, Maharashtra and Himachal Pradesh. Six high yielding accessions with more than 300 g dry root weight / plant and free from nematode infestation were selected and proposed for MLT to six AICRP centres.

Mutation breeding in *Gloriosasuperba*

- The LD 50 values for mutated seeds were determined as follows;
 - a. Gammarays – 4 kR
 - b. EMS – 4%
 - c. DES– 2%

- The first generation mutated progeny (V1M1) from tubers produced short statured plants (108.57cm) in DES (1.5%) and high seed yield (58.74g/plant) in DES (1.25%) treatments respectively.

Plant protection

Agricultural Entomology

- In *Gynemasyvestre*, foliar application of neem seed kernel extract 5percent showed maximum efficacy interms of minimum number of leaf webber, *Bocchorisony chinalis* and looper, *Comostolapyrrhognaper* per plant, per cent defoliation and maximum herbage yield (1.98 kg/plant), followed by *Bacillusthuringiensis* @750 g/ha.
- In *Cassiaangustifolia*, foliar application of neem seed kernel extract 5 percent showed maximum efficacy with the least number of pod borer, *Etiellazinckenella* (1.1 per plant), minimum pod damage (4.93 percent) and maximum leaf yield (576.7kg/ha) which was found to be statistically on par with standard chemical check.

Plant Pathology

- In *Gloriosasuperba*, spraying *Bacillus subtilis* 0.2% on 30 and 60 days after planting was effective in managing the leaf blight disease which recorded the lowest disease intensity of 17.9 percent and increased seed yield (518.8kg/ha). In the control, the highest leaf blight disease intensity of 33.4 percent and minimum seed yield of 369.2 kg/ha was observed.
- In *Gloriosasuperba*, dipping the tubers in *Bacillus subtilis* 0.2% followed by drenching with *B.subtilis* 0.2% on 30 days after planting with the lowest disease incidence of 14.8 per cent and the maximum seed yield (514.4 kg/ha). The highest root rot disease incidence of 26.4 percent and the minimum seed yield of 364.5kg/ha was recorded in control.
- In *Cassiaangustifolia*, seedtreatment with *Bacillussubtilis* @10g /kg seed followed by spraying *B.subtilis*@ on 30DAS & 60DAS recorded the lowest disease intensity of 10.6 percent as against the highest leaf blight disease intensity of 18.4 percent in the control.

SEED CENTRE

Seed Production Achievements

Crop	Units in quintals			
	2015 - 16		2016 - 17	
	FS	CS/TFL	FS	CS/TFL
Paddy	4250.23	8981.04	1351.50	1498.27
Millets	-	285.34	-	57.75
Pulses	-	463.90	44.62	104.57
Oil seeds	-	127.76	-	79.21
Cotton	-	3.57	-	-
Forage crops	-	88.39	-	5.70
Green manure crops	-	938.00	-	29.70
Vegetable crops	-	96.23	-	66.37
Planting materials (setts/rhizome)	-	1332.46	-	1399.08
Bajra Napier hybrid CO (BN) 5 (Nos. in lakhs)	-	-	-	11.00
Guinea grass CO (GG) 3 (Nos. in lakhs)	-	-	-	12,000 slips*
Planting materials/tissue culture plants (in nos.)		2758397		2893570

Automated Seed Vending Machine – An innovative seed delivery system

The Seed Centre of TNAU, Coimbatore facilitated to install an Automated Seed Vending Machine first of its kind in Tamil Nadu during January, 2014 on an innovative and improved seed delivery system. In order to make easy access to the quality vegetable and flower seeds to the urban and semi urban dwellers and to encourage the kitchen and roof garden an automated seed vending machine facility was created in TNAU in front of the botanical garden. The purpose of automated seed vending machine is to facilitate the vending of seed packets like vegetables and flower seeds available to the consumers/ farmers without any difficulties in any time by 24 x 7 by paying Rs.10/packet. So far 3.00 lakhs seed packets were sold through ASVM for the benefit of 3.00 lakhs consumers within a year.

Due to the overwhelming response among the consumers, the Seed Centre of TNAU installed 10 more such machines across state for the benefit of consumers (Trichy, Pudukottai, Madurai, Theni, Thirunelveli, Salem, Thiruvannamalai, Chennai, Paiyur, Vridhachalam)

Tribal Sub Plan Scheme

2015-2016

The Tribal sub plan training programme on “Seed production technologies and value addition techniques in small millets” was conducted at Thavalappatti Village, Attur taluk, Salem district in association with KVK, Sandhiyur and TCRS, Yethapur on 21.02.2016.

A modern Millet Processing Unit was established by the Seed Centre of Tamil Nadu Agricultural University at the cost of Rs.5.00 lakhs at Thavalapatti, a tribal hamlet in Attur taluk of Salem District, under the Tribal sub-plan programme of ICAR, New Delhi. The Millet Processing unit comprising of seven equipments *viz.*, Destoner cum Grader cum aspirator, Millet mill, Pulveriser, Grader with Aspirator, Dehuller, Grain Polisher and Polybag packing machine was inaugurated by Dr.K.Ramasamy, Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore. A one day awareness cum training programme was also organized to offer a demo and 'hands on training' on the usage of the new machineries was given to the identified tribal farmers.

The awareness on improving the quality of grains from farm to the consumer as well as the importance of value added products and its impact on consumers were delivered to the farmers. The training book on Seed production in small millets and value addition and the inputs like millet seeds were freely distributed to the farmers.

After the training and supply of seeds to the farmers, the crop kudiraivali was introduced to the village and now the farmers are cultivating kudiraivali.

Improved Seed Production Technologies

1. Pulse sprout extract for enhanced productivity

Foliar spraying of pulse sprout extracts of cowpea and horsegram is an eco-friendly approach which leads to flowering advancement, uniformity and increased seed yield.

Sprout extracts preparation

- Soaking of seeds with water for 12 h followed by 12 h incubation for sprouting. Grind the sprouts at 1:1 ratio with ice water and squeeze with cloth to get extract milk.
- Mix 10 ml of cowpea extracts milk with 1 litre of water to get 1 % cowpea sprout extract.
- Mix 20 ml of horsegram extracts milk with 1 litre of water to get 2 % horsegram sprout extract.

Sl. No.	Crop	Methodology
1	Paddy	Foliar spray of 1 % cowpea sprout extract or 2 % Horsegram sprout extract on 30 to 35 days and 60 - 80 days after transplanting.
2	Maize	Foliar spray of 1 % cowpea sprout extract or 2 % Horsegram sprout extract on 35 days and 65 days after sowing.
3	Cotton	Foliar spray of 2 % cowpea sprout extract or 3 % Horsegram sprout extract on 45 days and 75 days after sowing.
4	Tomato	Foliar spray of 2 % cowpea sprout extract or 2 % Horsegram sprout extract on 45 days after transplanting followed by 3 to 4 spray at 15 days interval.



Sprouting



Extraction



Spraying

2. Controlled atmospheric seed storage technology for storage insect pests management

In a controlled atmospheric storage, atmospheric gas concentration is maintained at a level lethal to insects throughout the storage period. Usually in controlled atmospheric treatment, atmospheric gases rich in CO₂ and low in O₂ or a combination of these two gases are maintained in a storage structure. Controlled atmospheric storage with elevated levels of CO₂ was effective against major stored product pests *viz.*, lesser grain borer, rice weevil, pulse beetle and groundnut seed borer without affecting the seed viability. The effective CO₂ concentration and storage periods are mentioned in the below Table. Thus CO₂ can be a good alternative to the use of chemical insecticides including fumigants for preventing storage insect pests infestation in paddy, maize, green gram and groundnut.

Effective CO₂ concentrations and storage periods against important storage insect pests

Crop	Storage insect pests	Storage period	CO ₂ concentration
Paddy	Lesser grain borer, <i>Rhyzopertha dominica</i>	12 months	40 per cent
Maize	Rice weevil, <i>Sitophilus oryzae</i>	12 months	40 per cent
Green gram	Pulse beetle, <i>Callosobruchus sp</i>	9 months	50 per cent
Groundnut	Groundnut seed borer, <i>Caryedon serratus</i>	12 months	40 per cent



Controlled atmospheric storage of seeds

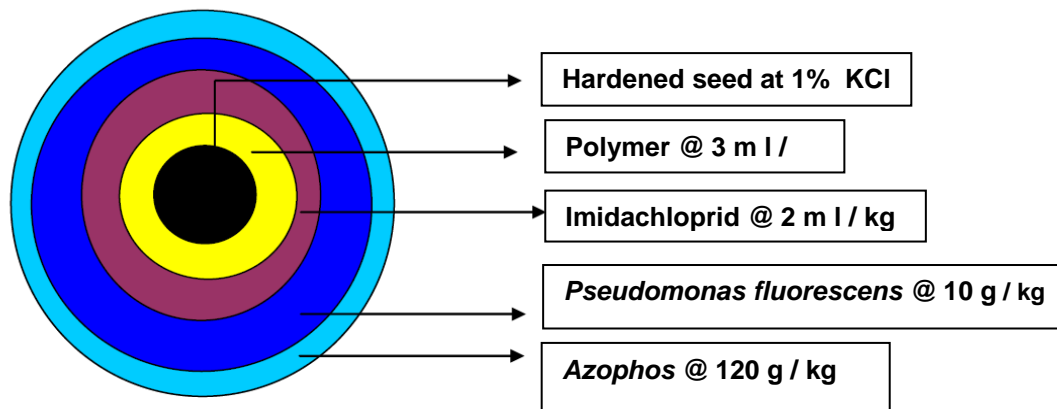
3. Cotton Designer Seed Technology

Designer seed technology is an integrated seed management technique for enhanced field emergence, crop growth and seed yield. This technology involved seed invigouration followed by polymer coating and seed treatments with insecticide, bio-control agents and bio-fertilizer in a sequential manner.

Cotton designer seeds are prepared by soaking the cotton seeds in 1% KCl for 6 hrs and drying back to original moisture content followed by seed coating with polymer @ 3 m l / kg + imidachloprid @ 2 ml / kg + *Pseudomonas fluorescens* @ 10g / kg + *Azophos* @ 120g / kg. The designer cotton seed recorded enhanced seedling emergence, plant growth and seed yield.

Benefits

- Precision sowing through mechanized drilling
- Enhanced germination and field emergence
- Improved seedling vigour
- Sustained protection against pests and diseases during early growth period
- Reduced plant protection cost and seed rate
- Increased yield



AGRICULTURAL ENGINEERING

IMPLEMENTS RELEASED

Tamarind Deseeder

Tamarind deseeder is developed for removing the seeds from dehulled tamarind fruits. The roller gap in the deseeder can be adjusted for deseeding fruits of various sizes. The deseeding process using the implement separates pulp strip, seeds and other broken pieces. The capacity of the machine is 40 kg/h and cost operation per kg is around 2.5 rupees.



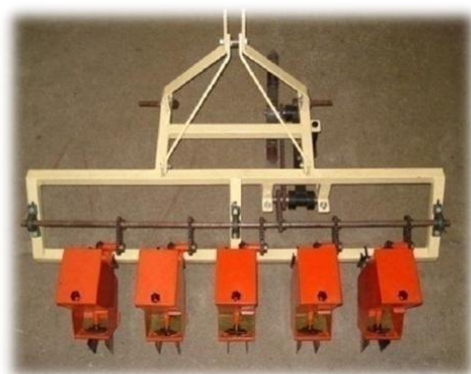
Double Chamber Centrifugal De-Huller for Millets

Double Chamber Centrifugal De-Huller can be used for removing the husk without any damage to the bran and endosperm of little millet, prosomillet, foxtail millet, barnyard millet and kodomillet. The de-huller consists of feed hopper, two centrifugal chambers made of cast iron, impellers with curved vanes, blower and separate outlets for collecting kernel and husk and has the capacity of removing husk from 300 kg of grains in one hour with 95% efficiency and requires only one person to operate the machine. The unit is powered by 5 HP motor with suitable power transmission system and one unit cost is about Rs.1,20,000/-



Tractor Drawn Precision Pulse Seeder

The pulse seeder is suitable for sowing blackgram and greengram with a hill to hill spacing of 10 cm. In a day one hectare can be covered. Using this machine results 40 percent saving in seedrate when compared to conventional method of sowing. A saving of 19.1 and 97.0 percent in cost and time of operation respectively compared with conventional method of sowing. The cost of the unit : Rs.50,000/-



FARM IMPLEMENTS AND MACHINERY

Harvester cum Collector for Cluster Onion

A harvester cum collector for cluster onion is developed for harvesting onion cultivated on raised beds. The harvester cum collector consisted of, digger blade, riddle conveyor, collector chamber cum cross conveyer, and bucket elevator. The trials conducted with CO 4 onion revealed that the harvester was able to harvest the onion crop without any difficulty and without any damage to the onion bulbs. The un-dug onion was only 1.5 percentage. The quantity of soil carried by the conveyer was significantly low when the soil was in friable state. The field capacity of the developed unit is 0.16 ha/h with a field efficiency of 80 per cent. The cost of the developed unit is Rs 75,000/-.



Tapioca Detopper

De-topper for cutting and conveying the tapioca stems ahead of the digger was developed as a front attachment to the tractor. The de-topper is driven by tractor hydraulics. The base cutting is done by circular cutting discs of 450mm diameter. Conveying of cut stems is done by a pair of chain conveyers with projecting pegs. The cutting cum conveying unit is raised and lowered by a double acting hydraulic cylinder. The cutting discs are driven by separate hydraulic drive motors. The chain conveyers are powered by a hydraulic motor. This makes it possible to vary the height of cut. The cutter-heads can be independently moved along the frame to accommodate variation in row spacing. The cost of the attachment alone is estimated to be Rs. 80,000. The unit can cover an area of around 0.5ha/day.



System for Controlled Level of Puddling

A system of controlled puddling using conventionally available 2WD tractor (MF1035) was developed and field tested. The system uses a commercially available laser transmitter, receiver and control box (Black stallion – ES1313007). The receiver is mounted on top of a mast fitted to a rotary tiller (Escorts NSE-RP 0055). The output of the tractor's hydraulic pump is tapped through a flow diversion valve mounted on the hydraulic system housing. The lifting and lowering of the implement is done by a pair of externally mounted



hydraulic cylinders at the rear of the tractor and powered by the hydraulic output from the tractor. A special hydraulic circuit was developed for use with the external hydraulic system. The system was assembled and field experiments were conducted to verify the performance of the tractor in the field. The cost of the modification excluding the laser system and rotary tiller is Rs40,000. The cost of the entire system is Rs. 5.5 lakhs. The field capacity is 0.26ha/h. The cost of controlled puddling with this system is Rs.2300/ha.

Transplanter for SSI Sugarcane Seedlings

The automatic SSI transplanter is an electro-pneumatic system. The basic functions of the pick and placing mechanism adopted for the transfer of seedling from the tray to the planter chute consisted of three axes of motion and a gripper arrangement. The tray feed motion was adopted from the previous model and the tray was incrementally fed by a DC motor driven belt conveyer. The clamping of the plant, to pull out the plant from the tray was done by a pair of fingers that are pivoted and operated by a pneumatic cylinder. The pulling out action was implemented by a parallelogram mechanism that was activated by a pneumatic cylinder. The entire clamping and pulling arrangement was designed to ensure lesser weight in order to reduce inertial forces. The traverse of the plant from the cell location to the drop chute was done by an electrically driven ball screw. The ball screw was operated by a stepper motor and controlled by a PLC to ensure accurate positioning. The entire cycle of operation was automated by a PLC and hence it can be flexibly adopted for different protrays and seedling.



Redgram Protray Seeder

To facilitate the redgram transplanting using protray seedlings, the existing semi-automatic protray seeder was evaluated for filling the nursery medium and dibbling the seeds in protrays. The trays selected, have a staggered layout of cells and hence cannot be used in the existing semiautomatic medium filling and sowing machine already developed. Hence design and development of a red gram protray seeder that can be flexibly configured to suit different tray sizes and cell layout was done. The main components of the seeder are 300 mm wide slat conveyer in two sections, Media dispenser hopper, configurable two row seeder for sowing both straight and staggered patterns, and covering media dispenser.



ERGONOMICS AND SAFETY IN AGRICULTURE

Development of safety kit for spraying operation

Face mask, Hand gloves, Eye protector and Apron were designed and evaluated using different materials. From the evaluation the materials viz. double layer polypropylene, PVC materials, plastic frame with fiber glass (EP₃) and water proof polyester were found suitable for designing Face mask, Hand gloves, Eye protector and Apron during spraying.



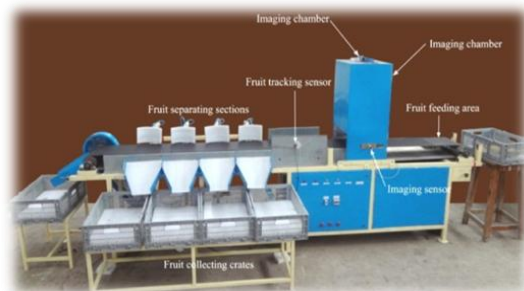
The other studies conducted include Ergonomic evaluation and refinement of power weeder for paddy, Interventions for minimizing health hazards of workers in turmeric polishing and Ergonomic interventions in hand tools for selected activities in grape cultivation.

FOOD AND AGRICULTURAL PROCESS ENGINEERING

Online Mango Grader

Salient Features

- The effectiveness of 98.6 per cent was observed in Alphonso, followed by 96 per cent for Banganapalli and 93.33 per cent for Neelam mango.
- The capacity of the machine was calculated to be 620 to 650 fruits/h or 200-300 kg/h.
- The cost of operation for machine was calculated as Rs.0.60 per kg of fruits, compared to the cost of manual grading of Rs. 2.60 per kg of fruits.



Turmeric Washer

Salient Features

- Developed washer has a washing capacity of 400 kg/h.
- At washing speed of 40 rpm with a water discharge of 360 lpm at an angle of inclination for the drum kept at 30 degree, washing efficiency was found to be 95 %.
- To the corresponding condition, bruise index was found to be 1%.



Turmeric Rotary Dryer

Salient Features

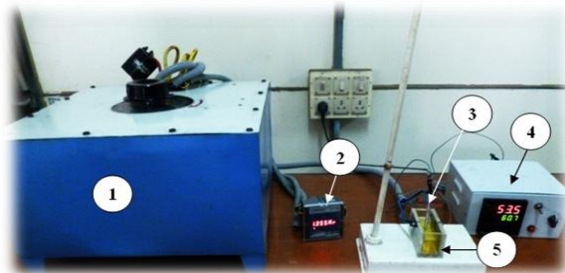
- Rotary drying of turmeric rhizomes reduces drying time and shrinkage, thus improves the colour of the dried turmeric.
- Complete drying of turmeric was achieved in 30 hours with an air temperature and air velocity of 50°C and 3 m/s, respectively wherein conventional drying takes about 2-3 weeks.
- 70% polishing of rhizomes can be achieved during drying, which minimizes qualitative and quantitative loss.
- Curcumin content of dried turmeric is increased compared to conventionally dried product.



Static Ohmic Heating System for Liquid Egg white

Salient Features

- The static ohmic heating system was developed with a specially designed process control system to vary the frequency and wave shape.
- Voltage gradient 17.93 V/cm, 10 Hz frequency, 1.6 minute holding time with sine wave was found to be the best combination for ohmic heating of liquid egg white with respect to functional properties *viz.* turbidity, soluble protein content, amylase activity, foaming capacity and stability.
- The ohmically optimized liquid egg white was found to be clear as fresh egg white, retained high soluble protein content of 98.41 per cent and exhibited the lowest amylase activity of 3 μg maltose $\text{ml}^{-1} \text{min}^{-1}$.
- The foaming capacity and stability were found to be improved over the fresh egg white and it was found to be 406.81 and 31.67 per cent respectively.
- The nutritional properties of angel cake and custard incorporated with ohmically heated liquid egg white were on par with fresh liquid egg white



Ozone Fumigation System for Food Grains

Salient Features

- The Capacity of the fumigation bin is 500 kg and Ozone generating system is 5L/min.
- Time required to attain 500 ppm is 2 hour 40 minutes.
- In farm level storage bin Ozone concentration of 500 ppm for 10.5 and 14.5 h were required to kill all adult *R.dominica*, in paddy and rice grains
- Cost of the system is Rs. 2,50,000



Low Cost Ripening Chamber for Fruits

Salient Features

- A low cost ripening chamber is used at house hold /farm level for ripening of fruits.
- Size of the structure is 1 x 1.5 m²
- Capacity – 200 kg fruits
- Optimum Ethylene Concentration for fruit ripening:
 - Banana- 200 ppm- 25 hours
 - Mango- 400 ppm- 25 hours



BIOENERGY

Solar biomass integrated drying system

The solar tunnel dryer (STD) with tray system is loading capacity of 2000 coconuts per batch. STD consists of a drying chamber of 18.0 m x 3.75 m x 2.0 m, which is oriented towards east-west direction. It is semi cylindrical shaped tunnel made of pipe frame structure covered with ultra-violet stabilized semi-transparent polyethylene sheet (200 micron thick).



The biomass hot air generation system consists of two chambers and distribution ducts. The first chamber is the combustion chamber for burning biomass or agro residues. The second chamber is the gas to air heat exchanger for exchanging heat between hot flue and fresh air. During the flue gas flow in the heat exchanger, the heat from hot flue gas transferred to the fresh air. The biomass hot air

generation system is fed with coconut husk as a fuel with consumption rate of 17 kg/h.

The monitoring system consists of sensors for monitoring the temperature and relative humidity inside solar tunnel dryer and temperature inside biomass hot air generation system. The sensors were installed for real time continuous monitoring of the solar and biomass integrated drying system. While integrating two different types of drying system, the continuous monitoring helps in regulating the constant environment throughout the drying period, thus avoids the deterioration of quality of the product.

The control mechanism developed based on exhaust fan at each chimneys, exhaust fan at front of the tunnel and proportional actuator control at distribution pipe. Exhaust fan at chimney is controlled based on the average temperature and relative humidity at each zones of the solar tunnel dryer. Exhaust fan installed at front end of the solar tunnel dryer is controlled based on overall average temperature and relative humidity of the solar tunnel dryer. During the operation of biomass hot air generation system, the proportional actuator control was designed and controlled based on the overall average temperature of the solar tunnel dryer. The maximum drying rate of 0.045 g of moisture per g of dry matter per hour recorded during first day of drying process and minimum drying rate was reached at the end of drying period as 0.022 g of moisture per g of dry matter per hour. Improved quality of copra with four different grades such as white copra (77 per cent), brown coloured copra (7.46 per cent), wrinkled copra (2.22 per cent) and the mouldy copra (13.3 per cent) under solar and biomass integrated drying system. The cost of drying of coconut is estimated savings of Rs.1045/ton of coconut compared to open sun to be Rs.1762/ton of coconut with monetary savings.

Solar Hot Air Generation System (SHAGS)

Experimental setup of SHAGS and biomass gas stove integrated with Farmers' Smoke House (2*1*1m) made at Elevampadam Rubber Producers Society, Pallakad District, Kerala. In the heat balance study of conventional smoke house, it was found only 24% of input energy is used for drying remaining heat is lost through exhaust (34.5 %), walls and door losses (25 %), stored energy (12 %) and remains as unaccountable. Initial moisture content of the machine dripped rubber sheets was 24.8 % (w.b), reduced to 0.8 % (w.b) which is optimum for rubber sheets with the drying temperature of 60°C. Uniform heat distribution is achieved inside the FSH. During sunshine hours maximum temperature obtained is 50°C and off sunshine hours reached 60°C. The energy stored by PCM tank is used 2 hours as heat back up. Fuel wood consumption is reduced as 55-60 % of the quantity. Fuel consumption requirement is 45 kg/day for drying 150 sheets in traditional method whereas only 15 kg/day in integrated drying system.



Plasma Gasification System

A plasma gasifier was developed for gasification of biowastes. The reactor had a height, bottom diameter and top diameter of 1.0, 0.20 and 0.48 m respectively. The plasma torch acts a heat source for gasification. It works efficiently with the current of 350 A and steam pressure of 1.5 kg cm^{-2} for plasma generation with flame length of about 15 cm.



The percentage of carbon monoxide, carbon dioxide, hydrogen and methane in producer gas is in the range of 36.48 ± 6.055 , 13.08 ± 2.39 , 20.65 ± 7.79 and 3.225 ± 0.855 respectively. The temperature of producer gas is in the range of 149.50 ± 3.50 °C. The producer gas yield of plasma gasifier was in the range of $3.99 \pm 0.88 \text{ Nm}^3 \text{ kg}^{-1}$ with a higher heating value of $4.325 \pm 0.955 \text{ MJ Nm}^{-3}$. The hot gas efficiency of gasification is in the range of 75.65 ± 14.96 %. The cold gas efficiency is in the range of 28.57 ± 16.26 %. The plasma energy ratio of feedstock varied in the range of 0.089 ± 0.29 . The overall thermal efficiency of plasma torch based gasifier was 38.67 %. The average specific gasification rate was found as $18.47 \text{ kg m}^{-2} \text{ h}^{-1}$. From the energy analysis of plasma gasifier revealed an energy balance closure of 84.395 \pm 12.145 percent. The cost economics indicated that benefit cost ratio was 2.12 with the payback period of 2 years 2 months.

Design and development of tar and particulate removal system for producer gas

Tar is a major nuisance in both gasification and pyrolysis. It is a thick, black, highly viscous liquid that condenses in the low-temperature zones of a gasifier, clogging the gas passage and leading to system disruption s. Tar is highly undesirable, as it can create man y problems including:

- Condensation and subsequent plugging of downstream equipment.
- Formation of tar aerosols.
- Polymerization into more complex structures.
- Nevertheless, tar is an unavoidable by-product of the thermal conversion process.

Updraft gasifier is suitable for the solid biomass which has high-moisture (up to 60%), high-ash (up to 25%) and low-volatile fuels such as charcoal and it is also called as a countercurrent gasifier. Updraft gasifier has some advantages over downdraft gasifiers such as, good thermal efficiency, flexible with moisture content, small pressure drop across the reactor, low tendency of slag formation etc. Updraft is more suitable for direct firing, where the gas produced is burnt in a furnace or



boiler without cleaning or cooling. Biomass is fed from the top of the gasifier and a gasifying medium (air) is fed from the bottom of the gasifier. In this countercurrent reactor, the product gas leaves from the top while solids fuels and ash leave from the bottom. The design of the gasifier can be a major influence on the amount of tar in the product gas.

Design of Sand Bed Filter

The design philosophy behind the sand filter is as follows:

- The sand is neutral and non-reactive material.
- It is inexpensive and easily available.
- It is easily available in different grain size grades.
- It can withstand high gas temperature
- It is easy to clean and recycle i.e. regenerative material.

The sand bed filter was designed, developed and tested with the existing 20 kWe updraft type gasifier. The area of sand bed filter was designed for superficial velocity of 0.1 m s⁻¹ and gas flow rate of 60 Nm³h⁻¹ i.e. the designed flow rate of the gasifier. The sand bed filter rectangular was fabricated from 3 mm thick mild steel sheet and wire meshes fabricated from stainless steel 304 were used to separate filter bed.

Biodigested Slurry Value Added to Supplement Organic Agriculture

In fullscale anaerobic digestion systems the major issue is the disposal of the solid and liquid parts of the digestate. Hence in order to value add the biodigested slurry a techno-economic feasibility of the organic nutrient was assessed by conduct of field experiments on application of bio-digested enriched compost and slurry on vegetable, fruit and commercial crops.



Field experiments were conducted in TNAU farmlands and farmers' fields to determine the manurial value of bio-digested slurry and enriched compost on vegetable, fruit and commercial crops.



Application of poultry litter waste bio-digested enriched compost to the crops at 12.5 t ha⁻¹ level triggered biometric and yield qualities. In case of sugarcane, more number of millable canes (112.00±4.10 (000' ha¹), single cane weight (1.31±0.08 kg), highest cane yield (131.25±8.68 t ha⁻¹) and sugar yield (15.98±0.98 t ha⁻¹) than application of 12.5 t ha⁻¹ farm yard manure were obtained. In Bhendi the attributes were as, maximum plant height (112.50±1.11 cm) and highest pod yield (19.55±0.27 t ha⁻¹). In turmeric, the attribute were as maximum plant height (57.47±0.23 cm) and rhizome yield (32.24±6.77 t ha⁻¹) and in Banana, the bunch yield was 20.73±0.19 kg/plant. The values were significantly superior than FYM application. Application of poultry litter waste bio-digested slurry

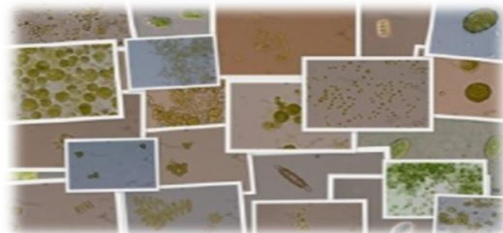
@ 75% of slurry n ha⁻¹ enhanced the biometric and yield parameters as follows. Sugarcane: cane yield (161.19±7.10 t ha⁻¹); sugar yield (21.02±0.73 t ha⁻¹); number of millable canes (109.33±3.88 (000' ha⁻¹) and single cane weight (1.47 ±0.07 kg); Bendi: maximum plant height 112.28±0.27 cm and pod yield (19.67±0.16 t ha⁻¹); Turmeric: maximum plant height (58.40±0.19 cm) and rhizome yield (28.87±4.96 t ha⁻¹); Banana: maximum bunch yield (19.83±0.08 kg/plant) @ 50% of slurry n ha⁻¹. The farmers adopting application of bio-digested compost and slurry can sought for organic agriculture. It is advantageous as a rich nutrient source; increases yield when applied in the proper dilution; saves a huge amount of money spent on commercial fertilizers by the farmers. The real goodness is quality boost of crops like greenness in bhendi and turmeric curcumin and tomato lycopene. Hence the organic biodigestate application in agricultural fields could benefit the farmers in water, nutrient and cost saving.

Algae as a Sustainable Biofuel

Bioprospecting of fresh and marine water samples of Tamil Nadu including the sacred aquatic bodies for algae potential of biofuel production was attempted. In the process, the suitability of different growth media for various microalgal isolates was configured.



The department stocks potential hyper lipid (22-40 %) producing microalgae. A high throughput assay for screening microalgal isolates using Nile red fluorescence (correlated to lipids) has been optimized. Effects of elevated CO₂ levels were tested on microalgal isolates and biomass was estimated. The Chlorophyceae, *Tetrademus wisconsinensis* showed optimal nutrient requirement as dextrose (20 mM) or Sodium bicarbonate (40 mM); 30 mM N as NaNO₃/ (NH₄)₂Cl; 20-30 mM P as K₂HPO₄. A light intensity of 62.64 μ mol m⁻² s⁻¹ and photoperiod of 14:10 light and dark cycle resulted in higher biomass on dry weight basis. The GC-MS FAMES profile revealed three major fatty acids viz., octa-decadienoic acid, octadecenoic acid and



hexadecanoic acid (39.11%). Further the fuel properties of microalgal fuel like kinematic viscosity (1.378 cSt), specific gravity (0.12), flash point (92°C), ash content (5.05%) etc., were well within the ASTM standards for biodiesel. Mixotrophic growth of

Tetrademus with petroleum refinery wastewater in open raceways was established. The refinery wastewater characterized as pH 7.1, EC 880 μs/cm, TDS 508 mg/L, phenol concentration 0.16 mg/L, oil and grease 0.204 mg/L, TSS 12 mg/L, iron 0.363 mg/L and COD 460 mg/L. Combination of 60% wastewater and medium (BG11) supplementation produced biomass of 1.34 g L⁻¹ on dry weight basis. Lipid content in heterotrophic cells reached as high as 54.70%, which was about three times that in autotrophic culture (19.46%). Computation of raceway studies in 21.25 m² pond with working volume of 4250 L net energy ratio (NER) of 0.69 considering algal biodiesel production; however a NER of 1.97 was evident when energy available in biogas and digested cake was inclusive.

FORESTRY

- Eighteen species have been characterized for wood quality and the analysis indicated the superiority of the following eight species *Meliadubia*, *Leucaenaleucocephalla*, *Dalbergiasissoo*, *Acacia auriculiformis*, *Albiziafalcataria*, *Meliacomposita*, *Acrocarpusfraxinifolis* and Poplars.
- *Meliadubia* has been identified as the potential pulpwood species which recorded pulp yield of 50.5% and kappa number of 19%. This variety can be recommended for release exclusively as pulpwood.
- A new clone in Casuarina (CJ27) has been identified as a higher yielder which has an yield potential of 80 tonnes per acre and the variety is recommended for release.
- The hybrid developed both in Casuarina and Eucalyptus can be advanced further for evaluation.
- Fifteen species have been identified for biomass power generation utility with a Gross Calorific Value ranged between 3000 Kcal and 5000 Kcal
- Two species viz., *Dalbergiasissoo* (Clone 18) and *Leucaenaleucocephalla*(LL15) have been identified as potential species amenable for High Yielding Energy Plantations (HYEP) and High Density Short Rotation Energy Plantations (HDSR).
- Three Contract energy farming models have been designed and implemented in association with biomass power industries.
- Seven energy firms were attracted through this approach and enrolled as members in the Consortium of Industrial Agroforestry.
- Eleven species viz., *Meliacomposita*, *Alstoniaschloris*, *Sterculiafoetida*, *Khayasenegalensis*, *Chuckrasiatabularis*, *Greviatilifolia*, *Toonaciliata*, *Swieteniamacrophylla*, *Populusdeltoides*, *Sterculiaalata* and *Anthocephalus cadamba* have been identified as alternate plywood species.
- A new species *Maesopsiseminii* has been identified as a superior plywood species in terms of colour, peeling recovery, basic density, screw and nail holding factors.
- *Acrocarpusfraxinifolius* has also been found suitable for plywood making in terms of colour, peeling recovery and other mechanical properties.
- Improvement programme has been initiated for Melia (30 progenies), Silver oak (18 progenies), Acrocarpus (30 progenies) and Maesopsis (16 progenies).
- Two contract plywood farming models have been designed and implemented in Tamil Nadu which attracted 950 acres of Melia based plywood farming.
- Distributions of 21 species (18 indigenous and 3 exotics) in almost all the coastal districts have been identified.
- Among the species, the predominance of *Thespesia*, *Lannea* and *Albizia* has been found wider distribution across the coastal districts.
- Tree improvement programme has been initiated with 20 progenies in *Thespesia*, 30 clones in *Lannea* and 27 progenies in *Albizialebeck*.
- The wood quality analysis indicated that *Lanneacoromandelica* and *Thespesiapopulnea* are found amenable for paper quality compared to other species.

- 25 clones in Kadam, 30 in Melia and 17 in Casuarina have been selected and incorporated in the evaluation programme.
- The wood quality assessment of Kadam identified that Kadam is suitable for pulp and paper industry from 3rd years onwards.
- The wood quality assessment of Kadam also identified that the wood is suitable for match industry from 6th year onwards.
- The DUS traits identified distinct colour in bark and variability in texture which will ensure protection of IPR.
- In Kapok clonal progeny evaluation planted at 6 x 6 m spacing, MTPCP 18 (Arachalur) recorded the maximum number of pods (357 pods tree⁻¹) which works out to be 98,889 pods ha⁻¹ resulting in the floss yield of 494 kgha⁻¹.
- At eight years of age, MTPCP 18 (Arachalur) was observed to be the highest yielder besides being able to tolerate drought
- The highest mean yield of Cassava was recorded to be 17.8 tha⁻¹ in the treatment S₅ (STCR – IPNS recommendation) followed by the treatment S₄ (150 % RDF) (16.0 tha⁻¹).
- In case of chillies the maximum yield of 1.60 tha⁻¹ was recorded in the treatment S₅ (STCR – IPNS recommendation) followed by the treatment S₄ (150 % RDF) (1.45 tha⁻¹).
- The crop equivalent yield was also worked out with respect to cassava.
- The biometrical observations of the tree crop, *Dalbergiasissoo* was recorded during the harvest of the cassava crop and the tree height growth of 350.4 cm was recorded in the treatment S₅ (STCR – IPNS recommendation)..
- The post harvest soil samples were analysed. The maximum available nitrogen was recorded to be 168.0 kgha⁻¹ (S₅). The available phosphorus was recorded to be 36.5 kgha⁻¹ (S₅). The organic carbon was recorded to be maximum in S₅ (4.3 gkg⁻¹).
- Intercropping with *Gmelinaarbore* was taken up with the second cropping sequence, Beetroot-Raddish-Onion.
- The maximum yield was recorded in the treatment S₄ (125 % RDF) in Beetroot (15.69 tha⁻¹). Raddish recorded the highest yield in the treatment S₄ (125 % RDF) (18.75 tha⁻¹). The highest yield of onion was recorded to be 13.44 tha⁻¹ (S₄ (125 % RDF)).
- The yield obtained from each intercrop was converted to crop equivalent yield with that of tomato, the previous crop in the first cropping sequence. The highest crop equivalent was recorded to be 1250.
- The carbon foot print estimation was done for the institutions to attain the neutrality. The emissions of CO₂ are estimated through food, transport, electricity and other activities of the institutions. Among these, transport holds highest percentage (around 90%) of emission of CO₂.
- *Dalbergiasissoo* and *Acrocarpusfraxinifolius* performed best in eco-physiological attribute, whereas, lowest eco-physiological was registered by *Bambusa vulgaris*.
- Among the four forest types Combretaceae was the dominant family followed by Fabaceae, in Dry deciduous and Semi evergreen forest of Kalrayan hills whereas Fabaceae was the dominant family followed by

Combretaceae in dry deciduous scrub forest, southern tropical hill forest and southern dry mixed deciduous forest in Pachamalai hills.

- In Kalrayan hills the dry deciduous forest scored highest Shannon – Weiner index when compared with semi evergreen forest. In Pachamalai hills the dry deciduous scrub forest scored highest Shannon – Weiner index when compared with southern dry mixed deciduous forest and southern tropical hill forest
- Species richness was found to be highest in dry deciduous forest of Kalrayan hills and highest in dry deciduous scrub forest of Pachamalai hills
- The results showed that the plot applied with gliricidia GLM cut at the interval of 6 months, 1m above ground level and applied as soil incorporation recorded more plant height, number of tillers, DMP and grain yield in Ragi.
- The results showed that the plot applied with gliricidia GLM cut at the interval of 6 months, 1m above ground level and applied as soil incorporation recorded more plant height, number of tillers, DMP and grain yield in barnyard millet.
- The results showed that the plot applied with gliricidia GLM cut at the interval of 4 and 6 months, 1m above ground level and applied as soil incorporation recorded more plant height, Root length, DMP and Pod yield in groundnut.
- The height and the basal girth of the trees were recorded at tri-monthly interval.
- The results showed that all the three tree species are performing well. Among the three fodder tree species, *Albizialebbek* (Vagai) recorded the maximum height growth and basal girth followed by *Pterocarpusmarsupium* (Venkai) and *Thespesiapopulnea* (Poovarasu).
- The observations on biometrics of fodder crops were taken and the results revealed that, among the fodder crops fodder sorghum (CoFS-29) recorded the maximum green and dry fodder yield followed by cenchrus and stylosanthus and the lowest yield was recorded in desmanthus.
- During the second year the reduction in the yield of fodder crops was noticed due to above and below ground interaction among the fodder trees and fodder crops.
- Among the ten tree species evaluated under nursery conditions, three tree species viz., *Meliadubia*, *Dalbergiasisoo* and *Ailanthus excelsa* expressed superiority for eight biometric traits viz., plant height, collar diameter, volume index, shoot length, root length, fresh weight, dry weight and number of branches at 180 days when irrigated with treated domestic sewage water.
- The height growth of the tree seedlings 14 months after planting when irrigated with treated domestic sewage water was maximum in *Meliadubia* (341 cm) followed by *Eucalyptus tereticornis* (260 cm), *Dalbergiasisoo* (218 cm), *Acrocarpusfraxinifolius* (189 cm) and *Neolamarckiacadamba* (156 cm). The collar diameter of the planted seedlings 14 months after planting was highest in *Meliadubia* (84 mm) followed by *Eucalyptus tereticornis* (76 mm), *Dalbergiasisoo* (62 mm), *Acrocarpusfraxinifolius* (48 mm) and *Neolamarckiacadamba* (39 mm).

- The soil physical properties viz., Bulk density, Particle density and Porosity did not vary considerably, but a slight decrease in bulk density and particle density were observed. The soil pH slightly decreased, the organic carbon content was increased when irrigated with treated domestic sewage water for six months. The available macro and micronutrients in the root zone of the soil was increased Due to the addition of organic carbon content from treated domestic sewage water the Dehydrogenase enzyme activity was increased in the root zone of *Eucalyptus tereticornis* and *Dalbergiasissoo*. The rhizosphere microbial analysis revealed maximum number of colonies of bacteria, fungi and actinomycetes in root zone of *Dalbergiasissoo* irrigated with treated domestic sewage water.
- In ecophysiological behaviour of trees, photosynthetic rate, transpiration rate and stomatal conductance was found to be higher in *Dalbergiasissoo* and *Eucalyptus tereticornis*. The inter Cellular CO₂ concentration (CINT) was high in *Meliadubias* six months after planting.
- North western zone of Tamil Nadu was recorded maximum seed yield, tamarind kernel powder (TKP) outturn and tamarind seed gum (TSG) production than other six agro-climatic zones.
- Tamarind germplasm namely PKM 1, Urigam, Sweet Tamarind, Red Tamarind , Mullampadi, Hasanur 07, Hasanur 10, Salem 132 and Salem 201 were planted in Tamarind gum garden at FC&RI, Mettupalayam.
- Tree gum garden was established at FC&RI, Mettupalayam and the Gum yielding trees planted are *Buteamonosperma*, *Acacia nilotica*, *Moringaoleifera*, *Lanneacoromandelica*, *Azadirachtaindica*, *Acrocarpusfraxini folius*
- Age-class of 40-50 years was observed maximum seed yield, tamarind kernel powder (TKP) outturn and tamarind seed gum (TSG) production.
- The model tamarind processing unit was established at FC&RI, Mettupalayam with tamarind decorticator, tamarind dehuller and seed pulverizer with user friendly mechanism.
- The 30 per cent pruning intensity in the tamarind plantation helped in increasing thenutrient status of leaf (Total nitrogen, total phosphorus and total potassium), chlorophyll content, biochemical attributes and tamarind fruit yield.
- The carbon footprint for the 10 institutions/schools was calculated.
- The biometric attributes and scientific assessment of carbon sequestration in the existing trees for 10 institutions/schools was estimated.
- Totally 25,000 seedlings were planted in 10 institutions/schools. And the biometric data and scientific assessment of carbon sequestration for the planted seedlings was taken in a regular interval.
- The waste generated from the institutions/schools was utilized for mushroom cultivation in 10 carbon neutral institutions/schools.
- The nature awareness campaign like jungle strolling, snake handling techniques, Bird and animal watching in forest were given to 10000 students, 550 teachers for all 10 carbon neutral schools/institutions.
- The biometric attributes and yield table curve was constructed for *Meliadubia* in Western zones of Tamil Nadu (Erode, Coimbatore).

- The biometric attributes and yield table curve was constructed for *Tectonagrandis* in Cauvery delta zones of Tamil Nadu (Trichy, Tanjaore, Thiruvavarur).
- The biometric data for *Gmelinaarborea* and *Ailanthus excelsa* were collected in Cauvery delta zones and western zones of Tamil Nadu.
- *Melia* progenies differed significantly and two potential progenies have been identified based on growth and development.
- Eleven species have been identified as potential and alternate plywood species and the species evaluation has identified superiority of Kadam, Khaya and *Toonaciliata* in terms of productivity.
- *Acrocarpusfraxinifolius* and *Maesopsisemini* have been identified as an alternate species found superior for plywood quality through physical and mechanical properties.
- Improvement of *Acrocarpus* has been initiated deploying 30 progenies and are under evaluation.
- Inventory of *Maesopsis* in Tamil and Karnataka has identified 15 potential progenies and are under evaluation.
- Silver oak has been identified as a species amenable for core veneer and improvement programme has been initiated with 20 progenies.
- Inventorized and identified predominant distribution of 21 indigenous species (*Azadirachta indica*, *Lanneacoromandelica*, *Thespesiapopulnea*, *Tectonagrandis*, *Acacia planifrons*, *Polyalthialongifolia*, *Terminaliaarjuna*, *Alstoniascholaris*, *Aeglemarmelos*, *Pongamiapinnata*, *Madhucalongifolia*, *Calophylluminophyllum*, *Cassia siamea*, *Erythrina indica*, *Acacia nilotica*, *Dalbergiasissoo*, *Albizzialebeck*, *Sterculiafoetida*, *Hibiscus tiliaceae*, *Switenia mahogany* and *Eugenia*)
- Three species viz., *Thespesia*, *Albizzia* and *Lannea* were dominant across coastal district.
- Tree improvement programme has been initiated by collection superior progenies in the following species viz., *Thespesia* (20 Progenies), *Lannea* (30 Clones) and *Albizzia* (30 progenies),
- New species like *Acacia* (9 hybrids), *Dalbergia* (DS 18) and *Anthocephalus* (AC7) have been introduced for amplified screening tests.
- Seventy five clones have been selected which incorporated 20 clones in *Casuarina*, 30 clones in *Melia* and 25 clones in *Kadam*. These clones are under evaluation through systematic clonal tests.
- The mini clonal multiplication process standardized and followed for *Casuarina* and *Meliadubia*.
- The superior selected trees after harvesting were billeted and deployed for wood analysis.
- The basic density varied between 429 Kg/m³ (*Kadam CL 01*) and 441 Kg/m³ (*Kadam CL 11*) in case of *Kadam* genetic resources.
- The basic density of *Melia dubia* varied between 504 Kg/m³ (CL 30) and 537 Kg/m³ (CL43)
- The pulp quality analysis in *Melia* exhibited average hollocellulose content of 67%.

- The DUS traits have identified distinct markers in bark of both Melia and Kadam. The stem and leaf traits based characterization have also been completed for these two species.
- The Kadam bark exhibited three distinct colours viz., Brown, light brown and black.
- The stem of the Melia genetic resources have been characterized based on the size and frequency of lenticels
- 138 Stakeholders have been linked in the consortium which incorporated 17 industries, 32 Scientists, 48 farmers, 38 rural industries and 3 financial institution.
- Organized First Annual Workshop on 21.09.2016 inviting all stakeholders and the existing constraints in Production to Consumption in industrial agroforestry have been identified.
- A new industry viz., M/s. Century Ply / Sharon Ply have enrolled as a member and MoU has been signed for strengthening education and research activities
- Policy guidelines have been prepared for implementing agroforestry policy in Tamil Nadu and the proposal has been sent to Govt. for implementation.
- Around 1500 beneficiaries visited the agroforestry department during the last 10 months and are exposed towards the various consortium activities.
- In Thengumaragadha area, almost 75 ha of reserve forest land under alien invasive (*Prosopis juliflora*) was eradicated during 2014-15. This alien invasive clearance had given a positive impact towards enhancement of biodiversity.
- Based on baseline biodiversity study, we have witnessed *Prosopis* as a dominated tree species in Thengumaragadha area and the indirect evidence of large mammals were also very less, but the present investigation has witnessed *Acacia planiferon* as dominant tree species and *Solanum torvum* dominant shrub species even the soil conditions were also improved. Now we have witnessed many direct and indirect evidence of wild animals like Black buck, Spotted deer, Sambar deer, Indian Guar, Sloth Bear, Dholes, Leopard and Tiger
- The habitat conditions like crown density, cover density and grass density was also increased.
- We have also witnessed the spreading of *Prosopis* in the cleared areas due to wind and animal dung, so it has to be monitored regularly and timely eradication is needed to ensure the growth of native flora and fauna
- Survey was conducted in four villages of Pachamalai hills of Trichy forest Division.
- The survey revealed that Nine commercial NTFPs (Bamboo, Honey, Myrobolan, Mango, Amla, Soapnut, Naval, Tamarind, *Acacia concinna*) were collected seasonally and occasionally
- Survey was conducted in three villages of Kalrayan i hills of Attur forest Division
- The NTFPs like *Terminalia chebula*, *Emblica officinalis*, *Phoenix spp.*, *Tamarindus indica* and honey were the common important commercial products collected in almost all the four villages of Pachamalai hill.

- The NTFPs like *Terminalia chebula*, *Phyllanthus emblica*, *Cycasspp*, *Tamarindus indica* were the common important commercial NTFPs collected in the identified three villages of Kalrayan hill .
- Mass propagation techniques for *Acacia concinna*, *Sapindus emarginatus* and *Syzygium cummunii* has been carried out.
- Among the various treatments the seeds of *Acacia concinna* scarified with commercial grade H₂SO₄ for 12 minutes and overnight soaking in 0.5% of KNO₃ has enhanced the germination to 79%.
- With different methods of seed treatments the seeds of *Sapindus emarginatus* treated with commercial grade H₂SO₄ for 12 minutes and soaking for 3 hours in vermiwash enhanced the germination upto 70%.
- Coldwater soaking of *Syzygium cummunii* seeds for 18 hours improved the germination to 87%.
- Preparation of cuttings and treatment with different concentrations of growth hormones (IBA) for *Acacia concinna* and *Sapindus emarginatus* is under progress.
- Survey was conducted in Palani hills (Kadasai Kadu, Bharathi Anna Nagar and Sowrikadu)
- The data collected from the survey revealed that the major NTFP's collected by the local forest dwellers were Honey, Phoenix grass (Eacham Pul), Amla, Myrobolan, Lichens and some edible tubers.
- The collected NTFP's were marketed through middle man.
- The livelihood of the forest dwellers of the Palani hills is being significantly contributed by the above mentioned NTFP's collection and sale.
- Significant differences were observed in the biometric traits viz. tree height, basal diameter and number of branches in two trials at Mettupalayam and Devanurpudhur
- Pod length ranged from 20.5 cm (Kallar progeny MTPCP 8) to 37.1 cm (Paramakudi progeny MTPCP 37)
- Veerapandi progeny (MTPCP 2) recorded the lowest floss weight (20.8 g) and Mettupalayam progeny (MTPCP 4) recorded the highest floss weight after drying (40.5 g)
- Salakudi progeny (MTPCP 38) recorded the lowest number of pods (74 pods) while Arachalur progeny (MTPCP 8) recorded the maximum number of pods per tree (357).
- An experimental trial comprising six promising progenies viz. Thalamalai I, Kallar, Thalamalai II, Mettupalayam, Neithalpuram and Kodipuram was established at Mondipatti., Trichy district.
- Significant differences were observed among the progenies for growth traits viz. girth at breast height and total height at 9 MAP and 12 MAP.
- Biometric data was recorded in main crop (*Casuarina*) and intercrops at 9, 12 and 15 MAP
- Significant differences were observed in the growth traits of the main crop
- Green fodder yield was maximum in *Casuarina* + *Sesbaniagrandiflora* followed by *Casuarina* + *Leucaenaleucocephala*.

SERICULTURE

Mulberry

Crop Management

Comprehensive nursery management in mulberry

- Application of FYM @ 20 t/ha or 12.5 t of composted coir pith, VAM@ 100g/sq.m, soil application of *Trichoderma viride* and *Pseudomonas flourescens* @ 2.5 kg/ha each, continuous mulching for 5 cm height and dipping the saplings in Azospirillum solution (1 kg in 40 litres of water) for 30 minutes before planting.
- Use of comprehensive package for mulberry nursery resulted in 92.0 % sprouting against 62.0 % in farmers practice with a benefit cost ratio of 3.54.

Micronutrient mixture for enhancing quality mulberry leaf production

- Foliar application of micronutrient mixture (ZnSO₄ 1% + FeSO₄ 2% + Borax 0.4 % + MnSO₄ 1 %) on 15th and 30th day after pruning was found to be more efficient in enhancing the leaf quality and yield of mulberry and increasing the silkworm characters and cocoon productivity.

Sericulture based Integrated farming system

- Sericulture as an important component in IFS was found to be more remunerative than crop and animal component (goat and poultry) with additional income of Rs. 90, 000/ha/yr.

Crop Protection

IPM for leaf webber management

- Flooding of mulberry field immediately after pruning to expose the leaf webber pupae.
- Release of pupal parasitoid, *Tetrastichus howardii* @ 50, 000/ ha on next day after pruning followed by release of egg parasitoid, *Trichogramma chilonis* @ 5cc/ha at 10 days after pruning.
- Spraying of Dichlorvos 76 WSC @ 1ml/litre on 30 days after pruning.
- Clipping and burning of affected shoots.

Integrated management of mulberry root rot

- Microbial consortia for root rot management was developed by involving consisting of *Trichoderma viride*, *T. harzianum*, *Bacillus subtilis* and *Pseudomonas flourescens* @ 100g/plant.
- Drenching of 0.1 % ZnSO₄ + 0.1 % carbendazim thrice at monthly intervals was found to be effective in the control of mulberry root rot disease.

Silkworm

Quality Improvement

Food supplementation for higher cocoon yield

- Soya flour @ 5g/kg of shoot and 10 g/kg of leaves are effective in improving the quality of mulberry leaves and thereby enhancing cocoon yield by 9kgs/100 dfls with a cost benefit ratio of 1.3: 33 and 1:4.6 respectively.

- Application of Illamathi (phytojuvenoid hormone) during second day of fifth instar @ 1 ml/litre (5ml/100 DFLs) for increasing cocoon yield @ 8 kg per 100 dfls.
- Exogenous application of amino acids @ 100 ppm (glycine, alanine and serine) and minerals @ 200 ppm (calcium chloride, zinc chloride and potassium chloride) was found to increase larval weight, cocoon weight, shell weight, fibroin content, filament length, denier and silk productivity.

Protection

TNAU seri dust for management of silkworm disease

- Application of TNAU seri dust @ 4kg/100 dfls resulted in an additional yield of 6.44 kgs/100 dfls and had broad spectrum activity against grasserie and flacherie disease of silkworm.

Technology for management of flacherie disease of silkworm using paint products

- Leaf treatment with 1000 ppm chloroform extract of botanicals *Thuja orientalis*, *Aegle marmelos* and 500 ppm of Streptomycin sulphate @ 5 litres spray solution for 100 dfls and feeding worms with treated leaves after second, third and fourth moult respectively resulted in additional income of Rs. 1733/100 dfls and incremental cost benefit ratio of 5.42.

Eco friendly technology for management of grasserie disease of silkworm

- Administration of 800 ppm hexane extract of *Plectranthus ambonicus* immediately after second moult, third moult and gentamycin (50 ppm) after fourth moult through leaf dip method and use of TNAU seri dust @ 4 kgs/100 dfls .

Integrated pest and disease management package for silkworm

- Grasserie management: TNAU seri dust as bed disinfectant @ 4 kg/100 dfls and *Psoralea corylifolia* spray @ 800 ppm during third instar.
- Flacherie management: Application of chloromphenicol @ 500 ppm during third, fourth and fifth instar.

IPM package for Uzi fly management

- Nylon net fixed on doors and windows.
- Application of uzicides @ 5 litres/100 dfls during third, fourth and fifth instar.
- Release of hyperparasitoid, *Nesolynx thymus* @ one lakh adults /100 dfls during third, fourth, fifth instar and after harvest.
- Installation of uzitrap using azipore @ 25 ml/litre and changed once in every three days from third instar stage onwards.

Value Addition in Sericulture

- Chitin and chitosan extracted from silkworm pupae are found to have antibacterial activity.
- Pupal powder, chitosan and pupal oil have antioxidant activity.
- Chitosan and pupal oil found to possess wound healing activity.

HOME SCIENCE

Processing of *Moringaoleifera* leaves and its products as an income generating activity

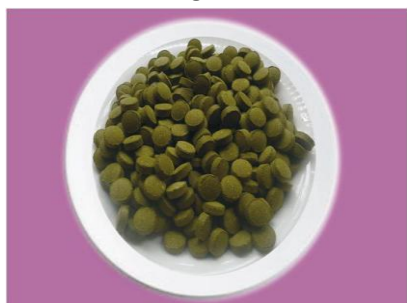
- Commercially viable value added products form moringa leaves were developed by using standard technologies.
- A suitable drying technique for moringa leaves has been developed with maximum retention of β -carotene (14.31 mg), calcium (2003 mg) and iron (26 mg). The dried samples could be stored at ambient temperature in MPP packaging for a period of six months.,
- By using dried leaves and powder value added products viz ; soup mix, rice mix, pickle and spiced products etc were developed suitable for domestic and export market.
- Nutrient analysis of the products prepared from the fresh and dried moringa leaves have shown that there is an increase in the β -carotene, calcium, iron and crude fibre.
- The developed technology was transferred through training programmes and entrepreneurs are at present adopting the viable technologies.
- The cost of the different moringa products were within the range of Rs.150-200/kg



Moringa leaves



Moringa leaf powder



Moringa Leaf cube

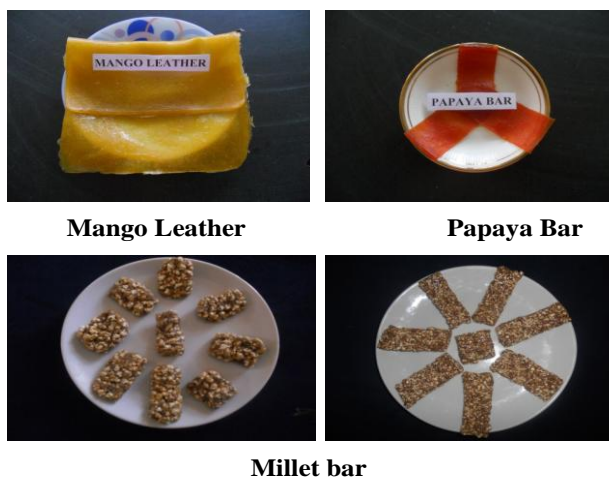


Moringa products

Millet Fruit Bar

- Whole puffed sorghum (35 g), flaked and gritted bajra (7.5 g) and finger millet (7.5 g) grits were utilized for producing an acceptable millet bar.
- To enhance the nutrient content in terms of protein and fat roasted whole bengal gram(30 g), roasted and peanut grits (10g) were incorporated in the millet bar.

- The palatability and nutrient content of the millet bar was further improved by adding intermediate moisture fruit product – mango leather (10g).
- Jaggery syrup in hard crack stage yielded a good texture to the product. The product had high energy of 137 kcal, protein 3.65, iron – 1.73 mg% and calcium – 35.15 mg% per serving (25 g).
- The product packed in metalized polypropylene pouch has a shelf life of about 6 months.
- An acceptable, healthy snack bar can be prepared using low cost millet products and fruits. A variety of millet fruit bars can be produced by varying the fruit bars, nuts and chocolate thus varying the flavours.
- The cost of fruit bar is Rs. 10.69 / 25 g.



Quality evaluation and product development of Kavuni rice (*Oryza sativa*)

- Kavuni rice (black rice), red rice (TPS-1) and white rice had crude fibre content of 3.49, 3.83 and 3.21 per cent respectively. The amylose content was 33.2, 24.5 and 48.5 per cent respectively. Kavuni rice had the lowest amylose content.
- Phenylalanine was the most abundant amino acid and lysine was the limiting amino acid. The chemical score was calculated with kavuni rice, red rice and white rice having a chemical score of 55, 59 and 61 mg/gN respectively compared to 100 mg/gN in reference protein (egg protein).
- Linoleic (18:2), and oleic acid (18:1), were found to be the major fatty acids followed by palmitic acid (16:0). Arachidonic acid (20:4) was present in both black and red rice varieties, while it was not deductable in the white rice. The glycemic index (GI) of the test food (pittu) prepared from the selected rice varieties (glutinous white rice, black rice, and red rice varieties viz., TPS-1 and TKM-9) were assayed and compared with that of the reference food. The GI was maximum for glutinous white rice (78) and lowest for red rice TPS-1 (44) compared to black rice and TKM-9 which had GI of 61 and 51 respectively.
- The red rice varieties fall under the category of low GI food, black rice as intermediate GI food and the glutinous white rice falls under the category of high GI food.

- The glycemic load, with lowest values recorded for red rice varieties TPS-1 (16), followed by TKM-9 (19.0), black rice (23.2) and highest values for glycemic load was observed in white rice (33).

Novel Approach on gluten free formulation of pasta products

- Amaranth flour, rice flour, corn flour, tapioca flour and potato flour were used as novel ingredients in the development of gluten free pasta products.
- Standardized the gluten free pasta products (noodles and macaroni) by using amaranth flour as base and other flours viz., rice flour, corn flour, tapioca flour and potato flour were used in different proportion.
- The amaranth flour (60%) and corn flour (40%) was found to be the best combination and the acceptability was also higher with the score value of 8.0
- The nutrient analysis of the pasta product prepared with amaranth and corn flour was having higher protein, calcium, iron, fibre, magnesium and manganese when compared with the pasta prepared from refined wheat flour

Assessing the health and nutritional profile of the workers in small scale fruit and vegetable processing and bakery and confectionery units in Madurai District

- Total number of women workers surveyed in food processing unit (fruit vegetable, bakery and confectionery units)
- The mean age of the food processing workers was 34.80 ± 10.10 years. Eighty six per cent of the women workers were married and the workers were of semi skilled and unskilled workers.
- Only 34 per cent of the workers had primary school education followed by 32 per cent had education upto high school level.
- Sixty four per cent were from nuclear family and only 36 per cent were from joint family. Families of 62 per cent of the workers had four to six members. The average total monthly family income was Rs. 13367.35 ± 4007.51 .
- The mean age of entry into food processing units was 27 ± 8.2 years. Their work experience ranged from one year to 38 years with a mean of 8 ± 7.9 years.
- During regular days, workers spend more than 10 hours in food processing units which is over and above their household activities and during festival seasons (i.e. peak days), workers are made to work between 11 and 12 hours per day.
- The Health profile of the women workers were assessed in terms of body mass index systolic and diastolic and blood glucose level.

Development of functional capabilities of rural women on sustainable agro processing technologies for income generation by developing marketing network

- Nutrient analysis, shelf life study was done for the standardized millet products. The standardized food mixes had the shelf life up to six month in

MPP packaging. All the standardized products had overall acceptability of 82 to 89 percent.

- Assessed the cost analysis of the standardized products. The cost of the products per kg was worked out as for spiced chappathi mix (Rs. 95/-), health mix (Rs.91/-), murukku mix (Rs.200/-), multigrain food mix (Rs.155/-), spiced dosa mix (Rs.152/-) and multigrain roti mix (Rs.118/-).
- An effort has been taken to transfer the technology to the entrepreneurs by conducting capacity building and skill development programme.
- 22 – Awareness programme was conducted in collaboration with State Department of Agri and Agri Marketing and NGO's.
- 11 – Capacity building programme on Processing of Agro based Value added products was conducted.
- Conducted Vendor Development Programme and Buyers-Sellers Meet in collaboration with MSME, MADITSSIA, NSIC and Central Bank of India on 30.12.2014 at Madurai.

Ergonomic Interventions to promote Occupational Health and Safety of Women Workers employed in Small Scale Food Processing Units

- One hundred and thirty two women workers were assessed for their lung function performed spirometry test .
- The worker's age, height and weight were recorded for use in calculation of reference values .
- The results indicated a lower level of lung function parameters among 40% of the women workers as against their actual predicted values.
- There was a reduction the lung function parameters with increase in age , years of experience and their exposure level to dust

Development of Innovative High value Pulse based food products with enhanced functional and nutraceutical properties of potential utilization (F38HU)

Development of pulse based functional foods

Gluten free noodles

- Multigrain formulations from lentil flour (13 to 63 g), barnyard millet flour (13 to 63 g) and corn flour (20g) were computed using Response Surface Methodology (RSM) for the development of Gluten free noodles.
- Based on the experimental trials, the optimum formulation for gluten free noodles was lentil flour- 63g, barnyard millet flour-13g, corn flour-20g, xanthan gum-2g and salt – 2g based on the response factor of hardness (N), bulk density (g/cm^3), diameter (mm), lateral expansion (%), water absorption index (gel/g), water solubility index (%), overall acceptability, cooking time (min.), water absorption (%) and cooking loss (%). The formulation also had high protein ($13.6 \pm 0.22\text{g}/100\text{g}$) and fiber content ($2.89 \pm 0.04\text{g}/100\text{g}$), and low in fat content (7.36 ± 0.23).

Gluten free eggless cake from ready to bake cake mix

- Experimented gluten free eggless cake from ready to bake cake mix from six treatment combinations based on chickpea flour and barnyard millet flour.
- Based on the sensory evaluation, the highly acceptable cake combination comprised of 50 to 70% of chickpea flour, 25 to 30% of barnyard millet flour and 10 to 20% of corn flour with 1.5% xanthan gum and 1.5% sodium bicarbonate.

Pulse based Dhokla mix

- Dhokla was experimented from different pulses (red gram, lentil, peas, green gram and horse gram) at level of 50-100% incorporation with Bengal gram (standard). The process parameters such as soaking time of pulses, fermentation time, temperature, steaming, addition of food additives was varied as per the treatment combinations. Processing conditions to optimize product acceptability were experimented so as to produce highly accepted dhokla with 100 per cent pulse flour. The ready to cook dhokla mix were standardised as per the above formulation. The physical characteristics of the product such as height, volume and texture and chemical constituents such as moisture, protein, fat and crude fibre were analysed. Storage study of the ready to cook dhokla mix is in progress.

Pulse based Yogurt

- Pulse based yogurt was standardised using starter cultures viz., *Lacto bacillus delbrueckii var bulgaricus* and *Streptococcus thermophilus*. The selected pulses namely lentil, peas, green gram, chick pea were soaked and the pulse milk was extracted and combined at different levels of 25, 50, 75, and 100% of pulse milk to toned milk, pasteurized and inoculated with the selected starter culture.
- Based on the sensory evaluation, 1:1 of pulse and toned milk formulation was found to be on par with control followed by 3:1 combination. Moisture content of the yoghurt was standardised as 86 - 89%, pH 4.0 - 4.5. Total soluble solids of pulses milk was found to be 8 - 9°Brix, total acidity in terms of lactic acid percentage was in the acceptable limit of 0.6 to 1.1% in all combinations of each pulse yogurt. The protein and fat content of the yogurt samples were analysed. Storage study of the yogurt has been initiated and determination of changes pH, acidity and viable cell count during storage is in progress

Dissemination of Nutri Knowledge among the Rural Women and Children for their Nutritional Security through Participatory Approaches in Madurai District

- Baseline survey was conducted with 180 respondents in Madurai District to study the existing socio-economic conditions of the rural women and

children. The existing dietary pattern and nutritional status was assessed using Anthropometry and dietary survey methods.

- Based on survey results the nutritional requirements was assessed through participatory approaches like Focus Group Discussion, PRA Methods, Group meetings etc., While seeing the dietary and intake pattern, fast foods, junk foods and maida based foods are the dominant foods taken by majority of the respondents.
- Hence the major nutritional requirements needed for the respondents are related to iron rich foods, calcium and protein rich foods and millet based food products. They also had very poor nutritional awareness and knowledge on major food groups and balanced diet.
- In order to disseminate the nutritional knowledge various extension approaches like home visits, Group Discussions, series of trainings, demonstrations on low cost nutritious recipes, discussions on importance of growth monitoring and child nutrition, technology week, exhibitions, nutrition week and nutrimela, nutritious Quiz competitions, nutrition rally were conducted and publications distributed to give awareness among the rural women and children.
- The next stage in the projects is formation of Nutri Clubs. In each village one Nutri Club was formed to transfer the nutritional knowledge to the whole village people. Each Club consists of 10 -15 members and given different exposure/ capacity building on nutrition aspects.
- The project also focuses on the establishment of Nutri Gardens which increases the availability of greens and vegetables throughout the year for the attainment of nutritional security.
- Assessing the direct and indirect perceived impact due to interventions is in progress using interview schedule and participatory methods.

Dehydration of egg fruit

- Foam mat drying techniques was found to be highly suitable technique for processing of fruit powder using guar gum (3%) with a whipping time of 20 min.
- Gallic acid (15.35 mg) and quercetin (14.78 mg) were found to be the major phenolic compounds.
- More than 60 percent retention of polyphenolic compounds and 66 percent retention of bioactive compounds observed in egg fruit powder.
- Egg fruit powder could be substituted in cake, ice cream mix and in biscuit upto 25% level.



Noni fruit squash

- Noni fruit was used for processing of noni fruit juice blended squashes by extracting juice.
- Maximum yield (52.47%) of juice was obtained by cold processing (freezing for 24 hours and thawing) treatment method.
- The noni fruit juice blended squashes were prepared by using amla juice, sathukudi juice and grape juice. Squash was processed with blended juice as per FSSAI (2006) specification.
- Organoleptic evaluation showed that noni juice (80%) and amla juice(20%) was found to be highly acceptable.



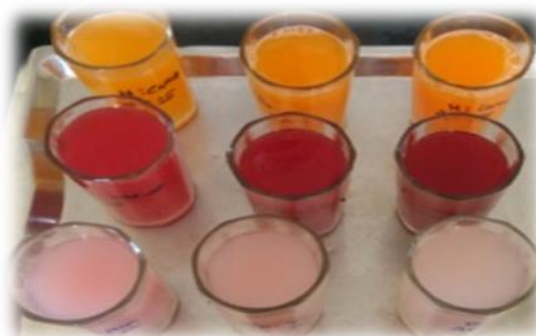
Noni Fruit



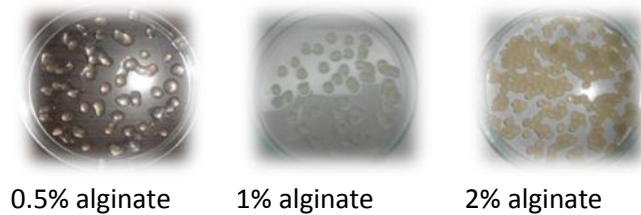
Noni fruit juice blended squash

Non dairy probiotic RTS beverage

- Non dairy probiotic RTS beverage was developed with the combinations of pine apple + cucumber, water melon +tomato,beetroot + orange, muskmelon + carrot, pomegranate +pumpkin in different ratios viz, 75:25, 50:50 and 25:75 with four strains of probiotics.
- Based on sensory evaluation the best combinations were 50:50 ratios of beetroot + orange and carrot + muskmelon, 25:75 ratios of cucumber + pineapple, tomato and watermelon, pomegranate + pumpkin.
- Among the probiotic strains used,*Lactobacillus acidophilus* NCDC 11,*Lactobacillus plantarum*NCDC 25 showed maximum acid and bile tolerance.
- To increase the viability of probiotic cells, encapsulation was done with sodium alginate 0.5%, 1% and 2%. Among which 2% sodium alginate formed stable beads with the cell load @ 10^8 log cfu/ml.



Non dairy probiotic RTS beverage



Probiotic fruit yoghurt

- Plain yoghurt was standardized with the commercial yoghurt culture NCDC 260 @ 2% level. Fruit yoghurt was standardized using banana(5,10,15%), papaya(5,10,15%), sapota(7.5,10 %) and custard apple(7.5,10%).
- Organoleptic evaluation of the product was assessed and found fruit yoghurt with 10 % of fruit pulp(banana, sapota and custard apple) had better score values in terms of quality attributes.
- Probiotic yoghurt was standardized with the commercial yoghurt culture NCDC 260 along with probiotic cultures (*L.casei*NCDC 298, *L. rhamnosus*NCDC 19, *L. plantarum*NCDC 25) @ 2% level (1:1 ratio). Organoleptic evaluation of the product was assessed and found probiotic yoghurt with *Lactobacillus casei* had better score values in terms of quality attributes.
- Probiotic fruit yoghurt from *L.casei*NCDC 298, *L.rhamnosus*NCDC 19, *L.plantarum* NCDC 25 was incorporated with mango and sapota pulp @ 5%, 10% and 15 % and 6 ml of sugar solution (TSS- 62⁰ brix). Among the trials probiotic fruit yoghurt with 10% of sapota pulp and mango pulp had better score value in terms of quality attributes.

Nutritional and phyto-chemical components of *Cocosnucifera* vegetative bud

- *Cocosnucifera* vegetative bud has good effect on curing the ailments related to gastro intestinal tract like stomach pain, peptic ulcer, jaundice,kidney problem etc., as per the local vendors and traditional medicinal practitioners.
- *Cocosnucifera* vegetative bud was analyzed for its nutritional and phytochemical properties.
- Nutrients like crude fibre (6.27 %), starch (1.6 %), fat (2.36 %), protein (2.71%), ash (9.32%) and moisture (81.37%) were found
- It has near neutral pH (6.37) and acidity (3.07%).
- *Cocosnucifera* vegetative bud contains phosphorus-0.24g,potassium-1.68 g, sodium- 1.79g, calcium -0.80g, magnesium -2.54g iron -205.0 ppm, manganese -279 ppm, zinc -44.9 ppm and copper -1.74 ppm.
- Anti nutritional factors such as tannin -0.24g and phytic acid -1.5g content were also present in the bud.



Coconut vegetable bud

Microbial and heavy metals contamination in commonly consumed selected species of marine and inland fresh and dry fish

- Fresh inland Ayirai and Viral varieties and marine fishes Nethili and Nagarai were collected from the local fish market for the study.
- Indigenous practices like washing with salt and turmeric at the concentration of 1,2 and 5% were tried to reduce microbial load in the sample.
- Moist and dry (deep fat) cooking was done to study the microbial load of the selected fish samples.
- Indigenous practices of washing the fishes with salt and turmeric at 1, 3 and 5% reduced the microbial load (Salmonella-Shigella, Vibrio and Coliforms)
- Among the different concentrations, the loads of the pathogens (Salmonella-Shigella, Vibrio and Coliforms) were decreased in the range of 50-60%, 20-40% and 15-33% after washing in 1% salt concentration, whereas it decreased to 16-25%, 10-42% and 33-44% by washing in 1% turmeric .
- The pathogens were found to be nil after when cooked by moist heat method (boiling at 100°C for 25 min) and dry heat method (deep fat frying at 175°C for 8 min) using indigenous practices.



Nagarai-SS agar (Salt wash @ 1 %)

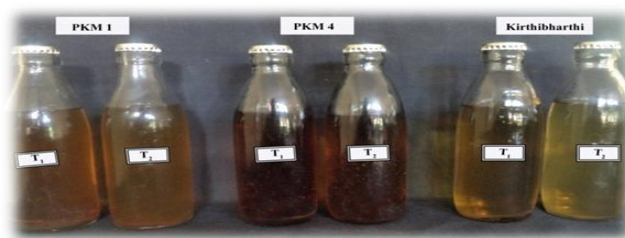


Nethili-VRBA (Salt wash @ 5 %)



Viraal- TCBS (Turmeric wash @ 5%)

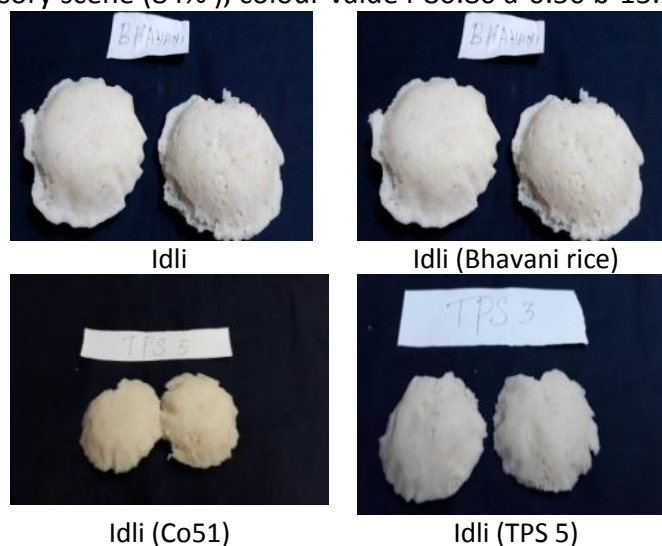
Development and standardization of sapota RTS to improve the economic status of sapota farmers



- Clarified sapota RTS has been processed by extracting juice from the matured, ripened sapota fruit
- The concentration of the enzyme, incubation temperature and time were optimized as 0.15 per cent pectinase enzyme + 0.05 % amylase enzyme at 45°C for 2 hours for the production of clarified RTS from sapota fruits.
- After incubation, the enzyme was inactivated by heating the pulp at 90°C for 5 minutes and then the juice was extracted from the pulp by filtering through double fold muslin cloth.
- The clarified sapota juice was pasteurized at 80° C and filled in sterilized glass bottles (200 ml) and sealed with a crown cork.
- The bottles were again pasteurized at 80°C for 20 minutes, cooled and stored at refrigeration temperature.
- The developed sapota RTS had a shelf life of ninety days.
- The cost of the developed sapota RTS was Rs.15.00/ 200 ml

Physico-chemical nutritional and functional properties of traditional unpolished rice varieties suitable for the preparation of ethnic foods of Tamil Nadu

- The rice payasam and fermented rice were prepared with TPS 5, TPS -3, CO-51 and bhavani rice.
- The rice payasam prepared using TPS was found to have highest sensory score (86%) among the other varieties. The fermented rice (palayasadham) prepared with Bhavani rice was found to have highest sensory score (88%), CO51 (84%), TPS3 (82%) and TPS 5 (80%). Idli with Bhavani rice found to have better sensory scene (84%), colour value L-80.80 a-0.50 b-13.71



Effect of processing on antinutritional factors and assessing the bio active components of proteins in selected TNAU pulse varieties

- Collected samples of Pulses :
Cow Pea varieties: Paiyur 1, Co4, Co6, VBN2
Black gram varieties : VBN(Bg) 6, MDU(Bg) 1, VBN(Bg) 4, VBN(Bg)8
Green gram varieties : Co 8, VBN(Gg) 3

- Among the Cowpea varieties the protein content was high in Paiyur 1 (25.85%) followed by Co6 In the blackgram varieties the protein content was high in VBN 4 (28.20%) followed by VBN 6. In green gram VBN 3 had highest protein (26.50%)
- Between the cultivars VBN 2 in cowpea (2450.23TIA /100 g) and MDU 1 in black gram (2000.56 TIA /100 g) and Co 8 (2509.98 TIA /100 g) in green gram had lower levels of TIA
- Among the treatments lowest TIA level was reduced by pressure cooking (69 to 82) as cooking inactivates. Highest reduction was in VBN 2 (71%) for Cowpea and CO4 (72 %). In blackgram VBN(Bg)6 and MDU(Bg) 1 had highest reduction of TIA 77 and 76 per cent respectively In greengram there was not wide difference between cultivars. (81-82%
- Sprouting of seed (39 to 57 %)was found more effective in reducing TIA . the reason could be mobilization and breakdown of chemical constituents including trypsin inhibitor

Effect of processing on the bioactive carbohydrates and dietary fibre of selected cereals

- The bioactive carbohydrates of wheat,maize,sorghum and oats in whole, grits and flour were analysed
- The total dietary fiber, resistant starch and β glucan content of the wheat grain was 12.60, 8.60 and 1.5 % respectively and the percentage retention of total dietary fiber content due to secondary processing methods ranged from 34.92 to 80.95 %
- . The percentage retention of total dietary fibre (80.95), resistant starch (90.70) and β glucan (80.0) content of the broken wheat was high followed by wheat flour (80.56; 54.65; 50.0), semolina (40.48; 63.95; 73.33), wheat flakes (68.73; 86.05; 66.67) and it was low in refined wheat flour (34.92; 9.88; nd).
- The percentage retention of total dietary fibre (74.48), resistant starch (90.33) and β glucan (55.83) content of the sorghum flour was high followed by sorghum flakes and it was low in puffed sorghum (28.57; 26.23; nd).
- The retention of dietary fiber, resistant starch and β glucan were higher in all the whole grains of wheat, maize, sorghum, and oats followed by the processed grains broken wheat and flours of wheat, maize, sorghum, and oats grains.



Wheat and its processed products



Maize and its processed products



Sorghum and its processed products



Oats and its processed products

Estimation of heavy metals in children foods and street food available in Madurai market

- Eight street food samples were collected from Madurai Simmakal Area commonly consumed by the children were analyzed for heavy metals were analyzed for heavy metals in AAS.
- Maximum lead content was present in cassava chips (0.455 $\mu\text{g/g}$), samosa (0.370 $\mu\text{g/g}$) and followed by Rose milk (0.65 $\mu\text{g/g}$) respectively. Maximum permissible limit of lead content was 0.3 $\mu\text{g/g}$ in solid foods and in liquid foods the maximum permissible limit of lead is 0.5 $\mu\text{g/g}$.
- Maximum cadmium content was present in cassava chips (0.0378 $\mu\text{g/g}$), Karasev (0.383 $\mu\text{g/g}$) and followed by Badam Milk (0.492 $\mu\text{g/g}$) respectively. Maximum permissible limit of cadmium content was 0.3 $\mu\text{g/g}$ in solid foods and in liquid foods the maximum permissible limit of cadmium is 0.5 $\mu\text{g/g}$.
- Maximum Nickel content was present in Karasev (0.117 mg/kg) and Raw banana bajji (0.131 mg/kg) and followed by Rose milk (0.196 mg/kg) respectively. Maximum permissible limit of Nickel content was 0.14–0.15 mg/kg in solid foods and in liquid foods the maximum permissible limit of lead is 1.0 mg/kg.

CENTRE FOR AGRICULTURAL AND RURAL DEVELOPMENT STUDIES

DEPARTMENT OF AGRICULTURAL ECONOMICS

GOI/CARDS/CBE/AEC/1970/R01 Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in Tamil Nadu (Since 1971)

- The Commission on Agricultural Costs and Prices (CACP) primarily depends on the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, New Delhi for most of its data requirements relating to cost of cultivation / production of various agricultural commodities, and for the purpose the State Agricultural Universities collect representative data on inputs and outputs by cost accounting method through sample surveys under Comprehensive Scheme for Studying the Cost of Cultivation Scheme (CCS).
- The data on cost of cultivation forms an important basis for arriving at Minimum Support Prices (MSPs) of different crops, which are announced by the Government of India every year.
- Cost of Cultivation estimates are being generated for major crops from 1971-72 onwards.
- Compiled data for principal crops in Tamil Nadu, viz., paddy, maize, jowar, black gram, groundnut, coconut, sugarcane and cotton for the year 2015-2016 have been sent to the Directorate of Economics and Statistics, New Delhi.
- Cost accounting method is adopted for the collection of household level data from 600 farmers spread over 60 villages / clusters in 29 districts of Tamil Nadu.
- In order to ensure the quality data, a new system of collection of data in accordance with the questionnaires developed suitable for FARMAP package has been developed along with a set of instructions to collect data in these questionnaires.
- Data on cost of cultivation from the sample respondents and input and output prices data for the year 2016-17 have been collected and sent to the Directorate of Economics and Statistics, New Delhi.
- The data collected under CCS are used every year to assess varietal adoption and yield gap of major crops grown in Tamil Nadu and the following results were presented in Social Scientists' Meet – 2016 conducted in TNAU, Coimbatore.
- Results on 'Varietal Adoption' by the sample farmers during 2014-15 revealed that under paddy crop, 11 per cent of the farmers adopted ADT 43 followed by CR 1009 (9 per cent), ADT 45 (8 per cent) and ADT 37 (5 per cent). In black gram, ADT 3 variety was adopted by 52 per cent of the sample farmers followed by T 9 (13 per cent) and ADT 5 (12 per cent). In groundnut, TMV 7 variety was cultivated by 41 per cent of the sample farmers followed by VRI 2 (11 per cent).
- Yield gap analysis for major crops grown in Tamil Nadu was taken up using the cost of cultivation scheme data every year. During 2014-15, the yield gap

of major varieties ranged from 8 to 10 quintals per ha and for ground nut, the yield gap was around 3 quintals per ha.

- The Scheme data for major crops were provided to the Coimbatore District Central Co-operative Bank for fixing the 'scale of finance' for the major crops.
- Data were also provided to the National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi sponsored project on Regional Crop Planning for Improving Resource Use Efficiency and Sustainability for a period from 2013 to 2016.

DBT/CARDS/CBE/ AEC/2014/R10 Indo - Swiss Cassava Network Project: Socio - Economic Research in the Cassava Biotechnology Research Network in India (2014-17)

- Farmers predominantly cultivated H226 in drip irrigation system, Kunguma rose in ridges and furrow irrigation system and H165 in rainfed hill system due to higher yield and starch content.
- Farmers preferences for varieties were based on characteristics like high starch content, higher yield, resistance to drought, short duration and resistant to pests and diseases.
- Desirable quality parameters for cassava include starch content, duration of crop, time of harvest, flesh color, shape of tuber, absence of tuber neck and character of tuber skin.
- The total cost of cultivation of cassava was Rs. 59,214 in rainfed hill system to Rs.1, 08,744 per ha in drip system. The net income from the different production system ranged from Rs. 57,183 in rainfed hill system to Rs.1,19,614 in drip irrigated system.
- The cassava starch product chain is extensive, as the carbohydrate and binding properties of its starch allow for technical application across industries like textiles, paper, animal feed, food, adhesives, pharmaceuticals, biofuel, and biopolymers.

CARDS/CBE/AEC/2014/R04 Value Chain Analysis of Rice in Thanjavur, Pudukottai and Coimbatore Districts of Tamil Nadu (2014-16)

- The paddy value chain was traced for two varieties of paddy such as ADT 37 and BPT 5204 and for commodities such as branded rice and rice bran oil.
- In the study area, five marketing channels were identified among them, the channel: Producer - Rice Miller
- Consumer was found to be more efficient.
- Paddy value chain analysis indicated that there was no much value addition at the farm level and the value addition process begins from the rice miller.
- The value addition can be enhanced from existing Rs. 12,128 to Rs. 19,536 per tonne of ADT 37 paddy and from Rs.14,428 to Rs.21,326 in case of BPT 5204 variety through the enhanced value chain model that will benefit all the stake holders of paddy value chain.

CARDS/CBE/AEC/2016/R01 An Assessment of Performance of Regulated Markets for Reforming Agricultural Marketing in Tamil Nadu

- This research work was taken up as a component of Institution of Endowment Chair in Agricultural Marketing established with an endowment of Rs.50 lakhs in the Department of Agricultural Economics, Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University, Coimbatore.
- All Regulated Markets in the State (277 Nos.) were visited and the information on constraints and suggestions from farmers, traders and market functionaries (2016 - 2017) were gathered to assess their performance.
- The major constraints identified in the functioning of regulated markets in Tamil Nadu were:
 - As there is no uniform notification of crops across the districts in Tamil Nadu, the traders use it as an advantages for doing malpractices.
 - As one – third of the RMs are being functioning in rented buildings, adequate infrastructural facilities that are required by farmers and traders could not be established in the premises of RMs.
 - Immediate cash payment to farmers is a problem for traders, as the traders also need adequate time to mobilize funds and settle payment to farmers.
 - The pledge loan limit is very less and also storage period is not adequate to farmers.

DST/CARDS/CBE/ AEC/2013/R04 *Developing Computer Based Model for Impact Assessment of Watershed Development and Building Capacity in Tamil Nadu (2013-15)*

- Developed methodologies and framework for Impact Assessment of Watershed Development
- Developed a computer based model for impact assessment named “WatDIMP (Watershed Development Impact Assessment Model)

GOI/CARDS/CBE/ AEC/2014/R11 *Developing Guidelines and Methodologies for Socio-Economic Assessment of LMOs (2015-16)*

- The important maize varieties grown included NK 6240, Gargil 900, CP 818, NK 6668, Pioneer 3546, CP 828, Pioneer 828, and AP 244.
- Farmers used Atrazine (pre- emergence) and 2,4 - D (post-emergence) for weed control, with average quantity and price being Atrazine: 1.32 kg and Rs. 378.10 and 2,4-D: 1.29 kg and Rs. 382.50 (Both used within 3 days of sowing)
- The average quantity and price of the pesticides used for stem borer management were 482 ml per hectare and Rs. 829 per hectare, respectively.
- GM Trait valuation: Net change in income per hectare due to new traits in GM Maize (Kharif) varies from Rs.5028.62 to Rs.13705.52 [with an assumed yield increase from 5 to 15 per cent and 20 per cent increase in seed cost].

NCAP/CARDS/CBE/AEC/2013/R07 Regional Crop Planning for Improving Resource Use Efficiency and Sustainability (2014-17)

- In Tamil Nadu, about 30 (60%) out of 47 l ha of net sown area were under irrigation in triennium ending (TE) 2011-12. Irrigation covered only 46.88% of gross cropped area (GCA) in TE 1973 which has been increased to about 58% in TE 2013. Well irrigation was major source of irrigation (44%) followed by canal irrigation (24%), tank (16%) and tube well (15.57%) of the NIA (27.62 lha) in TE 2013-14.
- Profitability of pulses out beat the cereals profit by Natural Valuation (NRV) method of cost estimation.
- Region Crop Model (RCM) model mostly increased the area under cereals and pulses in the normal situation and slightly reduced the area under paddy and high water consuming crops (banana, sugarcane, and turmeric) in reduced water availability scenarios.
- The shadow price of water (Surface Water + Ground Water) is more in case of SW dominated zones viz., Cauvery delta, western and central zones (Rs.4/m³) than that of other zones (Rs.3/m³) indicating that more irrigation efficiency supporting programmes need to be focused in the SW dominated zones.
- In general, the optimal plans of RCM results revealed that there is a 72.77% increase in GCA over a current plan in market price scenario whereas it was more than 74% in other two scenarios. Considering the social point of view, the RCM model suggested new alternative crops sets that would result Rs.48.11, Rs.49.89 and Rs.49.65 billion of net income in three different scenarios.
- The increasing area under food grains in the RCM support for ongoing development programmes like ICDP, NFSM, ATMA, and RKVY. Hence, further intensification of the development programmes based on RCM results may be taken up.
- The shadow price of water is relatively more in food grain dominating Cauvery delta and Western zones than that of Southern and Northern zones. Hence, necessary supportive measures like micro irrigation system, soil and water conservation programmes and more location specific subsidy support in minor irrigation structures may be taken up to avoid more food grain production loss in the state during the water stress period.

SPC/CARDS/CBE/AEC/2013/R06 Preparation of Perspective Plans under State Balanced Growth Fund (SBGF) for Coimbatore District (2014-16)

- Number of Projects Proposed from the project (Poverty/Health – 7, Education – 6) : Rs.1637.97 crores
- State Planning Commission (SPC) sanctioned the following 3 projects for Valparai Municipality worth of Rs.825.34 lakhs:
- ✓ Augmenting Health Security by Creating Essential Infrastructural Facilities in Government Hospital, Valparai

- ✓ Augmenting Health Security by Creating Essential Infrastructural Facilities in Government Primary Health centre (PHC), Valparai and Sholayar Nagar (Tribal PHC)
- ✓ Improving residential school in Valparai

SPC/CARDS/CBE/AEC/2014/R09 Preparation of District Human Development Report of Coimbatore District (2014-16)

- Targeted approach for poverty alleviation through special schemes is necessary in Sulthanpet, Anaimalai and Thondamuthur blocks.
- Women empowerment programmes and women worker participation rates should get special emphasis in Anaimalai, Sulthanpet and Annur blocks.
- Focused and priority attention is needed in Anaimalai block to address infant mortality rate, mortality rate (under five of age), malnourishment of children and maternal mortality rate.

Impact Evaluation of Educational Infrastructure Projects Supported Under NABARD-RIDF in Tamil Nadu (2013-16)

- Forty five schools spread across three districts (Salem, Dharmapuri and Villupuram) in which the school infrastructure created under NABARD-RIDF were effective and created significant positive impacts both at school level and social level.
- The key impacts included increase in pass percentage and enrollment of students, decrease in drop outs, improvement in health conditions and female literacy at village level etc.
- It was found that the development of school infrastructure also created adequate employment and income to the rural households.

NABARD/CARDS/CBE/ AEC/2014/R08 Impact Evaluation Study on Irrigation Projects Supported under NABARD – RIDF in Tamil Nadu (2015-17)

- Impact on social status: Enhanced livelihood support activities like fishing, livestock animal
- Impact on Income and Employment: Increment income of Rs.5000/ha/year from agriculture
- **Impact on yield and production:** Increase in yield of crops particularly in rice has been observed in most of the project areas. In Erode district, the increase in yield in rice varies from five per cent in head and middle reach to nine per cent in tail region. In Dindigul district, the increase in yield in rice varies from one per cent in head and middle reach to eight per cent in tail region.
- **Cropping pattern:** Increased access to irrigation helped to achieve crop diversification and changes in cropping pattern. For instance, in Erode district, small changes in cropping pattern in tail region are noticed. A four per cent increase in banana and 2 per cent increase in sugarcane were observed in tail region.

- **Cropped area:** Increased water supply due to the intervention helped to expand cropped area. For instance, in Madurai district, the impact of the rehabilitation of KondamariOdai is expansion in cropped area of 814 hectares.

CIMMYT/CARDS/CBE/AEC/2015/R13 Production Risks and Welfare Implications of Maize Hybrids on the Subsistence Farms of South India (2015-16)

- In Irrigated maize, underutilization of seed, optimum N and Overutilization of P & K were reported in Tamil Nadu, In Karnataka, overutilization of seed, optimally used N and underutilization of P & K were reported and overutilization of seed & N, underutilization of P & K were reported in Andhra Pradesh.
- In rainfed maize, underutilization of seed, and overutilization of N, P & K were reported in Tamil Nadu; optimally used seed and overutilization of N,P & K were reported in Karnataka and in Andhra Pradesh, rainfed farmers overutilized seed, N, P & K.
- Farmers in Tamil Nadu were the most maize technically efficient maize producers followed by Karnataka and Andhra Pradesh farmers in irrigated maize.
- Tamil Nadu farmers were also the most maize technically efficient maize producers in rainfed maize cultivation followed by Andhra Pradesh and Karnataka farmers.
- Labour, seeds and number of irrigation were risk reducing inputs and agronomic practices and quantity of fertilizers were risk increasing inputs in Tamil Nadu.
- Labour, seeds and number of irrigation were risk reducing inputs and agronomic practices, frequency of visits of extension functionaries and quantity of fertilizers were risk increasing inputs in Karnataka.
- Labour, seeds and number of irrigation were risk reducing inputs and frequency of visits of extension functionaries and quantity of fertilizers were risk increasing inputs in Andhra Pradesh.
- Labour scarcity was the most important risk according to Tamil Nadu farmers' perception. The second most major risk was natural risk (drought, flood, wind, storms, etc.) followed by input risk (non-availability of inputs at the right time),
- But in Karnataka and Andhra Pradesh, the major risk was labour scarcity followed by price risk and natural risk. The price risk was major factor in deciding the area under maize cultivation. Among all the three states, the price of maize was the lowest in Karnataka.
- In Andhra Pradesh, as the state government announces Minimum Support Price (MSP) for maize, there was no price fluctuation in Andhra Pradesh.
- The risk attitudes of the sample maize farmers in three states showed that majority of the farmers (37 percent) were risk neutral followed by risk preferers (33 per cent) and risk averse (30 per cent).

- Maize is mainly marketed through two channels where channel I is farmers, village traders, wholesales then to processing and channel II is farmers, wholesalers then to processing without village traders.
- The degree of value addition at village trader stage is 1.6 per cent which is followed by 2.2 per cent at wholesaler level and 55.48 per cent at the processor level in case of poultry feed.
- The degree of value addition at village trader stage is 1.6 per cent, followed by 2.2 per cent at wholesaler level and 7.9 per cent at the processor stage in case of cattle feed.
- The degree of value addition at village trader level is 0.93 per cent, followed by 1.74 per cent at wholesaler level and 6.80 per cent at the processor level in case of starch production.

No.CARDS/CBE/AEC/2013/01 An Economic Analysis of Consumer Behaviour Towards Buying of Processed Small Millets Products in Coimbatore

- Most of the respondents (46.6 %) belonged to 35 years and above and nearly 66 per cent of the consumers were graduates.
- Around 86.6 per cent of the respondents preferred the purchase of the processed small millet products and 13.3 per cent were not preferred to purchase these products.
- Frequency of purchase indicated that 40 per cent of the respondents purchased whenever needed and 26.6 per cent of the respondents purchased once in a week followed by 13.3 per cent twice in a week and fortnightly, and 3.3 per cent of the respondents purchased daily.
- 76.66 per cent of the consumers bought these products from Departmental stores and 13.3 per cent from the bakeries and 10 per cent from the retail outlets.
- Among the millets, ragi was preferred mostly by 76.6 per cent of the respondents followed by 16.6 per cent for cumbu and 10 per cent of the respondents preferred for Varagu and 6.67 per cent for Samai millets.

Among the sample respondents, nearly 40 per cent are willing to pay 20-30 per cent more than what they are paying now, 23 per cent were willing to pay 10-20 per cent more, 15 per cent were willing to pay more than 30 per cent, 12 per cent were willing to pay less than 10 per cent and 10 per cent of the respondents were not willing to pay more than the present price.

CARDS/CBE/AEC/2014/R04 Value Chain Analysis of Rice in Thanjavur, Pudukottai and Coimbatore Districts of Tamil Nadu

- The paddy value chain was traced for two varieties of paddy such as ADT 37 and BPT paddy varieties and for commodities such as branded rice and rice bran oil. In the study area, there were five marketing channels. Paddy value chain analysis indicated that there was no much value addition at the farm level and the value addition process begins from the rice miller. The value addition can be enhanced from existing Rs. 12,128 to Rs. 19,536 per tonne of

ADT 37 paddy and from 14,428 to 21,326 in case of BPT variety through the enhanced value chain model that will benefit all the stake holders of paddy value chain.

B. DEPT. OF AGRICULTURAL AND RURAL MANAGEMENT

CARDS/CBE/ARM/2014/R09 Innovative Water Saving Irrigation and Investment Priorities for Food Security and Water Sustainability in India

- 70 per cent of the farmers suggested that concrete [or] cement slab lining of the branch canals and distributaries would significantly reduce the summer times water loss due to unlined canals and channels. So it is crucial and also important in water saving (approximately 10-12 per loss may to controlled)
- 90 per cent of the farmers said that damaged sluice structures and shutters to be replaced with new structures by the Irrigation Department, because of these damaged structures significant quantity of water is being lost and not used; it had an impact on the water availability in the middle and tail reaches.
- 70 per cent of the respondents felt that appointment of more luskars (lowest cadre in the PWD Irrigation Division of the Government) at the rate of three for every five kilo meters on eight hours duty basis. Even though, WUAs are in practice, there is need for monitoring by Government servant so as to avoid the possibility misuse of the water.
- 80 per cent of farmers suggested that rotation [or] turn system (may be ten days ON and five days OFF) of water release during scarcity periods.
- 75 per cent of farmers recommended that strengthening of Branch canal and distributaries level committees for efficient water allocation through (Warabhandhi) time scheduling according to the land holding (time scheduling may be prepared by revenue department with the consultation of Irrigation Department and WUAs), so that equity in time, quantity and productivity of water may be achieved across the farms irrespective of their location.
- All the respondents felt that awareness about Government schemes available for on-farm water saving and also other water conservation related activities should be taken up on wider scale.
- 35 per cent of the farmers suggested that detailed information on canal number, command area, sluices and also other information such WUA and luskar's name etc to be displayed in every canals of the system
- 65 per cent of the farmers recommended for pricing of the industrial and commercial water use (water price should be periodically increased) and there should be transparency in industrial water charge by way of making it.
- 50 per cent of the respondents concluded unauthorized water pumping for agricultural and non agricultural purposes from canal may be strictly restricted with heavy penalty. Because of illegal withdrawal of water from canal and river, it affects the flow and availability of water in the system as whole.

**NABARD/CARDS/CBE/ARM/2015/R04 Potato Value Chain Analysis in select states
(Tamil Nadu, Uttar Pradesh and Bihar)**

- The major stakeholders in the potato value chain were input suppliers (mainly seed suppliers), market intermediaries, supporting-service providers (cold storage) and enablers (Acts and Legislation).
- The producer's share in consumer's rupee was found to be 74, 71 and 38 per cent in Bihar, Uttar Pradesh and Tamil Nadu, respectively.
- Due to upsurge in establishment of cold storage units, the farmers, wholesalers and retailers used such facilities. In Tamil Nadu, the established cold storage units were targeting storage of potato from other states.
- The volume of potato export from India reaching 3.77 lakh tonnes in 2014-15 as against 0.78 lakh tonnes in 2005-06.
- Indian potato varieties are grown in countries like Afghanistan, Nepal, Bhutan, Bangladesh, Sri Lanka, Philippines, Madagascar, Bolivia and Vietnam either under original Indian names or local names e.g. KufriChandramukhi (in Afghanistan), KufriJyoti (in Nepal and Bhutan) and KufriSindhuri (in Bangladesh and Nepal). This provides greater opportunity to India for increasing seed potato exports to these countries.
- Among the various inputs used for cultivation, seed was found to be a very critical input and it constituted about 25 to 57 per cent of the total cost of cultivation. The cost of cultivation/ha in Tamil Nadu was Rs. 1.36 lakhs (un-irrigated) and Rs. 1.55 lakhs (irrigated) yielding a net profit of Rs. 1.36 lakhs and Rs. 1.30 lakhs under un-irrigated and irrigated conditions respectively. The total cost of cultivation/ha was Rs. 1.35 lakhs (Uttar Pradesh) and Rs. 1.06 lakhs (Bihar) yielding a net profit of Rs. 0.74 lakhs and Rs. 0.84 lakhs in Uttar Pradesh and Bihar respectively.
- The production function estimates in the three select states varied uniquely and the results showed that among the various inputs viz., seeds, farm yard manure, chemical fertilizer and plant protection chemical influenced the yield of potato.
- Given the specifications of the above function with inefficiency effect, it was found that the coefficients related to education of farmers and credit availed had negative signs implying that low educational levels and credit had a significant contribution towards inefficiency.
- Given the current technology, most of the farmers in Tamil Nadu (75%) under rain fed cultivation had achieved low technical efficiency (less than 80%) in production of potato. However, the percentage was higher with respect to irrigated farmers as about 47% of farmers had achieved more than 80% efficiency scores. The results also indicated that there existed perceptible gap in yield levels achieved by the progressive farmers and other fellow farmers and increase in farm size had only negative impact on efficiency levels.
- In Uttar Pradesh, most of the farmers (73%) had achieved a higher technical efficiency (more than 80%) in production of potato. The frequency distribution however revealed that still considerable amount of productivity was lost due to inefficiency. The results also indicated that there existed

perceptible gap in yield levels achieved by the progressive farmers (>90) and other farmers. In Bihar, the potato growers had achieved better efficiency scores as 93% of the farmers had achieved an efficiency score of more than 90%. Yield difference was however observed (7 tonnes) implying further scope for improvement in yield of the potato crop by considering the variables responsible for inefficiency.

- The marketed surplus of potato was estimated and the farmers supplied almost 97 to 99%. The economic implication is that there is a need to create adequate infrastructure to handle such huge volume of surplus produced by the farmers in few months.
- Among the various market intermediaries, local trader (Bihar: 39%), commission agent (Tamil Nadu: 74%, Uttar Pradesh: 37% and Bihar: 39.77) and wholesaler (Tamil Nadu: 25.67%, UP: 42.46% and Bihar: 31.11%) were preferred by the farmers to sell the produce. The preferred place of disposal was Commission Mandi (Tamil Nadu), Village shandy (UP) and nearest wholesale market (Bihar).
- Commission agents in Tamil Nadu and Bihar had played a major role in meeting out the credit requirements of potato growers. The other agencies, especially commercial banks played a prominent role across the states.
- A credit gap of Rs. 77,171, Rs. 4,93,347 and Rs. 1,38,644 was found among the respective states which could be filled by the institutional agencies.
- In terms of investment potential, new storage facilities have to be created particularly in Bihar as there is gap of about 37.12 lakhs tonnes of cold storage capacity. In the other two states, though there was no such gaps, the existing capacities have to be effectively linked with the production points. The cold storages have to be created considering the production centres and have to be linked with transport and other infrastructure.
- There is a need to have adequate transport and logistic support besides other services like storage, pack house, price information etc. The mandies of the surplus producing states have to be adequately equipped with grading, sorting, packing and storage facilities. Except in Tamil Nadu, the other two states have witnessed a rise in potato production and surplus has been stored in these cold storage facilities.
- In case of pack houses, at all India level only 249 pack houses were so far established. It is estimated that at all India Level, about 70,080 units have to be established and have to be concentrated near production centres so as to create and support appropriate supply chain operations in the cold-chain. Besides, it is also estimated that the requirement of reefer vehicles is about 61,826 throughout the country.
- The farmers and other stake holders informed that market intelligence covering product intelligence, place intelligence, price intelligence and time intelligence are needed to be developed and disseminated to farmers.
- Establishment of information kiosks, regular SMS based market information dissemination, pre-sowing and storage sell advises could facilitate informed decision makings at various levels and also among the stake holders.

C. DEPT. OF TRADE AND INTELLECTUAL PROPERTY

OPEC/CARDS/CBE/2016/ R05 Estimating the Yield of Kharif /Rabi 2015-16 Groundnut and Sesame Crops in Tamil Nadu

Groundnut

- Nearly 89 per cent of sample farmers were marginal and small farmers. Area under groundnut was less than one ha in 79.62 per cent of the farms .All the sample farmers raised groundnut under rainfed condition during kharif 2016
- Nearly 77 per cent of the sample farmers used own seeds, 19.23 per cent purchased seeds from private company and 3.85 purchased seeds from Govt. department.
- About 41.54 per cent of the farmers raised TMV-7 variety followed by local variety (30.38 per cent). Pollachi red, Co-2 and VRI 2 were cultivated in 7.31, 6.92 and 5.77 per cent of farms, respectively.
- **Yield:** The average yield of groundnut varied from 602 Kg / ha in Dharmapuri district to 814 Kg/ha in Vellore district and the average yield was 685 Kg / ha.
- Risk in groundnut production was assessed by coefficient of variation and it was found to be very high (53 percent) during Kharif 2015 which indicates groundnut production is a risky crop enterprise. The variation is mainly due to rainfall and distribution of rainfall.
- **Groundnut -Yield Gap – I :**TMV-7 was the major groundnut variety grown in the sample farms during 2015 and 2016. Under rainfed the potential yield was 1100kg /ha while the average yield was 1034 and 517 kg/ha during 2015 and 2016, respectively. The gap was 66 kg/ha and 665 kg/ha during 2015 and 2016 respectively. Yield gap was found to be low during 2015 as compared to 2016. This is mainly due to normal rainfall during 2015 and low rainfall during 2016.
- **Groundnut -Yield Gap – II :**The gap between the best farmers yield and average actual yield was 1560 kg/ha in 2015 and 1418 kg/ha in 2016. Though the average yield varied much between two years the yield gap in terms of quantity was found to be somewhat similar. In terms of ratio it was 0.40 in 2015 and 0.23 in 2016. This clearly indicates the potential to increase farm level yield of groundnut.

Gingelly

- Nearly 65 per cent of gingelly sample farmers were small and marginal farmers.
- Average farm size was 2.34 ha. Average area under gingelly was 1.16 ha.
- The source of irrigation was open wells, bore wells and canal. Nearly 40 per cent of the farms it was raised as rainfed crop.
- Own seeds was used by 30.14 per cent of the sample farmers and 64.38 per cent purchased seeds from private company. Only 5.48 per cent of the sample farmers purchased seeds from Government department.
- Gingelly Varieties grown in the sample farms during Kharif 2016 revealed that 34.25 per cent of the farmers raised Local white variety followed by Senguru variety (28.77 per cent). TMV-3 was raised by 16.44 per cent of

sample farms; TMV-4 and CO-2 by 2.74 per cent each. Other varieties such as TMV-5, TMV-7, VRI-1 and VRI-4 each occupied 1.37 per cent of the sample farms.

- The average yield of Gingelly varied from 307.61 Kg / ha in Karur district to 376.08 Kg/ha in Thanjavur district and the average yield was 346.41 Kg / ha.
- **Yield gap –I** is the difference between potential yield and average actual yield. Under rainfed the potential yield was 400-650kg /ha while the average yield was 373 and 345 kg/ha during 2015 and 2016, respectively. The gap was 27 kg/ha and 52 kg/ha during 2015 and 2016, respectively.
- **Yield gap-II** is the difference between the best farmers' yield and average actual yield. The best farmer's yield was 688 kg/ha and 790 kg/ha during 2015 and 2016, respectively. The yield gap II was 315 kg/ha in 2015 and 442 kg/ha in 2016.

This clearly indicates that there exists potential to increase farm level yield of Gingelly.

GoTN/CARDS/CBE/2015/ R02 An Economic Analysis of declining trend Groundnut area in Tamil Nadu

- Area under groundnut has declined at the rate of 4.04 per cent per annum during the period 1985 to 2013 in Tamilnadu. (Area under groundnut has declined from 9.6 lakh hectares in 1984 - 85 to 3.39 lakh hectares in 2013-14.)
- The groundnut production has declined at the rate of 1.68 per cent per annum. However the yield of groundnut has increased at the rate of 2.4 percent per annum.
- The results of acreage response function for Groundnut revealed that the previous year area was found to be the major factor in determining the area under groundnut. Rainfall is having positive and significant influence on area allocation. The results also revealed that minimum support price for groundnut has positive influence on area allocation for groundnut whereas the minimum support price for maize, a competing crop has negative influence on area allocation for groundnut.
- There are 20 varieties were grown by the sample farmers. Of which the major varieties grown in the sample farms were TMV 7, TMV 2, VRI-2, G-2, G-7, CO-2, CO-6 and JLR.
- The share of TMV 7 was highest with 59.67 percent followed by VRI-2 with 13.50 percent, G-7 with 6.83 percent and G-2 in 6.17 per cent of farms.
- The variety wise yield of Groundnut in the sample farms revealed that productivity of groundnut in irrigated condition varied from 860 kg/ha in TMV 1 to 2545 kg/ha in Western-44. Whereas the productivity of groundnut in rainfed condition varied from 728 kg/ha in TMV 2 to 1816 kg/ha in JLR.
- The productivity of major variety TMV-7 grown by sample farmers was 1196 kg/ha under rainfed and 1510 kg/ha under irrigated. The average yield of VRI -2 was 1900 kg/ha under irrigated and 1265 kg/ha under rainfed.
- Average yield of groundnut was 14.55 quintals/ha
- On an average price received by the sample farmers was Rs.4180 per quintal for dried groundnut pod.

- Total cost per hectare was Rs.47445 and Rs.30394 under irrigated and rainfed groundnut cultivation, respectively. Overall average cost per hectare was Rs.40023.
- The net income realized was Rs. 18073/ha in rainfed and Rs.37807/ ha under irrigated condition.
- Nearly 48 per cent of the sample farmers sold the produce to the village merchants. About 20.67 per cent through commission agents and 21.33 per cent through regulated markets.
- Marketing cost per quintal was found to be high with Rs.280 if the produce was sold through commission agents. It was Rs.165/quintal, Rs.160/quintal and Rs.155/quintal when the produce was sold through Regulated markets, Cooperative marketing society and to the processors, respectively.
- The major reason identified for decline in area under groundnut in the sample farms was low and erratic rainfall followed by labour problem for harvesting operations, wild boar, peacocks damage and pests and diseases.
- Maize is the profitable alternate crop raised by the sample farmers. Higher MSP for maize had negative influence on area allocation for groundnut crop.

CARDS/CBE/TIP/2015/R01Export Potential of Grapes in Tamil Nadu

- **Farm size:** in Coimbatore district 70 % of sample farmers were belong to semi-medium to large farm size category with an average landholding of 3.81 ha and the remaining 30 per cent were small farmers.
- In Dindigul district, 97 % of the sample farmers were small and marginal farmers with an average farm size of 1.28 ha. Grape is being cultivated in small and marginal holdings under the foothills of Sirumalai.
- Grape was the major crop accounted for 41 % (Coimbatore district) and 60% (Dindiguldistrict) to the total area under cultivation in the sample farms.
- **Varieties:** Panneer (Muscat Hamburg) was the only variety grown by all the sample farmers in Coimbatore and Dindigul districts.
- One crop (grape vineyard) is normally maintained for 15 years in the sample districts.
- **Harvesting:** there are two harvests in a year followed by two prunings in Coimbatore district i.e.120 days after pruning whereas in Dindiguldistrict it was three prunings and three harvests.
- **Yield:** Average yield was 24,368 kg/ ha/year in Coimbatore district and 12000 kg /ha in Dindigul district

Cost of cultivation and Cost of Production – Panneer Variety

Coimbatore District

- Establishment cost of grapevine orchard per ha was Rs. 4.25 lakhs, of which, stone & wire mess accounted for major share (70%) followed by farmyard manure & fertilizers (12%).
- The total variable cost was Rs. 2.92 lakhs /ha/year; of which the share of labour cost was 29 per cent followed by plant protection charges (12 per cent) and machine power (9.7 per cent).
- The total cost of cultivation of grapes was Rs.3.58 lakhs /ha/year.

- The average price received by sample farmers was Rs.27/kg and Cost of production was Rs.15/kg of grapes.
- Gross Income and net income was Rs.6.58 lakhs and Rs.3.00 lakhs /ha/year

Dindigul District

- Establishment cost of grapevine orchard per ha was Rs. 2.74 lakhs, of which, stone & wire mesh accounted for major share (68%) followed by intercultural operations (25%).
- The total variable cost was Rs. 1.12 lakhs /ha/year, of which labour cost accounted for 31 % followed by fertilizers (25%), and pesticides (13%).
- The total cost of cultivation of grapes was Rs.1.50 lakhs /ha/year
- The average price received by sample farmers was around Rs.30/kg and Cost of production was Rs.13/kg of grapes.
- Gross income and net return obtained was Rs.3.60 lakhs and Rs.2.10 lakhs /ha/year, respectively

CARDS/CBE/TIP/2015/R03 Value Chain of Banana in Tamil Nadu

Three major traditional banana growing districts viz., Tiruchirappalli, Erode and Coimbatore are purposively selected for the study.

Value Chain

- There were two major value chains present in the study area:
 1. Farmers-Pre-harvest contactors/Commission Agents – Wholesalers –Retailers – Consumers
 2. Farmers – Commission agents –Wholesalers/retailers – Consumers
- Nearly 70 percent of bananas were traded in Value Chain - I and 30 percent in Value Chain - II.
- Karpooravalli, Poovan and Rasthali were the major varieties traded in Trichy district
Poovan, Robusta and Nendhran were the major varieties traded in Erode district
- Robusta, Nendhran, Kathali& Red banana were the major varieties traded in Coimbatore district.
- Value addition was found to be low in the study area. Nendhran variety of banana was used to produce Chips and Poovan for dry banana chocolates.

Constraints

- The major constraints reported by the farmers were wind, price fluctuation and high cost of cultivation

CARDS/CBE/TIP/2015/R02 Domestic Trade and Export Potential of Hill Banana with GI tag in Tamil Nadu

- Hill banana varieties viz., Sirumalai and Virupakshi are grown as a shade crop in coffee plantations.

Cost and Returns

- The total cost of cultivation of Virupakshi and Sirumalai banana was Rs.582250/ha and Rs.469025/ha respectively
- The net income from Virupakshi banana cultivation was Rs.54,250/ha, Rs. 2,05,500/ha & Rs.4,18,000/ha for main crop, I ratoon and II ratoon respectively
- The net income from Sirumalai banana was Rs.18,050/ha, Rs.1,56,200/ha & Rs.3,10,725/ha for the main crop, I ratoon and II ratoon respectively
- The average cost of production of banana is Rs.1.8/ banana
- The major trading markets are Dindigul for Sirumalai banana and Thandikudi, Vadakavunchi, K.C.Patti, Adalur&Perumalmalai for Virupakshi.
- The hill bananas were traded in lots of 400 bananas. The prices were quoted for the lot.
- The average auction price of GI tagged Virupakshi and Sirumalai hill banana was Rs.4.50 & Rs.5.00 /banana respectively.

Constraints

- Wild animal problem, pseudostem weevil, bunchy top of banana and wind were the major problem in cultivation of hill banana
- Lack of adequate quantity, black spots in fruits & Inadequate size to export were the major constraints to export of banana

New Research Initiatives during 2015-17

A.Department of Agricultural Economics

- A new project on “Adoption and Spread of TNAU Varieties in Tamil Nadu”
- A Study on Yield gap for Major Crops in Tamil Nadu” have been taken up.
- An Assessment of Performance of Regulated Markets for Reforming Agricultural Marketing in Tamil Nadu A new project on “An Economic Analysis of Little Millet Production and Opportunities for Value Chain Development in Tamil Nadu (2017-2018)” has been taken up.

B.Dept. of Trade and Intellectual Property

External funded projects

- Estimating the yield of Kharif /Rabi 2015-16 Groundnut and Sesame Crops in Tamil Nadu
- An Economic Analysis of declining trend in Groundnut area in Tamil Nadu

University sub projects

- CARDS /CBE / TIP / 2015 / 01 Export Potential of Grapes in Tamil Nadu
- CARDS/CBE/TIP/2015/02 Domestic Trade and Export Potential of Hill Banana with GI tag in Tamil Nadu
- CARDS /CBE / TIP / 2015 /R 04 A study on export potential and performance of Mango in Tamil Nadu

WATER TECHNOLOGY CENTRE

System of Rice Intensification (SRI)

The SRI method of cultivation can be adopted in all the rice growing regions which will save 40-50 percent of the water consumed under flooding method of irrigation. The main components of SRI system are

- Planting of 14-15 day old single seedlings
- Square planting with 25cmx25 cm spacing
- Alternate wetting and drying method of irrigation at 2.5 cm irrigation depth.
- Cono weeding 3-4 times at 15 day interval from 15 DAT onwards.
- Integrated nutrient management – Using Leaf Colour Chart for N management.

Sustainable Sugarcane Initiative (SSI)

SSI is a resource conservation technology to increase sugarcane productivity. The main components are viz.,

- Planting of 25-35 days old chip bud seedling
- Wider Spacing (150 x 60 cm)
- Pruning of mother shoot at 25-35 DAP
- Providing drip fertigation and
- Raising of intercrop

Alternate Wetting and Drying Irrigation (AWDI) for water saving in Rice

- AWDI is a water saving technology recommended by TNAU for water saving in transplanted rice.
- Water is there beneath the soil which can support rice growth even if it is not seen on the surface.
- Installing Field Water Tubes in the field, the depletion levels are monitored.
- Safe AWD levels have been identified as 15 cm for heavy soils and 10 cm for light soils of TN

Drip Fertigation in Rice

Rice crop could be grown under drip fertigation under cropping system approach in areas where rice is grown utilizing ground water source of irrigation. The recommended practices are:

Recommendation

- Drip fertigation for rice could be recommended in non command areas where rice is grown utilizing ground water resources
- Drip fertigation in rice could be adopted in a cropping system approach

Drip Design Features

- System : Inline
- Lateral spacing : 0.9 m
- Drippers Spacing : 0.4 m
- Drippers Discharge : 2 lph

Lay out

- I crop : Vegetables - April -May
- II crop : Maize - June - September
- III crop : Rice (Direct seeding) - October -February
- Raised bed formation
- Use of hybrids/high yielding variety
- Adoption of irrigation and fertigation schedule
- Application of early post emergence herbicide (Bis Pyribac Sodium)
- Micro nutrient application (FeSO_4 & Zn SO_4)

Drip Irrigation System Maintenance

- Drip irrigation system maintenance needs to be taken up periodically for improving water productivity.
- Filters, Main, Sub Main, Lateral tubes are to be cleaned regularly.
- For removing the salt encrustation, acid cleaning with dil.HCL acid needs to be undertaken once in three months.

Artificial Recharge thro' Shafts

These are the most efficient and cost effective structures to recharge the aquifer directly. In the areas where source of water is available either for some time or perennially e.g. base flow, springs etc. the recharge shaft can be constructed. Following are site characteristics and design guidelines: -

- To be dug manually if the strata is non-caving nature.
- If the strata is caving, proper permeable lining in the form of open work, boulder lining are should be provided.
- The diameter of shaft should normally be more than 2 m to accommodate more water and to avoid eddies in the well.
- In the areas where source water is having silt, the shaft should be filled with boulder, good sand from bottom to have inverted filler. The upper most sandy layer has to be removed and cleaned periodically. A filter be provided before the source water enters the shaft.

Groundwater Management in coastal region of TN

- In the coastal region of Nagapattinam district, ground water can be used for raising crops with good salt tolerance in conjunction with the special soil management techniques viz., providing good drainage, high leaching and addition of organic matter.

IMPACT OF TN- IAMWARM Project

Tamil Nadu Agricultural University (TNAU) is one of the implementing agencies of Tamil Nadu –Irrigated Agriculture Modernization and Water bodies Restoration Management Project funded by World Bank in Tamil Nadu. The project activities were carried out in 9 sub-basins (Phase I), 16 sub-basins (Phase II), 25 sub-basins (Phase III) and 5 sub-basins (Phase IV).

Based on the existing cropping system in each sub basin, activities were formulated in DPR (Detailed Project Report) in convergence with line departments as project mode and mission mode with the prime focus on water conservation. System of Rice Intensification (SRI) and Precision Farming (PF) were the major components demonstrated in all the sub basins in the context of water saving and increased land and water productivity. Innovative programmes like, Sustainable Sugarcane Initiative (SSI) and E-Velanmai were also introduced on pilot basis.

System of Rice Intensification (SRI)

The components of SRI were first tested in TNAU in 2000 and later on in 2003 under ART in two major river basins Tamiraparani and Cauvery of Tamil Nadu. After implementation and execution of the trials, the components *viz.*, less seed rate 7.5 kg/ha, raising mat nursery, young seedling (14-15 days old), square and single seedling transplanting per hill in wider spacing (25 x 25 cm), mechanical weeding 4 times (10, 20, 30 & 40 DAT), limited irrigation and nutrient management through LCC were counseled for adoption. Initial adoption and spread remained low in Tamil Nadu from 2004 to 2006. Considering the lower acceptance and existing scope for adoption, TNAU included SRI as one of the water saving technologies in TN-IAMWARM Project.

SRI is a system of strategic rice cultivation, designed to address the present-day requirements of farmers, including the requirement for reducing water consumption. Despite very positive results, the progression of SRI across the state has been highly variable and rather constricted. Due to the tendency of farmers to avert risks and a lack of awareness about the scientific facts behind the components of SRI, these techniques have been adopted variably, usually partially, using only some of the principles SRI. This has led to incongruous results in different farmers' fields. Thus, SRI, although it is a promising as well as a sustainable yield-enhancing tool, has so far encountered many challenges that have prevented its take-off a large scale. SRI became the central thrust of the TN-IAMWARM Project due to its scope for sustainable productivity and water saving. TN-IAMWARM has provided an ambient platform for large-scale demonstration and awareness-creation endeavors to promote SRI in Tamil Nadu, and has also provided technical and financial assistance.

Prospects of Scaling up SRI Adoption in Tamil Nadu

- Any intervention towards improving agricultural productivity should be integrated with endeavours to sustain soil fertility and crop yield in an economically viable, socially acceptable and eco-friendly manner.
- The sparkling spread of SRI in Tamil Nadu is a solid articulation of the above principles. It should be unsurprising that SRI has progressed with quantum increases in yield and tremendous expansion in areas under the TN-IAMWARM Project. The total SRI area demo area under TNAU was 27,358 hectares from 2007-2014.
- Despite the initial skepticism of the farmers, SRI has proven its merit beyond reservations in Tamil Nadu. From the beneficiary-wise analysis, it can be

observed that a majority of the farmers have reaped a 20-30 per cent increase in yield by following SRI strategies.

- In general, an increase in rice productivity through SRI methods, as against the conventional system of rice cultivation, has been observed over these seven years. This has created a remarkable consciousness among the rice growers of the State. The widespread adoption of SRI has put aside many more theoretical queries about its adoption at the field level, which is evident from the increasing percentage of yield (from 13.4 to 37.3 per cent. The average SRI yield increase during 2007-2014 was 28.6 per cent over conventional method of cultivation. Above all, SRI has revived the interest of many rice growers who had intended to give up rice cultivation due to numerous difficulties.

Precision Farming

Micro irrigation is an effective tool for conserving water resources and studies have revealed significant water saving ranging between 25 and 50 per cent by drip irrigation compared with surface irrigation, with yield increases as high as 100 per cent in some crops under specific locations. World Bank assisted IAMWARM Project (Irrigated Agriculture Modernization and Water Bodies Restoration and Management Project) was formulated with the objective to improve irrigation service delivery and productivity of irrigated agriculture with effective integrated water resources management in 25 river basins of Tamil Nadu. In the last seven years, precision farming has been demonstrated by TNAU over in an area of 4800 ha over a wide range of crops. In many of the districts of the state, first time introduction was done through the IAMWARM project by TNAU and the sustainability proved is a daunting task and standalone example of achievement.

Precision Farming in TN- IAMWARM Project

Knowing the benefits of drip irrigation, Tamil Nadu Agricultural University has formulated demonstration of drip irrigation in a large area in Phase I sub-basins in 2007-08. There was stiff resistant among farming community to implement the component since it involves huge initial investment from the farmers side. The obstacles identified are high initial investment, lack of awareness, low technical know how about the system operation and maintenance, lack of handhold support, lack of crop husbandry practices to match with drip irrigation.

Study on sustainability issues in precision farming

A random survey of 1000 farm holdings from all sub-basins (100 large, 200 medium, 300 small and 400 marginal) was done to analyse sustainability issues, skill and knowledge level on the fertigation schedules, periodic system maintenance, profitability and power consumption. The analysis showed that Sustainability was also surveyed in the same samples. Those who understood the concept of precision farming well and maintaining the systems in good condition (75%) are sustaining the usage and reaping the benefits. Though 85% of the farmers adopted fertigation, only 52% farmers with literacy were aware of the importance of proper fertigation. Periodic maintenance was so common in marginal farmers (95%) than small (68%)

and large (45%) farmers. The survey also revealed that 89% of the respondents felt that proper service back up for maintenance and repair at door step could further help to penetrate and sustain.

Precision Farming made social changes among down trodden

TNAU has undertaken strenuous efforts on improving the livelihood security of Bhoomidhan Land Farmers in Periyakalakkadi Village through World Bank funded TN-IAMWARM Project. In this village Bhoomidhan lands were allotted to rural landless and poor labours with the greater vision of Acharya Vinobha Movement during the period of 1985. In spite of the untired efforts of the many social workers including few NGO's on grouping and land consolidation, the farmers were grown a single short duration field crops with the net income of ranges between Rs.3000-4000/year /acre. In pursuance of less income and less interest towards the agriculture, the land holders have been inspired by the allied enterprises in terms of jobs for their sustenance of family daily needs. In consequence, they have kept their land as current fallow. This system is being in vogue for the past 25 years.

Interventions was made through TN-IAMWARM Project first time in Tamil Nadu at Bhoomidhan lands have been brought under saturation of micro irrigation for an extent of 87 acres in Periyakalakkadi village by Department of Agricultural Engineering. The herculean task on establishment of micro irrigation has fulfilled as out sheer necessity of the pro poor farmers. But, they have lacked the proper guidance in cropping, since they failed to have continuing the cropping even after the micro - irrigation system. Most of the lands were kept barren and less utility by the poor rural peoples due to crop failures and less income.

TNAU has taken up a special initiative to bringing vegetable cultivation under collective mode by incorporating precision farming technologies for the livelihood security of the pro- poor's by reaping higher yield and profitability. Cluster approach invigorate positive attitude towards vegetable farming and moot out healthy competition between different groups. Initially find difficult to organize the farmers towards collective farming in cluster approach. By the Passionate approach infused interest by sharing many success stories in off campus training programmes. The uniqueness of the project is 6 farmers groups each group owns 15 acres of land each, wherein the each group is cultivation the crop in collective mode. By repeated capacity building and exposure visit through IAMWARM project,58 acres area under vegetable crops like Brinjal, Bhendi, cluster bean, Lablab, Moringa, Curry leaf and tuberoses out 87 acres. Now the farmers are being interested towards cultivation different kind of vegetable crops.

Presently farmers groups are reaping daily income and trapping them towards farming in their land and giving least importance for other jobs. One of group leader expressed that this project has given the permanent address towards because social recognition and economic development. In a short span of time we have realized the income accrued from vegetable crops roughly Rs.40,000-50,000 net income was realized from an acre which is being a great nuance for as towards expanding cultivation of vegetables in more area.

The participation of woman farmers is dominated than the men farmers in cropping to marketing. Now many officials, farmers are visiting this collective farming area because of the development has impressed and will be model and unique project in Tamil Nadu particularly in the Panjami lands (Bhoomidhan lands).

Drip irrigation system under TN-IAMWARM Project

Micro irrigation technologies especially drip fertigation was demonstrated in crops viz., sugarcane, banana, tapioca, vegetables and flowers. Through this programme farmers were supplied with elite seedlings or hybrids of crop and inputs viz., water soluble fertilizers. The drip fertigation system was installed at subsidized rate for demo farmers. Results indicated that drip fertigation increased the crop yields from 30 to 100 per cent over conventional practice besides saving of irrigation water (20 to 50 per cent). Micro irrigation technology helped to conserve the ground water for irrigation along with increased crop productivity.

Economic viability of drip irrigation system

Demonstration results on economics of drip irrigation system also proved that the drip method is economically viable for variety of crop. The demonstration results showed that the productivity of crops, saving of water and profits were significantly higher for the crop cultivated under drip irrigation. The mean system installation cost was Rs.72, 000/-. Total average cost of water soluble fertilizers, seeds/ seedlings including planting/ maintenance charges till harvest was Rs. 1, 05,000/- and this cost include drip irrigation split over 5 years. The gross income realized was 3, 01,000/-. The mean expenditure was 1, 05,000/- which resulted in an additional income of 1, 96,000/- which was higher by 45-60 % than conventional cropping. It is further shown that farmers can regenerate the capital cost of drip system from the profit of very first season without waiting the subsidy. The benefit cost ratio under drip investment for all crops taken together ranged from 1.57 to 5.2. The benefit cost ratio was greater than one in all the demonstration, thus revealed that capital investment in drip system is economically viable.

Economic returns

The net returns under drip irrigation system are found considerably very high in tomato by 81 % and 69 % in sugarcane. The major contributing factor is increase in productivity particularly in tomato (60 to 70 %) due to very favourable conditions created by precise and timely application of irrigation water and nutrients. The operational expenditure incurred in cultivation for various crops under drip irrigation system is also lower due to saving in inputs and labour.

Water use efficiency

The water use efficiency of drip irrigation method is estimated over 95% higher than that of any other irrigation method. The drip system has thus ensured results in a saving of 40 to 80 % as compared to surface irrigation. In heavy soil, the saving in water with drip irrigation, ranged between 30-50 %, while in the shallow permeable soils, it is estimated that 55 to 80 % of the root zone of the plant

concerned is contained in the wetted area around each outlet and thus this system is well suited for sandy soils when percolation loss is high. Thus, the water savings and water use efficiency are much higher than that of conventional method of irrigation.

Scaling up issues

Adoption of precision farming technology become common in sub basins; achieved through organising lot many formal and informal meetings; in which lead farmers are acting as torch bearers. Many of the small, medium and large farmers who have tasted the multiple uses of precision farming in enhancing productivity of soil, water and labour have gone completely into precision farming. Depending upon the market demand, farmers choose between TC banana, vegetables and flowers. Among the years, whenever there was deficit rainfall, sudden demand for drip system installation become common.

Sustainable Sugarcane Initiative (SSI)

A promising technology developed by Tamil Nadu Agricultural University is Sustainable Sugarcane Initiative (SSI) which has potential of increasing sugarcane productivity by about 35 per cent and reducing water requirement by 30 per cent in addition to improving fertilizer use efficiency and sugar recovery. Essential components of this technology validated on farmer's field are nursery raising using chip buds, laying buried drip fertigation system and planting in widely spaced rows which also facilitate intercropping with short duration pulses and vegetable crops. The SSI technology initially tested under TN-IAMWARM in four sub-basins covering 81 beneficiaries. The results were encouraging and farmers obtained nearly 30-80 per cent increased yield.

After analyzing the success of SSI technology SSI was introduced in Govt. programme for large scale adoption. Presently SSI is being promoted by Govt. of Tamil Nadu in all the schemes under sugarcane.

DIRECTORATE OF EXTENSION EDUCATION

Role of KVKs in Technology Transfer and Adoption of TNAU Technologies

Krishi Vigyan Kendras (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, 3 KVKs under the control of TANUVAS, 2 KVKs with Deemed Universities and the remaining 11 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 farm 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.

Accomplishments of KVKs [2014-15 to 2016-17]

On Farm Testing [OFT]

On Farm Testings 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 265 OFTs were conducted in an area of 625 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 farmers field to assess their performances. The successful technologies of the OFTs will be converted as FLDs. A total of 830 FLDs were organized in an area of 2395 ha directly benefitting 6568 farmers in various districts of Tamil Nadu. The year wise accomplishments of the OFT/ FLD along with lists of technologies disseminated are presented in the table 1 & 2.

Skill Teaching by Trainings: To create awareness, knowledge, skill and adoption of TNAU technologies a total of 1786 trainings were organized benefitting 68128 farmers, 638 sponsored training programmes benefitting 30312 farmers. To develop farmers as entrepreneurs 111 Vocational training programmes were organized benefitting 3674 farmers. The year wise accomplishments of the trainings are presented in the table 1.

Exhibitions / mela and other Extension activities: To create awareness and to popularize TNAU technologies, exhibitions, mela, field day, farmers day and campaigns were organized by KVKs at the District and State level. A total of 538 programmes were organized benefitting 219035 farmers during the period 2014 to January 2017. Besides, KVKs have organized various Extension activities /programmes for the benefit of farming community in transfer of technology during Farmers day (2014 to 2016), Agri Intex at TNAU, Coimbatore.

Table 1: Accomplishments of TNAU KVKs (2014-2017)

S.No.	Year / Particulars	2014 - 15	2015 - 16	2016-17	Total
On Farm Trial					
1	OFT (Nos.)	82	66	117	265
2	OFT (Area in ha)	151	189	285	625
3	OFT beneficiaries (Nos.)	465	380	498	1343
Front Line Demonstration					
1	FLD (Nos.)	211	256	363	830
2	FLD (Area in ha)	696	906	793	2395
3	FLD beneficiaries (Nos.)	2124	2207	2237	6568

Trainings					
1	Trainings On Off – (Nos.)	818	487	481	1786
2	No. of farmers – On and Off campus trainings	30996	20466	16666	68128
3	Vocational training	54	27	30	111
4	No. of farmers – Vocational trainings	2023	2784	2867	7674
5	Sponsored training (Nos.)	266	296	276	838
6	No. of Beneficiaries (farmers) of sponsored training	9844	15339	15129	40312
Exhibition/Farmers Day/Field day/ Mela					
1	Exhibition/Farmers Day/Field day/ Mela (Nos.)	277	154	207	638
2	No. of farmers participated	62018	77364	79653	219035

The TNAU technologies demonstrated by KVKs for adoption by farmers during the period 2014-17 are listed below.

Table 2 : Demonstration of TNAU Technologies (varieties) by KVKs for Adoption

<ul style="list-style-type: none"> • Annual Moringa -PKM1 • Barnyard Millet CO (KV)2 • Bhendi hybrid CO 4 • Black gram VBN (Bg) 6 • Blackgram (MDU1) • Blackgram -VBN-8 • Bottle Gourd Hybrid CO – 1 • BSR2 turmeric • Bush type lab lab CO (GB)14 • Bush type Lablab CO (GB) 14 • Castor Hybrid YRCH-1 • Cluster bean – MDU 1 	<ul style="list-style-type: none"> • Fodder Cowpea CO 9 • Fodder sorghum CO FS 31 • Greengram var CO8 • Ground nut TNAU TMV (GN) 13 • Groundnut – CO7 • Groundnut variety VRI 8 • Horse gram CRIDA 18R • Hybrid Maize CO 6 • Kuthiraivalli CO (KU) 2 • Little Millet (Samai) CO 4 • Maize CO 6 • Maize Hybrid (CO H 6) 	<ul style="list-style-type: none"> • Rice CO 51 • Rice CR 1009 Sub 1 • Rice TKM 13 • Sesame – TMV(Sv)7 • Sesame TMV 7 • Small onion Co5 • Snake Gourd PLR 2 • Sorghum K12 • Sunflower hybrid TNAU CO (SFH) 2 • Tapioca YTP 1 • TKM 13 paddy
<ul style="list-style-type: none"> • CO (FS) 31 Fodder Sorghum • CO (KV) 2 Kuthiraivalli • CO 15 ragi • CO 3 varagu • CO (TG) 3 milky mushroom • CO Bh H1 bhendi • Coriander CO (CR) 4 • Cumbu CO 10 	<ul style="list-style-type: none"> • Paddy variety TKM 13 • Papaya CO 8 variety • pearl millet variety CO (Cu) 10 • PLR (SG) 2 Snake gourd • Ragi CO 15 • Redgram -BRG-4 • Ribbed gourd MDU 1 • Rice ANNA 4 	<ul style="list-style-type: none"> • TNAU Maize hybrid CO 6 • TNAU Malai vembu MTP 1 • TNAU Paddy Variety CO 51 • TNAU Paddy Variety MDU 6 • TNAU papaya variety

<ul style="list-style-type: none"> • Cumbu CO 9 • Cumbu Napier Hybrid CO (BN) 5 grass • Field bean variety HA4 • Fodder Cowpea (COFC – 8) • Marigold MDU1 • Multicut Fodder Sorghum CO (FS) 31 • Multicut grass CO (CN) 5 • Paddy CO 51 • Paddy variety MDU 6 	<ul style="list-style-type: none"> • Rice CO (R) 51 • TMV (mb) 1 moth bean • TNAU Bhendi hybrid CO 1 • TNAU Chilli hybrid CO 1 • TNAU Chilli Hybrid COCH 1 • TNAU Cumbu hybrid CO (Cu) 9 • TNAU Dual Purpose Sorghum CO(S) 30 • TNAU Green gram variety CO 8 • TNAU Ground nut CO 7 	<ul style="list-style-type: none"> CO 8 • TNAU Rice CO 51 • TNAU Rice ADT (R) 49 • TNAU Rice Hybrid CO 4 • TNAU Rice TPS 5 • TNAU Sorghum CO 30 • TNAU Sorghum K12 • TNAU Tapioca YTP 1 • TNAU Tomato Hybrid Co3 • TNAU Turmeric CO 2 • TNAU AmaranthusPalur 1 (Sirukeerai A 8) • TRY 3 rice • Varagu CO 3
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Abstract of activities by KVKs during 2015-16 & 2016-17

During 2015-16 TNAU KVKs have organized 66 On Farm Testing (OFT) in an area of 189 ha; 256 Front Line Demonstrations (FLDs) in an area of 906 ha of newly released varieties and technologies, besides, conducting 487 On and Off campus training programmes benefitting 20466 farmers; 27 vocational training programmes benefitting 784 farmers besides training extension officers.

During 2016-17 TNAU KVKs have organized 117 On Farm Testing (OFT) in an area of 285 ha; 363 Front Line Demonstrations (FLDs) in an area of 793 ha of newly released varieties and technologies, besides, conducting 481 On and Off campus training programmes benefitting 16666 farmers; 30 vocational training programmes benefitting 867 farmers besides training extension officers.

Technology dissemination through Special Programmes of KVKs

Also, the TNAU technologies are disseminated to a large number of farmers through the following special programmes of KVK

- Cluster Frontline Demonstrations of oil seeds and pulses (2015 - 2017)
- World Soil Day (2015 & 2016)
- Pre *Kharif* and Pre *Rabi* Campaigns (2015 - 2017)
- Pradhan Mantri Fasal Beema Yojana (2016 - 2017)
- *Jai Kisan Jai Vigyan* and Technology Week (2016 - 2017)

Table 3 : Details of Special Programmes of KVKs

S. No.	Special Programme	Technology Demonstrated	No.
I	Cluster Frontline Demonstration of Rabi Pulses and Oilseeds (2015 - 2017)	Improved production technologies	2136 Demos
ii	World Soil Day (2015 & 2016)	Soil sampling techniques, soil health management, soil nutrient and its management	4296 Farmers
iii	a. Pre <i>kharif</i> campaign (2015-2016)	Technologies pertaining to <i>Kharif</i> season through exhibition stalls, technical sessions and demonstrations organized by 14 TNAU KVKs	5822 Farmers
	b. Pre <i>Rabi</i> campaign (2015-2016)	Technologies pertaining to <i>rabi</i> season	2137 Farmers
iv	Pradhan Mantri Fasal Beema Yojana (2016-2017)	Awareness programme cum exhibition on the importance of crop insurance	8858 Farmers
v	<i>Jai Kisan Jai Vigyan</i> and Technology Week (2016-2017)	Exhibitions and technical sessions organized for promoting the use of science for the welfare of farmers	2511 Farmers

EXTERNAL AGENCY FUNDED SCHEMES

S. No.	Name of the Dept. / Colleges / Project Title	Funding Agency	Project period	Budget (Rs. in lakhs)	Project Leader (S) (PI/CO-PI)
	COIMBATORE				
	CPBG				
1.	Centre of advanced faculty training in genetics and plant breeding	ICAR-CAFT	2015-2016	6.05	Dr.K.Ganeasamurthy, Dr.N.Meenakshi ganesan, Dr.L.Mahalingam, Dr.D.Malarvizhi, Dr.P.Anantharaju
2.	Enhancing pulses production in delta and non-delta districts by TNAU under NADP (Non-delta region - CPBG and Delta region - TRRI, Aduthurai)	NADP	April 2016 to March 2019	128.00	Dr.K.Ganesamoorthy, Dr.J.R.Kannan Babu, Dr.R.Ravi, Dr.K.Subramanian
3.	Strengthening cytogenetics science at CPBG	ICAR 50 crore	1.4.2016 to 31.3.2017	27.08	Dr.A.John joel
	RICE				
4.	Stress tolerant rice for poor farmers in Africa and South Asia – Phase II	IRRI BMGF - STRASA	1.4.2015 to 31.3.2016	5.00	Dr.S.Robin, Dr.P.Jeyaprakash, Dr.S.Geetha
5.	Marker assisted breeding for developing early maturing version of CR 1009, a popular rice variety of Tamil Nadu	DBT-GOI	2015-2018	25.90	Dr.R.Sudhagar, Dr.S.Robin, Dr.M.Raveendran
6.	Consortium Research Platform (CRP) on hybrid rice	ICAR	2015-2017	20.10	Dr.R.Saraswathi, Dr.S.Manonmani
7.	Consortium Research Platform (CRP) on Agro biodiversity	ICAR	2015-2016	4.08	Dr.S.Robin, Dr.A.Ramanathan, Dr.K.Amudha
8.	Consortium Research Platform on rice biofortification	ICAR	Jan. 2015 to March 2017	240.00	Dr.S.Robin, Dr.D.Sudhakar, Dr.M.Raveendran, Dr.S.Rajeswari, Dr.K.S.Subramanian
9.	Maintenance, characterization and use of EMS mutants of upland variety Nagina 22 for functional genomics in Rice - Phase II	DBT-GOI	1.11.2015 to 31.10.2020	105.62	Dr.S.Robin, Dr.M.Raveendran, Dr.S.Manonmani
10.	Development of pre-breeding genetic stocks, in rice for yield enhancement, heterotic potential and resistance to brown plant hopper and stem borer	ICAR-EM	Jan. 2016 to March 2017	20.83	Dr.S.Robin, Dr.P.Jeya Prakash, Dr.S.Manonmani, Dr.R.P.Soundar Rajan

11.	Improvement of lodging resistance in rice cultivars through introgression of "SCM2" gene conferring culm strength	DST-GOI	15.6.2016 to 14.6.2019	27.70	Dr.G.Subashini, Dr.S.Robin
12.	ICAR - Consortium Research Platform on Agrobiodiversity: Multi-location evaluation of rice germplasm	ICAR-CRP	1.4.2016 to 31.3.2017	2.77	Dr.P.Jeyaprakash, Dr.K.Amutha, Dr.A.Ramanathan
13.	Field testing of IRRI stress tolerant rice for Africa and South Asia (STRASA) (Dept. of Rice and ADAC&RI, Trichy)	IRRI, Phillippines	1.8.2016 to 31.7.2017	2.35	Dr.P.Jeyaprakash, Dr.K.Amutha, Dr.S.Geetha
14.	Establishment of Centre for Excellence in Molecular Breeding	NADP-COE-GoTN	Jan.2016 to March 2016	100.00	Project Director, Centre of Excellence in Molecular Breeding, CPBG, Coimbatore
15.	Front Line Demonstration during Kharif 2016-17 of ICAR-Fully Financed scheme	ICAR-FLD	1.4.2016 to 31.3.2017	2.25	Dr.P.Jeyaprakash, Dr.R.Saraswathi, Dr.K.Amutha
	MILLETS				
16.	Developing guidelines for conduct of test for distinctiveness, uniformity and stability in small millets (finger millet, foxtail millet, kodo millet, little millet, barnyard millet and proso millet)	PPVFRA-GOI	April 2015 to March 2016	3.94	Dr.R.Ravikesavan
17.	Revitalization of millets for nutritional security and enhanced productivity	TANII-GoTN	2016-17	72.60	Dr.K.Ganesamoorthy, Dr.R.Ravikesavan
	PULSES				
18.	Creation of seed hub for increasing indigenous production of pulses in India - Tamil Nadu and its sustenance at the Coimbatore centre of AICRPs on Pulses	ICAR-GOI-NFSM	1.4.2016 to 31.3.2018	150.00	Dr.J.R.Kannan Babu, Dr.D.Kumaresan, Dr.R.Sudhagar, Dr.P.Anantharaju, Dr.A.Thanga Hemavathy
19.	Front Line Demonstration on Chickpea, executed by the Coimbatore centre of ICAR-AICRP on Chickpea	ICAR-FLD	1.4.2016 to 31.3.2017	0.75	Dr.P.Anantharaju, Dr.K.Eraivan Arutkani Aiyathan
	OILSEEDS				
20.	Development of hybrids in sesame	ICAR-IIOR	April 2015 to March 2016	2.00	Dr.B.Meenakumari

21.	Fast tracking release of high oil and high oleic groundnut varieties and promoting their adoption by farmers for enhanced production and quality of groundnut oil - Phase II	ICRISAT	1.4.2016 to 31.3.2017	11.99	Dr.PL.Viswanathan, Dr.N.Manivannan, Dr.R.Chandirakala, Dr.T.Selvakumar
22.	Front Line Demonstration on Oilseeds: Sunflower, executed by the Coimbatore centre of ICAR-AICRP on sunflower	ICAR-FLD	1.4.2016 to 31.3.2017	0.22	Dr.N.Manivannan, Dr.R.Chandirakala, Dr.T.Selvakumar, Dr.L.Rajendran
	COTTON				
23.	Development of compact genotypes in cotton (<i>G. hirsutum</i>) suitable for high density planting system and mechanized harvest	TNCCM-GoTN	2015 to 2018	198.64	Dr.M.Gunasekaran, Dr.N.Premalatha, Dr.K.Bharathikumar, Dr.S.Hari Ramakrishnan
24.	Tribal sub-plan in cotton	ICAR	2015-2016	1.00	Dept. of Cotton
	FORAGE CROPS				
25.	Development of pearl millet forage hybrids and pearl millet - napier (PN) hybrids for high biomass and quality suited for different agro climatic zones of India	ICRISAT-CGIAR	1.9.2015 to 31.8.2016 (Extn. 1.9.2016 to 30.9.2016)	26.68	Dr.C.Babu, Dr.P.Sumathi
26.	Conduct of training on forage seed production techniques and vermicomposting under State Fodder Development Scheme	GoTN	1.4.2016 to 31.3.2017	3.20	Dr.S.D.Sivakumar
	PGR				
27.	Consortia Research Platform (CRP) in "Biofortification in selected crops for nutritional security - Maize"	ICAR-CRP	April 2015 to March 2016	7.50	Dr.A.John Joel, Dr.S.Ganeshram, Dr.R.Ravikesavan, Dr.V.Thiruvengadam
28.	Establishment of cryo-conservation modules for the conservation of farmers varieties / land races of Tamil Nadu for posterity	NADP-GoTN	April 2015 to March 2016	196.00	Dr.A.John joel, Dr.S.Ganeshram, Dr.V.Thiruvengadam
29.	Conduct of 10 days short course on utilization of platn genetic resources through classical and innovative pre-breeding approaches	ICAR	20.9.2016 to 29.9.2016	1.95	Dr.A.John Joel, Dr.S.Ganesh Ram, Dr.V.Thiruvengadam
	BIOTECHNOLOGY				
30.	Developing phosphorous efficient and blast resistant rice genotypes through molecular marker assisted selection	DST-GOI	2015-2018	11.70	K. Chithrameenal, PhD scholar, Dr.J.Ramalingam (Major advisor)

31.	Morphometry and phylogeography of honey bees and stingless bees in India - Phase II	DBT-GOI	April 2015 to March 2018	84.96	Dr.S.Mohankumar
32.	Program support for developing resilient rice through genomics (Sub Project I:Accelerating the development and delivery of multiple stress tolerant and resilient rice genotypes through genomics assisted breeding) (Sub Project II: Understanding physiological and molecular basis of QTLs controlling grain yield under drought stress in rice) (Sub Project III: Ensuring rice productivity under warming climate and molecular dissection of heat tolerance related traits)	DBT-GOI	21.1.2016 to 20.1.2021	500.00	Sub Proj.I: Dr.M.Raveendran, Dr.R.Chandra Babu, Dr.N.Kumaravadivel, Dr.J.Ramalingam, Dr.S.Manonmani, Dr.R.Suresh, Dr.S.Muthuramu, Dr.N.Balakrishnan, Dr.G.Karthikeyan, Dr.L.Arul Sub Proj.II (Dr.R.Chandrababu, Dr.M.Raveendran, Dr.D.Sudhakar) Sub Proj.III: Dr.D.Sudhakar, Dr.M.Raveendran, Dr.S.Robin, Dr.S.Utharasu, Dr.D.Vijayalakshmi, Dr.A.Gurusamy)
33.	Programme support for developing resilient rice through genomics	DBT	21.1.2016 to 20.1.2021	500.00	Dr.M.Raveendran, Dr.R.Chandrababu
34.	Transcriptome of barnyard millet to characterize the Fe/Zn uptake metal transporters and transcriptional regulators involved in Fe and Zn homeostasis	DST	Feb. 2016 to Jan. 2019	24.00	Dr.S.Varanavasiappan
35.	Understanding molecular basis of resistance against YMV in mungbean through transcriptome profiling	DST	Fe. 2016 to Jan. 2019	23.60	Dr.M.Sudha
36.	NPDF to Reyaz Ahmad Lone on Identification and characterization of cry gene pool from indigenous <i>Bacillus thuringiensis</i> strains against field evolved resistant population of pink bollworm (<i>Pectinophora gossypiella</i>) to Bt cotton (Bollgard-II) in India	DST-SERB-NPDF	5.8.2016 to 4.8.2018	19.20	Dr.V.Udayasuriyan, Dr.N.Balakrishnan
	BIOINFORMATICS				
37.	Developing phosphorus efficient and blast resistant rice genotypes through molecular marker assisted selection	DST-Women Scientist Scheme - GOI	2015-2018	102.39	K.Chithrameenal, Dr.J.Ramalingam

38.	Program support for Research and Development in Agricultural Biotechnology Phase II	DBT-GOI	16.5.2015 to 15.5.2017	163.76	Dr.K.K.Kumar, Dr.D.Sudhakar, Dr.P.Nagarajan, Dr.M.Pandiyan, Dr.R.Chandra Babu, Dr.M.Raveendran, Dr.N.Manikanda Boopathi, Dr.D.Vijayalakshmi, Dr.N.Senthil, Mr.S.Vellai Kumar
39.	Development of shoot fly resistant sorghum varieties suitable for Tamil Nadu through marker - assisted selection	DBT-GOI	29.6.2015 to 28.6.2020	66.79	Dr.N.Kumaravadivel, Dr.B.Selvi, Dr.T.Elaiyabharathi, Dr.P.Anandhi
40.	Mapping of shoot fly resistance QTLs in sorghum	UGC-GOI	1.7.2015 to 30.6.2018	13.23	Dr.N.Kumaravadivel, Dr.B.Selvi, .P.Anandhi
41.	Genome and transcriptome sequencing of aromatic rices from North Eastern region: Coimbatore centre subproject 7 - Development and validation of markers (SSRs, SNPs) on drought, aroma mapping population for marker assisted introgression	DBT-GOI	19.10.2016 to 18.10.2019	25.48	Dr.J.Ramalingam, Dr.M.Jayakanthan, Dr.M.Raveendran, Dr.R.Chandrababu
42.	Establishment and operation of bioinformatics sub-DIC (Distributed Information Centre) at TNAU, Coimbatore under DBT, GOI	DBT-GOI	1.4.2016 to 31.3.2017	16.75	Director, CPMB, Dr.J.Ramalingam
	ACRC				
43.	Gramin Krishi Mausam Sewa (GKMS) : Rural Agro Meterological Advisory Services	IMD - GOI	1.4.2015 to 31.3.2016	12.41	Dr.Ga.Dheebakaran
44.	Provision of Personnel Computer etc. to the Coimbatore Centre Agrometerological Field Unit (AMFU) of IMD	IMD-GOI	1.4.2016 to 31.3.2017	0.60	Dr.S.Panneerselvam, Dr.Ga.Dheebakaran
45.	Organizing Farmers' awareness programme by Coimbatore centre Agrometerological Field Unit (AMFU) of IMD	IMD-GOI	1.4.2016 to 31.3.2017	0.35	Dr.Ga.Dheebakaran, Dr.S.Panneerselvam,
46.	Organizing Tamil Nadu State Level Meeting of Stakeholders on Agromet Advisory Services by Coimbatore centre Agrometerological Field Unit (AMFU) of IMD	IMD-GOI	1.4.2016 to 31.3.2017	1.41	Dr.Ga.Dheebakaran, Dr.S.Panneerselvam,

47.	Development of Agro Advisory Services using Automatic Weather Station data at block level in Tamil Nadu under NADP 2013-14	NADP-GoTN	1.4.2016 to 31.3.2017	350.00	Dr.S.Panneerselvam, Dr.Ga.Dheebakaran, Dr.S.Kokilavani
48.	Expansion of automatic weather station network in 73 blocks of Tamil Nadu (Phase II) under NADP 2011-12	NADP-GoTN	1.4.2016 to 31.3.2017	576.35	Dr.S.Panneerselvam, Dr.Ga.Dheebakaran, Dr.S.Kokilavani
49.	Expansion of automatic weather station network in 88 blocks of Tamil Nadu (Phase III) under NADP 2012-13	NADP-GoTN	1.4.2016 to 31.3.2017	718.00	Dr.S.Panneerselvam, Dr.Ga.Dheebakaran, Dr.S.Kokilavani
	CROP PHYSIOLOGY				
50.	Marker assisted introgression of QTLs controlling heat tolerance related traits into elite rice genotypes of Tamil Nadu for adaptation to climate change	DBT-GOI	2015-2018	37.10	Dr.D.Vijayalakshmi, Dr.M.Raveendran, Dr.S.Robin
51.	Multi-site monitoring network of canopy micrometeorology and heat stresses of rice under the climate change	NIAES, Japan	1.4.2016 to 31.3.2019	6.66	Dr.C.Viajyalakshmi, Dr.D.Viajyalakshmi
52.	Conduct of 10 days short course on recent advances in applied crop physiology	ICAR	14.9.2016 to 23.9.2016	1.95	Dr.P.Jeyakumar
	SUS. ORGANIC AGRICULTURE				
53.	Network project on organic farming	ICAR	2015-2016	8.45	Dr.E.Somasundaram
54.	Lean farming for sustainable crop productivity improvement	GoTN	april 2016 to May 2016	4.84	Dr.E.Somasundaram
	SS&AC				
55.	TNAU mineral water production unit under revolving fund scheme	ICAR-RF	2016-17	4.86	Dr.N.Chandrasekaran
	AGRL. MICROBIOLOGY				
56.	Lytic bacteriophages as a biorational biocontrol agents against the bacterial wilt disease of Brinjal	DBT-GOI	2012-2016 (1.10.2015 to 31.3.2016)	29.26	Dr.M.Senthil Kumar, Dr.U.Sivakumar
57.	Development of SCAR markers for strain authentication and to improve the quality assessment of bioinoculants	DBT-GOI	2013-2016	37.47	Dr.D.Balachandar

58.	Lactic acid bacteria of functional interest in nutrition of finger millet	MFPI-SERB, DST, GOI	2015-2017	21.85	Dr.R.Subhashini, Dr.M.Senthilkumar, Dr.G.GuruMeenakshi
59.	Developing newer methods of mass production of Arbuscular mycorrhizal fungi for sustainable sugarcane production	SDF	1.4.2015-2017	7.88	Dr. K. Kumutha, Dr. P. Marimuthu
60.	Biodiesel production: Sago processing industrial wastewaters as feed stock for the microbial production of oils and derived co-products	DBT-GOI	20.3.2015 (Extn. 20.3.2015 to 19.3.2018)	66.80	Dr.U.Sivakumar, Dr.K.Kumutha, Dr.D.Ramesh
61.	Exploitation of potential antagonistic actinobacteria mediated induced systemic resistance for the management of <i>Fusarium</i> wilt disease in banana	DST-GOI	1.12.2015 to 30.11.2018	28.30	Dr.R.Rajesh, Dr.P.Marimuthu
62.	Production and characterization of bacterial cellulose from natural fibre biomass	ICAR, Circot, Mumbai	1.9.2016 to 31.3.2017	20.50	Dr.U.Sivakumar, Dr.G.Gayathri
63.	Standardizing the seed coating strategies of beneficial endophytes in soybean crop	M/s Tropical Biosciences Pvt. Ltd., Chennai	Dec. 2016 to Nov. 2018	17.23	Dr.P.Marimuthu, Dr.R.Umarani
64.	Plant health manipulation through innovative tools and techniques: Rhizotron - based plant - microbe - soil interaction studies for yield sustainability	TANII-GoTN	1.11.2015 to 31.10.2016	900.00	Dr.P.Marimuthu, Dr.D.Balachandr, Dr.C.N.Chandrasekaran
65.	Active additive application of bio-inoculants through seed pelletization for enhancing productivity and profit of dryland agriculture	NADP-GoTN	April 2015 to March 2016	107.22	Dr.P.Marimuthu, Dr.D.Balachander, Dr.K.Kumutha, Dr.I.Johnson
66.	Assistance for the conduct of International Conference on "Sustainable utilization of tropical plant biomass: Bioproducts, biocatalysts and biorefinery	DST-SERB-GOI-	1.4.2016 to 31.3.2017	1.25	Dr.U.Sivakumar
	RS&GIS				
67.	Remote Sensing information for crops and insurance in emerging economies (RIICE)	IRRI-RIICE	1.4.2015 to 31.3.2016 (Rs.1.14 lakhs)	32.69	Dr.S.Pazhanivelan , Dr.R.Jagadeeswaran

68.	Creating GIS database of soil nutrient status and generating nutrient maps with cadastral base for Tiruvarur district	GoTN	1.8.2016 to 30.6.2017	3.13	Dr.R.Sivasamy, Dr.R.Jagadeeswaran, Dr.V.Balasubramanian Th.S.Manoharan
69.	Land Degradation Mapping (Second Cycle) in Tamil Nadu	GOI-DOS-NRSC	1.9.2016 to 31.8.2017	22.02	Dr.S.Pazhanivelan, Dr.R.Sivasamy, Dr.R.Jagadeeswaran, Dr.R.Kumaraperumal, Dr.Balajikannan, Dr.K.P.Ragunath
NANOTECHNOLOGY					
70.	Project-1 : Diagnostic kit for early detection of nutrient deficiency in rice and maize and smart delivery of nano fertilizers for balanced nutrition in maize Project-2 (i) : Customizing nano-particles for seed quality enhancement Project -2(ii) : Fabrication of slow release of nano encapsulated herbicide formulation for season long weed control Project-3 :Targetting activated oxygen quenching in plants using nano-metals to increase crop yield under abiotic stress conditions and Project -4 :Development of antimicrobial and anti-oxidative nano-packaging film for perishables	ICAR-PLATFORM PROJECT	01.04.15 to 31.03.16	34.49	Dr. K. S. Subramanian
71.	Mycofiltration to remediate multi-heavy metals from vegetable production system in peri urban areas	DST-GOI-SERB	1.12.2015 to 30.11.2018	34.70	Dr.N.Balakrishnan, Dr.K.S.Subramanian
ENV. SCIENCES					
72.	Eco-friendly utilization of Seshasayee paper mill effluent and solid wastes and monitoring its impact on soil and groundwater	Seshasayee paper and boards limited, Erode	April 2015 to March 2016	4.12	Dr.P. Subramanian, Dr.M.P.Sugumaran
73.	Evaluation of long term effect of utilization of TNPL effluent water for irrigation and remediation of effluent irrigated soil habitat	TNPL, Karur	1.4.2015 to 31.3.2018	69.00	Prof. & Head, Dept. of Environmental Sciences
74.	Microbial odixation of methane in paddy eco system and development of methane oxidising bacteria for field performance	ICAR-ES	1.12.2015 to 31.11.2017	18.94	Dr.P.Doraisamy (Retired)

	AGRL. ENTOMOLOGY				
75.	Formulation of pheromones for important agricultural pests	ICAR-EM	1.1.2016 to 31.3.2017	9.73	Dr.C.Durairaj, Dr.N.Ganapathi
76.	Establishment and maintenance of a laboratory at the Dept. of Agricultural Entomology, TNAU, Coimbatore for Acorus calamus based product development and quality analysis	Bhuvicare, Tirunelveli	1.4.2016 to 31.3.2018	1.04	Dr.S.Jeyarajan Nelson, Dr.K.Senthil
77.	Ecology of thrips and <i>tospoviruses</i> interactions in tomato and watermelon pathosystems	DBT-GOI	13.7.2016 to 12.7.2019	57.49	Dr.D.Rajabaskar, Dr.G.Karthikeyan
78.	Impact of indiscriminate use of chemical fertilizers and pesticides	NIPHM, Hyderabad	Oct. 2016 to Sept. 2019	71.40	Dr.J.S.Kennedy, Dr.R.Shanmugasundaram
79.	Evaluating impact of neonicotinoids on pollinators executed by the Coimbatore centre of AICRP on Honey bees and pollinators	ICAR (FF)	1.1.2017 to 31.12.2018	28.62	Dr.M.R.Srinivasan, Dr.T.Elaiyabharathi
80.	Large area impact demonstration of fruit flies trapping technology to minimize yield losses to horticulture farmers in Tamil Nadu	TANII-GoTN	1.11.2015 to 31.10.2018	245.00	Dr.K.Ramaraju, Dr.N.Natarajan, Dr.M.Suganthi, Dr.T.Elaiyabharathi, Dr.P.Thilagam, Dr.P.S.Shanmugam
81.	Implement of food safety and quality of agri-horti produces through NABL accredited laboratories in TNAU	NADP-GoTN	2015-2016	600.00	Dr.K.Ramaraju, Dr.T.Manoharan
82.	Strengthening of insect museum at TNAU, Coimbatore	NADP-GoTN	2015-2016	110.00	Dr.N.Chitra, Dr.T.Manoharan, Dr.K.Ramaraju
	PLANT PATHOLOGY				
83.	Emergence of Tobacco streak virus infecting cotton: Investigations on transmission, spread and symptom remission	DBT-GOI	8.5.2015 to 7.5.2018	49.70	Dr.P.Renukadevi, Dr.V.G.Malathi, Dr.G.Karthikeyan, Dr.S.Nakkeeran, Dr.S.Mohankumar
84.	Outreach programme on fungal foliar diseases	ICAR	April 2015 to March 2017	17.56	Dr.S.Nakkeeran
85.	Development of eco-friendly management strategies for coconut nut rot disease	UGC-GOI	July 2015 to June 2018	11.40	Dr.G.Gopalakrishnan, Dr.A.Kamalakkannan

86.	Liquid formulated mycoparasite (<i>Sphaerellopsis filum</i>) mediated resistance in pearl millet against <i>Puccinia substriata</i> and elucidation of proteome interaction	DST-GOI	1.4.2016 to 31.3.2018	19.20	Dr.R.Manikandan, Dr.T.Raguchander
87.	Eco-friendly management of root rot disease in mulberry (<i>Morus alba</i>) through PGPR (Plant Growth promoting Rhizobacteria) mediated resistance	UGC	1.4.2016 to 31.3.2014	7.53	Dr.S.Vanitha
88.	Enterprising mushroom biotechnology for food, feed and biomanue	UGC-GOI	April 2016 to March 2021	62.00	Dr.A.S.Krishnamoorthy
89.	To strengthen the post graduate teaching and research facilities in the Department	DST-FIST-GOI	July 2015 to June 2020	60.00	Dr.Alice, Dr.G.Karthikeyan, Dr.P.Renukadevi, Dr.T.K.S.Latha
	NEMATOTOLOGY				
90.	Development of novel biodegradable beads of bacterial parasite, <i>Pasteuria penetrans</i> as bionematicide	DST-SERB	1.9.2016 to 31.8.2019	21.55	Dr.N.Swarnakumari, Dr.S.Paul Sebastian, Dr.A.Santhi
	SEED TECHNOLOGY				
91.	Sub-mission on Seeds and planting Material (SMSP) under National Mission on Agricultural Extension and Technology (NMAET)	GOI-GOI	2015-2016	29.80	Dr.M.Bhaskaran, Dr.K.Malarkodi, Dr.K.Nelson Navamaniraj, Dr.N.Indra, Dr.R.Arulprakash
92.	Development of advance seed quality enhancement tgechnology through seed coating and pelleting, nanotechnology and pulse magnetic field	ICAR	2015-2017	88.58	Dr.P.Selvaraju, Dr.V.Vakeswaran, Dr.K.Raja
93.	conduct of 21 days winter school on "Recent trends in seed production, post harvest handling and value addition techniques for effective seed supply chain	ICAR	14.9.2016 to 4.10.2016	3.75	Dr.P.Selvaraju, Dr.R.Umarani, Dr.K.Sundaralinga,, Dr.K.Malarkodi, Dr.K.Nelson Navamanirau
94.	Feasibility survey for expanding production of agricultural products in the dry areas of India with roll planter drip fertigation	Japan International Cooperation Agency (JICA)	1.11.2015 to 31.12.2016	15.99	Dr.B.J.Pandian, Dr.K.Vaiyapuri, Dr.S.Selvakumar
95.	Collaborative network project on "National initiative on climate resilient agriculture"	ICAR Fully	2015-2016	10.00	Dr.A.Raviraj, Dr.A.Valliammai, Dr.P.Jothimani

96.	Groundwater contamination due to geogenic factors and industrial effluents and its impact on food chain	IWM, ICAR	Jan. 2016 to Dec. 2017	11.40	Dr.B.J.Pandian, Dr.D.Jayanthi, Dr.A.Raviraj
97.	Impact assessment of watershed based livelihood interventions	Axis Bank Foundation, Mumbai	June 2016 to Nov. 2016	4.25	Dr.B.J.Pandian, Dr.S.Senthilnathan
98.	Conduct of 10 days short course on advances in micro irrigation for improving water use efficiency and productivity		15.6.2016 to 24.6.2016	1.95	Dr.B.J.Pandian, Dr.SP.Ramanathan, Dr.D.Jayanthi
99.	Irrigation management techniques for irrigated agriculture for Puducherry ATMA officials	ATMA	10.8.2016 to 26.8.2016	1.76	Dr.B.J.Pandian, Dr.SP.Ramanathan
	AMRC				
100.	Manually propelled platform for harvesting of vegetables	ICAR-EM	1.2.2016 to 31.1.2018	15.05	Dr.D.Manohar Jesudas
101.	Treatment of sago industrial waste water through high rate bio-methanation and utilizing the recovered energy for the roasting and value addition of sago project	DST-SERB-GOI	1.8.2016 to 31.7.2017	5.50	Dr.V.Palaniselvam
	BIOENERGY				
102.	ICAR-Consortia research platform on energy from agriculture	ICAR	2015-2016 to 2016-17	33.75	Dr.S.Pugalendhi, Dr.S.Sriramajayam
103.	Development of biogas / producer gas cum solar thermal energy based integrated drying system for efficient drying of ribbed smoked sheets (RSS)	GOI-RRII	23.7.2015 to 22.7.2017	6.00	Dr.R.Mahendiran, Dr.Jacob Mathew (RRII, Kottayam), Dr.R.Angeeswaran
104.	Eliciting soil microbiome responses of rice for enhanced water and nutrient use efficiency under anticipated climate change	ICAR-NASF	July 2015 to June 2018	61.35	Dr.S.Karthikeyan, Dr.D.Balachander
105.	Biogas development and training centre (BDTC)	MNRE-BDTC-GOI	April 2015 to Mar. 16	27.85	Dr.S.Pugalendhi
106.	Process development and evaluation of plasma gasification for producer gas generation from bio-wastes	ICAR-EM	2015-2018	45.90	Dr.S.Pugalendhi, Dr.S.Sriramajayam
	PHTC				
107.	Use of protective foods in the development of micronutrients rich food products	ICAR-CRP on Health Foods	1.4.2015 to 31.3.2017	40.65	Dr.N.Varadharaju, Dr.D.Malathi

108.	Conversion of mango fruit waste into a micronutrient fortifying agent for the development of functional foods	ICAR-EM	1.2.2016 to 31.3.2018	18.20	Dr.G.Gurumeenakshi
109.	Scaling up of small millet post harvest and nutritious food products (CIFSRF Phase2)	IDRC, Canada	18.1.2016 to 15.3.2018	73.25	Dr.D.Malathi, Dr.N.Varadaraju, Dr.S.Ganapathy
110.	Maintenance of single line Food Processing Training Centre (FPTC) for fruit and vegetable products, set up with the seed capital assistance of MFPI, GOI	GOI-MFPI	1.4.2015 to 31.3.2016 - contd. 1.4.2016 to 31.3.2017	9.50	Dr.P.Banumathi
111.	Maintenance of single line Food Processing Training Centre (FPTC) for bakery products, set up with the seed capital assistance of MFPI, GOI	GOI-MFPI	1.4.2016 to 31.3.2017	14.00	Dr.D.Malathi
112.	Operational maintenance of the Food Processing Incubation cum Training Centre (FPITC) of GoTN at Kinathukadavu by TNAU on self supported mode	GoTN	16.11.2016 to 15.11.2019	15.00	Dr.P.Banumathi
	AGRL. ECONOMICS				
113.	Developing guidelines and methodologies for socio-economic assessment of LMOs	GOI	1.1.2015 to 31.12.2016	6.00	Dr.K.R.Ashok, Dr.M.Chinnadurai
114.	Mid-course and impact evaluation of watershed projects implemented under WDF of NABARD in Tamil Nadu	NABARD	2015-2016 (extn. 1.4.2016 to 31.3.2017)	11.88	Dr.M.Chinnadurai, Dr.S.Muraligopal, Dr.D.Suresh Kumar, Dr.S.Varatharaj, Dr.P.Balasubramanian
115.	Production risks and welfare implications of maize hybrids on the subsistence farms of South India	CIMMYT, Mexico	1.4.2015 to 31.3.2016	14.70	Dr.A.Vidhyavathi, Dr.R.Balasubramanian
116.	Impact evaluation study on irrigation projects supported under NABARD-RIDF in Tamil Nadu	NABARD	April 2016 to March 2017	13.50	Dr.M.Chinnadurai, Dr.D.Suresh kumar, Dr.S.Varatha Raj
117.	Price forecasting and development of market advisories to interface with e-Resource Division of Agro Marketing Intelligence (AMI) and Business Promotion Centre (BPC), Trichy	NADP-GoTN	1.12.2016 to 31.3.2017	37.00	Dr.K.M.Shivakumar, Dr.S.Selvam, Dr.A.Robhini, Dr.M.Prahatheeswaran, Dr.D.Muruganathi

118.	Study on market potential of treated secondary timber species in Erode, Nilgiris and Coimbatore districts - case study approach	TNFD (TN Forest Dept.)	27.12.2016 to 26.12.2017	2.00	Dr.S.Varadha Raj, Dr.M.Chinnadurai, Dr.M.Anjugam, Dr.R.Revathi
	AGRL. EXTENSION				
119.	Developing a climate led agricultural extension module on the impact of climate change in the rice eco system of Tamil Nadu	ICAR-EM	March 2016 to March 2017	9.70	Dr.R.Arunachalam, Dr.M.Asokhan, Dr.Ravikumar Theodore, Dr.S.Somasundaram
120.	Promoting rural entrepreneurship and empowerment of rural young women self help groups (SC/ST) through capacity building for setting up of bio-inoculants production units in Vellore district of Tamil Nadu	DST	April 2016 to March 2018	9.92	Dr.P.Sumathi, Dr.P.Latha, Dr.A.Thirumurugan, Dr.M.Asokhan
	AGRL. RURAL MANAGEMENT				
121.	Preparation of District Agriculture Plan, State Agricultural Plan and State Agricultural Infrastructure Development Programme for Tamil Nadu	NADP-GoTN	2016-2017	95.85	Dr.M.Chinnadurai, Dr.R.Venkatram
	TRADE & INTE. PROPERTY				
122.	An economic analysis of declining trend in groundnut area in Tamil Nadu	ATMA	1.7.2015 to 30.6.2016 (Extn. 1.7.2016 to 30.9.2016)	2.52	Dr.M.Chinnadurai, Dr.T.Alagumani, Dr.M.Ashokan, Dr.S.Kalaivani, Dr.A.Sundar, Dr.N.Kiruthika
123.	Estimating the yield of kharif / rabi groundnut and sesame crops in Tamil Nadu	IOPEPC, Mumbai	1.10.2016 to 31.3.2017	7.45	Dr.T.Alagumani, Dr.M.Chinnadurai, Dr.K.Chandran
	SPICES				
124.	Promotion of organic cultivation for quality black pepper production in Kolli hills of Tamil Nadu under NADP	NADP	3.8.2016 to 31.3.2017	21.39	Dr.S.Balakrishnan, Dr.S.Subramanian, Dr.K.Nageswari, Dr.P.Paramaguru, Dr.A.Ramar, Dr.B.Senthamizh Selvi
	FLORICULTURE				
125.	Interspecific hybridization and grafting in jasmine for off-season flowering and flower quality	ICAR-EM	1.1.2016 to 31.3.2017	19.43	Dr.M.Ganga, Dr.K.Hemaprabha

126.	Standardization of extraction methods and quantification of bio-colourants from potential ornamental flowers	ICAR-EM	1.1.2016 to 31.3.2014	24.75	Dr.S.P.Thamaraiselvi, Dr.Uma
OPEN & DIST. LEARNING					
127.	Support for the conduct of International Conference on "Open and Distance Learning for Sustainable Development in Agriculture (ODLSDA-2016)" during November 2016 by TNSPC	TNSPC	2016-17	2.00	Dr.V.Gomathi
TRRI, ADUTHURAI					
128.	The improvement of methane emission estimates from South Asia using COSAT and the development of an emissions mitigation proposal	GSH-CU-JAPAN	1.4.2016 to 31.3.2018	20.38	Dr.V.Ravi, Dr.K.Vanitha, Dr.P.Jothimani, Dr.C.Umamageswari (USD 4450)
129.	Survey on Direct Seeded Rice (DSR) in Cauvery Delta Zone of Tamil Nadu	ICAR-IIRR-BASF	April 2016 to March 2017	0.30	Dr.K.Subramaniyan, Dr.K.Rajappan, Dr.V.G.Mathirajan
130.	Exploitation and characterization of antagonistic bacterial endophytes bio-consortia for the management of soil borne disease in cotton	DST-SERB-GOI	April 2015 to March 2018	21.36	Dr.P.Ahila Devi
131.	Bio-consortia of PGPRs from different growth stages of peanut (<i>Arachis hypogaea</i>) for the management of stem rot caused by <i>Sclerotium rolfsii</i>	DST-GOI-SERB	1.8.2015 to 31.7.2018	21.97	Dr.R.Thilagavathi
132.	Real time pest dynamics on rice	NICRA-ICAR	April 2015 to Mar 16	8.21	Dr.V.Ravi, Dr.S.Suresh, Dr.K.Rajappan, Dr.M.G.Mathirajan
133.	Early carrier research award on physiological evaluation of rice genotypes for multiple stress tolerance	DST-SERB-GOI	14.11.2016 to 13.11.2019	24.08	Dr.V.Vanitha, Dr.P.Boominathan
134.	Front Line Demonstration on MULLaRP executed by the TRRI, Aduthurai centre of ICAR-AICRP on MULLaRP	ICAR-FLD	1.4.2016 to 31.3.2017	1.88	TRRI, Aduthurai
RRS, AMBASAMUDRAM					
135.	Nitrogen use efficiency of rice varieties and fertilizer management for sustainable production in Tamiraparani command area of Tamil Nadu in the context of inter-linking of rivers	DST-SERB-GOI	1.4.2016 to 31.3.2018	11.00	Dr.S.Jothimani

	ARS, BHAVANISAGAR				
136.	Diagnostic analysis on the seed supply chain and policy suggestions for quality improvement and management of paddy seeds of TNAU	ICAR-EM	10.3.2016 to 31.3.2017	21.70	Dr.J.Venkata Pirabu, Dr.R.Jerlin, Dr.D.Kavithamani, Dr.S.K.Natarajan, Dr.S.Varadharaj
137.	Revolving Fund for the seed production in agricultural crops at ARS, Bhavanisagar under ICAR Mega Seed Project	ICAR-RF	1.4.2016 to 31.3.2017	33.41	Dr.R.Jerlin, Dr.G.Sasthiri, Dr.R.Vigneshwari
138.	Revolving Fund for the seed production in horticultural crops at ARS, Bhavanisagar under ICAR-Mega Seed Project	ICAR-RF	1.7.2016 to 30.4.2019	5.75	Dr.P.Hemalatha
139.	Revolving fund for the Breeder seed production in agricultural crops at ARS, Bhavanisagar under ICAR-National Seed Project	ICAR-RF	1.4.2016 to 31.3.2017	65.62	Dr.K.N.Ganesan, Dr.D.Kavithamani
	CEM, THIRUVANNAMALAI				
140.	Revolving fund for the seed production in small millets at CEM, Athiyandal initiated with the seed money of Seed Centre, TNAU, Coimbatore from ICAR-Mega Seed Project	ICAR-RF-MSP	1.4.2016 to 31.3.2017	5.00	Dr.A.Nirmalakumar, Dr.P.Parasuraman, Dr.B.Sivakumar
	HSC&RI, MADURAI				
141.	Ergonomic interventions to promote occupational health and safety of women workers employed in small scale food processing units	DST-GOI	1.7.2015 to 30.6.2018	24.84	Dr.P.Parimalam, Dr.B.Nallakurumban
142.	Manufacture of simulated rice analogues from millets using extrusion technology	DST-SERB-GOI	1.8.2015 to 31.8.2019	51.54	Dr.G.Hemalatha
143.	Development of innovative high value pulse based food products with enhanced functional and nutraceutical properties for potential utilization	SPCDB, Canada	1.12.2015 to 30.11.2018	109.88	Dr.G.Hemalatha, Dr.G.Pushpa, Dr.T.Uma Maheswari, Dr.M.L.Mini
144.	Dissemination of nutri knowledge among the rural women and children for their nutritional security through participatory approaches in Madurai district of Tamil Nadu	ICAR-EM	1.3.2016 to 31.3.2017	20.00	Dr.A.Janaki Rani, Dr.V.Veeranan Arun Giridhari, Dr.S.Amutha

145.	Development of functional fermented millet based drink for combating vitamin B12 deficiency	DST-SERB-ECR	14.9.2016 to 13.9.2019	23.78	Dr.T.Uma maheswari
146.	Conduct of one day Promotional programme on value addition of pulse based foods during December 2016		1.4.2016 to 31.3.2017	0.46	Dr.G.Hemalatha, Dr.V.Meenakshi, Dr.G.Sashi Devi, Dr.L.Karpagapandi
	HRS, KODAIKANAL				
147.	All India Network Challenge Programme on "Canopy management and plant architectural engineering on temperate fruits"	ICAR	2015-2016 & 2016-17	21.62	Dr.A.Ramar, Dr.G.Ashok kumar, Dr.N.Seenivasan
	AC&RI, KILLIKULAM				
148.	Augmentation and assessment of redgram (<i>Cajanus cajan</i> L.) global collection and application of molecular approaches for identifying and developing new germplasm to enhance its productivity in India	DBT-ISCB-GOI	1.8.2015 to 31.7.2018	25.76	Dr.M.Arumugam Pillai
149.	Techno-economic empowerment of dry land farm women for livelihood security under millets (under utilized crops) based eco-system : whole farm approach	DST-SEED	1.4.2016 to 28.2.2017	5.50	Dr.J.Pushpa, Dr.S.Kanchana, Dr.C.Vanniarajan
150.	Integrated seed production hub for southern districts of Tamil Nadu	TANII-GoTN	2015-2017	500.00	Dean, AC&RI, Killikulam
151.	Diversified agricultural cafeteria with the state of art technologies for third generation under NADP	NADP	3.8.2016 to 31.3.2017	700.00	Dr.V.Subramanian (and 33 scientists involved)
152.	Establishment and maintenance of bioinoculants production units for enhancing productivity of pulses in Northern and Southern districts of Tamil Nadu at AC&RI, Killikulam under NADP 2016-17 , initiated with the borrowed grant from FMC account of TNAU	NADP	23.12.2016 to 31.3.2017	140.00	Dean, AC&RI, Killikulam, Dr.R.Kannan, Dr.R.Uma Sankareswari, Dean, AC&RI, Vazhavachanur, Dr.T.Raguchander, Dr.E.Jamuna

	HC&RI, PERIYAKULAM				
153.	Mission for integrated development of horticulture: Seed & planting material production, distribution and transfer of technology in spices	GOI-DASD	1.4.2015 to 31.3.2016 (Extn. 1.4.2016 to 31.3.2017)	89.32	Dr.T.N.Balamohan, Dr.S.Prabhu, Dr.T.Thangaselvabai, Dr.P.Paramaguru, Dr.R.Chitra, Dr.L.Nalina, Dr.K.Nageswari, Dr.S.Subramanian, Dr.M.Palanikumar, Dr.T.Saraswathi, Dr.Karthikeyan, Dr.G.Ashokumar, Dr.P.Hemalatha, Dr.Arthirani, Dr.Rajendran, Dr.J.Prem Joshua
154.	Cloning and nematocidal protein encoding cry genes from Indian isolate of Bt and their expression in tomato	DBT-GOI	Aug. 2015 to July 2018	45.11	Dr.V.Balasubramani, Dr.V.Udayasuriyan, Dr.D.Sudhagar, Dr.K.Devrajan
155.	Collection, conservation and characterization of indigenous pickling mango varieties of Karnataka, Tamil Nadu and Kerala by TNAU	ICAR-EM	1.1.2016 to 31.3.2017	4.00	Dr.T.N.Balamohan, Dr.J.Rajangam, Dr.K.R.Vijayalatha
156.	Assessment on the utility of water hyacinth (<i>Eichhornia crassipes</i>) biomass as potential bio-sorbent for sequestration of heavy metals from tannery effluent and desorption of chromium from bio-sorbent for effective reuse	DST-SERB-GOI	1.9.2016 to 31.8.2019	17.12	Dr.E.Parameswari, Dr.S.Avudainayagam, Dr.V.Davamani
157.	Ultra high density orcharding and modern method of fruit cultivation	TANII-GoTN	1.11.2015 to 31.10.2018	157.00	Dr.T.N.Balamohan, Dr.J.Rajangam, Dr.K.Thangavel, Dr.I.Sekar, Dr.I.Muthuvel, Dr.R.Balakumbahan, Dr.C.Subesh Ranjith Kumar, Dr.T.Anitha
158.	Establishment of Moringa (<i>Moringa oleifera Lam.</i>) germplasm garden	USA	4.12.2015 to 3.12.2016	3.15	Dr.N.Manikanda Boopathi, Dr.R.Balakumbahan, Dr.P.Geetharani, Dr.V.Balasubamani, Dr.T.N.Balamohan

	AEC&RI, KUMULUR				
159.	Fertigation scheduling for paddy by simulation modelling	ICAR-EM	Jan. 2016 to March 2017	14.03	Dr.V.Ravikumar, Dr.T.Sherene Jenita Rajammal
160.	Establishment of farm machinery testing centre	GOI – Agricultural mechanization	2015-2018	150.00	Scientists in the Dept. of Farm machinery and Bioenergy, AEC & RI, Kumulur
161.	Skill development centre - operation, repair and maintenance of agricultural machinery	GoTN-NADP	2015-16Extn. 1.4.2016 to 31.3.2017)	60.00 (Phase I) 389.00 (Phase II)	Dr.K.Ramasamy-Dept. of Farm machinery and Bioenergy, AEC & RI, Kumulur
162.	Seed production in agricultural crops under Revolving Fund	ICAR-RF	1.5.2016 to 30.4.2019	12.41	Dr.P.Masilamani, Dr.V.Alex Albert
	PHYSICAL SCIENCE & INFORMATION TECHNOLOGY				
163.	Establishment and sustenance of Kani Tamil Peravai (Tamil Computing Society) at AEC&RI, TNAU, Coimbtore under Revolving Fund mode	GoTN	1.4.2016 to 31.3.2017	0.30	Dean,AEC&RI, Coimbtore, Dr.B.Sridhar, Mr.N.Raja
	ADAC&RI, TRICHY				
164.	Eco-friendly utilization of distillery effluent and value added products from sugar and distillery industrial wastes in agriculture and its effect on soil, crops and ground water quality	EID Parry India Ltd.	1.4.2015 to 30.9.2017	21.11	Dr.M.Baskar, Dr.K.G.Sabarinathan
165.	Environmental quality assessment in the use of Paper Board Industry (TNPL Unit II) waste water for agro-forestry system	TNPL	1.11.2015 to 31.10.2018	4.95	Dept. of SS&AC, ADAC&RI, Trichy
166.	Mitigation of methane emission through enhanced methane oxidation and rhizosphere engineering under rice eco-system	UGC-GOI	1.7.2015 to 30.6.2018	13.78	Dr.M.Maheswari, Dr.K.Boomiraj
167.	Molecular and functional characterization of Casparian strip membrane domain proteins (CASPs) in rice for salinity stress tolerance	UGC-MRP-GOI	1.7.2015 to 30.6.2018	14.20	Dr.L.Arul, Dr.K.K.Kumar, Dr.P.Boominathan

168.	Development of photo-thermo insensitive and yellow mosaic resistant pre-breeding lines in Mungbean (<i>V. radiata</i> L.) and urdbean (<i>V. mungo</i> L.)	ICAR-EM	Jan. 2016 to March 2017	15.70	Dr.S.Chitra, Dr.T.Kalaimagal, Dr.S.Geetha
169.	Exploring the feasibility of drip irrigation for Kuruvai paddy and summer vegetable cultivation under sodic soil with saline water	NETAFIM	1.2.2016 to 31.1.2017	3.96	Dr.T.Ramesh, Dr.S.Rathika
170.	Developing agribusiness models linking farmers groups and farmer produce organizations to markets through value chain management under ICAR NASF	ICAR-NASF	1.10.2016 to 30.9.2019	162.00	Dr.S.D.Sivakumar, Dr.S.Selvam, Dr.M.Jawaharlal, Dr.N.Venkatesa Palanichamy, Dr.S.Gurunathan, Dr.K.Mahendran, Dr.T.Samsai, Dr.P.Balaji, Dr.M.Chandrakumar, Dr.R.Ravikesavan, Dr.S.Ganapathy, Dr.T.N.Balamohan, Dr.I.Muthuvel, Dr.Velusamy
171.	Preparation of Comprehensive District Agricultural Plan (CDAP) for Trichy District by ADAC&RI, Trichy	DPO, Trichy	1.11.2016 to 30.6.2017	5.00	Dr.P.Pandiyarajan, Dr.C.Sekar, Dr.B.Thiagarajan, Dr.S.D.Sivakumar, Dr.P.Balasubramaniam, Dr.S.Selvam, Dr.S.Gurunathan, Dr.D.Periyar Ramasamy, Dr.R.Parimalarangan
172.	Strengthening of tissue culture unit	TANHODA, NHM, Chennai	Nov. 2015 to March 2016	19.90	Dr.L.Arul, Dr.R.Arulmozhiyan
173.	Centre of excellence in sustaining soil health	NADP-COE-GoTN	1.4.2016 to 31.3.2017	420.00	Dr.P.Santhy
174.	Enhancing the livelihoods of tribal - women through technological interventions of training on non-wood forest products	NADP-GoTN	1.5.2016 to 30.4.2018	16.50	Dr.P.Balasubramaniam, Dr.D.Malathi, Dr.R.Jude Sudhagar
175.	Construction of farmers trainees Hostel at ADAC&RI, Trichy	NADP-GoTN	3.8.2016 to 31.3.2017	257.00	Prof. & Head, Dept. of Social Science, ADAC&RI, TRY

176.	Farm Women Knowledge Centre	NADP-GoTN	1.4.2016 to 31.3.2017	75.00	Dr.S.Geetha
177.	Revolving fund for the Seed production in agricultural crops at ADAC&RI, Trichy initiated with the seed money of seed centre, TNAU, Coimbatore from ICAR Mega seed project	ICAR-RF	1.4.2016 to 31.3.2017 (Extended each year)	8.73	Dr.T.Eevera
	AC&RI, MADURAI				
178.	Habitat adopted phyllosphere methylotrophs as a plant probiotics for improving plant health and kernel quality in groundnut (<i>Arachis hypogaea</i> L.)	DST-SERB-GOI	18.5.2016 to 17.5.2018	19.20	Dr.R.Krishnamoorthy, Dr.R.Anandham
179.	Production of natural colours from microorganisms and its feasibility for food applications	UGC	1.7.2015 to 31.6.2018	11.48	Dr.R.Saravanakumar, Dr.S.Kanchana, Dr.B.Jeberlin Prabina
180.	Evolving climate resilient farming systems in South India through integrated modelling, adaptation and stakeholders participation	AgMIP	May 2015 to Sept. 2016 (Extn. 1.10.2016 to 31.3.2017)	72.53	Dr.V.Geethalakshmi, Dr.S.Kokilavani, Dr.P.Paramasivam. Dr.Saravanakumar, Dr.D.Sureshkumar, Dr.A.Lakshnmanan, Dr.S.Robin
181.	Molecular breeding to mitigate chilli leaf curl virus (ChiLCuV) incidence by augmenting host plant resistance against its vector whitefly <i>Bemisia tabaci</i> in chillies (<i>Capsicum annum</i> L.)	DBT-GOI	27.3.2015 to 26.3.2018	44.36	Dr.M.Murugan
182.	Sustainable livelihood enhancement through bee keeping in Horticultural Ecosystem: A multi-stakeholder analysis	ICAR-EM	1.1.2016 to 31.3.2017	25.17	Dr.K.Suresh, DR.B.Usharani
183.	Engineering resistance against groundnut bud necrosis virus in tomato through RNAi approach	DST-GOI	May 2015 to April 2018	30.86	Dr.R.Rabindran, Dr.M.Raveendran
184.	Amma Agricultural Innovation Chair	TNAU	15.12.2016 to 31.12.2019	45.00	Dean, AC&RI, Madurai
185.	Marker assisted breeding for improving salinity tolerance in popular rice varieties of Tamil Nadu	DBT-GOI	2013-2016	34.43	Dr.S.Banumathy, Dr.M.Raveendran, Dr.G.Manickam

186.	Establishing model climate responsive villages and dissemination of climate change adaptation and water management technologies through digital and folk media	DST-GOI	2015-2017	11.28	Dr. M. Ramasubramanian
187.	A multi-dimensional study on gender responsive budgeting among three tiers of Panchayat set up on Madurai district of Tamil Nadu	UGC-MRP	July 2015 to June 2018	10.19	Dr.M.Ramasubramanian, Dr.P.P.Murugan, Dr.B.Parthipan, Dr.G.Selvarani
188.	A multi-stakeholder analysis of value chain management in selected farmer producer companies in Tamil Nadu	ICAR-EM	1.10.2016 to 31.3.2017	11.40	Dr.M.Ramasubramanian Dr.G.Selvarani
189.	Enrichment of nutritional quality in maize through molecular breeding	DBT-GOI	April 2015 to March 2020	88.63	Dr.N.Senthil, Dr.R.Ravikesavan, Mr.S.Vellaikumar
190.	Strengthening of tissue culture unit	TANHODA, NHM, Chennai	September 2015 to March 2016	20.00	Dr.E.Kokiladevi, Dr.P.Meenakshisundaram, Dr.R.Arunkumar, Dr.N.Senthil Dr.C.Vanniarajan
191.	Centre of excellence in innovation	NADP-COE-GoTN	April 2015 to March 2016	530.60	Dr.N.Senthil
192.	ICAR Revolving Fund - Seed production in agricultural crops	ICAR-RF	1.4.2016 to 31.3.2017	2.92	Dr.V.Paramasivam, Dr.A.Sabir Ahamed
	FC&RI, METTUPALAYAM				
193.	Developing yield table for few fast growing trees grown in farm settings	TNFD, CBE	1.4.2016 to 31.3.2017	3.00	Dr.A.Balasubramanian, Dr.S.Manivasagam, Dr.P.Sudha, Mrs.M.Vijayabhama
194.	Monitoring biodiversity and impact in critical habitats after removal and maintenance of invasive alien species and efficacy of maintenance works in Sathyamangalam Tiger Reserve	TN Forest Dept. (DFO, Sathyamangalam)	1.4.2016 to 31.3.2021	2.18	Dr.K.Baranidharan, Dr.R.Revathi, Mrs. M.Vijayabhama

195.	Promotion, commercialization, post-harvest processing and industrial application of annatto (<i>Bixa orallana</i> L.) as a source of natural dye under TANII	TANII-GoTN	2016-2017	224.00	Dr.K.Kumaran, Dr.P.R.Renganayaki, Dr.S.Umeshkanna, Dr.P.S.Devanand, Dr.M.Umadevi, Dr.P.G.Kavitha, Mrs.S.Sridevy, Dr.P.Sudha, Dr.M.Tilak, Dr.C.Cinthia Fernandes, Dr.V.Karthik
196.	Screening, evaluation and improvement of indigenous tree species for coastal agroforestry	TNPL, Karur	1.4.2015 to 31.3.2018	14.80	Dr.K.T.Parthiban, Dr.S.Umesh Kanna, Dr.S.Vennila
197.	Fruit yield and economic analysis of amla and tamarind under agro forestry systems in Tamil Nadu	SFD	1.4.2015 to 31.3.2016 (Extn. 1.4.2016 to 30.4.2016)	1.25	Dr.A.Rohini, Dr.C.Cinthia Fernandaz, Dr.V.Karthick
198.	Development of High Yielding Short Rotation (HYSR) clones for industrial Agroforestry	ICAR-EM	1.1.2016 to 31.3.2017	29.32	Dr.K.T.Parthiban, Dr.R.Jude Sudhagar, Dr.C.Cinthia Fernandaz
199.	Consortium of Industrial Agroforestry (CIAF)	CIAF	1.4.2016 to 31.3.2017	77.47	Dr.K.T.Parthiban, Dr.I.Sekar, Dr.S.Umeshkanna, Dr.P.Rajendran, Dr.A.Rohini, Dr.C.Cinthia Fernandaz, Dr.S.Vennila
200.	Conduct of National workshop on agroforestry strategies for climate change mitigation and adaptation during 21-22 March 2017 at FC&RI, Mettupalayam supported by NABARD	NABARD	1.4.2016 to 31.3.2017 (two days workshop 21 & .22.3.2017)	1.60	Dr.K.K.Suresh, Dr.K.T.Parthiban, Dr.R.Jude Sudhagar, Dr.C.Cinthiya Fernandaz, Dr.V.Karthick
	HRS, OOTY				
201.	Maintenance of existing Ethnographic Park at Wood house farm	HADP	2015-2016	3.90	Dr.N.Selvaraj
202.	Establishment of medicinal plant nursery for promotion of medicinal plant cultivation in Nilgiris	GoTN-SPC	1.4.2016 to 31.3.2017	19.25	Dr.B.Anita, Dr.M.Anand
	RRS, PAIYUR				
203.	Studies on the diversity of endophytic bacteria in pulses and to exploit them as bio-inoculants	UGC-GOI	1.12.2015 to 30.11.2018	12.78	Dr.R.Thamizh Vandan, Dr.D.Balachandar

204.	Mango Research Centre, Paiyur under NADP (sub centre, Fruit crops, Coimbatore)	NADP	3.8.2016 to 31.3.2017	200.00	Dr.M.Ananthan, Dr.S.Mohamed Jalaluddin,Dr.A.Punitha, Dr.K.Krishna Surendar, Dr.R.Thiyagarajan, Dr.T.Anand, Dr.M.Vijayakumar
	SWMRI, THANJAVUR				
205.	Revolving fund for the seed production in agricultural crops under ICAR Mega Seed Project	ICAR-RF	1.4.2016 to 31.3.2017	14.59	Dr.N.Punithavathi
	HC&RI FOR WOMEN, TRICHY				
206.	Demonstration project on IPM packages in major agriculture and horticulture crops to enhance livelihood of scheduled caste population in Cuddalore district of Tamil Nadu	DST-TALIMSC-GOI	2015 to 2018	9.16	Dr.V.Ambethgar
	ARS, VAIGAI DAM				
207.	Enhancement of nutritional security of under privileged farming community of Southern Tamil Nadu through dissemination of advanced approaches in seed production, post harvest techniques and value addition of barnyard millet and little millet	DST-GOI	1.10.2016 to 30.9.2019	15.54	Dr.D.Thirusendura Selvi, Dr.A.Balakrishnan, Dr.S.Kanchana
208.	Seed production in agricultural crops under Revolving Fund (horticultural crops)	ICAR-MSP	1.4.2015 to 31.3.2018	2.95	Dr.S.Saraswathy, Dr.M.Madhan Mohan, Dr.D.Thirusendura Selvi
209.	Special food grain production programme	ICAR-MSP	1.4.2015 to 31.3.2018	0.96	Dr.D.Thirusendura Selvi, Dr.M.Madhan Mohan
210.	Breeder seed production of rice, oilseeds and pulses under Revolving Fund (NSP crops)	ICAR-MSP	1.4.2015 to 31.3.2018	5.25	Dr.M.Madhan Mohan, Dr.D.Thirusendura Selvi, Dr.S.Utharasu
	TCRS, YETHAPUR				
211.	Technological Empowerment and sustainable livelihood of Tribes in Pethanaickanpalayam Block	DPC under SBGF, Chennai	2015-2018	20.80	Dr.S.Manickam, Dr.M.K.Kalarani, Dr.S.Suganya, Dr.M.Senthilkumar

	FRS, THOVALAI				
212.	Standardization of grafting techniques in cucumber to mitigate root-knot nematode and soil borne diseases	DST-GOI	From 1.6.2015 to Sept. 2015	20.10	Dr.C.Thangamani
	DARS, CHETTINAD				
213.	Establishment of food processing research and training centre	GOTN	2015-2016	40.27	DARS, Chettinad
214.	Centre of Excellence in Dry Farming	NADP-COE-GoTN	Jan. 2016 to March 2016	136.00	DARS, Chettinad
	KVK, SANDHIYUR				
215.	A study on factors responsible for declining area under groundnut cultivation in Salem district	ICAR-ATMA	July 2015 to June 2016	2.40	Dr.N.Sriram, Dr.M.Vijayakumar, Dr.P.Geetha, Dr.A.Sudha, Mr.G.Senthilnathan
	RRS, VRIDHACHALAM				
216.	CRP-AB Project - PGR management and use on Characterisation, multiplication and conservation of germplasm in groundnut	DGR, Junagadh	Nov. 2015 to March 2016	2.50	Dr.R.Ushakumari
217.	Real time pest dynamics (RTPD) in relation to climate change (Target crops: Rice, Pigeonpea, Groundnut and Tomato) - Groundnut under NICRA	ICAR-NICRA	2016-2017	5.00	Dr.A.Karthikeyan, Dr.P.Indiragandhi, Dr.C.Harisudan
218.	Agro biodiversity in sesame	ICAR - CRP	2016-2017	4.00	Dr.T.Ezhilarasi, Dr.M.S.Aneesa rani
	ARS, PATTUKOTTAI				
219.	Centre of Excellence in Oilpalm	NADP-COE-GoTN	Jan. 2016 to March 2016	3.00	Dr.R.Rajendran, Dr.T.Sumathi
220.	Creation of revolving fund for the production of breeder seed of cereals and pulses under central sector special food grain production programme	ICAR-RF	April 2016 to March 2019	2.05	Dr.A.Bharathi
	CRS, SANKARANKOIL				
221.	Establishment of New Citrus Research Station at Sankarankoil in Tirunelveli district	NADP-GoTN	Jan. 2016 to March 2016 (Ext. 1.4.2016 to 31.3.2017)	109.53	Prof. & Head, CRS, Sankarankovil

	NPRC, VAMBAN				
222.	Probing the seed borne / transmission nature of yellow mosaic virus affecting major grain legumes and devising integrated management strategy	DST-SERB-GOI	1.7.2015 to 30.6.2018	14.22	Dr.V.K.Satya, Dr.D.Alice, Dr.V.G.Malathi
223.	Pest dynamics in relation to climate change (Target crops: Rice, Pigeonpea, Groundnut and Tomato - Pigeonpea) under NCIPM, NICRA	ICAR-NCIPM-NICRA	2016-17	5.00	Dr.Zadda Kavitha, Dr4.C.Vijayaraghavan, Dr.V.K.Sathya
224.	Revolving fund for the seed production in agricultural crops at NPRC, Vamban initiated with the seed money of Seed Centre, TNAU, Coimbatore from ICAR-Mega Seed Project	ICAR-RF	1.4.2016 to 31.3.2017	9.05	Dr.R.P.Gnanamalar, Dr.C.Vanitha
225.	Creation of seed hub for increasing indigenous production of pulses in India - Tamil Nadu and its sustenance at the NPRC, Vamban, Coimbatore centre of ICAR-AICRPs on Pulses under GOI NFSM 2016-17	ICAR-GOI-NFSM	1.4.2016 to 31.3.2018	150.00	Dr.R.P.Gnanamalar, Dr.C.Vanitha, Dr.S.Lakshmi Narayanan, Dr.A.Mahalingam
226.	Front Line Demonstration on MULLaRP	ICAR-FLD	1.4.2016 to 31.3.2017	0.75	NPRC, Vamban
	DIRECTORATE OF STUDENTS WELFARE				
227.	Assessment of employability skill requirement of agricultural graduates	ICAR-EM	Jan. 2016 to March 2017	14.50	Dr.Shibi Sebastian, Dr.Srivafa Buddhi
	AGRI BUSINESS DEVELOPMENT				
228.	Promoting agripreneurship through formal education - Developing innovative agricultural education model	ICAR-EM	Jan. 2016 to March 2017	14.50	Dr.C.Muralidharan, Dr.C.Velavan
	VEGETABLE CROPS				
229.	Vegetable seed production on contract basis under ICAR revolving fund scheme	ICAR-Rev. Fund	May 2016 to April 2019	98.42	Dr.T.Arumugam, Dr.K.Kumaran
230.	Bio-prospecting the scientific principles on the use of bio-electromagnetic energy as a new paradigm in improving soil health, crop productivity and drought resistance	WCSC, Aliyarnagar	1.4.2015 to 31.3.2017	4.34	Dr.K.Shoba Thingalmaniyan

	SPGS				
231.	Dr.A.P.J.Abdul Kalam Fellowship	TNAU funding	16.12.2016 to 15.12.2019	15.22	Dean, SPGS
	KVK, SIRUGAMANI				
232.	Creation of seed hub for increasing indigenous production of pulses in India - Tamil Nadu and its sustenance at KVK, Sirugamani	ICAR-NFSM - GOI	1.4.2016 to 31.3.2018	150.00	Dr.R.Vijayalakshmi
	KVK, SANDHIYUR				
233.	Creation of seed hub for increasing indigenous production of pulses in India - Tamil Nadu and its sustenance at KVK, Sandhiyur centre of ICAR-AICRPs on pulses under GOI NFSM	ICAR-NFSM - GOI	1.4.2016 to 31.3.2018	150.00	Dr.N.Sriram
	HREC, GUDALUR				
234.	ICAR-FF-Voluntary centre for AICRP on Rice (AICRIP) trials at HREC, Gudalur	ICAR(FF)	1.4.2015 to 31.3.2017	0.99	Dr.S.Manonmani
	SRS, CUDDALORE				
235.	Development of sugarcane crop with (i) Demonstration on intercropping in sugarcane, (ii) Breeder seed production, (iii) Strengthening of tissue culture lab and production of tissue culture plants for sugarcane and (iv) State level training - capacity building training programme	GOI-NFSM	2016-2017	24.72	Dr.S.Thirumarassan, Dr.G.Manickam, Dr.S.Ganapathy, Tmt.R.Anitha, Dr.M.Jayachandran
	CRS, VEPPANKULAM				
236.	Technical advisory support for establishing DxT hybrid coconut nursery at Vaduvur Thenpathi village of Mannargudi Taluk, Thiruvallur district	GoTN	1.4.2016 to 31.3.2019	6.20	Dr.S.Mohandas, Dr.K.S.Vijai Selvaraj

MEMORANDUM OF UNDERSTANDINGS

INTER INSTITUTIONAL RESEARCH COLLABORATIONS

S. No.	Details of MoU	Collaborating Agency
Research		
1.	To strengthen the research programs on genome sequencing and Bioinformatics (December'2015)	Genome Life Sciences, Chennai
2	Developing Resilient Rice through Genomics (December'2016)	DBT, New Delhi
3	Enhancing nutritional security of pregnant women, infants and young children in rural households of Tamil Nadu, India through agricultural intervention" (January'2017)	BIRAC, New Delhi and University of California Davis, USA
4	Deploying biotechnology based decision making tools in postharvest grain pest management to enhance food security and market access	DBT, New Delhi
5	Bt cotton research	CICR, Nagpur
6	Ecofriendly crop protection technology development" on 09. 07. 2015	M/s. Sun Agrobiotech Research Centre, Chennai
7	Impact of indiscriminate use of chemical fertilizers and pesticides	NIPHM Hyderabad
8	Studies on Physiological and molecular basis for action of bio-stimulant <i>Vasicinein</i> tomato	EID Parry, Chennai
9	Investigation on conduciveness of aflatoxin development in Indian senna (<i>Cassia angustifolia Vahl.</i>) and its biological management	NMPB, Dept. of AYUSH, New Delhi
10	Emergence of <i>Tobacco streak virus</i> infecting Cotton: Investigations on transmission, spread and symptom remission	DBT, New Delhi
11	Industrial Forestry	Century Plyboards (I) private ltd
12	Research Collaborations on Forest and Wild Life	SACON, Coimbatore
13	Collaborative Research on neem	EID Parry, Chennai
14	Research collaborations on medicinal plants	AryaVaidya Pharmacy, Coimbatore
15	Inter-Institutional Research Collaboration	Northwest A and F university, China
16	Standardizing the seed coating strategies of beneficial endophytes	Tropical Biosciences Pvt, LTD, Chennai Agrosystem, Chennai

Commercialization of TNAU Technologies		
S. No.	Details of MoU	Collaborating Agency
1	TNAU – SRI Power Weeder	M/s. Sharp Garuda Farm Implements Pvt. Ltd.,
2	TNAU – Downdraft Gasifier	M/s. Excess Renew Tech (P) Ltd.
3	SolarCropDrier (Tunnel Type)	M/s. Excess Renew Tech (P) Ltd.
4	Greening of Chennai Corporation	Chennai Corporation
5	TNAUMaizeHybridCO7&CO8 (F1 Commercial Seed)	M/s. Karnataka State Seed Corporation limited (KSSC)
6	TNAU – Liquid based Biofertilizer	M/s. Devi Biotech Pvt Ltd
7	Seed Pelleting of Sesame seeds using seed pelleting Mixture for Sesame	M/s Reliable Corporation, Chennai
8	Rice Hybrid CORH-4	M/s. Trimurti Plant Sciences Private Limited, Hyderabad, Telangana
9	TNAUMaizeHybridCOH (M)8 (F1 Commercial Seed)	M/s. Trimurti Plant Sciences Private Limited, Hyderabad, Telangana
10	Sugarcane Juice BottlingTechnology	M/s. Skysis Foods and Beverage Private Limited.Sonipat, Haryana
11	Consultancy on Palmyrah	M/s. Bihar Agricultural University, Sabour, Bihar

TAMIL NADU INNOVATION INITIATIVE SCHEMES

FOR STRENGTHENING TNAU RESEARCH AND DEVELOPMENT INFRASTRUCTURE

Budget (Lakh Rs.)				
Sl.No	Project Title	Budget	Released	Expenditure
1	Rhizotron based Plant – Microbe – Soil Interaction to Yield Sustainability	900.00	900.00	897.00
2	Ultra high density orcharding and modern method of fruit cultivation	157.00	152.00	98.60
3	Large area impact demonstration of fruit flies trapping technology to minimize yield loss to mango farmers in Dharmapuri and Krishnagiri Districts of Tamil Nadu	245.00	190.00	127.50
4	Integrated Seed Production Hub for Southern Districts of Tamil Nadu AC & RI, Killikulam	500.00	500.00	17.00
5	Promotion, Commercialization, Post Harvest Processing and Industrial Application of Annatto (<i>Bixa Orellana</i> L.) as a Source of Natural Dye	224.00	224.0	New programmes. Work commenced
6	Revitalization of Millets for nutritional security and enhanced Productivity	187.80	72.60	
7	Mitigating occupational drudgery of farm women through ergonomic interventions	177.00 Allotted	To be released	-
8	Establishment of Silvipastoral Module Suitable for <i>Alfisol</i> Tract of Tamil Nadu at DARS, Chettinad	395.00	To be released	-
TOTAL		2785.80	2038.00	

The following three projects have also been approved for funding by the SPC and funds are to be released during 2017-18

1. Development of Nutritionally enhanced Premium Quality and Stress Resilient Rice Varieties for TamilNadu. **(Rs. 264.40 lakh)**
2. Organic Inputs and Bio-inputs Characterization for Sustainable Organic Agriculture. **(Rs. 132.00 lakh)**
3. Production and supply of quality vegetable seedlings of major vegetable crops - An innovative approach **(Rs. 277.75 lakh)**

NATIONAL AGRICULTURAL DEVELOPMENT PROGRAMME (NADP)

FOR STRENGTHENING TNAU RESEARCH AND DEVELOPMENT INFRASTRUCTURE

A. PRODUCTION GROWTH

Sl. No.	Scheme	Financial Allocation (Rs. in lakhs)
1	Promotion of Quality Seed Production In Green Manures	114.080
2	Active additive application of Bioinoculants through seed pelletization for enhancing productivity and profit of dry-Land agriculture	107.220
3	Promotion of organic cultivation for quality black pepper production from Kolli Hills of Tamil Nadu	21.389
Total		242.689

B. INFRASTRUCTURE AND ASSETS

Sl. No	Scheme	Financial Allocation (Rs in lakhs)
1	Strengthening of Insect Museum at Tamil Nadu Agricultural University, Coimbatore	110.00
2	Establishment of cryoconservation modules for the conservation of farmers varieties / Land Races of Tamil Nadu for Posterity	196.00
3	Construction of Farmer Trainees Hostel at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli	257.00
4	Diversified Agricultural Cafeteria with the State of Art Technologies for Third Generation	700.00
Total		1263.00

C. CAPACITY BUILDING

Sl. No	Scheme	Financial Allocation (Rs in lakhs)
1	Skill Development Centre – Operation, Repair and Maintenance of Agricultural Machinery	750.00
2	Price Forecasting and Development of Market Advisories to interface with e-Resource division of Agro Marketing Intelligence and Business Promotion Centre (AMI&BPC), Trichy	37.00
Total		787.00

D. STRENGTHENING OF AGRICULTURAL RESEARCH

Sl. No	Scheme	Financial Allocation (Rs in lakhs)
1	Establishment of Six Centres of Excellence by Tamil Nadu Agricultural University	
	a. Centre of Excellence in Molecular Breeding	150.00
	b. Centre of Excellence in Dry Farming	136.00
	c. Centre of Excellence in Sustaining Soil Health	420.00
	d. Centre of Excellence in Innovation	594.85
	e. Centre of Excellence in Oil Palm	3.00
	f. Farm Women Knowledge Centre	75.00
2	Enhancement of productivity and quality in Grapes through Hi-tech management practices	197.50
3	Establishment of New Citrus Research Station at Sankarankoil in Tirunelveli district	150.00
4	Establishment of New Mango Research Station at Regional Research Station, Paiyur in Krishnagiri district	200.00
	Total	1926.35

E. FOOD SAFETY

Sl. No	Scheme	Financial Allocation (Rs in lakhs)
1	Implantation of food safety and quality of Agri-horti produces through NABL Accredited Laboratories in TNAU	600.00
	Total	600.00

