TAMILNADU AGRICULTURAL UNIVERSITY

48th RESEARCH COUNCIL MEETING

Research Highlights 2014-15

CROP IMPROVEMENT

Released Varieties – National level

Maize

The evaluation of new hybrid combinations under All India Coordinated Research Programme (AICRP) across the country resulted in the identification of four hybrids *viz*. CMH 08-381, CMH 09-464, CMH 08-282, and CMH 08-287. These hybrids were identified for central release by the Varietal Identification Committee (VIC) of AICMIP. The details of the hybrids identified are given below.

- CMH 08-381 is a late maturing (105-110 days) single cross (UMI 1211 x UMI 1221) hybrid with bold orange yellow grains with dent type. It gave an average grain yield of 9359 kg per hectare in Zone 3 and 4 as mean yield of three years in kharif season. It has consistent superiority in yield over qualifying checks *viz*., PMH 1 (16.65percent), PMH 3 (9.46 percent), Seed tech 2324 (18.06 percent) and Bio 9681 (23.57 percent).
- CMH 09-464 is another late maturing (105-125 days) modified single cross [(UMI 1200 x UMI 1210') x UMI 1223] hybrid possessing bold orange yellow grains with dent. It has high shelling (80 percent) and high test weight (41g/100 kernels) which helps in fetching high price in the market. It remains stay green at maturity which adds up fodder value. It gives an average grain yield of 8320 kg per hectare in Zone-3.
- CMH 08-282 is single cross (UMI 1200 x UMI 1230) late maturing hybrid (105-125 days) having orange yellow bold grains with semi dent type. It has high shelling (80 percent), high test weight (41g/100 kernels) and has stay green trait at maturity. It gives an average grain yield of 8951 kg per hectare in zone-4 in rabi season. It has consistent superiority in yield over qualifying checks *viz*., Buland (19.47 percent) and Bio 9681 (9.48 percent) in breeding trials during rabi season (Zone -4). It showed moderate resistance to *Turcicum* leaf blight, sorghum downy mildew, post flowering stalk rot and common rust disease under artificial conditions over qualifying check varieties. It also showed moderate resistance to stem borer *Chilo partellus*.
- CMH 08-287 is a single cross (UMI 1210 x UMI 1220) late maturing hybrid with bold orange yellow grains with dent. It has high shelling (80 percent) and high test weight (41g /100 kernels). It has consistent superiority in yield over qualifying checks *viz*., seed tech 2324 (17.21 percent), Buland (26.51 percent) and Bio 9681 (15.92 percent) in breeding trials during rabi season (Zone-4).

Cotton

- TSH 0250 culture had been tested in AICCIP in National as well as South Zone trials under irrigated conditions from 2010 to 2013. This culture is of semi spreading type with long staple length (29.4 mm) and bundle strength (22.0g/tex). Maturing in 140-150 days, this culture possesses moderate resistance to leafhopper. The results revealed that TSH 0250 recorded mean seed cotton yield of

1835 kg/ha as against 1635 kg/ha of national check Surabhi which is 12.2 % increase over Surabhi. This culture was identified by Central Variety Identification Committee for South zone in the year 2013-14.

Cultures in pipeline

Rice

- CB 05022 (CO 43/ADT 39), a high yielding medium tall culture with resistance to blast, bacterial leaf blight, rice tungro disease, white backed planthopper and green leafhopper is found suitable for cultivation under organic condition. The evaluation of CB 05022 in larger plots (one acre) of 41 registered organic farmers gave promising results. It recorded an average grain yield of 5476 kg/ha with 23 percent higher yield over ADT 46, 20.96 percent over CO (R) 50 and 18.6 percent over BPT 5204. The highest yield recorded was 14.1 tonnes in Dharmapuri district. However, the average yield observed under 119 adoptive research trials (ART) conducted with normal agronomic management was 6071 kg/ha. The three years evaluation of CB 05 022 as IET 20884 under AICRIP trials revealed its suitability for Southern and Western zones.
- CB 09123 (BPT 5204/CO50) a fine grain culture with medium duration (135 days) is under second year of testing in ART Rice 15/2014-15. Farmers' feedback on this culture is encouraging based on 43 on-farm trials conducted across Tamil Nadu and they reaped a good harvest and a remunerative market price than BPT 5204.The culture is moderately resistant to blast, brown spot, white backed planthopper and green leafhopper. It has good head rice recovery (63.1percent) and high linear elongation ratio (1.67).
- An early duration culture maturing in 113 days, CB 08504 (Raskadam/IR 50) recorded a mean grain yield 6058 kg/ha with fine grain quality. It is moderately resistant to stem borer, blast and sheath blight. The culture is under second year of testing under ART Rice 3/2014-15 (ART – Early).
- The promising early duration quality rice culture CB 08513 (JGL 384/Rasi) is under second year of ART Rice 14/2014-15 (ART – Quality rice). It recorded a mean grain yield of 5952 kg/ha in 112 days which was 12.6 percent increase over ADT 43. It is found to be moderately resistant to brown planthopper, white backed planthopper and yellow stem borer, blast, sheath rot and sheath blight.
- CB 06803 (PMK (R) 3/ Norungan) and CB 08702 (IR 80013-B-141-4) are the two promising drought tolerant cultures being tested under ART. CB 06803 recorded 2603 kg/ha in 117 days with 51.6 percent increase over TKM (R) 12 and 40.9 percent increase over Anna (R) 4 whereas CB 08702 recorded 2528 kg/ha in 122 days with 47.2 percent increase over TKM (R) 12 and 36.9 percent increase over Anna (R) 4.
- The research on evolving rice varieties with therapeutic values resulted in the identification of a medium duration line with insensitivity to photoperiod from photoperiod sensitive *kavuni* rice. The improved version of *kavuni* rice is in the early stage of evaluation.
- The research on the evolution of rice hybrids resulted in the identification of three promising rice hybrids. TNRH 280, an early duration hybrid recording the highest yield of 6897 kg/ha with 20.32 percent increase over the check CORH 3 (5747 kg/ha) is in first year of ART16/ 2014-15. TNRH 241, a medium duration hybrid recorded the maximum yield of 7036 kg/ha with 11.38 percent increase over the check CORH 4 and is in first year of ART 17 / 2014-15. The promising two line rice hybrid TNTRH 55 (TNAU 60S/ CB 55) maturing in 130 days is under advanced stage of evaluation. It has medium slender grain type with good cooking quality.

- The new CMS lines *viz.*, COMS 27A, COMS 28A, COMS 29A and COMS 30A were identified as promising with desirable floral characters and quantitative traits. The stability of these lines is under testing to use them for developing new hybrid combinations.

Sorghum

- The culture TNS623 (2219B x SPV 1390) is a dual purpose, short duration culture resistant to shoot fly and stem borer and is in second year of ART. The average grain yield potential is 2742 kg/ha. It is moderately resistant to shoot fly and stem borer.
- Two promising cultures *viz*., TNS 660 and TNS 661 recorded the highest grain yield of 4345 and 4335 kg/ha which is 13 percent increase over check CO 30. The fodder yield were 15 and 16 t/ha respectively.
- The sweet sorghum entry TNSS 212 was evaluated in MLT and AICSIP trials. It was selected from TNS 603/SPV881. Maturing in 117 days, this culture yields fresh biomass of 34.2t/ha and grain yield of 3042 Kg/ha with a brix of 16.3.
- The single cut forage sorghum entries TNFS 204 and TNFSH 205 were evaluated in MLT and AICSIP trials. The entry TNFS 204 recorded the green fodder yield of 377q/ha, dry fodder yield of 125q/ha and IVDMD of 56 percent. This entry was evaluated for two years in MLT. TNFSH 205 recorded the green fodder yield of 28.67 tonnes/ha.

Pearl millet

- UCC 32, a promising composite was developed and tested under different advanced stage of testing. It performed well both under rainfed and irrigated situations in Tamil Nadu. This composite is medium in stature (160-180cm) with 85-90 days duration. It produces 4-6 productive tillers and recorded a mean grain yield of 3474 kg/ ha under irrigated condition which is about 17 and 23 percent increase over the checks CO (Cu) 9 and ICMV 221 respectively. The mean grain yield under rainfed condition is 2916 kg/ha which is 15 and 24 percent increase over CO (Cu) 9 and ICMV 221 respectively.
- Two promising hybrids, TNBH 08804 and TNBH 08813 are being tested for second year in ART during 2014-15. These hybrids recorded an average yield of 4076 kg/ha and 2867 kg/ha respectively under multi location trials (MLT). The hybrids possess compact earhead with bold grains and are highly resistant to downy mildew.
- Under diversification of male sterility, 85 lines with 100 percent sterility and phenotypically uniform were identified and are under BC_6F_1 generation. These lines will be tested for their stability in maintaining sterility.
- A total of 200 recombinant inbred lines (RIL) was developed to identify agronomically superior inbred lines with rich beta carotene content by crossing PT 6129 (yellow parent) and PT 6029 (grey parent). The RIL *viz.* TNBG-06-45-5-5-2-2-10, TNBG-06-82-5-5-2-4-2, TNBG-06-67-5-5-3-4-7 and TNBG-06-194-5-5-2-1-1 performed better and recorded maximum grain yield per plant and showed desirable mean performance for most of the yield attributing traits. The other RIL *viz*. TNBG-06-132-5-5-3-2-10, TNBG-06-77-5-5-2-1-10, TNBG-06-53-5-5-3-2-5 and TNBG-06-81-5-5-3-3-1 possess higher levels of beta-carotene content.

Maize

- Among the sweet corn hybrids, CSCH14003 recorded the highest cob yield of 15597 kg/ha which is 19.02 percent increase over the high yielding check Sugar 75 (13104 kg/ha). Two hybrids viz., CSCH14012 (14167kg/ha) and

CSCH14001 (13424 kg/ha) were also found to perform better with higher green cob yield than the best check.

Redgram

- CRG 10-01 with the parentage of APK 1/LRG 41 gave a yield of 1160 kg/ha in 180 days and is found to possess resistance to sterility mosaic disease.
- COPH 2010-01 (R), a redgram hybrid (ICPL 2043/LRG 41) recorded 1638 kg/ha of grain yield in 170-180 days.
- CRG 2013-10 (ICPL 2052/ICPL 86020) and CRG 2010-12 (Co (Rg) 7/BSMR 853) are the two redgram cultures under MLT testing with resistance to sterility mosaic disease.

Blackgram

- COBG 10-05 (VBN (Bg) 5/*V. mungo* var*. silvestris)* is an advanced culture maturing in 60-65 days with tolerance to yellow mosaic virus (YMV) and yield potential of 997 kg/ha.
- The other two promising cultures with better tolerance to YMV are COBG 11-02 (R) (VBN 4/*V. mungo var. silvestris) and* COBG10-06 (CO (Gg) 7/COGG 11).

Greengram

- COGG 11-03 (R), a greengram culture with the parentage of CO (Gg) 7/COGG 11 gave a grain yield of 870 kg/ha. The culture comes to synchronous maturity in 60-65 days.
- COGG 11-03 (R) (CO (Gg) 7/COGG 11) and COGG 10-10 (COGG 912/Pusa 0672) are the other two promising greengram cultures with early and synchronous maturity.

Groundnut

- Groundnut bunch type cultures *viz*., ICGV 07222, ICGV 07018 and ICGV 06146 are being tested in Multi Location Trial during kharif 2014. The cultures recorded pod yield of 2907, 2912 and 2925 kg/ha respectively. They could give 15 percent more yield than the check variety *viz.* VRIGn 6 at station trials.
- A semi spreading type culture ICGV 03128 recorded 3490 kg/ha which is 20 percent increased pod yield than the check variety CO 6 in station trials. It is being tested in Multi Location Trial.

Sesame

- Sesame cultures *viz.* CSX 13006 (brown seed) and CSX 13015 (white seed) recorded 1130 and 640 kg/ha in station trials. This increase is more than 15 percent seed yield than check varieties TMV 7 and SVPR 1. These cultures will be proposed for testing in Multi location trial during 2015-16.

Sunflower

- Sunflower hybrid CSFH 9036 was evaluated under MLT (2011), ART (2011-12) and OFT (2012-13). It recorded an average seed yield of 2000 kg/ha during kharif season which is 15.0 and 16.1 percent higher than the checks Sunbred 275 and hybrid CO 2 respectively. During rabi season, this hybrid had the seed yield of 2200 kg/ha which is 14.8 and 11.4 percent higher than the checks Sunbred 275 and hybrid CO 2 respectively. Apart from seed yield, the hybrid CSFH 9036 has an oil content of 40.0 percent and volume weight of 43g/100ml.

- Sunflower hybrid CSFH 8031 recorded 1731 kg/ha in MLT 2012-13 rabi/summer season which is 17.9 and 13.2 percent increased seed yield than Sunbred 275 and Hybrid CO 2 respectively. This culture is being tested under ART during rabi/summer 2014-15.
- An attempt was taken to develop sunflower hybrid with high oleic acid (>80percent) content than normal sunflower hybrids (45-55percent). A hybrid CSFH 13075 recorded oil content of 37 percent, oleic content of 85-86 percent and yield potential of 3348 kg/ha in station trials. It is 12.3 percent increased yield over DRSH1. This hybrid will be proposed for MLT during 2015-16.

Cotton

- Cotton genotypes with more than 33.0 mm fibre length are considered as extra long staple category. The *G. hirsutum* culture TCH 1716 recorded more than 35 mm fibre length with big boll size. It has out yielded the check variety MCU13 [(MCU 5 x TCH 92-7) x MCU 5-1] by 21.2 percent and is in ART. It comes to maturity in 150 days and found to be better than MCU 13 for seed cotton yield (kg/ha), ginning outturn (percent), fibre length (mm) and fibre strength (g/tex).
- The production of cotton can be increased substantially by adopting high density planting system. However, only the compact plant type with zero monopodia and short sympodia is suitable for high density planting system. The *G.hirsutum* culture TCH 1822 (Khandwa 2/African I-2) is highly suitable for such system and is presently under MLT. It comes to maturity in 140 days with better attributes than Suraj cotton variety.
- TSH 0499, a high yielding long staple culture (31.4 mm) was tested under AICCIP. This culture recorded an average seed cotton yield of 1948 kg/ha which is 27.2 % increase over the check SVPR 2 (1530 kg/ha).

Forage Crops

- A promising fodder cowpea culture TNFC 0924 (CO 5/Bundel lobia 2) superior to the released variety CO (FC) 8 has been identified and is under evaluation under OFT since kharif 2013 and at MLT during kharif 2014. This entry has also ranked first at National level in IVT (kharif 2012) and AVT I (kharif 2013) consecutively in AICRP trials.
- A clone FDC 265 has been selected from Kangeyam local. As it belongs to *Cenchrus setigerus* species, the seeds are bold and free from awns which facilitate easy collection of seeds unlike CO 1 which belong to *C. glaucus* species in which collection of seeds is very difficult owing to its free dispersal mechanism after maturity. This culture is under OFT since kharif 2013 and in MLT during kharif 2014.
- Gamma ray induced mutation attempted on the introduced variety hedge lucerne during 2010 had resulted in the selection and identification of an elite mutant (in 450 Gy) TNDS 1308 from M_5 generation. It has recorded a higher green fodder yield of 138 t/ha/yr over the check (120 t/ha/yr). It will be proposed for evaluation under MLT and OFT from kharif 2015 onwards.
- A promising lucerne culture TNLC 15 (RCP 2-1) has been identified from the polycross breeding programme (2003-2010). It had registered a green fodder yield of 136 t/ha /yr as compared to check CO 2 (124 t/ha /yr). It will be proposed for evaluation under MLT and OFT during rabi 2015-16 besides sponsoring to AICRP trials (rabi 2015-16).

TRRI, Aduthurai

Development of high yielding long duration rice variety superior to CR 1009 suitable for *Samba* season.

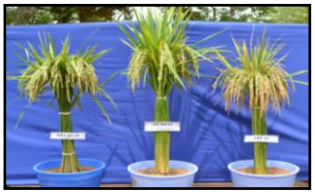
The perusal of the grain yield data from 2009-10 to 2013-14 revealed that AD 09367 with the duration of 158 days has registered an overall mean grain yield of 7024 kg/ha with the yield advantage of 11.1 per cent over CR 1009 (6244 kg/ha). It has 1000 grain weight of 22.6g with 66.2% head rice recovery. Besides yield and cooking qualities, it also has non lodging habit, resistance to BPH, stem borer and leaf folder and moderate resistance to blast, BLB and sheath rot.

This culture was also evaluated in farmers' fields during 2014 *Samba* in Thanjavur, Thiruvarur and Nagapattinam districts at 8 locations to assess the yield and farmers' preference. In farmers field AD 09367 recorded mean grain yield of 6112 kg/ha, which is 17.8 per cent higher than CR 1009. In majority of the farmers field severe incidence of BPH was noticed in CR 1009 whereas in AD 09367 BPH incidence was not observed.

Team of scientists including Director, TRRI visited the large scale field trials in the farmer's field as well as the ART trials conducted by the Department of Agriculture and Krishi Vigyan Kendras on 21.1.2015 and 29.1.2015. Farmers were highly impressed upon the yielding ability, non lodging nature, pest and disease resistance of this culture.

Evolution of short duration rice variety with inbuilt tolerance to BPH and Blast in addition to superior grain quality characters.

AD 08010 – ADT(R) 45/ AD 01236



- Duration – 115 -118 days
- AD 08010 was evaluated in different station trials from 2008-2010. Based on its performance it was nominated to MLT I during 2011.
- In MLT 2011, this culture recorded a mean grain yield of 6248 kg/ha in 115 days, a yield increase of 14.3% over ADT(R) 45 (mean of 20 locations) and ranked first in MLT 2010 and 2011.
- The culture is resistant to stem borer (score –1), moderately resistant to GLH, blast, sheath rot, brown spot.
- It possesses medium slender grain with good cooking qualities, intermediate gelatinization temperature, amylose and soft gel consistency.
- This culture was promoted for conduct of Adaptive Research Trials for two years during Crop Scientists' Meet – Rice, 2012. At present, this culture is under evaluation in 2nd year ART 2014-15 (Rice 3 / 2014-15).
- It was nominated to AICRIP IVT E during Kharif, 2012 and further promoted to AVT 1E during 2013 and to AVT-2E during 2014-15.

AD 07073 – ADT 43/JGL 384

- Fine grain culture AD 07073 with the duration of 112 days, recorded a mean grain yield of 5758 kg/ha with 11.2% higher yield than ADT 43 in two years of MLT.
- This culture possesses good cooking qualities *viz.*, LER -1.64, BER – 1.33, intermediate amylose, GT and soft GC.
- Besides yield and quality it has moderate resistance to brown spot, blast, sheath rot, and WBPH.
- This culture was promoted for conduct of Adaptive Research Trials for two years during Crop Scientists' Meet – Rice, 2013. Now, this culture is under evaluation in 2nd year ART trial (Rice 14/2014-15 Special transplanted).

Development of medium duration rice with high yield potential, preferential grain quality suitable for irrigated ecosystem of Tamil Nadu.

AD 08142 - ADT 43/IR 64

- Recorded an average grain yield of 6156 kg/ha in 134 days with 12.3% and 12.9% increase over ADT 49 and BPT 5204 respectively in two years of MLT. This culture was topper in MLT QR-M during first year.
- In all India trials during 2012-13, it ranked 7th with mean grain yield of 5205 kg/ha and highest number of panicles/m^2 (396).
- Moderately resistant to BPH, GLH, blast and sheath rot.
- Medium slender grains, more LER (2.0), less BER (1.35), more VER than BPT 5204
- This culture is currently being tested for first year in Adaptive Research trial Rice 15/2014-15 Special transplanted

AD 09493 – I.W.Ponni/Bansakthi

- Duration - 135 days
- In station trials, the culture AD 09493 recorded a mean grain yield of 6294 kg/ha with more than 20.0 per cent yield advantage over fine grain checks.
- The panicles are more than 30 cm long with 400 to 425 filled grains per panicle
- Grains are medium slender with good cooking qualities
- During first year of MLT, this culture ranked first with mean grain yield of 6729 kg/ha in 134 days. It is being tested in second year of MLT during 2014-15.

CROP BIOTECHNOLOGY

Crop biotechnology is one of the most rapidly adopted technologies in crop production. It has the potential to improve the lives of millions of people, especially in the developing countries by enhancing the productivity of crops, imparting resistance against pests, diseases and environmental vagaries including climate change and helps to achieve food and nutritional security. At the Centre for Plant Molecular Biology and Biotechnology, research is focused towards improving major crops viz., rice, maize, cotton, banana, tomato, cocoa, barnyard millet and soybean for resistance against major biotic and abiotic stresses and nutritional quality through molecular and bioinformatics tools. Broadly, research activities in CPMB&B are done under the following thematic areas viz.,

1. Molecular breeding for resilience in major crops
2. Biofortification of nutrient/therapeutic properties in staple crops
3. Bio prospecting, tissue culture, genomics and bioinformatics

Molecular breeding for resilience in major crops

Biotic stresses

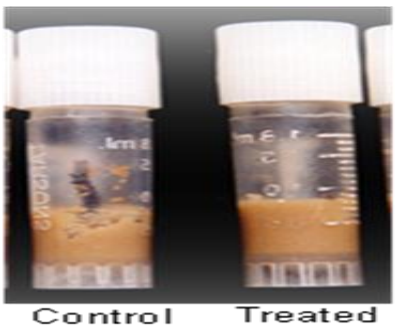
Pests and diseases pose serious threat to crop production. Efforts are undertaken for genetic enhancement of resistance against major pests and diseases in rice, cotton, pulses, banana, brinjal and papaya through genetic engineering and molecular marker-assisted breeding. These include:

- Genes for resistance against blast (*Pi54, Pi9*), bacterial blight (xa5, *xa13, Xa21, Xa33, Xa38)* and gall midge (*Gm1, Gm4*) are introgressed using MAB into popular rice varieties viz., CO43, ADT 43, ADT 47 and ASD16. Improved ADT 43, ADT 47 and ASD 16 with three bacterial blight resistance genes are being evaluated under MLT.

Screening for BB resistance in BC_2F_3 generation

- A rice culture, CB011043 pyramided with two gall midge resistance genes (*Gm1*, *Gm4)* and another multiple stress tolerant line, *CB011020* pyramided with two gall midge resistance genes (Gm1 and Gm4), a bacterial blight resistance gene (*Xa21*) and a blast resistance gene (*Pi54*) have been developed through MAB and are in MLT III.
- Soybean varieties (CO 3 and JS 335) have been introgressed with *Phytophthora* and powdery mildew resistance genes through marker assisted backcross breeding.
- Novel Bt genes (such as *cry2AX1 and cry2Ai)* have been isolated from indigenous isolates and are being used for transformation of cotton, rice and tomato.

H. armigera



Control Treated

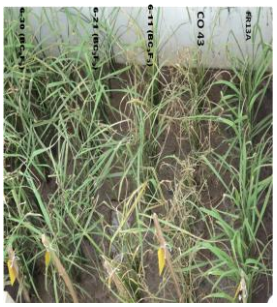
- Transgenic cotton plants transformed with *cry2AX1* have been developed. Detached leaf bit bioassay on T_3 plants recorded (on 105 DAS) 70 to 95 per cent mortality in neonates and 20 to 40 per cent mortality in third instar larvae of *H. Armigera.*
- A total of 30 PCR positive T_0 transgenic ASD16 rice lines harbouring *cry2AX1* gene were generated. Detached leaf bit bioassay of selected T_1 transgenic rice plants showed 83.3 to 90.0 per cent mortality against neonates of rice leaf folder.
- Eight ELISA positive *cry2Ai* transformants of tomato recorded 100 per cent mortality in neonate larvae of *H. armigera.* Southern blot hybridization analysis of five promising transformants of tomato revealed stable integration of *cry2Ai* gene in one or two loci. A tomato line with single transgene insert is being advanced to T_1 generation.
- Banana lines showing resistance to banana bunchy top virus have been developed through RNAi technology and their efficacy is being tested under controlled conditions.
- Genes encoding chemosensory proteins in *Spodoptera litura* and *Nilaparvata lugens* are cloned towards controlling major insect pests using RNAi approach. OR83b co-receptor and chitin synthase A are found to be potential targets to manage insect pests using RNAi approach.
- 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 percent in most of the populations.

Abiotic stresses

- Local rice landraces *viz*., Norungan and Nootripathu are used in mapping of genes for drought tolerance. A meta-QTL for grain yield under drought stress in rainfed production environment has been mapped on chromosome 6 using Norungan, further fine mapped to 94.0 kb and is deployed in marker assisted breeding (MAB).

- Near Isogenic Lines (NILs) introgressed with QTLs for deep and thick roots from CT9993 into IR20 have been developed using MAB and evaluated for root growth and plant production under drought in TPE. NILs with higher grain yield under drought stress identified and are being tested for stability.

- Submergence tolerant version of CO 43 (CO 43+*Sub1*), salinity tolerant version of Improved White Ponni (IWP+*saltol*) and high yielding, drought tolerant rice lines (CBMAS14065 and CBMAS14142) with superior grain quality have been developed through MAB and are being evaluated under MLT.

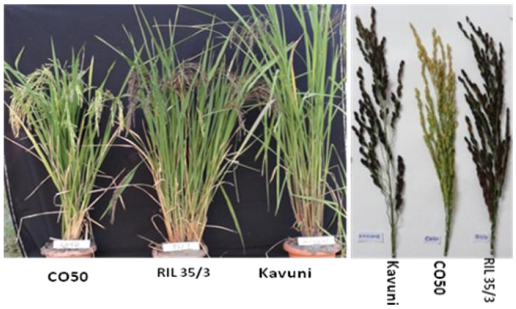


- Rice lines pyramided with major QTLs for tolerance against multiple stresses (drought, salinity and submergence) have been developed through marker assisted breeding and are being evaluated.
- Efforts are in progress towards targeted genetic manipulation of duration, yield and flowering behaviour in rice through molecular breeding.
- Genes for drought and salinity tolerance are being isolated from diverse plant sources (drought tolerant rice, finger millet, barnyard millet, Clerodendrum and resurrection plants) to improve abiotic stress tolerance in rice and other major crops.

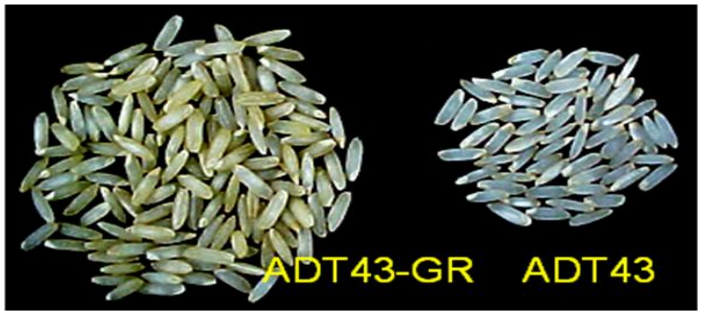
Biofortification of nutrient/therapeutic properties in major crops

Enriching staple food crops with nutrients and therapeutic properties will help overcoming malnutrition and thus improving nutritional security. At CPMB&B, research is undertaken towards enriching nutrients and therapeutic compounds in staple crops. These include:

- A traditional therapeutic rice “Kavuni” is characterized for nutrient and therapeutic properties. It was found to possess anti-diabetic properties and therapeutic carotenoid, “lutein”. A putative candidate QTL controlling accumulation of lutein in rice has been mapped.
- High yielding and photo-insensitive versions of “Kavuni” have been developed through molecular breeding.



- ASD16 and ADT43 rice lines expressing genes for beta-carotene biosynthesis and enhanced level of iron have been developed.



- High protein rice has been developed using *O.nivara* and is being tested.

Bio-prospecting, Tissue Culture, Genomics and Bioinformatics

Bioprospecting is the exploration, screening and isolation of biological diversity for valuable genetic and biochemical resources. Novel coumarins have been identified and isolated from medicinal plant, *Aegle mermolos* and being tested for anti-microbial, anti-feedant and anti-cancer activity. Plant tissue culture is used widely in the plant sciences, forestry and horticulture for several applications viz., commercial production of plantlets, conserving endangered plant species, large-scale production of metabolites, development of novel hybrids through protoplast fusion, embryo rescue and doubled haploid production etc., At this centre, tissue culture technology is used in:

- Development of reproducible regeneration protocol for coconut
- Doubled haploid production in tomato and cocoa
- Production of secondary metabolites through cell suspension

Recent advancements in the field of omics-based research have. Genomics and Bioinformatics platforms have enabled accelerated gene discovery and functional analyses of genes through whole genome sequencing and allele mining. At CPMB&B, research efforts have been takenup towards deployment of various omics technologies in understanding molecular basis of abiotic stress tolerance in crops.

- RNA-Sequencing and proteomics have been used to understand molecular basis of salinity tolerance in finger millet. Putative candidate genes and novel miRNAs associated with salinity tolerance in finger millet have been identified and are being validated.
- Genomic resources are being developed in finger millet, barn yard millet and pulses.
- Initiatives have been taken for whole genome sequencing of native crops of Tamil Nadu.

Developing databases for TNAU released varieties/hybrids of rice, millets and pulses. A tool for comparative codon usage analysis has been developed. Structural bioinformatics strategies are being used to study host-pathogen interaction in crops.

SEED CENTRE

Seed quality enhancement

Seed invigouration in the form of pre-soaking and priming with various organic and inorganic products found to influence the physiological and biochemical changes in the seed during the pre and post metabolic germination process. The seed management practices can be adopted inseed lots identified as having poor quality in order to prevent further quantitative and qualitative losses due to biotic and abiotic factors. One of the approaches is using suitable botanicals and bio-agents for maintaining vigour and viability during storage. The identification of eco-friendly, easy to-do suitable treatments with botanicals would be of great advantage for maintenance of seed quality during storage.

The following are the various results obtained for different crops.

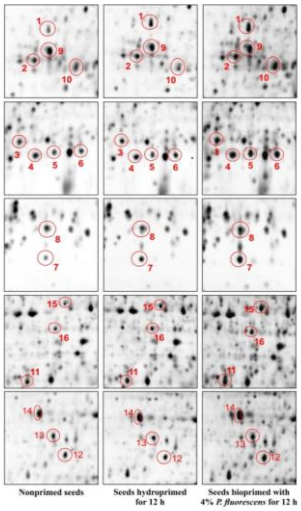
Crop	Treatment
Rice	Biopriming with *Pseudomonas fluorescens*60% for 12 h (or) Liquid *Azospirillum* 20% for 12 h (or) liquid Phosphobacteria 15% for 12 h.
Blackgram	Seed dry dressing with fenugreek seed powder @ 3g kg^{-1} or custard apple leaf powder @ 4g kg^{-1} with shaking.
Groundnut	Seed invigouration with inorganic nanoparticles of ZnO @1000g kg^{-1} and Ag @1250g kg^{-1} and organic nano powder of fenugreek seed @ 2g kg^{-1}
Tomato	Biopriming with *Trichodermaviride* 60% for 3 h (or) *Pseudomonas fluorescens*80% for 3 h (or) liquid *Azospirillium*15 % for 9 h liquid Phosphobacteria 20 % for 6 h
Chilli	Biopriming with *Pseudomonas fluorescens*80% for 3 h
Bhendi	Biopriming with Liquid *Azospirillium*15 % for 12 h
Onion	Biopriming with *Pseudomonas fluorescens*60% for 6 h; ZnO and Ag nanoparticles @ 100 mg kg^{-1}
Brinjal	Biopriming with *Pseudomonas fluorescens*60% for 6 h
Pumpkin and Bittergourd	Biopriming with *Pseudomonas fluorescens*60% for 18 h
Ashgourd and Ribbed gourd	Biopriming with *Pseudomonas fluorescens*80% for 12 h
Snakegourd	Biopriming with *Pseudomonas fluorescens*80% for 24 h

Plausible reasons

- The seeds treated with fenugreek seed powder or custard apple leaf powder in dry or wet form possessed high free radical scavenging property and resulted in lower solute leakages. Also possessed higher α - amylase activity and lower protease activity and free amino acid content.
- Analysis of DPPH free radical scavenging property of botanicals revealed high antioxidant property. ICP analysis of botanicals revealed the presence of minerals in botanicals.
- Early synthesis of low molecular weight proteins and other hormones responsible for triggering improved germination and other seed quality parameters in primed seeds.
- There are 29 proteins differentially expressed in bioprimed seeds when compared to hydroprimed seeds. Out of 29 proteins, 19 proteins were up-regulated and 4 proteins were down-regulated in bioprimed seeds. However, two proteins (27 and 28) were expressed only in hydroprimed seeds.The

proteins, which were differentially expressed in bioprimed seeds, may be responsible for superior performance of bioprimed seeds over hydroprimed seeds.

Relative abundance of protein from 12 h germinated CORH 4 rice hybrid seed



Seed production and quality regulation

Hybrid seed production technology

The technological interventions in both varietal and hybrid seed production are very much essential in enhancing and maximizing the production and productivity of crops. The seed to seed crop management strategies are very much essential for maximizing and up scaling the seed quality. To achieve this, standardization and recommendation of appropriate production technologies as per the changed environment is highly essential. To enhance the seed set and seed yield inCORH 4 rice, staggered sowing of R line need to be followed. In *rabi* season, it was found that staggering R line at -16, -13, -10 and 0 days and in *kharif,* season, staggering at -14,-11,-8 and 0 days as optimum.

Organic seed production

Seeds bioprimed with 10% *Azospirillum*for 9 hrs and applied with 100 % RDF poultry manure resulted in higher seed yield and productivity in chilli (Cost Benefit Ratio :2.94). The applied poultry manure compensated both major and minor essential nutrient elements as well as organic matter content in the soil which improves moisture and nutrient retention. Organic manures apart from releasing essential nutrient to the soil also improved the soil structure, pH and cation exchange capacity of the soil and provides better environment for root development, aeration and plant stand with yield attributing characters.

Post harvest technology

Post harvest care in handling of seeds is equally important as that of pre production stages in order to attain the desirable quality of seeds with high storability. In addition, the seed quality parameters also vary due to physical characters like seed size, weight, colour etc.

Marigold seed upgrading

Marigold seeds, inspite of its density variationrequires grading and upgrading to eliminate immature and ill filled seeds which otherwise would lead to low viability and vigour.

- Among all the liquid (water, acetone, petroleum ether, methanol and dichloromethane) used for seed separation by liquid floatation, acetone was found to be the best because of its low specific density.
- Seed upgradation in marigold seeds is achieved based on density using acetone
- Upgradation with air blower technique with upper and side outlet opening combination of U_{100} and S_{25}, respectively.

Floatation technique with different chemicals in Marigold hybrid

Water Acetone

Seed storage

Modified atmospheric storage with 50 % CO_2 in blackgram

Modified atmospheric storage with 50 % CO_2 in blackgram can be a good alternative for chemical fumigants against pulse beetle (*Callosobruchusmaculates*) upto 6 months of storage with the expenditure of Rs.30 per ton of seeds.The generation of oxygen – depleted, carbondioxide – enriched interstitial atmosphere caused by the respiration of the living organisms in the ecological system of a sealed storage. This prevents the infestation of *Callosobruhusmaculatus*, which eventually die due to asphyxiation without impairing seed germination in 6 months of storage.

Modified atmospheric storage

Paddy seed storage in super grain bag

Paddy seeds with 10 % moisture content stored in super grain bags had prolonged storage life followed by fabricated bag. Super grain bags are multi layered plastic bag with Ca vapour barrier sandwiched between two layers of polythene.This combination made from an ultra-low permeability and multi-layered plastic using an inner layer of a proprietory gas barrier acts as vapour proof container.

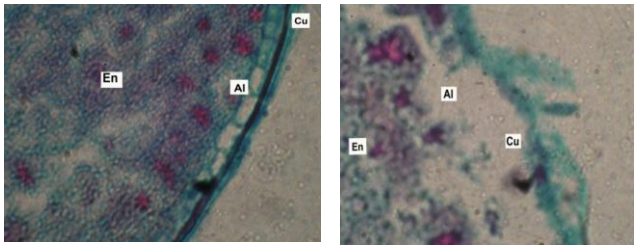
Low temperature storage in blackgram

Exposure of blackgram seeds packed in 700 gauge polythene bag to low temperature (-18^{0}C) for 6 h reduced the infestation level of pulse beetle during storage for 10 months storage.

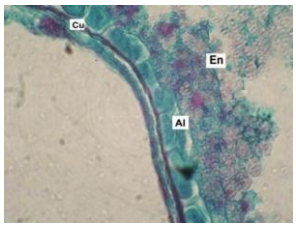
Causes for poor storage and enhancement of shelf life in rice cv. ADT 38

In Thanjavurregion, about 120 tonnes of ADT 38 seeds (fresh and stored) recorded poor germination during 2010 to 2013. Studies undertaken to notice the changes in anatomical features of seed of ADT 38 revealed the presence of less distinct cuticle, disintegrated aleuronic layer, non presence of nucleoliand poor cytoplasmic contents of the cells in aleuronic layer during storage which might be the causes for failure in germination / viability during storage. It could be managed by reducing the moisture content to 10 per cent, treating with halopolymer and storing in super grain bag for a period of 10 months.

6 months stored seeds – ADT 38



6 months stored seeds – ADT 39

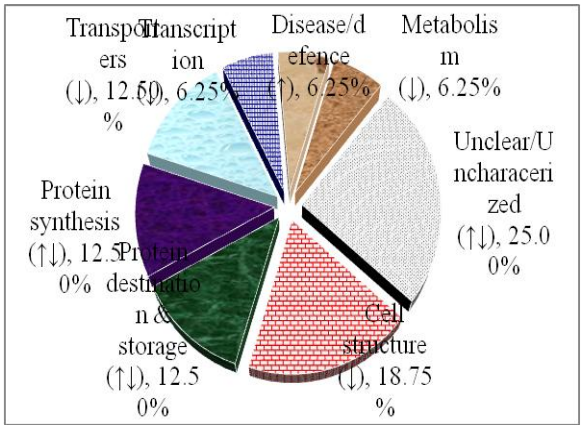


Causes for seed deterioration in blackgram (*Vignamungo* L.) seeds

The loss of seed quality in different kind of seeds varies with their composition and genetic potential. The deterioration process is faster in proteinaceous seeds. Tracing out the causes is more important to slow down the rate of deterioration and to extend the shelf life of seeds.

Protein analysis of fresh and aged seeds revealed 16 differentially expressed proteins. These proteins were identified using MALDI-TOF-MS and classified into 8 functional groups. Out of 16 proteins, 4 were up-regulated and 12 were down-regulated indicating that these proteins play an important role in seed viability. Seven down-regulated proteins were functionally related to cell structure, transporters, metabolism andtranscription and one up-regulated protein was related to defense.

Functional category distribution of 16 differentially expressed proteins in blackgram seeds



Seed production achievements

In 169 varieties of 33 principal crops, 23,000 quintals of various classes of seeds and 27,000 lakh nos. of planting materials were produced and distributed through Research Stations, Krishi Vigyan Kendras and also through farmers participatory seed production approaches for the benefit of Central, State, other agencies and farmers.

Impact of seed programme

In rice, 40 % of rice growing area in Tamil Nadu is covered with cv. CO 51 within 2 years of its release due to systematic planning and execution of seed production and distribution on a village hub based model. Similarly, in all other crops also same system is being followed due to which within a shorter period of variety it was made possible to distribute seeds in a shorter period and make the farmers to derive benefit of new varieties.

Strengthening infrastructure facilities for seed quality control

Under the GOI-Central Sector scheme for Quality control arrangement on seeds “Development and strengthening of infrastructure facilities for production and distribution of quality seeds” with a budget outlay of Rs.174.00 lakhs, the following infrastructure facilities were created.

Infrastructure created	Research Stations
Grow out test farm	TRRI, Aduthurai, ARS, Vaigaidam and ARS, Bhavanisagar
New seed testing laboratory	ARS, Bhavanisagar and ARS, Vaigaidam
DNA finger printing	ADAC&RI, Trichy and ARS, Vaigaidam

Grow out test farm at Tamil Nadu Rice Research Institute, Aduthurai

DNA finger printing laboratory at ADAC&RI, Trichy

Seed testing laboratory at ARS, Bhavanisagar

Innovative seed delivery system - Automated Seed Vending Machine

As an innovative seed delivery system for the benefit of kitchen and roof garden growers, the Automated Seed Vending Machine (ASVM) was purchased and installed during January 2014 in TNAU campus. The seed packets are constantly uploaded by the Dept. of Vegetables in this machine for meeting out the consumer demand.

CROP MANAGEMENT

Evaluation of water soluble fertilizers and normal fertilizers on cane yield under subsurface drip fertigation

Subsurface drip fertigation at 100% RDF with water soluble fertilizers was found to be superior in registering higher cane yield of 177.40 t/ha, higher water use efficiency of 161.15 kg/ha mm, water saving of 24.22 per cent and higher net income of Rs. 215799/ha compared surface irrigation. Considering economics, subsurface drip fertigation at 100% RDF as Normal Fertilizer was found to be superior in registering higher return per rupee invested (B:C ratio 2.55).

Evaluation of water soluble fertilizers and normal fertilizers on yield of tissue culture banana under drip fertigation

Drip fertigation at 100% RDF with water soluble fertilizers + Foliar Spray (Micro nutrients) yielded 90.74 t ha^{-1} of fruits with higher water use efficiency of 54.50 kg ha^{-1} mm^{-1} and water saving of 20.17 per cent compared surface irrigation. Considering the economics, drip fertigation at 100% RDF as normal fertilizer + No foliar spray was found to be superior in registering higher net income of Rs. 814828/ha. However drip fertigation at 75% RDF as Normal Fertilizer + No foliar spray registered higher net income per rupee invested (B:C ratio 2.92).

Nitrogen use through method and time of N application in sorghum

Applying 25% N at sowing + 50% at 30 DAS + 15% at boot leaf stage + 10% at grain filling stage improved the yield and economics of all the grain sorghum genotypes tested (CSH 16, CSV 20 and Co S (30)) as compared to the recommended practice applying 50 % as basal and 25 % each at 15 and 30 DAS.

Drought mitigation in pigeonpea

Combined application of pusa hydrogel @ 2.5 kg/ha along with vermicompost @ 2.5 t/ha, mulching with fingermillet straw @ 5 t/ha and FYM @ 5 t/ha and application of pusa hydrogel alone favoured high soil moisture contents during flowering stage.

Permanent herbicide trial in transplanted lowland rice -rice cropping system

Echinochloa colona and *Leptochloa chinensis* under grasses and *Cyperus iria* under sedges present in the first crop were completely absent in the 30th crop. *Panicum repens* under grasses emerged as a new weed. Weed shifted from grasses to broad leaved weeds. Application of butachlor in *kharif* and pretilachlor in *rabi* @ 0.75 kg/ha followed by POE 2,4-DEE, @ 0.4 kg/ha at 15 DAT for both seasons with integration of nutrients for effective weed control, higher yield and economic returns in rice-rice cropping system. Continuous application of butachlor + 2,4-DEE herbicide mixtures in every season or rotational application of butachlor + 2,4-DEE during *kharif* and pretilachlor + 2,4-DEE during *rabi* did not show build up of these herbicides in the post harvest soil or grain and straw.

Long term trial on weed management in rice based conservation agriculture system

Transplanted rice with conventional tillage (CT) in CT- CT - ZT (Zero Tillage) system with PE butachlor 1.0 kg/ha at 3 DAT + inter crop daincha incorporation with mechanical weeding on 40 DAT had low weed density, dry weight with high weed control efficiency and grain yield and also registered high post harvest soil organic carbon. Total bacteria, fungi and actinomycetes populations were high in direct seeded zero tillage - zero tillage + CR - zero tillage. Establishment of both transplanted and direct seeded rice in zero tillage under wet land situation was poor.

Evaluation of integrated weed management with pre and post emergence herbicides in turmeric

Pre-emergence application of metribuzin 0.7 kg/ha + two hand weeding on 45 and 75 DAP were effective for weed control, high rhizome yield and economics in turmeric. Post-emergence application of glyphosate 1.03 and 1.54 kg/ha showed phytotoxicity in turmeric.

Post emergence weed management in transplanted and direct wet seeded rice

In transplanted rice, pre emergence application of pretilachlor 750 g/ha at 3 DAT + post emergence application of chlorimuron & metsulfuron 4 g/ha at 25 DAT for broad spectrum weed control resulted in high grain yield and net returns. None of the herbicides had any phytotoxicity. In direct seeded rice, PE pendimethalin at 1000 g/ha + POE bispyribac sodium at 25 g/ha + hand weeding on 45 DAS for effective broad spectrum weed control, high grain yield and economic returns. PE oxadiargyl 100 g/ha showed phytotoxicity & caused moderate crop damage like yellowing & stunted crop growth up to 14 DAHS (days after herbicide spray) and recovered thereafter.

Long term trial on tillage in different cropping systems

Conventional tillage in CT-CT system and atrazine at 0.5 kg/ha for maize and pendimethalin 1.0 kg/ha for sunflower + hand weeding on 45 DAS had low density and dry weight of weeds with high weed control efficiency, yield and net return. Zero tillage in ZT-ZT encouraged more of grass weeds.

Evaluation of clomazone 50 EC for bio-efficacy, phytotoxicity and residues in sugarcane and on succeeding crops

Application of new molecule of pre-emergence herbicide clomazone 50% EC 1250 g/ha at 3 DAS or hand weeding twice on 30 and 60 DAS was effective for control of grasses and broad leaved weeds and high cane yield without any phytotoxocity to the crop at this dose. The succeeding crops were not affected by the application of this herbicide to the previous crop. The herbicide did not have any deleterious effect on soil physico-chemical properties.

Herbicide combinations for control of complex weed flora in transplanted rice

Field experiment was conducted to study the bio-efficacy of combination of herbicides against weed complex and their effect on growth and yield of transplanted rice and to study the phytotoxic effects on the crop. The experiment was started in 2014. The results of the first crop of the first year experiment revealed that early post emergence (EPOE) application of bispyribac sodium 20 g/ha + chlorimuron + metsulfuron (Almix) 4 g/ha on 25 DAT and Pretilachlor 750 g/ha on 3 DAT + chlorimuron+metsulfuron (Almix) 4 g/ha on 25 DAT and hand weeding twice (25 and 45 DAT) for broad spectrum weed control, higher grain yield and economic returns in transplanted rice. None of the herbicides exhibited phytotoxicity

Herbicide combinations for management of complex weed flora in drum seeded rice

Field experiment was conducted to study the bio-efficacy of combination of herbicides against weed complex and their effect on growth and yield of drum seeded rice and to study the phytotoxic effects on the crop. The experiment was started in 2014. The results of the first crop of the first year experiment revealed that pre emergence application of oxadiargyl 80 g/ha at 8 DAS followed by post emergence application of azimsulfuron 35 g/ha at 28 DAS for effective broad spectrum weed control, higher grain yield and economic returns in drum seeded rice. None of the herbicides exhibited phytotoxicity.

Evaluation of integrated farming system involving crop-dairy-goat rearing for irrigated upland

On-station integrated farming system research for irrigated upland with Crop-Dairy- Goat rearing with biogas and vermicompost units initiated during June 2011 revealed that cropping component resulted in the net return of ₹ 84,671 while dairy and goat unit ₹ 89,939 and ₹ 83,942 respectively. In the biogas unit with 2 m^3 bio gas produced daily, value was worked out to be ₹ 8,212. From the vermicompost unit through the recycling of livestock waste and crop residues 13.9 tonnes of vermicompost was produced and recycled in the crop component. By the adoption of crop-horticulture- dairy-goat rearing - biogas - vermicompost as components, a net return of ₹ 2,66,485 / year could be realized from 1.20 ha farm unit.

Development of innovative farming practices to mitigate the effects of climate change

Cotton - green gram cropping system produced higher cotton equivalent yield of 3521 kg ha^{-1} under minimum tillage and 3196 kg ha^{-1} under conventional tillage compared with other cropping systems. Minimum tillage registered higher cotton equivalent yield in cotton - green gram (3521 $kgha^{-1}$), veg. cowpea - sunflower (1480 $kgha^{-1}$) and bhendi - maize (4239 $kgha^{-1}$) cropping systems than with red gram - maize cropping system conventional tillage registered higher cotton equivalent yield (2141 $kgha^{-1}$)**.** With regard to mulching with fertilizer application, mulch + 100% recommended dose of fertilizers yielded high cotton equivalent of 2730 $kgha^{-1}$ and followed by no mulch + 100% recommended dose of fertilizers (2708 kg ha^{-1}). High soil organic carbon (SOC) content could be observed in the vegetable cowpea and maize system irrespective of tillage and mulching practices. Minimum tillage resulted in higher SOC than conventional tillage invariably under different mulching, nutrient and residue management practices. Mulching reduced soil temperature without any influence on canopy temperature.

Development of organic farming package for chillies - cowpea - baby corn cropping sequence

Application of 50% NPK as Chemical fertilizer + 50%N as Enriched FYM (EFYM) produced high chillies equivalent yield of 15870 kg/ha and followed by the application of 100% N as EFYM + Vermicompost + Neem cake (1/3rd each) with Panchagavya 3% foliar spray thrice (15199 kg/ha) while less chillies equivalent yield of 12403 kg/ha with the application of 50 % N as EFYM + Biofertilizer along with phosbhobacteria. Based on the net returns obtained from the cropping system of chillies- cowpea as a whole, treatment receiving 50% N as inorganics +50% N as organics resulted in net returns of Rs. 1,45,101 /ha with B-C ratio of 2.57, while 100% NPK as inorganics with Rs. 1,40,957/ha with B-C ratio of 2.64. Under organic treatments, application of 100 % N as EFYM + Bio compost + Neem cake promoted high net returns of Rs.1,07,000/ ha with the B-C ratio of 1.91 while less net return (Rs.87,683/ha) and B-C ratio (1.90) with the application of 50 % N as EFYM + BF with *phosbhobacteria*. Cost involved in applying 100 % as organics do not commensurate with the returns compared with application of either 50% or 100 % as inorganics.

Integrated nutrient management in sunflower based cropping system

Site specific (soil test based) target yield NPK + S (Gypsum @ 500kg/ha) + Limiting micronutrient (B @ 2 kg/ha) + 5 t FYM/ha + Crop residue incorporation of the previous crop of blackgram with *Trichoderma viride* was found to be the best management practice to get higher yield and returns in sunflower.

Development of management practices for yield maximization in TNAU SFH CO2 sunflower

Application of FYM @ 5t/ha along with 125% of RDF (75 – 113- 75 kg NPK/ha) and adopting a spacing of 60 x 30 cm was optimum and best management for getting higher yield (2425 kg/ha) and returns (BC ratio of 2.74) in TNAU SFH Co2 Sunflower hybrid.

Integrated weed management in sunflower

Post emergence spray of Quizalofop ethyl and Chlorimuron ethyl exerted detrimental effect on the crop leading to phytotoxicity from the initial stage of the crop itself. Chlorimuron ethyl was highly phytotoxic to sunflower. Both the post emergence herbicides controlled grasses only. The major dominant weed *Trianthema* was not effectively controlled by both the post emergence herbicides. Control of weeds effectively by Pendimethalin + one hand weeding resulted in significant increase in growth and yield attributes of sunflower. Weed free environment in the above treatment resulted in producing significantly higher seed yield of 2327 kg/ha (which was on par with weed free) which accounted for 77.6 per cent yield increase than the unweeded control. Effective and economical weed management in sunflower could be achieved with pre emergence application of Pendimethalin@ 1.0 kg ai/ha as pre emergence spray + one hand weeding on 30 DAS is the best practice.

Performance of Cumbu Napier hybrid grass CO (CN) 4 as influenced by micro nutrients under irrigated conditions)

Application of recommended dose of NPK (150:50:40 kg/ha) along with $FeSO_4$ @ 50 kg/ha and $ZnSO_4$ @ 25 kg/ha was found to be advantageous in enhancing the growth, yield and quality of Cumbu Napier hybrid grass CO (CN) 4 besides fetching higher economic returns.

Crop response to elevated CO_2 and temperature in black gram genotypes

Among the 19 black gram genotypes screened 6 blackgram genotypes (VBG-06-002, VBG-06-005, VBG-06-010, VBG-07-001, VBG-10-008 and Co BG-759) were identified as tolerant for high temperature and elevated CO_2 based on physiological, biochemical and molecular parameters and the tolerant genotypes had high sulphur containing amino acids with increased pollen viability and flower retention.

Influence of silicon solubilisers on growth, physiology and induced stress tolerance in rice genotypes

Split Application of silicon solubilizer (Imidazole – 20 gram) and Na silicate (50ml) at vegetative and panicle initiation stages increased the leaf area, biomass and yield and yield parameters.

Oxidative stress tolerance to develop saline tolerant lines through screening of EMS rice mutants

Hydroponics system has been standardized for screening saline tolerant rice lines. Totally 48 saline tolerant lines have been selected out of 6000 EMS mutants. Field level screening is being done at CSRC, Ramnad.

Shelf life and quality improvement in banana and mango fruits using 1-MCP technology

1-Methylcyclopropene (1-MCP) treatment @600ppb enhanced the shelf life of (18 days) of Grand Naine banana fruits under cold storage (17^0C) compared to the untreated fruits which recorded a shelf life of 7 days.

Nutriophysiological changes during growth and postharvest behavior of leguminous vegetables due to bioinoculants

Seed treatment with *TagTeam* (Bioinoculant – *Rhizobium leguminosarum & Penicillium bilaii*) @8.1 g/kg improved the morpho-physiological parameters and nutrient uptake.

Integrated Assessment of Climate change impacts on Principal crops and farm household incomes in Southern India (AgMIP)

- With certainty, the projected increase in maximum and minimum temperature for Coimbatore is 0.2 to 4.1 ºC and 0.3 to 5.3 ºC respectively. Rainfall is projected to decrease by 15.0 per cent for Coimbatore during 21st century.
- SWM is projected to have a higher increase in both maximum and minimum temperature than NEM. Rainfall is projected to increase more in NEM than in SWM, indicating more extreme rainfall events during NEM season in the future.
- Yield had both positive and negative deviations ranging from -21.9 to +26.7 percent for rainfed and -42.0 to +33 per cent for irrigated maize.
- Sowing window alteration witnessed a good positive response followed by supplemental irrigation and supplemental fertilizer application. Irrigated maize showed a consistent positive response for sowing window and population adaptation.

Estimation of soil moisture from radar remote sensing data (RISAT-1) and correlation with ground based and meteorological observation in Western Agro-Climatic Zone of Tamil Nadu

Vast variability in soil and terrain features in Western Agro Climatic zone was observed. Predictability horizontal polarization is better compared to vertical polarization. Correlation observed between satellite derived soil moisture and observed soil moisture

Assessing the water productivity and green house gas fluxes from different systems of rice cultivation and designing mitigation measures to minimize global warming potential of rice soil

SRI system of rice cultivation with Blue Green Algae (BGA) inoculation has the advantages of improving the water productivity and yield and more importantly the enhanced productivity could be achieved with low greenhouse gas fluxes from rice soil eco system. The investigation also gives evidence that blue green algal and *Azolla* consortium could reduce global warming potential from rice soils under different systems of cultivation at the levels of greenhouse gas production, transport, and oxidation. Point-source carbon capture and sequestration potential of blue green algal systems in rice soils could be promoted as a climate change mitigation strategy.

Response of C3 (rice) and C4 (maize) plants to elevated temperature and CO_2

- Rice and maize crops grown under 4°C elevated temperature recorded lesser number of tillers per plant in rice, lesser number of leaves per plant in maize and lower dry matter production in rice and maize compared to ambient condition.
- C_3 plants responded more favourably to CO_2 enrichment which was observed through increased rate of photosynthesis and the yield loss due to +4°C elevated temperature was compensated by 10 per cent in rice crop. Such effect was very minimum in C_4 plants and the CO_2 enrichment under elevated temperature compensated only 3 per cent loss in maize crop.
- The DSSAT model was very sensitive in simulating phenology and grain yield of rice and maize for rise of 1°C, 2°C, 3°C, 4°C and 5°C over the ambient temperature with and without CO_2 enrichment.

Agro-ecological zonation at micro level using remote sensing and geographical information system

- Under non-agriculture area, Salem had more area under forest (27.9 %), Sivagangai had more area under water bodies (16.2 %) and Thiruvarur had more area under built-up (8.1 %).
- Length of growing period (LGP) was categorized into four classes as L1 (9-13 weeks), L2 (14-17 weeks), L3 (18-21 weeks) and L4 (22-30 weeks). Sivagangai and Thiruvarur had LGP classes of L1 and L2.
- Biomass was categorized into four classes *viz.,* poor, moderate, good and excellent based an NDVI values of 0.06 – 0.10, 0.10 – 0.20, 0.20 – 0.40 and > 0.4, respectively. In the entire districts B4 category (excellent) covered larger area followed by B3 (good).
- Category S4 which had loamy texture occupied most of the area in all the districts indicating better suitability for cropping.
- Of the three categories of elevation,[E1 (<500 m), E2 (501-1000 m) and E3 (>1000 m)] Salem district had all the three classes while Sivagangai and Thiruvarur had E1 category alone, owing to its proximity to east coast.
- Each of the four inventory layers were overlaid using ArcGIS 9.3 platform and Agro Micro Meteorological Areas were identified. This resulted in 46, 18 and 22 zones for Salem, Sivagangai and Thiruvarur districts, respectively.
- Considering the constraints in the utility of these zones in terms of transfer of technology, zones which had less than 100 ha were merged and finally 36, 16, 14 zones were obtained for Salem, Sivagangai and Thiruvarur districts, respectively.
- The zone L2B4S4E1 was predominantly covered the Salem and Thiruvarur district while the zone L1B4S4E1 ranked first in Sivagangai.

Effect of elevated temperature on rice

- Highest rice grain yield of 5992 kg ha^{-1} and straw yield of 8903 kg ha^{-1} could be obtained with ambient temperature (T_0) while the lowest with 4^{o}C elevated temperature besides reduced uptake of nutrients like nitrogen, phosphorous, potassium, sulphur and zinc
- Hybrid (C_1) had 17.3 per cent higher grain yield and 13.9 per cent higher straw yield over the variety (C_2).
- Corroboration with The CERES – Rice model prediction

Contingent cropping for *kuruvai* in Cauvery Delta Zone

Among the minor millets, tenai, kuthiraivalli and panivaragu can be recommended as a contingent crop during *kuruvai* season in the canal dependent areas of Cauvery Delta Zone at times of non – receipt of canal water and withdrawal of kuruvai rice cultivation.

Unpuddled machine transplanted rice technology for thaladi rice in Cauvery Delta Zone

Water saving was around 219 mm (17.2 % lesser than puddled ecosystem) in unpuddled machine planting system with savings on labour cost of Rs.6600/ha (includes land preparation and machine transplanting) resulted in a net return Rs. 24,050 / ha. Unpuddled machine planting of rice technology would be very useful to the farmers of Cauvery Delta Zone where t*haladi* rice cultivation is taken up after the harvest of k*uruvai*.

WATER TECHNOLOGY CENTRE

Enhancing water productivity thro' AWDI in rice farming

Improvisation of the water management techniques adopted by the farmers for the production of rice is the main theme adopted in this attempt. An unique method to save water in irrigated rice cultivation is the intermittent drying of the rice fields instead of keeping them continuously flooded. This method is referred to as Alternate Wetting and Drying Irrigation (AWDI). This innovative method was found to increase the productivity of water at the field level considerably by reducing seepage and percolation during the crop growing period.

In conventional practice, water is ponded to a depth of 5cm for each irrigation and subsequent irrigation was given one day after the disappearance of ponded water which consumed very high quantity of irrigation water. The surface moisture had been considered to be the index for further irrigation. As revealed by several research reports, the moisture was still available to support the crop growth even after surface drying occurred. According to IRRI, depletion of ponded water (DPW) 15 cm below the soil surface was reported to be the safe AWDI practice for transplanted rice. In line with this, the WTC initiated field trials to determine the safe AWDI.

Irrigation at DPWs at 10,15,20 cm from 7 DAT up to 10 days prior to harvest and staggered DPWs at critical stages of crop growth were evaluated in a field trial during 2013-14 and the results of the preliminary trial revealed that scheduling irrigation after 15 cm depletion of ponded water (DPW) below the ground level from 7 DAT upto maximum tillering and continuous submergence upto 10 days prior to harvest registered favorable plant growth and higher grain yield (5855 kg ha^{-1})which was comparable to that of conventionalirrigation practice of ponding 5 cm submergence one day after disappearance of ponded water.

In order to find out the safe AWDI for different rice growing regions of Tamil Nadu, a multilocation trial has been initiated at 8 centres*viz.*,Bhavanisagar, Madurai, Thanjavur, Tirur, Aduthurai, Ambasamudram, Killikulam and Coimbatore during 2014 Rabi involving DPW levels 10 cm and 15 cm and the evaluation will be for two years.

Drip fertigation in rice

Aerobic rice is considered as a viable water saving agro-technology to cope up with the looming crisis of water resources.With the objectives of determining the optimal drip lay out for aerobic rice, field experiments were conducted during DS 2013 with different lateral distances and fertigation under different rice cultivars.

Higher grain yield (5703 kg/ha) was recorded with the hybrid JKRH 3333 followed by CORH 4 (5460 kg/ha).The total water applied was 721.4 mm for conventional irrigation as against 533.8 mm in the case of drip system.The grain and straw yields were higher in the 0.8 m lateral distance SDI @ 1 lph. The drip irrigation is being adopted in a larger area (around 20 ha) in Govindapuram village of Dharapuramtaluk wherein the performance of rice was good when raised under rice-onion-maize cropping system.

Sustainable Sugarcane Initiative (SSI) – An unique system to increase water productivity in sugarcane

Water is increasingly becoming a major limiting factor for agriculture, especially where irrigated crops and dry land agriculture are maintained. The impact of irrigated crops on dry land agriculture is significant, particularly in semiarid regions

where irrigation is primarily based on ground water exploitation, leading to decline in soil moisture and seriously reducing the productivity. During the past 10 years, sugarcane production in India has been fluctuating between 233 million tonnes to 355 million tonnes. The production and productivity was continuously stagnant for the past 4 decades. To increase the production and productivity, Water Technology Centre, Tamil Nadu Agricultural University introduced new cultivation technique SSI with the financial help of National Bank for Agriculture and Rural Development (NABARD). Sustainable sugarcane initiative is a package of practice based on the principle of “more with less” in agriculture. The technology implies reduced inputs like water, fertilizer, labour and seed material with increased sugarcane production and productivity. The main aim of the technique is to make sugarcane cultivation simple, affordable and profitable for industry, both small and large farmers.

Bud chip nurseries in sugarcane increase the monthly income of Rs.38, 000/- for the seedling growers. On Farm Demonstrations - SSI (five) recorded averagely high no. of internodes (26.2), single cane weight (2.12kg), millable cane (18 nos) andcane yield 116.2t/ha.

Comparative performance of SSI over Conventional method

Characters	SSI	Conventional
Plant height (cm)	322.4	277.2
Inter node length (cm)	13.24	10.54
Number of internodes	26.2	22.6
Girth (cm)	4.74	4.36
Single cane wt (kg)	2.11	1.68
Millable cane (No.)	18	14.2
Brix content	18.10	17.24
Pol	14.96	13.55
Purity	82.49	78.50
Cane yield (tonnes/ha)	115.16	84.86
Water consumption (mm)	1778	2020
Water productivity	6.56	4.19

The farmers recorded a maximum yield of 128 tons/ha with purity of 83.6percent.

Study on impact of artificial recharge structures in recharging groundwater in Parambikulam - Aliyar- Palar (PAP) basin

It was estimated that the storage structures in the watershed alone contributed 11.5 percent of the annual rainfall as potential recharge. The efficiency of RWH structure is a function of infiltration, structure, shape and size rather than rainfall amount. These factors also influence the amount of rainfall that gets recharged. Percolation pond and check dams are significantly different during higher rainfall years. The aquifer response due to rainfall indicated that one month lag period is required for the rainfall to recharge in all the observation wells in the watershed, which clearly reflect in recharge values. The recharge values from the wells were much lower than the estimates of potential recharge from the RWH structures. This suggested that either the recharge from RWH was not reaching the aquifer or the aquifer had large transmissivity and therefore strong lateral flow. The analysis in this study suggested that about 30 percent Rep was stored in the soil while at least another 38 percent moved laterally. The groundwater recharge zones were identified and validated through SCS Curve number technique.

NATURAL RESOURCE MANAGEMENT

Dept. of Soil Science & Agricultural Chemistry

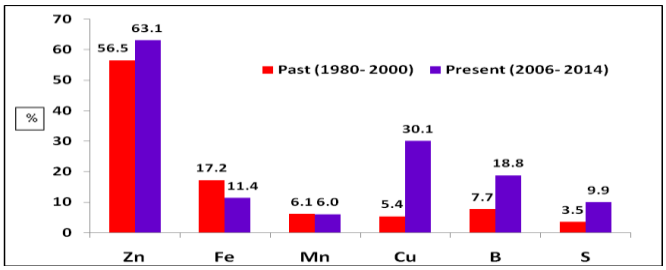
Soil Fertility Assessment and Improvement
Assessing variations in crop response to nutrient use efficiency
Crop and genotypic variation - a tool to enhance phosphorus use efficiency for sustainable cropping in low phosphorus soils

To test verify the efficiency of the selected cultivars (with varying P acquisition) for their P efficiency under field condition in P deficient soil, a field experiment has been taken up in a farmer's field at Chinnamathampalyam village of Periyanaickan-palayam block of Coimbatore district.

Significant variation in genotypes was observed with regard to dry matter production and internal P utilization at 45 DAS. Under P stress condition, internal P utilization ranged from 774 for CMH08- 350 to 1005 for CMH08 - 292 exhibiting 1.3 fold increases. Three genotypes CMH08- 292, CMH08337 and CO 6 recorded higher internal P utilization values than mean indicating their ability to produce higher DMP with low P requirement. Genotypes CMH08 -292 and CMH08-337 recorded significantly higher grain yield of 4952 and 6250 kg ha^{-1} under P stress (no P application) with Phosphorus Efficiency of 66 and 82 per cent. Decrease in Ca- P values over the initial values was recorded under no P application.

Geospatial delineation and reassessment of micronutrients and sulphur status in soils of Tamil Nadu.
Reassessment and Mapping of Micronutrients status in soils of various districts of Tamil Nadu (II Phase)

A comparative analysis was made to assess the changes in status of micronutrients and sulphur between 1980-2000 and reassessment (2006 to 2014) in soils of 19 districts. The results showed that the Zn deficiency increased from 56.5 to 63.1 per cent and Cu deficiency is fast emerging (5.4 to 30.1 per cent). There are no apparent changes in Mn status of the 19 districts reassessed while the deficiency of Fe is slightly decreasing from 17.2 to 11.4 per cent. The B and S status also showed an increasing trend with per cent deficiency of 18.8 and 9.9 per cent respectively.



Change in Micronutrient status in soils of Tamil Nadu

Innovative Approaches for Nutrient Management
IPNS recommendation for irrigated and rainfed crops including fertigation
Soil Test Crop Response Correlation Studies through IPNS for Glory Lily

Fertilizer prescription equations (FPEs) under IPNS for desired yield target of *Gloriosa superba* were developed under NPK alone and IPNS. Using the FPEs, nomograms were formulated and the equations are under test verification.

Fertilizer prescription equations

NPK alone			IPNS (NPK+FYM)		
FN	=	41.45 T - 0.53 SN	FN	=	41.45 T - 0.53 SN – 0.71 ON
FP_2O_5	=	23.21 T - 2.07 SP	FP_2O_5	=	23.21T - 2.07 SP - 0.81 OP
FK_2O	=	30.45 T - 0.21 SK	FK_2O	=	30.45 T - 0.21 SK - 0.64 OK

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

Soil Test based Fertiliser Prescriptions for maize - tomato sequence

The results of the test verification trials with maize - tomato confirmed the validity of the fertilizer prescription equations and the post-harvest soil test values prediction equations on Palaviduthi soil series (Typic Rhodustalfs). Based on the outcome of the sequential trials with maize - tomato, targeting of 10 t ha^{-1} of hybrid maize in the first season and 90 t ha^{-1} of hybrid tomato in the second season would be ideal in terms of yield, response ratio and soil fertility on Palaviduthi series (red non-calcareous soils).

Rescheduling of fertilizer recommendation for lowland hybrid rice

Field experiments were conducted for two years during 2012-14 with CORH 3 and CORH 4 rice hybrids during both *Kharif* and *Rabi* seasons in order to re-fix the fertilizer schedule in rice-rice cropping system. The treatments comprised of three levels of N (175, 200 and 225 $kgha^{-1}$), P_2O_5 and K_2O ha^{-1} (60, 75 and 90 kg ha^{-1}) besides control. All treatments received a basal application of $ZnSO_4$ @ 25 kg ha^{-1}.

The application of 200:75:75 kg N, P_2O_5, K_2O ha^{-1} was found to be optimum for enhancing the yield attributes and yield of hybrid rice (CORH 3 and CORH 4) during *Kharif* and *Rabi* seasons with an average grain yield of 7069 and 6368 kg ha^{-1} with high response ratio (AE) of 9.62 and 6.0 when compared to the RDF (175:60:60 kg N, P_2O_5, K_2O ha^{-1}) which recorded 5746 and 5739 kg ha^{-1} with a response ratio of 6.60 and 4.99, respectively. The application of higher levels of N, P_2O_5, K_2O $kgha^{-1}$ (225:90:90 kg N, P_2O_5 and K_2O ha^{-1}) did not result in yield increase, however enhanced the post harvest soil nutrient status.

Enhancement of quality of crops

Relationship of Micronutrient (Zinc) status in soil-plant-animal continuum

A field experiment will be conducted in Zn deficient soil with Zn efficient maize hybrid (NK 30), involving two treatments viz., i) no Zn application and ii) application of 100 kg $ZnSO_4$ ha^{-1} as basal + 0.5 % $ZnSO_4$ foliar spray at vegetative stage. The crop was grown upto tasseling stage and the above ground biomass was fed to the milch cows @ 25 kg $animal^{-1}$ day^{-1}. After the stabilization period, the samples viz., milk, urine, dung and blood serum were collected from milch cows and also from heifers at weekly intervals for 30 days. The collected samples were analyzed for hemoglobin and Zn content.

The results revealed that in milch cows and heifers, a considerable increase in the content of Zn to the tune of 47 and 41 per cent in serum of milch cows and heifers, 26 % in milk samples of milch cows and 48 and 53 per cent in dung samples of milch cows and heifers was noticed on 28^{th} day after stabilization due to feeding of Zn enriched maize fodder. Comparatively higher levels of Zn in fodder were reflected in serum and milk. This indicates that a good relationship is found between available Zn in soils and Zn content in fodder and in turn in animal and human health.

Dept. of Agricultural Microbiology

Impact assessment of long-term nutrient management on microbial activities of soil

Monitoring the changes in soil biological properties due to nutrient managements or agronomical practices

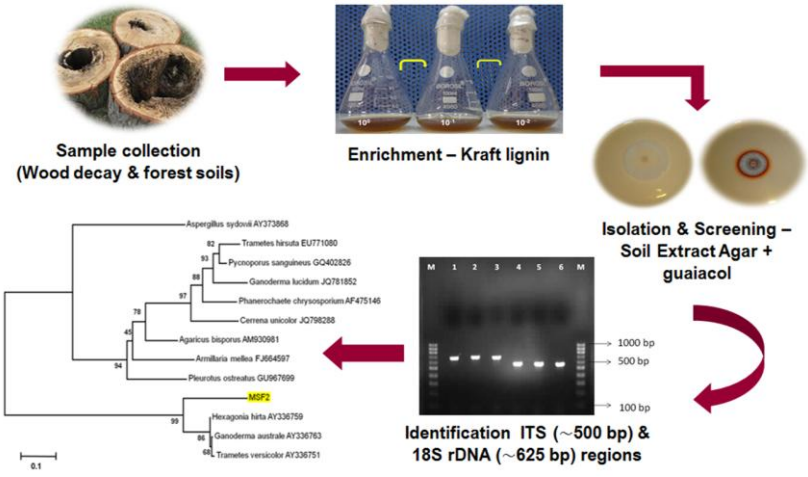
The overall biological properties of Alfisol were controlled by the long-term nutrient management adoptions and to some extend by the growth stages of maize and their interactions. Microbial Biomass Carbon (MBC), counts of observed microbial communities and hydrolytic enzymes were highest in organically managed and integrated nutrient management enforced soils at active vegetative stage of maize crop.

The inorganic nutrient amendments and no fertilizer application had same magnitude on the biological and biochemical properties of soil throughout the maize crop growth. In general, the amplitude of interaction effect was higher order in OM and INM at vegetative stage than the mean values of the treatments at flowering, harvest and other samples. The respiration study indicates that metabolic quotient of the soil was significantly increased in early stage of maize due to agronomical disturbances and subsequently declined and stabilized during vegetative and flowering stages of maize. MBC, SIR, actinobacterial and diazotrophic counts and activities of dehydrogenase, acid phosphatase and aryl sulphatase are the most sensitive soil biological indicators responded to both nutrient managements as well as the maize crop growth stages.

Microbes mediated biofuel production from biomass

Development of process for microbial delignification of lignocellulosic biomass / waste for fuel ethanol production

A novel high laccase producing fungal isolate MSF2 was isolated from wood decay sample and selected based on guaiacol oxidation and their extracellular enzyme production was further confirmed in SEA media containing guaiacol (0.04%). Lignin depolymerization was carried for kraft and black liquor lignin using crude laccase enzyme and analysis of lignin derived using GC-MS is under progress. Higher laccase yield of 1944.44 $U.ml^{-1}$ was obtained in much shorter period (12 days). A maximum lignin removal of 47.6 and 32.9 per cent was achieved using a novel biodelignification process compared to enzymatic removal of 29.7% and 20.22% in wood and corncob, respectively



Identification of an efficient lignolytic fungus

Development and evaluation of microbial bio-inoculants
Developing microbial consortium for nutrient management
Evaluation of crop response of liquid bio inoculants and their effect in rice nutrient management

*Azospirillum (*Az 204*)*, Phosphobacteria (Ps1), Potash bacteria (KRB9) and *Pseudomonas* (Pf1) were compatible under *in vitro* condition to develop the liquid bioinoculants. The pH of the mixed liquid bioinoculant was slightly reduced from 7.5 to 6.5. Among the four bioinoculants, population load was slightly reduced in potash bacteria, whereas the others were not reduced that much. The effect of fluorescent pigment was very mildly affected the growth of potash bacteria based on inhibition zone formed in agar well diffusion method and others growth was not affected.

Sustained availability of nitrogen, phosphorus and sulphur through soil bacterial consortia with special reference to *Burkholderia sp, Bacillus megaterium* and *Thiobacillus sp.* in groundnut

Ten *Burkholderia* isolates were obtained from the rhizosphere of different crops. Among the ten isolates two isolates viz., B1 and R1 were found to have phosphate solubilizing nitrogen fixing and antagonistic activity against *Macrophomina phaseolina*. B1 and R1 were found to produce 36 and 32 mg of P per 100 ml broth respectively and found to produce IAA 12 and 10 µg per 50 ml broth respectively. The above two isolates were identified as *Burkholderia thailandensis* and *Burkholderia vietnamensis.* Shelf life studies revealed the bacterial consortia can be stored upto 120 days under refrigerated storage against 90 days under room temperature. Seed treatment of groundnut with consortia along with soil application @ 5 kg ha^{-1} on 45 DAS registered the highest pod yield, shelling per cent, 100 kernel weight as compared to seed treatment alone with soil bacterial consortium.

"Biotization"- A novel bioinoculant delivery strategy for banana micropropagation

The protocol for direct shoot induction with modified MS media with BAP 4 ppm+ NAA 2 ppm was standardized. Emergence of shoot was observed on 120 DAI when compared to other treatments with BAP and NAA. Average of three to four regenerated plantlets was obtained through this treatment combination. For *invitro* acclimatization, the plantlets dipped in *Methylobacterium* bacterial suspension (10^8 cells ml^{-1}) before planting has better survival than the uninoculated tissue culture plants.

Value addition
Bacteriophages - A Novel Biopreservative for Vegetables

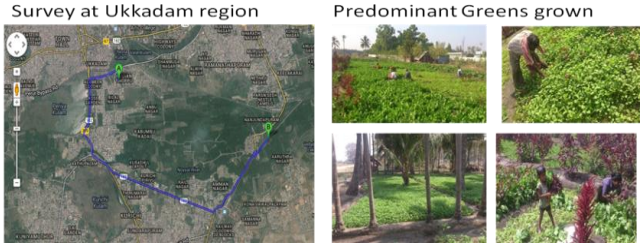
Bacteriophages were identified as a new biocontrol agent for the management of soft rot disease losses under post harvest condition. The technology was standardized for the slow release of bacteriophages when treated with tomato and potato. Technology was optimized for the bacteriophage coating of tomato and potato. Entrapment of bacteriophages in a water soluble edible protein for the sustained / slow release of phages in coated tomato and potato

Dept. of Environmental Sciences

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

The pollution potential of sewage irrigation at Ukkadam, Coimbatore was assessed. Samples of greens and soil were collected from sewage irrigated areas of these regions and analyzed. It was found that *Amaranthus dubius* (Araikeerai) contain high Cr, *Amaranthus caudatus* (Thandu keerai) contain high Ni while *Trigonella foenum* (Vendhayakeerai) contain high Cd. All the metal concentrations

were above the permissible limits of 1.5 mg kg^{-1}. Apart from heavy metals, all greens and the soil were contaminated with pharmaceutical compounds and organic pollutants. It contains 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 spent wash (PMDSW) as foliar spray was assessed by analyzing its biochemical constituents. 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 PMDSW is being applied to soil @ 100 KL ha^{-1} $year^{-1}$ as per the recommendation. A survey was conducted to identify its impact with two, three and five times application. The soil organic matter status was assessed. The total organic carbon was found to increase in all the soil samples with two, three and five times PMDSW application. 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).

Pre sown application of spent wash

Effect of biomethanated spent wash on lucerne as pre sown application

The effect of biomethanated spent wash application on lucerne was studied. The quantum of spent wash was applied to meet the N and K requirement @ 20KL ha^{-1}. The P was applied @ 120 kg ha^{-1} and was compared with recommended dose of 25:120:40 kg ha^{-1} (control). The higher yield of 102 t ha^{-1} was recorded by spent wash application as compared to 88 t ha^{-1} under recommended dose of fertilizers (control) with an increase of 16 per cent. 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 biomass yield and quality of lucerene.

Biomethanated Spentwash @ 20 KLha^{-1}

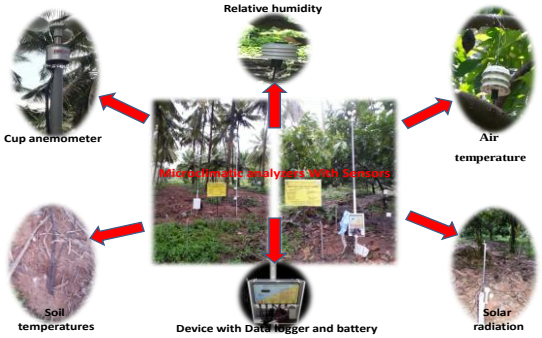
Refuse derived fuel from municipal solid waste rejects

Municipal solid waste rejects (paper, plastics (with exception of Polyvinyl chloride), textiles) were collected 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} with moisture content of 8 per cent, ash content of 2.8 per cent and mean volatile matter of 83.1 per cent. The calorific value was 6474.9 k cal $kg^{-1.}$ The municipal solid waste rejects will be used as good energy source for furnaces.

Refuse derived fuel

Environmental impact and cocoa intercropping in coconut

A study was undertaken to evaluate the environmental impact of cocoa cultivation as an intercrop in coconut was evaluated in comparison with coconut monoculture 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 as compared to coconut monoculture. The average quantity of leaf litter accumulation ranged from 3 to 7.5 t ha^{-1} yr^{-1} in 2 to 10 years old cocoa plantations. The total biomass carbon accumulated in the ten year old cocoa plantation was 4.39 t ha^{-1} with the fixation of 16.1 t of CO_2. Soil organic content increased with the age of cocoa and ranged from 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 sole coconut cropping. 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 ha^{-1}.



Microclimatic analyzers in cocoa plantations

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 water were found to be unfit for human and animal consumption. However, the concentrations were well within the permissible limit of 5 mg L^{-1} prescribed for irrigation water.

Dept. of Remote Sensing and GIS

Region based recommendation to improve coconut production through Remote Sensing and GIS

The project is aimed at mapping coconut growing areas in Tamil Nadu through RS and GIS techniques and to create soil database using GIS so as to identify the soil related production constraints. This data would enable to formulate soil ameliorative measure to augment coconut production in Tamil Nadu.

In Tamil Nadu, coconut is grown in almost all the districts. Coimbatore has largest area under coconut (84,653 ha) among all districts of Tamil Nadu, followed by Tiruppur, Thanjavur and Dindigul. In terms of percentage of coconut area to the total geographical area of the district, Tiruppur (25.5) leads the list, followed by Kanyakumari, Coimbatore and Thanjavur.

The soil data was linked with coconut map to generate soil related limitations which will affect the growth and productivity of coconut. The soil limitations and their area extent for various districts were generated. Among the various limitations the deficiency of micronutrients particularly Fe and Zn as well as imbalance between calcium, magnesium and potassium accounts for 42.5 per cent of the total coconut areas followed calcareousness (42.1 %).

Remote Sensing based information and insurance for crops in emerging economies

The scheme on 'Remote sensing-based Information and Insurance for Crops in Emerging economies (RIICE)' aims to reduce the vulnerability of rice small holder farmers in low-income countries in Asia and beyond. The parties make use of remote sensing technologies to map and observe rice growth in selected regions in Cambodia, India, Indonesia, Philippines, Thailand and Vietnam. Such information helps governments to make the necessary provision to meet potential food shortages given that rice is the most important crop for most Asian countries.

Large, homogeneous and landscape-dominating rice areas and small, fragmented, heterogeneous rice areas are all classified equally well. The overall classification accuracy was consistently high (87% to 92%). The consistently high accuracy of the rice area classification across these sites demonstrates that the methodology is appropriate for rice detection across the most common rice agro-ecologies.

Rice area map 2013 samba season

Developing spectral library and spectral indices for early prediction ofcrop nutrient deficiencies

The visual observation of nutrient deficiency symptoms and its correction during the middle of the cropping season could give only partial remedy. Canopy reflectance measurements and remote sensing techniques offer the potential for monitoring crop growth conditions over large areas and a non-destructive method of determination of crop nutrient deficiency in advance. The present investigation is aimed at studying the effect of varying levels of nutrients *viz.,* N, P and K on the growth and spectral reflectance characteristics of rice and maize under pot culture (sand culture) and to generate pure spectral signature for each nutrient deficiency.

The NDVI calculated from the spectral measurement showed that varying levels of N significantly influenced the NDVI value and they vary from 0.50 for no N to 0.86 for 100 per cent N whereas the P and K levels did not make any significant differences. The Red Edge Position (REP) for no nitrogen application and absolute control treatments were significantly lower than 50, 75 and 100 per cent N or P or NPK. The lower REP of 707 to 713 nm for no nitrogen indicates the curve shift towards shorter wavelength and thus, the crop is under stress. The correlation showed that NDVI correlate well with chlorophyll a, b and total and N and P at different crop stages, indicating the crop stress due to N & P deficiency could very well be detected through Hyper spectral Remote Sensing Techniques.

Creating GIS database of soil nutrient status and generating nutrient maps with cadastral base in six selected blocks of Tamil Nadu

The project involves creation of digital village maps for Manikandam (Trichy), Kodavasal (Tiruvrurur), PN Palayam (Coimbatore), TN Palayam (Erode), Kaniyambadi (Vellore) and Sattur (Virudhunagar) blocks in Tamil Nadu to generate soil macro and micronutrient maps. The survey number wise soil sample analysis results are integrated to create soil resource GIS database to support farm level crop planning.

Soil samples from all the blocks except Kaniyambadi registered low available N. Available P in about 80 per cent samples from Sattur block was low, from TN Palayamblock was medium and from Kodavasal block was high. Available K was high in 94 per cent samples from PN Palayam block, 78.1 per cent samples from Sattur block and 69.1 per cent samples from Kaniyambadi block.

About 85 per cent soil samples from PN Palayam, TN Palayam and Kodavasal blocks registered sufficient available Fe. Available Mn in about 85 per cent samples from TN Palayam and Sattur blocks was sufficient. Available Zn was deficient in 96.7 per cent samples from Sattur block, 76 per cent samples from Kodavasal block and about 68 per cent samples from Kaniyambadi, TN Palayam, PN Playamblocks.Sattur block recorded maximum Cu deficiency followed by TN Palayam and PN Palayam blocks. Soil available copper was sufficient in 68.4 per cent samples from Kaniyambadi block and 51.6 per cent samples from Kodavasal block.

Hyperspectral radiometry for detection and estimation of damage caused by pests in brinjal

This project is aimed at detecting pest damage in vegetable crops through remote sensing technique. The spectral reflectance characteristics of healthy and pest damaged (caused by chewing and sucking pests) brinjal crop (CO 2) was studied to determine the best spectral bands relevant to insect pest detection in brinjal and to explore possibility of estimating pest damage severity based on spectral properties.

The damaged plants, there was a decrease in reflectance at green (520 to 590 nm) red (620 to 680 nm) as well as near infra red (NIR) (770 to 860 nm) wavelength regions when compared to healthy plants. The Red Edge Position (REP) of mites infested plants with medium (25 - 50%) and high (>50 %) level of damage (10 - 25 %), shifted to 720.26 to 707.64 nm and 701.33 nm, respectively than the healthy crop (720.26 nm). There was a significant negative correlation between damages caused by mites and vegetation indices (VIs) namely normalized difference vegetation index (NDVI) (-0.99**) and simple ratio (SR) (-0.98*).

The results revealed that the spectral reflectance curve of brinjal plant damaged by mealybugs were different from that of the healthy plants. The most negative value in the sensitivity analysis curve was situated in NIR band. The Red Edge Position (REP) of mealybug infested plants shifted towards lower wavelength. Plants with low level of damage (10 - 25 %) have same red edge position as that of healthy plants (720.26). Whereas, plants with medium (25 - 50%) and high (>50 %) level of damage, red edge position shifting was observed from 720.26 to 718.68 nm. The data on spectral indices influenced by aphids showed that the Red Edge Position (REP) of aphid infested plants and healthy plants were same (720.26 nm). There was a significant negative correlation between damages caused by aphids and vegetation indices (VIs) namely normalized difference vegetation index (NDVI) (-0.99**), simple ratio (SR) (-0.98*) and green red vegetation index (GRVI) (-0.91*).

Water requirement satisfaction index (WSRI) as a tool to assess soil-crop-water balance in Tamil Nadu using remotely sensed data

Understanding the crop water requirement, use and consumption in irrigated agriculture is a prerequisite for better management and conservation of agricultural water. In the present study an attempt is made to develop methods to quantify accurate irrigation water requirement from remote sensing data for the conservation and management of water resources. Normalized Difference Vegetation Index (NDVI) was computed from the MODIS reflectance data individually for 8 day composite and over the years. The NDVI map indicated the greenness condition and the trend is well correlating with the rainfall map.

Determination of soil colour through hyperspectral remote sensing techniques

Soil colour is an important soil property and reported in all soil profile descriptions. Colour can be estimated with a spectrophotometer; but it is commonly described using Munsell soil colour system, it has disadvantages *viz.,* absence of direct mathematical conversions and require large look up tables to make continuous transformations. Hence, an attempt is made to determine the soil colour through remote sensing techniques. The spectral signature of these soil samples indicates observable difference among different coloured soils in the visible as well as in IR region. Darker the colour, lower is the quantity of energy or light reflected. Thus, the spectral measurement technique is able to differentiate soil colours as those of Munsell soil colour chart

Dept. of Nano Science and Technology

Hexanal formulation spray on shelf-life extension of mango fruits

Two per cent hexanal formulation as pre-harvest spray twice ie. 30 and 15 days before harvest extended the shelf life and reduced the PLW, ethylene evoluation and respiration. A marginal increase in fruit yield and quality were also observed. The extension of shelf life by hexanal spray and cold storage is nearly 18-21 days in cv. Banganapalli, Alphonso and Imampasand and about 12 days in Neelum and Bangalora.

CENTRE FOR PLANT PROTECTION STUDIES

Dept. of Agricultural Entomology

Insect taxonomy and biology of major crop pests

Insect diversity in agro ecosystems in South India

Field surveys and light trap collections were carried out in cropped and forest areas from different parts of Tamil Nadu , Kerala and Karnataka *viz.,* Kallar, Harur, Lower Pulneys, Madurai, FC & RI, Mettupalayam, Valparai, Kothaiyar, Mudhumalai, Periyakulam, Thadiyankudisai, Anaikatti, Thrissur in Kerala, Dharwar in Karnataka A total of 6,287 insect specimens *viz.,* Coleoptera (1,825) , Lepidoptera (3,580), Hemiptera (150), Hymenoptera (120), Odonata (56), Orthoptera (130), Neuroptera (58), Trichoptera (320) and plant mites (48), Phytoseiidae (24), Cunaxidae (6), Anystidae (3), and Stigmaeidae (15) were documented.

Biological control of insect pests

Biological control of brinjal mealybug

For the management of brinjal mealybug, *Coccidohystrix insolita,* the release of predators *Cryptolaemus* @ 1500 ha^{-1}, *Brumus suturoides* @ 1500 ha^{-1} and *Scymnus*@ 1500 ha^{-1} effectively checked mealybug population. The fruit yield in plots released with coccinellid predators ranged from 62.3 to 67.8 t ha^{-1}.

Efficacy of Bt strains against Diamondback moth (DBM) in cauliflower

The trail on the management of DBM on cauliflower with four Bt formulations revealed that the formulations PDBC BT1 and NBAII BTG 4 performed better at 1% and 2% concentrations in reducing the larval population of DBM up to 82 %. These treatments were superior and on par with insecticide (chlorpyriphos) treatment.

Microbial control of chilli mite, (*Polyphagotarsonemus latus*)

Application of *Paeciliomyces fumosoroseus* and *Beauveria bassiana* @ 10^8 spores/ml was effective against chilli mites with reduction of 37.92 and 37.77 % in the first trial, 50.53 and 45.66% in the second trial, respectively.

Insecticide toxicology studies

Monitoring of pesticide residues and screening of new pesticide molecules

- Out of 874 fruits, vegetables, spices, tea, rice , pulse , fish and water samples analysed, 187 samples showed detectable level of various pesticide residues
- Twenty one samples including chilli, okra, dry chilli, grapes and cardamom showed residues exceeding MRL. The residues of ethion, cyhalothrin-Lamda, triazofos, cypermethrin-alpha, quinalfos, profenofos , triazophos exceeded above PFA / Codex MRL
- Curry leaf showed the maximum number of samples with high level of insecticide residues followed by cardamom and dry chilli.
- Fenpyroximate 5 EC @ 30 g a.i. ha^{-1} in chilli and tea showed minimum number of mite and maximum yield and did not show any phototoxic effect at 30, 60 and 90 g a.i. ha^{-1} in tea and chilli, respectively.
- Emamectin benzoate 5 SG at 11 g a.i.ha^{-1} recorded the lowest number of thrips and relatively less toxic to natural enemies in grapes. No visual phytotoxic symptoms were observed at 11, 22 and 44 g a.i.ha^{-1} in grapes. Harvest time residues of emamectin benzoate 5 SG sprayed at 11 and 22 g a.i. ha^{-1} were found to be below detectable level (BDL) in grapes.

- Harvest time residues of emamectin benzoate applied at 8.5 and 17 g a.i. ha^{-1} were at below detectable level (BDL) in okra fruit collected 7 days after last spray and soil at final harvests.
- Harvest time residues of emamectin benzoate applied at 11 and 22 g a.i. ha^{-1} were at below detectable level (BDL) in red gram (seed and soil) and cotton (lint, seed and soil) at final harvests.
- Profenofos at 500 g a.i. ha^{-1} was found to be highly effective in controlling the mites, tea mosquito bug , aphids and semilooper infestation in tea and no phytotoxicity symptoms were observed on plants in any of the tested doses. The safe waiting period suggested is 6.5 days for profenofos @ 500 g a.i. ha^{-1} (recommended dose).
- Chlorpyriphos 20 EC at 2000 and 1000 ml ha^{-1} was highly effective in controlling the shoot and fruit borer in brinjal and sucking pest in citrus and it is found to be safer to natural enemies.The residues were at below detectable level (BDL) when sprayed @ 2000 and 1000 g a.i. ha^{-1} in brinjal and citrus at harvest.
- Fipronil 80 WG at 40- 50 g a.i. ha^{-1} was highly effective against grapes thrips and did not cause any phytotoxic symptoms at 40, 80 and 160 g a.i. ha^{-1} and found to be safer to the natural enemies.
- Newer insecticide were evaluated against gram pod borer, spotted pod borer and plume moth in redgram.Pod damage was comparatively low in indoxacarb 15.8EC 73g a.i. ha^{-1} (7.11%, 6.22% and 1.78% respectively) and rynaxiper 18.5 SC 30g a.i. ha^{-1} (7.33%,6.67% and 2.22% respectively) sprayed plots followed by acetamiprid 20 SP 20g a.i. ha^{-1} .

Integrated pest management

Bio intensive IPM (BIPM) package for the management of key pests of tomato

The BIPM package of installing bird perches, marigold (trap crop), yellow sticky trap and pheromone traps, release of *Trichogramma preteosum* and *Chrysoperla* and application of azadirachtin 1.0% effectively reduce the population of sucking pests and fruit borer, *Helicoverpa armigera* compared to farmers practice. The incidence of fruit borer was 4.2 to 5.6% in BIPM plot as compared to 10.6 to 12.8 % in farmers practice at 75 to 105 DAT. The fruit yield was significantly higher in BIPM plot (32.6 t/ha) as compared to farmers practice (28.3 t/ha).

Bio intensive IPM (BIPM) module against *Aleurodicus dispersus* on Cassava

Biointensive IPM module involving placing of yellow stick trap @12 per ha for monitoring, release of predator, *Mallada* @1.0 lakh first instar grubs ha^{-1}, application of entomopathogen *Lecaniicillium lecanii* @$2x10^9$ conidia per ml, application of NSKE 5% and application of triazophos 40%EC @2.5ml/ha effectively controlled the spiraling white, *Aleurodicus disperses* on cassava with a BCR of 1:3.34.

Plant-pest interaction and assessing host plant resistance to major crop pests

Interaction of major rice insect pests on rice in different type cultivation practices

The results showed that stem borer damage was more in the transplanted crop (12.55%) than the direct sown rice (4.22%). However, drastic change in the level of leaf folder damage. The incidence was more in the direct sown crop (10.27%). The hybrid crop CO RH 3 suffered more damage. Change in microclimate

may be the reason and in-depth further study will be carried out in the subsequent season.

Storage pests and their control

Eco-friendly plant origin product for the management of pulse beetle

A seed treatment formulation of sweet flag powder and gum has been developed and tested against pulse beetle and found that 1% concentration registered 63.31% mortality on 5th day after treatment. Cent percent mortality was observed in sweet flag 20EC (petroleum ether extract) on second day after treatment

Among the botanical powder tested against bruchids, seed damage was less in turmeric powder (0.23%), acorus rhizome powder (0.38%) while in control it was 44.77%. Minimum weight loss of 3.77% was recorded in turmeric powder followed by acorus powder (4.2%).Adult emergence was maximum in untreated control (525) and minimum in acorus rhizome powder (1.67).

Among the plant oil tested against bruchids in blackgram, less number of eggs were observed in neem and groundnut oil treated seeds(2.33/100g seed) followed by coconut and sunflower oil(3.00), illuppai oil (4.00) and palm oil(4.33) while untreated control it was 7.33.

Honey bees and their economic utilization

Diagnosis of honeybee disease in apiaries

A technique has been developed for diagnosing Thai Sac Brood Virus (TSBV) in *Apis cerana indica* colonies through RT-PCR. SBV primers reported by Grabensteiner *et al* (2001) were used for amplifying different regions of the TSBV genome. The RT-PCR method was found to be very useful for diagnosis of this virus in larval samples collected from different parts of Tamil Nadu. The result of homology search of nucleotide sequences showed that the TSBV had maximum similarity of 99 and 98 per cent with the sequence of SBV attacking A.c.indica of different samples available in the NCBI database.

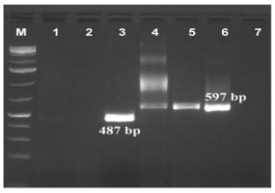
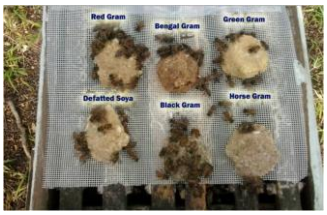


Fig. 1: Lane 1-3 : (221-708 region) ;Lane 4-6 (8038-8635) of the SBV genome. Lanes M, DNA size markers (1kbdna ladder Plus); lane 1,4 –Marthandam Sample; Lane 2,5: Coimbatore sample; Lane 3,6- Gobichettypalayam sample; Lane 7: Negative control.

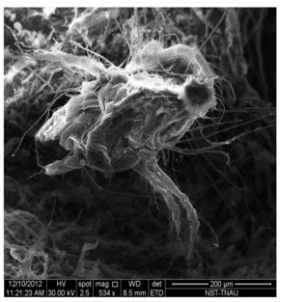
Standardization and evaluation of pollen substitutes for Indian honey bee, *Apis cerana indica* F

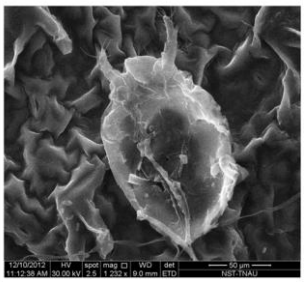
Apis cerana indica bee colonies fed with redgram flour (Redgram flour 26%+ skimmed milk powder 24%+ sugar powder 5% + glucose 10% + honey 35%) showed increase in bee population, area of sealed broods, honey storage area and pollen storage.



Management of *Varroa* mite,*Varroa jacobsoni* on *Apis cerana indica*

Treatment on brood frames with Sugar powder at 5 g, *Acorus calamus* powder at 2 g or Sulphur dust at 2 g per brood frame effectively controlled the *Varroa jacobsoni* mite and recorded lesser mites 15 days after treatment and improved brood area of *A. cerana indica.*





Dept. of Plant Pathology

Identification of sources of disease resistance in crops

Evaluation of pearl millet germplasm accessions for multiple disease resistance

- The initial pearl millet entries *viz*., PIT106, PIT 117, PIT 118, PIT 119, PIT 144, PIT 161, PIT 199 and PIT 203 showed resistance against downy mildew and rust diseases under downy mildew sick plot conditions.
- The entries *viz*., PIT 136 and PIT 157 exhibited resistance against downy mildew and ergot diseases.
- The advanced pearlmillet entries *viz*., PAT 208, PAT 221, PAT 222, PAT 224, PAT 225, PAT 227, PAT 228 and PAT 229 had multiple resistances against downy mildew and rust diseases under sick plot conditions.
- The entries *viz*., PRT 301, PRT 316, PRT317 and PRT 318 had multiple resistances against downy mildew and ergot diseases under sick plot conditions.

Screening of mungbean and urdbean lines against major diseases

- Out of 28 mungbean AVT and IVT entries screened during Summer 2014, PM14-1 was resistant to root rot, PM14-6 was resistant to stem necrosis and PM14-14 and PM14-21 were resistant to leaf crinkle disease and out of 12 urdbean entries screened, PU14-1, PU14-3, PU14-4, PU14-9 and PU14-10 were resistant to stem necrosis and PU14-3 was resistant to leaf crinkle disease.
- Out of the TNAU genotypes screened during summer 2014, mungbean entry CoGG11-03 was resistant to powdery mildew, YMD, stem necrosis and leaf crickle and urdbean entry CoBG10-06 was resistant to powdery mildew, YMD and leaf crinkle diseases.
- Out of 51 mungbean entries screened during Kharif 2014, KPM-25and KPM 44 were resistant to root rot, stem necrosis and leaf crinkle diseases. Among 34 urdbean entries screened during Kharif 2014, KPU-1, KPU-11, KPU-13, KPU-16, KPU-26 and KPU-31 were showing multiple resistance against root rot, stem necrosis and leaf crinkle diseases.

Screening of sunflower genotypes against *Alternaria* leaf spot and necrosis

Nine Advanced Hybrid Trial (AHT) entries were screened under artificial condition for *Alternaria* leaf spot and necrosis. Among them, AHT 7 was moderately resistant to *Alternaria* leaf spot with 18.5 per cent disease severity. The entries, AHT 1, AHT 3 and AHT 9 were moderately resistant to necrosis. Out of 19 Initial Hybrid Trial (IHT) entries screened under artificial condition for *Alternaria* leaf spot IHT 992 and 996 were moderately resistant to *Alternaria* leaf spot disease with 21.9 and 24.0 per cent severity respectively. IHT 988, 991, 992 and 997 recorded moderately resistant reaction to necrosis under artificial condition.

Survey and screening for the occurrence of cotton diseases in Tamil Nadu

The incidence of TSV varied from 2.0 to 40% in Tamil Nadu. The maximum incidence of TSV (40%) was noticed in RCH II Bt at Coimbatore followed by 22% incidence in RCH II Bt in Veppanthattai, Edayanthankudi and Ariyalur. Besides, 22% incidence of TSV was also observed in the hybrid Kaveri Jaddhu at Vetakudi village of Perambalur district. The hybrid RCH II, which was cultivated predominantly, was more susceptible to TSV.

Identification of resistance sources for Sigatoka and *Fusarium* wilt in banana

- The cvs. Quintal Nendran, Attunendran, Popoulu, Anaikomban, M.B Bhimkol, Pisang Lilin, Hatidat, Gowria, Bagner, Rose, Chakia, Elavazhai were found resistant to *Fusarium* wilt under artificial inoculation**.**
- The cvs. Ambalakadali, Calcutta-4, Rose, BRS-1, BRS-2, H201x Pey Kunnan, Hatidat, Sennachenkadali were immune to Sigatoka leaf spot. The cvs. Jurmony, Pisang Mas, Bhurkel, Govarkar, Barsain, Onkamannan, H 96/7, Gowria, Daksinsagar were found highly resistant and the cvs. Bibutia, Pisang Lilin, Erachivalzhai, Chinali, Peykadali, Kalibow, Ladan, FHIA-1, Lambi Chennabale, Bilekadali, Kappukadali, Boodibale Neyvannan, Pey kunnan, Pisang Jaribuaya, Attu Nendran were found resistant to sigatoka leaf spot.

Survey for the incidence of Banana diseases

Fusarium wilt incidence of 6 to 12% in Grand Naine with external disease score up to 3, internal disease score up to 6 was observed at Theni district. The pathogen was confirmed as VCG 0125 of race 1 of *Fusarium oxysporum* f.sp*. cubense*. In other cultivars, *Fusarium* wilt incidence ranged from 7.0 to 18.6 % in Karpooravalli, 6.0 and 8.0 % incidence in Chakia and Monthan, 6.0 to 27 % incidence in Neypoovan, 6 to 10.2 % incidence in Rasthali. Sigatoka leaf spot incidence with DSI of 9.2 to 16.0 in Grand Naine, 9.2 to 16.5 in Karpooravalli, 9.4 to 20.3 in Nendran, 16.7 to 17.1 in Ney poovan and 13.6 in Poovan were recorded.

Survey and evaluation of turmeric genotypes for resistance to foliar diseases

- Survey taken up in different turmeric growing areas of Tamil Nadu revealed that the incidence of leaf blotch was found to be more (78 PDI) in Erode District.
- Different CVT entries were screened for the tolerance to foliar diseases. Among the entries, CL 32, 34, 52 and 54 showed resistant reaction to turmeric leaf spot and leaf blotch.

Studies on the occurrence of *Sclerotium* wilt of Jasmine

Survey on the incidence of *Sclerotium* wilt of Jasmine revealed that the disease was maximum in Sathyamangalam (Pavuthampalayam) (17.00 per cent) followed by Thottampalayam (14.66 per cent) and Kankkarasampalayam (13.32 per cent).

TRRI, Aduthurai

Management of False smut

On - farm trial conducted during *thaladi* 2014 for the management of false smut disease using the rice variety ADT R 46 indicated that application of trifloxystrobin 25% + tebuconazole 50% (0.4 g/l) at booting and 50% panicle initiation recorded the minimum per cent of infected spikelets / panicle (2.8), infected panicles / hill (25.0), infected hills (42.2) and higher yield (4022 kg/ha) as compared

to the untreated control which recorded 10.8**%** of infected spikelets / panicle, 42.3% of infected panicles / hill, 60.7% of infected hills with an yield of 3211 kg/ha.

Biological control and integrated management strategies for major diseases affecting agricultural and horticultural crops

Bio-prospecting of ACC deaminase producing Plant growth Promoting Rhizobacterial (PGPR) strains against root rot disease in Mungbean and Urdbean

Forty three bacterial cultures were isolated from rhizosphere soils from different crops of which 30 isolates belonged to *Pseudomonas fluorescens* and 13 isolates were *Bacillus subtilis.* The *P. fluorescens* isolates Pft5, Pfm6, Pfo11 and Pfh13 were found to be highly effective in inhibiting the mycelial growth of *Macrophomina phaseolina*, the dry root rot pathogen of mungbean and urdbean under *in vitro*.

Development of microbial based bioformulations for the management of major fungal diseases in Urdbean

- Among 20 isolates of fluorescent pseudomonads tested against mycelial growth of *M. phaseolina*, PfUL(A), PfAL1 and PfCBE9 exhibited maximum inhibition of 44.4, 41.1 and 41.1 per cent respectively. They were on par with each other in inhibiting pathogen mycelial growth.
- Among ten *Bacillus* isolates tested against *M. phaseolina*, BSOP2, BCBE1 and BKK3 exhibited maximum mycelial inhibition 36.7, 33.33 and 31.1 per cent respectively..
- Out of 10 isolates of *Trichoderma* spp. tested against mycelial growth of *M. phaseolina*, the isolates TVL1, TCBE3 and TOKK1 showed better inhibition when compared to others.

Effect of *B. subtilis* (EPCO 5) in the management of ragi blast

- Seed treatment @ 10g/kg + foliar spray @ 0.2 per cent with *Bacillus subtilis* (EPCO 5) recorded lesser disease severity of leaf blast (2.60 PDI), neck blast (2.20 PDI), finger blast (1.00 PDI) with 58.06, 59.25, 80.00 per cent reduction over control respectively under field conditions.
- Seed treatment @ 10g/kg + foliar spray @ 0.2 per cent with *Bacillus subtilis* (EPCO 5) recorded enhanced plant height of 110 cm, 6 tillers/ hill, 5.80 ear heads per hill, 8.60 fingers per ear heads, 8.73 cm finger length, 2360 grains per ear head, 1000 grain weight of 2.91 g and yield of 2759 kg/ ha.

Integrated disease management of foliar diseases in cotton

Seed treatment with *B. subtilis* (BSC5–TNAU) @ 10 g/kg + soil application @ 2.5 kg/ha + foliar spray @ 1% on 60, 90 and 120 days after sowing was effective in controlling, *Alternaria* leaf blight and TSV. In the above treatment the incidence of ALS, TSV and seed cotton yield in RCH II Bt was 7.0 PDI, 6.0 % and 11.1 quintals/ha respectively whereas in farmers practice the incidence of ALB, TSV and seed cotton yield was 24.0 PDI, 23.3 % and 7.0 quintals /ha respectively.

Biological control and integrated management strategies for major diseases affecting medicinal crops

- Dipping stem cuttings in *Pseudomonas fluorescens* (0.2%) followed by soil drenching with *P. fluorescens* (0.2%) 30 days after planting was effective in managing root rot disease (*Rhizoctonia bataticola*) of *Coleus forskohlii* under field conditions. Plant growth and yield parameters were found to be enhanced and the tuber yield was found to be maximum by dipping stem cuttings in *P. fluorescens* (0.2%).

- Root rot disease (*Macrophomina phaseolina*) of *Gloriosa superba* was effectively managed by dipping the tubers in *Bacillus subtilis* (2 g/l) followed by drenching with *B. subtilis* (2 g/l) on 30 days after planting. The plant growth and seed yield were found to be increased by *B. subtilis* treatment.

Evaluation of new fungicides against rice blast

- The combination fungicide CF-110 (tricyclazole 45% + hexaconazole 10% WG) @ 1g/lit was found to be highly effective in controlling leaf blast incidence.
- Spraying tebuconazole 0.1% twice on 30 and 60 days after planting was effective in managing the leaf blight disease (*Alternaria alternata*) of *Gloriosa superba* and increasing the seed yield.

Development of management modules for the powdery mildew disease of mungbean

Foliar application of Azoxystrobin @ 0.1%, first spray at 25 DAS and second at 15 days later, was found to be effective in controlling powdery mildew of mungbean (*Erysiphe polygoni)* under field conditions in both Kharif 2014 and Rabi 2014 trials followed by Propiconazole @ 0.1%.

Integrated management of *Fusarium* wilt disease of Banana

Dipping of corm with 0.2 % Carbendazim for 30 min.+ drenching with 0.2 % Carbendazim + pseudostem injection with Carbendazim @ 3ml (2% solution) at 3rd 5th and 7th month recorded the least incidence of 18.5 % with external disease score of 1.0 and internal vascular disease score of 1.1. Control plants recorded maximum wilt incidence of 80.4 % with external and internal vascular disease score up to3.2 and 5.0 respectively.

Bio-priming of banana tissues culture plantlets with PGPR endophytes for enhanced resistance to rhizome rot of banana caused by *Erwinia carotovora* pv. C*arotovora*

Thirty four endophytic bacterial PGPR isolates were isolated from the healthy banana plants and screened against the rhizome rot pathogen *Erwinia carotovora* pv. c*arotovora* and the results revealed that *Bacillus subtilis* strain PP, NB10 and CL3 effectively inhibited the growth of pathogen under *in vitro*.

Studies on the management of *Sclerotium* wilt of Jasmine

- Trifloxystrobin + Tebuconazole (0.1%) and Difenaconazole (0.1%) was the most effective in inhibiting the mycelial growth *in vitro* with 100 percent inhibition over control.
- Mahua oilcake extract and castor cake extract were found effective in inhibiting the mycelial growth of *Sclerotium rolfsii in vitro.*

Plant disease diagnosis

Diagnosis of CGMMV in cucurbits

The diagnostics methods viz., DIBA, TIBA and RT-PCR for *Cucumber green mottle mosaic virus* in cucurbitaceous crops were standardized.

Detection of aflatoxin B1

Aflatoxin B1 (AFB1) was conjugated to keyhole limpet hemocyanin (KLH) and polyclonal antibodies were raised against AFB1-KLH in a New Zealand White inbred rabbit. By using the developed antibody, a sandwich ELISA method was standardized for quantifying AFB1 in foods and feeds.

The developed polyclonal antibodies were highly sensitive and could detect AFB1 at a dilution of 1:10,000 and the detection limit of AFB1 was 10 ppb. In order to understand the magnitude of AFB1 contamination, a total of 68 samples consisting of maize-based foods and poultry feed samples collected from retail shops, supermarkets, poultry farms and poultry feed dealers of Tamil Nadu, India were analyzed for AFB1 contamination by ELISA. AFB1 contamination in maize based food products was detected in nine samples out of 17 samples tested. However, only one sample exceeded the tolerance level of 20 µg/kg. AFB1 contamination in feeds was observed in more than 88 % of the samples tested and its level ranged from 5.4 to 125.4 µg/kg and 31 samples out of 51 samples tested contained AFB1 above 20 µg/kg.

Host-pathogen interactions and biotechnology

Genetic engineering of groundnut for Peanut stem necrosis disease (PSND) resistance

The feasibility of controlling PSND in groundnut caused by *Tobacco streak virus* (TSV) was explored by expressing double stranded (ds) RNA of the replicase (Rep) gene of TSV in groundnut through genetic engineering. Cotyledon explants of groundnut cultivar TMV-7 were transformed with *A. tumefaciens* harbouring the hpRNA cassette (Plate 1). The gene integration in the transgenic plants up to T_3 generation was confirmed by PCR amplification of the 535 bp fragment of TSV *Rep* gene (Plate 2). No significant differences in morphology and growth were observed between transgenic lines and non-transformed plants. T_3 progeny from selected lines were evaluated for resistance to TSV under greenhouse conditions. The results indicated that the transformants did not show any symptoms of infection until harvest. On the contrary, non-transformed plants were severely affected with distinct necrosis symptoms (Plate 3). ELISA results indicated that the non-transformed plants inoculated with TSV recorded the highest virus concentration compared to the transgenic lines.

Plate 1. Different stages of groundnut cv. TMV-7 transformation with a plasmid containing inverted repeat of the Rep gene of TSV

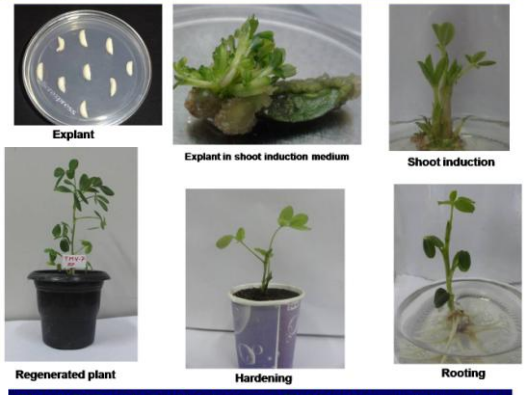
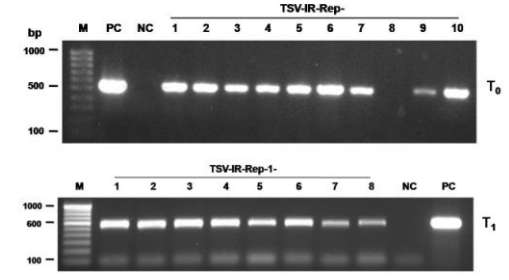
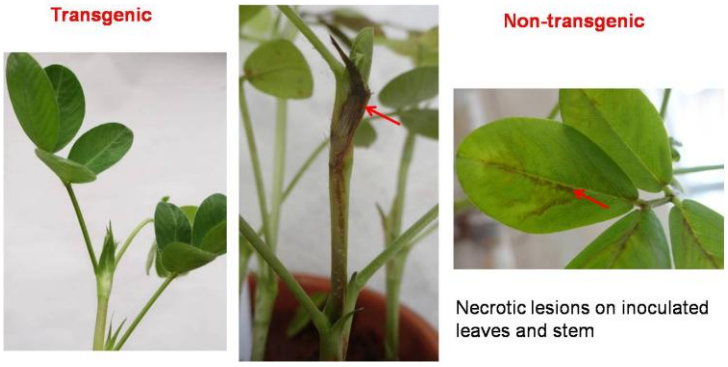


Plate 2. PCR analysis of total genomic DNA from transgenic groundnut plants transformed with inverted repeat TSV-Rep gene construct



Total DNA from transgenic groundnut plants was analyzed by PCR for the integration of TSV-IR-Rep gene. Lane M, 100-bp DNA ladder, Lane PC, positive control [pHANNIBAL (TSV-Rep) DNA]; Lane NC, negative control (DNA from non-transformed groundnut plant).

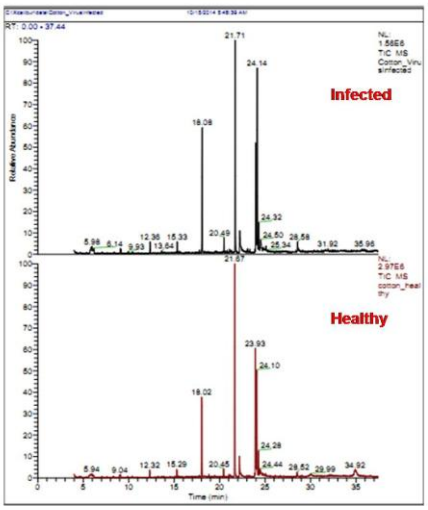
Plate 3. Symptoms induced on leaves of transgenic (T_1) and wild type groundnut plants following mechanical inoculation with TSV



Biochemical changes in cotton infected with TSV

Studies on host plant resistance revealed the differential display of various metabolites associated with healthy and infected plants in the TSV infected plants. The compounds such as Benzoic acid, 3,5-dicyclohexyl-4-hydroxy-, methyl ester, Benzoic acid, 3,5-dicyclohexyl-4-hydroxy-, methyl ester; 1-Heptadec-1-ynyl-cyclohexanol; 1-methyl-1,3,4-triazolin-2,5-dione and 1-Chloroeicosane were found to be present in healthy cotton plants (Plate 4). However, they were absent in the TSV infected plants.

Plate 4. Metabolite profile in the TSV infected and healthy cotton plants



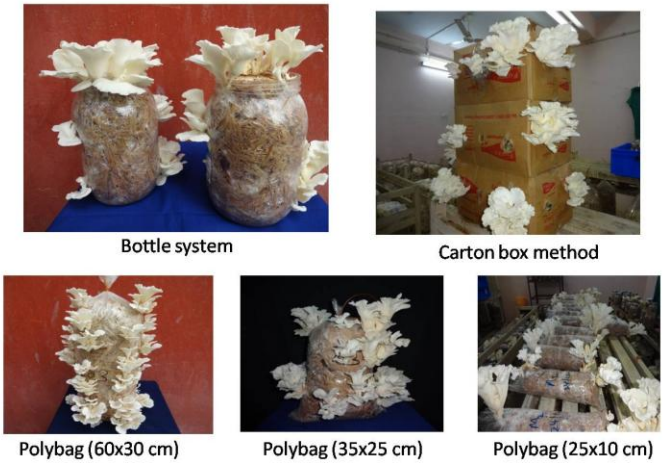
A new Begomovirus in Coccinia (ivy gourd)

The complete genome of a new bipartite begomovirus infecting ivy gourd in Tamil Nadu was characterized through rolling circle amplification (RCA). The genome sequence of DNA A of the new begomovirus had a maximum identity of 78% with *Loofa yellow mosaic virus* from Vietnam. It has been tentatively named as *Coccinia mosaic Tamil Nadu virus* based on begomovirus species demarcation criteria of 91%. The association of two DNA B fragments with DNA A was confirmed and they had a nucleotide sequence similarity of 94% themselves and had only 53% identity with the DNA B of ToLCNDV.

Development of innovative technologies and varieties for commercializing edible and medicinal mushrooms

- Ten different wild mushroom specimens which include *Calocybe*, *Pleurotus*, *Volvariella*, *Ganoderma*, *Coriolus*, *Cordyceps* and *Schizophyllum* have been collected, identified and pure cultured and conserved for further exploration.
- Exotic specimens of White button mushroom, Portabella, Shiitake, Auricularia and Flammulina have been collected, pure cultured and conserved for further use.
- Production of oyster mushrooms in different container systems like poly bags of different sizes (60x30 cm; 35x25 cm and 25x10 cm); PP bottles (1800ml) and carton box (36x18x12cm) have been evaluated for the cultivation of *Pleurotus florida* (PF), *P. platypus* (PP); *P. eous* (var.APK1) and *Hypsizygus ulmarius* (Var.CO 2). Polybag and Carton box methods were found to be suitable for the cultivation of all oyster mushroom species (Plate 5). Bottle technology was found to be suitable for the cultivation of *P. platypus* (PP) and *Hypsizygus ulmarius* CO 2 oyster mushroom.

Plate 5. Container systems evaluated for the cultivation of oyster mushrooms



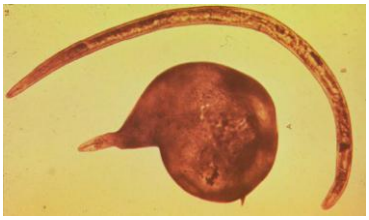
Dept. of Nematology

Emerging problem of root knot nematode on guava

The results of the studies confirmed the root knot nematode infesting guava as *M. enterolobii* and it is occurring above the pathogenic level of one juvenile/g of soil in Dindigul district of Tamil Nadu. The treatment with carbofuran 3 G @ 1 kg ai/ha is found to be effective for the suppression of nematodes.

Severe galling and complete drying of plants

Adult root knot nematode, *M.enterolobii* female and male



Root knot nematode problem in beetroot.

The root knot nematode species associated with beetroot is confirmed as *M. incognita* and management studies are under progress.

Beetroot infested with root knot nematode showing galls and malformation

Root knot nematode problem in carrot

Seed treatment with *Paecilomyces lilacinus* @ 20g/kg seed followed by soil application of *P.lilacinus* @ 2.5kg+FYM @2. 5 t/ha significantly reduced the nematode population in soil by 27 per cent and root knot index of 3.0 and increased the yield by 32 per cent compared to untreated control.

Carrot infested with *M.hapla* showing galling, forking and malformation

Research focus and action plan for 2015-16

- Biodiversity and systematics of nematodes.
- Identification of nematode hot spot areas, assessment of yield loss due to nematodes and evolving suitable man0agement strategies.
- Continuation of screening of germplasm for the identification of varieties resistant to nematodes.
- Influence of cropping sequence on nematode population.
- Intensification of biological control of nematodes and identification of nematode specific native antagonistic organisms.
- Attempting for green synthesis of nano particles effective against nematodes.
- Identification of emerging nematode problems.
- Basic and applied research on entomopathogenic nematodes (EPN).

Sericulture

Enhancing silk production

Combined foliar application of micronutrients *viz.,* 1.0 per cent zinc, 2.0 per cent iron + 0.1 per cent citric acid, 0.4 per cent boron, 1.0 per cent manganese on 15th and 30th day after pruning was found to be more efficient in enhancing the quality and productivity of mulberry with increased economic returns.

Absolute control (Without micronutrient application)

Foliar application of zinc (1.0%) + iron (2.0% + 0.1% citric acid) +boron (0.4%) + manganese (1.0%)

All India Co-ordinated Experiments on mulberry (AICEM)

Among the high yielding varieties tested, C 2038 and G4 performed better under Tamil Nadu condition with more than 80 tonnes of green leaves per ha. per year as compared to V1 and other varieties which yielded less than 60 tonnes of green leaves per ha. per year with increased net return and B:C ratio.

Integrated pest and disease management in sericulture

Induction of antibacterial factors and their role in the management of bacterial disease of mulberry silkworm, *Bombyx mori* L

Ten protein fractions were eluted from haemolymph of three silkworm breeds, *viz*., Rong Daizo, Double hybrid and CSR 2 after immunization with bacterial pathogens through column chromatography. Among them, ninth fraction was found to be effective producing an inhibition zone of 3.01cm, 2.89 cm and 2.98 cm respectively against *Escherichia coli*, 3.10 cm,2.98 cm and 3.05 cm against *Staphylococcus aureus* and 1.82 cm, 1.79cm and 1.81cm against *Bacillus thuringiensis*. Treated Control (Streptomycin sulphate) recorded an inhibition zone of 7.12 cm, 8.12 cm and 6.32 cm for Rong Daizo, Double hybrid and CSR 2 respectively.

Mass production of parasitoids and predators of sericultural importance

- Mass production of *Acerophagus papayae* was carried out and the produced parasitoids were distributed freely to the farmers for the management of papaya mealy bug.
- Nucleus culture of *Cryptolaemus montrouzeuri* and *Nesolynx thymus* were maintained and released in various places of Coimbatore, Tirupur, Salem, Erode districts.

Management of root rot disease caused by *Macrophominaphaseolina* in mulberry through chemical and non chemical methods

Drenching $ZnSO_4$ (0.1%) + Carbendazim (0.1%) thrice at monthly intervals recorded the lowest root rot disease incidence 9.65 per cent and highest leaf yield of 11,685kg/ha compared to control which recorded the maximum disease of root rot (59.10 per cent) and recorded the lowest leaf yield (9,105^{d} kg/ha).

Studies on the pathogens and other factors involved in causing root rot and wilt disease complex in mulberry and screening of available mulberry varieties accessions against root rot and wilt disease

- The pathogens isolated from the infected tissues of mulberry root were *Macrophomina phaseolina* and *Fusarium sp*. The identification of pathogen confirmed by morphological characters and proved the pathogenicity.
- The soil and irrigation type influenced the occurrence of highest incidence of root rot. Red soil with bore well irrigation system recorded the highest root rot incidence (43.60%) followed by black soil with bore well irrigation type recorded 32.60% root rot incidence and black cotton soil with bore well system recorded 31.60% root rot incidence.
- The seasonal analysis of root rot incidence in different mulberry growing areas showed that the hot weather influenced the highest occurrence of root rot in all surveyed places *viz.*, Coimbatore (34.7%), Erode(30.6), Tirupur (29.2%), Dharmapuri (26.9%), Krishnagiri (29.3%), Pudukottai (27.2%), Tirunelveli (29.5%).
- The seasonal analysis of root rot incidence in different mulberry growing areas showed that the highest root rot was recorded during May month in all surveyed places *viz*., Coimbatore (49.3%),Erode (45.1%), Tirupur (45.5%), Dharmapuri (36.5%), Krishnagiri (36.3%), Pudukottai (35.5%), Tirunelveli (35.1%**).**
- Out of fifteen mulberry entries screened against root rot disease, the two entries *viz*.,V1 (14.58%) and S36 (17.42%) showed moderately resistant reaction on root rot disease in mulberry.

Eco-friendly management of root rot disease in mulberry (*Morus alba*) through PGPR (Plant Growth Promoting Rhizobateria) mediated resistance

The Plant Growth Promoting Rhizobacteria (PGPR) (*Pseudomonas* sp. and *Bacillus* sp.) were isolated from ten different mulberry growng rhizosphere soil through serial dilution technique by pour plate method. The isolated *Bacillus* and *Pseudomonas* screened against root rot disease causing pathogen under *Macrophomina phaseolina in vitro* conditions showed that among the ten *Pseudomonas* isolates screened against *M. phaseolina* the highest inhibition of 45.6% was recorded by the *P. fluorescens* (MP2) collected from Mathampatti, Coimbatore (dt). Among the *Bacillus* isolates screened against *M. phaseolina* the highest inhibition of 53.0% was recorded by the *Bacillus* sp. MB1 collected from Puthur, Coimbatore (dt).

Value Addition in Sericulture

Conversion of mulberry silkworm pupal waste into eco - friendly bio products

The antibacterial activity of chitosan was evaluated *in vitro* against *Enterococcus faecalis.* The antibacterial activity of the chitosan was carried out by using LB medium. Chitosan markedly inhibited the growth of organisms. Among the different concentrations 750 µl /ml showed highest zone of 17.5 mm.

HORTICULTURE

CROP IMPROVEMENT

Germplasm conservation and evaluation for major horticultural crops
Evaluation of germplasm for identifying high yielding and short duration aggregatum onion

Among the 66 accessions screened, the Acc No. Aca 15 recorded the highest bulb yield of 19.12 t/ha as against the check CO (On) 5 (15.0 t/ha). The duration of the crop is 66 days for bulb to bulb crop and 95 days for seed to bulb crop.

Evaluation of germplasm for selection of high yielding clove for lower elevations

Accession SA 3 has been accepted for release as a state variety by the AICRPS.SA-3 had highest tree height of 7.94 m, stem girth of 37.50 cm, dry bud yield of 5.2 Kg/tree and bud oil yield of 16 percent. This accession yields 25 percent higher in dry bud yield and 15 percent higher oil compared to pechiparai local.

SA 3 CLOVE-FIELD VIEW	SA 3 CLOVE-FLOWER BUDS
	
SA 3 CLOVE-FRESH BUDS	**SA 3 CLOVE-DRY BUDS**
	

Development of a drought tolerant coconut hybrid with high nut yield, tender nut water, copra output and oil yield

Cross combination LCOT x CCNT was identified and released as first Tall x Tall – hybrid in the South Asia as VPM 5. The performance of LCOT x CCNT cross combination recorded higher nut yield with high copra and oil content with drough tolerant nature. The mean nut yield of this hybrid during the stabilized bearing period was 161 nuts/palm/year which is 62.6, 43.8 and 11.0 per cent higher than ECT, VHC 2 and VHC 3 respectively.

Selection of most suitable oil palm hybrid for Cauvery Delta Zone

Among the 10 hybrids (NRCOP 11 – NRCOP 20) evaluated for growth and yield parameters in the farmers holdings, the hybrid NRCOP 11 recorded significantly the highest palm height of 2.78 m and palm girth (3.27 m). Number of leaves produced per year (20.50) and number of female inflorescence (12.72) were the highest in NRCOP 14. Data on yield from July to December 2014 revealed that the highest FFB yield (135.50 kg/tree) was registered in the hybrid NRCOP 17.

Among the other set of 10 hybrids (NRCOP 1 – NRCOP 10) studied for growth and yield parameters in farmers holdings, the results revealed that the highest palm height (1.90 m), palm girth (2.50 m), number of leaves produced per palm per year (23.20) and number of female inflorescence (12.38) was recorded in the hybrid NRCOP 5. Hybrid NRCOP 3 recorded significantly the highest number of male inflorescence. Data on yield from July to December 2014 revealed that the highest FFB yield (81.79 kg/tree) was also recorded in the hybrid NRCOP 9.

NRCOP 17

- Palm height (1.85 m)
- Palm girth (2.43 m)
- Number of leaves (19.70)
- Number of female inflorescence (11.59)
- FFB yield (135.50 kg/tree)

NRCOP 9

- Palm height (1.58 m)
- Palm girth (2.23 m)
- Number of leaves (23.00)
- Number of female inflorescence (11.72)
- Highest FFB yield (81.79 kg/tree)

Enriching the germplasm of chrysanthemum for genetic enhancement

Out of 147 accessions being maintained, Accessions, Acc. 8 - Star of India (for pot mums), Acc 14 – Jwala and Acc 124 - Punjab Anuradha (for loose flowers and garlands), Acc 33 – Mohini and Acc 85 - RRS 85(for cut flower) were found to be promising when compared to the local check (CO1).

Star of India (Acc 8)

Mohini (Acc. 33)

RRS 85 (Acc 85)

Punjab Anuradha

Jwala (Acc 14)

CO 1 (Acc 124)

Identification of suitable single and double type cultivars for commercial cultivation through germplasm collection and evaluation

Among the 15 types of tuberose evaluated, Prajwal (single) and Suvasini (double) showed its superiority over other genotypes with respect to growth and yield parameters *viz.,* number of florets/ spike (48.23, 54.23 nos.), length of the floret (6.42, 7.58 cm), weight of florets per spike (75.89, 146.98 g), number of spikes/m^2 (48.23, 34.78 nos.) and yield of florets/ plot (2 x 2 m) (4.48, 4.98 kg). Based on the superior performance, these two cultivars have been identified for further evaluation.

Prajwal

Suvasini

Breeding for high yield for increasing the productivity

Development of gum-less jackfruit variety with high yield

Among the 37 types already marked at different locations, four promising types were identified out of which two are gum less with good quality carpels.

AH 10 (gum less, high yielder)

AH 20 (High TSS 31 %)

AH 45 (Off-season bearing, high TSS)

AH 46 (Red carpelled, off-season bearing, gum less)

The accession AH 10 is promising with 150 fruits per tree, medium sized fruits of 3-5 kg suitable for urban market, sweet carpels, 28 % TSS, 75 carpels per fruit without any latex in the fruit after ripening which enables easy extraction of carpels.

Breeding for high yield and quality F1 hybrids in Ridge gourd

The hybrid (IC 410147 x IC 373361) is suitable for medium and long duration cultivation as fruits are available up to 14 harvests. The fruit is 30.50 cm length and 15.55 cm girth which is ideal for packing and transport. Each fruit is weighing about 200-250 gm. It contains 0.50 mg/100 gm crude fiber. Each plant bears about 25 fruits. The yield is 27.03 t/ha.

Evaluation of peas varieties / lines suitable for Kodaikanal conditions

Among the twenty six varieties of pea evaluated under Kodaikanal (upper Pulney hills) condition, Azad P-3 recorded the highest fresh pod yield of 240.05 g/plant followed by Mater Ageta – 6 (167.64 g/plant).

Evaluation of garlic varieties for high yield and quality

Among the 72 entries, Accession evaluated 72 recorded the highest bulb yield of 19.5 tonnes/ha followed by Accession 11 recording 13.70 tonnes/ha. Accession No. 72 is found to be suitable to Nilgiris condition.

Development of jasmine variety with off-season flowering and year-round flowering potential

Among the nine underexploited species of jasmine evaluated ***J****asminum nitidum, J. rigidum, J. flexile, J. humile, J. primulinum, J. calophyllum, J. arborescens, J. angustifolium and J. multiflorum,*, *J. nitidum, J. flexile, J. calophyllum and J. multiflorum* flowered throughout the year. The flower buds of J. nitidum possess desirable quality parameters such as attractive bold buds, bright pink colour and longer shelf life.

J. nitidum

Flower buds and opened flowers ***Flower string (Veni)***




J. flexile

Flower buds and opened flowers ***Flower string (Veni)***



J. calophyllum

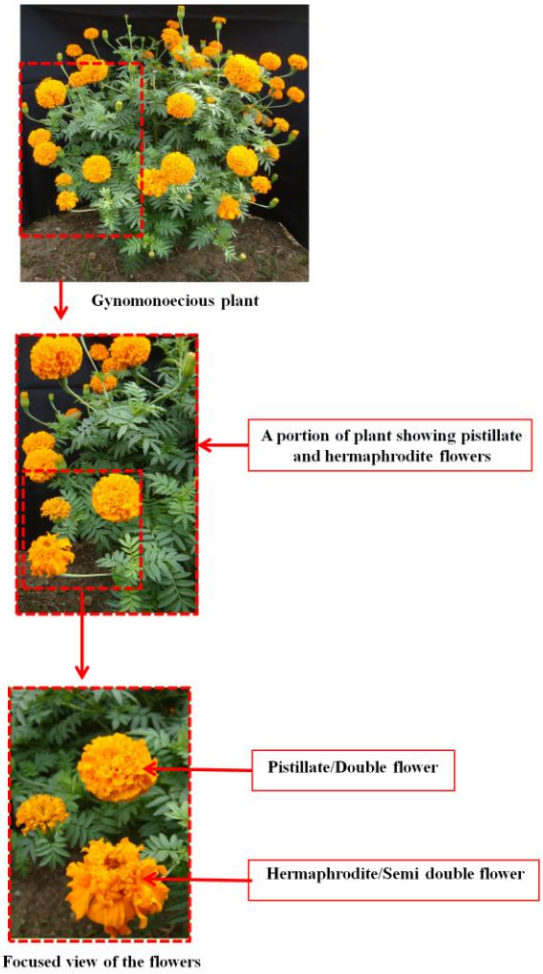
Flower buds and opened flowers ***Flower string (Veni)***



Development of African marigold hybrids with improved yield and quality

A total of twenty four plants expressing gynomonoecious sex form was evaluated. Of these, fourteen (C4-3, C4-7, C4-35, C4-53, C4-61, C4-72, C4-120, C4-126, C4-130, C4-158, C4-199, C4-211, C4-234 and C4-259) resulted from the cross Coimbatore Local Orange x Siracole and ten (C5-10, C5-52, C5-57, C5-199, C5-204, C5-205, C5-206, C5-207, C5-209 and C5-215). These progenies proved superior than the rest of the progenies in the F_1 population due to their seed setting ability and desirable mean performance for morphological, flower yield and quality parameters. Therefore, these progenies have been forwarded to F_2 generation for further evaluation.

Gynomonoecious sex form in African marigold genotype Siracole



Developing turf grass suitable for aesthetic and utility (sports) purpose

Among the twelve genotypes evaluated, *Brachiaria reptans, Digitaria bicornis, Axonopus compressus*, *Cynodon dactylon* X *C. transvaalensis* and *Zoysia japonica* have been identified as suitable for sports and athletic fields and *Zoysia japonica, Zoysia tenuifolia, Stenotaphrum secundatum* and *Stenotaphrum secundatum* 'Variegata' for landscaping uses.

Selection of genotype with high root yield and plumbagin content in *Plumbago zeylanica*

From the 43 accessions evaluated two promising accessions were identified viz., TN*PZ* 40 (Thanjavur local) and TN*PZ* 19 (Salem local).The accession TN*PZ* 40 recorded dry root weight of 442.00g/plant with plumbagin content of 0.10%. The accession TN*PZ* 19 recorded 310g of dry root weight /plant with plumbagin content of 0.34%.

TN*PZ* 40 (Thanjavur local)

TN*PZ* 19 (Salem local)

Collection and evaluation of French beans for higher yield and high nutritive quality

Among the 26 bush bean types evaluated, accession number FBB-7 (Aruvath avarai) has recorded the highest pod yield of 712.73 g/plant, pod weight of 15. 80g/ pod. Among the bush bean types, accession number FBB-7 (Aruvath avarai) has recorded the maximum plant height (67.21), no. of branches (6.80), no. of compound leaves (44.70), days taken for flowering, (25.29), days taken for pod setting (42.00), no. of pods (34.15), pod length (18.48 cm), pod diameter (3.35cm) and pod weight (15.80g), with highest pod yield (712.73 g/plant), total green pod yield of (19.8 t/ ha) and pod weight (15. 80g/ pod).

Breeding for resistance / tolerance to biotic and abiotic stresses

Development of banana hybrids resistant to Fusarium wilt

Banana hybrid H.212 (AB) is developed with tolerance to *Fusarium* wilt and nematodes. This entry gives an average bunch weight of 13.0 kg with 11 hands and 160 fingers. This hybrid resembles Ney Poovan in taste. This is under Multi Location Testing in 8 different locations of Tamil Nadu.

Development of brinjal hybrid resistant to shoot and fruit borer

Two pre release hybrid derivatives viz., HD 1 and HD 2 have been evolved for shoot and fruit borer resistance.

HD 1: It is a high yielder with the fruit yield of 3.25kg/plant and single fruit weight of 52.59 grams. Fruits are purple in colour with medium long in length and cluster bearing. Total number of fruits per plant is 61.82. Percentages of shoot and fruit borer incidence are 11.59 and 11.98% respectively.

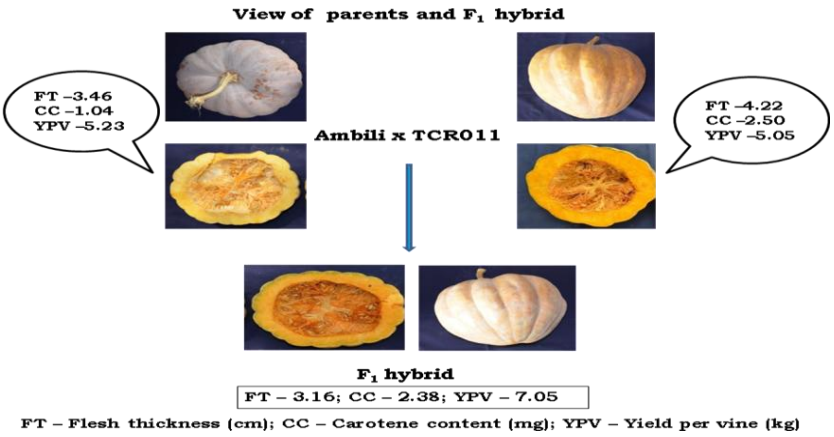
HD 2: It is also a high yielder with 2.53kgs of fruits/plant and single fruit weight of 44.47grams. Fruits are purple in colour with medium long and cluster bearing habit. Single plant produces 56.49 fruits/plant.

HD 1 **HD 2**

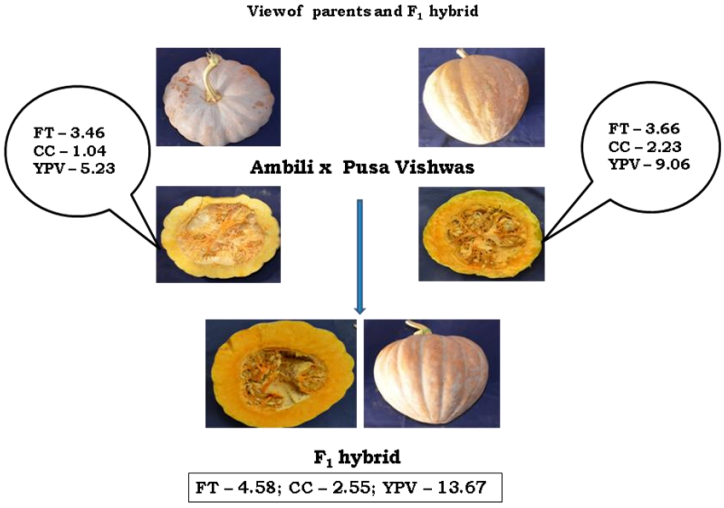
Development of F1 hybrid in bhendi with high yield and resistant to YVMV

The another CBH 3 has an average fruit weight of 20 g and has the potential to yield 25.6 t/ha which COBH H 1 and Sakthi were yielding 20.6 & 22.2 t/ha fruits.

Breeding for post harvest qualities and suitable for processing
Identification of QTLs for carotene content and flesh thickness in pumpkin (*Cucurbita moschata* Duch ex Poir.) to enable biofortification.



FT – Flesh thickness (cm); CC – Carotene content (mg); YPV – Yield per vine (kg)



FT – Flesh thickness (cm); CC – Carotene content (mg); YPV – Yield per vine (kg)

The F_1 hybrid developed using Ambili x TCR 011 and Ambili x Pusa Vishwas recorded positive significant heterosis for carotene content (34.46 per cent and 55.96 per cent) and yield per vine (37.16 per cent and 91.32 per cent) respectively which are now under advanced stage of evaluation.

CROP MANAGEMENT

Propagation studies
Standardization of propagation techniques in persimmon

Studies on different methods of grafting and budding in persimmon revealed that, whip and tongue method of grafting recorded a success percentage of 71.42% on *Diospyros virginiana* as rootstock.

On evaluation of rooting of cuttings of different species of persimmon, hard wood cuttings of *D. virginiana* planted in the months of July-November recorded a maximum rooting percentage of 43.33%. Cold stratification of persimmon seeds at 4-5 C for 2-3 months recorded 48 % germination in *D. virginiana.*

Grafting techniques in brinjal

Grafting can also be practiced in brinjal as that of fruit crops like mango and sapota for containing the problems of dry root rot, root rot nematode and *Fusarium* wilt by using a resistant rootstock. Grafted brinjal becomes a perennial with extended duration of 2-3 years. Works have been utilized in this direction using non bitter *Solanum torvum* 09-05 as non stock with wedge grafting using any commercial variety / hybrid as soon.

Large scale trials in the farmer's field are in progress

Grafted brinjal in Protray

Large scale trial at Orchard on Grafted brinjal

Standardization of agro techniques for spices and plantation crops

Single bud rhizome technology of turmeric resulted in high fresh rhizome yield of 46.20 t/ha with 25.23% yield increase over the conventional method and recorded a highest C: B ratio of 1:2.47.

Nutrient management and water management

Improved methodologies including integrated nutrient and water management for enhancing productivity, quality and shelf life of banana.

In banana cv. Rasthali, application of 100% RDF along with AM fungi (250 g/plant) + Phosphate Solublising Bacteria (50 g/plant) + *Azospirillum* (50 g/plant) + *Trichoderma harzianum* (50 g/plant) recorded the highest bunch weight (11.49 kg) with the least *Fusarium* wilt incidence (5.53%). The cost-benefit ratio was 1:2.87 as against 1: 2.41 in control.

Developing an Integrated Nutrient Management Module for garlic

Application of 75:40:40:40 Kg NPKS + 5 t FYM / ha + 2.5 t PM + 2.5 t VC/ ha significantly increased high yield of garlic (10.61 t/ ha) which was 25 per cent higher than the control.

Standardization of nutritional requirement for Dendrobium orchid

Among different treatments trial, the plants that received NPK 20:10:10 (as foliar spray) 0.2% has registered the highest plant height (28.82 cm), number of shoots/plant (12.00) , no. of pseudobulbs per plant (5.00), inter nodal length (4.90 cm), shoot diameter (4.96 cm), number of spikes/plant (2.50), spike length (61.50 cm), number of florets per spike (13.50).

270 P

300 DAP

Canopy management and high density planting

Standardization of planting systems, high density and Ultra high density planting

In banana cv. Poovan, planting three suckers at 1.8 × 3.6 m (4630 plants/ha) with 100 per cent fertilizer dose registered the highest estimated yield of 63.10t/ha with the highest benefit cost ratio of 3.13 as against 2.98 in control.

Standardization of training and pruning systems for sustainable and higher productivity

Pruning techniques for the introduced “Red Globe” grape variety was standardized as 5-6 bud level, leaving 50% of the shoots for vegetative growth and remaining 50% of the shoots for reproductive phase. The variety recorded an average bunch weight of 675g and 15-18 kg/vine. The average yield is 25-30 tonnes/ha with a TSS of 16-18 brix. This variety was found amenable to obtain two crops in Tamil Nadu.

Standardization of cropping system

Suitable cropping system under coconut garden

Among the five coconut based commercial flower cropping systems tried Chrysanthemum (*Dendranthema grandiflora*), Tuberose (*Polianthes tuberosa*), Marigold (*Tagetes erecta*), Zinnia (*Zinnia* sp.) and Gomphrena (*Gompherena globosa*), marigold inter cropping had resulted in flower yield of 5,948 kg/ha with a net income of Rs. 2,08,960 / ha and B:C ratio of 2.62 followed by gomphrena (2.49:1 BC ratio).

FOREST COLLEGE AND RESEARCH INSTITUTE METTUPALAYAM

Pre and post breeding evaluation and maintenance of germplasm

Twenty five species viz., *Tectona grandis, Kaya senegalensis, Albizia, Thespesia populnea ,* Eucalyptus spp., Casuarina spp., Melia spp., Bamboos spp., Ailanthus spp., *Populus deltoides, Acacia* spp., *Acrocarpus fraxinifolius Anthocephalus cadamba, Chukrassia tubularis, Dalbergia sissoo, Gmelina arborea, Lannea coromendalica*, *Mitragyna parviflora, Paulownia tomentosa*, *Salix tetrosperma, Toona ciliate, Leucaena leucocephala, Prosopis juliflora, Cassia siamea and Glyricidia sepum* have been assembled in the form of species / provenance / progeny / clone based field gene bank and incorporated in improvement and utilization programme.

Breeding climate resilient genotypes for enhanced wood quality and quantity
A new ligno cellulosic species for paper production

- One new species viz., *Lannea coromandalica* has been found amenable for making quality paper due to its superior wood quality. The species exhibited a bulk density of 0.36 – 0.45 kg/m^3 and found equivalent to *Casuarina* wood.
- The packing density is also found amenable and ranged between 220 and 228 kg/m^3 and found superior to *Eucalyptus* (214 – 224 kg/m^3). The moisture content of the wood is found to be 32-34% and comparable to both *Casuarina* and *Eucalyptus.*
- The industrial pulp yield of this species is 43% at the pulp kappa number of 22.5% and found as an alternate species for pulp and paper industry.
- The species has excellent natural adoption in coastal districts of the state and extend scope for improvement and promotion.

Breeding for plywood quality

- Ten species viz., *Melia (Control), Alstonia, Anthocephalus, Grevia,* Silver oak*, Swietenia, Sterculia, Khaya, Eucalyptus* and *Thespeasia* have been found amenable for plywood utility through physical and mechanical properties.
- The plywood quality of the species have been characterized through seven major properties viz., Density (0.67 – 0.80 g/cm^3), Moisture content (12-15%), Tensile strength (above 700 – 850 kg/cm), bending strength (350 – 450 kg/cm), screw holding (225 – 260 kg), nail holding (above 550 kg) and swelling in water (less than 1%).
- Among ten species, *Anthocephalus, Grevia*, Silver oak, *Swietenia* and *Eucalyptus* proved superior in terms of plywood quality.

Dendro energy species

- *Dalbergia sissoo* and Subabul have been shortlisted as an alternate and amenable dendro energy species due to their energy properties viz., Calorific value (4300 – 4800 KJ), moisture content (12%), volatile matter (60-70%), ash content (1-1.5%), fixed carbon (22%), Ash deformation temperature (1100° c) and Ash fusion temperature (1200° c)

Breeding for high yielding and short rotation clones / progenies
Melia

- A superior clone in *Melia dubia* (FCRI MD 15) has been identified as high yielding variety (60 tonnes) compared to 45-50 tonnes in Melia MTP 1.
- This clone expressed superiority in terms of pulp quality and recorded pulp yield (52.1%), acid insoluble lignin (21.8%), hollocellulose (74.5%), kappa

number (19.6), tear index (10.2 mNm^2g^{-1}), tensile index (87 Nmg^{-1}) and burst index (5.9 K Pa m^2 g^{-1}).

- This clone is amenable for harvest from 18 months onwards due to the wood quality suitability towards pulp recovery.

Subabul

- A new progeny FCLL 15 has been identified as a high yielding short rotation culture and has recorded an yield of 125 tonnes / ha in 30 months through amplified test. This progeny is found suitable both for paper (pulp yield 44-46%, kappa number 22-24%,) and dendro power generation (calorific value 3800 – 4200 Kcal).

Identifying seed production area and seed orchards and standardizing mass multiplication technologies for forestry trees

Micro and Macro propagation

In vitro protocol has been developed for *Melia dubia* using micro shoots from mini clonal garden. The auxillary shoot bud differentiation was achieved in MS medium supplemented with 3-4 mg / l BAP + 0.5 mg/liter kinetin + 1 mg / l IAA. Subsequent sub culturing of induced shoots was done through MS medium supplemented with 2 mg / l each of BAP and kinetin. This sub cultured micro shoots were rooted successfully in MS medium supplemented with 3 mg / l IBA + 0.5 mg / l IAA. The micro propagated plants are established in mini clonal garden infused with 17:17:17 (NPK) fertilizers at 0.1-1 gm per plant periodically. First cutting was collected after 60-75 days. These mini shoots were trimmed and treated with carbendazim 1% to avoid fungal infection. The treated cuttings were treated with 3000 ppm IBA and planted in sterile coir compost. These treated cuttings are housed in mist chamber at 65-70% humidity with an intermittent misting of water once in every 20 minutes. The cuttings rooted to the tune of over 70% and the rooted cuttings are hardened and supplied to various user agencies.

Seed germination in Melia

Seed germination of *Melia dubia* is reported to be very poor (< 5 per cent) highly protracted (germination period extends upto 6 months), sporadic (sudden increase in germination in a particular period) and erratic (does not exhibit any particular trend). Results of the experiments undertakes indicated that break the hard endocarp using a vice to extract the seeds (to overcome mechanical dormancy); soaking the seeds in GA_3 (250 ppm) for 12 h and subjecting to humid invigouration (humigouration) for 2 days followed by drying seeds to original moisture content (to invigourate the seeds). The new treated seeds were sowing in poly houses with high relative humidity (to improve the mobilization of stored seed reserves to germinating embryo) and could yield better results seed germination from 12 percent (control) to 48 per cent in these treated seeds were observed. The remaining 52 per cent seeds succumbed seed rot, probably due to internal seed borne pathogens. Germination period has been reduced from 35 days to 20 days.

Improvement and utilization of tree borne oil seeds for biodiesel

Jatropha

Jatropha CJ 3 (CJH 3) clone has been registered (INGR14006) by plant germplasm committee of ICAR on 31.1.2014. This clone is having special characters viz., high yield, early flowering (125 days) and high oil content (38.01 %). Besides IC number were observed for 10 clones from NBPGR.

Mahua

In order to identify the best genotypes of Mahua seed parameters *viz.,* colour, length, diameter, 100 seed weight, kernel/seed coat ratio and seed germination

percentage were recorded for all the progenies. The seed kernel oil content of the Mahua progenies from ranged 30.0 percent to 52.8 percent. The highest seed kernel oil percentage was recorded from the progeny TNML-12.

Developing profitable agroforestry land use systems

Application of FYM @ 10 kg tree^{-1}+ 200:80:80 kg N,P , K ha^{-1} + *Azospirillum* and *Phosphobacteria* @ 25 g tree^{-1} recorded the highest basal diameter (35.1 cm), tree height (9.22 m) ,pod yield (4236 kg ha^{-1}) and floss yield (1083 kg ha^{-1}) in kapok (*Ceiba pentandra*).

Understanding perennial – annual crop's interaction for enhanced exploitation

To evolve compatible intercrops for *Melia dubia* based silvipasture system, seven fodder crops were tried. Yield and economic analysis revealed that Guinea grass (CO (GG)3) and Cumbu Napier grass (CO (CN)4) could be profitably cultivated under four years old *Melia dubia* plantations.

Developing tree farming strategies for waste lands in Tamil Nadu

Carbon sequestration potential of trees

- Studies were carried out to estimate the net carbon gain from afforested plantation of five different fast growing species, *viz*., *Tectona grandis*, *Gmelina arborea, Dalbergia sissoo*, *Bambusa vulgaris* var. *vulgaris* and *Swietenia macrophylla* in the waste lands of Sivagangai District, Tamil Nadu.
- Among the five afforested tree species, carbon content recorded in *Dalbergia sissoo* was high (43.37%) and contributed more biomass (14970.82 kg ha^{-1}) and biomass carbon (6593.55 kg ha^{-1}).
- Eco-physiological behavior of the tree revealed that *Dalbergia sissoo* and *Bambusa vulgaris* var*. vulgaris* were able to maintain very high ecophysiological activities whenever the environmental conditions are conducive and safe for growth, thus showing their suitability for wasteland afforestation and high carbon sequestration value.

Pollution Abatement of Trees

- Pollution abatement potential of 23 trees was assessed in Coimbatore and Chennai Corporation in terms of their dust capturing efficiency and the levels of nitrogen and sulphur in leaves.
- Dust collection potential was high in *Tectona grandis* at polluted site (0.444 mg/cm^2) crop area to control site (0.095 mg/cm^2). Generally broad-leaved trees with rough surface or pubescence have high dust collection capacity.
- NO_2 absorption potential was high in *Delonix regia* (8.18% polluted site, 6.63% to control site) followed by *Syzygium cumini*, *Cassia siamea, Lannea coromandelica* and *Samanea saman* in heavy traffic areas.
- SO_2 absorption potential was high in *Thespesia populnea* (0.270 mg/g in polluted site, 0.129 mg/g in control site) followed by *Ficus racemosa*, *Ficus religiosa, Mangifera indica* and *Anthocephalus cadamba* in heavy traffic areas.

Post harvest management of pest and diseases

Management of pests in seeds of TBOs

- Food acceptability by the saw-toothed beetle, *Oryzaephilus surinamensis* or the red flour beetle, *Tribolium castaneum* was reduced when stored neem or pungam or mahua seeds were treated with protein-rich pea fraction (Bonneville). At low concentrations, the repellent response was not very high, whereas at 1% concentration, there was a significant increase in the

repellency, suggesting that the protein-rich pea fraction has the potential of repelling insects from treated stored seeds.

- Probe trap studies indicated that a greater percentage of insects were caught in the traps placed in protein-rich pea fraction treated seeds compared to the insects caught in traps placed in untreated and whole-pea flour treated seeds. Repellent activity of protein-rich pea fraction enhanced the trapping efficiency of probe traps.
- Higher percentage of *Oryzaephilus surinamensis* adults were caught in probe trap studies as compared to *Tribolium castaneum* during the same time duration which depicts that *O. surinamensis* was found to be the most sensitive insect, *T. castaneum*, being less sensitive.

Management of wood rotting fungi

The aerial mycelium consists of mostly thin walled branched hyphae with clamp connections. The combination of *Pseudomonas fluorescens* (Pf.1), *Trichoderma viride* (*Tv*.1) and *Bacillus subtilis* (Bs.1) effectively inhibited the growth of pathogen (60.24%) whereas in control, *Ganoderma* spp. covered the plates within 6 days after placing the disc. Tridemorph @ 0.1 % was found to be effective in inhibiting the white rot fungi by 68.64 percent.

HOME SCIENCE COLLEGE AND RESEARCH INSTITUTE
MADURAI

A total nine projects are being operated under the theme areas Food Processing and Value Addition and Nutrition and Health

Evaluation of antioxidant potential of fresh and processed fruits

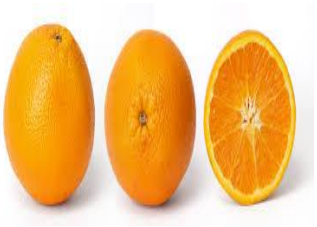
- Amla, pomegranate and sweet orange were selected for processing of fresh juice and squash and the antioxidant components were analyzed.
- Among the fruits, the antioxidant activity of Amla was found to be more when compared to pomegranate and sweet orange fruits.
- The antioxidant components such as ascorbic acid, total poly phenols, total flavonoids, tannins and AAEAA (Ascorbic acid equivalent of antioxidant activity) were higher in fresh amla than the processed products (Table 1).
- The retention of antioxidant components found to be higher in fresh juice followed by squash (Table 2).

Amla

Amla squash

Pomegranate

Pomegranate juice



Sweet orange

Sweet orange juice

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 (Table 3).
- 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 (Table 4).

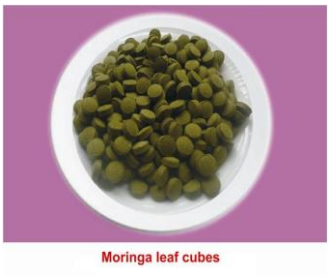
Amaranth Noodles

Amaranth Macroni

Economic empowerment of SC&ST women on processing of *Moringa oleifera* leaves and its products as an income generating activity

- Developed variety of commercially viable value added products viz., moringa leaf cubes, soup mix, rice mix, spiced products etc., 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 B-carotene, calcium, iron and crude fibre (Table 5 & 6).
- The developed technology was transferred through training programmes and six small scale entrepreneurs using these technologies for producing these products commercially are Aboorvaa Food Products, Madurai, Adchaya Products, Madurai, Karpagam Products, Chennai, Rich Masala, Coimbatore, Sri Ranga products, Erode and Iyarkai Unavagam, Madurai.

Standardized value added products



Dissemination of the Technology

Awareness Program

Standardized value added mixes

Development and standardization of value added products from Cocoa

- A maximum yield of cocoa butter was obtained by pressing the cocoa mass using Hydraulic press (45%) than that of the solvent extraction (18%).
- Maximum yield of cocoa powder was obtained from solvent extraction.
- Chocolates prepared by using cocoa bean mass were crunchy and tasty compared to the chocolates prepared by using cocoa butter.
- Incorporation of osmo dried coconut and carrot scrapings (10%) in the chocolate preparation enriched the nutrient content and acceptability of the product.

- Special training on the technology of chocolate making using cocoa bean was offered to the entrepreneur/farmer growing organic cocoa.



Training on value addition of cocoa

Dissemination of improved tapioca production technologies and value addition techniques among SC/ST tapioca growers for their economic upliftment in salem district of tamil nadu

- Impact of the interventions was assessed through Participatory Approaches.
- Socially backward cassava growers gained knowledge and skill (45%) on improved production technologies.
- It was observed that there was an increase in the yield (3.24 t/ac) of tapioca and also there was an increase in the income of the farmers (Rs.9000/-) when compared to the previous year.
- Women growers acquired skill for the production of value added food products from tapioca, which helped them to fetch more family income of Rs. 4020 for every Rs.1000 investment.
- Overall men (76.00%) and women (82.00%) opined that these interventions brought them for the sustainable livelihood security.



Demonstration on Tapioca minisett | **Nursery technologies** | **Training on tapioca value addition**



Hands on training | **Tapioca cutlet preparation** | **Free chipping machine distribution**

Optimization of technology for millet and pulse blended low glycemic functional pasta foods for metabolic disorder

- To develop low glycemic pasta products with the help of modified starch form the millets. (The structure of the starch of the millet flour was modified by autoclaving at a temperature of 121^{o}C for 15 minutes and cooled to a

temperature of 4^{o}C. The low glycemic value of millet flour and modified millet flour was 69.56 and 47.23).

- Optimizing quantity of various flour (wheat flour, millet flour and pulse flour) for the production of pasta and standardized the composite flour based pasta.
- Among them the best composite flour blends were whole wheat flour (50%), modified millet flour (30%), pulse flour (10%), egg albumen (10%) and guar gum (2%) based on the organoleptic evaluation with acceptable score value of 8.8.
- With regard to nutrients, the pasta products developed with the soya flour were found to have higher protein (20 to 21 %) content than horse gram flour incorporated pasta (18 to 19 %) and control (13%). The fibre and total dietary fibre content was maximum in millet and pulse incorporated pasta (4 to 5 and 11 to 13 %) than control pasta (2 to 3 and 8.6 %) (Table 7).
- There was a significant reduction of glycemic index observed in rats fed with millet and pulse based pasta when compared to control pasta. (Initial value - 189.50 to 195.12 and final value - 106.12 to 108.29 mg/dl respectively).
- The low glycemic pasta are of therapeutic products to reduce the occurrence of life style disorder

Development of whole wheat flour and millet flour and pulse flour incorporated low glycemic pasta products

Creation of health and nutritional awareness among school going children

- Assessed the nutritional knowledge on functions of food, nutritional properties of food, nutritional deficiency diseases, food choices and sources of nutrients, maintenance of health of the body and Importance of personal hygiene of school going children (12 years) in the selected schools of nearby villages of HSC&RI by using interview schedule.
- Provided intervention programmes through lecture cum demonstration, film shows, exhibitions about the balanced diet, functional foods, nutritious snack foods, importance of green leafy vegetables, fruit and vegetables in the diet and personal hygiene and health. Post assessment of knowledge gain on nutrition intervention was carried out.
- Post test (after nutrition education) to assess the nutrition knowledge was conducted on children revealed that 63 per cent of the children gained adequate knowledge, 37 per cent of the children gained moderate knowledge on nutrition information (Table 8).
- Nutrition knowledge imparted healthy eating behaviour, maintenance of personal hygiene and improved scholastic performance among the children.

- Nutrition knowledge imparted the healthy practices among children like inclusion of fruits and vegetables in the diet, additional energy-dense, protein-rich food supplement in the diet, Inclusion of vitamin A rich foods, vitamin C rich foods and high fiber foods in the diet, usage of boiled water for drinking, washing hands before taking foods and performance of physical activity
- Nutrition intervention had a positive impact upon the school going children.
- Dietary diversification through nutrition education on long term basis may possibly reduce nutritional deficiency diseases, communicable diseases and degenerative diseases.


Nutrition Education Programme

Study on the dietary antioxidant consumption among the adults and the effect of cooking and processing on the activity of antioxidants

- Survey completed in 340 households of urban and rural areas.
- Commonly consumed vegetables in the selected area were manathakkali leaves, mint, beet root, carrot, bitter gourd and tomato.
- Common cooking methods employed at household level were boiling, pressure cooking and stir frying. Extended time of cooking applied for various household processing methods brought about reduction in the antioxidant compounds. Hence antioxidant content and activity were analyzed in selected commonly consumed foods and its retention on different methods of cooking adopted at village level were studied at laboratory level.
- Of the selected vegetables fresh mint and manathakkali leaves showed highest antioxidant activity both in DPPH (301.2 mg AAEAA and 196.8 mg AAEAA respectively) and FRAP assay (169.7 mg AAEAA and 120.9 mg AAEAA respectively).
- Among the cooking methods stir frying of vegetables retained maximum total polyphenols (0.5 to 3 times), total flavonoids (3 to 6 times) tannins (2 to 4 times) and antioxidant activity particularly in greens (264.7 mg AAEAA and 420.6 mg AAEAA in manathakkali and mint leaves in FRAP assay respectively compared to fresh samples.)**.**


Household survey

Vegetables selected for the study

Processed vegetable products

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 23.2, 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).

Kavuni rice and its products

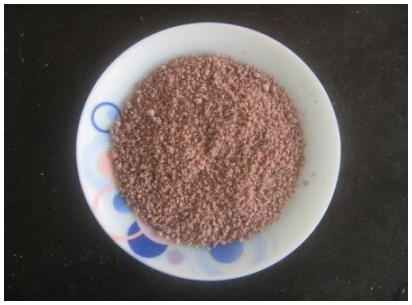



Table 1. Antioxidant components in fresh fruits and processed products

Products	Ascorbic acid (mg/100g)	Total Carotenoids (mg/100g)	Total Polyphenols (mg/100g)	Total Flavonoids (mg/100g)	Tannins (mg/100g)
Amla juice	456.17	0.503	2207.04	268.41	1815.20
Amla squash	313.58	0.348	1772.16	171.59	1545.28
Pomegranate juice	24.21	0.218	148.61	209.83	1620.45
Pomegranate squash	9.05	0.126	90.65	110.12	385.66
Sweet orange juice	102.20	0.256	128.47	64.20	386.76
Sweet orange squash	35.40	0.157	69.73	31.17	102.48

Table 2. Per cent retention of antioxidant components in fresh fruits and processed products

Products	Ascorbic acid	Total Polyphenols	Total flavonoids	Tannins	Antioxidant activity
Amla juice	86.59	76.00	72.65	84.80	86.45
Amla squash	39.17	64.10	57.59	24.70	55.23
Pomegranate juice	80.70	86.85	84.80	85.00	87.58
Pomegranate squash	30.17	62.97	54.39	20.23	44.89
Sweet orange juice	84.23	75.28	78.85	76.45	85.12
Sweet orange squash	29.18	40.86	68.28	22.91	51.86

Table 3. Organoleptic characteristics of Products standardized using composite flour based pasta

Samples	Appearance	Colour	Flavour	Texture	Taste	Acceptance
Amaranth flour + Rice flour (50:50)	7.0	7.0	7.5	6.8	7.0	7.5
Amaranth flour + Corn flour (60:40)	8.5	8.2	8.0	8.5	8.0	8.0
Amaranth flour + Tapiaco flour (50:50)	7.8	7.0	7.5	7.8	7.0	7.8
Amaranth flour + Potato flour (50:50)	8.0	7.8	8.0	7.8	7.5	8.0

Table 4. Nutrient composition of refined wheat flour, refined wheat pasta, amaranth flour and amaranth pasta

Nutrients	Refined wheat flour	Amaranth flour	Corn flour	Refined Wheat pasta	Amaranth & corn pasta
Moisture (g)	12.2	10.2	12.4	5.6	5.2
Protein (g)	10.1	15.6	9.8	8.0	15.8
Energy (Kcal)	341	315	319	342	312
Calcium (mg)	48	190.7	9.7	42.5	185
Iron (mg)	4.9	13.9	1.6	4.5	13.0
Fiber (g)	1.9	6.2	1.7	3.0	5.1
Magnesium (mg)	132	220	119	100	212
Manganese (mg)	2.29	6.3	0.3	3.2	5.8

Table 5. Nutrient content of fresh and dried moringa leaves

Nutrients	Fresh leaves	Shade drying
Moisture (%)	75	5.0
Protein (g)	6.9	17
Fat (g)	1.5	3.8
Crude fibre (g)	0.8	3.8
β- carotene (mg)	14.31	8.62
Vitamin- C (mg)	205	120
Ash (g)	2.8	3.0
Calcium (mg)	335	966
Phosphorus (mg)	70	210
Iron (mg)	1.9	2.6
Copper (ppm)	0.07	23.2
Magnesium (mg)	42	345
Potassium (mg)	259	101
Sulphur (mg)	1081.8	716
Zinc (mg)	0.16	256.4

Table6. Nutrient content of processed moringa products

Products	Per cent incorporation of moringa leaf powder	Moisture (g)	Fibre (g)	Beta carotene (µg)
Moringa leaf spiced chappathi mix	5	6.3	3.2	7398
Ready to use soup mix	5	6.0	4.6	3337
Moringa leaf versatile food mix	10	5.5	3.5	6358
Nutri rice mix	25	5.8	2.9	5108
Moringa leaf cubes	75	3.75	5	14716

Table 7. Nutrient composition of whole wheat flour pasta and millet pulse blended pasta

Nutrients	Whole wheat flour pasta	Kodo millet + pearl millet + soya flour pasta	Little millet + pearl millet + soya flour pasta
Moisture (g)	5.48	5.66	5.51
Protein (g)	13.42	20.72	20.90
Fat (g)	1.31	3.05	3.50
Fibre (g)	2.81	4.88	4.34
Carbohydrate (g)	60.98	50.62	50.75
Dietary fibre (g)	8.59	11.80	13.33
Calcium (mg)	51.70	150.76	150.38
Iron (mg)	5.86	6.75	7.82

Table 8. Pre and post test of nutrition knowledge

Tests	Control group n=100		Experimental group n=100	
	Adequate (%)	**Inadequate (%)**	**Adequate (%)**	**Inadequate (%)**
Pre test on nutrition knowledge	22	78	18	82
	Adequate (%)	**Moderate (%)**	**Adequate (%)**	**Moderate(%)**
Post test on nutrition knowledge	29	71	63	37
Impact on adoption	24	76	76	24

AGRICULTURAL ENGINEERING

Agricultural Machinery Research Centre

Mechanization of oilseed crops

Groundnut is an important oilseed crop of rain-fed areas. India is the second largest producer of groundnut after China. On an average it accounts for 31.81 per cent of the oilseeds. The annual production of seed groundnut and groundnut oil are 5.8 and 1.5 million tonnes, respectively. Around 75 per cent of the crop is produced in kharif season (June- September) and remaining 25 percent in rabi season (November-March). In India Gujarat is the largest producer contributing 40.80 per cent of the total production, followed by Andhra Pradesh (17.68 per cent), Tamil Nadu (10.90 per cent), Karnataka (12.64 per cent) and Maharashtra (5.51 per cent) during 2010-11.

Tractor operated machines reduce the labour scarcity and drudgery and results in enhanced quality of work with comfort. Introducing matching implements with the various power sources like power tillers and tractors. Enhancement of productivity through mechanization.

In the year 2010-11, groundnut occupied an area of 5.86 M ha in India with a production 8.26 mt. In Tamil Nadu, groundnut is cultivated in an area of 0.39 M ha with a production of 0.90 mt of pods. The average pod yield is 23087 kg ha^{-1}. Tamil Nadu alone accounts for 6.66 and 10.90 per cent of the area and production of groundnut respectively in India (2010-11). Over four decades since 1956-57, there is 46.50 per cent increase in area and 52.50 per cent increase in production in groundnut cultivation. Of the total area grown under groundnut, the irrigated rabi groundnut occupies 27.40 per cent.

The sowing, weeding, harvesting and threshing operations are done manually. Manual harvesting is labour intensive and time consuming. This was one of the main bottlenecks for increasing acreage and productivity.

Tractor drawn cultivator mounted seed drill, tractor/ powertiller operated harvester, stripper were developed for groundnut and being popularized among the farming community through different sister organizations and departments.

To improve the effectiveness of harvesting of oilseed crops over the present methods through mechanization is the need of the hour. The development of self propelled combine harvester for groundnut is under research. Now the challenge is to improve the existing methodology of intercultural operations with respect to narrow row spacing, Hence, development of a proper self propelled weeder that could be operated between the narrow row spacing of 30cm is proposed.

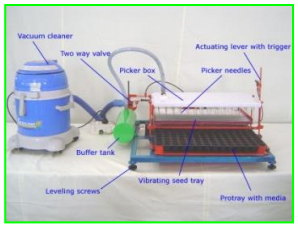
Mechanization of horticultural crops

Horticultural crop constitute a significant component of total agricultural production in India. The horticultural crops put together covered nearly 11.6 million hectares with a total production of 91 million tonnes. Although horticultural crops covered 6.7 per cent of the gross cropped area in a year, yet they contributed more than 18 per cent of the gross values of agricultural output. Similarly their contribution to the total agricultural export is substantial (52 %). The cropped area under orchard in India being about 3 per cent and it shares about 14 percent of total pesticides consumption. The area under orchard crops is growing tremendously, owing to higher cost requirement in field crops and non-availability of labour.

Enhancement of horticulture production through mechanization

The necessity of mechanizing vegetable crops increased during the recent years and the need will become more acute in future as the cost of labour increases and the availability of good labour decreases. Farmers raising horticultural crops must mechanize or else turn to other crops that have already become mechanized and thus require a minimum labour for their production.

Along with the forced use of machines is the necessity for changes in cultural practices such as seed bed preparation and crop geometry.



The tractor operated spading machine, subsoil coirpith applicator, manually operated protray seeder and automatic protray seeder, semi automatic vegetable transplanter, power weeder, coconut tree climber, aerial access hoist for plantation crops and rotary slasher cum in situ shredder were some of the machinery developed and perculating among the farming community through various extension agencies.

In addition to this attempts were made to develop a suitable harvesting machine for cassava and planting machinery for turmeric rhizomes.

Event though these machineries were available, the felt need of the farmers are like detopping of cassava crops at the time of harvesting which promotes the usage of cassava harvester. Moreover inter cultivation machines are being developed as matching machinery for the tractors available with an intension to operate the tractor in the spacing without affecting the standing crops.

Modifications of the crop geometry with out losing the recommended plant population is also taken into account for the development of new machinery.

Dept. of Bioenergy

Biodigested slurry value added to supplement organic agriculture
Researchers value add bio-digestate to evade disposal and to enhance income

TNAU caters the necessities of agro-based industries and in that way IOT-Mabagas Limited, Namakkal had a pilot scale floating type digester of 100 kg capacity and the biogas production optimized with the varying composition of feedstock mixture and stirrer on /off timings and adequate volume of the digestate.

Organic matter content of TN soils declined from 1.26% (1980s) to 0.68% (2010-2011)

The solid and liquid parts of the digestate were value added as plausible organic source of nutrients. The 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 manure 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.

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 tha^{-1}) than application of 12.5 t ha-1 farm yard manure.

Bhendi: maximum plant height (112.50±1.11 cm) and highest pod yield (19.55±0.27 t ha^{-1}).

Turmeric: maximum plant height (57.47±0.23 cm) and rhizome yield (32.24±6.77 t ha^{-1}).

Banana: bunch yield (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} amended the biometric and yield parameters.

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).

Bhendi: 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

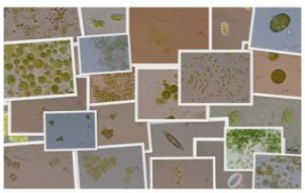
yield when applied in the proper dilution; saves a huge amount of money spent on commercial fertilizers by the farmers. The real goodness is quality boost of crops like greenness in bhendi and turmeric curcuminand tomato lycopene. Hence the organic biodigestateapplication in agricultural fields could benefit the farmers in water, nutrient and cost saving.

Algae as a Sustainable in Indian scenario

Researchers validated an indigenous microalgal strain under small scale open raceways for biofuel production

Algal biofuels continue to be a topic of great possibility and great controversy. While viewed as one of the most promising next generation sustainable biofuels, algae have garnered a good deal of criticism as well when comprehensive analyses are undertaken to understand potential environmental and economic impacts. Though proof of concept exists for algal biofuel production it is not yet economical owing to cost and energy intensive production pathway. Hence, algal cultivation systems were validated under Indian conditions to commercialization of algal fuels.

Water-deficit India can barely meets it agricultural needs. Producing a kg of algal oil require 5,000 L of water.



The project was undertaken bioprospecting of fresh and marine water samples of Tamil Nadu including the sacred aquatic bodies. 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 CO_2 levels were tested on microalgal isolates and biomass was estimated. The Chlorophyceae, *Tetradesmuswis consinens is* showed optimal nutrient requirement as dextrose (20 mM) or Sodium bicarbonate (40 mM); 30 mM N as $NaNO_3$/ $(NH_4)_2Cl$; 20-30 mM P as K_2HPO_4. 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.

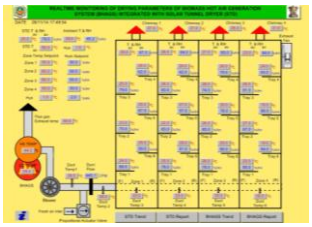
Under a collaborative project with BPCL, mixotrophic growth of *Tetradesmus*with petroleum refinery wastewater in open raceways was established. The refinery wastewater characterized as pH 7.1, EC 880 µs/cm, TDS 508 mg/L, phenol concentration 0.16 mg/L, oil and grease 0.204 mg/L, TSS 12 mg/L, iron 0.363 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 m^2 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.

Solar biomass integrated drying system
A continuous drying system to facilitate uniform drying and improve quality of the dried product

The automatically controlled solar - biomass integrated drying system consists of solar tunnel dryer and biomass hot air generation system for maintaining the temperature and relative humidity throughout the drying period. The solar tunnel dryer is used for drying during sunshine hours and biomass hot air generation system is used for drying during off-sunshine hours. This can be used for drying of coconut, chilli, medicinal herbs, fruits and vegetables. The integrated drying system facilitated uniform hot air flow and well suited for continuous drying application with improved quality of produce.

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) for natural rubber drying
A continuous rubber drying with PCM based energy storage system

In traditional natural rubber drying process, heat is generated from direct combustion with rubber wood as fuel in smoke house. In order to achieve uniform heat distribution, to reduce heat loss and to reduce fuel wood consumption the integrated drying system is introduced. The SHAGS consists of solar flat plate collector (1.5 * 0.75 m) and Phase Change Material (PCM) based shell and tube type heat exchanger (0.74*0.47*0.47m) for energy storage. Solar collector consist of four parts, transparent cover (3 mm poly carbonate sheet) to increase the transmittance, absorber material (1 mm perforated aluminum sheet with black coated) to improve the absorbtivity, insulation (glass wool) to reduce the convective heat loss in the solar collectorhot air. Paraffin wax is used as PCM with the melting point of 60°C. As the solar heat source rises the temperature of the collector during sunshine hours upto 60 ^{o}C and PCM breaks up the material changes phase from solid to liquid. The phase change is a endothermic process and therefore, the PCM absorbs heat. The material begins to melt when the PCM reaches melting point. PCM release the heat by exothermic process and phase change occur. The amount of heat stored is usable during off-sun shine hours for drying process. Also biomass stove was introduced as supplementary heat source with SHAGS during off-sun shine and rainy hours. Temperature, RH, air velocity, were measured with sensors and atmospheric parameters and automatic weather station.

Experimatal setup of SHAGS and biomass gas stove integrated with Farmers' Smoke House (2*1*1m) made at Elevampadam Rubber Producers Soceity, 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.

Department of Food and Agricultural Process Engineering

Post harvest practices of onion

Aggregatum onion is produced only in southern states of India i.e. Tamilnadu, Andhrapradesh and Karnataka. Important post harvest operations employed in small onion are threshing, curing and storage. The existing post harvest operations are tedious, time consuming and also leads to quality and quantity loss. By adopting the improved post harvest practices, these losses can be minimized. Some of the research works carried out were highlighted below.

Materials and methodologies

Onion umbel thresher was developed which works on the principle of impact force of pegs in pre thresher, which detaches florets from umbel heads.

Rubbing and impact forces of rasp bars in thresher separate seeds from the florets. The blower cleans the seeds from the light weight trashes. The capacity of the thresher was found to be 100 Kg/h. The developed thresher resulted in less seed damage of 2 %, germination percentage of 87 and high vigor index.

Threshing Efficiency = 95%
Time saving = 97%
Cost saving = 91%
Cost of the machine = Rs. 1, 00,000/-

The major losses of 30-40% (sprouting, rotting and physiological loss in weight) of onion bulbs occur during its post-harvest storage. Curing removes excess moisture from the outer layers and provides a surface barrier to water loss and microbial infection. Lack of adequate storage facilities and high price fluctuations are recognized as the most important constraints. The losses occurred in the conventional storage structures were due to improper ventilation at the bottom. Development of a ventilated storage structure for onion is crucial and the research work in this direction is in progress. Towards maintaining onion bulbs at longer shelf life and allow them amenable for transport and marketing with minimum losses, a grader for onion, a storage structure with forced air ventilation system and controlled atmospheric storage are being researched upon.

Emerging areas in food processing

Various methods of food preservation techniques such as sun drying, pickling, and fermentation which have been supplemented with more energy consuming techniques such as refrigeration, freezing and canning. Each of these methods has its merits and limitations. Man has always been on the search for newer methods to preserve foods with least change in sensory qualities. Emerging technologies in food processing includes ohmic heating, microencapsulation, ozone preservation, high pressure processing, pulsed electric field, preservation by UV rays, etc. Some of the research works carried out were highlighted below.

Microencapsulation-A micro level packaging technology

Microencapsulation is a technology for packaging solid or liquid materials in a form that can release the contents at controlled rates under specific conditions. Curcumin from turmeric shows low solubility under acid and neutral condition which limits its bioavailability and clinical efficacy, high decomposition in alkaline condition, oxidation in the presence of oxygen and photo degradation in organic and aqueous solutions.

Microcapsules prepared with gum arabic and spray dried at the inlet air temperature of 175°C showed the best quality characteristics

Encapsulation could protect turmeric oleoresin from external environment and improve the solubility and bioavailability of curcumin and also helps in releasing the contents at controlled rates under specific conditions. Further research is progressing on microencapsulation of other products.

Ohmic heating – A novel Approach

Ohmic heating is yet another emerging area in which high temperatures can be attained in a fraction of second. During pasteurization, protein fractions in the egg white undergo denaturation and theses adverse changes make the eggs unsuitable for use as an ingredient in food products such as cake, bread etc. In order to overcome these undesirable changes, egg white should be subjected to high temperature as fast as possible.

Ohmically heated egg at 20 V/cm (4 min) gave the maximum foaming capacity, foaming stability and foam overrun. Lower values of hardness and higher values of cohesiveness and springiness were observed in the gels made from ohmically heated egg white. The overall acceptability of the cakes prepared from ohmically heated liquid egg white at 20 V/cm was found to be good. An attempt to pasteurize the papaya pulp by means of ohmic heating resulted in a pulp of higher quality.

Voltage gradient of 13.33 V/cm with a holding time of 2 minute was the best treatment combination

A continuous ohmic heating process facility is in progress. The institute plans to explore the following areas namely, the usage of ozone in food grain storage and preservation of food by Pulsed electric field.

Post Harvest Technology Centre

Processing and value addition of small millets

India is facing widespread malnutrition and related food insecurity issues. Among the children under age of five years stunted growth and under weight has been recorded and on the other hand chronic and non communicable diseases are on the increase. Small millets are one of the important food groups that had been moved out of the Indian food basket in recent times. Small millets include the finger millet, kodomillet, little millet, foxtail millet, proso millet and barnyard millet. All small millets are rich in dietary fibre and have a low glycemic index apart from providing various micro nutrient complexes. Hence they are known as both preventive and curative foods.

Efficient dehulling for small millets
Millet based food receipts

Extensive dehulling studies were done on millets too assess the efficiency of dehulling with available machines. Since the dehulling efficiency was around 50% only, a double chambered centrifugal dehuller was developed, which is under intensive testing. Small millets based value added products including traditional recipes, bakery products, pasta products, flaked and popped products, instant food mixes were developed. The level of incorporation of small millets in these foods were standardized. Trials were made from 10 to 100 per cent incorporation in preparation of these foods and the suitable level of incorporation was standardized by analyzing the nutritional and sensory quality of these products.

Traditional foods prepared with 100 per cent millet flour are Idli, Dosa, Paniyaram,Idiappam, Rotti, Pittu, Upma, Adai, Porridge, Khakra, and Chappathi Sweets like Halwa, sweat kolukattai, Adhirasam, Kesari, Nutritious ball and Kheer and snacks Snacks like Vadai, Pakoda, Ribbon pakoda, Omapodi, Murukku, Thattu vadai, Hot kolukattai and Vadagam. This indicated that millets can be replaced with cereals and pulses in all traditional foods with no compromise in the quality apart from being nutria rich.Small millets were incorporated in different variations from 10% to 50 % levels for the development of bread, cake, cookies, soup sticks and khari replacing refined wheat flour. Pasta products were also developed such as vermicelli, noodles and macaroni and the standardized level of incorporation was 30 per cent. The products had comparatively higher levels of calcium and iron compared to the conventional pasta products.

Precision Farming Development Centre

Plastic mulching and drip fertigation in vegetable crops

Plasticulture techniques such as drip irrigation and plastic film mulch have undoubtedly contributed to increase the productivity of agricultural and horticultural crops in many regions of the world. In India, Drip irrigation cum plastic film mulch in vegetable crops has shown promise for increasing productivity. Drip irrigation is an effective tool for conserving water resources and studies have revealed significant water saving ranging between 40% and 70% by drip irrigation compared with surface irrigation. Fertigation is practiced in several parts of the world in horticultural crops. Drip fertigation increases the efficiency of the applied fertilizers thus economizing the quality of fertilizers and water, and cost of labour and energy resulting in reduced cost of cultivation. The conservation of soil moisture by plastic mulch may help in preventing the loss of water through evaporation from the soil facilitating maximum utilization of moisture by the plants.

Field experiments were conducted in PFDC field to evaluate the effect of drip fertigation and mulching in tomato and chilli. The different levels of drip irrigation and plastic mulching significantly influenced the plant growth and yield parameters of tomato and chilli. The response of Tomato F1 hybrid and chilli on black plastic mulch with drip fertigation were found to have higher moisture conservation, high yield, maximum water use efficiency, maximum fertilizer use efficiency and higher weed control. Among the all mulching and fertigation treatments, the best performance in terms of growth, yield and quality were observed in 25 micron thickness mulching treatment with 120% RDF drip fertigation.

Black plastic mulching stimulated the plant growth results enhancing yield attributes and higher fruit yield of both crops. Black plastic Mulching produced maximum yield attributes compared to no mulching. This increase in the yield attributes was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface. This study recommends black plastic mulch of 25 micron thickness along with fertigation @ 120% RDF to get maximum yield in tomato and chilli. Studies on the adoptability of drip fertigation and plastic mulching in vegetables as bhendi, grafted brinjal and bitter gourd in open field condition and capsicum under protected cultivation is in progress.

NEED FOR RESEARCH PRIORITY SETTING, MONITORING AND EVALUATION

Research priority setting in-terms of crops and constraints is very essential for the following reasons.

- Science based solutions and options needed to address the present and emerging problems and challenges.
- It involves large financial resources and scientific manpower.
- Demand for public funds is increasing manifold for new development needs. With the available resources, R&D system has to address many and often conflicting goals.
- This necessitates allocation of resources very carefully based on well informed criterion and need and is utilized in the best way.
- Use of public funds also demands greater transparency and accountability.
- This implies need for resource allocation and monitoring criteria which can clearly establish link between programme and developmental goals. PME mechanism helps to meet this objective.

The CGIAR's Science Council and FAO's System Priorities are the following:

- Conservation and characterization of genetic resources
- Genetic improvement of specific traits
- Better management and use of forests and forest landscapes
- Declining world water availability per capita (It is projected to shrink by one-third from 2000 to 2050) needing improved water management and use in agriculture.
- Change puts additional pressure on natural resources and food security through higher and more volatile temperatures, changes in precipitation patterns, and increased occurrences of droughts and floods needing attention.
- Better soil and land management and their use
- Improved production and processing systems for high-value commodities
- Value addition through post-harvest management and processing
- Markets and marketing and enterprise development; linking farmers to markets (commodity and value chains) including related policy issues for increased income
- Information communication technology, knowledge management and exchange, development of information, communication tools and techniques
- Production and use of biofuel from agriculture

However, the priorities may vary depending on local condition and stages of development of the resources and the Economy at large.

Important criteria for Priority setting in Agricultural research

Two most important criteria for priority setting in agricultural research are:

- economic importance (Efficiency): This starting point checks for congruence or parity of value of production and research expenditures across commodities
- potential to reduce absolute poverty (Equity).

The others are:

- Sustainability
- Food self-sufficiency and food security
- Foreign exchange earning potential/ saving
- Public good

The Modified Congruence Model for Priority Setting

Criteria	Efficiency	Equity	Foreign Exchange
Extensity parameter	Value of produce	Area covered	Export
Weighting Scheme	45	45	10
	40	50	10
	40	40	20

Priority ranking based on the Initial Base Line

Irrigated crops	Rain fed crops
1. Rice	1. Ground nut
2. Coconut	2. Other cereals
3. Banana	3. Pulses
4. Sugarcane	4. Cotton
5. Other vegetables	5. Tea
6. Turmeric	6. Tapioca
	7. Mango
	8. Maize
	9. Other Fruits
	10. Other Spices
	11. Other Oil seeds

ICAR (NAARM) suggested criteria for Priority Setting, Monitoring and Evaluation

I. Criteria for Priority Setting (rather evaluation of research proposal submitted?)

1. Relevance of research question
2. Addressing priority of the Institute and/or National-ICAR vision),Institutional-Institute vision)
3. New innovativeness expected in the study
4. Appropriateness of design/ techniques for the questions to be answered
5. Elements of bias addressed in the study
6. Extent of system review and meta-analysis
7. Effective control to experiments
8. Economic evaluation and cost efficiency analysis
9. How appropriately the expected output answers the questions being addressed in the specific subject matter/area(Basic/Applied/Translational/Others)?

II. Criteria for Monitoring during Review Meetings

1. Activities planned
2. Data collection/ Documentation
3. Publications: Research Papers (Peer Reviewed Journals), Reports / Manuals Working and Concept Papers, Popular Articles, Books / Book Chapters, Extension bulletins
4. Process/products/ produce / technology / technique / software / knowledge developed / refined/ evolved
5. Questions answered
6. Trainings / Demonstrations organized
7. Trainings attended
8. Workshops, seminars, symposia, conferences attended/ presented

III. Criteria for evaluation of research projects after completion

1. Achievements against approved and stipulated outputs under the project
2. Publications/ awards
3. Additional facilities created and maintained

4. Human resource development
5. Training imparted
6. Team work
7. Revenue generated under the project/avenues created for revenue generation
8. Product / Process / Technology / IPR / Commercial value of the technology developed
9. Quality of available documents of the project duly authenticated
10. Budget utilization
11. Timeliness of the execution of the project

These criteria are evaluated on a 10 point scale to arrive at a final score as regards suitability of the project or the satisfactory level of progress and quantum of impact. These criteria suggested by NAARM are presented for discussions in the forum.

NEW ACTIVITIES UNDERTAKEN

a. Release of varieties and agricultural implements 2015

A total of nine releases comprising of seven varieties / hybrids (six in agricultural crops, one in horticultural crop) and two agricultural implements proposed by the University Variety / Technology Release Screening Committee (UTRSC) for consideration and approval by the 45th State Variety Release Committee for State Release were approved. These technologies were released in the Southern Regional Agriculture Fair and Farmers' Day 2015 held during Jan. 6-9, 2015.

Sl.No.	Varieties / hybrids / agrl. implements
1.	Rice TKM 13
2.	Rice CR 1009 Sub 1
3.	Rice MDU 6
4.	Sorghum K 12
5.	Wheat CO W 3
6.	Cluster bean MDU 1
7.	Coconut hybrid VPM 5
8.	Tractor drawn turmeric rhizome planter
9.	Hydraulic brake for two wheel tractor trailer system

b. **Newer initiatives taken in Directorates / Colleges / Research Stations / Departments**

Water Technology Centre

- World Water Day 2014 : The World Water Day 2014 was celebrated at WTC on 21.3.2014 by way of organising special lectures on water management.
- Prof. R.K.Sivanappan Endowment Lecture: A special lecture on "Water Security–Issues–Challenges and Solutions" by Dr.E.J.James, Distinguished Professor of Karunya University was organised for the Endowment Lecture on 16.9.2014
- Tamil Nadu Water Week 2014 : In order to commemorate the importance of water, the TN Water Week 2014 was organised under the theme" Water management for Sustainable Development" at TNAU in collaboration with the Dhan foundation, MIDS and CWR, Anna University during 8-12, Dec 2014.
- Community College: Under MoU for providing technical support to the Central University of Tamil Nadu, the first batch of 34 rural youth were graduated for the certificate course on Water Management offered by WTC at Tiruvarur under Community Colleges. The second batch of students have been admitted for the certificate course. The MoU will continue up to 2016.
- Sir C.V.Raman fellowship for Indo African research collaboration: Mr.Isaya Vincent Sijali, Irrigation Engineer form Nairobi was hosted for a visiting scientist fellowship from 27.11.2013 to 28.2.2014.

Hort. College & Research Institute, Coimbatore

- International Horti Intex 2014, a mega show was conducted from 7th to 9th November, 2014 at at CODISSIA Trade Fair Complex, Coimbatore to show case the Horticultural wealth to the farmers of Tamil Nadu and other states. The Hon'ble Minister of Agriculture Th. S.S. Krishnamurthy inaugurated the International Horti Intex. Besides, 6th Indian Horticulture Congress-2014 holding the theme on 'Horticulture for Inclusive Growth' was also organized by the Horticultural Society of

India (HSI), New Delhi in collaboration with TNAU during the same period.

Open Distance Learning

- Works are initiated for launching MBA (Rural Banking and Agricultural Finance Management) programme with the approval of Academic Council. (120th AC Meeting)
- Approval is obtained for launching M. F.Tech programme for those who have completed B.F.Tech programme (123rd AC Meeting).
- Certificate programmes on Gardening and Landscaping and Mushroom Production are offered to school students of Cambridge Matriculation School, Cheyur, Avinashi.

Agri. Business Development

Sl.No.	Company name	Technology commercialized	MoU signed on
1.	Arunai Agro Technology, Thiruvannamalai	TNAU-Herbal Insect Repellant	23.1.2014
2.	M/s Rasi Seeds Pvt. Ltd., Attur, Salem Dist.	Rice Hybrid CORH 3	3.2.2014
3.	S2 Associates, Guwahati	Insect Management Kit	19.2.2214
4.	Kushboo Enterprises, Guwahati		
5.	M/s Metahelix Life Seciences Pvt. Ltd., Bangalore	Rice Hybrid CORH 3	12.6.2014
6.	Bhuvi Care P. Ltd., Tirunelveli	TNAU-Insect Management Kit	10.12.2014

AEC&RI, Kumulur

- A proposal has been submitted to Govt. of India under NMCET for establishment of Farm Implements Testing Centre at a cost of Rs.1.5 crores. The proposal has approved by Govt. of India and GO is awaited from Tamil Nadu State Government.
- An Agricultural Skill Development Centre at a cost of Rs.20.00 crores is approved in the forum of Tamil Nadu State Assembly for which the following initiatives were made to get the funds from different resources.
  - A proposal with Rs.9.00 crores for Infrastructure Development was submitted to the State Government.
  - Another proposal for Machinaries / Implements with Rs.7.5 Crores was submitted for NADP.

FC&RI, Mettupalayam

Establishment of Consortium of Industrial Agroforestry (CIAF)

- For the promotion and development of Industrial Agroforestry for productivity and profitability improvement and promotion of research in Forestry, Agroforestry and the associated value chain activities through multi-stake holder partnership, “Consortium of Industrial Agroforestry (CIAF)” is established in the Department of Tree Breeding to benefit the farmers, wood based industries, research organization, rural industries, nursery growers, felling and marketing group, NGOs, financial institutions and members of men and women self help groups. As on date, 12 wood based industries, 15 farmers, self-help groups, NGOs, 8 small and medium scale nurseries and 14 scientists enrolled as members of the consortium.

CSRC, Ramnad

Spiral separator for winnowing round type grains

- Grain spiral separator was demonstrated in Peraiyur & Perunali villages of kamuthi block in Ramanathapuram district. Winnowing of seeds after threshing on road side is a common phenomenon in Ramanathapuram District. The drudgery involved is tedious and the farmer has to spend the whole day waiting for the breeze which is very rare during the summer.
- The spiral separator is a simplified unit / implement which does not need electricity, wind and is easily portable which is specifically suited for round type grains (blackgram, greengram, redgram, sorghum, soybean, groundnut etc.,). It has a capacity to winnow 300 kg of seeds per hour utilizing gravitational and centrifugal forces which are readily available.
- The spiral separator unit was demonstrated at "Southern Regional Agricultural Fair and State Level Farmers' Day 2015" held at TNAU, Coimbatore during 7th 9th Jan'2015 and Golden Jubilee Special Regional Mela'2015 held at AC & RI, Madurai on 23rd-25th Jan'2015 where nearly 3000 farmers were updated of this simple drudgery free winnowing technology.

CRS, Veppankulam

- "World coconut day" celebration was conducted at Mannankadu on 02.09.2014. A total of 100 coconut farmers attended and benefited.
- One day seminar on "Coconut Production Technologies" was conducted on 11.09.2014 at CRS, Veppankualm. A total of 1500 coconut farmers from five districts *viz.,* Thanjavur, Thiruvarur, Pudukkottai, Ramanad and Nagapattinam attended and benefitted.

HRS, Kodaikanal

- On evaluation of low and medium chilling varieties of apple collected from CITH, Srinagar, the variety Mayan, Vesta Bella and Mollies Delicious performed well with reference to morphological, flower initiation and fruit set under Kodaikanal conditions.
- Among the eight almond varieties evaluated, the varieties Merced and IXL exhibited flowering and fruit set under low chilling conditions.
- Evaluation of the walnut varieties (CITH –1 to CITH -10) revealed that varieties CITH-1 and CITH-5 performed best in terms of growth parameters, flower initiation and nut formation.
- Saffron bulbs were introduced for evaluation under Kodaikanal conditions..

HRS, Ooty

All India Coordinated Research Project on Floriculture was shifted from Horticultural Research Station, Yercaud to Horticultural Research Station, Ooty along with three posts and budget and is in operation since 1.4.2014. In this project, the following new activities were initiated.

- Collection, evaluation and maintenance of Orchid, *Lillium, Alstroemeria*, Carnation and Gerbera germplasm
- Staggered planting of carnation for extending flower availability in carnation
- Standardization of propagation technology for Lillium
- Standardization of growing medium for *Lillium* and *Alstroemeria*

Dept. of Rice

- Development of climate resilient rice varieties resistant to drought, salinity and submergence through molecular breeding

- Improvement of Swarna sub 1 and ASD 16 for total carotenoid content through molecular breeding
- Improvement of fine grain rice varieties like Paiyur 1 for blast resistance through molecular breeding

Dept. of SS&AC

- A Monograph on GPS and GIS based soil fertility appraisal for selected districts of Tamil Nadu" was released by the Agricultural Production Commissioner and Director of Agriculture, Tamil Nadu on 4.3.2014.
- To commemorate the Worl Soil Day on 5th December, the 3rd Dr.B.Ramamoorthy Memorial Lecture was organized by Coimbatore Chapter of Indian Society of Soil Science at Golden Jubilee Hall in the Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore. The renowned soil scientist Dr.S.Natarajan, Vice-Chancellor, Gandhigram Rural Institute, Dindigul and Former Director, Centre for Soil and Crop Management Studies, Tamil Nadu Agricultural University, Coimbatore delivered the memorial lecture entitled "Soil Resource Data Base-basis for soil testing and fertilizer recommendations" which is highly warranted for the rational fertilizer application and sustainable soil health in the country.

Dept. of Plant Pathology

- Exploiting lipopeptide producing strains of *Bacillus subtilis* with genetic competence for the management of soil borne diseases of pigeonpea and chickpea
- Bio-Priming of Banana tissues culture plantlets with PGPR endophytes for enhanced resistance to rhizome rot of banana caused by *Erwinia carotovora pv.carotovora*
- Development of isotonic aqueous formulation of *Chaetomium globosum* for the management of foliar and soil borne diseases of potato
- Liquid *Chaetomium* induced transcriptional and proteomic changes in the management of *Phythium* rhizome rot in turmeric
- Recently the Department of Science and Technology, Government of India sanctioned Rs.60 lakh to this department under FIST programme for infrastructure development.

Dept. of Microbiology

- Two students from Senegal, Africa attended PDF training on Techniques for Genetic Engineering of microorganisms in this department for three months from August-November, 2014

Dept. of Nanoscience & Technology

Enhanced Preservation of Fruits Using Nanotechnology

The Tamil Nadu Agricultural University is one of the early birds in nanotechnology research in India and has received a major collaborative research grant being jointly funded by Canadian Government (DFATD, Department of Foreign Affairs, Trade and Development) and International Development Research Center (IDRC), Canada. The project entitled *"Enhanced Preservation of Fruits using Nanotechnology"* is being funded under the Canadian International Food Security Research Fund (CIFSRF) involving six institutes namely University of Guelph, Canada, TNAU, India, Industrial Technology Institute, Sri Lanka, University of Nairobi, Kenya, Skoine University, Tanzania and University of West Indies in Trinidad & Tobago, with a total budget of 4.2 million CAD (equivalent to Rs. 23.1 Crores)

of which TNAU received Rs. 6.65 crores. The project is intended to use Hexanal technology (Pre-harvest spray of Hexanal Formulation at 15 and 30 days before harvest) to assist retention of mango fruits in the orchards for 3 weeks and further extension of shelf-life for additional 3 weeks which offers lucrative price for the farmers. This technology is going to be scaled up during the second phase of the IDRC project. In addition, research is under way to develop nano-matrices to regulate the release of hexanal.

ICAR Nanotechnology Platform Projects for TNAU

The ICAR Nanotechnology Platform Project has been approved for TNAU with a financial support of Rs.7.77 Crores to be spent during the 12th Plan ending March 2017. The funding is primarily for the purchase of equipments and infrastructure for nano-product testing facility (Rs. 440 Lakhs) and project operational costs for undertaking 11 projects approved by the ICAR under the program (Rs.337 Lakhs). The 11 projects are intended to develop nano-agri inputs (Fertilizers, Herbicide and Seed Customization), early detection of plant diseases (nutrient deficiency in rice and maize and aflatoxin), nano-packaging to improve shelf-life of perishables besides nano remediation of soil and aquatic pollutants.

Regional Research and Extension Advisory Council (RREAC) Meetings conducted

- Regional Research and Extension Advisory Council, the zonewise body to address specific issues feed by the farmers on a holistic manner involving scientists, department officials and progressive farmers was revived after a decade. The meet was held at all seven agro climatic zones as detailed.

Location	Agro Climatic Zone	Date
RRS, Paiyur	North Western Zone	19.11.2014
RRS, Vridhachalam	North Eastern Zone	5.9.2014
TRRI, Aduthurai	Cauvery Delta Zone	21.7.2014
RRS, Aruppukottai	Southern Zone	11.12.2014
ARS, Bhavanisagar	Western Zone	24.10.2014
HRS, Pechiparai	High Rainfall Zone	15.12.2014
HRS, Thadiyankudisai	High Altitude and Hilly Zone	13.2.2015

Recommendations pertaining to researchable issues suggested in the above meets are furnished zonewise.

North Western Zone

- Evolving nutrient requirement schedule including micro nutrient based on leaf analysis for regular and off-season bearing mangoes
- Evolving mosaic virus resistant tapioca variety in collaboration with CTCRI, Trivandrum for getting the slips of tapioca grown in Switzerland and distribution to selected farmers under close monitoring by including YMV resistant/tolerant tapioca varieties developed by M/s Rasi seeds.
- Standardising protocols / GAP for tapioca through staggered planting and micro nutrient mixture for boosting the yield.
- Replacement of TMV 7 groundnut with a variety having equivalent characters and with high yield for Krishnagiri district.
- Characterizing "Konakai" cowpea through selection process at four centres along with 4-5 varieties from Madurai.
- Analysing the available zinc in ground water and water used in rice growing areas

- Collection of local red sorghum varieties with high tannin and forwarding to research stations.
- Collection of red sorghum varieties with 120 days duration from ICRISAT Hyderabad for inclusion in research program of the University.

North Eastern Zone

- A new high yielding rice variety with earliness to replace ADT 39 and ADT 45
- A new high yielding variety with good quality characters to replace the BPT 5204 variety
- A new alternate variety to sugarcane 86032
- Cashew varieties with high yielding, lesser canopy suitable for High Density Planting
- Replacement of TMV 7 and VRI 2 groundnut varieties released 20 years ago with high yielding varieties
- Introduction of short duration rice variety, high yielding rice hybrid, short duration ragi varieties, salt and heat tolerant tomato varieties

Cauvery Delta Zone

- Drought tolerant rice varieties
- Rectification of red rice problem in CR 1009
- Non-lodging, blast resistant, fine grain rice variety to replace BPT
- Intensification research on rice variety with medicinal values
- Short duration rice variety for samba season
- Replacement of BPT rice variety for *Thaladi*
- Alternative rice varieties to ASD 16 and TKM 9 for coastal areas with high pH due to the sea water intrusion
- Saline tolerant sugarcane variety
- Alternate variety to rice fallow blackgram ADT 3
- Alternate variety to JL 24 and VRI 2 groundnut
- Alternate sesame variety to TMV 2
- Salinity tolerant sugarcane variety

Southern Zone

- Tractor drawn cage wheel for breaking the dried coconut for further extraction of oil
- Machinery for harvesting cotton kapas at one time
- Combined machinery to be developed for loading and unloading Farm Yard Manure
- High yielding, drought tolerant, pest and disease tolerant varieties in small millets and pulses suitable for rainfed condition
- Equipment for complete removal of husk in minor millets
- Paddy transplanter suitable for planting aged seedlings in areas affected by rain water inundation due to which young seedlings planted get submerged during north east monsoon season in Thoothukudi district
- Paddy variety suitable for submerged condition and short duration coconut variety suitable for Ramanathapuram district

Western Zone

- Machinery for weeding in between curry leaf crop.
- Harvester cum solar drier for turmeric.
- Moringa processing method and varieties suitable for export and ratoon.
- Short duration fine varieties of rice.

High Rainfall Zone

- Alternative easy harvesting technologies for pepper and clove
- Newer intercrops in coconut and rubber
- TNAU coconut climber with less weight for easy handling and safety
- Alternative supports to pepper instead of *Erythrina* supports
- New varieties performing well in offseason or improving the existing chengaivarukai variety of mango
- New variety in pineapple or improving the existing varieties
- Introducing new varieties in *Colacasia*, Yam, *Dioscorea*, Arrowroot, Sweet potato and a short duration tapioca
- High yielding coconut variety superior to Eathamozhy tall
- Intensification of research on the management of stem borer and blight of clove
- Introduction of Dhavana and other filler crops in coconut gardens
- Rhizome production in lotus
- Soil management measures for fluffy acid soils
- Short duration, bold seeded and high yielding rice varieties with resistance to pest and diseases yielding higher than TPS 3 and TPS 5
- Alternate rice variety for Ponmani and ASD 16
- Modification of light weighted cono weeder to suit heavy soils.
- Improvising the existing paddy transplanter for undulated terrains
- Remodeling the lazer leveler for use in small and marginal farms

High Altitude and Hilly Zone

- Improvised pepper cultivation practices
- Selection of suitable jack clones and development of good agricultural practices
- Identification of off season vegetables
- Perfecting nursery technologies for large scale production of tree sapling of fruits and spices
- Introduction of olive as anew crop
- Post harvest technology of important fruits
- Intensifying the research on orange die back
- Host Plant Resistance against hernbivores in perennials

List of MoUs signed between TNAU and other academic institutions and private companies from January 2014 to December 2014

Sl. No.	Name of the institutions / companies / firms with which MoU signed	Name of the project / study / scheme etc.	PI incharge of the project	Duration
1.	USAID-Virginia Tech-, USA	Management of groundnut leaf miner in Eastern Africa- sub award for TNAU	Dr.S.Mohankumar CPMB	27.7.2014 Up to 2017
2.	Canadian Department of Foreign Affairs, Trade and Development (DFATD) & International Development Research Center (IDRC), Canada. under the Canadian International Food Security Research Fund (CIFSRF)	Enhanced Preservation of Fruits Using Nanotechnology	Dr. K.S.Subramanian Dept. of Nanotechnology	Dec. 1, 2014 to March 31, 2018
3.	Bill Melinda Gates Foundation – IRRI, Phillippines	Salinity Breeding Network and PVS – STRASA Phase III	Dr.S.Geetha ADAC&RI, Trichy	28.10.2015 to 27.10.2015
4.	GOI-Ministry of Human Resource Development	Centre of Excellence in Frontier areas of science & Technology (FAST) on Microbes to feed the world. Plant microbe interactions to boost Agricultural production	Prof. & Head, Dept. of Agrl. Microbiology, Coimbatore	Oct, 2014 – Sept, 2018 MOU signed on 08.08.2014
5.	GOI-Department of Biotechnology-Indo-USSR Collaborative Research Project	Development of integrated (biotechnological & nano catalytic) biorefinery for fuels & platform chemicals production from lignocellulosic biomass (crop/ wood residues)	Dr.U.Sivakumar Professor	Nov, 2014 – Oct, 2017 MOU signed on 10.10.2014
6.	India Meteorological Department, Ministry of Earth Sciences, Government of India, New Delhi	Gramin Krishi MausamSeva (Previously Known as Integrated Agromet advisory Services)	Dr.N.K.Sathya-moorthy, ACRC	2012- 2017
7.	BIRAC, DBT, New Delhi	Establishment of University Innovation Cluster at TNAU	CPMB	2014-18 1.6.2014

8.	TNAU and Coconut Development Board	Development of in vitro culture techniques through somatic embryogenesis for propagation of elite coconut cultivars	Dr.R.Renuka CPMB	2014-17 Commencement April 2014
9.	ICAR-AICRP on Honeybees and Pollinators, Division of Entomology, IARI Campus, New Delhi	Cooperating centre for AICRP on Honeybees and Pollinators	Dr.M.R.Srinivasan, Dept. of Agrl. Entomology, TNAU, Coimbatore	Nov 2014 onwards
10.	DST, New Delhi & Shri Murugappa Chettiar Research Centre (MCRC), Chennai	Validation of Chromatogram technique for soil nutrient analysis	Dr. P.Malarvizhi Dept. of SS&AC	01.04.2014 To 30.09.2014
11.	DBT, New Delhi	Bio-remediation of degraded calcareous sodic and saline-sodic soils	Dr. T. Chitdheswari Dept. of SS&AC	06/2014 to 05/2017
12.	Tamil Nadu Open University, Chennai	Offering 16 Certificate Courses (Tamil) of DODL, TNAU through Constituent Community Colleges of Tamil Nadu Open University, Chennai	Dr.P.Santhy ODL	Three years from 4.07.14
13.	M/s. Bannari Amman Sugars Limited, Erode	Studies on Ecomonitoring of the Land Application of biomethanated distillery spentwash on quality of water, soil health, yield and produce quality of crops and sustainable environment	Dr.P.Thangavel Dept. of ENS, Coimbatore	October, 2014 to September, 2017
14.	Sustainable Agro Alliance (SAAL), Madurai	Offering Vocational Certificate Course on Organic Agriculture as 90 days programme.	Dr.P.Santhy ODL	Two years from 19.08.14
15.	M/S Arunai Agro Tech. Thiruvannamalai Tamilnadu	Vasambu based TNAU-Herbal insect repellant	Dr.S. Jeyarajan Nelson, Dept. of Agrl.Entomology	3 years from 23.01.2014
16.	Bhuvicare Pvt. Tirunelveli	TNAU Stored Grain Pest Management Kit	Dr.S.Mohan, SPGS	3 years from 10.12.2014
17.	M/S Kushboo Enterprises, Guwahati	TNAU Stored Grain Pest Management Kit	Dr.S.Mohan, SPGS	3 years from 18.02.2014

18.	S2 Associate, Guwahati	Insect Management Kit	Dr.S.Mohan, SPGS	3 years From 19.02.2014
19.	Various companies	Utilization of Food Processing Business Incubator (FPBI) for commercilizing the technologies standardized at PHTC	Dr.N.Varadharaju PHTC	2014 - 2015
20.	World Community Service Centre, Aliyarnagar	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.	Dr. K.Shoba Thingalmaniyan, Asst. Prof. (Hort.),	2 years (2014 – 2016)
21.	M/s ACC Limited, Madukkarai Cement Works, Coimbatore	Studies on developing a water conservation plan for ACC Limited, Madukkarai Cement Works	Dr.M.P.Sugumaran, Asst. Prof. (ENS) Dept. of SOA, Coimbtaore	April 2014 to March 2015

EXTERNAL AGENCY FUNDED PROJECTS

Sl. No.	Project Title	Funding Agency	Project period	Budget (Lakh Rs.)	Project Leader (S) (PI/Co-PI)
	Centre for Plant Breeding and Genetics				
	RICE				
	Dept. of Rice, CPBG				
1.	**DBT/CPBG/CBE/RIC/2012/R001** Metabolic and molecular profiling of aromatic rice germplasm of India for gaining insights about aroma	DBT	2012-2015	19.65	Dr. S. Robin Dr. S. Rajeswari
2.	**DBT/CPBG/CBE/RIC/2012/R002** Rice biofortification with enhanced iron and zinc in high yielding non-basmati cultivars through marker assisted breeding and transgenic approaches- Phase II-marker Assisted Breeding	DBT	2012-2018	61.00	Dr.S.Rajeswari Dr. S. Robin
3.	**UGC/CPBG/CBE/RIC/2013/R003** Molecular approaches towards identification of zinc deficiency tolerance under aerobic rice ecosystem	UGC	2013-2016	10.53	Dr. K. Amudha
4.	**DBT/CPBG/CBE/RIC/2013/R004** Marker assisted introgression of different traits to develop new generation rice varieties	DBT	2013-2018	82.02	Dr. S. Robin Dr.P.Jeyaprakash Dr. R. Rabindran Dr. S. Suresh
5.	**DBT/CPBG/CBE/RIC/2013/R005** Wild Rice Magic	DBT Indo-UK	2013-2017	32.72	Dr. S. Robin Dr.P. Jeyaprakash
6.	**DBT/CPBG/CBE/RIC/2013/R006** Indo Australia Project on Comparative transcriptomics between rice and resurrection plants and exploitation of novel genes for dehydration tolerance for improvement of drouht tolerance in rice	DBT Indo-Australia	2013-2016	57.57 36.51	Dr. S. Robin Dr. M. Raveendran
7.	**IRRI/CPBG/CBE/RIC/2014/R007** Stress tolerant rice for poor farmers in Africa and South Asia – Phase II	IRRI BMGF	2014-2015	US$ 5000	Dr. S. Robin
	ARS, Thirupathisaram				
8.	**BRNS/CPBG/TPS/RIC/2012/R001** Development of dwarf and early mutant in white ponni rice using mutation breeding	BRNS	2012-2015	19.43	Dr. M. Arumugam Pillai
9.	**UGC/CPBG/TPS/RIC/2012/R002** Introgression of SALTOL gene in drought tolerant CMS background for developing superior hybrid in rice	UGC	2012-2015	4.83	Dr. M. Arumugam Pillai
	RRS, Paiyur				
10.	**DST/CPBG/PYR/RIC/2012/R001** Development of cold tolerant rice lines through doubled haploid technique	DST	2012-2015	14.66	Dr.M.Dhandapani
11.	**DBT/CPBG/PYR/RIC/2013/R002** Identification and mapping of QTLs governing zinc deficiency tolerance in Rice	DBT	2013-2016	38.66	Dr.M.Dhandapani

	VRS, Palur				
12.	**DBT/CPBG/PLR/RIC/2012/R001** Development of wide compatible restorers in rice through marker assisted backcross breeding	DBT	2012-2015	17.97	Dr. K. Sakthivel Dr. M. Uma devi, Dr. S. Manonmani Dr. S. Robin
13.	**UGC/SEED/PLR/RIC/2012/R002** Infusing microbial consortia for seed quality enhancement	UGC	2012-15	3.40	Dr. K. Raja Dr. R. Anandham Dr. K. Siva-subramaniam
	RRS, Tirur				
14.	**DBT/CPBG/TKM/RIC/2013/R001** Marker assisted breeding for improving salinity tolerance in popular rice varieties of Tamil Nadu	DBT	2013-2016	34.43	Dr. S. Banumathy Dr.M. Raveendran Dr. G. Manickam
	MILLETS				
	Department of Millets, CPBG				
15.	**PPV/CPBG/CBE/MIL/2012/R001** Developing guide lines for conduct of test for Distinctiveness, Uniformity and Stability (DUS) in small millets	PPV&FRA	2012-2015	15.65	Dr.A.Thanga Hemavathy Dr.S.Geethanjali
16.	**UGC/CPBG/CBE/MIL/2012/R002** Development of high culm strength bold seeded and compact plant type genotypes in kodo millet suitable for mechanical harvesting	UGC	2012-2015	9.63	Dr.A.Subramanian Dr.A.Nirmala-kumari
17.	**UGC/CPBG/CBE/MIL/2012/R003** Identification of high beta carotene pearl millet lines (Golden Millet) to enhance the nutritional security	UGC	2012-2015	10.13	Dr.P.Sumathi Dr.P.Veera-badhiran Dr.N.Senthil
18.	**UGC/CPBG/CBE/MIL/2013/R004** Identification of Quantitative Trait Loci (QTLs) for drought tolerance in sorghum	UGC	2013-2016	11.21	Dr.S.Sivakumar
19.	**NIAS/CPBG/CBE/MIL/2013/R005** Evaluation of NIAS Gene Bank Sorghum Genetic Resources (mini core accessions)	NIAS, Japan	2013-2015	11.00	Dr. S. Sivakumar
20.	**DBT/CPBG/CBE/MIL/2013/R006** Marker aided back cross breeding for introgression of sugar enhancer (se) gene from sweet corn to normal maize inbred lines for enhancing the sugar content	DBT Biocare	2013-2016	22.86	Dr. A.Thanga Hemavathy
21.	**DST/CPBG/CBE/MIL/2013/R007** Identification of major downy mildew resistance QTLs in maize inbreds / RILs and development of downy mildew resistant single cross hybrids suitable for commercial cultivation.	DST	2013-2016	14.88	P.M. Tamilarasi, Ph.D. scholar Dr. G. Nallathambi (Major advisor)
	RRS, Paiyur				
22.	**NABARD/CPBG/PYR/MIL/2012/D001** Production of quality seeds of wheat and popularization of wheat cultivation in Krishnagiri and Dharmapuri districts of Tamil Nadu	NABARD	2012-2015	6.75	Dr. K. Geetha
	CEM, Athiyandal				
23.	**MARICO/CPBG/ATL/MIL/2012/R001** Evolution of high yielding and nutrient rich oat variety suitable for value addition	Marico-Mumbai	2012-2015	37.26	Dr. A. Nirmala Kumari Dr.A.Subramanian

24.	**DBT/CPBG/ATL/MIL/2013/R 002** Development of waxy and non-waxy foxtail millet genotypes suitable for Assam and Tamil Nadu and preparation of value added food products	DBT	2013-2016	18.45	Dr. A. Nirmala Kumari Dr. N. Senthil Dr. A. Subramanian
	PULSES				
	Dept. of Pulses, Coimbatore				
25.	**BRNS/CPBG/CBE/PUL/2012/R 001** Development of low phytate soybean (*Glycine max* L (Merr.) through induced mutagenesis	BRNS	2012-2015	18.85	Dr. T. Kalaimagal Dr. N. Senthil
	ARS, Virinjipuram				
26.	**DST/CPBG/VRM/PUL/2013/R001** Development and validation of SNP marker platform for *Vigna* complexes to map the MYMV and bruchids resistance	DST-SERB	2013-2017	33.80	Dr M. Pandiyan
	RRS, Tirur				
27.	**UGC/CPBG/TKM/PUL/2012/R001** Identifying new greengram varieties with high yield and yellow mosaic virus (YMV) resistance through participatory varietal selection	UGC	2012-2015	10.00	Dr A. Sheeba Dr. S. Banumathy Dr. G. Manickam
	OILSEEDS				
	Dept. of Oilseeds, CPBG				
28.	**ICRISAT/CPBG/CBE/OIL/2011/R001**Development and promotion of promising varities/ lines with high yield and high oil content with enhanced O/L ratio for enhancing production and quality of groundnut oil in drought prone environments to boost the income of small and marginal groundnut farmers in India	ICRISAT	2011-2015	49.50	Dr.N.Manivannan
29.	**DBT/CPBG/CBE/OIL/2013/R002** Integrated MAS to develop groundnut varieties for resistance to foliar fungal diseases rust and late leaf spot	DBT	2013-2018	64.01	Dr. N. Manivannan Dr. A. Mothilal
30.	**DBT/CPBG/CBE/OIL/2014/R003** Identification of molecular markers linked to high oleic content and development of high oleic CMS line in Sunflower	DBT	2014-2016	16.12	Dr.R.Chandrikala Dr. N.Manivannan
	COTTON				
	Department of Cotton				
31.	**DBT/CPBG/CBE/COT/2012/R001** Identification and mapping of QTLs linked to jassid tolerance in cotton	DBT	2012-2015	23.25	Dr.P. Amalabalu
	Dept. of Forage crops				
32.	**KANCOR/CPBG/CBE/FC/2010/R001**Evolution of lucerne genotype possessing high biomass and chlorophyll content	Kancor Ingredients Ltd., Cochin	2010-2016	8.56	Dr.C.Babu Dr.K.Velayudham Dr.K. Iyanar Dr.K. Sathiya Bama
	Centre for Plant Molecular Biology and Biotechnology				
	Dept. of Plant Biotechnology				
33.	**DBT/CPMB/CBE/DPB/2012/R001** Rice bio-fortification with enhanced iron and zinc in high yielding non-basmati cultivars through marker	DBT	2012-2015	178.64	Dr. D. Sudhakar Dr. M. Raveendran

	assisted breeding and transgenic approaches- Phase II – Transgenic Approaches				
34.	**DBT/CPMB/CBE/DPB/2012/R002** Molecular breeding for developing drought tolerant Ahu rice cultivars suitable for upland ecosystem	DBT	2012-2015	19.00	Dr. M. Raveendran Dr. S. Robin Dr. D. Vijayalakshmi
35.	**DBT/CPMB/CBE/DPB/2012/R003** Identification of molecular targets for the management of crop pests using RNAi approach	DBT	2012-2015	50.56	Dr.S. Mohankumar
36.	**DBT/CPMB/CBE/DPB/2012/R004** Development and transfer of technology from Queensland University of Technology, Australia to India for bio-fortification and disease Resistance in banana	DBT BIRAC	2012-2018	113.30	Dr. P. Bala-subramanian
37.	**DST/CPMB/CBE/DPB/2012/R005** Ensuring food security, harnessing science to protect grain harvest from insect threats	DST	2012-2015	45.43	Dr. S. Mohan-kumar Dr. S. Mohan
38.	**DST/CPMB/CBE/DPB/2012/R006** Engineering transcription factors ABI3 and ABI5 in rice for salt and drought tolerance	DST	2012 - 2015	18.00	Dr. B. Rajagopal
39.	**UGC/CPMB/CBE/DPB/2012/R007** Development of molecular markers associated with drought tolerance in Barnyard millet (*Echinochloa frumentacea*)	UGC	2012-2015	8.40	Dr. B. Rajagopal
40.	**IRRI/CPMB/CBE/DPB/2012/R008** Safe guarding Asian rice production from a rapidly warming climate	IRRI Philippines	2012-2015	30.86	Dr M. Raveendran
41.	**DBT/CPMB/CBE/DPB/2013/R009** Bioprospecting of coumarins obtained from medicinal plants and their synthetic derivatives for the anti -microbial, anti -feedant and anti -cancer activity.	DBT	2013-2016	16.17	Dr. V.P.Santhana-krishnan Dr. P. Bala-subramanian
42.	**UGC/CPMB/CBE/DPB/2013/R010** Development of repeatable protocols in induced androgenesis for gametoclonal variations to combat high priority problems in tomato (*Lycopersicon esculentum*)	UGC	2013-2016	9.99	Dr. R. Gnanam
43.	**DBT/CPMB/CBE/DPB/2013/R011** Towards developing nutrient rich anti diabetic rice genotypes through molecular breeding	DBT Biocare	2013-2016	25.46	Dr R. Valarmathi Dr.M. Raveendran
44.	**IRRI/CPMB/CBE/DPB/2014/R012** Development of heat tolerant rice	IRRI	2014-2015	4.88	Dr.M. Raveendran
45.	**CDB/CPMB/CBE/DPB/2014/R013** Standardization of *in vitro* techniques through somatic embryogenesis for propagation of elite coconut cultivars	Coconut Development Board	2014-2017	35.83	Dr. R. Renuka Dr. R.Gnanam Dr. M. Mohana-lakshmi
46.	**BIOSEEDS/CPMB/CBE/DPB/2014/R014** Development of insect resistance technology for crop plants through cry2Ai gene	Bioseeds	2014-2017	59.15	Dr. V. Udaya-suriyan Dr. D. Sudhakar Dr.N.Balakrishnan Dr.S.Mohankumar
47.	**DBT/CPMB/CBE/DPB/2014/R015** Engineering rice for resistance to major lepidopteran pests using a novel synthetic cry2AX1 gene	DBT	2014-2017	38.20	Dr. D. Sudhakar Dr.V.Udaya-suriyan Dr.N.Balakrishnan

48.	**MONSANTO/CPMB/CBE/DPB/2014/R016** Breeding for drought resilience in rice: Fine mapping and characterization of near isogenic lines for plant production, transcriptome, root system architecture and drought physiology	Monsanto Beachel-Borlaug International Scholarship	2014-2018	38.00	Mr. Asish Rajukar, Ph.D. scholar Dr. R. Chandra-babu (Major advisor)
49.	**DST/CPMB/CBE/DPB/2015/R017** Developing phosphorous efficient and blast resistant rice genotypes through molecular marker assisted selection	DST	2015-2018	11.70	K. Chithrameenal, PhD scholar Dr. J. Ramalingam (Major advisor)
50.	**DBT/CPMB/CBE/DPB/1989/D001** Post Graduate Education and Training Programme leading to M.Sc. Degree in Biotechnology	DBT	From 1989 on wards		Dr. R. Chandra Babu
51.	**DBT/CPMB/CBE/DPB/2014/D002** Establishment of University Innovation Cluster at TNAU	DBT BIRAC	2014-2018	214.40	Dr.V.Udaya-suriyan Dr. R. Chandra-babu Dr. J. Ramalingam
52.	**DBT/CPMB/CBE/PMB/ 2009/R001** Marker assisted selection and development of gall midge, blast and bacterial blight resistant rice varieties suitable for Tamil Nadu	DBT	2009-2016	80.78	Dr. N. Kumara-vadivel Dr. R. Rabindran Dr. J. Ramalingam
53.	**DBT/CPMB/CBE/PMB/ 2012/R002** DBT-Support for Research and Development in Agricultural Biotechnology Phase II	DBT	2012-2015	193.08	Co-ordinator: Dr.R.Chandra-babu Scientists: Dr.P.Bala-subramanian Dr.M. Raveendran
54.	**UGC/CPMB/CBE/PMB/ 2012/R003** Functional marker assisted introgression of blast and bacterial blight resistance genes for the development of superior hybrid in Rice	UGC	2012-2015	12.26	Dr.J.Ramalingam Dr. R. Saraswathi Dr. R. Rabindran
55.	**DBT/CPMB/CBE/PMB/ 2013/R004** Marker assisted selection for *Phytophthora* and powdery mildew resistance and effective nodulation in soybean (*Glycine max*L.Merr.)	DBT	2013-2016	27.05	Dr.J.Ramalingam Dr. V. Udayasuriyan Dr. R. Sudhagar
56.	**DBT/CPMB/CBE/PMB/ 2012/D001** Establishment of Biotechnology Information System (BTIS) User Centre	DBT	2012-2017	5.80	Coordinator Dr. R. Chandra-babu Co-coordinator Dr.J.Ramalingam
	Directorate of Crop Management				
	Dept. of Agronomy				
57.	**UGC/DCM/CBE/RS/2012/R001** Remote sensing techniques for large scale quantification of nitrogen and water stress in crops	UGC	2012-2015	11.07	Dr.S.Pazhanivelan
58.	**DST/DCM/CBE/RS/2013/R002** Evaluation of real time nitrogen management technique in aerobic rice under integrated nutrient supply system	DST	2013-2015	21.75	Dr. M. Senthivelu
	Agro Climate Research Centre				
59.	**IMD/DCM/CBE/ACR/2010/R001** Yield forecasting for rice, maize	IMD	2010-2018	9.02	Dr. V. Geetha-lakshmi

	and groundnut in western zones of Tamil Nadu using space, agrometeorology and land based observation (FASAL)				
60.	**CSIRO/DCM/CBE/ACR/2012/R002** Can seasonal climate forecasts improve food security in Indian ocean rim countries in a variable and changing climate?	CSIRO, Australia	2012-2015	30.95	Dr. V. Geetha-lakshmi
61.	**NIAER/DCM/CBE/ACR/2012/R003** Adaptation to climate change: An integrated science-stakeholder approach to develop adaptation framework for water and agriculture sectors in Andhra Pradesh and Tamil Nadu states of India – CLIMAADAPT	NIAER, Norway	2012-2016	310.00	Dr. V. Geetha-lakshmi
62.	**DST/DCM/CBE/ACR/2012/R004** Climate change: assessing impacts and developing adaptation strategies for agriculture in Tamil Nadu	DST	2012-2015	65.87	Dr. V. Geetha-lakshmi
63.	**DST/DCM/CBE/ACR/2014/R005** Validation of research outcome on fly ash utilization in agriculture to bring out university recommendation	DST	2014-2017	5.25	Dr.N.Maragatham
64.	**IMD/DCM/CBE/ACR/2014/R006** Gramin Krishi Mausam Sewa (GKMS) : Rural Agro Meterological Advisory Services	IMD, Pune	2014-2015	13.14	Dr.N.K.Sathya-moorthy
	Dept. of Crop Physiology				
65.	**UGC/DCM/CBE/CRP/2012/R001** Root zone technology for bio-removal of heavy metals and other toxic contaminants of factory effluents of Tirupur hosiery units' using grass species under constructed wetlands	UGC	2012-2015	8.27	Dr. C. N. Chandra-sekhar
66.	**UGC/DCM/CBE/CRP/2012/R002** Crop response studies on climate change with particular reference to elevated carbon di-oxide and interaction with temperature in blackgram	UGC	2012-2015	7.64	Dr. H.Vijaya-raghavan
67.	**UGC/DCM/CBE/CRP/2013/R003** Oxidative stress tolerance to develop saline tolerant lines through screening of EMS rice mutants	UGC	2013-2016	10.70	Dr.P. Boomi-nathan
68.	**UGC/DCM/CBE/CRP/2013/R004** Shelf life and quality improvement in banana and mango fruits using 1- methyl cyclo propene (1-MCP) technology	UGC	2013-2016	11.25	Dr.P. Jeyakumar
69.	**UGC/DCM/CBE/CRP/2013/R005** Physiological and molecular characterisation of soybean (*Glycine max* Merr.) genotypes under phosphorus stress	UGC	2013-2016	11.05	Dr.S. Vincent
70.	**IRRI/DCM/CBE/CRP/2013/R006** Physiology of weeds in rice-ecosystem'=	IRRI, Philippines	2013-2015	4.37	Dr.S. Vincent

	Tamil Nadu Rice Research Institute, Aduthurai				
71.	**IMD/DCM/ADT/AGR/2011/R001** Yield forecasting for rice in Cauvery Delta Zone in Tamil Nadu using space, meteorology and land based observations	IMD, Pune (FASAL)	2011-2017	4.34	Dr. K. Subrah-maniyan
72.	**ICAR/DCM/ADT/AGR/2011/R002** Mitigating abiotic stress and enhancing resource use efficiency in pulses in rice fallow condition	ICAR-IIPR	2011-2016	34.54	Dr. K. Subrah-maniyan
73.	**NCMRWF/DCM/ADT/AGR/2013/R003**Experimental Agro-Met Advisory Services (AAS), Aduthurai. GOI - Agro.Met.-NCMRWF- Scheme.	NCMRWF, GOI	2013-2017	11.28	Dr. K. Subrah-maniyan
74.	**IRRI/DCM/ADT/AGR/2013/R004** Options for water saving / improving water use efficiency and drought avoidance in the Cauvery Delta	IRRI, Philippines	2013-2015	5.49	Dr.R.Rajendran
	ARS, Bhavanisagar				
75.	**DST/DCM/BSR/AGR/2012/R001** Evaluation of suitable integrated farming system components for wetland situation in erode district of Tamil Nadu	DST	2012-2015	14.50	Dr. K. Ramah
	CRS, Sriviliiputhur				
76.	**DST/DCM/SVR/AGR/2013/R001** Up scaling pulses productivity through micro mission mode farmers participatory approach in thickly SC/ST populated Villages in virudhunagar district of Tamil Nadu	DST	2013-2016	15.25	Dr.R.Veera-puthiran
	ARS, Kovilpatti				
77.	**IMD/DCM/KPT/AGR/1995/R001** Gramin Krishi Mausam Sewa (GKMS) : Rural Agro Meterological Advisory Services	IMD, Pune	1995-2015	13.88	Dr..C.Uma-mageswari
78.	**NICRA/DCM/KPT/AGR/2010/ R002** National Initiative on Climate Resilient Agriculture – Technology Demonstration to Farmers	ICAR	2010-2015	79.91	Dr. D. Jawahar Dr. M. Rajeswari Dr.A. Ramalingam Dr. S. Elamathi Dr. V. Sanjivkumar Dr. C. Uma-mageswari Dr. N. Sritharan Dr. P. Anandhi
79.	**NICRA/DCM/KPT/AGR/2010/ R003** National Initiative on Climate Resilient Agriculture – XI plan	ICAR	2010-2015	57.41	Dr. A. Solaimalai Dr. S. Subbu-lakshmi
	RRS, Paiyur				
80.	**TNSBGF/DCM/PYR/AGR/2014/R001**Enhancing profitability of farming by empowering farmers and farm women through small farm mechanization	TN SBGF	2014-2015	45.66	Dr. S. Vijaya-baskaran
	SWMRI, Thanjavur				
81.	**NETAFIM/DCM/TNJ/AGR/2014/R001**Standardization of lateral spacing and chemigation techniques in drip irrigated rice	Netafim Corporate, India	2014-2015	7.50	Dr. V. Ravi Dr. S. Porpavai Dr.G.Thiyagarajan
82.	**IRRI/DCM/TNJ/AGR/2014/R002** Effect of different management	IRRI	2014-2016	1.50	Dr. V. Ravi Dr.K.Paramesh-

	practices on the control of voluntary rice in direct seeded rice				wari
	Directorate of Natural Resource Management				
	Dept. of SS&AC				
83.	**DST/NRM/CBE/SAC/2012/R001** Crop and genotypic variation-A tool to enhance phosphorus use efficiency for sustainable cropping in low phosphorus soils	DST	2012-2015	33.29	Dr. S. Meena Dr. P. Malarvizhi
84.	**UGC/NRM/CBE/SAC/2012/R002** Enhancing the productivity of textile and dye industry polluted soils of Noyyal river basin, Tamil Nadu.	UGC	2012-2015	8.17	Dr. K. M. Sella-muthu Dr.R. Sridar Dr. V.P. Duraisami Dr. S. Mahimairaja
85.	**IRRI/NRM/CBE/SAC/2013/R003** Dynamics of N under different crop establishment methods and residue management	IRRI	2013-2015	11.45	Dr. P. Malarvizhi Dr. R. Rajendran Dr. Parasuraman
86.	**DBT/NRM/CBE/SAC/2014/R004** Bio-remediation of degraded calcareous sodic and saline-sodic soils	DBT	2014-2017	40.97	Dr.T. Chitdheswari Dr. U. Sivakumar Dr. P. Malarvizhi
	Dept. of Agrl. Microbiology				
87.	**BRNS/NRM/CBE/AGM/2010/R001** Investigation on diversity of arbuscular mycorrhizal fungi in agricultural soils of Tamil Nadu for improved inoculants development	BRNS	2010-2015	20.00	Dr.D.Balachandar Dr.K. Kumutha
88.	**DBT/NRM/CBE/AGM/2012/R002** Sustained availability of N, P and S through soil microbial consortia with special reference to *Burkholderia* sp, B*acillus* sp and *Thiobacillus* sp in groundnut	DBT	2012-2015	27.59	Dr.R.Sridhar
89.	**UGC/NRM/CBE/AGM/2012/R003** Exploration of the diversity and lipid storing capacity of algal isolates of the pristine forest and marine ecosystem and establishment of a repository	UGC	2012-2015	9.74	Dr.T.Kalaiselvi
90.	**DST/NRM/CBE/AGM/2012/R004** Biotization - A novel bioinoculant delivery strategy for banana micropropagation	DST	2012-2015	22.25	Dr.M.Senthil Kumar
91.	**DBT/NRM/CBE/AGM/2012/R005** Lytic bacteriophages as a biorational biocontrol agents against the bacterial wilt disease of Brinjal	DBT	2012-2016	29.26	Dr.M.Senthil Kumar Dr.U.Sivakumar
92.	**DBT/NRM/CBE/AGM/2013/R006** Development of SCAR markers for strain authentication and to improve the quality assessment of bioinoculants	DBT	2013-2016	37.47	Dr.D.Balachandar
93.	**DBT/NRM/CBE/AGM/2013/R007** Improving biomethanation and bioremediation efficiency of cassava sago effluent by nitrogen amendments and *Spirulina* cultivation under HRAP system for safe recycling	DBT	2013-2016	36.35	Dr.K.Kumar Dr.S.Karthikeyan Dr.D.Balachandar
94.	**DBT/NRM/CBE/AGM/2013/R008** Microbial transformation to enhance formation of humic polymer	DBT	2013-2016	38.66	Dr.U.Sivakumar Dr.D.Balachandar

95.	**DBT/NRM/CBE/AGM/2013/R009** Ecotoxicology assessment of engineered metaloxidenNanoparticles on PGPR microorganisms - *Pseudomonas* species	DBT	2013-2016	16.66	Dr.M.Senthil Kumar Dr. M. Prasanth-rajan
96.	**TAS/NRM/CBE/AGM/2013/R010** Isolation, screening and evaluation of bioactive molecules from actinomycetes against major crop mites	Tropical Agrosystems Pvt. Ltd., Chennai	2013-2016	14.32	Dr.P.Marimuthu Dr.K.Ramaraju
97.	**GOI/NRM/CBE/AGM/2014/R011** Formulation of microbial consortium of liquid formulation for sustainable sugarcane production	Directorate of Sugar, GOI, New Delhi	2014-2016	6.40	Dr.P.Marimuthu Dr. K. Kumutha
98.	**DBT/NRM/CBE/AGM/2014/R012** DNA fingerprinting of lignocelluloses degrading microbes isolated from protected forest areas of Assam and Mizoram	DBT	2014-2017	23.77	Dr.U.Sivakumar Dr.M.Senthil Kumar
99.	**DBT/NRM/CBE/AGM/2014/R013** Development of integrated (biotechnological & nano catalytic) biorefinery for fuels & platform chemicals production from lignocellulosic biomass (crop/wood residues)	DBT Indo-Russia Collaboration	2014-2017	69.56	Dr.U.Sivakumar Dr.D.Ramesh
100.	**DBT/NRM/CBE/AGM/2014/R014** Molecular detection and quantification of shiga – like toxin producing *Escherichia coli* in fresh vegetables	DBT	2014-2017	25.65	Dr.D.Balachandar Dr. Z. John-kennady Dr.S. Karthikeyan
101.	**MHRD/NRM/CBE/AGM/2014/R015** Microbes to feed the world: Plant microbe interactions to boost agricultural production	MHRD COE-FAST	2014-2018	250.00	Dr. U. Sivakumar Dr. P. Marimuthu Dr. D.Balachandar Dr. K. Kumutha Dr. M. Senthil Kumar
102.	**MFPI/NRM/CBE/AGM/2015/R016** Lactic acid bacteria of functional interest in nutrition of finger millet	MFPI	2015-2017	21.85	Dr.R.Subhashini Dr.M.Senthilkumar Dr. G. GuruMeenakshi
	Dept. of RS&GIS				
103.	**IRRI/NRM/CBE/RS/2012/R001** Remote Sensing based information and insurance for crops in emerging economies (RIICE)	IRRI	2012-2015	32.69	Dr. S.Pazhani-velanI Dr. P. Christy Nirmala Mary Dr. S. Thiruva-rassan Dr. M. Nagarajan Dr.E.Subramanian Dr. A. Kamaraj Dr. M. Bhaskaran Dr. T. Ramesh Dr. S. Soma-sundaram Dr. P. Kannan Dr.R.Sivasamy Dr.R.Jagadees-waran Dr.BalajiKannan
104.	**DST/NRM/CBE/RS/2013/R002** Developing spectral library and spectral indices for early prediction of crop nutrient deficiencies	DST	2013-2016	11.70	Dr.R.Jagadees-waran

	Dept. of Nano-Science and Technology				
105.	**DST/NRM/CBE/NST/2011/R001** Fabrication of nano agri inputs for promoting groundnut productivity and environmental safety	DST Nano mission	2011-2015	64.26	Dr.K.S.Subra-manian Dr.N.Natarajan Dr.K.Gunasekaran
106.	**DST/NRM/CBE/NST/2013/R002** Green synthesis of bioactive silver nano-particles using plant extract and their anti-nemic properties	DST	2013-2015	20.63	Dr. B. Anitha Dr.K.Gunasekaran
107.	**DST/NRM/CBE/NST/2013/R003** Nano-technological strategies for seed invigoration in rainfed groundnut	DST	2013-2016	25.00	Dr. N. Natarajan
108.	**UGC/NRM/CBE/NST/2013/R004** Identification of effective insecticidal crystal proteins from *Bacillus thuringiensis* (Berliner) to spotted pod borer, *Maruca testulalis* (Geyer) in *Dolichos lablab*	UGC	2013-2015	6.93	Dr. M. Kannan
109.	**DST/NRM/CBE/NST/2014/R005** Development of sulphur nano fertilizer formulation for sunflower to enhance productivity efficiency and environmental safety	DST	2014-2017	20.40	Dr. R. Rajeswari
110.	**DST/NRM/CBE/NST/2014/R006** Construction and evaluation of Lithium ion battery with synthesized nano structure cathode materials- lithium compounds and development of bioformulations from novel antagonistic actinomycetes	DST	2014-2017	33.51	Dr. Selvasekara-pandian
111.	**IDRC/NRM/CBE/NST/2014/R007** Enhanced preservation of fruits using nanotechnology **(Phase II)**	IDRC	2014-2018	665.00	Dr. K. S. Subra-manian Dr.K.Gunasekaran Dr.G.J.Janavi Dr. M. Bala-krishnan Dr. A. Subbiah Dr. I. Muthuvel Dr. S. Marimuthu Dr. M. Kannan Dr. M. Djanagui-raman Dr.C.Sekar
	Dept. of Environmental Sciences				
112.	**CIL/NRM/CBE/ENS/2011/R001** Strategic environmental Assessment of Coco cultivation in Tamil Nadu	Cadburys India Ltd	2011-2016	49.28	Dr. M. Maheswari
113.	**IWMUS/NRM/CBE/ENS/2012/ R002** Standardization and value addition of IWMUST – municipal solid waste compost for its quality and effect on soil and crops	Integrated Waste Managem ent & Urban Services Co. Tamil Nadu Ltd.	2012-2015	23.32	Dr. K. Valliappan
114.	**ITC/NRM/CBE/ENS/2014/R003** Effective utilization of treated effluent water and sludge generated from ITC factory	ITC Ltd, Karamadi	2014-2017	29.62	Dr.P.Subramanian

115.	**ACSM/NRM/CBE/ENS/2014/R004** Evaluation of distillery wastewater for Agriculture and its impact on environment	Amaravathy Co-operative Sugar Mills, Udumelpet	2014-2017	8.58	Dr. M. Maheswari
116.	**SPBL/NRM/CBE/ENS/2014/R005** 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	2014-2017	2.58	Dr.P.Subramanian
117.	**BASM/NRM/CBE/ENS/2014/R006** Studies on eco-monitoring of the land application of biomethanated distillery spent-wash on quality of water, soil health, yield ,quality of crop produce and sustainable environment	Bannari Amman Sugars Limited, Erode	2014-2017	13.14	Dr. P. Thangavel
118.	**SD/NRM/CBE/ENS/2014/R007** Assessing the long term impact of distillery effluent application on soil and crop and evaluation of alternative use of distillery effluent for crop production	Sakthi Distillery, Bhavani	2014-2017	10.17	Dr.P.Subramanian
	ARS, Bhavanisagar				
119.	**UGC/NRM/BSR/SAC/2014/R001** Developing technologies for converting banana pseudostem and poultry waste into wealth	UGC	8.47	2014-2016	Dr. S. Thenmozhi Dr. R. Parimala-devi
	MRS, Vagarai				
120.	**UGC/NRM/VGI/SAC/2012/R001** Biofortification of zinc in maize grain using mycorhizal symbiosis	UGC	7.76	2012-2015	Dr. C. Bharathi Dr.K.S.Subra-manian Dr. M. Gomathy
	Dept. of Soil and Environmental Science, AC & RI, Madurai				
121.	**RCF/NRM/MDU/SAC/2013/R001** Evolving and evaluating soil and crop specific fertilizer best management practices for enhancing agricultural productivity	RCF, Mumbai MoFC	2013-2016	25.38	Dr. B. Bakiyathu-Saliha
	Dept. of Agricultural Microbiology, AC & RI, Madurai				
122.	**DBT/CPPS/MDU/AGM/2013/R001** Manipulation of the gut bacteria of extremely polyphagus species of mealy bug *Paracoccus marginatus* to develop a novel pest management strategy	DBT	2013-2016	16.13	Dr. R. Anandham
123.	**DBT/NRM/MDU/AGM/2013/R002** Developing bio-restoration technology using the microbial consortium for restoration of profoundly degraded orathupalayam dam due to accumulation of xenobiotics from textile processing units in Tiruppur, Tamil Nadu	DBT	2013-2016	33.54	Dr. R. Anandham
124.	**DST/CPPS/MDU/AGM/2013/R003** Interference of quorum sensing signals of *Pseudomonas syringe* by acetyl homoserinelaconase secreting *Bacillus* and *Variovorax* species	DST	2013-2016	20.35	Dr. R. Anandham

	Centre for Plant Protection Studies				
	Agricultural Entomology				
	Dept. of Agricultural Entomology, Coimbatore				
125.	**ICAR/CPPS/CBE/AEN/2005/R001** All India Network Project (AINP) on Insect Biosystematics	ICAR	2005-2015	96.45	Dr. K. Ramaraju Dr.N.Chitra
126.	**UGC/CPPS/CBE/AEN/2013/R002** Biology, molecular characterization and food volatiles of *Sitophilus oryzae* feeding on sorghum and split pulse	UGC	2013-2016	11.45	Dr. K.Bhuvaneswari
127.	**DBT/CPPS/CBE/AEN/2013/R003** Development of oil based formulation of entomopathogenic fungi for the management of major thrips species of vegetables	DBT	2013-2016	19.51	Dr. S.Jeyarani Dr. K. Ramaraju
128.	**DST/CPPS/CBE/AEN/2013/R004** Ensuring food security: Harnessing science to protect our grain harvest from insect threats	DST	2013-2015	61.83	Dr. S.Mohan Dr.S.Mohan kumar
	ARS, Thirupathisaram				
129.	**DST/CPPS/CBE/TPS/2012/R001** Integrated pest management of cabbage aphid, *Brevicoryne brassicae* (L.) and mustard aphid, *Lipaphierysimi* (Kalt.)	DST SERB	2012-2015	5.16	Dr. G. Preetha
	SRS, Melalathur				
130.	**SDF/CPPS/MLR / ENT / 2011 /R 001** Evolving bio-intensive IPM strategies for management of woolly aphids in Tamilnadu	Sugarcane Development Fund, Ministry of consumer affairs, Food and Public distribution, GOI, New Delhi	2011-2015	19.37	Dr.A.Thiru-murugan
	RRS, Paiyur				
131.	**DST/CPPS /PYR /AGM / 2014 /R 001** Exploration of indigenous *Bacillus thuringiensis* crystal proteins targeting different insect pests and characterization of nematicidal crystal proteins against root knot nematode, *Meloidogyne incognita*	DST SERB	2014 - 2017	20.00	Dr.A.Ramalakshmi
	Plant Pathology				
	Dept. of Plant Pathology, Coimbatore				
132.	**DST/CPPS/CBE/PAT/2012/R001** Bio-priming of banana tissues culture plantlets with PGPR endophytes for enhanced resistance to rhizome rot of banana caused by *Erwinia carotovora pv. carotovora*	DST SERB	2012-2015	16.31	Dr.S.K.Manoranjitham
133.	**DST/CPPS/CBE/PAT/2012/R002** Isolation and screening of novel rhizosphere and endophytic bacterial isolates using molecular markers and exploitation against sheath blight of rice	DST SERB	2012-2015	19.90	Dr.S.Harish

134.	**DST/CPPS/CBE/PAT/2012/R003** Development of microbial based bioformulations for the mangement of major fungul disease in Urdbean	DST SERB	2012-2015	22.00	Dr.P.Latha
135.	**DBT/CPPS/CBE/PAT/2012/R004** Development of isotonic aqueous formulation of *Chaetomium globosum* for the management of foliar and soil borne diseases of potato	DBT	2012-2015	19.30	Dr.T.Raguchander
136.	**DBT/CPPS/CBE/PAT/2012/R005** Exploiting lipopolysacharides producing PGPR in the development of aqueous formulation for the management of nematode disease complex in high value export oriented floriculture crops	DBT	2012-2015	44.97	Dr.E.I.Jonathan Dr.T.Raguchander
137.	**DST/CPPS/CBE/PAT/2012/R006** Development of immunological and molecular tools for diagnosis and management of Aspergillus flavus infection and aflatoxin contamination in foods and feeds	DST	2012-2015	39.50	Dr. R. Velazhagan
138.	**UGC/CPPS/CBE/PAT/2013/R007** Engineering resistance against peanut stem necrosis disease (PSND) in groundnut through RNAi technology	UGC	2013-2016	13.26	Dr.R. Velazhahan
139.	**DST/CPPS/CBE/PAT/2013/R008** Exploiting lipopeptide producing strains of *Bacillus subtilis* with genetic competence for the management of soil borne diseases of pigeonpea and chickpea	DST	2013-2016	19.55	Dr.E.Rajeswari
140.	**DST/CPPS/CBE/PAT/2013/R009** Bioprospecting of ACC deaminase producing plant growth promoting Rhizobacterial (PGPR) strains against root rot disease and terminal drought in mung and urdbean	DST-SERB	2013-2015	12.00	Dr. A. Kamala-kannan
141.	**DST/CPPS/CBE/PAT/2014/R010** Liquid Chaetomium induced transcriptional and proteomic changes in the management of Pythium rhizome rot in turmeric	DST-SERB	2014-2017	25.12	Dr. T. Ragu-chander
	RRS, Ambasamudrum				
142.	**UGC/CPPS/ASD/PAT/2012/R001** Eco friendly management of post flowering stalk rot (PFSR) of maize (*Zea mays*.L) by using biocontrol agents	UGC	2012-2015	8.08	Dr. N. Rajinimala
	CRS, Veppanthattai				
143.	**DST/CPPS/VTI/PAT/2012/R001** Exploitation of antibiotics and ACC- deaminase producing PGPR strains against biotic (root rot and wilt) and abiotic stress (parawilt /drought) in cotton	DST	2012-2015	19.15	Dr.T.Anand Dr.T.Raguchander Dr.R.Kavimani
	Seed Centre				
	Dept. of Seed Science and Technology				
144.	**PPV/SC/CBE/SST/2003/R001** Implementation of PVP legislation	PPV&FRA	2003-2015	16.50	Dr.A.Vijayakumar Dr.R.Vijayan

	through DUS testing under ICAR and SAU Systems				Dr.C.Menaka
145.	**UGC/SC/CBE/SST/2012/R002** Physiological, biochemical and molecular basis of seed biopriming with biocontrol agents and liquid biofertilizers in rice and maize	UGC	2012-2015	10.97	Dr.M.Bhaskaran Dr.P.Selvaraju
146.	**UGC/SC/CBE/SST/2012/R003** Development of technologies for organic seed production in vegetables	UGC	2012-2015	10.40	Dr.K.Sundara-lingam Dr.S.Lakshmi Dr.V.Manonmani
	Water Technology Centre				
147.	**NABARD/WTC/CBE/WTC/2012/R001**Sustainable sugarcane initiative – an unique system to increase water productivity in sugarance	NABARD	2012-2015	42.49	Dr. R. Chandra-sekaran
148.	**VWF/WTC/CBE/WTC/2013/R002** Performance of structured water on growth, yield and quality of cotton and vegetables.	VWF Industries	2013-2015	6.42	Dr.D.Jayanthi
149.	**NETAFIM/WTC/CBE/WTC/2013/R003** Drip fertigation studies in aerobic rice (Phase II)	Netafim	2013-2015	4.05	Dr.P.Manickasundaram
150.	**GOI/WTC/CBE/WTC/2013/R004** Assessment of fluoride contamination in the ground water of western zone of TN.	GOI	2013-2016	4.26	Dr.P.Jothimani
151.	**GOI/WTC/CBE/WTC/2013/R005** Soil and water quality appraisal in the salt affected land forms of Nagapattinam district, Tamil Nadu using Remote sensing and GIS techniques.	GOI	2013-2016	17.26	Dr.D.Jayanthi
152.	**GoTN/WTC/CBE/WTC/2014/R006** Evaluation study on the impact of command area development and water management programme in Gudaganar command project	Govt. of TN	2014-2015	0.53	Dr. S. Senthil-nathan
	TCRS, Yethapur				
153.	**DST/WTC/YTP/VEG/2012/R001** Spatial distribution of moisture and nutrients in root zone under drip fertigation in chillies (Operation at Soil and Water Management Research Institute, Kattuthottam, Thanjavur)	DST	2012-2015	13.00	Dr. S. Suganya
	Agricultural Engineering				
	Agricultural Machinery Research Centre				
154.	**DST/AEC/CBE/AME/2013/R001** Feasibility study for development of sensor based precision fertilizer application device for paddy	DST	2013-2015	19.07	Dr.R.Kavitha Dr. D. Anantha krishnan Dr.P.Santhy Dr.S.Vincent Dr. G. Guru
	Dept. of Bioenergy				
155.	**ICAR/AEC/CBE/BEN/2011/R001** Isolation of *Clostridium* strains and a two phase digestion system for efficient butanol production	ICAR	2011-2015	48.67	Dr.S.Karthikeyan
156.	**JCERDC/AEC/CBE/BEN/2012/R002**Second generation biofuels – US –India consortium for development of sustainable	JCERDC	2012-2017	89.35	Dr.S.Kamaraj Dr.S.Karthikeyan Dr.D.Ramesh

	advanced lignocellulosic biofuel systems (SALBS)- Network Project				
157.	**DST/AEC/CBE/BEN/2013/R003** Development of network and online metering of drying parameters of biomass hot air generation system integrated with solar tunnel dryer for agro products drying applications	DST	2013-2015	28.76	Dr.P.Venkata-chalam Dr.R.Mahendiran
158.	**MNRE/AEC/CBE/BEN/2014/R004** Development of hybrid high rate bimethanation reactor with locally available media for treating waste water and solid waste	MoNRE	2014-2016	59.33	Dr.S.Kamaraj Dr.J.John Gunasekar Dr.S.Pugalendhi
	Dept. of Food and Agricultural Process Engineering				
159.	**UGC/AEC/CBE/FAP/2012/R001** Development of farm level ripening chamber for fruit ripening	UGC	2012-2015	7.55	Dr. C. Indurani Dr.P.Rajkumar
160.	**MFPI/AEC/CBE/FAP/2013/R002** Design and development of ohmic heating system for pasteurization of liquid egg white and to enhance the functional properties of egg white albumen	MFPI	2013-2015	20.28	Dr. K. Thangavel Dr.M.Balakrishnan
161.	**AICTE/AEC/CBE/FAP/2014/R003** Design development of ozone based farm level storage bin for managing insects in stored grains in Indian storage condition	AICTE	2014-2017	12.88	Dr. V.Thirupathi
	Post Harvest Technology Centre				
162.	**DST/HCRI/CBE/PHT/2013/R001** Screening of Indian muskmelon varieties for high beta carotene quality traits and development of superior muskmelon hybrids for commercial cultivation	DST, SERB	2013-2015	12.00	Dr.K.Venkatesan
	Agricultural Engineering College, Kumulur				
163.	**MFPI/AEC/KUM/PHT/2012/R001** Design and development of a tamarind fruit dehuller and deseeder	MoFPI	2012-2015	10.40	Dr.P.Rajkumar Dr.R.Viswanathan Dr.C.Indu Rani
164.	**DST/AEC/KUM/SWC/2013/R002** Design and development of a sensor system for efficient water management in rice crop	DST	2013-2015	27.33	Dr.K.Ramaswamy
165.	**DST/AEC/KUM/ AME/2013/R003**Development of power operated sugarcane sett cutter cum detopper and detrasher	DST	2013-2016	4.14	Dr.P.Kamaraj
	RRS, Paiyur				
166.	**DST/AEC/PYR/FME/2013/R001** Development of tractor mounted hydraulic operated ladder	DST	2013-2016	7.85	Dr.R.Thiyagarajan Dr. A. Tajuddin
167.	**DST /AEC /PYR/ BEN / 2013 / R002**Production and evaluation of biochar characteristics that influence green house has emission	DST	2013-2015	£39953.50	Dr. P. Venkata-chalam
	KVK, AC&RI, Madurai				
168.	**DST/AEC/MDU/FME/2012/R001** Design and development of tractor operated precision planter for pulses	DST	2012-2015	5.45	Dr. P.K. Padama-naban

	Precision Farming Development Centre				
169.	**GOI/AEC/CBE/SWC/2014/D 001** Precision Farming Development Centre	GOI - National Committee on Plasticulture Applications in Agriculture and Horticulture, New Delhi	2014-2015 from 1986 and is a continuous scheme till date	52.92	Dr.S.V.Kottiswaran
	FORESTRY				
	Dept. of Silviculture				
170.	**CII/FCRI/MTP/DOS/2013/R001** Vision carbon neutral: A joint initiative for promotion carbon neutral schools/institutions	CII-Yi CBE	2013-2018	19.32	Dr.A.Bala-subramanian Dr.M.Tilak Dr.S.Radha-krishnan Dr.S.Varadharaj Dr.S.Velmurugan
171.	**IINRG/FCRI/MTP/DOS/2014/R002** Network project on harvesting processing and value addition of natural resins and gums – Tamarind seed gum	ICAR-IINRG Namkum	2014-2017	52.70	Dr.A.Bala-subramanian Dr.S.Radha-krishnan Dr.P.Pretheep Kumar Dr.M.Kiruba
172.	**DoETN/FCRI/MTP/DOS/2014/ R003** Utilization of treated domestic sewage water for wood production by afforesting fast growing trees	DoE Govt. of Tamil Nadu	2014-2017	4.12	Dr.S.Radha-krishnan Dr.A.Bala-subramanian Dr.K.Sivakumar Dr.M.Tilak
173.	**DST/FCRI/MTP/DOS/2012/R004** Evaluation of whole pea flour and protein rich pea fractions as a biopesticide for the management of insects attacking seeds of trees during storage	DST SERB	2012-2015	11.20	Dr.P.Pretheep Kumar
	Dept. of Forest products and Utilization				
174.	**NOVOD/FCRI/MTP/DFU/2011/ R001** Collection, evaluation and genetic Improvement of Mahua for high yield, oil content as well as superior oil quality	NOVOD Board	2011-2015	16.99	Dr.S.Manivasakan Dr. K. K. Suresh Dr. S. Umesh Kanna
175.	**ICFRE/FCRI/MTP/DFU/2012/R002** Survey, documentation and value addition studies in selected NTFPs of Tamil Nadu	ICFRE Dehra Dun	2012-2015	13.00	Dr. I. Sekar Dr.A.Vidyavathi Dr.R.Ananda-lakshmi
	Dept. of Tree Breeding				
176.	**SPB/FCRI/MTP/DTB/2011/R001** Genetic enhancement of pulpwood species through breeding and biotechnology	SPB Ltd, Erode	2011-2016	16.56	Dr.K.T.Parthiban Dr.S.UmeshKanna Dr.P.Rajendran Dr.P.S.Devanand
177.	**AMEC/FCRI/MTP/DTB/2011/R002** Promotion and popularization of renewable energy in Tamil Nadu in association with Auromira bioenergy	Auro Mira Energy Company Private Ltd. Chennai	2011-2016	25.01	Dr.K.T.Parthiban Dr.S.UmeshKanna Dr.P.Rajendran Dr.P.S.Devanand
178.	**APB/FCRI/MTP/DTB/2014/R003** Inventory, evaluation and promotion of genetic resources of	Ambiply Panels and Doors	2014-2019	10.06	Dr.K.T.Parthiban Dr. I. Sekar Dr.S.UmeshKanna

	tree species amenable for plywood making in Tamil Nadu	Mettupalayam			
	Centre of Excellence in Biofuels				
179.	**MNRE/FCRI/MTP/CEB/2010/R001** Demonstration of promising genotypes of *Jatropha i*n Tamil Nadu	MNRE	2010-2015	34.10	Dr.K.B.Sujatha Dr.R. Jude Sudhagar Dr.P.Renukadevi
180.	**NOVOD/FCRI/MTP/CEB/2011/ R002** National network project on litegrated development of *Jatropha* and Karanja	NOVOD Board	2011-2015	35.37	Dr.M.Paramathma Dr.P.Jayamani Dr.R.Umarani Dr.R.Revathi
	HORTICULTURE				
	Dept. of Fruits				
181.	**PPV/HCRI/CBE/FRU/2011/R001** Establishment of DUS centre at TNAU for Papaya	PPV&FRA	2011-2015	10.00	Dr. K.Soorianatha-sundaram Dr.J.Auxcilia
182.	**ICAR/HCRI/CBE/FRU/2014/R 002** Management of Papaya ringspot virus through breeding approaches	ICAR flagship	2014-2017	93.14	Dr. K. Soorianatha-sundaram Dr. C. Kavitha Dr. K. Thiribhu-vanamala
	Dept. of Vegetables				
183.	**DBT/HCRI/CBE/VEG/2011/R001** Identification of Quantitative Trait Loci for carotene content and flesh thickness in pumpkin (*Cucurbita moschata* L.) to enable bio fortification	DBT	2012-2015	7.56	Dr. T. Saraswathi Dr. L. Pugalendhi Dr. Ramalingam Dr. S. Makesh
184.	**DST/HCRI/VEG/CBE/2012/R002** Standardization of grafting techniques in cucumber (*Cucmis sativus* L.) to mitigate root knot nematode and soil borne diseases	DST	2012-2015	20.10	Dr.C. Thangamani Dr. L. Pugalendhi
	Dept. of Spices and Plantation Crops				
185.	**Kraft Foods/HCRI/CBE/SPC/2013/R001** Sustainable cocoa production in Tamil Nadu, India	Kraft Foods UK	2013-2018	248.93	Component 1: Dr. J. Suresh Dr. K. Rajamani Dr.S.Subramanian Dr.P.Jeyakumar Dr.N.Shoba Dr. V.Jegadees-wari Dr.P.Muthulakshmi Dr.M.Suganthi Component 2: Dr. R. Gnanam
186.	**NHM/HCRI/CBE/SPC/2006/D001** Centrally Sponsored Scheme – Mission for Integrated Development of Horticulture	GOI	2006 onwards	36.75	Dr.S.Subramanian
187.	**DST/HCRI/CBE/SPC/2013/R002** Molecular tagging of root rot (*Macrophomina phaseolina)* resistant gene in Brinjal (*Solanum melongena* L.)	DST	2013 - 2016	15.00	Dr. R. Chitra Dr. J. Suresh Dr. C. Ushamalini
188.	**DST/HCRI/CBE/SPC/2014/D002** Improvement of science and technology infrastructure in higher educational institutions	DST FIST	2014-2019	52.00	Dr. S.Mariappan Dr. J.Suresh Dr. R. Chitra Dr. S. Velmurugan
	Dept. of Floriculture and Landscaping				
189.	**PPV/HCRI/FLS/CBE/2014/R001** GOI Scheme - Validation of DUS	PPV&FRA	2011 onwards	19.16	

	testing guidelines for Jasmine				
190.	**C-DAC/HCRI/FLS/CBE/2013/ R002** Blossoming and quality testing of jasmine flower using electronic nose technology	C-DAC, Kolkatta	2013-2015	11.00	
	HC&RI(W), Trichy				
191.	**DBT/HCRI/TRY/FRU/2013/R001** Development of National Database in Mango	DBT	2013-2016	27.00	Dr.T.N.Balamohan Dr.A.Ramesh Kumar
	CRS, Aliyar Nagar				
192.	**DST/HCRI/ALR/SPC/2012/R001** Modern agricultural implements, science and technology transfer to tribal community for sustainable livelihood in the Western Ghats of Coimbatore district, Tamil Nadu (Part II)	DST	2012-2015	13.59	Dr.N.Shoba Dr.H.UshaNandhini Devi Dr.N.Premalatha
193.	**DST/HCRI/ALR/SPC/2012/R002** Genetic diversity, population structure and linkage disequilibrium assessment for association mapping studies in Coconut (*Cocos nucifera* L.) germplasm	DST	2012-2015	15.95	Dr.S. Geethanjali
194.	**ICRISAT/CPPS/ALR/OIL/2012/ R003** Agriculture for improved nutrition and health	ICRISAT	2012-2015	3.57	Dr. S. Sundaravadana
195.	**ICAR/CPBG/ALR/OIL/2014/R004** Multilocation evaluation of MABC derived disease resistant groundnut lines	DGR, Junagadh	2014-2015	9.55	Dr. N. Premalatha Dr. S. Sundaravadana
	HRS, Thadiyankudisai				
196.	**DBT/HCRI/TKD/FRU/2013/R001** Demonstration and popularization of perennial horticultural crops under rainfed cultivation for nutritional security to mitigate malnutrition, better livelihood and upliftment of tribal farmers in Western Ghats of Tamil Nadu	DBT	2013 - 2016	6.56	Dr.S.Praneetha
	HRS, Kodaikanal				
197.	**ICAR/HCRI/KKL/FRU/2014/R001** Network project on outreach of technologies for temperate fruit crops	ICAR	2014-2015	5.20	Dr. J. Rajangam Dr. B. Senthamizh Selvi
	HRS, Yercaud				
198.	**DST/CPPS/YCD/SPC/2012/R001** Cold tolerant rhizobacteria as bio nematicide for High value crops (Black pepper and Coffee) at hilly regions	DST	2012-2015	13.00	Dr.P.Senthilkumar
199.	**DST/CPPS/YCD/SPC/2012/R002** Enhancement of host plant defense mechanism and bio-surfactant management of rhizome rot of ginger and turmeric	DST	2012-2015	19.00	Dr. T. Saravanan
200.	**NHM/HCRI/YCD/SPC/2014/R003** GOI – Centrally sponsored scheme : Black pepper	NHM	2014-2015	13.13	Dr. N. Nageswari
	HRS, Ooty				
201.	**DST/CPPS/OTY/PAT/2014/R001** Development of bioformulations from novel antagonistic actinomycetes for the management	DST	2014-2017	17.00	Dr. S. Malathi Dr. D. Alice

	for major fungal diseases in pigeon pea				
202.	**GOI/DCM/OTY/ACR/2014/R 002** GOI scheme- Weather based integrated agro advisory services in the country- Weather based advice to the farming community	Indian Meteorological Department	2014-2019	5.51	Dr. P. Raja Dr. B. Anita Dr. N. Selvaraj
203.	**NMFP/AEC/OTY/PHTC/2014/ D001** Entrepreneurship development programme	GOI-NMFP	2014-2015	2.00	Dr.V.P.Santhi Dr.B.Anitha Dr.N Selvaraj
	AC&RI, Killikulam				
	Dept. of SSAC, AC & RI, Killikulam				
204.	**TNPL/NRM/KKM/ENS/2012/R001** Evaluation of long term effect of utilization of TNPL effluent water for irrigation and remediation of effluent irrigated soil habitat	TNPL	2012 - 2015	77.07	Dr. C. Udaya-soorian Dr. R. M. Jayabala-krishnan
205.	**ISRO/NRM/KKM/ENS/2012/D001** Establishment of aerosol radiative forcing over India	ISRO, GOI	2008-2015	78.00	Dr. C. Udaya-soorian Dr. N. Selvaraj Dr. R. M. Jaya balakrishnan
206.	**ISRO/NRM/KKM/ENS/2014/D002** Establishment of environmental observatory at woodhouse, HRS, ooty	ISRO	2008-2015	97.60	Dr.C.Udaya-soorian Dr. N. Selvaraj Dr. R.M. Jaya-balakrishnan
	Dept. of PBG, AC & RI, Killikulam				
207.	**DST/CPBG/KKM/MIL/2012/R001** Identification of novel suppressor/enhancer transcriptional regulatory proteins controlling mycotoxin synthesis in fungi and generation of mycotoxin free agricultural produce	DST	2011-2016	73.00	Dr. V. Rama-moorthy
208.	**DST/CPBG/KKM/RIC/2012/R002** Transcript profiling and identification of markers for drought and salinity stress tolerance in rice	DST	2012-2015	18.96	Dr. S. Rajesh
209.	**DST/CPPS/KKM/PAT/2012/R003** Enhancing antifungal activity of plant defensin proteins, MsDef1 and MtDef4, by site-directed and random mutagenesis approaches	DST	2012-2015	11.00	Dr.V.Rama-moorthy
210.	**DST/CPBG/KKM/RIC/2013/R004** Development and molecular characterization of new TGMS lines and two line hybrid rice (Oryza sativa L) suitable for Tamil Nadu	DST	2013-2016	13.99	Dr.A.Muthuswamy Dr. S. Rajesh
211.	**UGC/CPBG/KKM/FRU/2013/R005** Sex prediction in papaya through biochemical and PCR techniques	UGC	2013 - 2016	10.00	Dr. R. Amutha
212.	**UGC/CPBG/KKM/MUS/2013/R006** Cloning and characterization of promoters for over-expression of heterologous proteins in *Pleurotus ostreatus* and *Agaricus bisporus*	UGC	2013-2016	14.40	Dr. V. Rama-moorthy
	Dept. of Agricultural Entomology, AC & RI, Killikulam				
213.	**UGC/CPPS/KKM/ENT/2012/R001** Formulation of phytoanticipin	UGC	2012-2015	5.00	Dr. D.S. Rajavel

	Tomatine for the management of subterranean organisms with special reference to Termites, Nematodes and Soil borne fungus				
	HSC&RI, MADURAI				
214.	**UGC / HSCRI / MDU / HSC / 2012 /R 001** Study on the dietary antioxidant consumption among the adults and the effect of cooking and processing on the activity of antioxidants	UGC	2012 – 2015	10.18	Dr.T.Padmini
215.	**UGC / HSCRI / MDU / HSC / 2012 / R002** Value added products from yeast fermented heat sterilized defatted rice bran	UGC	2012 – 2015	12.21	Dr.P.S.Geetha Dr.B.Nalla-kurumban Dr.R.Anandham Dr.M.Sundaram
216.	**UGC / HSCRI / MDU / HSC / 2012 / R003** Formulation of probiotic millet fruit bar	UGC	2012 – 2015	10.88	Dr. R. Vijaya-lakshmi Dr.T.Padmini Dr.R.Anandham
217.	**UGC / HSCRI / MDU / HSC / 2012 / R004** Study the phytochemical and antioxidant properties of wild fruits and development of value added products from the selected wild fruits	UGC	2012 – 2015	10.36	Dr. B. Nalla-kurumban Dr.P.Banumathi Dr.P.S.Geetha
218.	**MFPI / HSCRI / MDU / HSC / 2013 / R005** Formulating value added products from minor tubers for food and industrial uses	MFPI, New Delhi	2013 – 2015	12.88	Dr.S.Parvathi Dr.S.Kanchana
219.	**DSIR / HSCRI / MDU / HSC / 2013 /R 006** Economic empowerment of SC and ST women on processing of moringa olefera leaves and its products as an income generating activity	DSIR, New Delhi	2013 – 2015	20.97	Dr.S.Parvathi Dr.S.Kanchana Dr.B.Nallakurumban
220.	**TNSCST/HSCRI/CBE/HSC/2013/ R 007** Optimization of technology for millets and pulse blended low glycemic functional pasta foods for metabolic disorders	TNSCST, Chennai	2013-2015	2.34	Dr. P. Banumathi Dr. S. Kanchana Dr. M. Ilamaran
	AC&RI, MADURAI				
	Directorate of NRM				
221.	**UGC/NRM/MDU/AGR/2012/R 001** Synthesis and fabrication of nano-encapsulated herbicide using direct and indirect core-core-shell and solvent evaporation method for slow release	UGC	2012-15	8.75	Dr C.R. Chninna-muthu
222.	**DBT / NRM / MDU / AGM / 2013 / R002** Developing bio-restoration technology using the microbial consortium for restoration of profoundly degraded orathupalayam dam due to accumulation of xenobiotics from textile processing units in Tiruppur, Tamil Nadu	DBT	2013-2016	33.54	Dr. R. Anandham

223.	**DST / NRM / MDU / SSAC / 2013 / R003** Empowering rural women population of Madurai District with Eco-WaSH literacy through SHGs	DST	2013-2015	8.25	Dr. K. Suganya
	Directorate of Crop Management				
224.	**DST / DCM / MDU / AGR / 2012 / R001** Response of rice fallow blackgram to various crop geometry under dibbling and machine sowing	DST	2013-2016	28.24	Dr.A. Veeramani
	Centre for Plant Protection Studies				
225.	**DST / CPPS / MDU / ENT / 2014 / R001** Upliftment of the coconut growers by adoption of IPDDM technologies in two major blocks of Madurai	DST	2014 - 2016	9.70	Dr.C.Muthiah
226.	**DBT / CPPS / MDU / ENT / 2014 / R002** Exploration of chemically mediated tritrophic interactions as induced by insect herbivory in rice ecosystem for biointensive insect pest management	DBT	2014--2016	25.45	Dr. R. Nalini
227.	**UGC / CPPS / MDU / PAT / 2014 / R003** Exploiting genetic variability of maize genotypes resistance to turcicum leaf blight disease under artificial epiphytotic condition"	UGC	2014-2016	7.92	Dr. K. Sethuraman
228.	**DST / CPPS / MDU / PAT / 2014 / R004** Viscosinamide – producing *Pseudomonas fluorescens* DR 54 strain for magaging major fungal diseases of maize"	DST	2014 - 2017	18.81	Dr. R. Radha-Jeyalakshmi
	Centre for Plant Breeding and Genetics				
229.	**UGC / CPBG / MDU / PBG / 2012 / R001** Mass Multiplication Through Direct Organogenesis in Bael (Aeglemarmelos (L.) and Asoka Tree (Saracaasoka (Roxb.))	UGC	2012-2015	7.66	Dr. R. Ushakumari
230.	**BRNS / CPBG / MDU / PBG / 2012 / R002** Development of an ideal ideotype for enhanced productivity and synchronized maturity through induced mutagenesis in Blackgram	BRNS	2012-2015	24.81	Dr. C. Vanniarajan
	Directorate of CARDS				
231.	**UGC / CARDS / MDU / TAM / 2013 / R001** Ancient tamil agriculture and proper technology dissemination	UGC	2013 - 2015	6.24	Dr.K.C.Kumaran
232.	**DST / CARDS / MDU / EXT / 2013 / R002** Techno economic empowerment of dryland farm women for livelihood security under millet based ecosystem whole farm approach	DST	2013-2015	7.86 6.32	Component I: Dr.J.Pushpa Component II: Dr. C. Vanniarajan Dr. E. Murugan
233.	**ICAR / CARDS / MDU / EXT / 2013 / R003** TMC MMI project : Production of	ICAR – CICR	2013-2016	26.00	Dr. P.P. Murugan

	documentary films on cotton technologies, publication of technical bulletin, development of cotton museum and technology park				
234.	**FMC / CARDS / MDU / AEC / 2014 / R004** Capacity building proramme on commodity futures market	Forward Market Commission	2014 - 2015	6.90	Dr.B.Parthipan Dr. M. Pragades-waran Dr. Angles
235.	**DST / CARDS / MDU / EXT / 2013 / R005** Establishing model climate responsive villages and dissemination of climate change adaptation and water management technologies through digital and folk media	DST	2015-2017	11.28	Dr. M. Rama-subramanian
	Centre for Agricultural Rural Development Studies				
	Dept. of Agricultural Economics				
236.	**GOI/CARDS/CBE/AEC/1970 / R001** GOI - Comprehensive scheme for studying the cost of cultivation in principal crops	GOI	1970-2017	450.00	Dr.R.Balasubramanian
237.	**GoTN/CARDS/CBE/AEC/1983/ R 002** Institution of endowment chair in agricultural marketing	Tamil Nadu Government	1983-2017	3.75	Dr.R.Balasubramanian Dr.S.Angles
238.	**GoTN/CARDS/CBE/AEC/2013/R 003** Estimating the Cost of Cultivation of Major Crops in Tamil Nadu	Govt. of Tamil Nadu	2013-2015	294.20	Dr.M. Chinnadurai Dr.M. David Rajasekaran Dr.M.Thilagavathy Dr. S. Varadharaj Dr. S. Angels Dr. S. Senthil-nathan Dr. A. Gurunthan Dr. M.Prahadees-waran
239.	**DST/CARDS/CBE/AEC/2013/ R 004** Developing computer based model for impact assessment of watershed development and building capacity in Tamil Nadu	DST	2013-2015	6.70	Dr.D.Sureshkumar Dr.P.Paramasivam Dr. M.Chinnadurai Dr.A.Raviraj
240.	**ATREE/CARDS/CBE/AEC/2013/R 005** Adapting to climate change in urbanising watersheds	Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore	2013-2015	5.65	Dr.D.Sureshkumar Dr.P.Paramasivam Dr. M.Chinnadurai
241.	**SPC/CARDS/CBE/AEC/2013/R 006** Preparation of perspective plans under State Balanced Growth Fund (SBGF) for Coimbatore district	SPC	2013-2016	1.00	Dr.M.Chinnadurai Dr.K.R.Ashok Dr.S.Varadha Raj
242.	**NCAP/CARDS/CBE/AEC/2013/R 007** Regional crop planning for improving resource use efficiency	ICAR - NCAP	2013-2017	10.00	Dr. M.Chinnadurai Dr. M.Chandra-sekaran Dr. R.Bala-

	and sustainability				subramanian Dr. K.R.Karuna-karan
243.	**NABARD/CARDS/CBE/AEC/2014 /R 008** Impact evaluation of educational infrastructure projects supported under NABARD-RIDF in Tamil Nadu	NABARD	2014-2015	9.50	Dr.M.Chinnadurai Dr.T.R.Shanmugam Dr.D.Sureskumar Dr.S.Varadha Raj
244.	**SPC/CARDS/CBE/AEC/2014/ R 009** Preparation of district human development report for coimbatore	SPC	2014-2016	3.00	Dr. M.Chinnadurai Dr. K.R.Ashok Dr. S.Varadha Raj
245.	**DBT/CARDS/CBE/AEC/2014/ R 010** Socio – economic research in the cassava biotechnology research network in India	DBT, GOI	2014-2017	14.14	Dr.K.R.Ashok Dr.M.Thilagavthi Dr.S.Varadharaj
246.	**GOI/CARDS/CBE/AEC/2014/R 011** Developing guidelines and methodologies for socio-economic assessment of LMOs	GOI	2015-2016	6.00	Dr.K.R.Ashok Dr.M.Chinnadurai Director
	Dept. of Agrl. Extension and Rural Sociology				
247.	**UGC/CARDS/CBE/AEX/2013/R 001** Promoting women entrepreneurship through Gender Analysis	UGC	2013-2016	9.05	Dr.R.Premavathi Dr.V.Ravichandran
	Dept. of Agrl. and Rural Management				
248.	**IFPRI/CARDS/CBE/ARM/2012/R 001** Innovative water saving irrigation and investment priorities for food security and water sustainability in India	IFPRI Washington	2012-2015	13.50	Dr.N.Venkatesa Palanichamy Dr.K.Govindarajan Dr.M.Shantha sheela
249.	**UGC/CARDS/CBE/ARM/2014/R 002** Explore and analyze the supply chain of organic food products and modelling organic consumer buying behaviour in Tamil Nadu	UGC-Post Doctoral Fellow for Women	2014-2020	22.66	Dr.V.Sakthirama Research Scholar
	Dept. of Trade and Intellectual Property				
250.	**DBT/CARDS/CBE/TIP/2011/R 001** Dissemination of improved tapioca production technologies and value techniques among SC/ST tapioca growers for their economic upliftment in salem district of Tamil Nadu	DBT	2011-2015	18.07	Dr.A.Janaki Rani Dr.K.Nageswari Mrs. M.Malarkodi
	TCRS, Yethapur				
251.	**GoTN/CARDS/YTP/EXT/2015/ D001** 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

NRTT, Mumbai

252.	NRTT/WTC/CBE/ AGR/2013/R006 Drip irrigation capacity building and management initiative for maximizing income of small and marginal farmers.	2013 - 16	35.73	Dr.SP.Ramanathan Prof (Agronomy)
253.	Upscaling and dissemination of Integrated Pest Management (IPM) in rice Tamirabarani river basin in Tamil Nadu	2013-2016	38.44	Dr. G.Ravi Professor and Head (Entomology)
254.	Popularization of SSI technology on sugarcane farmers of Salem district	2013-2015	14.08	Dr.S.Manickam Prof. and Head, TCRS, Yethapur Dr. K. Nageswari, Prof. and Head, HRS, Yercaud Dr. P. S. Kavitha, Asst. Prof. (Horti.), KVK, Sandhiyur
255.	Upscaling popularization of little millet in Javadu Hills of Tiruvannamalai district, Tamil Nadu for enhancing the livelihood of tribal farmers	2011-2015	32.12	Dr. A. Nirmala Kumari, CEM, Athiyanthal Dr. A. Subramanian
256.	Ensuring Nutritional Security to the Rural Poor through Nutritional Gardens in Villages of Dharmapuri District under the Reviving	Oct.-Dec. 2014	10.00	KVK, Papparapatty

TN-IAMWARM

257.	F38 AH - Tamil Nadu Irrigated Agriculture Modernization and Water Bodies Restoration and Management Project	2007 to till date	9238.00	WTC, Coimbatore

NADP

258.	Demonstration of synchronized maturing pulses varieties with key technologies and mechanisation for higher productivity	2013-14	60.00	Director, CMS, Dr. Latha, Prof. (Agron) Dept. of Pulses TNAU, Coimbatore
259.	Promotion of Quality Seed Production In Green Manures	2013-14	40.00	Special Officer (Seeds), TNAU, Coimbatore
260.	Enhancement of productivity and quality in Grapes through Hi-tech management practices	2013-14	90.00	The Prof. and Head Grapes Research Station,,Theni
261.	Demonstration of Direct Seeded Rice (DSR) in dry and puddled condition to enhance productivity in selected districts of Tamil Nadu	2013-14	100.00	Director, CMS, TNAU, Coimbatore
262.	Establishment of back office at Tamil Nadu Agricultural University to interface with e-Resource division of Agro Marketing Intelligence and Business Promotion Centre, Trichy	2013-14	70.00	Director, Extn. Education & Dr.N.Ajjan, Professor Dept. of ARM TNAU, Coimbatore
263.	Promotion of quality seed production in Green manures	2014-15	74.08	Special Officer (Seeds), TNAU, Coimbatore
264.	Enhancement of productivity and quality in Grapes through high tech management practices	2014-15	107.50	The Prof. and Head Grapes Research Station, Theni

Ongoing bio-efficacy, hybrid / varietal evaluation studies at TNAU

Directorate	No. of studies	Products (Numbers)	Nos.	Total Budget in Lakhs
DCM	9	Herbicides	5	77.848
		Liquid manure	1	
		Growth promoters	4	
NRM	3	Micro Neutrients	1	52.940
		Herbicide	1	
		Bio- pesticide	1	
CPPS	50	Insecticides	17	320.770
		Biopesticides	4	
		Fungicides	27	
		Biofungicides	5	
		Antiviral	1	
		Nematicides	2	
WTC	15	Structured water	1	15.80
		Growth promoter	1	
		Herbicide	1	
HORTICULTURE	3	Growth promoter	1	3.50
CPBG	1	Hybrid/varietal evaluation (cotton, maize, pearl millet, fodder sorghum & cumbu)	60	43.510
TOTAL	**81**	**73 (other than Hybrids and varieties)**		**514.368**

Ongoing AICRP Schemes at TNAU

Sl.No.	Project Number	AICRP schemes and centres
AGRICULTURAL ENGINEERING		
1.	AICRP/AGE/CBE/BEN/001	AICRP on Renewable Sources of Energy for Agrl. and Agro Based Industries, Dept of Bio energy, Coimbatore
2.	AICRP/AGE/CBE/FMR/002	AICRP on Farm Implements and Machinery, Dept. of Farm Machinery, Coimbatore
3.	AICRP/AGE/KMR/FMR/003	AICRP on Ergonomic and Safety in Agriculture, Dept. of Farm Machinery, Coimbatore
4.	AICRP/AGE/CBE/PHT/004	AICRP on Post Harvest Technology, Dept. of Agrl. Processing, Coimbatore
CROP MANAGEMENT		
5.	AICRP/DCM/CBE/AGR/001	AICRP on Integrated Farming System Research, Dept. of Agronomy, Coimbatore
6.	AICRP/DCM/CBE/AGR/002	AICRP on Weed Control, Dept of Agronomy, Coimbatore
7.	AICRP/DCM/KPT/AGR/003	AICRP on Agrl. Meteorology, ARS, Kovilpatti
8.	AICRP/DCM/KPT/AGR/004	AICRP on Dryland Agriculture, ARS, Kovilpatti
FORESTRY		
9.	AICRP/FOR/MTP/FOR/001	AICRP on Agro Forestry, FC&RI, Mettupalayam
10.	AICRP/FOR/MTP/FOR/002	All India Network Project on Potential Crops, FC&RI, Mettupalayam
HORTICULTURE		
11.	AICRP/HOR/ALR/SPI/001	AICRP on Palms, CRS, Aliyarnagar
12.	AICRP/HOR/VPM/CON/002	AICRP on Palms, CRS, Veppankulam
13.	AICRP/HOR/KKM/PAL/003	AICRP on Palms-Palmyrah, AC&RI, Killikulam
14.	AICRP/HOR/PTI/OIP/004	AICRP on Palms – Oilpalm, ARS, Pattukottai
15.	AICRP/HOR/CBE/FRU/005	AICRP on Fruits, Dept. of Fruit Crops, Coimbatore
16.	AICRP/HOR/PKM/FRU/006	AICRP on Fruits, HC&RI, Periyakulam

17.	AICRP/HOR/APK/FRU/007	AICRP Arid Zone Fruits, RRS, Aruppukottai
18.	AICRP/HOR/CBE/VEG/008	AICRP on Vegetable Improvement, Dept. of Vegetable Crops, Coimbatore
19.	AICRP/HOR/CBE/VEG/009	AICRP on Tuber Crops, Dept. of Vegetable Crops, Coimbatore
20.	AICRP/HOR/CBE/FLR/010	AICRP on Floriculture Improvement, Dept. of Floriculture & Landscaping, Coimbatore, Main Centre
21.	AICRP/HOR/OTY/FLR/011	AICRP on Floriculture Improvement, HRS, Ooty (Sub centre)
22.	AICRP/HOR/CBE/SPI/012	AICRP on Spices, Dept. of Spices and Plantation Crops, Coimbatore
23.	AICRP/HOR/YER/SPI/013	AICRP on Spices - Cardamom, HRS, Yercaud
24.	AICRP/HOR/CBE/MAP/014	AICRP on Medicinal and Aromatic Plants including Betelvine, Dept. of Medicinal and Aromatic Plants, Coimbatore
25.	AICRP/HOR/VRI/CSW/015	AICRP on Cashew, RRS, Vridhachalam
NATURAL RESOURECE MANAGEMENT		
26.	AICRP/NRM/CBE/AGM/001	All India Net Work Project on Soil Biodiversity and Biofertilizers, Dept. of Agrl. Microbiology, Coimbatore
27.	AICRP/NRM/CBE/SAC/002	AICRP on Soil Test with Crop Response, Dept of Soil Science and Agrl. Chemistry, Coimbatore
28.	AICRP/NRM/CBE/SAC/003	AICRP on Long Term Fertilizer Experiments, Dept. of SS&AC, Coimbatore
29.	AICRP/NRM/CBE/SAC/004	AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soil and Plants, Dept. of SS&AC, Coimbatore
30.	AICRP/NRM/TRY/SAC/005	AICRP on Management of Salt Effected Soil and use of Saline Water in Agri, ADAC&RI, Trichy
CENTRE FOR PLANT BREEDING AND GENETICS		
31.	AICRP/PBG/ADT/JUT/001	All India Network Project on Jute and Allied Fibres, TRRI, Aduthurai
32.	AICRP/PBG/ADT/RIC/002	AICRP on Rice, TRRI, Aduthurai
33.	AICRP/PBG/CBE/RIC/003	AICRP on Rice, Dept. of Rice, Coimbatore
34.	AICRP/PBG/CBE/MAZ/004	AICRP on Maize Improvement, Dept. of Millets, Coimbatore
35.	AICRP/PBG/VGI/MAZ/005	AICRP on Maize, MRS, Vagarai
36.	AICRP/PBG/CBE/SOR/006	AICRP on Sorghum, Dept. of Millets, Coimbatore
37.	AICRP/PBG/KPT/SOR/007	AICRP on Sorghum, ARS Kovilpatti
38.	AICRP/PBG/CBE/MIM/008	AICRP on Small Millets, Dept. of Millets, Coimbatore
39.	AICRP/PBG/CBE/PEM/009	AICRP on Pearl Millet, Dept. of Millets, Coimbatore
40.	AICRP/PBG/CBE/PIP/010	AICRP on Pigeonpea (Main Centre) Dept. of Pulses, Coimbatore
41.	AICRP/PBG/VBN/PIP/011	AICRP on Pigeonpea, NPRC, Vamban
42.	AICRP/PBG/CBE/CHP/012	AICRP on Chickpea, Dept. of Pulses, Coimbatore (w.e.f. 1.4.2015)
43.	AICRP/PBG/VBN/MUL/013	AICRP on MuLLARP (Main Centre), NPRC, Vamban
44.	AICRP/PBG/CBE/MUL/014	AICRP on MuLLARP, Dept. of Pulses, TNAU, Coimbatore
45.	AICRP/PBG/ADT/MUL/015	AICRP on MuLLARP, TRRI, Aduthurai (w.e.f. 1.4.2015)
46.	AICRP/PBG/CBE/SOY/016	AICRP on Soybean, Dept. of Pulses, Coimbatore
47.	AICRP/PBG/VRI/GNT/017	AICRP on Oilseeds - Groundnut, RRS, Vridhachalam
48.	AICRP/PBG/ALR/GNT/018	AICRP on Oilseeds - off Season Nursery (Groundnut), CRS, Aliyarnagar
49.	AICRP/PBG/BSR/GNT/019	AICRP on Oilseeds (Rabi Summer Groundnut), ARS, Bhavanisagar
50.	AICRP/PBG/CBE/SUN/020	AICRP on Oilseeds (Sunflower), Dept. of Oil Seeds, Coimbatore
51.	AICRP/PBG/VRI/SES/021	AICRP on Oilseeds - Sesamum, RRS, Vridhachalam

52.	AICRP/PBG/YPR/CAS/022	AICRP on Oilseeds – Castor, T&CRS, Yethapur
53.	AICRP/PBG/CBE/COT/023	AICRP on Cotton, Dept. of Cotton, Coimbatore
54.	AICRP/PBG/SVR/COT/024	AICRP on Cotton Improvement, CRS, Srivilliputhur
55.	AICRP/PBG/CUD/SUG/025	AICRP on Sugarcane, SRS, Cuddalore
56.	AICRP/PBG/CBE/FCR/026	AICRP on Forage Crops, Dept. of Forage Crops, Coimbatore
	SEED CENTRE	
57.	AICRP/STR/CBE/SEP/001	AICRP on NSP-Crops Seed Technology Research, Seed Centre, Coimbatore
58.	AICRP/STR/BSR/SEP/002	AICRP on NSP-Crops, ARS, Bhavanisagar
CENTRE FOR PLANT PROTECTION STUDIES		
59.	AICRP/PPS/CBE/AEN/001	AICRP on Biological Control of Crop Pests and Weeds, Dept. of Agrl. Entomology, CBE
60.	AICRP/PPS/CBE/AEN/002	AICRP on Acarology, Dept. of Entomology, Coimbatore
61.	AICRP/PPS/CBE/NEM/003	AICRP on Plant Parasite Nematodes, Dept. of Nematology, Coimbatore
62.	AICRP/PPS/CBE/PAT/004	AICRP on Mushroom Improvement, Dept. of Plant Pathology, Coimbatore
63.	AICRP/PPS/CBE/AEN/005	All India Net Work Project on Pesticide Residue, Dept. of Agrl. Entomology, Coimbatore (w.e.f. 1.4.2015)
WATER TECHNOLOGY CENTRE		
64.	AICRP/WTC/CBE/IWM/001	AICRP on Irrigation Water Management, AC&RI, Madurai-Sub Centre and ARS, Bhavanisagar – Sub Centre