

RESEARCH HIGHLIGHTS 2019

AGRICULTURE

I. CROP IMPROVEMENT

1. CENTRE FOR PLANT BREEDING AND GENETICS

Rice

Newly released varieties / hybrids

Rice ADT 51 (2018)

It is a cross derivative of BPT 5204/I.W.Ponni. It recorded an average grain yield of 6533kg/ha which is 9.8 and 12.7 per cent increased yield over CR 1009 and ADT 50. The grains of this variety are white medium, has high milling (70.3%) and head rice recovery (60.5%) and



good cooking quality similar to CR 1009. Cooked rice is non-sticky and soft. The

variety is moderately resistant to leaf folder, stem borer and BPH and resistant to blast and moderately resistant to sheath blight and sheath rot. It is recommended for transplanted or semidry cultivation in Samba season of Cauvery Delta districts of Tamil Nadu. This variety is considered as an alternate rice variety for CR 1009.



Rice ADT 53 (2019)

This variety is a cross derivative of ADT 43 / JGL 384 maturing in 110-115 days. The mean grain yield is 6334kg/ha and the maximum yield of 9875kg/ha has been

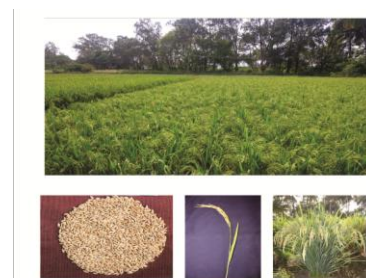


recorded at Alanganallor, Madurai district. It possesses medium slender rice with high milling outturn (65%) with intermediate amylose. This variety is moderately resistant to blast, sheath rot, brown plant hopper and leaf folder. This variety is suitable for cultivation as transplanted rice throughout Tamil Nadu.



Rice VGD 1 (2019)

This aromatic rice variety is a cross derivative of ADT43 and Seeragasamba. It gives an average grain yield of 5859 kg/ha with 32.56 and 13.80 per cent increase over Seeragasamba. It matures in 125-130 days. The variety is non lodging and photo-insensitive. It possesses short slender grain with good LER (2.1), intermediate amylose (21.9%) and head rice recovery (62.1%). The cooked rice is non-sticky and soft. It is suitable for making briyani. It is moderately resistant to leaf folder, blast and brown spot.



Cultures identified for release during 2019-20

CB 06803

The parentage of the culture is PMK (R) 3/ Norungan. It recorded an average yield of 3874kg/ha which is 12 % higher yield than TKM 12 and 13.6% higher than Anna (R) 4 under rainfed condition. It matures in 115-120 days. It is short bold rice variety with high milling, HRR and suitable for idly making. This culture possesses moderate resistant to leaf blast, neck blast, sheath rot and brown spot diseases. It is recommended for cultivation in rainfed tracts of Tamil Nadu.



AD 09493

This culture is a cross derivatives of I.W. Ponni / Bansakthi and matures with a duration of 131 days. It recorded an average yield of 6123 kg/ha which is 9.8 % increase over BPT 5204 and 11.2 % increase over ADT 49. It is suitable for cultivation in *Thaladi* /late *Samba* seasons. It is a medium slender rice variety with good LER of 1.6 and HRR of 60.1%. The physical and cooking qualities are on par with improved white Ponni. This culture is moderately resistant to BPH and brown spot diseases.

Cultures for On Farm Testing

AD 09219

The parentage of the culture is ADT (R) 45 / ACK 03002. It recorded an average yield of 6140 kg/ha which is 16% higher than ADT 43 and 12% higher than CO 51. The duration of this culture is 110-115 days. It is recommended for cultivation in Kar / *Kuruvai* / *Sornavari* / *Navarai* seasons. This culture is having resistant to blast and moderately resistant to sheath blight, stem borer and BPH. The grain of this culture is medium slender rice, HRR 63.6 % with good cooking qualities. It possesses high Iron and Zinc content (Zn: 30.28 ppm and Fe: 10.2 ppm).

TM 12061

This culture is a cross derivative of Senthuram / Vandana and matures in 115 - 120 days. It gives mean yield of 3126 kg/ha which is 18% higher than Anna (R) 4 under rainfed conditions. It possesses moderately resistant to Bacterial Leaf Blight and Blast (Score 3).It has good hulling (80%), milling (70 %) and HRR (66 %).

CB 12588

This culture is a cross derivatives of CB 04110/CB 05501 and matures in 118 days. It recorded average yield of 6127 kg/ha which is 12.1% higher than CO 51. This culture is resistant to blast, moderately resistant to brown spot. It is suitable for cultivation in *Kar/Kuruvai/ Sornavari / Navarai* seasons. The grain is medium slender with HRR of 61.4%.

CB MAS 14065

It is cross derivative of I.W. Ponni /Apo. It recorded an average yield of 6100 kg/ha (9.8 % than BPT 5204 & 11.2 % than ADT 49). Harboring two major effect drought QTLs viz., qDTY1.1 and qDTY3.1.This culture possesses medium slender fine grain rice with high head rice recovery (62%) and good cooking quality. This culture is suitable for cultivation in *Thaladi / Late Samba* seasons.

Cultures identified for evaluation under ART during 2019-20

S.No	Cultures	Yield advantage	Special features
Rice 4/2019-20: Transplanted (Oct 25 – Nov 10, 110 to 125 days)			
1	AD 12132 (R) (ADT 39/ Konark)	5608 kg/ha in 125 days 19.4 % higher than ADT 39	Moderately resistant to blast and resistant to brown spot LER - 1.64; BER - 1.48 Intermediate amylose
2	TP 08053 (R) (ADT 36/ ADT 42)	5464 kg/ha in 125 days 16.3 % higher than ADT 39	Long slender Rice LER – 1.49 Intermediate amylose Moderately resistant to blast and sheath rot
Rice 10/2019-20: Rainfed - Early (Sept.- Oct.)			
3	TM 12077 (R) (TKM (R) 12 / IET 21620)	2777 kg/ha in 120 days under dry condition and 2930 kg/ha under semi dry condition in 122 days 31.9 % and 3.8 high yield than Anna (R) 4 under dry and semi dry conditions respectively	Medium slender
Rice15/2019-20 : Special transplanted Medium (Sept-Oct sowing:125-140 days)			
4	CB 12132 (R) CO (R) 50 / CB 05501	6254 kg/ha in 135 days 15.0 % than BPT 5204	Medium slender Resistant to blast, Non lodging, HRR: 60.75
Rice18/2019-20: Aromatic slender grain (Sept – Oct sowing: 125 – 140 days)			
5.	CBMAS 14142 (R) I.W. Ponni /Apo	4647kg/ha in 120 days, 6.2% over Pusa Basmati 1	Medium slender with good linear elongation ratio. Resistant to brown spot
Rice 19/ 2019-20: Hybrid Rice Mid Early (Oct 25-Nov 10, 110 to 125 days)			
6.	TNTRH 55 (R) TNAU 95S/CB 55	5414 kg/ha in 125 days 15.3% over ADT 39	long bold grain with good linear Elongation (LER: 1.76)

Millets

Newly released varieties / hybrids

SAMAI ATL 1 (2019)

The samai culture TNPsu 377 was released as ATL 1 variety and it is a cross between CO (Samai) 4 x TNAU 141. The variety has the duration of 85-90 days. It has recorded an average grain yield of 1587 and straw yield of 3109 kg ha⁻¹ of grain and straw yield potential respectively under rainfed condition. It has recorded 11.2 and 13.7 per cent increased grain and 11.8 and 14.4 per cent increased straw yield over the checks, CO (Samai) 4 and Paiyur 2 respectively. The panicles are long and semi-compact with



non-shattering grains. The variety is Input responsive. The sturdy culm and uniform maturity with non-lodging trait aid for mechanized harvesting. Highly drought tolerant with no serious pest and disease occurrence. It has got bold grains with high bulk density. High milling out turn (66.3%) and suitable for value addition with consumer preference.

Cultures identified for release during 2019-20

Sorghum TNS 648

This culture is a cross derivatives of APK 1 x M 35-1 and matures in 105 - 110 days. It gives mean yield of 3051 kg/ha (Irrigated) 2231 kg/ha (Rainfed) which is 10% higher than Check CO 30. It possesses high protein content (12.59%), resistant to shoot fly and stem borer pest and grain mould and downy mildew diseases.

Ragi TNEc 1285

This culture is a cross derivatives of TNAU 900 x CO (Ra) 14 and matures in 110 days. It recorded average yield of 2256 kg/ha which is 12.5% higher than CO 15. This culture is resistant to blast, moderately resistant to brown spot. This culture possesses large panicle with bold seeds and gives higher yield.

Tenai TNSu 331

This culture is a cross derivatives of PS 4 x ISe 198 and matures in 85 - 90 days. It recorded average yield of 2889 kg/ha which is 22.80% higher than CO (Te) 7. This culture possesses high tillering ability with drought tolerant.

Cultures for on farm testing (OFT)

S.No.	Crop / Culture	Parentage	Duration (days)	Grain yield (Kg/ha)	Special attributes
Maize (Irrigated)					
1.	CMH 12-686	UMI N09153-1-2 x N148	100	10269	High yielding, Orange kernels MR to charcoal rot (3.6)
2.	CMH 15-005	UMI 1220 x UMI 1210	105	9657	High yielding suited for rainfed and irrigated situations
Maize (Rainfed)					
3.	CMH 15-005	UMI 1220 x UMI 1210	105	5276	High yielding, drought tolerant suited for rainfed situations
4.	VaMH 12013	UMI 1200 x VIM 419	100	5009	Suitable for rainfed condition, Orange yellow dent kernels, Moderately resistant to TLB (3.0)
Sweet corn					
5.	CSCH 15001	USC-1-2-3-1 x 12039-1	70-73	16363	High yield and big kernel size
6.	CSCH 15005	USC-1-2-3-1 x SC1107	71-73	15807	Long cobs and plumpy sweet kernels

Cultures identified for evaluation under ART during 2019-20

S.No	Cultures	Yield advantage	Special features
1.	Sorghum TKVS 1036 (R) (ICSB 518 x SPV 1489)	2102 kg/ha in 100 days	Dual purpose suitable for rainfed condition
2.	Sorghum TNS 661 (R) (TNS 603 x IS 18551)	3016 kg/ha in 100 days	Pearly white grain, Moderately resistant to shoot fly
3.	Pearl millet TNBH 121235 (R) (ICMA 01666 x PT 6303)	2676 kg/ha in 90 days	Compact earhead with bold grains and resistant to downy mildew
4.	Maize (Irrigated) CMH 11-586 (R) (N09 164-2 x N148)	7501 kg/ha in 105 days	High yielding, Orange kernels, Moderate Resistant to charcoal rot
5.	Maize (Irrigated) VaMH 12014 (R) (UMI 1200 x VIM 357)	7204 kg/ha in 100 days	High yielding, Yellowish dent kernels, Moderate resistant to TLB
6.	Ragi - TNEc 1294 (R) (CO (Ra) 14 x TNAU 950)	2256 kg/ha in 110 days	High yield, large panicle and bold seeds
7.	Tenai – TNSu 337 (R) (CO 6 x ISe 198)	1965 kg/ha in 85-90 days	High tillering, blast tolerant and tip sterility absent
8.	Varagu – TNPSc 176 (R) (Selection from DPS 19)	1698 kg/ha in 120-125 days	High yielding, suitable for rainfed conditions
9.	Panivaragu – TNPm 247 (R) (PV1403 x PV 1673)	1365 kg/ha in 69 days	High yield, large panicle and bold seeded
10.	Panivaragu – TNPm 238 (R) (Selection from IPM 19)	1935 kg/ha in 63 days	Stable in yield potential, drought tolerant and non lodging

Pulses

Newly released varieties / hybrids

Cowpea VBN 3 (2018)



It is cross derivative of TLS 38 x VCP 16-1. It recorded an average yield of 1013kg/ha with duration of 70-75 days. This variety is suitable for cultivation in September-October season in all districts of Tamil Nadu except in Nilgiris and Kanyakumari. It has determinate plant type with synchronized maturity. It is resistant to pod borer and pod bug and multiple resistance to rust and anthracnose diseases. It is nutritive with rice protein (25.22%).

Pigeonpea CRG 2012-25 (2018) - CVRC

Pigeonpea variety CRG 2012-25 is released for cultivation in south zone comprising of Tamil Nadu, Andhra Pradesh, Telangana, Karnataka and Odisha during 2018. It is a cross derivative of CO 6 x IC 525427. It is a medium duration (170-180 days) variety and has exhibited an average yield of 1700 kg/ha which is 19% superiority over the best



national check WRP-1, 17.58% and 14.61% over zonal checks CO 6 and ICP 8863 respectively. This variety is moderately resistant to SMD and wilt diseases and moderately tolerant to *Helicoverpa* and *Maruca* pests.

Greengram VBN 4 (2019)



The Greengram variety VBN 4 is a cross derivative of PDM 139 x BB 2664. It matures in 65-70 days and suitable for all seasons. The overall average yield of VGG 10-008 is 1024 kg/ha. It is 16.8 and 21.3 per cent increased yield over VBN (Gg)3 (876 kg/ha) and CO 8 (844 kg/ha) respectively. This variety is suitable for Adi, Puratasi, Markazhi / Thai and chithiraipattam. It gives high yield due to multi bloom with non shattering pods. It has moderate resistance to Mungbean Yellow Mosaic Virus (MYMV) and powdery mildew diseases and resistance to urdbean leaf crinkle virus disease. This variety is recommended for cultivation in all greengram growing districts of Tamil Nadu except Nilgiris and Kanyakumari.

Blackgram VBG 9 (CVRC)

The blackgram variety VBG 9 is a cross derivative of Mash 114 x VBN 3. It matures in 70-75 days and suitable for rice fallow season. It has determinate plant type with synchronized maturity. It recorded an average yield of 1230kg/ha which is 14.5, 24.5, 20.3% increased yield over the check varieties LBG 787, LBG 752 and ADT 3 respectively. It has moderate resistance to Mungbean Yellow Mosaic Virus (MYMV), urdbean leaf crinkle virus, leaf curl virus and powdery mildew diseases. This variety is recommended for cultivation south zone comprising Tamil Nadu, Karnataka, Andhra Pradesh, Telangana and Odisha.



Blackgram VBG 10 (CVRC)



The blackgram variety VBG 10 is released for cultivation in south zone comprising of Tamil Nadu, Andhra Pradesh, Telangana, Karnataka and Odisha. It is a cross derivative of VBN 1 x UH 04-04. It matures in 70-75 days and suitable for *Rabi* season. It has determinate plant type with synchronized maturity. The overall average yield of this variety is 1130 kg/ha. It is 9.4 and 16.2, 22.0 and 28.7 % increased yield over LBG 787 (1029 kg/ha), LBG 752 (969kg/ha), LBG 645 (923kg/ha) and COBG 653 (875 kg/ha) respectively.

This variety is resistant to Mungbean Yellow Mosaic Virus (MYMV), urdbean leaf crinkle virus and leaf curl virus diseases.

Cultures identified for release during 2019-20

Blackgram VBG 12-062

VBG 12-062 is a cross derivative of PU 31 x CO 6 and matures in 60-65 days. It recorded mean grain yield of 935 kg/ha which is 19.1% increased yield over VBN 8. It is suitable for cultivation in all seasons. It possess resistant to Mungbean Yellow Mosaic disease (MYMV) and moderately resistant to leaf crinkle.

Blackgram COBG 10-05

COBG 10-05 is a cross derivative of VBN (Bg) 5 x *V.mungo* var *silvestris* (22/10) and matures in 60-65 days. It recorded an average yield of 880 kg/ha in ART and it is being evaluated under OFT. It has determinate plant type with synchronized maturity suitable for single/mechanical harvest. It is bold seeded (5.0-5.5g /100 seeds). Suitable for cultivation in *kharif* and *rabi* seasons. Resistant to Mungbean Yellow Mosaic disease (MYMV) and moderately resistant to leaf crinkle, stem necrosis diseases.

Cultures identified for evaluation under ART during 2019-20

Blackgram

COBG 13-04 is a cross derivative of T 9 x ADT 5 and matures in 65-70 days. It recorded an average yield of 908 kg/ha which is 17.2 and 16.7 percent increased yield over the check varieties VBN 6 and VBN 8, respectively. This variety is resistant to MYMV.

Greengram

COGG 13-19 is a cross derivative of CO 6 x COGG 912 and matures in 60-65 days. It recorded an average yield of 815 kg/ha which is 14.4 percent increased yield over the check varieties CO 8. It is moderately resistant to MYMV. The cultures VGG 15-013, VGG 15-029 and VGG 15-030 which maturing in 60-75 days recorded mean yield ranging from 927 kg/ha to 977kg/ha and possesses moderate resistance to MYMV.

Oilseeds

Newly released varieties / hybrids

Groundnut TMV 14 (2018)

TMV 14, a bunch type groundnut variety is a cross derivative of VRI (Gn) 6 x R 2001-2. It is an early duration crop with the duration of 95-100 days. It recorded an average pod yield of 2124 kg/ha under rainfed condition during *Kharif* season and 2286 kg/ha under irrigated condition during *Rabi* season. Average oil content is 48%. Moderately resistant to late leaf spot and rust diseases and pests like pod borer, thrips and leaf minor. It has 11.5 per cent higher yield over VRI (Gn) 6, 15.2 per cent higher yield over TMV (Gn) 13 and higher shelling (70.6%) compared to VRI (Gn) 6 (68.0%).



Sunflower Hybrid COH 3 (2018)



Sunflower hybrid culture CSFH 12205 was released as Sunflower COH 3 during 2018 for commercial cultivation in Tamil Nadu. Sunflower COH 3 recorded high seed yield of 2410 kg/ha which is 14 per cent over CO2 hybrid and 14.2 per cent over Sunbred 275, with high oil content (42%) and resistant to *Alternaria* leaf spot, powdery mildew and necrosis.

Castor YTP 1 (2018)

Castor variety YTP 1 is a cross derivative between TMV 6 x Salem Local. The average yield is 1456 kg/ha and it can be maintained upto 3 years and gives 1st harvest on 115-120 days after sowing. This variety is suitable for both perennial and annual system as it gives 3kg of castor bean per plant per annum in mixed cropping / inter cropping system and perennial system. This variety is resistant to wilt disease.



Groundnut BSR 2 (2019)



The Spanish bunch groundnut culture BSG 0912 a cross derivative between VRI 2 x TVG 0004 maturing in 105 – 110 days. It is highly suitable for *kharif* and *rabi*/summer seasons for all the groundnut growing districts of Tamil Nadu. It recorded a mean pod yield of 2222 kg and 2360 kg/ha under rainfed and irrigated conditions which is 5.9 and 15.5 *per cent* superior over the best check variety VRI 8 (2099 kg/ha and 2044 kg/ha). It is having moderate level of resistance to foliar and fungal diseases (late leaf spot and rust diseases) sucking pests (aphids, thrips, jassids) and defoliators.

Cultures identified for release during 2019-20

Spanish Bunch Groundnut VG 13163

A Spanish bunch culture VG 13163 has been identified and recommended for release. It is cross derivative of VG 0420 X VRI Gn 6. It matures in 105-110 days. It recorded a mean pod yield of 2428 kg and 3200 kg/ha respectively under *kharif* and *rabi*/summer seasons, which is 8.44 *per cent* and 23.4 *per cent* superior over the best check variety VRI 8. The newly evolved culture registered a mean shelling outturn of 70.0 *per cent* and recorded a mean hundred kernel weight of 44 g. The oil content of this culture is 51 *per cent*. It registered moderately higher O/L ratio of 1.87. Hence, keeping quality of oil is good. It is moderately resistant to late leaf spot and rust diseases.

Cultures identified for evaluation under ART during 2019-20

Sunflower

Sunflower hybrid culture CSFH15020 has identified for conducting ART 2019-20 which recorded the yield of 1893 kg/ha which is 11.3% over check hybrid COH3.

Cotton

Cultures identified for release during 2019-20

Cotton TCH 1819

The cotton culture TCH 1819 has been identified and recommended for release. It was evolved by crossing khandwa x LH 220 and matures in 140 days. The average seed cotton yield recorded 1835 kg / ha which is 15.95% increase over the check variety Suraj. It possesses Compact and erect plant type, Zero monopodia and short sympodial branch, 15-20 bolls/plant, Boll weight between 3.50 g and 4.00 g, Synchronized boll maturity, High ginning

outturn of 35.10 %, Upper Half Mean Halo length is 27.0 mm and High bundle strength of 26.1g/tex.

Cultures identified for evaluation under ART I during 2019-20

S. No	Culture	Duration (days)	Seed cotton yield (kg/ha)	Yield increase Over CO 14 / SVPR 4	Special features
1	TCH1828	150	1825	17.0 per cent increase over CO 14	<ul style="list-style-type: none"> • Ginning outturn : 35.2 % • Boll weight : 4.3 g • UHML : 31.6 mm • Fibre strength : 30.7 g/tex • Micronaire value : 4.6 µg/inch
2	TSH 325	150	2155	29.8 per cent increase over SVPR 4	<ul style="list-style-type: none"> • UHML : 28.5 mm • Fibre strength : 28.2 g/tex • Micronaire value : 4.6 µg/inch • Moderately resistant to leaf hopper
3	TCH1199	150	2210	10.9 per cent increase over CO 14	<ul style="list-style-type: none"> • Ginning outturn :35.2 • UHML : 28.7 mm • Fibre strength : 26.5 g/tex • Micronaire value : 4.9 µg/inch
4	TSH0533	150	1945	22.8 per cent increase over SVPR 4	<ul style="list-style-type: none"> • Ginning outturn :34.2 • UHML : 29.5 mm • Fibre strength : 30.1 g/tex • Micronaire value : 4.2 µg/inch

Cultures identified for evaluation under ART- II during 2019-20

S. No.	Culture	Duration (Days)	Seed Cotton yield (kg/ha)	Yield increase over (%)		Special features
				SVPR 4	KC 3	
1.	TKH1197	140	1081	16.7	10.6	<ul style="list-style-type: none"> • Ginning outturn : 36.8 • Fibre length: 39.9 mm • Fibre strength: 30.2 g/tex • Micronaire value : 3.4 µg/inch • Highly resistant to leaf hopper and tolerant to drought
2.	TKH1185	140	1033	17.9	14.9	<ul style="list-style-type: none"> • Ginning outturn : 36.6 • Fibre length: 32.5 mm • Fibre strength: 28.8g/tex • Micronaire value : 3.6 µg/inch

Forage crops

Newly released varieties / hybrids

CVRC (2019)

***Cenchrus setigerus* (Black Kolukattai grass) CO 2** is identified for release in SZ (TN, AP, Telangana & Karnataka). This perennial grass is a selection from *Kangayam* local. It is Pasture land grass with lesser ADF (42.5 %) and NDF (64.17 %) indicating higher digestibility and intake. It has yields 45 t of green fodder per ha per year and 10.2 t of dry matter per ha per year.

***Desmanthus* (Hedge Lucerne) CO 2** is identified for release All India. It is a Gamma ray mutant of *Desmanthus* CO 1. It possesses Crude protein content of 16.5%, more palatable and resistant to rust. This perennial fodder has average yield potential of 130 t/ha/yr green fodder with 33 t/ha/yr dry matter yield.

Cultures for On Farm Testing

Fodder maize TNFM 131-9

Fodder maize culture TNFM 131-9 is a composite of five inbreds. It has yield potential of 45 tn/ha green fodder yield within 65 days. It grows ten days earlier than African Tall with white grain and more palatable.

Sugarcane

Newly released varieties / hybrids

Sugarcane COG 6 (2018)

Sugarcane variety COG 6 is a high yielding, high quality, high Jaggery recovery and salt tolerant early sugarcane variety suitable for salt affected soils of Tamil Nadu. The average cane yield under normal condition is 140.56 t/ha and under salt affected soil it is 131.74 t/ha. The average sugar yield is 18.39 t/ha. The canes are erect. Medium thick and non lodging. This variety is moderately resistant to red rot and smut disease and resistant to wooly aphids. It is less susceptible to shoot borer and internode borer.



Clones identified for release during 2019-20 (Pipeline)

C 29442

The clone C 29442 is a mid-late high yielding and high sugar clone with easy detrashability nature. This clone is characterized by thick, tall, straight cane with attractive red colour and it is also a good ratooner. It is a quick growing cane. It matures in 330-360 days. It has an average cane yield of 141.84 t/ha and sugar yield of 18.242 t/ha with CCS% of 12.86%. It is a spineless and non flowering type with a fibre content of 13.94%. It is moderately resistant to red rot, smut and yellow leaf disease and less susceptible to shoot borers.

G 2005047

The clone G 2005047 is an early maturing (300 – 330 days) type a cane yielding potential of 150.00 t/ha. It can yield 16.8 t of jaggery per ha . It performs better under salt affected soils and moderately resistant to red rot.

Cultures identified for evaluation under ART during 2019-20

Category	Clones	Cane Yield (t/ha)	CCS (%)	Red Rot reaction
Early	C 31 098	139.25	12.95	Moderately resistant
	G 08 028	133.20	13.01	Moderately resistant
	Co 13003	128.48	14.39	Moderately resistant
Mid-late	C 30 010	140.75	13.05	Moderately resistant
	G 08 019	132.00	13.06	Moderately resistant
	Co 06 031	139.57	14.65	Moderately resistant
	Co 14 016	140.71	13.58	Moderately resistant
	Co 15 007	106.28	15.05	Moderately resistant

Production and Distribution of Breeder Seed during 2018-19

(Unit : Kg)

Crop / Variety	Indent (2017-18) (Kg)				Supply (2018-19) (Kg)				
	State	GOI	Priv.	Total	State	TNAU	GOI	Priv.	Total
Paddy	10245	3400	67045	80690	14685	1060	4065	69234.5	89044.5
Millets	1310	1761	30	3101	1397	84	2264	135	3880
Pulses	7920	2030	3694	13644	8490	465.5	532*	4321	13808.5
Oilseeds	35130	1000	60	36190	35411	3340	620*	512	39883
Cotton	50	4	110	164	50	31	2	392	475
Forage Crops	0	766	0	766	0	0	531	55	586
Vegetable Crops	64.65	0	8.00	72.65	11.53	18.65	1.00	10.80	41.98
TOTAL	54719.65	8961	70947	134627.65	60044.53	4999.15	8015	74660.3	147718.98

Note: * - The indented quantity of breeder seeds were not lifted by the indented agencies.

Breeder Seed Production Programme for the year 2019-20 and supply during 2020-21

(Unit : Kg)

Crop	State	GOI	Private	Total
Paddy	6300	6180	107770	120250
Millets	1343	196	215	1754
Pulses	5210	290	4298	9798
Oilseeds	39300	4000	222	43522
Cotton	16	0	202	218
Forage Crops	0	675	0	675
Vegetable Crops	20.1	0	54.5	74.6
Total	52189.1	11341	112761.5	176291.6

CENTRE FOR PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

For Adoption

CO43-Sub1, a submergence tolerant rice

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

For On Farm Testing (2019-20)

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

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

For Information (ART/MLT)

CBMAS14142, a short duration (115-120 days) culture with long slender grain (Length = 7.3 mm; breadth = 1.9 mm and L/B ratio 3.8) is recommended for third year of evaluation under ART. This culture has high yield potential 4.5 – 5 t/ha, high head rice recovery (>60%) and high linear elongation ratio after cooking. Recommended for ART in Vellore, Dharmapuri, Salem, Erode, Coimbatore, Dindigul, Theni, Karur, Trichy and Perambalur districts.

CBMAS 14110, a high yielding (6t/ha) and short duration (110 – 115 days) rice culture possessing fine grains developed through marker-assisted pedigree breeding is recommended for second year of evaluation under MLT. It is a medium tall genotype with dark green leaves. Possess very high grain number per panicle (300 – 350 grains per panicle). It harbours 3 mega effect QTLs of Apo contributing for grain yield under drought.

A maize hybrid ACM15009 (UMI1200 β x UMI1230 β) rich in β carotene (9.60 μ g/g) is recommended for second year of evaluation under MLT during 2019-20. The hybrid is having high yield potential of 10730 kg/ha which is 11.3 % increase yield over the existing hybrid CO6.

For Adoption

Nitric Oxide donor based pre-sowing seed treatment for better seedling emergence and establishment in saline / sodic soils in rice

Soaking rice seeds in equal volume of 80 μ M concentration of sodium nitroprusside for 16 hrs is recommended for raising nursery in saline / sodic soils.

Mechanical sowing with primed seeds and foliar spray for increasing the productivity of rainfed horsegram

Priming the seeds with 100 ppm ZnSO_4 @ 1:1 seed to solution ratio for 3 hours and sowing by seed drill followed by foliar spray of 0.5 % ZnSO_4 at 50 % flowering is recommended for increased productivity of rainfed horsegram.

Arresting late formed flowers to improve seed yield in groundnut

Foliar application of NAA@ 200 ppm at 60 days after sowing is recommended to arrest late formed flowers and increase the seed yield in groundnut.

II. CROP MANAGEMENT

DIRECTORATE OF CROP MANAGEMENT

Technology capsule for productivity enhancement in semi-dry rice cultivation

- Sowing: Seed drill sowing with 40 kg/ha of hardened seed (Soaking for 16 hrs in 1% KCl and drying to original seed moisture)
- Weed management : Pre emergence application of Pretilachlor @ 0.45 kg /ha on 5th DAS and Mechanized weeding through power weeder on 30th and 45th DAS
- Irrigation management: Alternate wetting and drying (AWD) method
- Nutrient management: STCR based NPK application
- Productivity and economics: Grain yield – 7.91 t/ha; Net return – Rs. 71,746/ha; BCR – 3.56



Technology capsule for productivity enhancement in summer irrigated blackgram

- Sowing: Seed drill sowing with 25 kg/ha of seeds
- Weed management: Pre emergence application of Pendimethalin @ 1.0 kg ai/ha on 3 DAS and hand weeding on 20th DAS.
- Irrigation management: Sprinkler irrigation (3.09 kg/ha.mm of water use efficiency)
- Nutrient management: 25:50:25:20 kg/ha NPK&S or STCR based NPK & S application.
- Productivity and economics: Average yield - 1164 kg/ha; Net return - Rs. 39747/ha; BCR - 2.69.



Best sowing time for enhancing rainfed winter pulses productivity

- Bengal gram: Sowing during first week of November
- Horse gram: Sowing during last week of October
- Seed drill sowing is recommended for timely operation.



Drip fertigation for maize based cropping system

- Drip irrigation @ 100% Potential Evaporation (PE) level for maize - vegetables (Onion / Bhendi) cropping sequence
- Laying out of drip system in raised bed (90 cm) with lateral spacing of 120 cm and water discharge of 4 lph
- Nutrient management: Blanket recommendation of fertilizer: Maize - 250:75:75 kg NPK/ha; Onion - 60:60:30 kg NPK/ha and Bhendi - 200:100:100 kg NPK/ha.



Nutrient management for rainfed maize

- Recommendation: 188:56:56 kg NPK/ha for hybrid maize under rainfed vertisol ecosystem.
- Productivity and Economics: Yield - 5848 kg/ha; Net return - Rs.66847/ha; B:C ratio - 2.59.

Economically viable cropping system for rainfed agro ecosystem

- Recommendation: Samai intercropped with Redgram at 8:2 ratio and Horsegram as sequential crop.
- Productivity:
 - Samai: Grain yield - 663 kg/ha; Straw yield - 1688 kg/ha
 - Redgram: Seed yield - 177 kg/ha
 - Horsegram: Seed yield - 268 kg/ha.
- Economics: Net return – 19,664/ha; BCR: 2.4



Enhancing the productivity of Nutri-Cereals under rainfed condition

- Recommendation: Mulching of crop residue @ 2.5 t/ha with supplemental irrigation twice through mini portable sprinkler.
- Productivity: Grain yield: Samai - 969 kg/ha (Control: 694 kg/ha); Kuthiraivali - 1596 kg/ha (Control: 1147 kg/ha).
- Economics: Samai – Rs. 13,618/ha; BCR: 1.88
Kuthiraivali – Rs. 32,428/ha; BCR: 3.10



Optimizing area of green fodder production for balanced nutrition to livestock

- Recommendation for milch animals:
 - Green fodder cultivation in 13.6 cents i.e. Cumbu Napier hybrid grass: 8.4 cents and Desmanthus: 5.2 cents to feed a milch animal with a milk yield of 10 lit./day/ animal.
 - Productivity / day: 35 kg grass biomass + 10 kg leguminous biomass/day.
- Recommendation for goats:
- Cultivation of 2.3 cents of green fodder (Cumbu Napier hybrid grass: 1.2 cents and Desmanthus: 1.1 cent) to feed a goat with average body weight of 40 kg.
- Productivity / day: 5 kg grass biomass + 2 kg leguminous biomass/day.



Yield maximization in summer irrigated sesame

- Recommendation: Seed pelleting with neem leaf powder @ 760 g + 120 g *Azotobacter* + 120 g phosphobacteria for 1 kg seed with 1.5 % combined nutrient spray at 30 & 45 DAS
- Productivity: Sesame seed yield - 803 kg ha⁻¹ (30 % increase over control (615 kg ha⁻¹))
- Economics: BCR - 2.85.



Organic production technology for white seeded confectionery sesame

- Seed treatment: *Azospirillum* + Phosphobacteria + PGPR each @ 600 g ha⁻¹ of seed.
- Nutrient management:
 - Basal application of FYM @ 12.5 t/ha + soil application of biofertilizer (*Azospirillum* + Phosphobacteria + PGPR each @ 2 kg ha⁻¹).
 - Foliar application: Panchagavya 3% spray at 30 and 45 DAS.
- Productivity and Economics: Seed yield - 819 kg ha⁻¹; Net income - Rs.31,402 /ha; BCR-1.98.



Optimizing crop geometry to suit mechanized weeding in sunflower



- Recommendation: Altered spacing of 75 x 25 cm with pre-emergence application of Pendimethalin @ 1 kg a.i ha⁻¹ followed by power weeding at 30 DAS.
- Productivity and Economics: Seed yield - 1950 kg ha⁻¹; BCR - 1.75.

Intercrop and Nutrient management for Samai based cropping system in hilly areas of Tamil Nadu

- Intercrop: Castor intercropped with Samai @ 10:1
- Nutrient Management: 50% of N through organic (FYM @ 8.0 t ha⁻¹) + 50% inorganic N (22 kg N through Urea)
- Productivity and Economics: Samai equivalent yield - 1790 kg ha⁻¹; Net return - Rs.38,743/ha; BCR - 2.62.



Nipping of primary shoot to enhance the yield of irrigated perennial castor

- Recommendation: Nipping of primary shoot at 10th node of perennial castor YTP 1
- Productivity: Seed yield of 1990 kg/ha as compared to without nipping practices (1583 kg ha⁻¹).



Growth retardant for enhancing the cotton productivity



- Recommendation: Mepiquat chloride foliar spray @ 50 g a.i/ha at square formation and boll development stage and tembotrione spray @ 200 ml/ha at 130 DAS
- Productivity and Economics: Seed cotton yield - 2189 kg/ha; Net return - Rs. 50575/ha.

Plant geometry and intercropping for sustainable sugarcane initiative (SSI) in Cauvery delta region

- Recommendation: Planting of sugarcane in double rows at 150 cm row spacing and intercropped with sunnhemp for higher cane yield, crop equivalent yield and sugar yield in plant crop and ratoon crops.
- Economics: Net return - Rs.2,47,367/ha; BCR - 2.92.



Agro Climate Research Centre

Non-crop technologies

TNAU-AAS web cum mobile App

Weather based Automated Agro Advisory Services - Web cum Mobile App has been successfully developed under Govt. of Tamil Nadu sponsored NADP scheme at Agro Climate Research Centre, Directorate of Crop Management, TNAU, Coimbatore. The "TNAU-AAS web cum Mobile App" automatically generates block level weather forecast for next 6 days, develop and select one suitable weather scenario from the 54 weather scenario combinations, picks up location, crop and stage specific weather based agro advisories for 108 crops and 6 stages from the database of AAS server and send the timely advisories (both crop management and plant protection) to the registered farmer mobile as SMS. The same advisories are also available in the farmers' TNAU-AAS Android mobile App with past history of advisories, past 30 days observed weather and next six days forecasted weather.



The portal is available in web "aas.tnau.ac.in" and the Mobile App could be downloaded from Google Play store by typing "TNAUAAS" and installing "Automate Agro Advisory Service". The registered farmer will get weather based agro advisories for one crop per mobile number and there is no restriction for multiple mobile number registrations by a farmer. The approved block level officer can register 10 major crops his/her block per mobile number.

Usefulness of “TNAU - AAS web cum Mobile App”

- Response farming with timely weather based agro advisories helps the resource poor farmers to plan farm activities in advance, will reduce the weather based risks on input loss in addition to increase the yield.
- Timely, crop specific, stage specific, weather specific advisories at free of cost.
- Fully automated, reduce the workload of extension functionaries. The lab to land transfer of technologies become direct and easy. No holidays for receiving agro advisories.
- Surely reduce the crop failure risk of climate dependent farming and TNAU-AAS is enabled to send special advisory / extreme events warning SMS.
- AAS is a viable option to do weather based precision farming



Basic and applied meteorological studies TNAU – MAI calculator: A web application

Simple, user friendly, web based “TNAU Moisture Adequacy Index Calculator” is developed at Agro Climate Research Centre, Directorate of Crop Management, TNAU, Coimbatore for agricultural drought assessment using Weekly MAI calculation formula of Thornthwaite and Mather (1955). Moisture Adequacy Index (MAI) is one of the important indices for agricultural drought assessment. This calculator will be highly useful for Department of Agriculture and State Disaster Management officials, Scientist and Students to calculate weekly drought scenarios for any length of period during a year. In this application, simply typing the weekly rainfall data and PET of a district/block will give the MAI. If the current PET values are not readily available for the district, the MAI calculator is designed to use the PET normal of respective district, stored in Database. The web application was written in web based PHP programme with a database of MySQL.



DIRECTORATE OF NATURAL RESOURCE MANAGEMENT

Technologies for adoption

Rice

Bio-fortification of Zn in rice grains

Field experiments conducted at TNAU, Coimbatore and TRRI, Aduthurai with 21 short duration rice genotypes for bio-fortification of Zn revealed that, the genotypes CO 51, CO 47, ADT 47 and ADT 37 were found Zn efficient and responsive. Hence four field experiments were conducted and validated at both the locations with various Zn fertilization strategies and Zn efficient genotypes for Zn bio-fortification which revealed that,



basal soil application of 50 kg ZnSO₄ along with foliar spraying of 0.50% ZnSO₄ thrice at 50% flowering, milky and dough stages increased the yield (10.1 to 18.8 per cent) and grain Zn content. Higher grain Zn enrichment was noticed in CO 51 followed by CO 47 > ADT 47 = ADT 37 which was well correlated with higher Zn mobilization index and Zn uptake efficiency.



Millets

Fertiliser Prescription Equations under IPNS for pearl millet on Inceptisol

Targeting of 3.0 & 4.0 t ha⁻¹ of pearl millet under IPNS is found to be ideal in terms of yield (3.04 and 4.17 t ha⁻¹), RR (11.80 and 11.10 kg kg⁻¹) and BCR (1.42 and 1.87) and soil fertility maintenance. Therefore, Soil Test Crop Response



based fertiliser prescriptions under Integrated Plant Nutrition System (STCR-IPNS for 3.0-4.0 t ha⁻¹) *i.e.*

application of fertiliser N, P₂O₅ and K₂O based on initial soil test values along with FYM @12.5 t ha⁻¹ can be recommended for achieving higher yield, response ratio and BCR for pearl millet (hybrids) on Periyanaickenpalayam series (Vertic Ustropept) and allied soil series of Tamil Nadu.



Fertiliser Prescription Equations under IPNS for maize on Inceptisol

For hybrid Maize in Periyanaickenpalayam series targeting of 9.0 & 10.0 t ha⁻¹ of maize under IPNS is found to be ideal in terms of yield (8.88 and 10.06 t ha⁻¹), RR (14.20 and 14.43 kg kg⁻¹) and BCR (2.14 and 2.37) along with maintenance of soil fertility. Hence, Soil Test Crop Response based fertiliser prescriptions under Integrated Plant Nutrition System (STCR-



IPNS for 9.0-10.0 t ha⁻¹) *i.e.* application of fertiliser N, P₂O₅ and K₂O based on initial soil test values along with FYM @ 12.5 t ha⁻¹ can be recommended for achieving higher yield, response ratio



and BCR on hybrid Maize in Periyanaickenpalayam series (Vertic Ustropept) and allied soil series of Tamil Nadu.

Soil Test Based Fertiliser Prescription for Desired Yield Target of Maize Under Integrated Plant Nutrition System On Vertisol

For Hybrid Maize on Pilamedu soil series the target of 10.0 & 11.0 t ha⁻¹ of maize under IPNS is found to be ideal in terms of yield (10.15 and 11.08 t ha⁻¹), RR (14.05 and 13.95 kg kg⁻¹) and BCR (2.17 and 2.27) along with soil



fertility maintenance. Therefore, Soil Test Crop Response based fertiliser prescriptions under Integrated Plant Nutrition System (STCR-IPNS for 10.0-11.0 t ha⁻¹) i.e. application of fertiliser N, P₂O₅ and K₂O based on initial soil test values and FYM @12.5 t ha⁻¹ can be recommended for achieving higher yield, response ratio and BCR on hybrid Maize in Pilamedu series (Typic Haplustert) and allied soil series of Tamil Nadu.



Screening and evaluating maize hybrids for lime induced Fe chlorosis in calcareous soils

Screening of maize hybrids and their parents for lime induced Fe chlorosis in calcareous soils revealed that the hybrids CO 6, CO 8 and CO 7 were found tolerant to Fe chlorosis while the parent UMI 1230 was highly susceptible to Fe chlorosis in calcareous soils. Evaluation of tolerant maize



hybrids with various Fe management strategies to improve the crop yield and soil health indicated that soil application of 40 kg S as elemental sulphur either with 5 kg Fe EDTA or 50 kg FeSO₄ + 12.5 t FYM ha⁻¹ was effective in increasing the crop yields by 20-25% besides improving the Fe availability in soil and its uptake by maize.



Pulses

Effect of biochar and phosphobacteria on carbon build-up, phosphorus availability and blackgram yield in rainfed Alfisol

Application of redgram stalk biochar 5 t ha⁻¹ and phosphobacteria 2 kg ha⁻¹ with STCR based phosphorus application is ideal to overcome the problem of soil encrustation in red lateritic soil and enhanced blackgram seed yield by 32 per cent, soil phosphorus availability by 13 per cent and P uptake by 40 per cent over control in Alfisol under rainfed situation.



Sulphur fertilisation for Groundnut in calcareous and low sulphur soil

Application of 60 kg sulphur /ha as elemental sulphur along with STCR based N, P & K in calcareous and low sulphur soil increased the pod yield (2666 kg ha⁻¹), oil content (48.2%), protein content (25.0 %) and benefit - cost ratio (2.70) in groundnut.



Proposals for On Farm Testing

Evaluation of Zinc and Iron formulations for foliar nutrition of hybrid maize

Objective: To assess the newly developed Zn and Fe chelate formulations on yield and economics of hybrid maize

Treatments

- T₁ Recommended NPK as per STCR-IPNS
- T₂ Foliar spraying of 0.5% ZnSO₄ + 1% FeSO₄ + 0.1% citric acid
- T₃ Foliar spraying of 0.5 % Zn EDTA + 1.0 % Fe EDTA
- T₄ Foliar spraying of 0.5 % Zn citrate +1.0 % Ferric citrate

Observations to be recorded

Yield parameters
Yield
Economics
Fe and Zn content
Fe and Zn uptake
Soil available Zn and Fe status

Coordinating scientist: Dr. P. Malathi, Asst.Professor (SS&AC),HC&RI,Periyakulam
Centres and Scientists:

HC&RI, Periyakulam:Dr. P. Malathi, Asst. Professor (SS&AC), HC&RI, Periyakulam
AC&RI, Coimbatore:Dr. D. Jegadeeswari, Assoc. Professor (SS&AC), TNAU, CBE
ARS, Bhavanisagar:Dr. D. Muthumanickam, Professor (SS&AC), ARS, Bhavanisagar

Nuripellet pack fertilisation in sugarcane

Objective

- To develop soil health based fertilizer recommendation for improving cane yield and sustaining soil health

Treatments

- T₁ : Soil Test Based NPK + FYM (12.5 t ha⁻¹)
- T₂ : Nutripellet Pack (placed at 5 cm – twice at TP and at 90 DATP) + Sugar Industry Biocompost (SIBC) @ 2 t ha⁻¹

T₃: Nutripellet Pack enriched with TNAU MN mixture @ 50 kg ha⁻¹
Irrigation: Surface irrigation / Drip Irrigation

Observation to be recorded

- Growth parameters: Length of cane, Girth, No. of tillers hill⁻¹
- Yield parameters: Single cane weight; Cane yield
- Quality parameters: Brix; POL; Purity; Sugar Recovery

Scientists and Centres

Dr. L. Chitra, Professor (SS&AC), SRS, Sirugamani
Dr. M. Jeyachandran, Professor (SS&AC), SRS, Cuddalore
Coordinating centre & Scientist: Dr. D. Jegadeeswari, Dept. of SS&AC, TNAU, Coimbatore

Field scale validation of sensor for automated drip irrigation

Treatments

T₁ : Humidity sensor

Humidity sensor is the best soil moisture sensor for soils of all texture (measured up to 63 % in loamy/ clayey textures).

T₂ : Automatic Signal Handling and Switching Device

For automated irrigation a new sensor method was devised and test verified. The method works based on sensor data comparing the Critical Point of ΔT . Automated device set at Critical Point of ΔT of 3°C saved 23.7 per cent water in drip irrigation. The method uses non contact sensor and is useful in all soil types and all seasons.

Crop : Vegetables (Chillies)

Coordinating Scientist : Dr.K.Arulmozhiselvan , Professor (SS&AC)

Scientists and Centres:

Dr.P. Manikandan, Asst. Professor AC&RI, Killikulam
Dr.K.M.Sellamuthu, HC&RI, Periyakulam

Evaluation of TNAU Micronutrient Mixture for the management of multi-micronutrient deficiencies and increasing the productivity of irrigated cassava

Treatments

T₁: Recommended NPK based on STCR-IPNS

T₂: T₁+ Foliar spray of 1% FeSO₄ + 0.5% ZnSO₄ at 60 and 90 DAP

T₃: T₁+ TNAU MN mixture @ 20 kg ha⁻¹

T₄: Farmers practice

Co-ordinating Centre: Dept. of SS&AC, TNAU, Coimbatore

Scientists and Centres :

Dr.D.Jagadeeswari, Dept. of SS&AC, TNAU, Coimbatore
Dr.M.Vijayakumar, Asst. Prof. (SS&AC), RRS, Paiyur
Dr.M. Sangeetha, Asst. Prof. (SS&AC), KVK, Pappapatti

Dept. of Agricultural Microbiology

Technologies for adoption

Effect of combined inoculation of newer formulation of Arbuscular Mycorrhizal fungi and *Gluconacetobacter diazotrophicus* on growth and yield of sugarcane (SRS, Cuddalore)

- Sett treatment with AMF @ 67.5 gram/ha & *Gluconacetobacter diazotrophicus* @ 67.5 gram/ha (with 75% N&P) recorded higher plant growth, tiller production with 6.04 & 13.5% increase over control besides improved AM root colonization (87%) at 180 DAP.
- The above treatment also increased cane yield (113.4 t/ha), CCS% (8.03) and Sugar yield (13.38 t/ha) with an increase of 3.4%, 0.8% and 9.94% respectively over uninoculated control and 100% RDF

Evaluation of Water Soluble Seed Coat Formulation of *Rhizobium* and AM Fungi in Blackgram and Redgram

Seed coating with water soluble powder formulation of *Rhizobium* (10^{11} cells/g) and AM fungi (ten thousand spores/g) @ 25 g each/ha (with 75% N&P) can be recommended for seed coating of pulses.

Dept. of Nano Science & Technology

Technologies for adoption

Enhanced Preservation of Fruits using Nanotechnology (GAC-IDRC, Canada)

- Enhanced Freshness formulation for Pre-harvest spray and Post-harvest dip.
- Hexanal loaded Nano stickers.
- Hexanal loaded Nano pellets.

Pre-harvest spray for mango and other fruits

- Dilute 20 ml of fruity fresh formulation in one litre of water or 200 ml of fruity fresh in 10 litre of water.
- Spray over fruits and leaves when the fruits are at 60 - 70% maturity stage. For better results give one more spray after 10 days.
- The spray solution should be used on the same day and ensure entire tree foliage and fruits are soaked.

Post - harvest dip for mango and other fruits

- Dilute 20 ml of fruity fresh formulation in one litre of water or 200 ml of fruity fresh in 10 litre of water.
- Dip fruits for five minutes in the diluted solution and dry the fruits before packing.

Benefits of the fruity fresh

- TNAU fruity fresh spray can delay the harvest for two weeks in case of pre - harvest spray. Post - harvest dip in 2% TNAU fruity fresh extends the shelf life of fruits by two weeks in ambient storage condition and upto 4 weeks under cold storage.

Technologies for OFT

Chitosan nano-memulsion as an anti-transpirant and drought mitigation strategy

Technology detail : Application of chitosan nanoemulsion @ 1000 ppm as foliar spray induced stomatal closure and decline in stomatal conductance in corn and pearl millet

Corn

Treatment	Leaf temperature (°C)	Transpiration rate (mmol m ⁻² s ⁻¹)	Stomatal conductance (Gs)	Photosynthetic rate (μ mol CO ₂ s ⁻¹)
Control	42.2	20.84	0.71	10.84
Chitosan treated	42.4	18.70	0.56	9.51

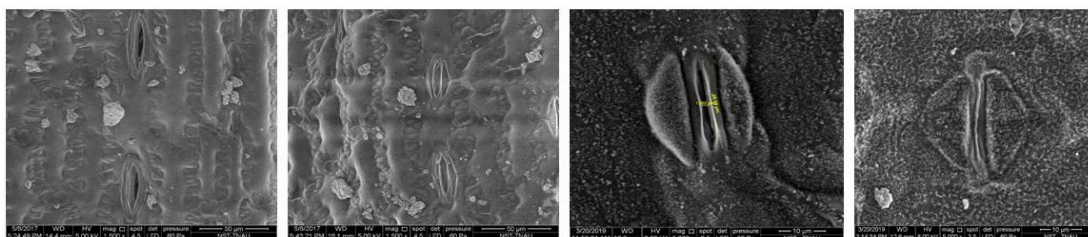
Pearl millet

Treatments	Photosynthetic rate (μ mol CO ₂ m ⁻² s ⁻¹)				Stomatal conductance (mol H ₂ O m ⁻² s ⁻¹)			
	1 Day*	3 Days	5 Days	7 Days	1 Day	3 Days	5 Days	7 Days
Control	27.58	24.51	17.57	10.35	0.237	0.208	0.161	0.096
Chitosan treated	26.23	21.62	18.38	16.69	0.221	0.141	0.128	0.119

Advanced IAA nano-formulation for improved germination and seedling vigor

Technology detail: Seed invigouration of IAA nanoformulation @ 15 ml kg⁻¹ as pre-sowing treatment improved germination and seedling vigour both in groundnut and blackgram.

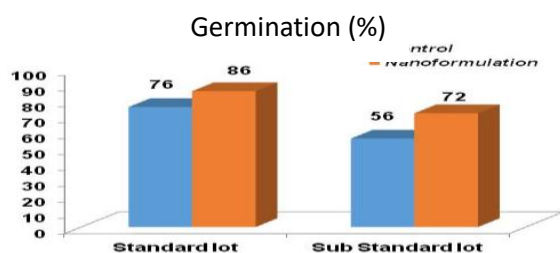
Impact of Chitosan nanomemulsion on stomatal behaviour in corn and pearl millet



Corn

Pearl millet

Groundnut



Seedling Vigour

Treatment	Standard lot	Sub standard lot
Control	1717	1254
Nanoformulation	2238	2067

Blackgram

Treatment	Standard lot		Sub standard lot	
	Germination (%)	Seedling Vigour	Germination (%)	Seedling Vigour
Control	76	1955	65	1595
Nanoformulation	90	2998	84	2903

Department of Remote Sensing &GIS

Technologies for Adoption

Sustaining Rice area and Yield monitoring

Sentinel 1A SAR data was acquired throughout the year from 12th January 2018 to 25th April 2019 and processed region wise for different crops during different cropping period. The village wise Rice area map and statistics was generated at 12 days interval for 11,365 villages. Start of the season, area, leaf area index and dB stack were generated during Samba season. The methodology for estimating end of season Rice yield was fine tuned integrating varietal information and satellite derived weather products and yield aggregates at district, block and village level were generated. In-season site visits were conducted across 280 monitoring locations in the footprints for classification purposes and more than 1665 field observations were made for accuracy assessment. A total rice area of 9.43 lakh ha was mapped with classification accuracy from 90.3 to 94.2 per cent with Kappa values ranging from 0.81 to 0.88. The end of season yield estimates for rice derived integrating remote sensing products and ORYZA crop growth model were in the range of 2022 to 5494 kg ha⁻¹ in the delta districts of Tiruchirapalli, Thanjavur, Tiruvarur, Nagapattinam, Ariyalur and Perambalur showing the capability of the methodology to capture spatial variations in rice yield. Further the methodology was effective in capturing crop failures resulting in poor yields of 214 to 255 kg ha⁻¹ in Ramanathapuram, Sivaganga and Pudukottai districts, where drought has caused yield reductions. Crop losses in Ramanathapuram, Sivagangai and Pudukottai district were assessed. During the last two years, in total 3793 villages were analysed for crop failure and 775 and 1035 villages were identified for failed sowing and crop failure respectively resulting in payouts of Rs. 1833 crores to rice farmers.

TNAU Remote sensing Technology for generating Maize Area Map and Yield estimation for Crop Insurances

Sentinel 1A synthetic aperture radar satellite data was acquired during the cropping season at 12 days interval. Pre-Processing techniques viz., mosaicking, co-registration, orbital correction, speckle filtering were done and dB stack was generated for entire cropping season. Parameterized classification and multi-temporal features extraction was used to generate Maize area map for Ariyalur and Perambalur districts. Block wise statistics showed that Veppanthattai block of Perambalur district and Ariyalur block recorded major Maize area of about 16342 ha and 6727 ha respectively in both the districts. Accuracy of the generated maize area map was 89-91%. Maize yield was estimated by integrating remote sensing products and DSSAT crop growth model and validated using CCE data which showed an agreement of 85%.

Smart sampling of CCE's

Smart sampling methods were developed using SoS, LAI and NDVI with eight, four and five strata respectively from each product with four levels of sampling viz., 500, 1000, 1500 and 2000 points for the district. Among the four levels of smart sampling, sample size of 1000 points for the district *i.e.*, two samples per village was found to be the best resulting in the highest R^2 value of 0.92 and agreement of 90.75 per cent. The three smart sampling methods resulted in comparatively better R^2 values of >0.85 and good agreement of >85 per cent indicating the suitability of all the three Remote Sensing based products of SoS, LAI and NDVI for smart sampling of CCEs.

Gaja Cyclone Damage Assessment using Drones and Satellite imageries

Damage caused by Gaja cyclone to Banana and Coconut plantations were assessed using two drones of copter and fixed wing type in Lalgudi block of Tiruchirapalli district and Madukkur, Pattukottai and Peravurani blocks of Thanjavur district. Large scale damage assessment was done by using Sentinel-1A SLC-radar satellite data acquired during 8th and 20th November, 2018 at 5m resolution. The multi temporal features of span ratio, maximum Increment and minimum increment with coherences were used for identifying damaged plantation. The Preliminary assessment shows that 38.74 lakh trees were damaged in total in Thanjavur, Thiruvarur and Pudukkottai districts. Peravurani and Sethubhavachatiram were the major blocks accounting for more number of damaged trees of 769701 and 603914 respectively. 38% of banana plantations in 1500ha area were found to be affected by Gaja cyclone in Lalgudi block of Tiruchirapalli district.

Rainfed area map of Tamil Nadu derived using Remote Sensing products

Rainfed cropland areas of Tamil Nadu were estimated as 25.67 lakh hectares using Remote Sensing products. The rainfed cropland area found to be higher in Ramanathapuram (2.27 L.ha) district followed by Villupuram (1.90 L.ha) and Thoothukudi district (1.65 L.ha). Accuracy of rainfed area classes were found to be 85 per cent between the ground control points and predicted map with a kappa coefficient of 0.70.

Spatial changes in LGP of Tamil Nadu from 2001 derived from satellite data

Seventeen years freely available satellite data from 2001 to 2017 for Tamil Nadu was used for computation of LGP (Length of Growing Periods). LGP deviation, start of season and area estimation was estimated and Zonal statistics were calculated to identify the area distribution of each risk zones in the districts of Tamil Nadu. Results revealed that, there was a decrease in the LGP around 40 per cent of the area in Tamil Nadu distributed spatially. It was observed to have an increased LGP in some parts and equally decreased LGP in other parts indicating the need for reorienting of growing season for rainfed crops in Tamil Nadu.

Progress of Drought during SWM 2019 based on Rainfall departure as on 10th July 201

MODIS data was acquired at 8 days composite for the month of June at a resolution 500m to assess the drought conditions of the entire state by deriving vegetation indices viz., NDVI (Normalized difference vegetation Index). NDVI map and Block-wise Zonal statistics was generated. It showed that most of the block ranged from (0.2-0.4) moderate to severe drought conditions.

III. CROP PROTECTION

CENTRE FOR PLANT PROTECTION STUDIES

Rice

- Rice + sunflower (or) rice + cowpea (or) rice + sesame cropping system with soil incorporation of either FYM (12.5 t/ha) or vermicompost (2.5 t/ha) and amendment with neem cake 250 kg / ha and azophos (2 kg/ha) (If azophos is not available, Azospirillum 2 kg/ha + Phosphobacteria 2 kg/ha can be applied).
- Increased attraction, conservation and virulent activities of entomophages, increased natural suppression of pests, maximum pest defender and occurrence ratios, and minimum preference ratio, moderate yield and CBR.

Management of Pulse beetle

- TNAU SWEET FLAG 6EC @ 10ml/kg of pulse seeds (Greengram, Blackgram, Bengalgram and Cowpea) caused cent per cent mortality of pulse beetle on third to fifth day after six months of treatment. Germination of treated seeds was not affected after six months of storage.
- Pongamia oil derived formulation @ 10ml/kg of pulse seeds was effective against the pulse beetle. Effective for long term storage (6 months) of pulses.

Management of white grub in sugarcane

Soil drenching of imidacloprid 17.8 SL @ 250 ml/ha in 1000 lit. of water in root zone of affected cane effectively reduced white grub population to a tune of 94.59 % over control with higher cane yield (93.72 t ha⁻¹) and BC ratio (2.50)

Mango Fruit Fly Trapping Technology

Mass trapping of fruit flies @ 25 traps/ha during March - June (Main season) and August - November (Off season) reduced fruit fly incidence by 50% with savings upto Rs. 10,500/ha on plant protection chemicals.

IPM Module for groundnut pest management

Basal application of neem cake @ 250 kg/ha, seed treatment with imidacloprid 17.8 SL @ 2ml/kg, cumbu as intercrop (6:1) ratio, yellow sticky trap @ 25/ha, release of *Chrysoperla* @ 40000/ha on 20 DAS and Azadirachtin 1% @ 2ml /lit. on 30 DAS.

IPM Module for castor pest management

Application of Btk @ 1g/l (on notice of egg and early instar larvae of semilooper), monitoring of *Spodoptera litura* by pheromone traps @ 5 /acre from 30 DAS, application of flubendiamide 39.35 SC @ 0.2 ml /l (for *Spodoptera* when foliar damage reaches 10%), profenofos 50EC @ 1ml/l (for capsule borer/leafhopper when damage reaches 10%).

Management of Fall armyworm (FAW), *Spodoptera frugiperda* (invasive pest)

- Apply neem cake @ 250 kg/ha during last ploughing and treat seeds with thiamethoxam 30 FS or *Beauveria bassiana* @ 10 g/ kg
- Adopt spacing of 60 x 25 cm for irrigated and 45 x 20 cm for rainfed maize and rogue spacing of 75 cm for every 10 rows

- Raise border crop of cowpea, sunflower or gingelly, and intercrop with black gram or green gram to attract and conserve natural enemies
- Raise border crop of Bajra Napier for irrigated maize or grain sorghum variety for rainfed maize to attract FAW adults on border crops
- Use solar light trap @ one /ha and sex pheromone traps @ 50/ha for mass trapping of adults from 10-15 DAS

Apply any one of the following/ ha

Early whorl stage (15 – 20 DAS)

- Azadirachtin 1% EC 20 ml/10 l
- Thiodicarb 75 WP 20 g/10 l
- Emamectin benzoate 5 SG 4g/10 l

Late whorl stages (40-45 DAS)

- *Metarhizium anisopliae* 80 g/10 l with 1×10^8 cfu/g
- Spinetoram 12 SC 5 ml/10 l
- Novaluron 10 EC 15 ml/10 l

Tasseling and cob formation stage (60 – 65 DAS)

- Flubendiamide 480 SC 4 ml/10 l
- Chlorantraniliprole 18.5 SC 4 ml/10 l

Millets

Management of Finger millet blast

Seed treatment with talc-based formulation of TNAU-Pf1 (10g/kg) plus two sprays of tricyclazole (0.1%) at maximum tillering phase and at heading phase is recommended.

Vegetables

Chemical management of tomato early blight caused by *Alternaria solani*

Application of propiconazole (0.1%) or hexaconazole (0.1%) on 30 and 50 days after planting was found to be effective in controlling early blight of tomato besides increasing fruit yield.

Biological management of rhizome rot in ginger

Rhizome dip in *Pseudomonas fluorescens* (0.1%) for 30 minutes along with soil application of *P. fluorescens* @ 2.5 kg/ha on 3, 5 and 7th months after planting was effective in the management of rhizome rot in ginger.

Nematology

- Management of root knot nematode, *Meloidogyne incognita* infesting tomato under polyhouse conditions - Application of egg parasitic fungus, *Purpureocillium lilacinum* as seed treatment @ 10g/kg of seed followed by soil application @ 50g/m² reduced *M.incognita* population in soil by 41.1% and increased the tomato yield by 37.2% compared to untreated control.
- Management of root knot nematode, *Meloidogyne hapla* in carrot - Biofumigation of mustard with soil application of neem cake @ 250 kg/ha and *P. lilacinum* @ 5 kg/ha was significantly reduced the root knot nematode, *Meloidogyne hapla* population by 47.1 % and increased the carrot tuber yield by 28.1% than untreated control.

- Management of reniform nematode, *Rotylenchulus reniformis* in castor - Soil application of *Pseudomonas fluorescens* Pf-1 @ 2.5 kg/ha reduced the *Rotylenchulus reniformis* population in soil by 47.32 per cent and 62.75 per cent in root and enhanced the castor seed yield by 34.0 per cent over untreated control.

Technologies for On Farm Testing

Rice

Management of sheath rot and grain discolouration in rice

- T1. Seed treatment with *Pseudomonas fluorescens* (Pf1) @ 10g/kg + one foliar spray with azoxystrobin @ 0.2 % at 50 per cent flowering.
- T2. Seed treatment with *Pseudomonas fluorescens* (Pf1) @ 10g/kg + one foliar spray with carbendazim + thiram+ mancozeb (1:1:1) @ 0.2 % at 50 per cent flowering.
- T3. Absolute control

Management of blast disease through combination fungicides

- T1. Foliar spraying of azoxystrobin + difenoconazole @ 0.1 % at the time of symptom appearance
- T2. Foliar spraying of zineb + hexaconazole @ 0.25 % at the time of symptom appearance
- T3. Foliar spraying of tricyclazole @ 0.1 % at the time of symptom appearance
- T4. Absolute control

Pulses

Biological management of chickpea wilt

- T1 Seed treatment with *Pseudomonas chlororaphis* (CPs3) @10g / kg of seeds + soil application @ 2.5kg /ha
- T2 Seed treatment with *Bacillus subtilis* (CaB5) @10g / kg of seeds + soil application @ 2.5kg /ha
- T3 Seed treatment with *Pseudomonas fluorescens* (Pf1) @ 10 g/ kg + soil application @ 2 .5 kg/ha
- T4 Seed treatment with carbendazim @ 2g / kg of seeds + soil drenching @ 0.1%
- T5 Untreated Control

Management of root rot and wilt diseases in redgram with biocontrol agent

- T1 Seed treatment with *B. subtilis* (CcB7) @ 10 g/ kg + soil application twice @ 2 .5 kg/ ha first at basal and second at 45 DAS
- T2 Seed treatment with *Pseudomonas fluorescens* (Pf-1) @ 10 g/ kg + soil application @ 2 .5 kg/ha
- T3 Seed treatment with Carbendazim @2g / kg of seeds + soil drenching @0.1%
- T4 Untreated Control

Oilseeds

Integrated disease management in groundnut

- T1 Seed treatment with tebuconazole 1.5 g/kg + furrow application of *T. asperellum* @ 2.5 kg/ha mixed with 50 kg FYM + application of *T. asperellum* @ 2.5 kg/ha mixed with 50 kg FYM at 40 DAS + two spray of tebuconazole @ 1 ml/l at initiation of foliar diseases and 15 days later
- T2 Seed treatment with mancozeb @ 2g/kg seed + foliar spray of hexaconazole @ 1 ml/lit at 30 and 45 DAS + soil drenching with carbendazim 0.1% during onset of the disease appearance T3: Control

Cotton

Assessing the efficacy of *Bacillus* spp. for the management of cotton necrosis caused by Tobacco streak virus

- (Three foliar sprays from 25 DAS at 15 days interval) – 10% buttermilk based suspension
- T1 *B. amyloliquefaciens* (VB7) (LF) – 1% , T2 – *Bacillus subtilis* - 1% and T3 – Untreated control

Fruit crops

Management of gummosis and die-back of mango

- T1 Removal of infected twigs and branches + three sprays of tebuconazole 25EC (0.1%) at 15 days interval
- T2 Farmers Practice-Three sprays of thiophanate methyl 70 WP (0.1%) at 15 days interval
- T3 Untreated check

Integrated management of citrus greening disease

- T1 50% more than recommended dose of phosphorus (RDP) + tetracycline hydrochloride 600ppm + ZnSO₄ + FeSO₄ (200g each/tree)
- T2 Farmers practice – tetracycline hydrochloride @ 500ppm
- T3 Untreated control

Vegetables

Development of eco-friendly bioformulation for the management of chilli anthracnose

- T1 Thyme oil 5EC -1 %
- T2 Farmers practice - carbendazim - 0.1%
- T3 Untreated control

Coconut

Management of leaf blight in coconut

- T1 Root feeding with tebuconazole @ 5 ml in 100 ml of water during Jan, April, July and October.
- T2 Root feeding with hexaconazole @ 2 ml in 100 ml of water during Jan, April, July and October.

- T3 Root feeding with carbendazim @ 2 g in 100 ml of water during Jan, April, July and October.
T4 Control

Non –crops

Polypropylene containers (reusable) as an alternative to polypropylene bags for oyster mushroom cultivation

- T1 Polypropylene containers (18 cm height, 10 cm dia.)
T2 Polypropylene bags (80 gauge; 60x30 cm) (Existing method)

Mushroom species: *Hypsizygus ulmarius* variety CO (OM)2 / *Pleurotus florida* (PF)

Evaluation of CBE-TNAU-1523 milky mushroom (*Calocybe indica*)

- T1 Test culture - *Calocybe indica* CBE-TNAU-1523
T2 Commercial variety- *Calocybe indica* (APK2)

Evaluation of Entomopathogenic Nematodes (EPNs) bacterial toxins against brinjal insect pests

Treatments Proposed:

- T1 - EPN bacterial toxin formulation @ 1ml/lit (to be repeated thrice 30, 60 and 90 DAT)
T2 - Farmers practice
T3 - Untreated check
Design : RBD
Replications : 7
Variety: Ruling variety

Observations to be recorded:

- Per cent damage of shoot and fruit borer and population of mealy bug, white fly, aphids, leaf hopper and Epilachna beetle
- Yield (Kg/ha), Benefit cost ratio.

Coordinating centre: HC &RI, Periyakulam (Dr. S. Prabhu, Asst. Prof. (Nematology))

Participating centers:

- AC &RI, Coimbatore (Dr. E. Sumathi, Asso. Prof. (Entomology))
AC &RI, Madurai (Dr. K. Suresh, Asst. Prof. (Entomology))
HC &RI, Periyakulam (Dr. S. Irulandi, Asst. Prof. (Entomology))
AC &RI, Killikulam (Dr. G. Preetha, Asst. Prof. (Entomology))

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

Treatments proposed:

- T1 - *Purpureocillium lilacinum* @ 75g mixed with FYM @ 2.5kg, pressmud @ 2.5kg, neem cake @ 125g/tree with marigold around tree basin
T2 - Farmers practice (carbofuran3G @ 60g/tree)
Design : Paired 'T' test
Replications : 14
Variety : L -49

Observations to be recorded:

- Initial and final nematode population soil (200cc) and root (5g) & No. of galls/ 5g root, No. of fruits / tree, Fruit weight (g),
- Yield: Kg/tree;
- C:B ratio.

Coordinating centre:

HC &RI, TNAU, CBE (Dr. P.Vetrivelkai, Asst. Prof. (Nematology))

Participating centres:

AC &RI, Coimbatore (Dr. P.Kalaiarasan, Asst. Prof. (Nematology))

HC &RI, Periyakulam (Dr. S. Prabhu, Asst. Prof. (Nematology))

AC &RI, Vazhavachanur (Dr. P. Senthilkumar, Asst. Prof. (Nematology))

Bio-management of root knot nematode, *Meloidogyne incognita* on tomato**Treatments proposed:**

T1 – *Purpureocillium lilacinum* @ 2.5Kg/ha mixed with FYM @ 250Kg/ha at the time of transplanting

T2 - Farmers practice (Carbofuran 3G @ 1kg ai/ha)

Design : Paired 'T' test

Replications : 15

Variety : Co.3

Design : Paired 'T' test

Replications : 15

Variety : Co.3

Observations to be recorded:

- Nematode population in soil (200 cc) and root (5g)
- Root knot Index
- Yield (t/ha)
- C:B ratio

Coordinating centre: TNAU, CBE (Dr. A.Shanthi, Professor (Nematology))

Participating Centres:

HC &RI, Periyakulam (Dr. S. Prabhu, Asst. Prof. (Nematology))

AC &RI, Trichy (Dr. P. Jayakumar, Asst. Prof. (Nematology))

VRS, Palur (Dr. K. Senthamizh, Asst. Prof. (Nematology))

Overall package for nematode management of root knot nematode, *Meloidogyne incognita* infesting cucumber under protected cultivation (as large scale demo)**Treatments proposed:**

Step 1 Removal of root biomass from previous crop

Step 2 Soil solarisation of moistened soil using transparent polyethene sheets 25 micron thickness for a period of 2-3 weeks during peak summer (May-June).

Step 3 Incorporation of bio enriched farm yard manure/ vermicompost or both @ 1 ton per acre polyhouse (2x108 for *P.lilacinum*, *P.chlamydosporia* and *T.asperellum* and 2x1012 for *P.fluorescens*). The FYM heap has to be moistened, mixed with bioagents and kept for 3-4 weeks in shade (mixing and moistening once in a week).

Step 4 Crop rotation (Cucumber to be rotated with more tolerant host, capsicum followed by good host tomato/ cucumber).

Step 5 New molecule (Fluopyram 400SC) @ 250g a.i/ha at One day after transplanting and 25 DAT can be demonstrated through drip.

Step 6 Drip application of liquid formulation of *Pochonia chlamydosporia* @ 0.25 ml/m² (at the time of sowing to be repeated thrice at monthly intervals -30, 60 and 90 DAS).

Design : RBD

Replications: 7

Variety : Ruling Variety

Observations to be recorded:

- Nematode population in soil (200 cc) and root (5 g),
- Root knot Index
- Yield (Kg/m²) and converted into t/ha,
- C:B ratio

Coordinating centre : TNAU, CBE (Dr. N.Swarnakumari, Asst. Prof. (Nematology))

Proposed centers:

AC &RI, Coimbatore (Dr. P. Kalaiarasan, Asst. Prof. (Nematology))

AC &RI, Coimbatore (Dr. G. Jothi, Assoc. Prof. (Nematology))

AC &RI, Vazhavachanur (Dr. P. Senthikumar, Asst. Prof. (Nematology))

For Information

Rice

Thirty rice entries were identified with multiple disease resistance

Pulses

- Chickpea chlorotic stunt virus disease in Tamil Nadu has been observed in recent years. Preliminary studies on the etiology of the disease revealed the involvement of geminivirus.
- Resistant genotypes in redgram (for SMD - CRG 2016-12, IPA 8F, MA6, BDN2), Blackgram (for YMD - KUP18-351, KUP18-352, KUP18-353) and Greengram (for YMD - KMP18-29) have been identified.

Maize

- Seed treatment + soil application of *P. fluorescens* recorded the lowest banded leaf sheath blight incidence (2.66%) and recorded the highest yield of 7042 kg/ha
- Foliar application of hexaconazole (0.2%) recorded the lowest disease incidence of banded leaf sheath blight of (2.25 %) and recorded maximum yield of 6749 kg/ha

Pearl millet

- The entries viz., PT 6687, PT 6303, PT 6317, UCC 35, UCC 36, UCC 37 and TNBH 121235 were free from downy mildew incidence
- The entries viz., TNBH 1605, PT 6029, PT 6067 and UCC 37 were showing less than 5.0 per cent downy mildew incidence

Horticulture

Mahaffee spore trap for detection of airborne inocula of grapevine mildews

- A low cost impaction spore trap was designed to detect air borne inocula of grape vine downy mildew.

- A rapid highly sensitive detection technique, Loop Mediated Isothermal amplification Assay (LAMP) was developed for the detection of air borne inocula of grapevine downy mildew

Characterization of FOC races associated with Banana Var. Grand Naine

- Absence of FOC TR4 race in Tamil Nadu was confirmed by Polymerase chain Reaction with race 4 specific primer

***Brachybacterium paraconglomeratum* of banana against FOC– Race 1**

- Bacterial endophyte *B. paraconglomeratum* was effective in the suppression of FOC-Race 1
- Biomolecules produced by *B. paraconglomeratum* at the zone of inhibition were identified as valeric acid, clindamycin, phosphorothioic acid and 30 deoxy-d-mannoic lactone.
- Scanning electron microscopic studies confirmed that bacterial endophytes *B. paraconglomeratum* colonized the rhizoplane, pseudostem and petiole. Besides, improved the root architecture.

MAMP triggered immunity mediated through *Bacillus amyloliquefaciens* for the management of bud necrosis virus in tomato

- MAMP clones with Flagellin and Elongation factor triggered the expression of MAPKKK1, transcription factor WRKY33 and the defense genes NPR1, PR1 responsible for ISR and suppressed the viral infection up to 63%.
- Biomolecules pentadecenoic acid, heptadecenoic acid, octadecenoic acid, pyrrolo, piperazinedione and tetradecenoic acid suppressed the symptom expression in the bud necrosis virus inoculated tomato plants.

A new seed transmissible Bittergourd yellow mosaic virus (BgYMV)

- Virus is identified as a new recombinant virus and named as Bittergourd yellow mosaic virus.
- Virus is seed borne and seed transmitted.

Genetic diversity of GBNV infecting tomato and RNAi constructs for GBNV

- There was no diversity among the GBNV isolates collected from different locations of Tamil Nadu.
- RNAi constructs targeting coat protein and replicase of GBNV are available

Management of virus diseases in snake gourd

Basal soil application of micronutrient mixture @ 2.5kg / ha each ferrous sulphate, zinc sulphate, copper sulphate, manganese sulphate and borax along with foliar application of micronutrient mixture (0.2 per cent of each ferrous sulphate, zinc sulphate, copper sulphate, manganese sulphate and 0.1 per cent borax) was found to be effective in reducing the virus disease incidence in snake.

IV. HORTICULTURE

Dept. of Vegetable Crops

For Adoption

Crop Improvement

Ridge gourd COH 1 (2018)

Ridge gourd COH 1 is a F₁ hybrid of IC 410147 X IC 373361. It was developed by the Department of Vegetable Crops, HC&RI, Coimbatore. The hybrid is very early (days to first harvest is 30-35) and a prolific bearer with high yield (33.7 t/ha). The fruits are attractive green with soft pulp, less seed content, long (40 - 45 cm), ridged with an average fruit weight of 370-380 g. The fruits of the hybrid could be harvested for 15 – 17 times in 4 months duration. Due to the long harvesting period a single plant yields 25 - 30 fruits with an average yield of 10.57 kg/plant. The hybrid culture CRgH 1 proved its superiority with an estimated yield of 33.7 t/ha which was 35.5% increase over the check hybrid (Ankur Latika).



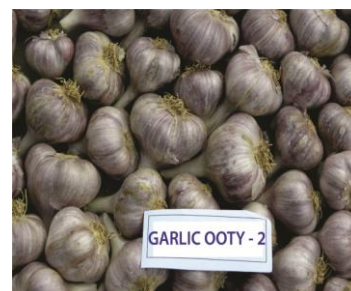
Bottle gourd PLR 2 (2019)



It is a selection, from local types collected from Uchimedu, with round fruit without bottleneck, very appealing light green fruit colour. High yielding (41.15 t/ha) with excellent taste. Average fruit weight is around 975 g. Ideal for small and medium family. Best for traditional vegetable lovers. It produces high marketable fruits and lower level of incidence of pest and diseases.

Garlic Ooty 2 (2019)

The accession As 72 has an average plant height (67.92 cm) with erect green foliage, number of leaves (6.75), equatorial diameter of bulb (45.78 mm), polar diameter of bulb (42.39 mm), number of cloves (16.09) and yield (16.94 tonnes / ha). The accession As 72 has a TSS content (47 ° Brix), allicin (3.87 µg/g of sample) and polyphenol content (3.08 µg/g of sample). The overall per cent increase in yield over check is 22.31.



For Information (MLT/ART/OFT)

Onion Aca 15 (ART)



Screening of aggregatum onion germplasm was done to identify a seed propagated aggregatum onion with short duration. Over the five years of evaluation the Aca 15, a selection from Puttarasal type recorded the highest bulb yield of 22.84 t /ha which is 22.32 % increased over the check CO (On) 5. The bulbs of Aca 15 are bold and pink colored with high TSS of 18.04 ° brix. The duration of the crop is 65-70 days for bulb crop and 90 days for seed to bulb crop. Seed yield is 300 kg/ha. Seeds of Aca 15 and check variety CO (On) 5 have been sent to 12 districts of Tamilnadu to conduct ART in 120 locations during January 2018.

Tomato CTH 1 (ART)

It is a F₁ hybrid of LE 127 x LE 239. Fruits are flat round with green shoulder, each fruit weigh about 75.3 g. The plant yields 32.1 fruits with average fruit weight of 75.0 g. The yield potential of the hybrid was 96.0 t/ha which is 22.6 % increased yield over COTH 3 (78.3 t/ha) and 26.3 % increased yield over Lakshmi (76.0t/ha). It is moderately resistant to leaf curl virus (10.5 PDI). The TSS of the fruit was 6.30 °brix and the ascorbic acid content is 30.43 mg/100 g .It also recorded an extended shelf life period of 40 days under the storage temperature of 8°C. Seeds of CTH 1 along with check hybrids viz., COTH 3 and Lakshmi have been sent to 21 districts of Tamil Nadu to conduct ART in 135 locations



Brinjal hybrid derivative (HD 10-6-5-3) (MLT II)



Brinjal hybrid derivative (HD 10-6-5-3) was selected from a cross Singampunari Local x Annamalai. This hybrid derivative possesses a plant height of 85.16 cm with 22.17 branches/plant. Each plant bears 39.14 fruits each weighing 47.50 g. The fruit is white in color with purple stripes which is locally called as Palgiri. Consistent yield was observed in the past seven generation with a potential yield of 2.12 kg /plant. It is highly suitable for local market of Southern districts. The hybrid derivative recorded 18.59 % and 36.64 % infestation of shoot and fruit borer respectively besides recording 18.45 % little leaf incidence

Cassava Me 681 (MLT 1)

Plants are erect, tall growing and branching at the top. The inter nodal length is shorter and the leaf size is bigger with sufficient canopy. The tubers are long, cylindrical with pinkish white skin. The rind colour is also pink with creamy white. The flesh is white in colour. The three years yield data revealed that the mean tuber yield per plant was 7.61 kg with the starch content of 29.80%. It is a dual purpose cassava accession suitable for edible purpose and for industrial use. It recorded the grade 1 to 2 for Cassava mosaic virus. Harvesting can be done at 10 months. Planting materials of Me 681 and check varieties has been sent to 17 centres for the conduct of MLT.



Crop Management

Seasonal influence on growth and seed yield of small onion cv. CO (On) 5 under Vaigaidam conditions

The results of the study showed that, out of different months of planting, November planting registered the highest plant height (32.50 and 64.65 cm on 30th and 60th day respectively), early flowering (37.10 days for first flowering and 54.15 days for 50% flowering), early harvest (109.75 days), highest number of flowering stalks/plant (5.06), number of umbellets/umbel (179.10), number of seeded umbellets/umbel (149.22), number of seeds/umbellet (4.12), umbel diameter (5.05 cm), number of seeds per umbel (355.20), seed weight/umbel (1.298 g), 1000 seed weight (3.066 g) and seed yield /ha (1047.23 kg).

Effect of seed treatment after ripening period on seed germination and seedling emergence of Ash gourd cv. CO 1

The findings of the study revealed that the fruits stored for 60 days recorded the higher germination (63 and 65 %) and the fruits of immediately after harvest which recorded the lowest germination (18 and 20 %) under field and laboratory condition respectively. It was evident that the germination percentage increased with the increase in after ripening period. After ripening, seed treatments for breaking dormancy before sowing of ash gourd revealed that warm stratification with a temperature of (40-50° C) for five days treatment gave higher germination of 63 and 66 per cent which was followed by ethrel 500 ppm for 16 h which recorded 62 and 64 per cent of germination and the control seeds which recorded lowest germination (13 & 12 %) under field laboratory condition.

Standardization of propagation techniques in annual moringa (PKM1 & PKM2)

Among the 24 treatments studied for standardization of vegetative propagation techniques in annual moringa, air layering treated with IBA 4000 ppm showed highest survival percentage of 100% for shoot and root characters in both PKM 1 & PKM 2.

Study of foliar spray and fertilizer levels on yield of Vegetable Cowpea (PKM 1)

Soil application of 125 % RDF + 2 % DAP foliar spray at flowering and pod formation recorded significantly higher green pod yield (17.40 t/ha), net return (Rs.1, 17,120/ ha), BC ratio (3.06) and 56 per cent increased yield over 75 % RDF.

Enhancing the productivity of vegetables in an organic production system

- Foliar spraying of 10 % herbal leaf extract (neem, notchi, pungam, calotropis and adhatoda) at 30 and 45 DAS recorded significantly higher vegetable cowpea yield of 14.16 t/ha. However, it was on par with foliar spraying of 5% Neem + *Ocimum* leaf extract compared to control.
- Foliar spraying of 10 % herbal leaf extract at 30 and 45 DAS recorded higher net returns (Rs.45,009/ha) and benefit cost ratio (1.47) compared to control (1.03).

Crop Protection

Combating pandal vegetable (snake gourd) diseases by organic approaches

Three sprayings with salicylic acid foliar spray @ 0.1% on 30, 45 and 75 days after sowing was found to be the best treatment in reducing the anthracnose disease incidence (PDI 13.28) as compared to control (PDI 26.00). Highest fruit yield of 12.27 t/ha was also recorded in the same treatment compared to 2.90 t/ha in control.

Dept. of Fruit Crops

For information

Crop Improvement

Banana hybrid H – 212

Banana is an important fruit crop cultivated in nearly 1 lakh hectare in Tamil Nadu. Among the various varieties cultivated, the cv. Ney Poovan is grown in large acreage in Erode, Coimbatore, Trichy, Tirunelveli and Kanyakumari districts. This variety fetches

premium price in the market as compared to Poovan, Karpooravalli and Grand Naine. This variety is susceptible to nematodes affecting banana and also sigatoka leaf spot. Efforts were taken up in TNAU to develop banana hybrids resistant to nematode, leaf spot and fusarium wilt. The hybrid H212 is an outcome of hybridization programme involving Karpooravalli and a resistant diploid parent "Pisang Lilin". During screening over the years the hybrid H212 was found to perform more or less similar to cultivated Ney Poovan in finger size, bunch weight, taste along with resistance to nematode (*Radopholus similis*). In Multi location trial conducted at 6 locations, the hybrid performed similar to Ney Poovan in yield additionally with minimum are nil presence of nematode infestation. The average bunch weight of H212 is 9.97 kg as compared to 9.89 kg in Ney Poovan. The crop duration of H 212 is 360 to 390 days. Both H 212 and Ney Poovan produced about 8 to 9 hands per bunch. The number of fingers per bunch is higher in H 212 (146) as compared to Ney Poovan (125). The TSS of both H 212 and Ney Poovan ranges from 22 to 26⁰ brix depending upon the stage of ripening. The H 212 had shown field tolerance to nematode population while Ney Poovan was found susceptible. Because of this resistant attribute and acceptable yield, fruit quality trait similar to Ney Poovan this hybrid can be cultivated with minimum nematicide usage or can also be fitted in organic production system.

Manila Tamarind (MT -02) – New culture

MT -02 is a open pollinated seedling from viruthunagar local. It is medium branching type. Growth habit is profuse. Twisted pale yellow fruit and attractive red aril and yields about 87 kg/tree/annum. TSS is 19⁰ Brix and the type is suitable for saline, alkaline soils and water logging conditions

Manila Tamarind (MT -02)

Crop Management

High density planting and canopy management in guava cv. Lucknow 49

The guava cv. Lucknow 49, was raised at Different spacing levels viz., S1- 2m x 1m; S2 – 3m x 1m; S3 – 3m x 1.5m; S4 – 5m x 5m (control) with different fertigation levels viz., F1 – 75:75:75 g NPK/plant; F2 - 150:150:150g NPK / plant; F3 - 225:225:225g NPK / plant to standardize optimum spacing and fertigation schedule in maximizing the productivity per unit area and quality of fruits

It was inferred from the two consecutive crops (2016-17, 2017-18) that a combination of S2F1 (Spacing, 3 m x 1 m (S2); Fertigation dose, 75:75:75g NPK/plant (F1)) was the best nutrient management practice for getting higher productivity with better quality parameters.

Dept. of Spices and Plantation Crops

Spices Crops

For Information

Crop Improvement

Coriander CS 38

It is a Selection from Rajasthan local. Leaf yield was 5016 kg/ha with the crop duration of 38 to 45 days. It is 21.5 per cent yield increase over the check variety CO (CR) 4. The high yielding leafy coriander culture CS 38 was forwarded to MLT during 2014-15 & 2015-16 and ART during 2018-19.

Adaptive Research Trial (ART) for the leafy coriander type CS 38 was conducted at eight districts Viz., Cuddalore, Coimbatore, Perambalur, Ramanathapuram, Thoothukudi, Trichy, Tiruppur, Virudunagar. The ART data of eight districts revealed that the highest herbage yield of 5016 kg/ha was recorded by CS 38 as compared CO (CR) 4 (4129 kg/ha) The per cent increase was 21.5 over CO (CR) 4. Further, Seeds of leafy coriander type CS 38 were multiplied for conducting ART trial during the ensuing rabi season of 2018-19.

Plantation Crops

For Information

Crop improvement

- Malayan Yellow Dwarf x Chowghat Green Dwarf was found to be the early flowering hybrid (22 months after planting) exclusive for tender nut water trade.
- Chowghat Orange Dwarf x Cochin China was found to produce high volume of tender nut water (520 ml/nut) in the summer.
- Aliyarnagar Tall x Malayan Yellow Dwarf was found to have higher Total Soluble Solids (5.8⁰ brix).
- Chowghat Green Dwarf x Malayan Green Dwarf was the dwarf palm among the other cross combinations under evaluation for tender coconut (560 cm) at an age of 6 years old.

Crop Protection

- Among the eight new systemic fungicides tested, Mancozeb 50% + Carbendazim 25% WS and Zineb 68% + Hexaconazole 4% WP were found superior recording 100 per cent inhibition of fungus *Ganoderma lucidum* and showed superior over the other fungicides tested under *in vitro*.

Dept. of Floriculture and Landscaping

For adoption

Crop Improvement

***Jasminum nitidum* CO 1 (Star Jasmine) (2019)**

The culture *Jasminum nitidum* ACC.Jn-1 recorded an yield of 1.40 kg /plant/year whereas *Jasminum grandiflorum* variety CO--1 recorded 1.04 kg /plant/year. The overall per cent increase over check is 33.1. It was found that the culture *J.nitidum* Acc.Jn-1 found to be flowering throughout the year under Tamil Nadu conditions.

For Information

***Jasminum multiflorum* culture Acc.Jm-1(KMD) (MLT/ART)**

Salient features of this culture are year-round flowering, Profuse flowering in winter and good quality parameters like Bold buds, Attractive pink colour corolla, Pink corolla tube with contrasting green tinge at the base, Long corolla tube – suitable for easy harvesting and string making, Longer shelf life (flower buds remain unopened for 10 hours under room temperature and 52 hrs under cold storage at 7-8⁰C), Higher fragrance level than Local White Kakada and Attractive plant architecture (ideal as decorative ornamental also).

Dept. of Medicinal and Aromatic Crops**For Information****Crop Improvement*****Solanum nigrum* (Sn -19 Kallipalayam local)**

Multi location trial of *Solanum nigrum* was conducted with the high yielding accession, 'Kallipalayam local' (Sn 19). The accession Kallipalayam local (Sn 19) recorded 23.0 percent increase in fresh herbage yield (g/plant) over check.

Crop Management**Development of microtuber technology for cost effective multiplication of quality planting material in *Gloriosa superba***

Glory lily is one of the important commercial crop cultivated approximately in 7000 acres in Tamil Nadu. The annual requirement of tubers is estimated to be 1000 t tubers for replanting alone. Planting material (tubers) accounts for 60-70% of the cost of cultivation. To reduce the cost of tubers, micro tuber technology was evolved from the Department of Medicinal & aromatic Crops. In this method, graded seeds were used for micro tuber production. During first generation 2-3 g micro tuber was obtained from seed and the tuber weight was bulked to 40-42 g during 3rd generation.

Micro tubers were field tested in farmers holding. The result revealed that seed yield obtained in 3rd generation micro tuber plants (tuber size 41.90g) was 21.60 g dry seed /plant with an estimated seed yield of 194.40 kg/acre as compared to 18.20 g dry seed yield with estimated seed yield of 163.80 kg/acre in farmer's practice wherein the tuber size planted was 51.66 g.

V. AGRICULTURAL ENGINEERING

For adoption

Laser leveller for wet land

- A tractor with rotovator was fitted with external hydraulics that is controlled by conventional laser leveller system
- The equipment was demonstrated at Lalgudi, Tanjore and Ponneri
- This system can achieve perfectly levelled puddled field
- The advantageous are
 - Uniform height of water in the field and reduction in quantity of water
 - Uniform depth of planting when using transplanters
 - Controlled depth of puddling and maintenance of sub soil hard pan



Silica production from biomass for PV cell production

- Rice husk was used to produce Silica with purity level of 99.96%.
- The production processes used are washing of rice husk, oxidation, reduction (SiO_2 and Mg (1:2)) and leaching (Hydrochloric acid and Acetic acid (1:4)).
- Silicon retrieved after leaching had purity level of 99.3%.

Hydrothermal liquefaction (HTL) reactor for biocrude production

- HTL process was developed with respect to suitable temperature, pressure and retention time. It operates from 200 to 350°C and pressures up to 20 MPa with residence time from 15 to 60 min in a wet environment.
- During distillation of biooil, petrol (5%), kerosene (25%) and diesel (45%) were observed which indicates a good scope of utilizing biocrude in transportation sector with suitable recovery and upgrading techniques.
- Energy consumption ratio for HTL was calculated as 0.7 to 0.97 and the Energy efficiency of the system was found to be 79%.

Turmeric value chain machinery

Quality loss in turmeric arises from improper handling and postharvest practices adopted by farmers. Interventions (Improved Machinery) are needed for washing, boiling, drying and polishing of turmeric.

Mechanical turmeric dryer

- Capacity – 300 kg/batch
- Drying time – 36 h
- Cost of machine – Rs. 4.00 Lakhs



Dust proof turmeric polisher

- Capacity 900 kg per batch
- Cost of machine – Rs. 3.15 Lakhs



Banana cable conveyor

A Banana Cable conveyor system for transport of banana bunches from the field to the Pack House was developed. The system with a carrying capacity of one tonne of banana bunches in a single run was designed and developed. The cable way conveyor facilitates to reduce the post harvest loss in handling the bunches from the farm to pack-house and also avoids human handling and physical drudgery. It is suitable for large farms and also for collective small holdings in transporting the farm inputs and to bring out the produce.

Components

- Prime mover, GI Pipe arch, Roller assembly, Ratchet lever hoist, C-Clamp, Steel rope, Support frame
- Specifications
 - (i) Length of the conveyor : 180 m
 - (ii) Width of the conveyor : 1 m
 - (iii) Height of the Conveyor : 3 m
 - (iv) Capacity, t/h : 2
 - (v) Speed, km/h : 5
 - (vi) Power required, hp : 4
- Cost of the operation : Rs. 50/- per batch
- Savings in time : 200 %
- Saving in labour : 250 %
- Coverage : 1 ha/day
- Cost : Rs. 4 lakhs



Sapota Jam

Value added products developed from sapota were sapota squash, RTS, flakes, candy, jam and powder. Amongst them sapota jam is more promising than other products. It is because the characteristic astringency of sapota was not present in jam. Moreover ripened, semi ripened sapota can be used for jam preparation. This alleviates the hinderance of non uniform ripeneing of sapota and creates a market for sapota. The product is also retained the nutrients of sapota apart from being at a affordable cost. The product is also commercially viable to compete with the mixed fruit jam, mango jam, berry jams commercially available in the market.

Sapota jam

Parameters	Value (per 100g)
Moisture	23.7 %
TSS	69 ^o B
Titration acidity	0.4 %
pH	3.5
Reducing sugar	32%
Total sugar	64%
Calcium	6.83 mg / 100 g
Iron	0.26 mg / 100 g
Ascorbic acid	4.32 mg /100 g
COST	Rs. 130 / 500 g
Shelf life	6 Months

Sapota jam was prepared by heating the fruit pulp (55 %) with sugar (45%), followed by the addition of citric acid (1%) and pectin (1%). The mass was cooked till it attained 65^o bx. Preservative added was sodium benzoate (500 ppm). The hot mass was filled in sterile bottles. The product had a moisture content of 23.70 %, TSS - 69^obX, Acidity 0.4 %, Reducing sugar – 32 % and Total sugars – 64 %. The product had a shelf life of 6 months under ambient conditions. The product obtained highly acceptable sensory scores for colour, texture, flavor, taste and over all acceptability. There was no astringent taste of graininess in the texture of the product. The cost of the product was worked out to be Rs 130/- per 500 g.

Kodo millet milk beverage

Traditional malting processes in many developing countries involve three main operations: soaking, germination, and drying. Germination or malting of cereal grains may result in some biochemical modifications and produce malt with improved nutritional quality that can be used in various traditional recipes. It has been found that germination appreciably improved the *in vitro* protein (14% to 26%) and starch (86% to 112%) digestibility and bio accessibility of minerals. Based on this, Kodo millet milk beverage was prepared.

Kodo millets (100 g) were cleaned and malted. To the malted grains water was added and milk was extracted. Sugar (10 %) and cardamom (0.1%) were added. The prepared milk was homogenized, bottled and in bottle pasteurization was done. The millet milk was assessed for their physical characteristics, nutritional characteristics and organoleptic characteristics.

The kodo millet based milk beverage has TSS (15^o brix), acidity (0.86), starch (5.73 g%), total sugar (3.26 g%), reducing sugar (1.79g%) and protein(1.75 g%) contents / 100 g.

The product cost is Rs. 25/ 200 ml. The shelf life of the kodo millet milk has shelf life of 3 months. Malting of millet increased the milk yield with less viscosity and minimum sedimentation. In sensory characteristics, it scored highest values in all aspects like appearance, colour, flavor, consistency, taste and overall acceptability.

Nutrient composition of Kodo millet milk beverage

Nutrients	Values per 100 ml
Protein (g%)	1.75
Starch(g%)	5.73
Reducing sugar(g%)	1.79
Total Sugar (g%)	3.26
Fat (g%)	1.21
Calcium (mg%)	1.63
T.S.S (°brix)	15
Acidity	0.86
Cost	Rs. 25/200 ml
Shelf life	3 months.

Crop Coefficients for drip irrigation Scheduling

$$ET_c = K_c \times ET_o$$

ET_c = Crop Evapotranspiration

K_c = Crop Coefficient (by field trial)

ET_o = Reference Crop Evapotranspiration

Crop Co-efficient of Brinjal

Crop stages	Crop co-efficient (K_c) (Open field)
Initial (30 days)	0.57
Developmental (40 days)	0.83
Middle stage (40 days)	1.03
End stage (20 days)	0.84

Crop Co-efficient of Chilli

Crop stages	Crop co-efficient (K_c)	
	Poly house	Open field
Initial (30 days)	0.48	0.52
Developmental (40 days)	0.74	0.80
Middle stage (90 days)	1.01	1.05
End stage (25 days)	0.70	0.78

For On Farm Trials

Tractor Operated Tissue culture banana planter

The planter does the following functions.

- Opening deep furrow for planting the banana plant at a depth of 200 mm
- Widening the furrow for width of 150 mm
- Dispensing banana plants on the furrow

- Earthing up the banana plants
- Compacting the soil around the plants

Ergonomic grape pruning tool

- Capacity to prune one hectare per day
- Provided with handle loop for the operator to relax during the pruning operation

For Multi Location Trials

Size grader for dehusked coconut

A size based mechanical grader for dehusked coconut was designed and fabricated. The existing roller size grader for fruits was modified for grading dehusked coconut. A trapezoidal feeding tray was fitted to feed the dehusked coconut into the machine. Collecting trays were attached to collect the desired graded nuts.

Salient Features

- Efficiency of coconut size grader - 85% at the speed of 1.7 m/s and 15° inclination for fully dehusked coconut
- Capacity of the size grader - 5000 nuts/h
- Cost of size based coconut grader is Rs. 1.00 Lakh.

Improved ventilated structure for aggregatum onion

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. An improved movable storage structure with forced air ventilation system was designed to extend shelf life up to 6 months. A blower assembly with suitable ducting was fabricated assembled and installed. There are three vertical pipes emanating inside the onion bulk and all of them have smaller lateral branches for distributing air through the bulk. An air flow of 1.15 m³/s was provided by the blower.

Salient Feature

- A movable ventilated storage structure of 1 tonne storage capacity with automatic control for aggregatum onion was designed and evaluated
- Onion can be safely stored for 6 months with this structure
- Cost of storage structure is Rs. 1.00 Lakh

VI. FORESTRY

For Adoption

Melia MTP 2 (2018)

A Clonal Selection from *Melia dubia* is a fast growing multipurpose tree species amenable for varied industrial utility and different agroforestry systems. The salient features of the variety are furnished below.



Variety	:	Melia MTP 2
Duration	:	<ul style="list-style-type: none"> • 24 - 36 Months for Pulp and Paper • 60 Months for Plywood
Utility	:	Pulpwood, Plywood and Fodder
Pulp yield	:	High paper pulp yield (49%)
Veneer recovery	:	62.56 %
Protein Content	:	Leaves are an excellent fodder with protein content of over 16 per cent
Kappa Number	:	19.20
Yield	:	<ul style="list-style-type: none"> • 80 - 120 MT/ ha for Pulpwood in 2 years • 120 - 150 MT/ ha for Plywood in 5 years

Kadam MTP 1

A clonal selection from *Neolamarckia cadamba* is a fast growing multipurpose tree species amenable for varied industrial utility under different agroforestry systems. The salient features of the variety are furnished below.



Variety	:	Kadam MTP 1
Duration	:	3-5 Years
Utility	:	Pulp and Plywood
Pulp yield	:	> 44 %
Kappa Number	:	Above 20 %
Veneer recovery	:	> 52 %
Splint recovery	:	1450 – 1750 splints / 100 g
Protein Content	:	Leaves are excellent fodder – Protein (16 – 22 %)
Yield	:	<ul style="list-style-type: none"> • 135 tonnes / ha in 3 years for pulp wood • 150 – 175 tonnes / ha in 5 years for plywood

Clonal technology for Kadam and African mahogany

A mini clonal technology has been developed for Kadam and African mahogany which will facilitate mass multiplication of the elite genetic resources using minimal space, rapid multiplication and ensuring clonal fidelity.

Technology	:	Mini clonal technology
Plant part	:	Apical shoots
Duration	:	21 – 30 days
Rootability	:	Over 80 %
Total period required for clonal seedling Production	:	90-120 days

***Ailanthus excelsa* as medium density core veneer for plywood production**

Ailanthus excelsa has maximum veneer recovery (60.95%), minimum veneer shrinkage (4.57%) and medium density of 711 Kg m⁻³. In addition , it has the modulus of elasticity of 5024 N mm⁻², the modulus of rupture of 34.68 N mm⁻² and glue shear strength of 1318 N mm⁻² . As *Ailanthus excelsa* wood has shown nearer physical and mechanical properties to the IS 1708 standard, it could be used as medium density plywood as core veneer.

Clonal Propagation of Annatto (*Bixa orellana*)

Method of Propagation	:	Rooting of stem cuttings
Propagule to be used	:	Semi-hardwood stem cuttings of 15mm thickness
Treatment	:	IBA 4000ppm
Rooting Media	:	Sand: soil @1:1
Propagation chamber	:	Low cost poly tunnels
Success rate	:	85%

Clonal Propagation of Neem (*Azadirachta indica*)

Method of Propagation	:	Rooting of stem cuttings
Propagule to be used	:	Semi-hardwood stem cuttings of 20mm thickness
Treatment	:	IBA 1000ppm
Rooting Media	:	Sand: soil @1:1
Propagation chamber	:	Low cost poly tunnels
Success rate	:	85%

Yield model & Yield table for Neem

- Local yield table in Neem (*Azadirachta indica*) is developed for western agroclimatic zone
- Yield prediction model for Neem (*Azadirachta indica*) grown in western agroclimatic zone is developed
 - Standard stem timber
- $Y = (-0.65) + (0.006 * \text{Age}) + (3.54 * \text{Diameter})$
 - Standard stem small wood
- $Y = (-0.226) + (-0.013 * \text{Age}) + (0.92 * \text{Diameter}) + (0.097 * \text{No. of branches})$

Roasting techniques for Tamarind seed

- Roasting of Tamarind seed at 105 degree Celsius for 10 min using seed roaster gives market preferred creamy white Tamarind Kernel Powder.

Pest management in *Ailanthus excelsa*

- Profenophos 50 EC @ 2 ml/litre is recommended for management of defoliators and sucking pest in *Ailanthus excelsa*.
- Azadirachtin 10,000 ppm @ 1 ml/litre is recommended for management of defoliators and sucking pest in *Ailanthus excelsa*.

For On-Farm Trials

Toona ciliata

Toon is identified as one of the potential and alternate species amenable for core veneer production through the laboratory and industrial test. Hence progeny trial has been carried out which identified the superiority of Toon – TC-02 and this progeny is recommended for advancing to OFT.

Salient features

Promising genotype	:	Toon TC-02
Veneer recovery	:	More than 50 %
Veneer Color	:	Pinkish brown
Bonding Quality	:	Excellent
Density	:	More than 600 kg / m ³
OFT	:	Two locations (farmer / Industrial site)
Date to be recorded	:	Growth attributes like Height, GBH, Clean bole height, basal girth and density

Multifunctional Agroforestry

A multifunctional Agroforestry model has been designed and tested more productive and remunerative for small farmers and hence the model is advanced to OFT.

Design	:	Multifunctional Agroforestry – MTP Model
Tree component	:	Ply, Timber, high value, biofuel and medicinal Trees
Horticulture components	:	Flowers and fruits
Agricultural components	:	Pulses and vegetables
Fodder component	:	Grasses

Precision silviculture techniques for fast growing trees(*Neolamarkia cadamba*, *Enterolobium cyclocarpum*)

Centres:

- Coimbatore district
- Thiruvannamalai district
- Sivagangai district

Treatment Details

T₁ - Irrigation level at 75 % PE and fertigation @ 100 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₂ - Irrigation level at 100 % PE and fertigation @ 100 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₃ - Irrigation level at 125 % PE and fertigation @ 100 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₄ - Irrigation level at 100 % PE and fertigation @ 75 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₅ - Irrigation level at 100 % PE and fertigation @ 100 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₆ - Irrigation level at 100 % PE and fertigation @ 125 % RDF (150:100:100 kg N,P and K ha⁻¹)

T₇ - Control

Design: FRBD

Replication: No. of plants per Replications - 4

Observations to be recorded :

- Biometric parameters (Height, collar diameter, diameter at breast height, Number of branches etc.)
- Biochemical characters: Chlorophyll, A, Chlorophyll B, total Chlorophyll
- Plant nutrients: NPK uptake
- Soil Nutrients: NPK and Soil organic carbon

Host compatibility evaluation for sandal

Centres

- Tuticorin district
- Coimbatore district
- Thiruvannamalai district
- Salem district

Treatment Details

T₁ - Sandal + *Acacia nilotica*

T₂ - Sandal + *Cassia siamea*

T₃ - Sandal + *Albizia saman*

T₄ - Sandal + *Wrightia tinctoria*

T₅ - Sandal + *Dalbergia sissoo*

T₆ - Sandal + *Albizia amara*

T₇ - Sandal + *Pongamia pinnata*

T₈ - Sandal + *Casuarina equisetifolia*

T₉ - Sandal + *Pterocarpus marsupium*

T₁₀ - Sandal + *Albizia lebbeck*

T₁₁ - Control

Design: RBD

Replication: No. of plants per replication: 3

Observations to be recorded:

- Biometric parameters (Height, collar diameter, diameter at breast height, Number of branches etc.)
- Biochemical characters: Chlorophyll, A, Chlorophyll B, total Chlorophyll
- Plant nutrients: NPK

Pest management of *Eligma narcissus* in *Ailanthus excelsa*

Centres:

- Coimbatore district
- Trichy district
- Krishnagiri district

Treatment Details

- T₁ - Swabbing the stem with grease
- T₂ - Swabbing the stem with castor oil
- T₃ - Swabbing the stem with coal tar
- T₄ - Untreated control

Design: RBD

Replication: No. of plants per Replications - 5

Observations to be recorded :

- Number of pupae per stem
- Biometric parameters (Height, DBH and volume)

For ART/MLT

Promising Progenies in Annatto (*Bixa orellana*)

Promising genotype	:	TN Bi 1 (MTP Bixa 1)
Locations(3)	:	FC&RI, Mettupalayam AC&RI, Killikulam Farmers field
No. of years of evaluation	:	2 years
Seed Yield	:	0.63 kg/ tree
Seed Yield	:	0.699 tonnes/ha
Promising genotype	:	KA Bi 1 (MTP Bixa 2)
Locations(3)	:	FC&RI, Mettupalayam AC&RI, Killikulam Farmers field
No. of years of evaluation	:	2 years
Seed Yield	:	0.53 kg/ tree
Seed Yield	:	0.588 tonnes/ha

VII. COMMUNITY SCIENCE

Technologies

Development of multigrain simulated rice analogues

The simulated rice analogues were developed utilizing multigrain mix of kodo millet, little millet, barnyard millet, foxtail millet and pearl millet by extrusion technology. Response Surface Methodology was carried out based on dependent and independent variable to optimize the multigrain mix formulation to develop micronutrient enriched simulated rice analogues. Independent variables were kodo millet (10-20%), little millet (5-10%), barnyard millet (30-40%), foxtail millet (30-40%) and pearl millet (5-10%). Dependent variables included nutrients, protein, iron, calcium, phosphorous, thiamine, riboflavin, fibre and antioxidant activity. Twenty-six formulations were generated and the nutrient content were analysed. The multigrain mix having a desirability value of 0.518, comprised of kodo millet-10.01g, little millet-10g, barnyard millet-31.31g, foxtail millet-38.68g, pearl millet-10g having higher nutrient content was optimized. Extrusion cooking was carried out using a twin screw extruder at optimised extrusion parameters such as barrel temperature: 35, 60 and 35°C for zone 1 to zone 3, die diameter of 3mm and screw speed of 180 rpm. Finally, the rice shaped analogues obtained were dried in cabinet tray drier to 11% moisture content at 65°C for 4 hours. The developed simulated rice analogues had 8.64g of protein, 2.84g of fat, 2.40g of zinc, 2.34mg of iron, 18.05mg of calcium, 268.22mg of phosphorous, 0.37mg of thiamine, 22.46mg of β -carotene, 4.68g of fiber and 5.54% of resistant starch. The simulated rice analogues were observed to have 0.59g/ml of bulk density, 4.25g/g of Water Absorption Index, 15.7g/g of Water Solubility Index and 147.39g of Hardness. The organoleptic characteristics of the cooked rice analogues and variety rice prepared from the rice analogues were highly acceptable. The multigrain formulation comprising of kodo millet-10.01g, little millet-10g, barnyard millet-31.31g, foxtail millet-38.68g, pearl millet-10g could be used to produce quality extrudates with high nutrient content and acceptable sensory quality. The simulated rice analogues could serve as a micronutrient enriched food to address micronutrient malnutrition. The technology is versatile and lends for blending with pulses, vegetables and other foods to further improve taste and nutrient content.



Processing and production of gaba rice

Brown rice is the ultimate alternative diet, it contains more, nutritional components such as dietary fibers, phytic acid vitamins E, vitamin B and γ -amino butyric acid (GABA) than polished rice due to the presence of outer bran layer being the main source for the nutritional elements. Germination is a low cost technology which starts with seed water uptake and ends at the protrusion of radicle from the seed. Reactivation of metabolism occurs during seed germination process which results in the hydrolysis of storage proteins and carbohydrates and the synthesis/accumulation of metabolites with health-promoting properties. Germination of brown rice increases the content of γ -amino butyric acid (GABA) and antioxidants such as phenolics compounds, γ -oryzanol and vitamin E among other bioactive compounds.



GABA is a non-protein amino acid and has been reported to provide beneficial effects for human health such as regulation of blood pressure and heart rate, alleviation of

pain, anxiety and sleeplessness. In addition, germinated brown rice extract with enhanced levels of GABA stimulates immune cells and it inhibits cancer cell proliferation. More recently, studies shows that GABA is a strong substance to stimulate insulin from the pancreas and effectively prevents diabetes. Hence the germination technology for brown rice and production of germinated brown rice based food products (cooked GABA rice, GABA rice grits based uppma and GABA rice flour based puttu) were standardized. Subsequently the developed GABA rice based food products have been used and encouraged for consumption as lunch and dinner instead of steamed white rice for effective management of diabetes among farm women of the adopted villages. The paddy and brown rice (Variety - NLR 34449) were selected, washed with tap water (2 or 3 times) and soaked in distilled water (1:5 w/v) for 6 hours at room temperature. Then, the soaked paddy and brown rice samples were placed in moist cloth layers (muslin / cheese cloth) and incubated separately 3 days for paddy and 22 hours for brown rice at room temperature for germination. Subsequently, the germinated paddy and germinated brown rice (GABA rice) were dried in a cabinet dryer at 50°C for 5 hours (GABA rice) and 8 hours (germinated paddy) or until the samples attained moisture content below 12 per cent. The sprouting portion of GABA rice was removed (for avoiding bitterness during products preparation) and cooled. At the same the dried germinated paddy was milled using paddy huller and collected GABA rice. Finally the GABA rice samples were packed in a suitable packaging material for long storage.

Vitamin B₁₂ Enriched functional millet beverage

Vitamin B₁₂ is well known as cobalamin and is one among the eight B complex vitamins. Over the past few decades, the incidence of megaloblastic anaemia reported to be increasing in India and Vitamin B₁₂ deficiencies are being reported in infants, toddlers, pregnant women and elderly people. Sub-clinical deficiency symptoms such as low birth weight, anaemia, risk of metabolic syndrome are associated with Indian pregnant women and infants. Vitamin B₁₂ is commonly produced by lactic acid bacteria especially dairy *Propionibacterium* spp and *Lactobacillus reuteri* strains. Various approaches to use Vitamin B₁₂ products microorganisms in the development of cereals based fermented products may pave plan in production of novel functional fermented foods *Propionibacterium* spp and *Pseudomonas* Spp are often used as microbial cultures for industrial production of vitamin B₁₂ which yields up to 15 µg/ml. In such case, nutritionally rich millet based food can be used as a delivery vehicle for vitamin B₁₂ producing *Propionibacterium* spp. Based on this the Vitamin B₁₂ producing organism was fortified in millet beverages processed using Foxtail



Millet (*Setaria italic*), viz., Little millet (*Panicum sumatrense*), Kodo Millet (*Paspalum scrobiculatum*) Proso Millet (*Panicum miliaceum*) and Barnyard Millet (*Echinochloa frumentacea*) to study the suitability of cereal food matrices for *in situ* active vitamin B₁₂ biofortification with selected *P. freudenreichii* strains for developing novel functional food by screening from 150 isolates of 11 raw milk samples, 4 cheese samples and two curd samples which was then characterized and screened for vitamin B₁₂ producing dairy *Propionibacterium* spp. Among the strains MM21

produced Vitamin B₁₂ of 1.3 µg/ml of broth, which was used in milled based beverage. The developed Millet based vitamin B₁₂ enriched beverage has good organoleptic scores, high nutritional parameters with a shelf life of one month under refrigerated condition. The beverage also showed significant recovery in hemoglobin, plasma insulin, plasma folic acid and plasma vitamin B₁₂ level in wistar albino rats. Among the five millet beverage, kodo millet beverage has high protein (9g / 100g), fibre (1.97g/100g), total and reducing sugar (2.79 and

0.4) and the millet beverage has optimum level of acidity (0.3 – 0.36), TSS (12-13) and pH (4) and vitamin B₁₂ (5-6µg/ml). the cost of production of the vitamin B₁₂ enriched millet beverage was Rs. 12.65, Rs. 12.82, Rs. 12.80, Rs. 12, 76 and Rs. 12.82 / 200 ml for the respective foxtail millet, little millet, kodo millet, proso millet and barnyard millet beverages.

Formulation of guava tea

Herbal teas have been gaining popularity as consumers believe that they are natural, safe and can promote health. Herbal teas and medicinal plant formulations are produced from green and dried herbs, flowers, fruits, leaves, seeds, barks and roots of medicinal plants. Guava leaves are rich sources of tannins, polyphenolic compounds, flavonoids, ellagic acid, triterpenoids, guajaverin and quercetin. Matured guava leaves were selected and subjected to steam blanching at 80°C for one minute followed by immersion in cold water. The primary herb was blended with supporting herbs such as coriander leaf and dry ginger along with activating herb such as cinnamon/ orange peel/ lemongrass. The lemongrass flavoured tea was most acceptable. The herbal tea blends were packed in non-drip tea bags. Each tea bag was packed with approximately 3 g of herbal tea blend. Further the tea bags were packed in glassine poly pouches. The flavouring compounds present in the herbal tea blends were analyzed by GC-MS. The compounds n-Hexadecanoic acid, Caryophyllene, 1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl, (E) and 9,12,15-Octadecatrienoic acid were predominantly found. The moisture content of herbal tea blends was 5.22. The acid content was 0.53 % and pH 5.07. The total phenol content was 98.5 mg GAE/g, total flavonoid was 12.723 mg QE/g, total antioxidants activity was 72.40 mg AAE/g and tannin 2.022 mg CE/ g. The steam blanched guava leaf infusions at 30 % concentration showed antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* with the zone of inhibition of 16 mm, 13 mm and 12 mm diameter respectively. The herbal tea had high organoleptic scores. The cost of 1.5g tea bags of lemongrass based tea bags worked out to Rs. 27 respectively per 10 bags which are very less than the commercial samples. Since the production of guava based tea blends is novel to our market, simple and which can be carried out with less investment, this viable technology can be taken up by farmers or young entrepreneurs as a business venture. Further the farmers will be benefited since the pruned guava leaves are wasted making it difficult to decompose. A nutritious, healthy and refreshing beverage at a low cost could be produced from the unutilized matured guava leaves.



Nutritional evaluation and development of functional beverage from quinoa seed

Quinoa (*Chenopodium quinoa wild*) which was *Chenopodiaceae* family. Quinoa grain is a gluten free pseudo cereal and it is considered as staple food in Andean region. In India the quinoa seeds are cultivated in Himalayan region, Andhra Pradesh, Uttarakhand and Rajasthan (semi-arid regions). Quinoa is rich in starch, protein, amino acid, antioxidant, vitamins and minerals. Bioactive compounds such as polyphenols, flavonoids, lignans, phenolic compounds, betalains, carotenoids, isoflavones and phytoosterols are powerful antioxidants which were present in quinoa seed. Germination of quinoa grain increases the availability of phytochemicals such as phenols, flavonoids, phytosterols, antioxidants, organoleptic properties and also decreases the anti-nutritional factors. The raw and germinated quinoa grains were utilized to prepare functional beverages with natural (carrot and beetroot extract, papaya pulp) and synthetic (vanilla, mango and chocolate essence) flavoring ingredients in order to increase the consumption of quinoa grain. The extracted raw and germinated quinoa milk (T₀) and natural and synthetic flavoured functional beverage (T₁ and T₂) was pasteurized separately at 60° C for 5 min and bottled in sterilized PET and

glass bottles and stored in 4° C for 15 days. The physical parameters (thousand grain weight, volume, length, breadth, hydration capacity, swelling capacity, grain to flour ratio and germination percentage), the nutritional composition (starch, protein, fat, fiber, soluble fiber, insoluble fiber, vitamin E, β -carotene, calcium and iron), functional properties (water absorption capacity), antioxidant activity and anti-nutritional property (saponin) were analyzed in raw, polished and germinated quinoa seed. The physico-chemical (pH, viscosity, color, TSS, acidity, starch, protein, fat, fiber, soluble fiber, insoluble fiber, vitamin E, β -carotene, calcium and iron), functional (water absorption capacity), antioxidant activity and anti-nutritional property (saponin) of raw and germinated quinoa milk (T_0) and beverages (T_1 and T_2) were analyzed. To target the consumers, the nutrient and calorie rich functional beverage developed was acceptable for all age groups, which may be recommended for lactose intolerance and celiac patients. Consumers may accept the quinoa due to its low allergenic and glycemic index. This promotes the awareness about the quinoa seed among the consumers.

Texturized Green gram based Liver curry

Liver fry is popular in households and restaurants. But for vegetarian version of liver fry, ground whole green gram was used to simulate the taste of liver. For the development of vegetarian version of liver curry, whole green gram at 100 percent level was used. Whole green gram was soaked and ground with 2g of salt to a fine paste with water (70 ml) in a blender to idly batter consistency. The batter was poured in greased idly plate and steamed for 10 minutes in an idly steamer, cooled and was cut into small pieces. Meanwhile the gravy prepared using onion, tomato and other spices along with green gram texturized meat pieces was cooled and packed in retort pouch and processed in a steam air retort. Time and temperature were determined during heat processing using data recorder cum F0 recorder. The total processing time was 34 minutes with Fo value of 3.60. The product was evaluated for its shelf stability under ambient condition (27 – 30 °C) for a period of 6 months. The chemical and microbial changes were observed at intervals of 30 days during storage. The nutrients viz., moisture, protein and fat content of the product were 66.73±0.54, 28.88±0.04 and 23.24±0.05 g per cent respectively. The free fatty acid and peroxide value was 2.80 ± 0.19 mg KOH/g and 1.99±0.21 meq/Kg respectively after 6 months of storage. The increase in free fatty acid and peroxide value was within the perishable limits and did not affect the sensory quality of the product. Microbiological analysis revealed that product was commercially fit for consumption. The product was acceptable and stable up to 6 months under ambient condition with good texture and sensory characteristics.

Improved Ring Cutter

Improved ring cutter is an ergonomically designed tool to harvest vegetables and such as lady's finger, brinjal and flowers like marigold etc. The improved ring cutter is a small tool which can be worn around the finger and the blade can be used to cut the stalk of vegetables and flowers.

The tool weighs 9.5 grams and it is easy to handle. The height of the blade is 4.3cm and the width of the blade is 2.8 cm. The diameter of the ring is designed according to the anthropometric dimension of the farm women viz., 15mm, 17mm, 19mm, 22 mm respectively.

Tool is comfortable to be used in any of the fingers while harvesting. The average heart rate of the subjects in conventional method was 109 bpm and while using the tool it reduced to 96 bpm. The average energy expenditure of the subjects was 286 kcal/hr in conventional method and 253 kcal/hr while using the tool. There was a significant reduction in the physiological workload of the farm women while using the improved ring cutter. Increased harvesting efficiency by 22.36% was observed while using the tool against the conventional method.

For Information

DIRECTORATE OF RESEARCH

Abstract

Externally Funded Projects - 2018-19

Sl.No.	Directorate / College	2018-19	
		No. of Projects	Amount in lakhs
1	CPBG	6	152.85
2	CPMB	8	561.79
3	CPPS	15	598.64
4	DCM	10	89.00
5	NRM	8	290.14
6	Seed	3	24.56
7	WTC	2	13.32
8	Agrl. Engg.	4	96.20
9	CARDS	5	78.22
10	HC&RI	8	178.15
11	ODL		
12	SPGS	1	13.93
13	DSW		
14	ABD		
15	Other colleges	37	596.31
16	Res. Stations	17	503.43
	Total	124	3196.54

List of University Research Projects (URPs) – 2018-19

Sl. No.	Directorate / College	Total no. of Projects	On going
1	CPBG	27	27
2	CPMB	0	0
3	CPPS	27	27
4	DCM	12	12
5	NRM	13	13
6	Seed	4	4
7	WTC	0	0
8	Agrl. Engg.	1	1
9	CARDS	12	12
10	HC&RI	21	21
11	CSC&RI	6	6
12	FC&RI	0	0
	Total	123	123

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

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

**Grand total – 500.00 lakhs
(5.00 Crores)**

AICRP Projects operated during the year 2018-19

Sl.No.	Title of the Project	Budget 2018-19 (Rs. in lakhs)
	AGRICULTURAL ENGINEERING	
1.	Energy in Agriculture and Agro Based Industries, Coimbatore	199.53
2.	Farm Implements and Machinery, Coimbatore	391.06
3.	Ergonomic and Safety in Agriculture, Coimbatore	106.51
4.	Post Harvest Technology, Coimbatore	156.90
	CENTRE FOR PLANT BREEDING AND GENETICS	
5.	All India Network Project on Jute and Allied Fibres, Aduthurai	25.00
6.	Rice, Aduthurai	32.40
7.	Rice, Coimbatore	49.90
8.	Maize, Coimbatore	133.33
9.	Maize, Vagarai	45.40
10.	Sorghum, Coimbatore	67.38
11.	Small Millets, Coimbatore	44.75
12.	Pearl Millet, Coimbatore	98.00
13.	Pigeonpea, Coimbatore	99.62
14.	Pigeonpea, Vamban	33.34
15.	Chickpea, Coimbatore	34.53
16.	MuLLARP, Vamban	122.02
17.	MuLLARP, Aduthurai	27.20
18.	Oilseeds – Groundnut, Virdhachalam	36.32
19.	Oilseeds - off Season Nursery (Groundnut), Aliyarnagar	21.21
20.	Oilseeds – Groundnut, Tindivanam	111.31
21.	Oilseeds (Sunflower), Coimbatore	39.93
22.	Oilseeds – Sesamum, Virdhachalam	104.51
23.	Oilseeds – Castor, Yethapur	33.09
24.	Cotton, Coimbatore	25.45
25.	Cotton, Srivilliputhur	88.39
26.	Sugarcane, Cuddalore	45.35
27.	Forage Crops, Coimbatore	88.74
	CROP MANAGEMENT	
28.	Integrated Farming System Research (Coimbatore, Thajavur, Bhavanisagar (OFR-1) Yethapur (OFR-2))	162.61
29.	Weed Control, Coimbatore	115.28
30.	Agri. Meteorology, Kovilpatti	57.53
31.	Dryland Agriculture, Kovilpatti	166.06
	NATURAL RESOURCE MANAGEMNET	
32.	All India Net Work Project on Soil Biodiversity and Biofertilizers, Coimbatore	17.82
33.	Soil Test with Crop Response, Coimbatore	61.61
34.	Long Term Fertilizer Experiments, Coimbatore	41.62
35.	Micro and Secondary Nutrients and Pollutant Elements in Soil and Plants, Coimbatore	87.46
36.	Management of Salt Effected Soil and use of Saline Water in Agriculture, Trichy	93.20

CENTRE FOR PLANT PROTECTION STUDIES		
37.	Biological Control of Crop Pests and Weeds Coimbatore	46.11
38.	Acarology, Coimbatore	30.10
39.	Plant Parasite Nematodes, Coimbatore	41.90
40.	Mushroom Improvement, Coimbatore	35.70
41.	All India Net Work Project on Pesticide Residue Coimbatore	21.50
42.	Honey bee & Pollinators, Coimbatore	24.25
SEED CENTRE		
43.	NSP-Crops Seed Technology Research Coimbatore	59.86
44.	NSP-Crops, Bhavanisagar	29.14
WATER TECHNOLOGY CENTRE		
45.	Irrigation Water Management (Coimbatore, Madurai, Bhavanisagar)	200.56
HORTICULTURE		
46.	Palms, Aliyarnagar	65.17
47.	Palms, Veppankulam	31.55
48.	Palms-Palmyrah, Killikulam	18.19
49.	Palms – Oilpalm, Pattukottai	16.17
50.	Fruits, Coimbatore	179.00
51.	Fruits, Periyakulam	235.30
52.	Arid Zone Fruits, Aruppukottai	75.03
53.	Vegetable Improvement, Coimbatore	35.00
54.	Tuber Crops, Coimbatore	23.17
55.	Floriculture Improvement, Coimbatore	86.17
56.	Spices, Coimbatore	12.67
57.	Spices, Yercaud	3.33
58.	Medicinal and Aromatic Plants including Betelvine, Coimbatore	12.00
59.	Cashew, Virdhachalam	47.40
FORESTRY		
60.	Agro Forestry, Mettupalayam	52.68
61.	All India Network Project on Potential Crops Mettupalayam	34.97
HOME SCIENCE		
62.	Home Science, Madurai	60.75
	Total	4542.03 (or) 45.42 Crores

CENTRE FOR AGRICULTURE AND RURAL DEVELOPMENT STUDIES

Price Forecasting

Domestic and Export Market Intelligence Cell (DEMIC) of TNAU has been developing and disseminating market advisories both pre –sowing and pre –harvest for major agricultural and horticultural crops of Tamil Nadu. At present, market advisories are developed for 15 crops at DEMIC and these advisories are disseminated through both print and electronic media. The crops include maize, blackgram, greengram, groundnut, sesame, cotton, chilli, coconut, copra. Fruit such as, major varieties of banana viz., Poovan, Karpooravalli and Nendran and vegetable crops such as, tomato, brinjal and bhendi are also covered under this price forecasting project.

Pre sowing advisories are given to farmers to take appropriate sowing decision, choice of crop and extent of crop area. Pre- harvest market advisories are given to farmers to take appropriate selling/ storing decisions. Forecast validity of the market advisories generated from DEMIC for pre- sowing and pre- harvest forecasts is around 91 per cent and 94 per cent respectively.

Market advisories are also disseminated through SMS to the registered farmers by Agro- Market Intelligence and Business Promotion Centre (AMI & BPC), Trichy functioning under the Commiserate of Agricultural Marketing and Agri Business (CAM & AB). During 2018-19, market advisories of DEMIC are send through SMS to 1.2 million beneficiaries, which include farmers, processors, scientists and policy makers. Besides, the market advisories are disseminated through email, web portal, news paper, Uzhavan App and whatsapp.

Impacts of Watershed Development Programmes

Evaluation of watershed development programmes implemented under DPAP/IWDP/IWMP/NWDPRA was carried out during 2018-19. The watershed development programmes have resulted in significant positive impacts. The increase in ground water table across the watersheds varies from 2M to 8 M. The increase in the yield of crops cultivated across the watersheds varied from 10 to 40 %. In 79 % of watersheds, the increase in irrigated area observed to be less than 10 %. While 13 % of watersheds have an increase of 10-20 % Around 8 % of watersheds have registered an increase of more than 20 % in irrigated area. Percolation ponds and farm ponds play crucial role in water resource development and help the farmers in achieving guaranteed yield. Construction of percolation ponds and farm ponds as a water storage structures may be promoted in a larger scale.

Many stakeholders were unaware of how their responsibilities change in the post-project period increasing awareness and providing clear information about roles and responsibilities will likely make more empowered and involved stakeholders. The structures are not maintained due to insufficient funds, lack of co-ordination among beneficiaries. Hence, protocols should be defined for using WDF funds and dovetailing with other development programmes.

Farmer Producer Organisations (FPOs)

Consider FPO as a Start Up company: FPO is a newly formed firm by farmers who have a no idea about forming and managing a private limited company. Few farmers under the guidance of officials of Department of Agril. Marketing and Agribusiness / Agriculture / Horticulture and other resource institutions initiate the process and all risk in on these set of

farmers to bring in participation of larger section of farmers. It takes about two to four years for a FPO to move on. Considering the risk involved and innovative approaches to be developed (each FPO is unique in its own way), it is essential to consider it as a Start – UP company promoted by a firm / agribusiness incubator .

FPO – market support – market linkages: Market oriented agribusiness is indispensable for FPOs. They should have following support from Dept of Agri Marketing and Agribusiness, Chennai.

- Continuous access to market information and through market exposure – participation in exhibitions / national and international fairs (like Agri Intex)
- Space in markets – Create FPO Supermarket /farmers shandy / FPO retail chains / exclusive space in existing cooperative supermarkets (Chinthamani, Coimbatore, Trichy, Erode etc / Ponni, Salem), – to display and sell the products of many FPOs

FPO training division: Continuous training for members and leaders of FPO are essential, as they move through various stages of life cycle of a company (initiation, establishment, growth and maturity). They need knowledge and skills on management, changes in business environment / policies of state and central government and other countries, production technology and systems, etc. Therefore it is essential to form a division to conduct need based programmes. Certificate courses on open and distance learning mode could be offered for members and leaders on the above aspects FPOs should operate based on market oriented agribusiness, collective farming, value chain management and equitable distribution of benefits.

Financial support for FPOs : The FPOs should be allowed to select the bank with which they would like to work with. Banks should be supported from NABARD so that these banks could fund the FPO as a Start-Up company. Venture capital from NABARD / SBI or any other banks could also be linked to FPOs. A scheme such as FPO Establishment Fund (FPO EF) must be devised by NABARD to provide funds required for implementing the business strategy of the FPO, after due diligence. The FPO EF must take care of financial needs for infrastructure creation (Investment capital - FPO office space / FPO market yard / processing, logistics etc.) and working capital needs for initial period (three years).

Cassava Cultivation: Seed system, Cropping system and Value chain

Farmers predominantly cultivated H226 in drip irrigation system, Kungumarose in ridges and furrow irrigation system and H165 in rainfed hill system due to higher yield and starch content. Other characteristics considered in selecting cassava varieties are drought tolerance, short duration, good keeping the quality of tubers, easiness to harvest, whiteness of the pulp of the tuber and less fibre (for sago production). The majority of industries prefer Thailand variety (white and black) due to the highest starch content. Majority of the farmers used their own planting material or sourced the planting material from farmers in same village or other nearby village and from relatives. The average yield of cassava in north Tamil Nadu is 32.19 t/ha in drip system, 27.54 t/ha in flood irrigated system, 22.30 in rainfed plains and 21.19 in rainfed hills. The total cost of cultivation per hectare ranges from Rs.59214 in rainfed hills to Rs. 108744 in drip irrigated cassava production system. The net income was Rs. 1.20 lakh in drip system, Rs. 1.02 lakh in flood irrigated system, Rs. 0.69 lakhs in rainfed plains and Rs. 0.57 lakhs in rainfed hills. Price instability is the major constraint in cassava marketing. Nearness to the factory, time of harvest and market conditions also influences the price of the tuber. During the study period the average price varied from Rs. 7092 to 5491 per tonne.

Tapioca cultivation in Tamil Nadu registered a negative growth of 8.2 per cent during 2006-07 to 2015-16. Long Term Trends in the Area cultivated of the important crops in the

study area for 20 years from 1996-97 to 2015-16 shows that the instability in the cassava area is moderate (around 25 per cent) compared to the instability of other crops. The long-term shift in cropping pattern shows the rice area has declined at an annual average rate of 5.23 per cent and groundnut area declined at an annual average rate of 7.35 per cent. In the last 20 years maize area has grown by an annual average rate of 20.64 per cent and cholam area increased by 3.71 per cent. But the instability, which indicates the year to year variation in area cultivated, is high in the case of maize and cholam cultivation.

All the farmers who cultivated the new variety reported absence of CMD and ranked as the most preferred trait in the new variety. The farmers ranked higher yield and high starch content as second and third most preferred traits in the new variety. Drought tolerance was ranked fourth. Other traits like mealiness of the tuber, easiness to harvest and cooking time were not ranked high in the new variety. The new variety was planted in 18.5 cents in April 2016 (First generation). The area of the new variety has spread to 1080 cents (4.37 Ha). This amounts to a multiplication ratio of 58.38 in three generations. $[1080/18.5=58.38]$. On an average cassava is cultivated in 45745 ha. The estimated area of the new variety to be planted to cover 50 per cent of the area in three years is 392 Ha. To cover 10 per cent of the cassava area by the new variety, 78 ha need to be planted with the new variety to produce sufficient planting material.

Coconut Farmers Producer Companies (CFPCs)

A research study conducted on selected coconut FPOs in western Tamil Nadu. Convergence of resources for creation of farm level infrastructure i.e. Specific schemes may be introduced for transportation, grading, processing etc and the benefit of equity fund and credit Guarantee fund scheme of SFACs may be extended to all CFPCs.

DIRECTORATE OF EXTENSION EDUCATION

KVKs are the frontier frontline extension system at the district level which functions with the mandate of “Technology assessment, refinement and demonstration of technology/products”. The KVKs in Tamil Nadu are instrumental in transfer of technologies of National Agricultural Research System (NARS) including TNAU technologies and impacted in the adoption of frontier technologies in agriculture and allied sector.

KVKs of TNAU are envisaged in promoting newly released TNAU varieties for the benefit of farmers and extension functionaries of the district through Front Line Demonstrations (FLDs), On Farm Testing (OFTs), Training programmes, Exhibitions, Mela and other extension activities.

Accordingly, a brief report pertaining to “Promoting Newly released TNAU varieties” by ICAR KVKs of TNAU during 2017 – 18 to 2018-19 is presented below:

- Rice: TKM 13, TPS 5, CR 1009 Sub1, Anna (R) 4, CO 52, CSR 36, MGR 100, BPT 5204, ADT 51, MDU 6, TRY 3
- Maize: COH (M) 6, COH 6, CO 7, CO H (M) 8, CO 8
- Pearl Millet (Cumbu): CO 10
- Ragi: CO 15
- Varagu: CO 3
- Kuthiraivalli: MDU 1, CO (KV) 2
- Thenai: CO 7
- Blackgram: VBN 6, VBN 8, CO 6, ADT 6, MDU 1
- Greengram: CO 6, CO 8
- Redgram: CO 7, CO 8, LRG 41
- Cow pea: VBN 3
- Cotton: SVPR 2/3
- Groundnut: VRI 8, TMV 14, VRI 2
- Sesame: VRI 3, TMV (SV) 7
- Castor: hybrid YRCH 2
- Fodder Sorghum: CO (FS) 31, CSV33MF
- Guinea Grass: Co (CG) 3
- Fodder Cowpea: CO 9
- Velimasal: CO 1
- Brinjal: Grafted Brinjal, PLR 2
- Bhendi: CO 4
- Tomato: COTH 3
- Snake Gourd: CO H 1
- Lab – lab: CO (GB) 14
- Chilli: CO 1, Hybrid CO 1
- Amaranthus: PLR 1

Varieties popularized during 2017-18 & 2018-19 at TNAU KVKs

S.No.	TNAU Varieties	No. of FLDs	KVKs involved	Districts
I.	Cereals			
A.	Rice			
1.	TKM 13	40	Sikkal, Needamangalam, Sirugamani	Nagapattinam, Tiruvarur, Trichy
2.	TPS 5	30	Needamangalam, Thirupathisaram	Tiruvarur, Kanyakumari
3.	CR 1009 Sub1	30	Sikkal, Needamangalam	Nagapattinam, Tiruvarur
4.	Anna (R) 4	12	Sirugamani, Tirur	Trichy, Tiruvallur
5.	CO 52	80	Thirupathisaram, Needamangalam, Tirur, Papparapatty, Vamban, Sikkal, Tindivanam, Vriddhachalam	Kanyakumari, Tiruvarur, Tiruvallur, Dharmapuri, Pudukkottai, Nagapattinam, Villupuram, Cuddalore
6.	CSR 36	10	Sikkal	Nagapattinam
7.	MGR 100	10	Thirupathisaram	Kanyakumari
8.	BPT 5204	10	Sikkal	Nagapattinam
9.	ADT 51	10	Needamangalam	Thiruvarur
10.	MDU 6	10	Madurai	Madurai
11.	TRY 3	10	Madurai	Madurai
II.	Millets			
A.	Maize			
1.	Hybrid COH (M) 6	60	Aruppukkottai, Sirugamani, Needamangalam, Thirupathisaram, Tirur, Papparapatty, Madurai	Virudhunagar, Trichy, Thiruvarur, Kanyakumari, Tiruvallur, Dharmapuri, Madurai
2.	CO H 6	10	Tirur	Thiruvallur
3.	CO 7	10	Thirupathisaram	Kanyakumari
4.	CO H (M) 8	20	Sirugamani, Papparapatty	Trichy, Dharmapuri
5.	CO 8	40	Vriddhachalam, Papparapatty, Sirugamani	Cuddalore, Dharmapuri, Trichy
B.	Pearl Millet (Cumbu)			
1.	CO 10	54	Vamban, Aruppukkottai, Sandhiyur, Maurai, Sikkal Vamban	Pudukkottai, Virudhunagar, Salem, Madurai, Nagapattinam, Pudukkottai
C.	Ragi			
1.	CO 15	20	Tindivanam, Vamban	Villupuram, Pudukkottai

E.	Varagu			
1.	CO 3	8	Vridhachalam	Cuddalore
E.	Barnyard Millet (Kuthiraivalli)			
1.	MDU 1	90	Aruppukkottai, Madurai, Tirur, Vamban, Ramnad	Virudhunagar, Madurai, Thiruvallur, Pudukkottai, Ramnad
2.	CO(KV) 2	10	Papparapatty	Dharmapuri
G.	Tenai			
1.	CO 7	20	Madurai, Tindivanam	Madurai, Villupuram
III.	Pulses			
A.	Blackgram			
1.	VBN 6	210	Needamangalam, Aruppukkottai, Sandhiyur, Tindivanam, Sirugamani, Madurai	Tiruvarur, Virudhunagar, Salem, Villupuram, Trichy, Madurai
2.	VBN 8	98	Tindivanam, Sikkal, Papparapatty, Aruppukkottai, Madurai, Sirugamani, Tindivanam	Villupuram, Nagapattinam, Dharmapuri, Virudhunagar, Madurai, Trichy, Villupuram
	CO 6	145	Sandhiyur, Aruppukkottai, Sirugamani, Needamangalam	Salem, Virudhunagar, Trichy, Tiruvarur
4.	ADT 6	20	Tirur, Needamangalam	Thiruvallur, Tiruvarur
5.	MDU 1	67	Sandhiyur, Madurai	Salem, Madurai
B.	Green gram			
1.	CO 8	127	Tindivanam, Sirugamani, Madurai, Sandhiyur, Papparapatty, Sikkal	Villupuram, Trichy, Madurai, Salem, Dharmapuri, Nagapattinam
2.	CO 6	24	Aruppukkottai	Virudhunagar
C.	Redgram			
1.	CO 7	66	Sandhiyur, Aruppukkottai, Sirugamani, Madurai	Salem, Virudhunagar, Trichy, Madurai
2.	CO 8	25	Papparapatty	Dharmapuri
3.	LRG 41	25	Papparapatty	Dharmapuri
D.	Cow Pea			
1	VBN 3	35	Aruppukkottai, Tirur, Papparapatty, Vamban	Virudhunagar, Thiruvallur, Dharmapuri, Pudukkottai
IV.	Commercial Crops			
A.	Cotton			
1.	SVPR 2/3	10	Madurai	Madurai

V.	Oilseeds			
A.	Groundnut			
1.	VRI 8	113	Sikkal, Virinjipuram, Vriddhachalam, Papparapatty	Nagapattinam, Vellore, Cuddalore, Dharmapuri
2.	TMV 14	5	Papparapatty	Dharmapuri
3.	VRI 2	10	Vamban	Pudukkottai
B.	Sesame			
1.	VRI 3	30	Tirur, Tindivanam, Sandhiyur, Vriddhachalam, Sirugamani	Thiruvallur, Villupuram, Salem, Cuddalore, Trichy, Dharmapuri
2.	TMV (SV) 7	25	Papparapatty	Trichy
C.	Castor			
1.	hybrid YRCH 2	10	Tindivanam	Villupuram
VI.	Fodder			
A.	Fodder Sorghum			
1.	CO (FS) 31	30	Needamangalam, Vamban, Tirur	Thiruvaurur, Pudukkottai, Tiruvallur
2.	CSV33MF	10	Thirupathisaram	Kanyakumari
B.	Guinea Grass			
1.	Co (CG) 3	10	Thirupathisaram	Kanyakumari
C.	Fodder Cowpea			
1.	CO 9	20	Vamban, Madurai	Pudukkottai, Madurai
D.	Velimasal			
1.	CO 1	10	Vamban	Pudukkottai
VII.	Vegetables			
A.	Brinjal			
1.	Grafted Brinjal	10	Sikkal	Nagapattinam
2.	PLR 2	10	Vamban,	Pudukkottai
B.	Bhendi			
1.	CO 4	20	Aruppukottai, Vamban	Virudhunagar, Pudukkottai
C.	Tomato			
1.	CO TH 3	10	Aruppukottai	Virudhunagar
D.	Snake Gourd			
2.	CO H 1	10	Sirugamani	Trichy
E.	Lab – lab			
3.	CO (GB) 14	10	Needamangalam	Thiruvaurur
F.	Chilli			
1.	CO 1	10	Ramanathapuram, Sirugamani	Ramanathapuram, Trichy
2.	Hybrid CO 1	10	Vamban	Pudukkottai
G.	Amaranthus			
1.	PLR 1	10	Thirupathisaram	Kanyakumari