82nd SCIENTIFIC WORKERS' CONFERENCE

(AGRICULTURE, HORTICULTURE,AGRICULTURAL ENGINEERING, FORESTRY AND SOCIAL SCIENCES)

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RESEARCH HIGHLIGHTS

Directorate of Research
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Contents

AGRICULTURE

CROP IMPROVEMENT

Paddy

Rice is the major food grain crop of Tamil Nadu. Total production of paddy was 7115195 metric tonnes in terms of rice during 2013-2014 and the following were the top 10 districts (area-wise) responsible for this overall production. The area, production and productivity of paddy in under the 10 districts are given below.

Area, Production and Productivity of Paddy (2013-2014)

District	Area (ha)	Production (tonnes)	Productivity (kg/ha)
Thiruvarur	174366	820538	4705
Villupuram	170443	796608	4673
Thanjavur	167289	831483	4970
Nagapattinam	154750	605329	3911
Cuddalore	127485	565960	4439
Ramanathapuram	114981	33928	295
Thiruvallur	95827	451522	4711
Kancheepuram	85564	391837	4579
Tiruvannamalai	82625	359403	4349
Pudukkottai	72652	119895	1650

Comparison of productivity across the districts indicated that per hectare productivity was not uniform in all the districts, where paddy is grown as a major food crop. Though there are many paddy varieties are available for cultivation the following are the major varieties from TNAU which are being cultivated by the farmers of Tamil Nadu.

Varieties released and varieties under 4cultivation

Release from	Varieties
Aduthurai	ADT37 (1987), ADT38 (1987), ADT39 (1988), ADT42 (1994), ADT43 (1998), ADT45 (2001), ADT46 (2002), ADT47 (2005), ADT49 (2011), ADT50 (2012)
Coimbatore	CR1009 (1982), CO43 (1982), CO48 (2007), CO49 (2008), CO49 (2008), CO50, (2010), CO51 (2013), CR1009 *Sub1* (2015)
Ambasamudrum	ASD16 (1986)
Tirurkuppam	TKM13 (2015)
Paramakudi	Anna (2009)

Thirupathisaram	TPS3 (1993), TPS5 (2014)
Trichy	TRY1 (1995), TRY3 (2010)
Madurai	MDU 6 (2015)

Figures in parentheses are year of release

Cultures in pipeline for release

The continued efforts of the rice breeders of Tamil Nadu resulted in the identification of two rice cultures which are ready for the release to the farmers of Tamil Nadu in the coming years. These two cultures were identified for the release based on their performance under the adoptive research trials conducted over Tamil Nadu.

AD 09367

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

CB 09123

CB 09123 is product of cross combination between BPT 5204 and CO (R) 50 with a duration of 135 days. The average yield recorded was 5982 kg/ha which is 4.67 and 8.40 percent increase over ADT 49 and BPT 5204 respectively. The grains are medium slender with medium amylose content. This culture was found to be moderately resistant to brown planthopper, white backed planthopper and green leafhopper.

Cultures identified for the evaluation under ART during 2016-17

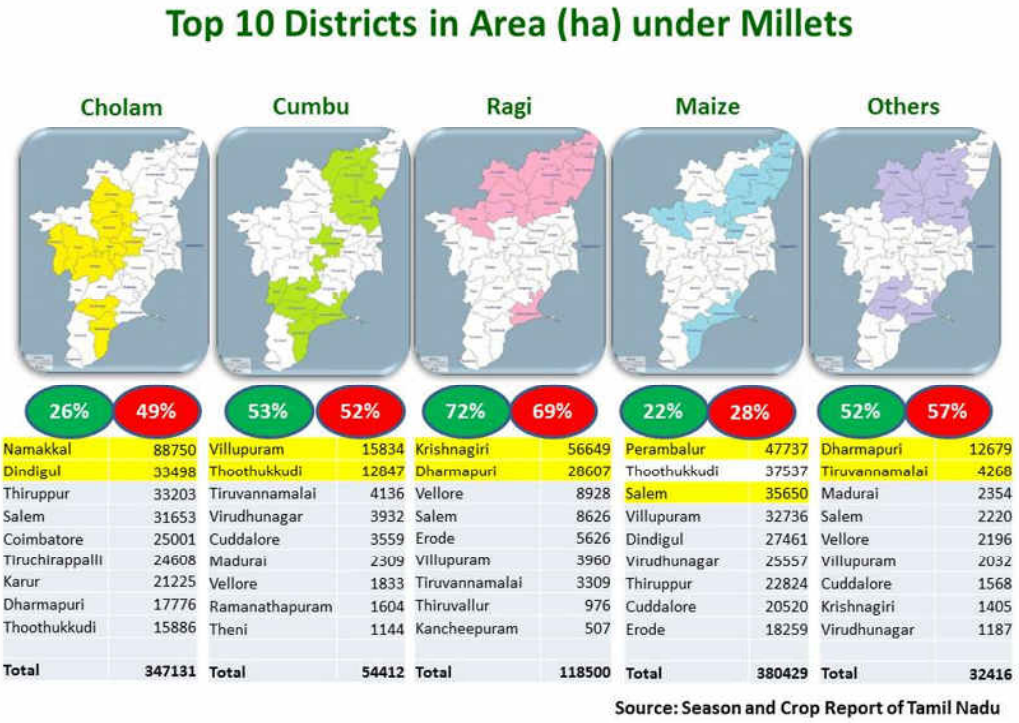
The following are the cultures identified for the evaluation under ART with varying features for the benefit of Tamil Nadu farmers.

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
Varieties				
AD 09219	ADT 45/ACK 03002	115	6147	Good cooking quality
CB 10553	BPT 5204/CB 05501	119	6099	Long slender grains
CB 11107	BPT 5204/CO 50	137	5188	moderate cooking quality
CB 12588	CB 04110/CB 05501	118	5955	Resistant to blast disease
TM 09135	Selection from IR82639-B-B-115-1	118	3848	Rainfed cultivation
TM 10085	ADT 43/CO 47	118	5961	Resistant to blast disease
TR 05031	ADT 39 /CO 45	135	5433	Salt tolerant
TR 09030	Mutant of TRY 2	108	3842	Salt tolerant
VG 09006	ADT43/Jeeragasamba	127	4695	Short slender grain
Marker Assisted Breeding				
AD (Bio) 09518	ADT 43/IRBB 60-5-1	118	5767	Bacterial leaf blight resistance
CB MAS 14065	Improved whiteponni/Apo	132	4968	Short slender grains
CB MAS 14142	Improved whiteponni / Apo	128	4695	Long slender grains
Improved white ponni *Saltol*	(Improved white-ponni/FL478)/ Improved whiteponni	131	4108	Salt tolerance

Hybrid				
TNTRH 40	TNAU95S/CB40	135	6321	Bold grains with inter-mediate amylose

Millets

The following figure gives the status of millet production in Tamil Nadu. The figures in green indicate the percent share of area under top two districts and the figures in red indicate the percent share of production under top two districts under each of the millets. Based on the analysis of available data on area and production of millets, maize dominates in production to some extent across the districts.



Varieties released and varieties under cultivation

Crop	Cutivars
Cholam	K8 (1986), CO29 (2001), CO30 (2010), COH5 (2011), CO31 (2014), K12 (2015)
Cumbu	CO9 (2004), COH9 (2011), CO10 (2016)
Ragi	CO14 (2004), CO15(2013)
Maize	COHM6 (2012)

Thenai	CO7 (2005)
Samai	CO4 (2006)
Varagu	CO3 (1995), VBN1 (1997)
Kudiraivali	CO2 (2009)

Figures in parentheses are year of release.

Varieties released

Pearl millet CO 10 (State release)

CO 10 is a pearl millet composite derived from inbreds *viz*. PT 6029, PT 6033, PT 6034, PT 6039 and PT6047. It is suitable for both rainfed and irrigated conditions in Tamil Nadu. This composite is medium in stature (160 -180 cm) with duration of 85 – 90 days. The composite CO 10 is highly resistant to downy mildew with an average yield of 3526 kg/ha under irrigated conditions. The mean grain yield under rainfed condition is 2923 kg/ha.

Multicut forage sorghum culture TNFS 209 (AICRP release)

A multi-cut forage sorghum culture TNFS 209 (In AICSIP-SPV 2242 (F)) was identified for release by Variety Identification Committee of AICRP during 2016 at national level. It is

an EMS induced mutant of Co (FS) 29. The variety has tall nature, thin stem, leafy and amenable for multiple cuttings. The green fodder yield of the variety is 1039.30 q/ha. This variety was identified for release at National level including the states of Tamil Nadu, Karnataka and Maharashtra.

Cultures in pipeline for release

Barnyard millet: ACM-10-145

ACM-10-145 is a pure line selection from Aruppukottai local. The duration is 95-100 days. The average grain yield is 2700 kg/ha and fodder yield is 3800 kg/ha. It has high iron content of 16.67 mg/100 g and compact panicle. ACM 10-145 recorded 12% higher yield over the variety Co (Kv)2.

Cultures identified for the evaluation ART during 2016-17

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

Pulses

In Tamil Nadu, over all pulses production remains 613799 metric tonnes and the following are the top 10 districts having maximum area under pulses. In this major area of growing pulses come under rice fallow (3.62 lakh hectares) and rainfed (4.01 lakh hectares) conditions

Major Pulses Growing Districts by Area

District	Area in ha	Production
Thiruvarur	111335	117283
Nagapattinam	86883	75629
Dharmapuri	71357	46281
Villupuram	68572	67200
Cuddalore	63942	64981
Thoothukkudi	56338	10580
Krishnagiri	55441	34347
Salem	45940	24954
Thanjavur	30191	26039
Vellore	28752	22293

Varieties released and varieties under cultivation

Crops	Varieties
Redgram	CO6 (1991), VBN1 (1992), VBN2 (1999), APK1 (1999), CO7 (2004), VBN3 (2005)
Blackgram	ADT3 (1982), ADT5 (1985), VBN2 (1996), VBN3 (2000), VBN4 (2003) VBN5 (2007), CO6 (2010), VBN6 (2011), VBN7 (2012), MDU1 (2014) VBN8 (2016)
Greengram	Paiyur1 (1985), ADT3 (1988), CO6 (2001), VRM1 (2001), VBN2 (2002) CO7 (2006), VBN3 (2009), CO8 (2013
Cowpea	CO6 (1993), VBN2 (1998), CO7 (2002), CO8 (2004), CO9 (2016)

Variety released

Blackgram: VBN 8

VBN 8 is a cross derivative of VBN 3 and VBN 04-008. It matures in 65 to 75 days with an average yield of 900 kg/ha, which is 11.9 % and 13.5 % increased yield over the check varieties VBN 6 and CO 6 respectively. It is suitable for cultivation in all the districts of Tamil Nadu except Nilgris and Kanyakumari. This variety is non- shattering and

synchronous maturity type, which is resistant to Yellow Mosaic Virus (YMV) and leaf crinkle diseases. The protein and arabinose contents are 21.9 and 7.5 percent respectively.

Cultures in pipeline for release

Redgram: CRG 10-01

CRG 10 01 is a cross derivative of APK 1 and LRG 41. It matures in 170 to 185 days with an average yield of the 1720 kg/ha, which is 13 percent increased yield over the check variety CO 6. This culture is highly branched with more number of pods per clusters and resistant to sterility mosaic and root rot diseases and tolerant to podborers.

Blackgram

COBG 10-05

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

VBG 10-024

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

ADBG 13-004

ADBG 13-004 is suitable for rice fallow condition. It is a hybrid derivative of VBN 1 and VBG 04-006 and matures in 70 days. It recorded an average yield of 764 kg/ha which is 16.8 percent increased yield over the check variety ADT 3.

KKB 05-011

KKB 05-011 is also suitable for rice fallow conditions. It is a cross derivative of COBG 643 and VBN 3 and matures in 65-70 days. It recorded an average yield of 606 kg/ha under rice fallow condition. It is moderately resistant to YMV and podborer. It is resistant to root knot nematode.

Greengram: COGG 980

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

Cowpea: VCP 09 – 013

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

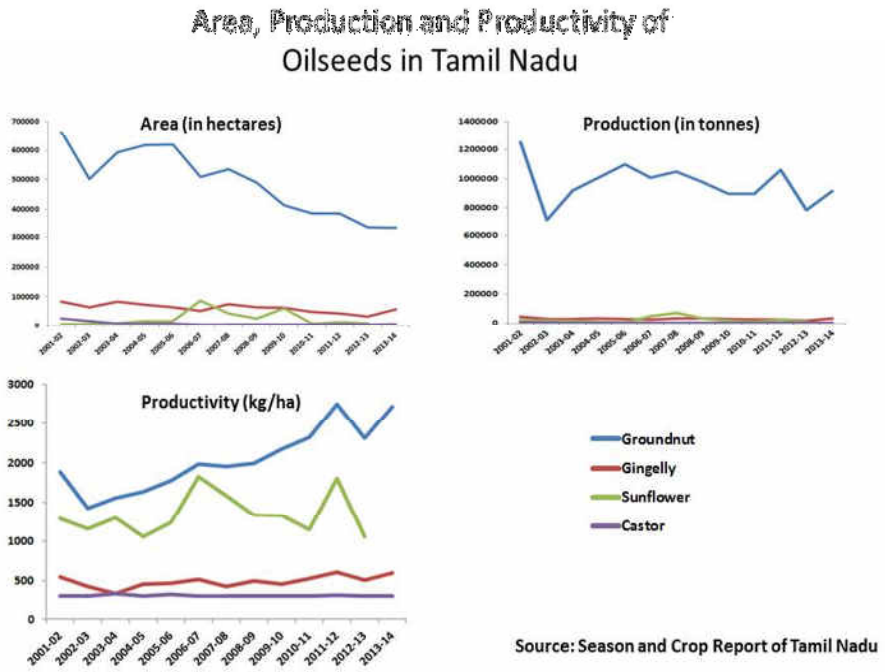
Cultures identified for the evaluation under ART during 2016-17

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
CRG 10-12	Co (Rg) 7/BSMR 853	180	1880	Resistant to sterility mosaic disease and indeterminate
VBG10-010	VBN 2/VBG 04-003	65	1095	Resistant to YMV
COBG 11-02	VBN 4/V. mungo var silvestris	65	748	Resistant to YMV
VBG 11 – 016	VBN 3/VBG 04-001	69	1137	Resistant to YMV

VGG 05-009	VBN (Gg) 2/VRM (Gg) 1	75	882	Moderately resistant to YMV
VCP 09 – 019	TY 860/CO(CP) 7	75	1370	Moderately resistant to YMV

Oilseeds

The four major oilseed crops grown in Tamil Nadu are groundnut, sesame, castor and sunflower. Among the four crops groundnut dominates all the other crops under area, production and productivity.



Top 10 Districts in Tamil Nadu by Area

Groundnut

District	Area (ha)
Tiruvannamalai	58303
Villupuram	45487
Vellore	36825
Namakkal	25429
Salem	18837
Erode	17111
Dharmapuri	13657
Krishnagiri	13006
Kancheepuram	12520
Cuddalore	11670

Sesame

District	Area (ha)
Villupuram	8580
Thanjavur	6910
Cuddalore	6487
Erode	5713
Karur	3387
Ramanathapuram	2429
Tiruvannamalai	2133
Pudukkottai	1871
Tiruchirappalli	1677
Kancheepuram	1639

Castor

District	Area (ha)
Namakkal	2427
Krishnagiri	1115
Salem	856
Tiruchirappalli	371
Erode	346
Vellore	275
Dharmapuri	187
Villupuram	171
Theni	165
Perambalur	145

Varieties Released

Groundnut VRI 8 (State release)

The Spanish bunch groundnut VRI 8 (VG 09220) is a hybrid derivative of ALR 3 and AK 303. It is a high yielding genotype with medium bold pods and kernels with rose coloured testa. It matures in 105-110 days. The new variety recorded a mean pod yield of 2127 and 2698 kg/ha under rainfed and irrigated conditions respectively which is 22.0 per cent and 26.6 per cent superior over VRI Gn 6. The shelling out turn and oil content are 70.0 and 49.0 percent respectively. It is moderately resistant to late leaf spot and rust diseases. It is suitable for all the groundnut growing districts of Tamil Nadu.

Groundnut ALG 06-320 (AICRP release)

ALG 06-320, a Spanish bunch groundnut culture has been identified by the Variety Identification Committee of the AICRP for the release in Zone III b which includes Tamil Nadu, Andhra Pradesh and Karnataka. It is a derivative of (J 11/CG 52)/ICGV 86015 and matures in 115 days. It recorded a mean pod

yield of 2741 kg/ha which is 33.0 per cent superior to the National Check TAG 24 (2060 kg/ha) and 29.0 per cent superior over the Zonal Check R 8808 (2124 kg/ha). The shelling outturn and oil content of the new genotype is 7.0 and 49.0 per cent respectively. The variety is resistant to rust and moderately resistant to late leaf spot diseases.

Cultures in pipeline for release

Sesame: VS 07-023

The white seeded sesame culture VS 07-023 is a cross derivative of SVPR 1 and TKG 87. The culture matures in 75-80 days and gives mean seed yield of 697 kg/ha which is 13.1 percent superior over the check SVPR 1. The oil content is 49.0 per cent. The incidence of root rot is low (18%) when compared to the check SVPR 1 (20%).

Castor Hybrid: YRCH 1116

The castor hybrid YRCH 1116 is a semi-dwarf hybrid with high basal branching. The hybrid is a cross derivative of M 619-1/SKI 215. It matures in 180 days and gives a mean seed yield of 2080 kg/ha which is 18.8 per cent superior over the check YRCH 1. The mean oil content is 49.0 per cent. The proportion of female flowers (95%) is high. It is a non-

lodging, non-shattering hybrid highly suitable for rainfed situations. The compact plant type is also suitable for intercropping.

Cultures identified for the evaluation under Adoptive Research Trials during 2016-17

Culture name	Parentage	Duration (days)	Yield (kg/ha)	Special feature
ICGV 06146	ICGV 92069 x ICGV 93184)/ICGV 96246 x 92 R/75	110	2040	Spanish bunch type
TVG 0856	VRI 6 x R 2001-2	103	2130	Spanish bunch type
ICGV 07245	ICGV 92069/ICGV 93184)/SIL 4/(ICGS 44/ICGS 763	120	2170	Virginia bunch type
ICGV 07247	ICGV 92069/ICGV 93184)/SIL 4/(ICGS 44/ICGS 763)	120	2133	Virginia bunch type
CSFH 12205	COSF 6A/IR 6	90	2010	-
YRCS 1205	TMV 6/Salem local	180	1342	Resistant to wilt

Cotton

Total area under cultivation is 150963 hectares and the following are the top 10 districts cultivating cotton with total production of 416560 bales.

Top 10 Districts in Tamil Nadu by Area

District	Area in hectares	Production in bales of 170 kg lint each
Perambalur	31087	91170
Tiruchirappalli	16462	35767
Salem	13003	45977
Dharmapuri	12486	36456
Virudhunagar	9722	23451
Villupuram	9589	21724
Ariyalur	9118	30594
Cuddalore	8614	29972
Vellore	6470	17304
Madurai	5895	9861

Varieties released

CO 14 (State release)

CO 14 is an extra-long staple cotton released during 2016. It recorded an average seed cotton yield of 1768 kg/ha which is 18.3 per cent increase over MCU 13. It recorded 34.8 per cent ginning out turn with 6.0 g boll weight. This culture recorded the highest span length of 35.00 mm and bundle strength of 22.7 g/tex as against 33.9 mm fibre length and 21.9 g/tex fibre strength of MCU 5. This culture matures in 150 days. As per the report of CIRCOT, Mumbai under full spinning test, this culture recorded 35.0 mm and 23.4 g/tex of fibre length and strength respectively in ICC mode and 36.2 mm and 29.6 g/tex respectively in HVI mode which can be spun up to 70's counts.

TCH 1705 (AICRP release)

The culture TCH 1705 recorded the highest seed cotton yield of 2807 kg/ha against the local check Suraj (2146 kg/ha) which is 30.8 per cent higher than the check Suraj. This culture belongs to medium staple category with 2.5 % span length of 27.1 mm and fibre strength of 21.5 g/tex. This culture earlier submitted to the central variety release committee has been accepted for release in south zone.

TSH 0250 (AICRP release)

The cotton culture TSH 0250 was released by central variety release committee for south zone during 2014. TSH 0250 is a cross derivative of NDLH 1658 and Surabhi and was developed from Cotton Research Station, Srivilliputtur. This culture recorded the highest seed cotton yield of 1845 kg/ha against the check Surabhi (1633 kg/ha) which is 13.0 per cent higher than Surabhi. This culture belongs to medium staple category with 2.5 % span length of 29.4 mm and bundle strength of 22.0 g/tex.

Culture in pipeline for release

TKA 9102/03

The cotton (*G. arboreum)* culture TKA 9102/3 which will be proposed for release during 2016-17 recorded an average seed cotton yield of 1193 kg/ha as against 1066 kg/ha of K11. The yield increase of TKA 9102/3 is 11.9 per cent over K11. TKA 9102/3 is a hybrid derivative of the cross K 11 and K 9 and was developed from Agricultural Research Station, Kovilpatti.

Cultures identified for the evaluation under Adoptive Research Trials during 2016-17

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

Sugarcane

The overall sugarcane production in Tamil Nadu during 2013-14 was 32454135 tonnes and the following districts were the top 10 districts by area.

Top 10 Districts in Tamil Nadu by Area

District	Area in hectares	Cane yield in tonnes
Villupuram	88786	10598908
Tiruvannamalai	37783	3084592
Cuddalore	30304	3286001
Erode	23539	2562633
Namakkal	16544	1965911
Salem	12652	1215553
Vellore	11591	1093697
Ariyalur	9875	1112304
Thanjavur	8580	1012422
Dharmapuri	8433	615686

Culture in pipeline for release

C 260628

C 260628 is a fast growing one with thick cane having cylindrical internodes and is suitable for early and special seasons. It is moderately resistant to red rot disease. The Bi Mill Test (BMT) indicates its sugar recovery is to the tune 9.1 percent.

Clones identified for evualuation under ART during 2016-17

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

Forage crops

Variety released

Fodder Cowpea CO 9

CO 9 cowpea (CO 5/Bundel Lobia 1) gives green fodder yield of 22.82 t/ha. Its dry matter yield is 3.85 t/ha. The reduced fibre portions confer increased digestibility, palatability and intake rate by the animals. The protein content in the fodder is 21.56 percent. It is moderately resistant to YMV.

BREEDER SEED PRODUCTION PLAN 2016-17

Crop	Varieties	Total
PADDY		
ADT 36, ADT 37, ADT 38, ADT 39, ADT 42, ADT 43, ADT (R) 45, ADT (R) 46, ADT 47, ADT (R) 49, ADT (R) 50, CO 43, CO (R) 49, CO (R) 50, CO (R) 51, CR 1009, CR 1009 SUB 1, MDU 6, IR 20, IR 36, IR 50, ASD 16, ASD 18, ASD 19, Improved whiteponni, TRY 1, TRY 3, TPS 5, TKM 9, TKM13, TKM 14, Anna (R) 4		32
MILLETS		
Sorghum	CO (S) 30, K 8, K 12	3
Ragi	CO (Ra) 14, CO (Ra) 15	2
Bajra	CO (Cu) 9, CO (Cu) 10	2
Maize	COH (M) 6, COH (M) 8, COH (M) 9 Parental lines	6
Samai	CO (Samai) 4	1
Varagu	CO 3	1
Tenai	CO (Te) 7	1
Kudiraivali	CO (Kv) 2	1
Panivaragu	CO (Pv) 5	1
	Total	18
PULSES		
Redgram	VBN 3, CO(Rg) 7	2
Blackgram	ADT 3, ADT 5, VBN 3, VBN (Bg) 4, VBN (Bg) 5, VBN (Bg) 6, VBN (Bg) 7, VBN (Bg) 8, CO 6, MDU 1	10
Greengram	ADT 3, VBN 2, VBN 3, CO 6, CO(Gg)912 (CO7), CO(Gg)8	6
Cowpea	CO (Cp) 7	1
Horsegram	Paiyur 2	1
	Total	20
OILSEEDS		
Groundnut	VRI 2, VRI (Gn) 6, VRI (Gn) 7, VRI 8, CO (Gn) 6, CO 7, TMV (Gn) 13. ICGV00348	8
Sesame	VRI Sv.1, VRI Sv.2, TMV 3, TMV 4, TMV 7, SVPR 1.	6
Castor	TMV 6	1
Sunflower	CO (SFV) 5	1

Total	16
COTTON	
MCU 5, MCU 7, SVPR 2, SVPR 4.	4
Total	4
FORAGE CROPS	
Fodder Sorghum: CO (FS) 29, CO (FS) 31, SPV 2242	3
Fodder Cowpea: CO 9	1
Total	4
VEGETABLES CROPS	
Tomato – PKM 1, Chillies – K 1, K2 , Bitter Gourd – CO 1, Ridge Gourd – PKM 1, Ash Gourd – CO 2 Snake Gourd – CO 2	7
Total	7
GRAND TOTAL	101

ABSTRACT

Breeder seed production programme during 2014-15 supplied during 2015-16 in kgs

Crop	Indented Quantity 2014-15				Supply of breeder seeds 2015-16			
	State	GOI	Priv.	Total	State	GOI	Priv.	Total
PADDY	16617	3330	81545	101492	16988	2985	76280	96253
MILLETS	396	-	36	432	559	-	113	672
PULSES	4346	1550	4162	10058	3127	1248	3646	8021
OILSEEDS	25488	9210	215	34913	10402	1000	165	11567
COTTON	-	4	225	229	-	2	258	260
FORAGE CROPS	-	325	-	325	-	350	-	350
VEGETABLE CROPS	-	-	65	65	0.5	-	24	24.5
TOTAL	46847	14419	86248	147514	31076.5	5585	80486	117147.5

Breeder seed production programme during 2015-16 to be supplied during 2016-17 in kgs

Crop / Variety	Indented Quantity 2015-16				Supply of breeder seeds 2016-17 (as on 30.06.2016)			
	State	GOI	Priv.	Total	State	GOI	Priv.	Total
PADDY	**25359**	**4390**	**109755**	**139504**	**11920**	**550**	**39686**	**52156**
MILLETS	**1266**	**76**	**5**	**1347**	**545**	**390**	**0**	**935**
PULSES	**10696**	**720**	**5085**	**16501**	**2012**	**200**	**1409.5**	**3621.5**
OILSEEDS	**76076**	**14000**	**442**	**90518**	**36750**	**0**	**50**	**36800**
COTTON	**50**	**0**	**139**	**189**	**0**	**0**	**0**	**0**
FORAGE CROPS	**0**	**200**	**0**	**200**	**0**	**200**	**0**	**200**
VEGETABLE CROPS	**0**	**0**	**115.5**	**115.5**	**0**	**5.6**	**2**	**7.6**
TOTAL	113447	19386	115541.5	248374.5	51227	1345.6	41147.5	93720.1

* *Kharif* Despatch instruction issued and supply is in progress. *Rabi* despatch instruction would be issued by the end of July, 2016

Breeder seed production programme during 2016-17 to be supplied durin 2017-18 in kgs

Crop / Variety	Indented Quantity 2016-17			
	State	GOI	Priv.	Total
PADDY	14000	9385	120425	143810
MILLETS	1115	926	135	2176
PULSES	8270	1120	6112	15502
OILSEEDS	75440	45576	740	121756
COTTON	35	10	186	231
FORAGE	300	1300	80	1680
VEGETABLE CROPS	0	0	25.5	25.5
TOTAL	99160	58317	127703.5	285180.5

CROP MANAGEMENT

FOR ADOPTION

Weed management in transplanted rice

Performance of pre and post emergence (PE and POE) herbicides were tried in transplanted rice during July 2012 to May 2015 as on-station trial and OFT during October 2015 to March 2016. Among the treatments, PE application of pretilachlor 750 g/ha at 3 DAT + POE chlorimuron + metsulfuron methyl (Almix) 4 g/ha at 25 DAT resulted in higher weed control efficiency (56 %) and grain yield of 6470 kg/ha which was 4.75 and 13.88 % higher than PE pretilachlor 1.0 kg a.i / ha followed by HW on 25 DAT and hand weeding on 25 and 45 DAT respectively. This treatment had higher net return (Rs. 47428/ha) with Benefit Cost ratio of 2.38.

Pre –emergence application pretilachlor 750 g/ha at three days after transplanting

Manual weeding on 25 days after transplanting

Weed management in wet seeded rice

In wet seeded rice, pre and post emergence herbicides were evaluated during July 2012 to May 2015 as on-station trial and OFT was conducted during season of 2015. Among the herbicides studied, pre-emergence application of pendimethalin 1.0 kg /ha at 8 DAS fb POE bispyribac sodium 25 g/ha at 25 DAS fb HW on 45 DAS resulted in higher weed control efficiency (60.9 %) and grain yield of 5550 kg/ha which was 5.64 and 9.58 % higher than PE pendimethalin 1.0 kg/ha at 8 DAS fb hand weeding 25 DAS and cono weeder weeding at 10 and 25 DAS respectively. This treatment gave higher net return (Rs. 52209/ha) with Benefit Cost ratio of 2.45.

Integrated Weed Management (IWM) practices for irrigated greengram

On farm trial on integrated weed management in irrigated greengram (CO 8) was conducted at four locations during *rabi* 2015 and results revealed that pre-emergence application of pendimethalin 30% EC + imazethapyr 2% EC (Ready-mix) @ 1.0 kg/ha on 3 DAS + one hand weeding at 30 DAS was found to be an effective weed management practice for greengram, which recorded lower weed density (5.6 Nos./m^2) and weed dry weight (61.9 kg/ha) at harvest stage and higher number of pods/plant (53.0), seeds/pod (10.3), grain yield (990 kg/ha) and registered maximum net return (Rs.30,612/ha) and Benefit Cost ratio (2.34).

Pendimethalin + Imazethapyr (Ready-mix) @ 1.0 kg/ha on 3 DAS + one HW at 30 DAS

Hand weeding twice

Nutrient management in groundnut-blackgram cropping system for irrigated condition

Nutrient management in groundnut-blackgram cropping system for irrigated condition were evaluated during June 2013 – May 2015 as on-station trial in Coimbatore and OFT was conducted during *rabi* 2015 at six locations. The results revealed that application of 100 % N with 150 % P and K (25:75:112.5 kg/ha) to groundnut recorded higher groundnut pod yield (2813 kg/ha) and 100 % RDF (25:50:25 kg NPK/ha) to blackgram recorded grain yield of 776 kg/ha compared 100 % RDF to groundnut and blackgram. This cropping system gave higher net return (Rs. 100111/ha) with Benefit Cost ratio of 2.13.

Management practices for yield maximization in TNAU SFH CO 2 sunflower

A trial on yield maximization in sunflower with best management practices was conducted in Coimbatore during June 2013 – May 2015 and OFT was conducted in five locations at farmers holding during *rabi* 2015. Adoption of 60 x 30 cm spacing (55,555 plants/ha) along with the application FYM @ 5 t/ha and 125 % RDF (75:113:75 kg NPK/ha) recorded higher seed yield of 1976 kg/ha, which was 17.6 % higher over farmer's practice (60 X 20 cm and fertilizer 60:90:60 kg NPK/ha) with net return of Rs. 31,927/ha and Benefit Cost ratio of 1.86.

60 x 30 cm spacing with FYM @ 5 t/ha and 125 % RDF (Var. TNAU SFH CO 2)

ON FARM TRIAL

Split application of N and K in semi dry rice cultivation

Split application of N and K in semi dry cultivation with Anna 4 rice variety was evaluated in OFT at ARS, Paramakudi during samba season 2015. The results revealed that split application of 1/4th N and K as basal and top dressing 3/4th N and K on 25, 45 and 65 DAS in three equal splits along with full dose of P recorded 25.6 % increased grain yield (3920 kg/ha) over basal application of recommended dose of 75:25:37.5 kg NPK / ha.

Safe Alternate Wetting and Drying Irrigation (AWDI) in rice for improving Water Use Efficiency (WUE) and productivity

Field Water Tube

A practical way to implement safe AWDI is to monitor the depth of ponded water on the field using a 'Field Water Tube' which is made of 40-cm long plastic pipe having a diameter of 15 cm so that the water table is easily visible. The tube should be perforated with holes on all sides. Tube should be inserted in to soil so that 15 cm protrudes above the soil surface. Care should be taken not to penetrate through the bottom of the pan. Soil must be removed from plough inside so that the bottom of the tube is visible. Water level must be maintained so that the inside tube is the same as outside the tube. The tube can be placed in a flat part of the field close to a bund, so it is easy to monitor the ponded water depth.

For the assessment of saving irrigation water by adopting 'safe' alternate wetting and drying irrigation practices in canal command areas over larger scale, the experiment was conducted at Tamil Nadu Agricultural University for the past three years. The results revealed that safe AWDI of 10 cm depletion in light soils and 15 cm in heavy soils was found to improve the water use efficiency in rice.

Stage specific microbial inoculants for rice

To assess the performance of stage-specific inoculants on the growth and yield of direct sown rice, field trials were conducted at six different centres. The results indicated that stage-specific inoculants with 75% RDF had maximum population build up in the rice rhizosphere at flowering stage of the crop.Stage-specific inoculants with 75% RDF had highest yield increase compared to other treatments, while, the stage-specific inoculants with 50% RDF had significantly lower yield than fertilizer control. Stage-specific inoculants with 75% RDF had an average yield increase of 12% higher than regular inoculant application + 75% RDF and 5.5% better than 100% RDF.

Altering crop geometry to suit mechanical weeding in maize

Field experiment was conducted with an objective to evaluate the mechanical weeder by altering crop geometry for enhancing productivity of maize hybrid CO 6 during *kharif* 2014-16. The results revealed that 75 x 20 cm spacing and weeding with power weeder (60 cm width) on 20 and 45 DAS resulted in higher weed control efficiency (91 %), grain yield (8685 kg/ha), net return (Rs.61721/ha) and B:C ratio (2.18) with labour requirement of 3.8 man days/ha.

Power weeder weeding at 20 and 45 DAS

Yield maximisation in redgram

To maximise the productivity and profitability in redgram through technological interventions**,** field experiment was conducted at RRS, Paiyur during June 2013 and March, 2016. Foliar application of 0.5% Mono Ammonium Phosphate (MAP) twice at flowering and15 days thereafter registered higher yield parameters like number of pods/ plant (1210), number of seeds / pod (5.1) and 100 seed weight (12.7g) resulting in higher grain yield of 2512 kg/ ha, net income of Rs. 95215/- and B:C ratio of 2.97.

Conservation tillage and supplemental irrigation for rainfed blackgram

Field trial was conducted at Kumulur during July 2012 to June 2014 to study the minimum tillage with supplemental irrigation under rainfed condition. The results showed that minimum tillage with crop residue application @ 5 t/ha combined with supplemental irrigation through rain gun at vegetative and flowering stages recorded increased water use efficiency (2.52 kg/ha/mm) and higher seed yield (930 kg/ha) in rainfed blackgram.

Sprinkler irrigation on different blackgram varieties under summer irrigated condition

The field trial was conducted at TRRI, Aduthurai to study the sprinkler irrigation on the performance of black gram varieties *viz*., ADT 5, VBN (Bg) 6 and PBG 6 during summer irrigated condition from May 2013 to April 2015. The results revealed that blackgram variety ADT 5 registered higher seed yield (1227 kg/ha) under sprinkler irrigation at 100 per cent PE followed by VBN (Bg) 6. Sprinkler irrigation at 100 per cent Pan Evaporation (PE) recorded lower water usage of 308.7 mm and saved the water (25.4 per cent) than conventional irrigation. It also recorded the maximum net income of Rs. 37905/ha and B:C ratio of 2.65 compared to conventional irrigation method.

Weed management in machine sown redgram under dryland condition

To evaluate the suitable weed management practices for rainfed redgram the field experiment was conducted at DARS, Chettinad during *kharif* season 2013 and 2014. The results of the experiment indicated that power weeding at 20 and 40 DAS in intra rows weeding registered higher weed control efficiency of 79.5 per cent and seed yield of 922 kg/ha. The mechanical weeding treatment registered higher net return (Rs.32363/ha) and B: C ratio (2.50).

Power weeding on 20 DAS

Crop Residue Mulching

Studies on tank mix application of early post emergence herbicides for efficient weed control in groundnut

Study on tank mix application of early post emergence herbicides for efficient weed control in groundnut was conducted at RRS, Vriddhachalam during June 2014 to March 2016. The results revealed that application of pendimethalin @ 1.5 kg/ha (PE) + one hand weeding at 25 DAS resulted in higher groundnut pod yield of 3060 kg/ha, net return (Rs. 117181/ha) and Benefit Cost Ratio (3.03). It was followed by pendimethalin @ 1.5 kg/ha (PE) + tank mix imazethpyr (50%) + quizalofop ethyl 25 g (50%) at 20 DAS with 3448 kg/ha of pod yield and net return (Rs. 113585/ha) and Benefit Cost Ratio of 2.98.

Improving the size of sesame seed through pelleting for mechanized sowing and storage potential

The experiment was conducted at Department of Seed Science and Technology, Coimbatore and Agricultural College and Research Institute, Madurai during July 2014 to June 2016 with the objective of evaluating the productivity of pelleted seeds under mechanical sowing and storage potential of pelleted seeds. The results of the field study revealed that, pelleted seeds recorded higher field emergence (81%) than non pelleted seeds (70%). Optimum population was maintained with pelleted seeds sown by centrifugal broadcaster. Pelleted seeds stored in 700 gauge polythene bag maintained higher germination and vigour index up to 9 months of storage.

Exploring the maximum yield potential of hybrid castor (YRCH1) under irrigated condition

To bridge the gap between actual and potential yield of castor, the trial on exploring the maximum yield potential of hybrid castor under irrigated condition was conducted at TCRS, Yethapur during August 2014 to March 2016. The study revealed that application of 100% RDF (90:45:45 kg NPK/ha) along with enriched TNAU micro nutrient mixture for castor @ 7.5 kg/ha + azophos @ 2 kg/ha + foliar spray of $FeSO_4$ and $ZnSO_4$ @ 0.5% on 45 DAS had recorded higher number of spikes / plant (21.4) and 100 seed weight (30.8 g) which resulted in significantly higher seed yield of 3122 kg/ha with a net return of Rs. 87760/ha and benefit-cost ratio of 3.43.

Performance of PSB (TNAU) and biophos on castor productivity under rainfed condition

Performance of biophos and PSB were studied with castor hybrid YCRH 1 during *kharif* 2015 at TCRS, Yethapur. The results revealed that application of 60 kg P_2O_5/ha + seed treatment with biophos @ 600 g inoculants/ kg seed recorded significantly higher spikes/ plant (16.85), No. of capsules /plant (68.8) with an average spike length and test weight of 48.7 cm and 28.45 g, respectively which reflected in higher seed yield of 1779 kg/ha with net returns of Rs. 38388/ha and benefit-cost ratio of 2.20.

Integrated weed management in cotton

To control complex weed flora in summer irrigated cotton the experiment was

conducted with combination of herbicides at Coimbatore during *rabi* 2014-16. Among different weed management practices, Pre emergence pendimethalin @1.0 kg/ha + early pest emergence application of quizalofop ethyl @ 50 g/ha 2-4 leaf stage + HW 45 application of DAS recorded higher weed control efficiency (98.8 %), seed cotton yield (2366 kg/ha), net return (Rs. 48559/ha) and benefit-cost ratio of 2.13.

Fertilizer prescription under Integrated Plant Nutrient System (IPNS) for hybrid cotton under drip fertigation

The fertilizer prescription equations under IPNS for cotton under drip fertigation on Perianaickenpalayam soil series (Vertic Ustropept - mixed black calcareous soils) was validated at TNAU, Coimbatore and farmer's holdings at Salem during 2012 to 2016. The increase in seed cotton yield due to STCR-IPNS 4.0 t /ha over blanket (RDF + FYM @12.5 t /ha) and farmer's practice with a tune of 22.5 and 39.0 per cent respectively besides recording relatively higher response ratio and Benefit Cost Ratio.

Sunnhemp (seed crop) as an alternate crop in Cauvery Delta Zone

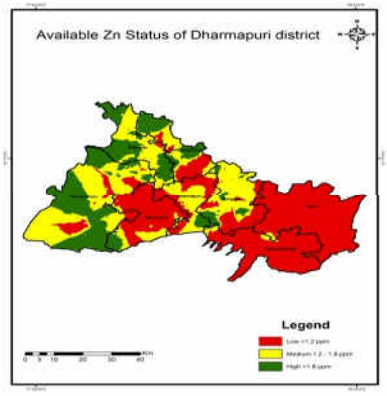
An experiment was conducted at TRRI, Aduthurai to find out the optimum spacing and fertilizer dose for getting maximum seed yield of sunnhemp.The results showed that sunnhemp raised with 60 x 15 cm spacing with 20:60:60 kg NPK/ha recorded higher seed yield of 1100 kg/ha with higher net return of Rs.41980 and benefit-cost ratio of 2.73

Standardization of management techniques for sugarcane under SSI system

The study was conducted to find out optimum plant spacing for transplanted seedlings under single and double row planting of sugarcane in SSI system. The results revealed that adoption of 150 x 30 cm spacing with 100 % RDF (300:100:200 kg NPK/ha) and topping of mother shoots increased millable cane (127500 /ha), cane yield (126.5 t/ha), CCS (10.92 %) and benefit-cost ratio (3.27) in plant crop. In ratoon crop also the same treatment performed better with millable cane (128560 /ha), cane yield (150.1 t/ha), CCS (10.92 %) and benefit-cost ratio (4.84).

FOR INFORMATION

Reassessment and mapping of micronutrients status in soils of Various districts of Tamil Nadu



During 2015 – 2016, village wise surface soil samples @ 4 per village at 0-15 cm depth were collected along with GPS coordinates from all blocks of Dharmapuri district. The collected soil samples were analysed for available Sulphur and micronutrients such as Zn, Fe, Cu, Mn and B and the soil samples were

grouped as deficient or sufficient based on the critical limits fixed for the soils. Per cent deficiency of micronutrients in each block was worked out. The results in general showed that Zn deficiency was most prevalent in Dharmapuri district (67.4 %) followed by Cu (7.8 %) and B (6.8 %). The spatial variability maps for showing status of different available micronutrients were generated at block level for Dharmapuri district for giving specific micronutrient recommendation to crops.

Potential Crops and Microbes for the reclamation of calcareous sodic and saline- sodic soils

Maize (COH M 6), Ragi (CO 15) and Sunflower (CO 4) were having better phyto reclamation potentials with higher calcite dissolution (20-30%) in calcareous sodic and saline-sodic soils. The efficiency was closely associated with the maintenance of sufficient Ca^{2+}supply, higher organic acids secretion and better Na^{-+} / salt removal efficiency (25-30%).

Brevibacterium halotolerans, Bacillus subtilis, Bacillus licheniformis were identified as potential microbes from calcareous sodic and saline sodic soils. These microbes have higher calcite solubilisation index (>1.50) and capable of producing organic acids, siderophore and biofilm production to dissolute the native calcite.

Study on Screening medium duration rice genotypes for high Zn efficiency

The following genotypes were identified as :

Zn efficient rice genotypes **:** CO 50, Improved White ponni, CORH4, ADT 46, TRY1 and DRRH3 which can be grown under Zn deficient condition to produce high DMP and yield. Grain Zn concentration was higher in Zn efficient genotypes under Zn stress condition; whereas in adequate Zn supply Zn inefficient genotypes had higher grain Zn concentration.

Permanent manurial experiment in sunflower

- Continuous application of 100% NPK + FYM @ 12.5 t ha^{-1} increased the sunflower yield to the tune of 20.55% over 100% NPK
- 100% NP and 100% NPK application produced comparable yield (1262 and 1282 kg/ha).

- Continuous application of single nutrient alone (N or P or K) reduced yield by 42.7, 30.2 and 38.1% and depleted soil N, P, K status.
- Organic carbon build up noticed from 0.32% (1974-79) to 0.62% (2015) under Integrated Nutrient Management.

Manganese Nutrition of sesame crop

Application of 10 kg ha^{-1} $MnSO_4$ with recommended NPKS (35:23:23:40) registered significantly highest seed yield (740 kg ha^{-1}), Seed oil content (49.2%), Seed oil yield (369 kg ha^{-1}) and Seed Mn content (19.2 mg kg^{-1}) over control (NPKS alone).

Permanent manurial experiment in millets

Continuous application of 100% NPK + FYM @ 12.5 t ha^{-1} recorded the highest maize and finger millet yield. The grain yield increase in INM practice was 18.5 and 14.4 per cent over 100% NPK in maize and finger millet respectively.

Since 100% NP and 100% NPK application produced comparable yield in maize and finger millet crops, application of 100% K is not necessary instead 50% can be followed for millets in soils with high K.

Studies on the yield and quality of chillies and onion as influenced by S fertilization in S deficient soils

In Chillies (TNAU hybrid CO1), application of S @ 80 kg ha^{-1} as elemental sulphur significantly enhanced the length of pod, oven dry weight of pod, uptake of S by pod and shoot. This was followed by S application @ 60 kg ha^{-1}.

CROP PROTECTION

FOR INFORMATION

RICE

- Among different stem borer species, the yellow stem borer, *Scirpophaga incertulas* Wlk. was found to be the predominant species (66.27%) followed by pink stem borer, *Sesamia inferens* (Walker) (33.73%) during *Kar* season, 2015 at Thirunelveli district.
- Application of two rounds of chlorantraniliprole 18.5 SC @ (150 ml/ha) found effective in controlling yellow rice stem borer.
- Neemazal 1% EC and neem baan 1% EC were effective against stemborer and leaffolder, respectively while neem oil (3%) was effective against sucking pests under field conditions.
- Basal application of calcium silicate 50 kg/ha either with silicic (6.2 no. /tiller) or salicylic acid (5.4 /tiller) could bring down the BPH eggs to the minimum level which was followed by the application of rice husk ash 500 kg/ha with silicic acid (8.6 /tiller) and calcium silicate 25 kg with salicylic acid (8.1 /tiller).

- Application of insecticide imidacloprid + ethiprole (125g/ha) at vegetative stage was found effective against hopper pests.
- Prolonged dry spell in the month of July 2015 at Thanjavur region favoured the development of two different mite species damage *viz.,* yellow leaf mite, *Oligonychus oryzae* (Hirst) and pink mite, *Steneotarsonemus spinki* Smiley. Continuous monitoring of these mites is required in the emerging seasons.

Management of false smut disease of rice

Spraying of trifloxystrobin 25% + tebuconazole 50% (0.4g / l) during booting stage reduced the false smut and recorded a minimum of 1.0% of infected spikelets per panicle with the maximum yield of 4680 kg/ha as compared to 8.13% of infected spikelets / panicle with the yield of 3810 kg/ha in the untreated control.

Management of rice diseases using newer fungicidal molecule

Spraying of zineb 68% + hexaconazole 4% WP immediate to the occurrence of disease symptoms (grade 1) in the field recorded the lowest incidence of blast disease (20.53 %), false smut (3.53 %) and increased the grain yield (4790 kg/ha) as compared to untreated control (which showed 30.42% of leaf blast and 7.00% of false smut incidence, respectively and recorded 3700 kg/ha grain yield).

New emerging disease in rice - Bakanae / Foot rot

A new emerging disease in rice, Foot rot or Bakanae [*Fusarium moniliforme (Gibberella fujikuroi* var. *fujikuroi)]* was noticed during 2015 cropping season at Gudalur, The Nilgiris Dt. The possible occurrence of the disease in other parts of Tamil Nadu during the ensuing season(s) may be monitored.

a. Symptoms

Abnormal elongation of the plant both in the seedbed and field. Infected plants will be taller by several cm than normal plants.

- Appearance of disease 20 days after transplanting.
- The affected plants loose, lusture and become thin and exhibit pale or yellowish green colour with a few tillers and the leaves dry up quickly.
- Plants that survive until maturity may produce partially filled or empty grains.
- Infected plants in the field will have pale green flag leaves, conspicuously projecting above normal crop canopy.
- Prominent adventitious roots will be noticed in the lower nodes.

b. Management

- Infected plants should be pulled out and destroyed away from the field.
- Spot drenching with 0.1% carbendazim in and around the infected clump covering at least 1m^2 area is recommended.

Abnormal elongation of the plant

Thin, yellowish green leaves

Adventitious roots at lower nodes

MILLETS

Finger millet

Seed treatment with *Pseudomonas fluorescens* Pf1 (TNAU formulation) @ 10g/kg of seed along with two rounds of spray @ 10 g/l had reduced the leaf blast, neck blast and finger blast disease incidence.

Seed treatment with pre-mixture fungicide (carbendazim 12% + mancozeb 63% WP) @ 3g/kg of seed along with one spray @ 2% on the appearance of disease symptom (grade 1) recorded lesser incidence of neck blast, finger blast and seed blackening.

Seed treatment with *Pseudomonas fluorescens* Pf1 @ 10g/kg of seed and foliar spray of Mancozeb (0.2%) on 45 DAS will be effective in controlling *maydis* bight incidence in maize.

PULSES

- IPM module comprising seed treatment with imidacloprid 17.8 SL @ 5ml/kg, on 30 DAS followed by two applications of 1% neem oil soap at 7 days interval, installation of yellow sticky trap @ 50/ha on 30 DAS and need based application of chlorantroniliprole 18.5 SC @150ml/ha resulted in 68 per cent reduction of sucking pest damage and 90 per cent in *Maruca* damage in greengram when compared to untreated check yielding 850 kg/ha with maximum benefit cost ratio of 1: 4.1.
- Two application of chlorantroniliprole 18.5SC @ 30g ai/ha (first spray at the time of flower initiation and second spray 15 days later) in pigeonpea reduced the pod borers damage to 77 per cent when compared to untreated check.

PULSES

Redgram

a. Management of Sterility Mosaic Disease (SMD) in Redgram

- Two rounds of spray with Propergite @ 0.1% first at 25 days after sowing and the

2nd spray after 15 days reduced SMD incidence by about 84.3% with an average yield of 815 kg/ha as against 460 kg/ ha in the control.

b. Management of wilt and root rot

- Seed treatment with *Bacillus subtilis* (strain CcB7) talc formulation @ 10 g/ kg + soil application twice @ 2.5 kg of formulation mixed with 50 kg of FYM / ha (basal dose + 45 DAS) effectively reduced wilt and root rot diseases (by 65.4 and 62.6 per cent, respectively).

BENGALGRAM

Management of wilt and root rot

- Seed treatment with *Bacillus subtilis* (strain CaB5) talc formulation @ 10 g/ kg + soil application twice @2 .5 kg of formulation mixed with 50 kg of FYM/ ha (basal dose + 45 DAS) effectively reduced wilt and root rot diseases (by 63.2 and 66.1 per cent, respectively).

Sugarcane

Unusual incidence of white grub was noticed sporadically and heavily in sugarcane crop in and around Kaduvanur areas due to prolonged drought and favourable weather conditions for the insect development besides the Vanapuram forest belt with lot of neem trees, *Acacia* and other trees serving as hosts of the adult beetles.

Integrated Management of white grub suggested

- Mechanical collection of easily detectable third instar grubs in the fields showing yellowing and drying of clumps late in the season
- Large scale mechanical collection of beetles that congregate on neem leaves on the night of emergence immediately after first showers during May-June reduces beetles population progressively over years.
- Application of chlorpyriphos 20EC @2ml/litre of water on small neem trees immediately after the first summer rain to kill the adult beetles that congregate on these trees the following day. Attracting the adults to big branches of the neem trees sprayed with insecticides by placing in the fields
- Spot application of phorate 10G @ 200 gms/cent (20 kg/acre) mixed with 1 kg of sand in the affected area and also surrounding area with healthy plants and irrigating immediately for dissolving the granules and repeating the application after 20 days for better control. Spot drenching of chlorpyriphos 20 EC @ 2 ml/litre in the affected clumps and also nearby surrounding healthy clumps @ 5 litres of insecticide solution per clump under severe incidence.

COTTON

- Cotton leafhopper incidence exhibited negative correlation with temperature while positive with RH and rainfall.

- Foliar application of clothianidin 50 WDG at 0.10 g/ l and dinotefuron 20 SG at 0.30 g/ l reduced the leafhopper population with a significant increase in crop yields (1323.05 and 1277.78 kg/ ha respectively) against the untreated check (804.53 kg/ ha) and also harbouring coccinellids (2.95 and 2.87/ ten plants) and spiders (3.74 and 3.63/ ten plants) equivalent to 3.92 coccinellids and 7.42 spiders/ ten plants in untreated check.
- IPM strategy (KC 3 resistant var+ bhendi trap cropping +blackgram intercropping+ seed treatment of 7 g/kg of Imidcloprid, neem oil 0.5% + *Chrysoperla* @ 10,000/ ha+ need based application of clothianidon 0.10 g/lit+ dinotefuran 20 SG 0.3g/l) evaluated against leafhopper in cotton was found to be significantly superior in reducing the leafhopper population from 3.68 to 1.85 hopper/ leaf with a C:B ratio of 1: 2.88 compared to non - IPM practices (1: 1.85).
- Pre-monsoon sown crop experienced minimum damage by stem weevil when compared to post-monsoon crop.
- Among the biointensive methods, application of neem cake 150 kg/ ha + carbofuran (1 kg a.i/ ha) at 10 DAS reduced the incidence of stem weevil, *P. affinis* to the minimum level (62.75% reduction over control) with a yield of 1102.88 kg/ ha and was on par with the treated check.
- Application of chlorantraniliprole 18.5 SC at 0.3 ml/ l and clothianidin 50 WDG at 0.2 g/ l were equally effective by reducing 77.91 and 71.81 per cent damage over untreated check and yielding 1242.80 and 1203.71 kg/ ha cotton respectively.

OILSEEDS

Groundnut

Integrated Disease Management

- Seed treatment with tebuconazole @ 1.5g/kg and basal application of *Trichoderma asperellum* (TNAU formulation) @ 4 kg mixed in 50 kg of FYM /ha + soil application of the same bioinoculant at 40DAS + two rounds of spray with tebuconazole @1ml/l was found to be the best in reducing the severity of collar rot (13.1%), root rot (11.2%), late leaf spot (25.2PDI) and rust (20.6PDI) diseases.

Sesame

- Foliar spray of myclobutanil @ 1 g / l effectively reduced the incidence of powdery mildew (PDI -17.50) and *Alternaria* leaf spot (PDI -15.14).

VEGETABLE

Tomato

- Incidence of tomato pinworm, an invasive pest, *Tuta absoluta* was recorded in Krishnagiri, Dharmapuri, Coimbatore, Salem, Tirupur, Dindigul, Tirunelveli, Theni, Madurai, Nilgiris Districts and the infestation level ranged from 0.50 to 92.50%

- Among the CIB & RC recommended chemicals (*viz.,* chlorantraniliprole, cyantraniliprole, indoxacarb, imidacloprid and flubendiamide), application of chlorantraniliprole 18.5 SC @ 150 ml ha^{-1} was found to be highly effective.

FRUITS

Papaya

Integrated management of Papaya ring spot virus (PRSV)

Raising of papaya seedlings under nylon net (40-60 mesh) and spraying of acephate @1.5 g/litre, 3 days before planting + border crop with maize (15 days before planting) + spraying of urea @ 10 g/l ; zinc sulphate @ 1.5g/l; boron @ 1.0 g/l (at monthly interval till 8 MAP) reduced PRSV incidence by about 41.7 % as compared to control (94.6 %).

Ber

Management of black leaf spot

Two sprays of propiconazole @ 0.1% (at the time of initiation and 15 days later) reduced black leaf spot (PDI-5.67) compared to control (PDI -53.00).

Emerging Disease in Guava- Guava wilt : *Fusarium* sp.

Leaves turn to yellow and gradual wilting of plants occurs. Nematode infestation aggravates the disease by pre disposing the plant to attack of wilt pathogen.

Management:

Soil drenching with 0.1% carbendazim at fortnightly intervals + Soil application of *Pseudomonas fluoresccens* @ 100g/tree

VEGETABLES

Brinjal

Management of root rot and wilt

Seed treatment with *Pseudomomas fluorescens* PF1(TNAU formulation) @ 10 g/kg + soil drenching with copper hydroxide @ 0.2% at 30 and 60 days after planting recorded 1.22 and 0.96 % incidence of root rot and fungal wilt, respectively as compared to 21.13 and 18.05 % of root rot and fungal wilt, respectively in control.

COCONUT

Management of leaf blight (*Lasiodiplodia theobromae*)

Root feeding of tebuconazole @ 2 ml in 100 ml of water at 3 months interval resulted in the maximum reduction of leaf blight (PDI -12.71) when compared to control (PDI - 33.78).

FLOWER CROPS

Marigold

Management of flower blight

Foliar spray of hexaconazole + zineb (0.2%) @ 30 and 45 DAP was effective against *Alternaria* leaf spot and *Botrytis* flower blight.

Emerging diseases in flower crops

Chrysanthemum Rust

White raised rusty pustules on lower surface of leaves resulting in drying of leaves, reduction in flower size and yield.

Management : Foliar application with 0.1% of azoxystrobin or picoxystrobin twice at 7 days interval

MEDICINAL CROPS

Glory lilly (Gloriosa superba)

Management of leaf blight of Glory lilly

Spraying *Bacillus subtilis* 0.2% (talc based formulation) on 30 and 60 DAP effectively reduced leaf blight disease (PDI-17.9) and increased the seed yield (518.8 kg/ha) as compared to control (PDI-33.4 and seed yield of 369.2 kg/ha).

Management of root rot of Glory lilly

Dipping of the the seed tubers in *Bacillus subtilis* 0.2% (talc based formulation) for 30 min.before planting + drenching with the same bioinoculant on 30 DAP recorded the lowest root rot incidence (14.8 per cent and maximum seed yield of 514.4 kg/ha) as compared to 26.4 per cent disease incidence and an average seed yield of 364.5 kg/ha in the control.

Biocontrol

- Three sprays of *Metarhizium anisopliae* ($1x10^9$ cfu/ml) liquid formulation from flower initiation in mango significantly reduced the hopper (*Idioscopus* spp.) population (89.2 %) over untreated with a fruit set of 3.2 fruits / inflorescence as against 1.6 fruits / inflorescence in the untreated check
- An arboreal generalist predator, the dusky lacewing, *Mallada boninensis* (Okamoto) was found to be effective with higher predatory potential. Total prey consumption by this predator was 1274.8 eggs of *Corcyra cephalonica*, followed by 399.2 nymphs of *Aleurodichus disparsus*, 266 Nymphs of *Aphids gossipii,* 143.4 nymphs of *Ferrisia virgata* per grub during its life. Desirable characters of high feeding preference towards *C. cephalonica* makes it amenable for easy mass rearing by simulating arboreal condition in the laboratory

Biological control of brinjal mealybug

In brinjal, two releases (15 days interval) of *Cryptolaemus montrouzieri* @ 600 grubs /acre on noticing the incidence of mealybug (*Coccidohystrix insolita*) significantly reduced the population of mealybug to 91.5 and 97.1 per cent over control during 2014-15 and 2015 -16, respectively.

Biointensive management of curryleaf leaf roller and psyllids

Adoption of biointensive pest management (BIPM) packages significantly reduced the major pests, *Psorosticha zizyphi* and *Diaphorina citri* resulting in an yield of 7.75 t/ha (as against 7.02 t/ha in farmer's practice) with a cost:benefit ratio 1:3.99

Psyllid damage Leaf roller Leaf roller damage

BIPM components to check major pests of curryleaf

- Monitoring adult psyllid population using yellow sticky traps (30 X 15 cm) @ 50 ha^{-1}.
- Monitoring leaf roller moth population through normal tungsten light source @ 1 ha^{-1}.
- Growing sorghum and cowpea to conserve the natural enemies population
- Releasing biological control agents - *Trichogramma chilonis* @ 5cc ha^{-1} (two releases at 35 and 50 days after pruning -DAP), *Goniozus nephantidis* @ 250 adults ha^{-1} (two releases at 40 and 55 DAP) targeting leaf roller *and Chrysoperla zastrowi sillemi* @ 10000 eggs ha^{-1} (two releases at 40 and 55 DAP) to manage psyllid.
- Using neem based plant product in combination with mineral oil (NSE 2.5% + mineral oil 0.25%) to manage left over population of both the psyllids and leaf roller.
- Applying thiamethoxam 25 WG @ 25 g a.i. ha^{-1} (0.005%) against psyllids, *Diaphorina citri* and chlorantranliprole 18.5 SC @ 30 g a.i. ha^{-1} (0.0056%) against leaf roller, *Psorosticha zizyphi* in case of epidemics, was found effective.

Onion

Two applications of *Beauveria bassiana* (Bb 112) oil formulation @4 ml/ lit at

fortnight interval as soon as the symptom of damage appears could reduce the population of onion thrips, *Thrips tabaci* significantly.

APICULTURE

- Indian honey bee, *Apis cerana indica* colonies placed @ 5 bee hives/ ha in the winter irrigated cotton (2015-2016) at TNAU, Coimbatore promoted cross pollination and increased the seed cotton yield in variety Suraj (10%) and also hybrid RCH2 BGII (16%)

- cerana indica foraging
- cotton flower

Field experiment to assess honeybee pollination in cotton

TOXICOLOGY

- Totally 1280 market samples of fruits, vegetables, spices, tea, rice, pulse, fish and water were analysed. Detectable level of organophosphorous and synthetic pyrethroid insecticide residues were found in okra, chilli, capsicum, brinjal, cauliflower, bitter gourd and cucumber, fruits- apple, grapes, spices- red chilli, red chilli powder, cardamom, curryleaf and tea.
- The MRL values (FSSAI /CODEX) exceeded 36 market samples consisting of four vegetables (cauliflower, capsicum, chilli, okra) and 32 cardamom samples.
- Out of 260 farm gate vegetables, six samples consisting of okra (3), brinjal (2) and lablab (1) showed residues of monocrotophos , lambda-cyhalothrin and cypermethrin exceeding FSSAI MRL.
- Supervised field trials were conducted on chilli to study the dissipation pattern of lambda cyhalothrin 5 EC and bifenthrin 10 EC (15 and 25 g.ai.ha^{-1}, respectively) during November to December, 2015 and residues of both the insecticides persisted up to 3 days.
- The waiting period worked out for chlorpyriphos 20 EC (300 g.ai.ha^{-1}) in bittergourd was 1.39 days (FSSAI MRL 0.2 mg/kg) and lambda cyhalothrin 5 EC (15 g.ai.ha^{-1}) in chilli was 3 days (FSSAI MRL 0.05 mg/kg).
- Decontamination process comprising washing under tap water for 2 minutes and cooking for 10 minutes was most effective in reducing the level of pesticide residues of chlorpyriphos 20 EC, quinalphos 25 EC, triazophos 40 EC, ethion 50 EC and carbendazim 50 WP by more than 80 per cent in cauliflower.

Insect biosystematics

- The cicada species, *Platylomia vibrans* (Cicadidae: Hemiptera) collected at HRS Thadiyankudisai and tiger moth, *Olepa schleini* in castor (Arctiinae: Eribidae) at TNAU, Coimbatore were reported for the first time in Tamil Nadu and India respectively.

Platylomia vibrans (Walker, 1855)
Cicadidae, hemiptera

Olepa schleini Witt *et al.* (2005)
(Arctiinae: Lepidoptera)

Nematode management

Plant parasitic nematodes are important pests causing severe infections resulting in reduced yields on numerous crops and can also affect consumer acceptance of many plants, including vegetables. Root knot nematodes, *Meloidogyne* spp. causes root galls and the degree of root galling generally depends on three factors: nematode population density, nematode species and race, host plant species and even cultivar. Lack of specific above ground symptoms for nematode infestation in plants makes it difficult for farmers to identify their existence in their fields and to take control measures. Prophylactic nematode management measures are ideal to keep them under check.

Emerging nematode problems in fruit crops

Major plant parasitic nematodes infesting fruit crops in Tamil Nadu

Crop		Major nematode infesting the crop
Guava	:	Meloidogyne enterolobii
Pomegranate	:	Meloidogyne incognita
Banana	:	Burrowing nematode, *Radopholus similis*, Lesion nematode, Pratylenchus coffeae

Of late, there have been incidences of sudden death of fruit trees such as guava and pomegranate in Tamil Nadu and across the country. The cause was found to be due to heavy incidence of root knot nematode, the species being *Meloidogyne enterolobii* in guava and *Meloidogyne incognita* in pomegranate. *M.enterolobii* infesting guava is a species of root knot nematode so far not encountered in India.

The trees start exhibiting yellowing and shedding of leaves within few months of planting and sometimes after 2-3 years of establishment. Such infested trees when tested for their roots, reveal several galls, very conspicuous in guava and minute in pomegranate. The nematode further paves way for the entry of a wilt causing fungus, *Fusarium* spp. which causes wilting of plants branch wise ultimately leading to complete death of the plant.

Guava and pomegranate are being propagated through grafts and ground layers. On inspection it has been found that the root stocks used for grafting, grafted materials and ground layers are infested with root knot nematode, revealing galls, harbouring several females and egg masses.

Management measures for guava and pomegranate

- Check for nematode free (gall free) planting materials
- Application of carbofuran 3 G @ 33 kg/ ha or phorate 10 G @ 10 kg per ha at the time of planting.
- 100kg of Farmyard manure /biocompost can be mixed with 1 kg of *Paecilomyces lilacinus*, kept for two three weeks with enough moisture in shade for multiplication and applied @ 500 g/kg/pit around the rhizosphere region. This may be repeated every three months.

Wilted plant of guava due to root knot nematode, *M.enterolobii*

Wilted plant of pomegranate due to root knot nematode, *M.incognita*

Roots of guava showing galling

Roots of pomegranate showing minute galls

Biomanagement of root knot nematode, *Meloidogyne hapla* in carrot

Carrot is a major root vegetable crop of The Nilgiris, Palani and Krishnagiri districts of Tamil Nadu. The root knot nematode, *Meloidogyne hapla* is the major constraint in carrot cultivation which reduces root yield up to 16 per cent. A nematode egg parasitic fungal

bioagent, *Purpureocillium lilacinum* (*Paecilomyces lilacinus*) was tested to manage the root knot nematode infesting carrot.

Application of *Purpureocillium lilacinum* as seed treatment @ 20g/kg of seed followed by soil application @ 2.5kg/ha along with FYM @ 2.5 t/ha reduced the root knot nematode population in soil by 41.8% and increased the carrot yield by 33.6 per cent compared to untreated control.

HORTICULTURE

HORTICULTURE

FOR ADOPTION

Bhendi hybrid CO 4

Bhendi is one of the important vegetable grown in Tamil Nadu for its peculiar taste and rich source of Iodine content. The major problem faced by the farmers for cultivation of bhendi is Yellow Vein Mosaic Disease and the yield loss of this disease may go upto 70 %. In order to combat the problem an attempt was made to develop high yielding F1 hybrid with resistant to this disease at the Dept. of Vegetable Crops, HC & RI, TNAU, Coimbatore from 2010 to 2012. As a result one F_1 hybrid CBhH 3 (BHD 9 x Karamadai local) was identified and tested in 12 MLT and 112 ART in 2013 and 2014 in major bhendi growing districts of Tamil Nadu. Based the results this hybrid was released as Bhendi Hybrid CO 4 for commercial cultivation during 2016.

It has resistance to yellow vein mosaic virus disease with high yield. Plants are tall and medium branched. The fruits are dark green, medium size (6.8 cm girth) and long (14-15 cm) with tapering apex. About 25-29 fruits are borne in a plant at short internodes. The fruits are having high consumer preference. Twenty two harvests can be made in duration of 110 days starting from 39 days after sowing. It recorded a yield of 25.6 t/ha. The yield increase was 19.6 % over COBhH 1 and 23.1 % over Sakthi. The crop can be grown at a spacing of 45 x 30 cm and at 30 days after sowing. It can be grown successfully during May – June, February-March and September-October under irrigated condition in all the districts of Tamil Nadu except in hilly regions of Nilgiris and Dindigul district.

Lime VRM 4

Lime VRM-1 was released during the year 2016. It is a selection from Tahiti lime introduced from Tahiti Island. The tree is moderately vigorous, medium to large (up to 4-6 m), thornless in nature, widespread branching habit. This can be easily multiplied by air layering. The fruits are big, each weighing 450 grams. It is usually seedless, rarely with one or a few non-viable seeds. The variety possess

special advantages of high yielding ability with cluster bearing habit, complete resistant to canker and leaf miner and moderately resistant to citrus butterfly. The average yield per tree/year is 69 kg. Lime VRM-1 is unique in nature for aroma. Fruits have high Ascorbic acid, Vitamin 'C' and Citric acid content. The minerals like Potassium, Calcium and Phosphorous content is 4-5 times higher than common lemon. The variety Lime VRM-1 is ideal for home garden. Fruits are ideal for juice making, pickle and cooking preparation. Lime VRM-1 can be recommended for all regions especially in drought and salt prone areas.

TECHNOLOGIES

Grafting in Brinjal

Brinjal is one of the important and popular vegetable crops grown throughout the year all over the country. The drastic yield reduction in In brinjal is due to several biotic and abiotic factors. Among the biotic factors hampering the production of brinjal, root knot nematode *Meloidogyne incognita* and dry root rot caused by *Macrophomina phaseolina* are important apart from shoot and fruit borer. Chemical control of these problems ends up with high input cost and residual toxicity. *Solanum torvum* is a close relative of brinjal posses resistance to root knot nematode and dry root rot. Hence, an attempt was made in 2009 to develop a grafting technology by using *Solanum torvum* as rootstock to overcome these problems. The studies showed that the grafting technology could be commercially adopted in brinjal by using *Solanum torvum* as rootstock with commercial variety / hybrid as scion.

Thirty days old brinjal seedlings of desirable variety/hybrid are used as scion and grafted on fifty five to sixty days old *Solanum torvum* seedlings by cleft grafting method. The grafted plants are to be placed in the mist chamber for 15 days and in the shade net for 15 days for hardening. The established grafts are to be planted in the main field at a spacing of 1.0 x 1.0 m. 10000 grafts are required for one ha. The recommended fertilizer dose of NPK @ 125:187.5:125 kg/ha has to be applied as basal and125 kg N/ha as top dressing on 30th day of planting. The crop can be retained for 6 months and after that ratooned by cutting back of main branches to 20 cm height from the base. First ratoon crop can be retained for four months. The fertilizer dose of 100:150:200 kg NPK / ha has to be applied for ratoon crop. In the same manner second ratoon crop can also be raised. The yield for hybrids in the main crop will be 70 t/ ha, first ratoon crop will be 45 t/ha and second ratoon crop will be 40 tonnes/ ha by adopting this technology.

Rapid multiplication of turmeric using single bud rhizome sprouts in protrays

Turmeric is vegetatively propagated by means of underground rhizomes. Due to unavailability of better quality and high yielding seed rhizomes to cater current requirements of the growers, the production of turmeric transplants through rapid multiplication technique is the only way to meet out the demand of seed rhizomes.

Description of the technology

Planting material	:	Finger rhizome with single bud
Seed rhizome rate	:	600 – 750 kg / ha
Media	:	Cocopeat + Pseudomonas fluorescens
Growing condition	:	50% Shade net with micro irrigation
Nursery	:	30 days

Comparison of growth on Direct planting Vs Transplanting of turmeric

Growing Phase	Direct planting method	Transplanting method (turmeric bud rhizome)
1. Sprouting phase		
	20 DAP	Plants have 3-4 leaves (1 month old)
2. Vegetative phase		
(i) One month after planting		
	2-3 leaves/plant	6-7 leaves/plant

(ii) Tillering stage

3 MAP

1½ – 2 MAP

3. Rhizome development phase

Starts from 5 MAP

Starts from 3 MAP

4. Rhizome maturation phase

7 – 9 MAP

6 – 7 MAP

Export packaging technology for jasmine flowers

Description of the technology

Jasmine buds are harvested early in the morning before 7.00 am at fully developed tight bud stage and the buds are tied into strings and cut into pieces of 30 cm length. The strings are dipped in 4% boric acid and surface dried. Five pieces of strings are packed in a small aluminium lined cardboard box of dimension 11 x 13.5 x 4 cm and further lined with butter paper. Twenty four such boxes are in turn packed in a larger thermocole box of dimension 60 x 45 x 30 cm lined with aluminium foil (in 3 layers with 8 boxes per layer) and ice gel sheets are placed in between each layer and the top layer is covered with aluminium foil. The boxes are closed and covered with brown sealing tape after which the packages can be airlifted.

Benefits of the export packaging technology based on impact assessment

- Shelf life of flowers increased to 72 hours against 36 hours in normal packaging system
- Use of gel ice sheets in the place of shredded ice reduced the weight and volume of the packages, besides maintenance of low temperatures within the package (4^0C during packaging and 16^0C during unpacking at destination) and uniform distribution of chillness and moisture in the packs helps in increasing the shelf life of flowers.
- Post harvest losses were reduced from 40% to 10%

Pre release culture

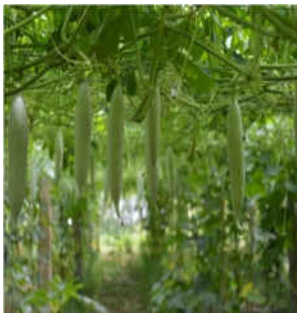
Banana hybrid H – 212

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 sigatako 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 with minimum or 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 26^0 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 and also fit into organic production system.

Snake Gourd CSgH 1

CSgH1 snake gourd is a F_1 hybrid of Kethanur Short x CO 2. This hybrid fruits have very good demand in the market due to its high consumer preference. It produces short fruits with an average length of 33.5cm, girth of 27.6 cm and weight of 380g. The fruits are

fleshy, attractive greenish white with white streaks and good cooking quality. This hybrid yields for a longer period and the fruits could be harvested for 14-15 times in 6 months duration. Due to its extended harvest a single plant yields 54.00 fruits with an average yield of 24.22 kg/plant. This hybrid proved its superiority with an estimated yield of 57.27 t/ha which was 36 % increase over the check hybrid (BSS 694). This hybrid showed consistent performance in Multi location Trial I, Multi location Trial II and Adaptive Research trials.



Salad Bottle Gourd LS 6-1

Bottle gourd is water rich vegetable and is preferred for its low calorific value. The identified culture LS 6-1 is suitable for preparation of salads because of mild sweet taste, and odorless nature and also suitable for juice preparation. It yields 39t/ha with 28% yield advantage over a local type LS26-3 (30.5 t/ha). It yields 12-13 fruits per vine and the first harvest begins in 55 days and it can be harvested 8-10 days after pollination. This culture can also be used as vegetable. The culture was tested under MLT during 2014-2016 and found promising. The culture was tested under ART during 2015-16 and yielded 29 t/ha with 26% increased yield over check. The culture is found to be rich in potassium content.


Salad Bottle Gourd LS 6-1

Amranthus (Sirukeerai) AP 12

Sirukeerai is preferred for its delicious nature and for its nutritious qualities due to presence of Fe and Vitamin A. Earlier released variety of Sirukkeerai (PLR 1) is harvested at one time. Amaranthus (Sirukeerai) culture AP 12 is highly suitable for both single harvest and multiple clipping/cutting. It yields 11.0 t/ha with 30% increased yield over PLR1 (8.5

t/ha) during single harvesting. Harvesting at an interval of 10 days produced higher biomass and yield. The yield levels of AP12 in multiple harvest (cutting) increases to more than twice (25-35t) than that of PLR1 (10-15 t/ha). The culture AP12 has recorded resistance to white rust. Hence, this accession can be best exploited for getting multiple yields from single crop. The culture was tested under MLT during 2014-15 and ART during 2015-16 and found promising.

French Bean FBP 5

French bean is one of the most important vegetable crop grown in mid and high elevations of Tamil Nadu. Both bush type and pole type french beans are cultivated in Tamil Nadu. Bush bean types are evaluated at HRS, Ooty for high yield and quality. Among the bush bean types, accession number FBP-5 was identified as high yielding type. It is a pure line selection from Thoothoormattam village. It yields throughout the year. Pods are shiny, less fibrous. Pod yield is 1.65 kg/plant with pod length of 19.08 cm and pod weight of 20.4 g/pod. The pod yield produced per ha is 39.80 t/ha. The protein content of the pods is 1.51 %, carotene content 1.92 ug /mg and the antioxidant activity is 2625 µg / gm. Total crop duration 108 days.

Leafy Coriander CS 38

Varieties in pipeline	:	High leaf yielding coriander culture CS 38
Parentage	:	Selection from germplasm UD 435 from Jaipur
Leaf yield	:	4238 kg/ha
Essential oil	:	0.036%
Duration	:	38 to 45 days
Salient features	:	Profuse branching, Field tolerant to wilt diseases

Technologies under OFT

Effect of salicylic acid on growth and yield of Onion

The area under common onion or bellary onion cultivation in Tamil Nadu is very less compared to small onion. In order to develop technologies for common onion cultivation an attempt was undertaken to study the effect of salicylic acid growth and yield of common onion cv. ALR. Foliar application of Salicylic Acid @ 250 mg/l at 30 DAS, II spray at 30 DAT & III spray at 45 DAT recorded the highest marketable yield of 24.8 t/ha and BC ratio of 3.18.

Standardization of Rapid Multiplication Technique (RMT) for cassava through protray system

Planting materials produced from protrays

Cassava (*Manihot esculenta* Crantz.) is vegetatively propagated through stem cuttings (setts). A mature plant with two stems will give about 12 to 20 normal sized (20 cm) setts after one year *i.e.,* the propagation rate is 12 to 20 times per year. Farmers are practicing 8-10 cm setts from the mature part of stem.

Cassava is highly susceptible to cassava mosaic disease (CMD) and disease spreads through infected setts and transmitted by white flies. In the new rapid multiplication technique, tagging disease free plants and using them for propagation offers reliable solution to manage the disease as lesser quantity of setts are only required under Rapid Multiplication Technique (RMT) of cassava.

In tapioca YTP 1, under Rapid Multiplication Technique (RMT), the sprouting percentage (98.00), number of roots (10.3), length of roots (33.20 cm) and yield plant^{-1} (7.92 kg) was maximum in cocopeat + *Pseudomonas* + chip bud/single bud.

Response of Tapioca on different levels of potassium in relation to tuber yield and starch content

Cassava is an important tuber crop respond well to the application of organic manures and inorganic fertilizers. Being a tuberous crops it is necessary to study the effect of soil test crop response based fertilizer recommendations through various sources of

organic manures (STCR-IPNS) on the growth and yield of Cassava besides the post-harvest soil fertility as influenced by the adoption of STCR-IPNS ecommendations.

STCR based fertilizer application along with composted poultry manure @ 10 t ha^{-1} recorded maximum tuber yield of 42.50 t ha^{-1} under yield target of 40 t ha^{-1} and 49.70 t ha^{-1} under yield target of 50 t ha^{-1}. The maximum starch content (26.9%) was recorded in STCR-IPNS (Composted Poultry Manure @ 10 t ha^{-1}) for yield target I (40 t ha^{-1}) followed by STCR-IPNS (Composted Poultry Manure @ 10 t ha^{-1}) for yield target (50 t ha^{-1}) (25.4%).

Response of tapioca for potassium

Ultra high density planting system of cashew var. VRI-3

High density planting is a modern method of cultivation of perennial horticultural trees involving dense planting of trees, using trees/varieties which are modified for canopy for better light interception, precocious cropping, regular high yields of good quality fruits. As the value of land is increasing, the available land for cultivation is decreasing, high density plantation is a very important and effective venture as great amount of fruit bearing volume per hectare would be attained at early years. Higher planting density produces higher level of photosynthetic active radiation with high leaf area index and better utilization of the available solar radiation.

The technology “Ultra-high density planting system in cashew” consisted of planting 1200 to 1666 plants per hectare combined with canopy management, foliar spray and drip fertigation to double/triple the nut yield. A novel technology has been standardized in cashew by planting grafts at 4 x 2 m or 3 x 2 m to accommodate 1200 plants and 1666 plants per hectare respectively. Training of plants up to six months after planting to contain in the provided space was essential. Training consisted of removal of sprouts in the grafts up to 75 cm from the ground level, followed by formative pruning to develop 2-3 primary branches, 4-5 secondary branches and 5-6 tertiary branches/secondary branch. The plants put forth flowering at 12 months of planting.

A nut yield of 250 kg/ha recorded from one year old plants. The plants were pruned during second week of July (tertiary branch pruning) to induce current season's shoot production. Drip irrigation was given daily @ 8 l/day for first one month, 16 l/day at alternate days from 6-8 months, 32 l/day once in 4 days from 8-12 months (except rainy days). Liquid fertilizers given in two splits (July and November) to supplement the recommended dose of 225:75:75 kg/ha. Foliar spray schedule was given as per recommendation and treatments. Increase in number of current season's shoots and number of flower panicles has doubled the yield. Actual yield per unit area recorded from two year old plants was 170 kg/0.35 acre in 3 x 2 m and 200 kg /0.35 acre in 4 x 2 m (compared to 81.2 kg/0.35 acre in 7 x 7 m and 112.5 kg/0.35 acre in 5 x 4 m). Estimated yield was 1275 kg/ha in 3 x 2 m, 1500 kg/ha in 4 x 2 m (compared to 609 kg/ha in 7 x 7 m).

Ultra High Density 2 years old

Plants ready for pruning during July

Pruned field

Flowering and nut set after pruning

Flowering in 5 year old VRI-3 UHDP

Flowering in 5 year old VRI-3 UHDP

Optimization of fertigation schedule for tuberose (*Polianthes tuberosa* L) cv. Prajwal

Drip irrigation with 125 per cent WRc and fertigation at 100 per cent WSF with mulch was found superior and resulted in:

Earliest spike emergence (75.66 days)

Highest flower yield plant^{-1} (0.593 kg)

Highest flower yield plot^{-1}(17.13 kg)

Highest estimated flower yield ha^{-1} (17.59 t).

Maximum water saving : 674.10 mm = (34 %)

Longer shelf life: 2.92 days under room temperature & 7.46 days under refrigeration

Efficacy of media incorporated with Pusa hydrogel on growth and production of quality foliage plants

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

AGRICULTURAL ENGINEERING

AGRICULTURAL ENGINEERING

FOR ADOPTION

Tamarind Deseeder

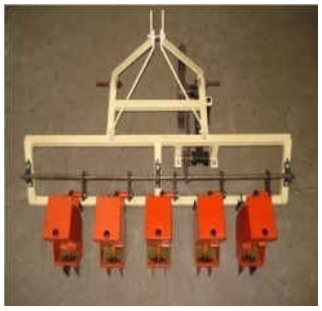
- Suitable for deseeding dried dehulled tamarind fruits
- Various sizes of the dehulled tamarind fruits can be deseeded
- The roller gap can be adjusted as per the size of the tamarind fruits
- The deseeded fruits are separated into pulp strip, seeds and broken pieces
- The cost of the unit : Rs.60,000/-
- Cost of operation : Rs. 2.5 /kg
- Capacity of the machine : 40 kg/h

Double chamber centrifugal de-huller for millets

- De-hulling of small millets (little millet, proso millet, foxtail millet, barnyard millet and kodo millet) using the newly designed double chamber centrifugal de-huller results in the removal of husk without any damage to the bran and endosperm.
- De-huller consists of feed hopper, two centrifugal chambers made of cast iron, impellers with curved vanes, blower and separate outlets for collecting kernel and husk.
- De-huller has the capacity of removing husk from 300 kg of grains in one hour with 95% efficiency and requires only one person to operate the machine.
- The unit is powered by 5 HP motor with suitable power transmission system and one unit cost is about Rs.1,20,000/-

Tractor drawn precision pulse seeder

A saving of 19.1 and 97.0 percent in cost and time of opération respectively compared with conventional method of sowing



- Results in 40 percent saving in seed rate when compared to conventional method of sowing
- Recommended hill to hill spacing (10 cm) is maintained
- The capacity of the unit : one hectare per day
- Suitable for sowing black gram and green gram
- The cost of the unit : Rs.50,000/-

Production of ready to eat milky mushroom curry in retortable pouches

Mushrooms are gaining increasing acceptance from the consumers in recent years. As they are highly perishable owing to high respiration, they are currently packaged in polythene bags with perforations. Even then their shelf life is very short, of the order of 1-2 days.

Processed forms are frozen, dried and canned mushrooms. But in these forms, undesirable flavours are imparted onto the products and they are less appealing to the consumers, Retort processing was considered to package mushroom in the form of readu to eat. An attempt was made to prepare mushroom curry was retort packaged.

Pre-cooked mushroom pieces (35 x 10x 10 mm) in gravy were packed in retort pouch (250g) and were hermetically sealed using a high pressure impulse sealer and processed in a retort. The packaged and retort processed milky mushroom curry samples were stored at room temperature of 28 ± 2°C, 55 ± 10 % RH for 240 days.

Sensory evaluation showed that the overall acceptability of milky mushroom curry was good after 240 days of storage. The cost of production of 250 g of ready to eat milky mushroom curry in retort pouch was Rs.36/- per pouch.

Biomass based hybrid drying system

TNAU has developed Biomass based hybrid drying system for drying various agro-products. Solar tunnel dryers are used for drying of coconut, chillies, medicinal plants and some food products.

This dryer consists of a semi-cylindrical tunnel structure and black coated cement concrete floor as absorber surface. It has trolley type loading and unloading of the produce.

Specifications

Capacity	: 0.5 to 2.0 tonne per batch
Dimensions	: 18.0 x 3.75 x 2.0 m
Material of Make	: GI pipe and LDPE Polyethelene sheet
Cost of the Unit	: 7.5 lakhs

As the produces can not be dried continuously in the solar tunnel dryer during night hours and rainy days, a backup heating system was necessary. Hence a biomass based hybrid drying system was developed and augmented to the solar tunnel dryer.

Biomass hot air generator consists of a biomass combustion system, and a shell and tube design heat exchanger. The flue gas moves through the heat exchanger shell and the fresh air flows through the pipes of the heat exchanger in cross flow pattern. The hot air is introduced through the drying chamber (trolley) and the moisture-laden air is sent out

through chimney. The dried products is of superior quality than open-sun drying. Its drying time varies from 40-60 % and saving in cost of drying is 60 %.

Turmeric dried in Hybrid Solar – Biomass dryer

Biomass based hybrid drying system

Downdraft gasifier system for thermal applications and water pumping

TNAU has designed a down draft gasifier (capacity : 50000 kcal / h) to generate producer gas from wood wastes of fast growing species (*Acacia, Prosopis* and *Casuarina*). This gasifier can be used for medium thermal applications in industries such as rice mills, turmeric processing etc.

Specifications

Material	:	Stainless steel
Diameter of the reactor	:	630 mm
Total height of the Reactor	:	1200 mm
Feed rate	:	15 - 20 kg/h
Overall efficiency	:	40 %.
Thermal output	:	50000 kcal /h
Gas flow rate	:	50 m^3 / h
Fuel Savings	:	65% (Firewood boiler)
		79% (Diesel boiler)
		82% (Electricity boiler)
Cost of the unit	:	1.5 lakhs

Downdraft Gasifier for Thermal Applications

Gasifier- Water Pumping

The producer gas obtained from the gasifier was used to run 5hp diesel engine to pump water at 5m head and discharge of 16M^3/h. A diesel saving of 60% under dual fuel mode was achieved.

FOR ON FARM TRIALS

Self propelled groundnut combine

A self propelled groundnut combine harvester was developed for harvesting, threshing and collection of groundnut pods in a single pass. The main components of the combine are engine, chassis, power transmission, digging assembly, gathering system, chain conveying system, stripping system, pod collecting system and cleaning system.

The self propelled groundnut combine is suitable for crop grown on ridges and furrow system of planting and also for raised bed system of planting. It was found that the harvesting efficiency, conveying efficiency and stripping efficiency were 96, 96 and 97 percentage respectively. The field coverage of groundnut combine was recorded as 0.05 ha/h.

Tractor drawn semi automatic vegetable transplanter

A tractor operated two row semi automatic transplanter is used for transplanting tomato, chilly and brinjal seedlings raised in protrays. The transplanter consists of a main frame with hitching system, ground wheel, furrow opener, compaction wheel, metering systems and depth control wheels. Two racks are provided for holding eight protrays at a time.

The seedling metering system consists of ground wheel, gear box and two discs. The seedlings are carried by pockets on a rotating cartridge, released into the seed tube and deposited into the furrow. The picking and placing of the seedling from the seed tray into the seedling cavities is done manually. Furrow openers are provided to open the furrow and two sets of press wheels are provided to compact the soil around the seedlings and firm them up in an erect position. The transplanter was tested for

planting chilly, tomato and brinjal seedlings grown in protrays. The field capacity of the transplanter was 0.14 ha h^{-1} at 75 per cent field efficiency.

Safety kit for spraying operation

An investigation of different personal protection devices for spraying operation was done. Based on the studies conducted, a safety kit was developed. This consisted of hand gloves, eye protectors, mask and apron, which were identified according to their efficiency in providing protection to the operator.

Face mask: The filtering material of double layer polypropylene was selected as filter for face mask as it filtered 74% of the inhalable chemicals. The mask also has water repellent quality.

Hand gloves: Hand gloves made of PVC material was recommended as it provided better gripping comfort and was not affected by acids and alkali solutions. It was found to be safe for hand and skin.

Apron: Based on pesticide penetration tests, selected fabrics apron made of water proof polyester is recommended as personal protection equipment for spraying operation. The penetration of chemical through the apron was within tolerable limits.

On-line grading system for mango

India is one of the leading producers and exporters of mango. Significant foreign exchange is earned through export of mango pulp. Mango grading and quality inspection are currently done manually and requires skilled manpower at high cost. The available mechanical on-line grading systems are based on only size. Grading based on the internal quality parameters is a promising venture and has gained support from producers, processors and consumers in the recent years. Hence a machine vision based system which could grade the commodities based on quality parameters can be substituted in place of manual system for grading. A machine vision based system to grade the mangoes based on internal and external quality has been developed.

Colour images of mango fruits namely Alphonso, Banganapalli and Neelam mangoes were captured in a shade free image chamber using machine vision camera during the course of ripening.Then physico-chemical, textural and colour properties of three varieties of mangoes were observed throughout the ripening period till decay. Based on the observed physico-chemical properties, external colour values and textural characteristics, the ripening period of each mango variety was classified into five stages viz. unripe, early ripe, partially ripe, ripe, over ripe/decay during ripening.

A machine vision algorithm was developed with two inputs using fuzzy logic to grade the mango fruits based on internal and external quality. Fruit size was selected as an external quality parameter and ripeness level was selected as internal quality parameter.

An online machine was developed with the capability of separating the mango fruits into five grades using the developed machine vision algorithm. Based on the performance evaluation of the machine, effectiveness of 98.6% was observed in Alphonso, followed by 96% for Banganapalli and 93.33% for Neelam mango. The capacity of the machine is 620 to 650 fruits/h (approx. about 200-300 kg/h). The cost of operation for machine was calculated as Rs.0.60 per kg of fruits, compared to the cost of manual grading of Rs. 2.60 per kg of fruits.

Preservation of Tender Coconut Water

Tender coconut water is one of the nature's most refreshing drinks, consumed worldwide for its nutritious and health benefiting properties. Each coconut may contain about 200 to 400 ml of water depending upon cultivar type and size. Raw tender coconuts can be kept at room temperature for about 5 days. It is composed of sugars, vitamins, minerals, electrolytes, enzymes, amino acids, cytokine, and phyto-hormones.

Tender coconut water extracted from young coconut appears to be a sterile sweet clear liquid. Once opened, its liquid soon turns sour and off-flavored due to intense enzymatic activity. Tender coconut water is very sensitive to biological and chemical changes.

A Process has been developed to enhance the shelf life of tender coconut water at Post Harvest Technology Center, Tamil Nadu Agricultural University Coimbatore. The process involves collection of tender coconut water under hygienic conditions, standardization, filtration, pasteurization, and packaging in bottles.The shelf life of processed tender coconut water at ambient storage conditions is 3 months.

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

Moringa has been cultivated only for drumstick (Vegetable purpose). The leaves have not been used much for product development. Moringa leaves have great contribution as food and medicinal uses. Now a day's many of us have been attracted by herbal and health oriented foods and moringa leaves are available in plenty. So value added products from moringa leaf based products have commercial utility.

Commercially viable value added products form moringa leaves were developed by using standard technologies. A suitable drying technique for moringa leaves have been developed with maximum retention of β-carotene (14.31 mg), calcium (2003 mg) and iron (26 mg). The dried samples could be stored at ambient temperature in MPP packaging for a period of six months. By using dried leaves and powder, different value added products

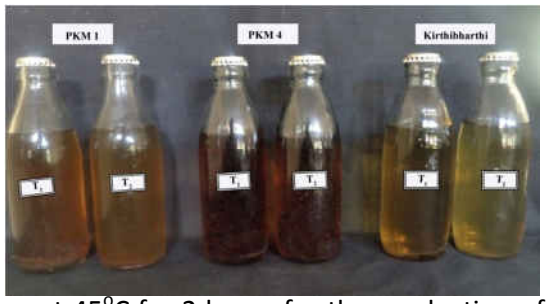
were tried. The products developed were soup mix, rice mix, pickle and spiced products etc., suitable for domestic and export market. Nutrient analysis of the products prepared from the fresh and dried moringa leaves have shown that there is an increase in the β-carotene, calcium, iron and crude fibre. The developed technology was transferred through training programmes and entrepreneurs are at present adopting the viable technologies. The cost of the different moringa products were within the range of Rs.150-200/kg.

Moringa pickle

Moringa products

Development and standardization of sapota Ready To Serve (RTS) to improve the economic status of sapota farmers

A technology for processing of sapota fruits into value added products such as juice which has huge market potential has been standardized. Tamil Nadu stands fourth and its contribution is 17 % (0.24 MT) of the total sapota production in our county. It is therefore necessary to utilize the fruits for making different products to increase its availability over an extended period and to increase the livelihood of the farmers.



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

Millet Fruit Bar

Snacks have not been regarded as true foods and their nutritive value has been scarcely emphasized. Because of the growing consumer demand for healthy, natural and convenient foods, attempts were made to produce natural snacks with high fiber, calorie and protein. One of the promising snack item that could be developed using millets is millet bars. Whole puffed sorghum (35 g), flaked and gritted bajra (7.5 g) and finger millet (7.5 g) grits were utilized for producing an acceptable millet bar. To enhance the nutrient content in terms of protein and fat roasted whole bengal gram(30 g), roasted and peanut grits (10g) were incorporated in the millet bar. The palatability and nutrient content of the millet bar was further improved by adding intermediate moisture fruit product – mango leather (10g). Jaggery syrup in hard crack stage yielded a good texture to the product. The product had high energy of 137 kcal, protein 3.65, iron – 1.73 mg%, calcium – 35.15 mg% and β carotene – 54.68 µg% per serving (25 g). The product packed in metalized polypropylene pouch has a shelf life of 6 months. An acceptable, healthy snack bar can be prepared using low cost millet products and fruits. A variety of millet fruit bars can be produced by varying the fruit bars, nuts and chocolate thus varying the flavours. The cost of fruit bar is Rs. 10.69 / 25 g.

FORESTRY

FORESTRY

FOR ON FARM TESTING

Promising Progeny in Annatto (*Bixa orellana)*

No. of Genotypes advanced	12
Locations (3)	HC&RI, Periyakulam, Namakkal, Thirumayam
No. of years of evaluation	2 years
Promising genotype	MTPBi 1
Seed Yield	0.63 kg/ tree
Seed Yield	0.699 tonnes/ha

Superior clone in *Melia dubia*

Melia dubia is a fast growing medium density species amenable for paper, veneer and plywood production. Hence improvement programme has been carried out during the last 8 years deploying 20 genetic resources selected from across the country. Among these, FCRIMD 15 has been identified as a potential clone amenable for short duration harvest and utilizable exclusively for paper industry. The salient features of the variety is furnished below.

- Clonal selection - FCRI MD15
- Rotation - 2 Years
- Yield - 60 tonnes
- Plant density - 1200 / acre

Quality parameters

- Pulp yield - 52.1%
- Acid insoluble lignin - 21.8%
- Hollocellulose - 74.5%
- Kappa number - 19.6
- Tear index - 10.2 mNm2g-1
- Tensile index - 87 Nmg-1
- Burst index - 5.9 K Pa m2 g-1

Casuarina Improvement Programme

Casuarina improvement programme is carried out during the last six years in order to identify superior clone to replace the existing varieties. Accordingly, 27 clones have been evaluated and among them the superiority of clone CJ27 has been witnessed and the salient features are furnished.

- Promising clone - CJ 27
- Wood Yield - 160 – 240 tonnes / ha
- Rotation - 36 Months
- Wood Density - 470 kg/m3
- Pulp yield - 45-47 %
- Kappa number- 21-23



Subabul

Subabul has been identified as the one of the fast growing species amenable for short rotation and suitable for pulp and paper and biomass power industries as a source of raw material. However, there is no released variety in this species and hence tree improvement programme has been initiated in the year 2008 using 20 superior progenies. Among them, the superiority of the progeny FCRILL 15 has been evidenced. The salient features of the variety are furnished.

- Promising genotype - FCRILL 15
- Yield - 125 tonnes / ha
- Rotation - 3 years
- Plant Density - 1770 / acre
- Pulp yield - 44-46%
- Kappa number - 22-24%
- Calorific value - 3800 - 4200 Kcal

Casuarina hybrid clone

An Interspecific hybrid between *Casuarina equisetifolia* and *Casuarina junghuhniana* has resulted in successful hybrids. The early evaluation of F1 progenies identified superiority of one hybrid clone which needs to be tested through amplified test programme.

Promising genotype - Hybrid clone 7 (C.e X C.j)

No. of location - 3

Anthocephalus cadamba

The cadam improvement programme has identified one superior progeny (cadam 13) which expressed higher volume coupled with acceptable wood properties for match and plywood utility.

- Promising Genotype - FCRI AC 12
- No. of location - 3
- Density - 0.60 g/cm^3
- Tensile strength - 840 kg/cm
- Bending strength - 421 kg/cm
- Nail holding - 640 kg
- Splints recovery - 16500 / kg

FOR INFORMATION

Promising Progeny in Annatto (*Bixa orellana)*

No. of Genotypes advanced	12
Locations(3)	HC&RI, Periyakulam, Namakkal, Thirumayam
No. of years of evaluation	2 years
Promising genotype	MTPBi 2

Seed Yield	0.53 kg/ tree
Seed Yield	0.588 tonnes/ha

Fertigation scheduling for Fast growing trees

Fertigation through drip irrigation system under red soil condition is standardized for fast growing trees like *Neolomarkia cadamba* and *Acrocarpus fraxinifolius* during initial growth period.

Fertigation schedule

Basal application of 100 kg P_2O_5 ha^{-1} with Fertigation of 150 kg N ha-1 and 100 kg K_2O ha^{-1} recorded maximum height and basal diameter.

Irrigation schedule

During summer, water requirement is 3.70 l / tree / day at 100% PE of 10.50 mm/ day

- During winter, water requirement is 1.40 l / tree / day at 100% PE of 4 mm / day

Spacing

The trees are planted in 2mX2m spacing, pit size 2ftX 2ft

Gum production from Tamarind kernel powder (TKP)

Tamarind kernel powder(TKP) obtained from the decorticated seeds of tamarind is used for production of gum for various industrial utility (both edible and non edible).

Roasting of seeds

Uniform roasting with sand media or roaster for a period of ten minutes gives 98 % decortication without browning in the kernel. This roasting gives creamy white tamarind kernel powder which is the most suited colour for gum preparation.

Gum extraction

Powder slurry (1:10 ratio of powder (TKP) and water) using spray dryer gives yield of 10 % creamy white polysaccharide (gum)

SOCIAL SCIENCES

SOCIAL SCIENCES

Price forecasting

DEMIC (Domestic and Export Marketing Intelligence Cell) operating in the CARDS is (i) providing price forecasts well in advance of sowing as well as before harvesting of major agricultural commodities, other market intelligence such as product qualities, high price markets for different commodities, (ii) dissemination of the above market intelligence through different mass media and (iii) training the farmers and officials of agricultural departments in various states in the use of above intelligence.

Time series data on the commodity prices of the mandatory crops are collected from the representative regulated markets and *Uzhavar sandhais*. The price forecasts generated are validated by conducting market survey, referring global commodity outlooks and comparing commodity futures market. After validation, the generated forecasts with minimum standard error are once again verified with the inputs of commodity market survey. DEMIC price forecasts are then made before sowing season / before harvest of crops and finally disseminated through both print and electronic media such as e-mails, SMS, T.V., Radio, Newspapers in English and Tamil (Regional Language), Agricultural magazines, Regulated markets, KVKs, Agricultural Department officials, etc.

During 2014-15, 23 advisories on pre- sowing and 39 advisories on pre-harvesting for the Cereals (Maize, Sorghum, pearl millet, Ragi), Pulses (Black gram, Green gram, Bengal gram), Oil seeds (Groundnut, Sunflower, Sesame), Plantation crop (Coconut (fresh and Copra)), Fibre crop (Cotton), Vegetables (Potato, Tomato, Small Onion, Brinjal, *Bhendi*, Tapioca, Carrot, Beetroot), Fruit (Banana cultivars *viz., Poovan, Nendran, Karpooravalli*), and Spices (Coriander, Turmeric, Red Chillies) were provided.

During 2015-16, 12 advisories on pre-sowing and 15 advisories on pre - harvesting were generated. An analysis on validation of forecast price considering actual price for the commodities revealed that the validation was more than 90 per cent.

Value chain analysis of rice

The study was conducted in Thanjavur, Pudukkottai and Coimbatore Districts of Tamil Nadu to identify the map of the existing rice value chain, value addition processes in rice, marketing efficiency and changes in consumer preferences towards branded rice and processed rice products. The value chain was traced for two varieties of paddy such as ADT 37 and BPT and for commodities such as branded rice and rice bran oil.

In the study area, there were five marketing channels. However, Producer – Rice miller - Consumer marketing channel was found to be more efficient, where the farmers' share in consumer rupee was 64 % in ADT 37 and 63 % for BPT 5204 rice varieties.

Paddy value chain analysis indicated that there was not much value addition at the farm level and the value addition begins from the rice miller. Enhanced value chain model facilitates reduction in number of intermediaries and more value addition was made through the adoption of production and post-harvest technologies. New interventions in rice value chain such as efficient milling machineries, Solvent extraction unit for Rice Bran Refined Oil (RBRO) and small scale processing units for broken rice to produce rice flour could be made.

Value addition in rice enhanced the profit from Rs.12,128 to Rs.19,536 per tonne in ADT37 and from Rs.14428 to Rs.21326 per tonne in BPT 5204, i.e., the farmers could realize a profit of Rs.7,408 per tonne in ADT 37 and Rs.6,898 per tonne in BPT 5204. Enhanced value chain model will benefit all the stake holders of paddy value chain.

On an average, 76 % and 91 % of the consumers were willing to pay more than the un branded rice and rice bran oil, respectively.

Efficiency of mango production and marketing and feasibility of establishing mango processing units

The study was conducted in Virudhunagar District. Owner operated mango farms were found predominant in the study area. Rajapalayam *sappatai* and *Panchavarnum* were the predominant varieties grown and the other varieties cultivated in the area were *Palamani* and *Neelum*.

Area under mango in Virudhunagar district had increased at the rate of 6.18 per cent per annum and the productivity declined by 2.53 per cent per annum and the increase in area was found offsetting the decrease in productivity and this in turn added to the production by 3.51 per cent per annum. Mango production in this district could be sustained only by maintaining its productivity.

Absence of suitable high volume sprayer for covering the canopy of the trees, incidence of fruit fly and sooty mould were the constraints in mango farms. Organizing mango growers' marketing society was the prime need for farmers in Virudhunagar district followed by the need for the establishment of common ripening chambers, provision of sprayers at subsidized rates, establishment of co- operatives to provide implements for intercultural operations for mango on hire basis, establishment of pack house, and provision of long term loan for deepening of the existing wells.

Developing computer based model for impact assessment of watershed development

The study was conducted in two watersheds in Coimbatore district to develop measurement methodologies for impact assessment of watershed development, to develop user friendly and interactive computer based model for impact assessment of watershed development, and to build capacity among the officials and researchers involved in watershed development in Tamil Nadu through organizing training cum workshops. Computer based interactive model namely, WatDIMP, was developed for impact assessment of watershed development. 96 officers of TAWDEVA, DWDA and NGOs were

trained under Capacity building training programme. Training manual on Impact Assessment of Watershed Development Programmes was also prepared.

Impact evaluation on irrigation projects in Tamil Nadu

In order to assess the impacts of irrigation development supported under Rural Infrastructure Development Fund (RIDF), various indicators were developed under five broad categories viz., (i) bio-physical, (ii) environmental, (iii) socio-economic, (iv) overall and (v) institutional indicators. A total of 21 irrigation projects spread across 11 districts of Tamil Nadu state has been selected for the study.

The research revealed that, after the project activities under NABARD, there were significant impacts in terms of reduction in leakages of water, improvement in the capacity of the irrigation system to supply adequate water to tail end areas, increasing groundwater recharge, improvement in flood protection benefits, increasing domestic use and improvement in public transport.

Increase in yield of crops, particularly, in rice has been observed in Erode district where the increase in rice yield varies from five per cent in head and middle reach to nine per cent in tail region. In Dindigul district, the increase in rice yield varies from one per cent in head and middle reach to eight per cent in tail region.

Increased access to irrigation helped to achieve crop diversification and changes in cropping pattern. In Erode district, small changes in cropping pattern, i.e., a four per cent increase in banana area and 2 per cent increase in sugarcane area were observed in tail region of the irrigation system.

Increased water supply due to the intervention helped to expand cropped area. In Madurai district, the rehabilitation of *Kondamari Odai* resulted in the expansion of cropped area of 814 hectares.

The project activities also helped to increase groundwater recharge, increased water level in the wells etc. However, there are also negative externalities caused in terms of reduction in groundwater recharge. This is particularly seen in the areas where canal lining has been done. It has been observed that in Dindigul district, the farmers experienced that after construction of the canal, there has been decline in groundwater. The other important benefit from the activities is *flood protection benefits*. In Madurai district, before the construction of the retaining wall in *Kondamari Odai*, a flood during 2005 has caused severe damage of crops. An area of around 17 hectares was completely damaged at Paravai village. The crops like rice and banana were completely washed out and farmers incurred huge loss. Now the construction of retaining wall helped to prevent damages from the floods.

It has been indicated by many stakeholders like officials of Water Resources Department, farmers and WUAs that the funding support from NABARD was adequate and very much beneficial to the society. However, adequate maintenance fund was lacking and it has been suggested by different stakeholders that sufficient amount of funds may be

allocated for meeting expenditure towards management and maintenance of structures. This may be allotted even at the time of sanctioning of the project.

District Human Development Report (DHDR) for Coimbatore district

District Human Development Report (DHDR) for Coimbatore district was prepared by computing the following indices viz., Human Development Index (HDI), Child Development Index (CDI), Gender Inequality Index (GII) and Multi Dimensional Poverty Index (MPI). The study results revealed that HDI is low in Anamalai, Sulthanpet, Annur, Kinathukadavu and Thondamuthur blocks and hence, priority attention is needed in reducing the IMR and MMR in Anamalai and Thondamuthur blocks. Gender inequality is high in Perianaickanpalayam, Madukarai, Thondamuthur, Sulur and Anaimalai. Child development index is high in Anaimalai, Perianaickanpalayam, Thondamuthur, Annur and Pollachi North. Multi-dimensional poverty is high in Sulthanpet, Anaimalai, Thondamuthur, Annur and Karamadai. The study suggested that (i) targeted approach for poverty alleviation through special schemes is necessary in Sulthanpet, Anaimalai and Thondamuthur blocks, (ii) Women empowerment programmes and women worker participation rates should get special emphasis in Anaimalai, Sulthanpet and Annur blocks of Coimbatore district, (iii) Focused and priority attention is needed in Anaimalai block to address infant mortality rate, under five mortality rate, malnourishment of children and maternal mortality rate.

An economic analysis of peri- urban horticulture

The study was conducted in Peri- Urban areas, *viz.,* Thondamuthur, Madukkarai and Karamadai blocks of Coimbatore district with the objective of estimating cost and returns of major crops.

Net returns realized per ha of banana were Rs.4,17,229, Rs.3,41,861 and Rs. 333511 in Thondamuthur, Madukkarai and Karamadai, respectively. The net return per hectare was the highest for onion in Thondamuthur with Rs.81,175. The net return obtained from tomato was Rs.72,025, Rs.73,282 and Rs.83,437 in Thondamuthur, Madukkarai and Karamadai, respectively. The net return obtained from gourds was the highest in Madukkarai and Karamadai with Rs.77,770 and Rs. 86,418, respectively. For curry leaves and jathimalli, net returns were Rs.1,04,654 and Rs.4,20,133.

An economic analysis of production and marketing of tapioca

The study was conducted in Salem district, where the farmers adopted different tapioca varieties namely H226, MVD1 (Mulluvadi 1), Sreejaya, YTP 1 (Yethapur 1), Vellai bontha and kunguma rose. The average yield obtained was 35.25 tonnes in case of drip irrigation system and in furrow and rain fed production system, it was 29.95 tonnes and 26.12 tonnes respectively. The net returns from drip irrigated, furrow irrigated and rain fed methods was Rs.35,738, Rs.18,169 and Rs.8541 respectively. Two major marketing channels for tapioca were identified in the district. After harvest, the tapioca growers sold their tubers to the processing units to convert into starch or sago. After processing into starch or sago they are transported to the sago serve. From there, starch or sago is auctioned and

sold to dealers from northern states. The channel I consists of producer – processor – sago serve. The price spread in channel I for starch and sago are Rs. 370.74 and Rs. 410.74 respectively.

Economic analysis of sugarcane cultivation under conventional and Sustainable Sugarcane Initiative (SSI) methods

The study was undertaken in Villupuram and Trichy districts to examine the economics of sugarcane cultivation under conventional and SSI method, factors responsible for productivity changes with SSI technology and constraints faced in sugarcane production. Among the districts, Villupuram, Thiruvannamalai, Erode and Pudukottai districts in Tamil Nadu recorded higher growth in both area and production over a period of 43 years from 1971-72 to 2012-13. The cost of cultivation per ha was Rs.1,79,008 and Rs.2,07,169 under conventional and SSI methods respectively.

The total cost of sugarcane production was lower (Rs.1325 ha) in SSI methods as compared to that of conventional method (Rs.1434 ha). It was due to higher cane yield under SSI technology (128.5 t/ha) than that of conventional method (102.5) and hence higher net return was realized under SSI method. An increase in productivity under SSI technology over conventional method was 24.41 per cent which was mainly due to higher input use (20.49 percent). Education and experience had the positive influence on willingness of adoption of SSI technology in sugarcane cultivation. Low price paid by sugar factory, labour shortage and damage by wild animals were the major constraints faced by farmers.

Implications of tank water use and management through ground water irrigation in tank command area

The study was undertaken in Dindigul district with the major objective to find the potential of conjunctive use of surface and groundwater along with different water management technologies. The yield was higher for farmers adopting water management technologies under conjunctive water use situation, i.e., an average rice yield of 6,900 kg/ha was obtained by adopter, whereas non – adopter realized only 5,928 kg/ha. Change in rice yield due to adoption of the technologies under conjunctive use was about 2.23 to 7.42 per cent and the contribution of other inputs to yield was about 3.20 to 11.2 per cent. Thus, the adopters of water management technology had realized increased productivity and thereby the returns from rice crop were comparatively higher. The cumulative effect in terms of increased productivity for adopters of technology was due to less seed rate, irrigation and labour. Farmers under adopter category supplemented tank with well water, gave less number of irrigation to rice crop (35-37 irrigations) when compared to non – adopter (42-47 irrigations).

Potentials and performance of international and domestic trade of major fruits and vegetables

The study also revealed that there was a very high demand for organic products

especially mangoes in Germany, France, Netherland and U.K. Hence, efforts should be taken to produce organic products and to reduce the usage of pesticides to get them accepted by the importing nations.

The most important constraint identified by the fruits and vegetables growers was the inability to meet the quality requirements for export (63.61). The importing countries imposed high quality specifications for each commodity and this resulted in realization of lower prices by the farmers, especially in exporting to distant market. The second major constraint ranked by the sample farmers was poor storage and transport facilities (53.01) as most of the fruits and vegetables are perishable. Dependency on pesticide usage (50.27), lack of institutional supports (43.83), and lack on information on organic cultivation (39.61) were the other important problems encountered by the sample farmers.

Analysis of constraints of fruits and vegetables exporters showed that the inadequate infrastructural facilities namely reefer vans, pack houses, quality packing materials, cool chain, Controlled Atmosphere (CA) containers was the major hurdle experienced by the exporters. Lack of standardization on post-harvest handling was the second most important problem expressed. This shows the need for standardization of protocol and training on post-harvest handling and Controlled Atmosphere (CA) and Modified Atmosphere (MA) storage facilities. The third important problem was the documentation procedure for export. The other problems include collusion among commission agents and auctioneers and unavailability of market information and strategies.

Importing countries: Top five importing countries of fruits and vegetables are given below.

Mango:	UAE, Bangladesh, Nepal, Saudi Arabia and UK.
Grapes:	Netherland, Russia, U.K, U.A.E. and Bangladesh.
Banana:	UAE, Saudi Arabia, Bahrain, Kuwait and Oman.
Onion:	Bangladesh, Malaysia, Sri Lanka, UAE, and Singapore.
Fresh Tomato:	Pakistan, UAE , Bangladesh, Oman and Nepal.

Quality attributes for Export of Mango

The most preferred export variety of mango is Alphonsa. Quality attributes preferred by the traders of mango are 200-250g size and yellow to green colour and ovate oblique shape with high flavour.

Domestic trade and export potential of hill banana with GI tag in Tamil Nadu

Virupakshi and Sirumalai Hill bananas are the two hill banana varieties registered under Geographical Indication (GI) in the year 2008. Virupakshi and Sirumalai bananas are grown in lower Palani hills and Sirumalai hills, respectively. Total area under Sirumalai

banana was 350 ha and Virupakshi banana was 1600 ha. Hill bananas are grown as a shade crop for coffee and other hill vegetables. Hill bananas are planted during the months of April and May in a pit. The average number of plants per acre is 400. The spacing adopted is 12'X8', 12'X12' and 10'X10'. Two ratoon crops are taken over a period of 40 months, i.e., total crop duration is 40 months. First planted banana come to harvest after 18 months and harvest is being done throughout the period upto 40 months.

After the harvest, hill bananas are transported to nearest market by local means of transport such as two wheelers, mini trucks and jeeps. The hill bananas are traded in lots of 500 numbers of bananas. The prices are quoted for the lot. The average price per fruit received by farmers for GI tagged Virupakshi was Rs.3.50 and Sirumalai hill banana was Rs.4.00. The major trading centres are Dindigul for Sirumalai banana and Thandikudi, Vadakavunchi, K.C.Patti, Adalur & Perumalmalai for Virupakshi. The major consumption centers of GI tagged Hill bananas are Chennai, Madurai and Coimbatore.

The major constraints in cultivation of hill banana are damage by wild animal, infestation of pseudo-stem weevil, bunchy top of banana disease and damage due to wind. Small size of fruits, skin discoloration, black spots and lack of grading are the major constrains in trading.

Impact assessment of mechanical transplantation in kuruvai rice cultivation in cauvery delta districts of Tamil Nadu

The study was conducted to assess the impact of Mechanical Transplantation in Cauvery delta Districts of Tamil Nadu implemented under the Kuruvai Special Assistance 2015. A sample of 250 farmers was interviewed for this study. The study was conducted in the six delta districts of Cauvery viz., Thanjavur, Tiruvarur, Nagapattinam, Trichy, Ariyalur and Cuddalore. The selected 250 farmers were selected and post-stratified into conventional and machine transplantation farmers. Out of the 250 farmers, 72 of them had followed conventional planting also.

Salient findings

- The total cost of seedling production under conventional planting method worked out to Rs. 3549.99 per acre, which is higher than that of mechanical transplanting with mat nursery prepared by the farmers themselves (Rs. 1771.93 per acre), and direct purchase of seedlings from commercial nurseries was Rs. 2300 to 2800.00 per acre. This resulted in a saving of Rs.1778.06 (50.08 %) under own mat nursery method, and Rs. 1049.99 (29.57 %) with direct purchase of seedlings.
- The cost incurred for main field cultivation under conventional planting was Rs.17584.24 per acre, whereas it was 14831.95 in the case of mechanical transplanting, with a saving of Rs.2752.29 (15.65 %) over conventional planting.
- The total cost of cultivation (nursery cost + main field cost) revealed that higher cost was incurred for conventional planting (Rs.21134.23), while it was lower under mechanical transplanting (Rs.16603.88), with a saving of Rs.4530.35 (21.44 %).
- Yield (productivity) increase of more than 38.83 per cent was reported in the case of mechanically transplanted fields as compared to conventional planting.

- The gross return as well as net return of machine transplanted fields were significantly higher, with 43.41 per cent increase in gross return and more than four times increase in net return (447.54 %) over the conventionally planted fields.
- With respect to level of satisfaction of this state government programme, nearly two-thirds (64.80 %) of the respondents were cent per cent satisfied with the machine transplantation programme, followed by about one-third (33.20 %) of the respondents who had expressed 51-75 per cent level of satisfaction.
- ''Subsidy may be extended for few more years to increase adoption rates', and 'Cono weeder and laser leveler may be made available at Agricultural Depots and Co-operative Socieites were the suggestions offered by the respondents for sustained adoption of machine transplanting. Majority of the respondents had realized the importance of land leveling as a pre-requisite for machine planting. As a result, farmers have insisted government support in terms of monetary or subsidized custom hiring facilities in all revenue villages. Farmers have felt that Cono weeding under machine planted field improves the crop growth and productivity and hence, they have demanded supply of adequate number of Cono weeders under any subsidy scheme.
- It was also learnt that farmers need to be given hands-on training on mat nursery technology in their villages.

Innovative water saving irrigation and investment priorities for food security and water sustainability in India

The study was conducted in Amaravathi River Basin

The study suggested that concrete [or] cement slap lining of the branch canals and distributaries will significantly reduce water loss by 10-12%. Farmers suggested that the damaged sluice structures and shutters replacement with new structures to improve water availability in the middle and tail reaches.

Potato value chain analysis in Tamil Nadu

The study was conducted in Nilgris district

The results revealed that the cost of potato seeds constituted up to 28% of the total cost of cultivation in potato. Seed supply chain has to be strengthened and sufficient quantity of seed potato must be made available in time to the potato growers of Nilgris and Krishnagiridistricts as the farmers find it difficult to obtain quality seed material. The Producers share in Consumers price is only 38% and hence institutional interventions like suitable storage, transport and distribution infrastructure will help the farmers to realize better prices and eliminate certain middle men.

Financial management practices and financial performance analysis of coconut oil mills in western Tamil Nadu

Majority of the oil mills faced the problem of higher (2 per cent) Central Sales Tax (CST) and Value Added Tax (5 per cent) levied on copra. Neighboring state Kerala exempted all the tax rates for copra. Karnataka levied only 2 per cent VAT on copra. Hence, it is suggested that the Government should take necessary steps to bring down the taxes, which

would encourage the entrepreneurial activity. Majority of the milling copra production was undertaken predominantly in Tamil Nadu. Coconut is currently classified under non-food crop. Coconut may be added under food crop list, asit will entail less tax.