# ACTION TAKEN REPORT FOR THE 80th SCIENTIFIC WORKERS' CONFERENCE 2014 HELD AT TNAU, COIMBATORE DURING 29-30 MAY, 2014

## CROP IMPROVEMENT

### 1. Developing green super rice, drought tolerant lines and high yielding varieties/ hybrids in millets

**Developing Super Green Rice**

- Super Green Rice is a major project led by the Chinese Academy of Agricultural Sciences and the International Rice Research Institute (IRRI) to evolve rice varieties and hybrids to perform well in the toughest conditions where the poorest farmers grow rice. These potential rice varieties and hybrids variously adapted to difficult growing conditions such as drought and low inputs, including no pesticide and less fertilizer and with rapid establishment rates to out-compete weeds, thus reducing the need for herbicides. More types of Green Super Rice that combine many of these traits are in the pipeline.
- The genetic materials received under Green Super Rice Project (GSRP) from IRRI are being evaluated in TNAU from the year 2012. A total of 32 lines was evaluated at Department of Rice, TNAU Coimbatore during Kuruvai 2012 and later during Samba/Thaladi 2013 season at three different locations viz., Ambasamudram (irrigated-acid soil), Tirur (irrigated- normal soil) and Paramakudi (rainfed). These lines were tested along with the checks ASD 16 (115 days) and CO 50 (135 days).
- All the GSR lines evaluated had 115 to 125 days duration. Under irrigated condition, the mean grain yield of all GSR lines were lesser than CO 50 (6807 kg/ha); however, the yield of EC 725255 (6218 kg/ha) was alone found to be on par with ASD 16 (6203 kg/ha).
- In the rainfed direct sown situation at Paramakudi, the crop suffered drought spells during initial establishment, tillering, booting and grain filling stage. The grain yield of the GSR lines at Paramakudi ranged from 238 kg/ha (EC 725249) to 894 kg/ha (EC 725237) which is lower than the local check Anna (R) 4 (1031kg/ha).
- From the overall observation, three GSR lines EC 725255(6218kg/ha), EC 725254(5978 kg/ha) and EC 725224 (5661 kg/ha) which are found promising have been identified for further evaluation. The GSR line EC 725224 (120 days) has been nominated for Multi Location Testing during 2015-16.

**Developing drought tolerant lines and high yielding varieties / hybrids in millets**

Development of varieties and hybrids tolerant to drought is the principal breeding objective in millets. In sorghum, a high yielding dual purpose drought tolerant sorghum culture TKSV 0809 has been released as K12 sorghum variety from Kovilpatti during 2015 in addition to the already existing variety CO 30 and hybrid CO 5. Four high yielding cultures TNS 660, TNS 661 , TKSV 1036 and ASV 11-029 are under MLT testing with preferable agronomic traits and tolerant to drought situations.

**Maize**

Single cross maize hybrid CO 6 is suited for both irrigated and rainfed conditions. It has bold grains with orange yellow color with a 100 seed weight of 40g and 81% shelling. CO 6 hybrid is moderately resistant to stem borer.

**Pearlmillet**

Pearl millet composite CO (Cu) 9 and hybrid CO 9 are drought tolerant and suited for rainfed conditions. Another composite UCC 32 is in the pipeline for release. UCC 32 matures in 90 days with an average yield of 2800 kg/ha under rainfed conditions. Two high yielding hybrids TNBH 08804 and TNBH 10885 are in ART testing.

**Small millets**

The following high yielding varieties released in small millets are drought tolerant and suited for rainfed situations.

| Crop | Variety |
|---|---|
| Ragi (Finger millet) | CO 14 and CO 15 |
| Samai (Little millet) | CO 4 |
| Tenai (Foxtail millet) | CO 7 |
| Varagu (Kodo millet) | CO 3 |
| Panivaragu (Prosomillet) | CO 5 |
| Kuthiraivali (Barnyard millet) | CO 2 |

In addition, three kuthiraivali cultures TNAU 157, ACM 145 and ACM 10-082 which are suited for drought situation especially for southern districts are under ART testing.

## 2. Evolving varieties and technologies against water deficit situations

### Varieties

- Development of varieties adapted to water deficit situation is the special objective in crop breeding and based on that objective, the current breeding programme in crops like rice, millets, pulses and oilseeds promising varieties have been tuned.
- In rice, drought tolerant variety Anna (R)4 was developed and released. Two cultures namely CB 08 702 (IR 80013-B-141-4) with a grain yield of 2603 kg/ha in 117 days and CB 06803 (PMK (R) 3/ Norungan) with 2528 kg/ha in 120 days were found to be promising and tested under ART in second year and the results are awaited. Sorghum variety K12, cumbu variety CO (Cu) 9 are also suited for water deficit environment. In case of maize, TNAU maize hybrid CO 6 is recommended for rainfed situation and ranked first in All India Trials especially under rainfed situations. Another maize hybrid VMH 12013 was found to be promising with the percentage increase of 10.65% (6568 kg/ha) which is tested in MLT under rainfed condition.
- All the released varieties of small millets are suited for water limiting environment.
- Three kuthiraivali cultures TNAU 157, ACM 145 and ACM 10-082 which are suited for drought situation especially for southern districts are under ART testing.

### Pulses

Redgram: Among the released varieties CO 6, VBN 2 and LRG 41 are suitable to cultivate under pure rainfed condition.

Greengram: Varieties VBN 2, VBN 3 and CO 6 are being cultivated in water deficit area.

Blackgram: Varieties VBN 3, VBN 4 and VBN 6 released for rainfed cultivation.

In addition, heat tolerant blackgram cultures viz., VBG 06-002, VBG 06-005 and COBG 759 are identified for further evaluation.

In oilseeds, groundnut variety, VRI (Gn) 7 released during 2008 is suitable for rainfed condition. It is a high yielding variety having yield potential of 1865 kg/ha. It matures in 120-125 days. It has 72% shelling and 48% oil content. Another virginia bunch variety CO6 has been released as a high yielding drought tolerant variety. It is suitable for the rainfed groundnut growing area of Salem and Namakkal districts of Tamil Nadu. It matures in 125-130 days. This variety has recorded an overall mean dry pod yield of 1914 kg/ha under rainfed

situation. The shelling outturn and oil content are 73.5 and 49.5 per cent respectively. The estimated kernel and oil yield of this variety under rainfed are 1407 and 696 kg/ha respectively.

In sunflower, variety CO4, a national variety released during 1996 is suitable for water deficit situations. It matures in 85 days. It has recorded 1250 kg/ha under rainfed condition. It has 39.7% oil content. Another drought tolerant rainfed castor hybrid, YRCH1 is suitable for rainfed situation. It is a non lodging and non shattering hybrid. It recorded a yield of 1861kg/ha under rainfed condition in 160 days.

**Technologies**

- Cultivating short duration crop/varieties
- *In-situ* water harvesting technologies like summer ploughing, tied ridging and broad bed furrow with crop residue mulch can be adopted
- Compartmental bunding with crop residue mulch @ 5 t ha-1 to groundnut conserve soil moisture in Alfisols.
- Laser land levelling application of crop residue mulch @ 5 t ha-1 for improving water productivity and nutrient use efficiency.
- Excess runoff water can be collected in farm pond and utilized for supplemental irrigation
- Supplemental irrigation through raingun / drip at critical stages of crop growth
- Mid season drought can be managed by thinning or harvesting the crop for fodder

## CROP MANAGEMENT

### 1. Climate change and its effect on agricultural productivity

- **Impact of elevated temperature on rice**
  Studies using CERES-Rice model conducted in rice under different temperature regimes and two planting options revealed that elevated temperature of 2$^{o}$C and 4$^{o}$C reduced the grain yield by 16 per cent and 32.8 per cent respectively. Starch content was also reduced due to increase in temperature.

- **Impact of climate change on field crops using DSSAT model**
  DSSAT simulation run in rice for HQ0 projection based on Hadly Centre Model for period from 1971 to 2100 revealed that without $CO_2$ enrichment, the rice yield could be declined from 3153 kg ha$^{-1}$(1971-80) to 1716 kg ha$^{-1}$(2091- 2100). In groundnut, the yield predicted was 941 kg ha$^{-1}$and 372 kg ha$^{-1}$ and in maize, the yield was 3303 kg ha$^{-1}$ and 2314 kg ha$^{-1}$ respectively for the decades 1971-80 and 2091-2100. Though yield decline was predicted in $CO_2$ enrichment simulations, the severity was lesser than non-$CO_2$ enriched simulations.

- **Impact on water demand in the delta region of cauvery basin**
  The potential irrigation water demand for rice was simulated in SWAT by assuming that unlimited supply of water and the extent of irrigated area remains the same in current and future climate. The results indicated that in the midcentury (2050), the predicted irrigation water requirement changes ranged from 4 to 8.1 per cent and 4.5 to 14.7 per cent in the end century (2100). The increasing trend in potential evapo transpiration is the main cause for the increase in water demand.

- **Shift in onset of monsoon**
  The decadal analysis for identifying the shift in North East Monsoon (NEM) onset at block level was done by using Jeevananda Reddy's 14-week moving average technique with 60 years (1951-2010) of daily rainfall data. The results clearly indicated that the onset week was shifted over these periods and the shift has both temporal and spatial variation. The shift observed in NEM onset was one or two weeks on either side. The NEM onset was two weeks earlier in southern districts of Tamil Nadu and one week earlier in north western and western parts of Tamil Nadu, whereas the onset was delayed a week in western ghats, north eastern and coastal regions of Tamil Nadu. In general comparing 1950, current monsoon onset is early towards inlands and delayed near sea.

**2. Performance of pulse wonder, groundnut rich, maize maxim, sugarcane booster in comparision with MN Mixture**

- Performance of TNAU pulse wonder in comparison with TNAU micronutrient mixture was experimented in blackgram (variety: ADT 5) at Department of Agronomy, TNAU, Coimbatore. Foliar spray of TNAU pulse wonder @ 5 kg/ha in addition to soil application of 100% recommended dose of NPK and DAP 2% on 45 DAS recorded a higher grain yield of 1116 kg/ha while TNAU micronutrient mixture applied as basal @ 5 kg/ha in addition to soil application of 100% recommended dose of NPK and DAP 2% recorded a grain yield of 981 kg/ha and the control (100% recommended dose of NPK) recorded grain yield of 730 kg/ha.
- Performance of TNAU groundnut rich in comparison with TNAU micronutrient mixture was experimented in groundnut at Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore. Foliar spray of groundnut rich @ 5 kg/ha at peak flowering and pod development stages in addition to soil application of 100% recommended dose of NPK recorded a higher pod yield of 2575 kg/ha while TNAU micronutrient mixture applied as basal @ 5 kg/ha in addition to soil application of 100% recommended dose of NPK recorded a pod yield of 2529 kg/ha and the control (100% recommended dose of NPK) recorded a pod yield of 2412 kg/ha.
- Performance of TNAU maize maxim and TNAU sugarcane booster in comparison with MN mixture will be taken up in the coming year.

**3. Use of pulse wonder instead of 2% DAP spray for increasing the pulse productivity**

Use of TNAU pulse wonder instead of 2% DAP spray for increasing the pulse productivity was experimented in greengram (varieties: CO 7 & VBN 2). In the variety CO 7, foliar spray of 2% DAP on 45$^{th}$ DAS recorded a grain yield of 748 kg/ha while foliar spray of TNAU pulse wonder @5 kg/ha on 45$^{th}$ DAS recorded a grain yield of 791 kg/ha (5.75% increase over DAP spray). Control plots, i.e., 100% recommended dose of NPK recorded a grain yield of 689 kg/ha. In the variety VBN 2, foliar spray of 2% DAP on 45$^{th}$ DAS recorded a grain yield of 682 kg/ha while foliar spray of TNAU pulse wonder @5 kg/ha on 45$^{th}$ DAS recorded a grain yield of 724 kg/ha (6.16% increase over DAP spray). Control plots, i.e., 100% recommended dose of NPK recorded a grain yield of 636 kg/ha.

**4. Development of package of practices for integrated farming system**

The validated integrated farming system for different ecosystems are furnished below.

**Possible IFS models for wet land eco system**

- Cropping + fish + poultry
- Cropping + fish + pigeon
- Cropping + fish + goat
- Cropping + goat + fish + poultry + mushroom cultivation
- Rice + fish + azolla + vegetables
- Rice + fish + mushroom + goat + compost

**Possible IFS models for garden land eco system**

- Cropping + dairy + goat + bio gas + vermi composting
- Cropping + dairy + bio gas + sericulture + apiculture
- Cropping + dairy + bio gas + fish + nutritious garden
- Cropping + dairy + bio gas + nutritious garden + fruit trees
- Cropping + dairy + bio gas + spawn production + mushroom cultivation
- Cropping + dairy + bio gas + nutritious garden + border trees

**Possible IFS models for dry land eco system**

- Cropping + goat + agro forestry + rabbit
- Cropping + goat + agro forestry + farm pond
- Cropping + sheep+ agro forestry + compost
- Cropping + sheep + buffalo + agro forestry + compost

**5. Strengthened research against Elnino effect in the field**

- **Impact of El-Nino - Southern Oscillation (ENSO) on the rainfall of Tamil Nadu**
  The correlation studies on ENSO and southwest monsoon (SWM) indicated that there is no significant correlation in the river basin. The weak El-Nino years had positive correlation with SWM of southern, central and north western parts of Tamil Nadu whereas strong El-Nino years had positive correlation in SWM of eastern and north eastern parts of Tamil Nadu. The North East Monsoon (NEM) of southern parts of Tamil Nadu showed positive correlation with El-Nino than other parts of Tamil Nadu. The weak El-Nino had negative correlation with NEM of western ghats and strong El-Nino had positive correlation with NEM of northern and central parts of Tamil Nadu.

- **Impact of El-Nino - Southern Oscillation (ENSO) on hydrology of cauvery basin**
  The composite study on hydrology of cauvery basin with El-Nino, La-lina and normal years inferred that there was an increased receipt of rainfall (1340 mm) than normal years (976 mm) and the rainfall variability was also higher (809 to 2366 mm) in El-Nino years. The rainfall received during La-Nina years was lesser than normal years. The total water flow, ground water recharge and evapo-transpiration was also more in El-Nino years than normal and La-Nina years. The studies indicated that the risk in crop production is much less in El-Nino years compared to normal and La-Nina years.

- **Impact of ENSO on rice productivity**
  EL- Nino and La-Nina events had varied influence on rice productivity. The highest productivity with less Co-efficient of Variation (CV) was recorded in El-Nino years while the CV was higher in La-Nina years. The rice productivity was shifted up in both El-Nino and normal years indicating the possibility of higher yields. The SWAT model is efficient in predicting the variation in rice productivity as influenced by El-Nino and could be well utilized for forecasting rice productivity under ENSO conditions for policy making.

## NATURAL RESOURCES MANAGEMENT

**6. Survey on soil health status in relation to soil organic components, photo oxidation in rainfed and irrigated areas**

Paramaters *viz*. pH, EC and organic carbon were estimated in soils of sixteen districts and the range and mean values observed are given below.

pH, EC and organic carbon status of sixteen districts

| Name of the District | pH | | EC (dS $m^{-1}$) | | Org.C (%) | |
|---|---|---|---|---|---|---|
| | Range | Mean | Range | Mean | Range | Mean |
| Vellore | 6.19-8.82 | 7.57 | 0.10-0.82 | 0.28 | 0.13-0.85 | 0.42 |
| Salem | 5.39-8.86 | 7.97 | 0.05-2.74 | 0.24 | 0.14-0.68 | 0.31 |
| Erode | 6.34-9.36 | 7.93 | 0.04-1.33 | 0.25 | 10.12-0.99 | 0.40 |
| Ramanathapuram | 6.29-8.74 | 7.93 | 0.01-0.69 | 0.23 | 0.14-0.54 | 0.25 |
| Pudukkottai | 4.23-9.12 | 7.05 | 0.04-0.60 | 0.28 | 0.16-0.59 | 0.34 |
| Sivagangai | 6.20-8.92 | 6.79 | 0.01-0.99 | 0.38 | 0.10-0.88 | 0.56 |
| Nagapattinam | 3.90-9.60 | 6.63 | 0.06-8.03 | 0.40 | 0.09-1.89 | 0.72 |
| Tirunelveli | 4.80-9.40 | 7.50 | 0.01-1.58 | 0.12 | 0.12-1.10 | 0.40 |
| Thoothukudi | 4.20-8.80 | 7.15 | 0.02-0.87 | 0.19 | 0.20-0.94 | 0.62 |
| Madurai | 5.50-9.11 | 7.22 | 0.10-1.06 | 0.20 | 0.03-0.50 | 0.23 |
| Villupuram | 5.10-9.00 | 7.30 | 0.05-1.21 | 0.16 | 0.03-1.67 | 0.44 |
| Thiruvannamalai | 6.60-9.40 | 7.40 | 0.02-1.83 | 0.29 | 0.03-1.88 | 0.50 |
| Cuddalore | 4.40-9.30 | 7.26 | 0.02-6.24 | 0.30 | 0.06-1.66 | 0.56 |
| Krishnagiri | 5.50-8.60 | 7.06 | 0.09-2.35 | 0.41 | 0.12-0.78 | 0.36 |
| Virudhunagar | 5.06-9.47 | 8.23 | 0.34-0.88 | 0.67 | 0.21-0.98 | 0.57 |
| Namakkal | 6.10-8.60 | 7.20 | 0.10-0.92 | 0.34 | 0.18-0.77 | 0.47 |

## 7. Drought management strategies such as Pink Pigmented Facultative Methylotrophs (PPFM)

For drought management, foliar spraying of PPFM (10 ml/litre of spary fluid) at 30 days interval or at critical stages of crop growth is recommended. This technology has been successfully demonstrated in 1.25 lakh hectares of drought hit rice crop in Cauvery delta area covering five districts of Tamil Nadu (Thanjavur, Tiruvarur, Nagapattinam, Trichy and Cuddalore) during 2011-12 and 2012-13. During 2013-14, foliar sparying of PPFM was undertaken in 1000 ha of rice grown areas in Sivaganga and Ramnad districts to mitigate the drought. A research project entitled 'Effect of *Methylobacterium* application on growth and yield of Kudiraivali – Var.Co (kv) 2' is also currently in operation. The results of this project has indicated that *Methylobacterium* seed treatment (seed imbibitions for 15 minutes) with 2% (20 ml / 1000 ml of water) showed better performance in seed germination (97%), early flowering (54DAP), number of productive tillers (13/plant), plant height (186 cm/plant), grain yield (2400 kg ha) and straw yield (6450 kg/ha), when compared to control (1320 kg/ha and 4350 kg/ha).

## 8. Replacement of chemical agents with bio-agents

Efficient biofertilizer strains/inoculants of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Gluconacteobacter diazotrophicus*, Phoshobacteria and K releasing bacteria have been developed by the Department of Agricultural Microbiology for

supplementing chemical nitrogenous, phosphatic and potassic fertilizers and are being used by farmers for different crops.

## 9. Fixation of cropwise, nutrientwise, districtwise critical levels for all micronutrients

The critical limit is the limit which isolates the deficient plants or soils from the non deficient ones. Although plant analysis as compared to soil analysis can evaluate better micronutrient supplying capacity of soil, it is generally performed at a stage when crop has already suffered considerably from nutrient deficiency. Since the deficiency of micronutrient element appears early in the growing season, soil analysis has the advantage over plant analysis and visual deficiency symptoms indicating the extent of micronutrient deficiency or their requirement for crops prior to sowing. Hence, soil analysis is extensively used as a diagnostic tool in monitoring nutrient status of soils for fertilizing crops.

In a district, more number of soil series were established and multi-various crops are grown. A series of experiments using various crops in different soil conditions in Tamil Nadu had been conducted during 1980 to 2000 to provide statewise uniform micronutrient recommendations. Based on the above, the following critical levels for various micronutrients in soils were fixed for adoption by the Agricultural University and State Department of Agriculture, Tamil Nadu.

**Critical limit of micronutrients in soils adopted by Government of Tamil Nadu**

| Micronutrients | Critical Limit (ppm) | Extractant used |
|---|---|---|
| Zinc - loamy soil | 1.20 | DTPA |
| Zinc - clayey soil | 2.00 | DTPA |
| Copper | 1.20 | DTPA |
| Iron- calcareous soil | 6.30 | DTPA |
| Iron- Non-calcareous soil | 3.70 | DTPA |
| Manganese | 2.00 | DTPA |
| Boron | 0.46 | Hot Water |
| Molybdenum | 0.05 | Ammonium Oxalate |

Field experiments were conducted on the refinement of critical limit for Zn in soils grown with maize crop and Cu in soils with onion crop and a critical value of 0.85 mg $kg^{-1}$ for Zn and 0.63 mg/$kg^{-1}$ for Cu in soils has been established.This has to be test verified under various locations. For wet land rice, similar studies on the refinement of critical limit for Zn and Cu in soils is under progress.

## 10. Soil test based micronutrient recommendations including foliar spray and fertigation

Besides macronutrients, soil testing for available micronutrients need to be performed for giving micronutrient recommendations. When the soil test values go below the critical limit of a particular micronutrient, there is a need for micronutrient fertilisation. Without soil testing, indiscriminate application of micronutrient fertilisers may be avoided. Based on the field experiments conducted using various crops in different soil conditions, micronutrient fertiliser recommendations were generated for agricultural and horticultural crops and the details of recommendations are given below.

**Micronutrient recommendations for Agricultural crops (Irrigated)**

| Crops | Element | Mode of application | Recommendations |
|---|---|---|---|
| Wetland rice | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ thrice at 30, 40$^{th}$ and 50$^{th}$ day after transplanting |
| Wetland rice - Cauvery delta | Copper | Soil | Basal application of 5 kg $CuSO_4$ $ha^{-1}$ combined with 0.2 % foliar spray of $CuSO_4$ thrice |
| Semidry and rainfed rice | Iron and Zinc | Soil | Combined application of 50 kg $FeSO_4$ along with 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | Foliar spray of 1.0 % $FeSO_4$ and 0.5 % $ZnSO_4$ at 15, 25 and 35 DAS |
| Sorghum, Maize | Iron | Soil | 50 kg $FeSO_4$ +12.5 t FYM $ha^{-1}$ as basal |
| | | Foliar spray | 1 % $FeSO_4$ + 0.1 % citric acid thrice |
| Sorghum, Finger millet and Cumbu | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ foliar spray (Thrice at 30$^{th}$, 40$^{th}$ and 50$^{th}$ DAS |
| Maize (Variety) | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| Maize (Hybrid) | Zinc | Soil | 37.5 kg $ZnSO_4$ $ha^{-1}$ as basal |
| Groundnut | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as enriched FYM as basal |
| | Boron | Soil | 10.0 kg Borax $ha^{-1}$ as basal |
| | Iron | Foliar spray | 1.0 % $FeSO_4$ + 0.1 % citric acid |
| Sunflower | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ 30, 40 and 50 DAS |
| Sesamum | Manganese | Soil | 5 kg of $MnSO_4$ $ha^{-1}$ as basal |
| Pulses | Zinc | Soil | 25 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ foliar spray thrice |
| Sugarcane | Iron | Soil | 100 kg $FeSO_4$ $ha^{-1}$ + 12.5 t FYM $ha^{-1}$ as basal |

| | | | |
|---|---|---|---|
| | | Foliar spray | 1 % $FeSO_4$ + 0.1 % citric acid on 90$^{th}$, 110$^{th}$ and 130$^{th}$ days after planting |
| | Zinc | Soil | 37.5 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ foliar spray thrice on 90$^{th}$, 110$^{th}$ and 130$^{th}$ days after planting |
| Cotton | Zinc | Soil | 50 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ thrice |
| Cowpea | Zinc and Boron | Soil | 25 kg $ZnSO_4$ and 10 kg Borax $ha^{-1}$ |
| Fodder grasses | Iron | Foliar spray | Repeated foliar spray of 1 % $FeSO_4$ + 0.1 % citric acid |

**Note:** Foliar spray should be given during the early stage of crop growth at 7 – 10 days interval for short duration crops and 15 days interval for long duration crops

## Micronutrient recommendations for Horticultural crops (Irrigated)

| Crops | Element | Mode of application | Recommendations |
|---|---|---|---|
| Cauliflower | Cooper | Soil | 10 kg $CuSO_4$ + 12.5 t $ha^{-1}$ |
| | Boron | Soil | 20 kg Borax + 12.5 t $ha^{-1}$ |
| Tomato | Boron | Soil | 10 kg Borax + 12.5 t $ha^{-1}$ |
| | Zinc | Soil | 50 kg $ZnSO_4$ $ha^{-1}$ as basal |
| Tapioca | Iron and Zinc | Foliar spray | 1.0 % $FeSO_4$ + 0.5 % $ZnSO_4$ twice at 60 and 90 DAP |
| Turmeric | Zinc | Soil | 50 kg $ZnSO_4$ $ha^{-1}$ as basal |
| | | Foliar spray | 0.5 % $ZnSO_4$ thrice |
| | Iron | Soil | 100 kg $FeSO_4$ + 12.5 t FYM $ha^{-1}$ as basal |
| | | Foliar spray | 1.0 % $FeSO_4$ + 0.1% citric acid |
| Grapes | Multi nutrient | Foliar spray | $ZnSO_4$ 0.2 % + boric acid 0.1 % + 1 % urea twice during blooming and ten days after first spray |
| Banana | Multi nutrient | Foliar spray | 0.5 % $ZnSO_4$ + 0.2 % $FeSO_4$ + 0.2 % $CuSO_4$ + 0.1 % boric acid at 3, 5 and 7 months after planting |
| Jasmine | Iron and zinc | Soil | 25 g $FeSO_4$ and 4.0 g $ZnSO_4$ / plant |
| | Iron | Foliar spray | 0.5 % $FeSO_4$ + 0.1 % citric acid spray at monthly intervals |
| Beet root | Zinc and Boron | Soil | 25 kg $ZnSO_4$ and 10 kg Borax $ha^{-1}$ |
| Radish | Zinc and Boron | Soil | 25 kg $ZnSO_4$ and 10 kg Borax $ha^{-1}$ |
| French beans | Zinc and Boron | Soil | 25 kg $ZnSO_4$ and 10 kg Borax $ha^{-1}$ |

**Note:** Foliar spray should be given during the early stage of crop growth at 7 – 10 days interval for short duration crops and 15 days interval for long duration crops.

**Secondary nutrient recommendation for specific crops (Irrigated)**

| Crops | Element | Mode of application | Recommendations |
|---|---|---|---|
| Cotton | Magnesium (reddening of leaves) | Foliar spray | 0.5 % $MgSO_4$ + 1.0% urea + 0.1 % $ZnSO_4$ |
| Potato | Magnesium | Soil as basal | 50 kg $MgSO_4$ $ha^{-1}$ |
| Rice | Calcium and Sulphur | Soil as basal | 500 kg gypsum $ha^{-1}$ |
| Maize | Sulphur | Soil as basal | 30 kg S $ha^{-1}$ |
| Sorghum | Sulphur | Soil as basal | 30 kg S $ha^{-1}$ |
| Groundnut | Calcium and Sulphur | Soil during per dermination | 400 kg gypsum $ha^{-1}$ |
| Sunflower | Sulphur | Soil as basal | 40 kg S $ha^{-1}$ |
| Sesame | Sulphur | Soil as basal | 40 kg S $ha^{-1}$ |
| Greengram/ Blackgram | Sulphur | Soil as basal | 40 kg S $ha^{-1}$ |
| Cotton | Sulphur | Soil as basal | 55 kg S $ha^{-1}$ |
| Onion | Sulphur | Soil as basal | 30 kg S $ha^{-1}$ |
| Sugarcane | Sulphur | Soil as basal | 45 kg S $ha^{-1}$ |
| Tapioca | Sulphur | Soil as basal | 20 kg S $ha^{-1}$ |

In addition to the soil application, foliar sprays are useful to correct nutrient disorders in crop plants during the crop growth period. The details of foliar spray recommendations are given below.

**Generalized recommendation for foliar spray of micronutrient for crops**

| Element | Fertilizer | Concentration (%) |
|---|---|---|
| Zinc | Zinc sulphate | 0.50 |
| Iron | Ferrous sulphate + Citric acid | 1.00 + 0.10 |
| Manganese | Manganese sulphate | 0.20 |
| Copper | Copper sulphate | 0.20 |
| Boron | Boric acid / Solubor / Agribor | 0.20 |
| Molybdenum | Sodium molybdate or Ammonium molybdate | 0.05 |

The micronutrient recommendations for various crops are available in Crop Production Guide 2012 and Crop Production Techniques of Horticultural Crops 2013.

## 11. Evolving newer specialized forms of micronutrients

Balanced fertilization should not be taken as application of only major plant nutrients as is probably happening today, but all essential elements limiting in the soil including secondary and micronutrients. This is important as the increasing demand for food is forcing the country to produce more and more per unit area per unit time by the increasing cropping intensity and / or following exploitative agriculture.

The use of crop specific fertilizer mixtures will largely help the farmers to go for balanced fertilization thereby increasing the productivity of their farm holdings. The list of 14 MN mixtures as approved in the FCO does not cover all the crops and some of them needs improvement in the context of the emerging multi-micronutrient deficiencies. The MN mixture meant for most of the crops does not contain proper quanity of all micronutrients. Since larger occurrence of Cu and Zn deficient soils due to mining of native micronutrients have been reported in the recent years, the improvement of the existing MN mixture formulations will help the farmers to manage the multinutrient deficiency problems involving secondary and micronutrients. Hence, TNAU has developed new formulations of Micronutrient mixtures in a definite proportion based on the crop nutrient uptake and the degree of deficiency of soil micronutrients in Tamil Nadu soils and those mixtures validated under field condtions at different Research Centres of TNAU. The details of the recommendations are given below.

**TNAU micronutrient mixtures for crops**

| Name of the crop | | Irrigated (kg/ha) | Rainfed (kg/ha) |
|---|---|---|---|
| Rice | | 25.0 | 12.5 |
| Maize | | 30.0 | 7.5 |
| Cereals | | 12.5 | 7.5 |
| Pulses | | 5.0 | 5.0 |
| Sugarcane | | 50.0 | - |
| Cotton | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 7.5 |
| Groundnut | | 12.5 | 7.5 |
| Gingelly | | 12.5 | 7.5 |
| Sunflower | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 10.0 |
| Castor | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 10.0 |
| Coconut - Varieties/ Hybrids | | 1 kg / tree / year | - |

The above mentioned quantity of TNAU Micronutrient mixtures have to be applied in the form of enriched farm at the ratio of 1:10 (MN mixture : FYM) incubated for 30 days at friable moisture, just before transplanting / sowing.

## 12. Plan on improving soil organic content

There are two approaches to improve soil organic matter content *viz.,* slowing down decomposition rates of soil organic matter and adding organic carbon inputs through organic materials.

**Plans for improving soil organic Carbon**

- Practice of leaving residues of crops and cover crops in place, including root residues.
- Incorporation of legume crop residues in soil after harvesting pods
- Regular green manuring and green leaf manuring
- Annual crop rotation with a legume crop and legume residue incorporation is most effective in enhancing soil carbon. Tap root of legumes slowly decompose and build soil organic carbon considerably.
- Regular annual application of farmyard manure or organic amendments at 12.5 t $ha^{-1}$
- No-tillage management enhances soil organic carbon remarkably and followed by minimum tillage moderately. Frequent disk ploughing reduces soil organic carbon.
- Application of high quality residues like vermicompost and biocompost having C:N ratio below 25 promotes rapid decomposition and mineralization of N and increases active soil organic matter.
- When crop residues are sold, then there is a need to apply compost or to grow a cover crop to add up the residues and conserve the soil. Manure and compost additions are effective ways to build soil organic matter even with complete removal of stover.
- Effluents from industries which have been found environmentally safe can be applied in field at recommended levels.
- In long term fertilizer experiments, it has been found that regular practice of Integrated Nutrient Management by way of application of farmyard manure at 12.5 t $ha^{-1}$ along with recommended doses of N, P and K and bioinoculants to each crop improve and sustain soil organic Carbon when compared to application of inorganic fertilizers alone.
- Soil organic carbon build up sensibly occur over a longer time frame, often taking a decade or more. It is important to test soil quality often to ascertain improvement in soil organic carbon.

## 13. *In situ* decomposting methods for coir wastes

Coir waste cannot be composted through *in situ* method. Coir waste has wider C:N ratio of 100:1. To bring down the C:N ratio to 30:1, for initiating composting, large quantities of nitrogen source has to be added. For attaining compost maturity, it takes minimum 90 days.

In this situation, if it is allowed to compost through *in situ* method, standing crop will get affected. Immobilization of nutrients happens in the soil. Moreover, *in situ* composting will be applicable to materials which are generated in the field itself. But coir waste is generated in coir factory. For coir waste composting, it is recommended to go for heap method of composting.

## 14. Evaluating the benefits of humic acid in improving soil health

Humic acid has marked role on soil physical properties, sequestration and biological activities. The effect of humic acid on soil health with or without NPK was assessed in various crops. Application of humic acid as potassium humate has pronounced effect on the organic carbon content and availability of NPK and micronutrients in soils. The efficiency of humic acid was found to increase when applied along with inorganic fertilizers.

**Findings**

Rice: 100% Recommended NPK + 10 kg humic acid/ha
Pulses: 75 % Recommended NPK + 20 kg humic acid /ha
Groundnut, sugarcane, onion and tomato: 100% Recommended NPK+20 kg humic acid /ha.

## 15. Gypsum recommendation for millets and pulses based on soil types

Gypsum is commonly applied to reclaim the soidc soils and not used as a nutrient source for millets. However for pulses, the required quantity of 10 and 20 kg S $ha^{-1}$ for rainfed and irrigated situation respectively can be applied through gypsum (50-100 kg $ha^{-1}$) if single super phosphate is not used.

## 16. Improving the NUE for N, P,K, Ca, S, Mg and micronutrients

The modified urea forms like sulphur coated urea, tar coated urea, neem oil treated urea, neem cake treated urea, nimin coated urea, gypsum coated urea, *etc*. can improve the NUE. Among the modified forms, some forms can be prepared by farmers themselves. By applying these modified forms, 25 per cent fertilizer N can be saved.

- In rice fields, placement of urea super granule at 8-10 cm depth in between the planted rows has shown three times increase in nitrogen use efficiency. However, there are no convenient applicators to place urea super granule in rice fields. Hence, urea super granule is not manufactured by fertilizer industries. In developed countries, for large scale farming, the technologies injecting liquid ammonia into soil is being adopted with the help of machineries.

- Instead of applying nitrogen fertilizers completely as basal, application in four equal splits at critical growth stages upto flowering gives more yield. In another method, LCC use based on the colour of rice leaves helps to assess the nitrogen supplying power of soil by comparing leaf colour with colour shades given in leaf colour chart (LCC). With the use of LCC, whenever the intensity of green colour is found to be less, then application of fertilizer nitrogen can be resorted. This method is at present recommended to rice crop only.
- In rice fields, one or two weeks before transplanting, application of farmyard manure, crop residues, composts@12.5 t $ha^{-1}$ / green manure @ 6.25 t $ha^{-1}$ and incorporation in soil during ploughing resulted in substantial supply of N to soil and hence there is a choice to reduce 1/3 of fertilizer nitrogen requirement. Similarly, organic materials like press mud, coir pith, poultry manure / residues that are available from nearby industries/ city composts yards can also be used as per recommendation.
- Adopting legume crops in crop rotation is a successful method to increase nitrogen status of soils only if the residues of legumes are incorporated in soil during land preparation. In the same manner, growing cowpea, sesbania, sunnhemp *etc*., as intercrop upto 50 days in between the rice rows and then incorporating them into soil will support rice crop by supplementing with nitrogen during the remaining period.
- Growing Azolla fern on the surface of flood water in rice field helps rice in many ways to utilize nitrogen. Azolla has atmospheric nitrogen fixing capacity upto 20–50 kg $ha^{-1}$ and also releases $NH_3$ in flood water. Due to spreading nature and shade effect, Azolla reduces the growth of wetland weeds. Azolla contains upto 4 per cent nitrogen in their tissue and hence contribute nitrogen to soil after senescence.
- When water soluble phosphatic fertilizers are applied to soil, they become sparingly soluble after few weeks due to chemical fixation and surface reaction with minerals and hence are seldom available to crops. For rice crop, diammonium phosphate is used in the nursery and super phosphate is used in the main field. For other crops, instead of broadcasting water soluble P fertilizers, application at root zone will enhance P use efficiency. To save the cost of P fertilizer, rock phosphate can be used if the soil reaction is relatively acidic. For all crops, rock phosphate can be applied in the form of enriched manure by blending with organic materials like farmyard manure/crop residues/composts and incubated for 4 - 6 weeks.
- Potassium is abundantly available in many soil types. However, K is low in sandy soils. In that case, potassium fertilizer can be applied in two splits instead of applying as basal in full. Further, application of zinc sulphate and sulphur in deficient soils shall improve the fertilizer use efficiency of N and P.
- It is important to apply fertilizer nutrients as per soil test and yield target (STCR-IPNS) for achieving desired crop yields and enhanced NUE for fertiliser NPK.

- Crops raised in the suitable season utilize soil and fertilizer N effectively. Similarly, use of herbicides in appropriate methods also reduces the count of weeds and increases nutrient use by crops.
- Nutriseed Pack Technique**:** In order to supply the whole nutrient requirement of crop at the root zone and maximize yield and fertilizer use efficiency, the Nutriseed Pack Technique can be followed.

Generally the micronutrient use efficiency is very low (1-5%), since most of the fertilizers are converted into unavailable forms in the soil. For increasing the use efficiency of micronutrient fertilizers, the following measures are to be taken both under irrigated and rainfed conditions:

- Micronutrient application to crops is to be based on soil test values. When the soil test values are below the critical limit of a particular micronutrient, there is a need for micronutrient fertilisation to crops
- Regular application of organic manures *viz*., FYM/Composted coir pith @ 12.5 t $ha^{-1}$ or Poultry manure/Pig manure/Biogas slurry/Vermicompost @ 2.5 t $ha^{-1}$ will take care of micronutrient requirement of crops. Green manuring is found helpful in enhancing the availability of native micronutrients in soil and thereby enhance the yield.
- Application of synthetic micronutrient chelates at lower doses shows higher efficiency compared to straight micronutrient fertilisers. However, their higher cost compared to straight fertilizers made chetated fertilizers most uneconomical for common use.
- Foliar spraying of micronutrient fertiliser is effective to correct nutrient disorders in crop plants during the crop growth period so as to minimise the yield loss.
- Under low availbility of organic manures, enrichment of micronutrient fertilisers with organics @ 1: 10 ratio and incubated for 30 days will help to increase the yield through enrichment with FYM, there is a possibility of 25-50% saving in micronutrient fertilsers.
- Application of micronutrient fertilisers should be based on cropping system as a whole instead of single crop basis. The residual effect of the micronutrient fertilisers given to first crop will take care of the succeddding crop.

## 17. Reclamation strategies for sodic soil in rainfed areas

There is no specific recommendation for sodic soil reclamation in rainfed areas. The management strategies for reclaiming sodic soil are developed in a holistic manner not on specific situations. Hence the following technologies currently available may be used to overcome the problem. For the sodic soils (pH > 8.5, ESP > 15%, SAR >13), ploughing the soil at optimum moisture condition, application of gypsum based on gypsum requirement, providing drainage, organic manure application, raising the crops in ridges and furrows, selection of

tolerant crops/varieties, addition of 25 % extra N along with 37.5 kg of zinc sulphate per ha can be followed.

**18. Feasibility of using biofertilizers consortium for boosting crop yield**

Technology for production of carrier based/liquid mixed inoculants such as Azophos and Azophosmet has been developed by the Department of Agrl. Microbiology and are available for use by farmers. A research project (No.NRM/CBE/AGM/14/003) to develop a consortium of biofertilzers containing *Azospirillum*, Phosphobacteria and Potassium releasing bacteria to supply N, P and K through single application to rice crop is currently undertaken and its performance in rice will be evaluated under field conditions.

**19. Recommendation of biofertilizers for medicinal crops**

Studies have already been conducted on the application of biofertilizers for medicinal plants. The biofertilizers such as *Azospirillum* and *Phosphobacteria* can be applied to the medicinal plants by seed treatment (600 g/ha) and soil application (2 kg/ha).

**20. Technology for K and Zn mobilising/solubilising micro organisms**

In total, seven zinc solubilizing bacteria such as SSB1, SSB2, SSB3, SSB4, SSB5, SSB6 and SSB7 were isolated from rice rhizosphere. Among these isolates, SSB4, SSB7 and SSB2 exhibited the maximum zinc solubilizing efficiency of 158.1, 124.1 and 120.6 per cent respectively in Bunt and Rovira medium amended with 0.1% Zinc oxide as insoluble zinc. These isolates were characterized using the 16S rDNA sequence analysis. The sequence result revealed that SSB4, SSB7 and SSB2 belong to *Bacillus altitudinis*, *Pseudomonas gessardii* and *Achromobacter xylosoxidans* respectively. Plant inoculation studies with these isolates are yet to be carried out.

*Bacillus mucilaginosus* (KRB-9) was selected as an efficient potassium releasing bacterium which recorded available K of 102.66 mg $l^{-1}$ and silicate solubilization of 173.44 mg $l^{-1}$ in the broth on 21 days after inoculation. Experiments conducted to evaluate the performance of KRB-9 revealed that grain and straw yield were significantly higher in 100 per cent K and KRB-9 treated plots (6.75 t $ha^{-1}$and 9.63 t $ha^{-1}$ with 43.6 and 28.8 per cent over the control respectively), followed by 75 per cent K and KRB-9. The work on Zn solubilizing bacteria is being undertaken by Dept. of Agrl. Microbiology, AC&RI, Madurai.

## CROP MANAGEMENT/NATURAL RESOURCES MANAGEMENT

### 21. Micronutrient recommendations for rainfed crops and organic farming

Under well established organic farming, the micronutrient deficiencies do not arise. The nutrients deficiencies are dealt with crop rotation, recycling of farm waste and *in-situ* incorporation of crop residue.

The details of micronutrient mixture recommendations for rainfed crops are given below.

**Generalized recommendation for foliar spray of micronutrient for crops**

| Element | Fertilizer | Concentration (%) |
|---|---|---|
| Zinc | Zinc sulphate | 0.50 |
| Iron | Ferrous sulphate + Citric acid | 1.00 + 0.10 |
| Manganese | Manganese sulphate | 0.20 |
| Copper | Copper sulphate | 0.20 |
| Boron | Boric acid / Solubor / Agribor | 0.20 |
| Molybdenum | Sodium molybdate or Ammonium molybdate | 0.05 |

**TNAU micronutrient mixtures for crops**

| Name of the crop | | Irrigated (kg/ha) | Rainfed (kg/ha) |
|---|---|---|---|
| Rice | | 25.0 | 12.5 |
| Maize | | 30.0 | 7.5 |
| Cereals | | 12.5 | 7.5 |
| Pulses | | 5.0 | 5.0 |
| Sugarcane | | 50.0 | - |
| Cotton | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 7.5 |
| Groundnut | | 12.5 | 7.5 |
| Gingelly | | 12.5 | 7.5 |
| Sunflower | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 10.0 |
| Castor | Varieties | 12.5 | 7.5 |
| | Hybrids | 15.0 | 10.0 |
| Coconut–Varieties/hybrids | | 1 kg / tree / year | - |

### 22. Fine tuning enriched farmyard manure preparation

**Existing practice:** Mix the recommended dose of P in terms of super phosphate / rock phosphate with 750 kg farmyard manure, moisten and keep in an anaerobic condition for 45 days.

**Improved method of EFYM preparation:** The Enriched Farmyard Manure compost is prepared by using 10 kg of rock phosphate and 10 kg of each biofertilizers *viz., Azospirillum*, *Azotobacter* and *Phosphobacteria*. All the above are thoroughly mixed with 1000 kg of well decomposed and powdered farmyard manure on dry weight basis and made into a heap and kept for 60 days for composting under shade with 60% moisture.

Enrichment for micronutrients / micronutrient mixtures may be done by mixing required quantity of micronutrient with FYM in the ratio of 1:10 and incubated for 30 days.

## WATER TECHNOLOGY CENTRE

### 23. Reorienting research for addressing the changes in the ground water level

As per the recommendations, research projects are carried out by including ground water table fluctuations in the technical programme and necessary approval has been accorded by the Director of Research, TNAU, Director (WTC) and Director, Indian Institute of Water Management, Bhubaneshwar.

- Studies on rainfall variability and ground water dynamics in Tamil Nadu are under progress.
- Studies on conjunctive use of surface and groundwater in tank and canal command areas of Periyar Vaigai, Lower Bhavani and Amaravathi basins are under progress.
- Studies on the relationship between ground water table and ground water quality in Amaravathi basin are under progress.
- Studies on augmentation of ground water by artificial recharge structures in Amaravathi basin are under progress and
- Studies on water productivity in rainfed, tank and canal commands with particular reference to groundwater are under progress in Bhavanisagar.

## AGRICULTURAL ENGINEERING COLLEGE AND RESEARCH INSTITUTE

### 24. Farm mechanization suitable to all ecosystems

Farm machinery/implements are available for different crops as detailed below:

**Paddy:** Tractor/power tiller cage wheel, puddler, roto puddler, land leveler, drum seeder, walk behind/ride on transplanters, cono weeder, finger type rotary weeder, power weeder, reapers, reaper binder, combine harvester and straw baler.

**Groundnut:** Tractor drawn cultivator seed drill, inclined plate planter, peg type/star type weeder, commercial power weeder, tractor drawn groundnut harvester, groundnut thresher and groundnut stripper. The development of prototype groundnut combine harvester suitable for raised bed system/ridges and furrows is in progress.

**Pulses:** Tractor drawn cultivator seed drill, peg type/star type weeder, multi crop thresher and CLAAS combine harvester for pulses.

**Maize:** Hill drop planter, Inclined plate planter, peg type/star type weeder, power weeder, self propelled reaper, maize combine harvester, maize husker sheller.

## 25. Economic utilization of agricultural byproducts

The agricultural residues can be converted into high energy intensity fuels by using briquetting technology. The agricultural residues like cotton stalks, soybean stalks and pigeon pea stalks were selected for briquetting purposes. The proximate analysis of selected feedstocks was determined and compared with that of briquettes. The volatile matter of the selected raw samples was in the range of 71 -73% and ash content was found to be 2.93 – 8.04%. Different combinations of low and higher calorific value feedstocks were mixed and briquettes were prepared with different diameters by ram and die briquetting. The quality parameters of briquettes were also analyzed and calorific value of these briquettes ranged from 3660 - 3910 kcal/kg. The cost of one ton of raw material varies from Rs. 1500 to 2400 per tonne and it may depend on feedstock, transport and collection area. The selling cost of the value added product obtained from biomass residues (*i.e*., briquettes) is Rs. 3000 - 4200/- per tonne.

## 26. Development of turmeric harvester and stripper, seed to seed mechanization for sugarcane and development of appropriate sugarcane harvester for harvesting the bend canes

Tractor and power tiller operated turmeric harvesters were already developed and released by TNAU.

A commercial model tractor operated potato digger (based on PAU model) was partially modified by removing the central coulter wheels. The harvester was tested for its suitability for harvesting turmeric at ARS, Bhavanisagar and found suitable for harvesting turmeric. The field capacity of the unit was 0.07 ha/h. The percentage of dug rhizomes varied from 94.5 to 96.5 per cent.

**Sugarcane mechanization**

Available machinery for sugarcane cultivation are as follows

1. **Land preparation:** Commercially available tractor drawn disc plough, rotovator
2. Seed bed preparation: Commercially available Tractor drawn ridger
3. **Seed preparation:** TNAU model sugarcane sett cutter, CIAE model sugarcane bud chipper – manually operated / motor operated / pneumatic operated
4. **Planting:** PAU model / commercial model tractor drawn cutter planters
5. **Weeding:** TNAU model power weeder, TNAU/PAU model Tractor operated three row weeder
6. **Shredding trashes :** Commercially available tractor drawn shredder
7. **Harvesting:** A tractor operated sugarcane harvester was developed under AICRP on FIM, AMRC, TNAU in collaboration with a farm machinery manufacturer. Field testing of the harvester is in progress.

   Two crop dividers are provided in the front of the harvester for lifting the lodged canes.

## SEED CENTRE

### 27. Notified varieties in green manure crops for seed production

TNAU has released the following green manure crops varieties which are not yet notified.

| Crop | Variety | Year of release |
|---|---|---|
| Sunnhemp *(Crotalaria juncea)* | CO 1 | 1983 |
| Manila agathi *(Sesbania rostrata)* | CO 1 | 1997 |
| Kolingi *(Teprosia purpurea)* | MDU 1 | 2008 |

However, the list of notified varieties in green manure crops at National level as is follows.

| Crop | Variety | Notification No. | Date of Notification |
|---|---|---|---|
| Sunnhemp *(Crotalaria juncea)* | SUN-053 | O.S. 2187(E) | 27-08-2009 |
| | 2 PAU-1691 (CROTA-L1) | S.O. 1108(E) | 08-05-2008 |
| | NARENDRA SANAI-1 | 122(E) | 02-02-2005 |
| | SAILASH (SH-4) | 122(E) | 02-02-2005 |
| | LAKSHMI | 13 | 19-12-1978 |
| | CHHINDWARA-1(JABALPUR-1) | | 01-01-1973 |
| | K-12YELLOW | | 01-01-1973 |
| Dhaincha *(Sesbania aculeata)* | PANT DHAINCHA-1 | 122(E) | 02-02-2005 |
| | DH-2 | 122(E) | 02-02-2005 |

## CENTRE FOR AGRICULTURAL RURAL DEVELOPMENT STUDIES

### 28. Market oriented survey for export

The following projects have been taken up to address the recommendation.

- Assessing the export trend for Non Basmati Rice in Tamil Nadu
- Value chain analysis for hybrid maize, potato, guava, small onion and banana
- Market study of hybrid corn seeds in Salem and Perambalur Districts of Tamil Nadu.
- Production, post Harvest value chain and export competitiveness of potato.
- Value chain analysis of guava in Dindigul District of Tamil Nadu.
- Value chain analysis of small onion in Perambalur Dist. of Tamil Nadu.
- A Study on Value Chain of Banana in Tamil Nadu.

### 29. Sensitizing the farmers for market-led agriculture by rendering crop advisory and market information through AMI&BPC

To sensitize the farmers on Market led agriculture and to provide crop advisory, the following activities were under taken

- Establishment of Back Office at TNAU to interface with e-Resource Division of Agro Marketing Intelligence and Business Promotion Centre (AMI&BPC), Trichy
- Sustaining e-Velanmai (TNAU model) in Tamil Nadu
- MRIN project on Market led Agriculture was conducted by the Department of Market Extension during 2014.

## DEPARTMENT OF AGRICULTURAL MARKETING, CHENNAI

### 30. Strengthening the post harvest infrastructure facilities to handle marketable surplus (Agrl. Marketing, Chennai)

Post-harvest loss of food grains and perishables is substantial because of which post-harvest management activities are considered as an integral part of agricultural production system. Equipping the farmers to handle their marketing surplus by creating appropriate infrastructure would increase the economic benefits to them.

The infrastructure facilities available for agricultural marketing in rural areas of Tamil Nadu are inadequate and hence every year, Department of Agrl. Marketing is creating infrastructure facilities for marketing and post-harvest management (storage godowns, cold storage, specialized market complexes, drying yards, equipments for value addition, technical and capacity building trainings, etc.,) after assessing the infrastructure gap by considering the need of the farming community, marketable surplus of farm produce in a locality, availability of suitable land, accessibility for transportation, etc.,

Marketing and post-harvest Infrastructures like Transaction Shed, Banana Ripening Chamber, Integrated market complex, Storage godown, Cold storage for fruits and vegetables, Market Complex and Traders shop in Regulated Markets of various districts are established at a total cost of Rs.64.75 crore under National Agriculture Development Programme and Market Committee fund.

### 31. Promotion of commodity groups, farmer producers, marketing organization and market linkage through SFAC and AMI&BPC

Commodity Group Formation and linking Commodity Groups with Traders through MoU are need of the hour for realization of better income by farmers. Agri Business Centres created under IAMWARM play major role to empower techno-economic support to the farmers, promote infrastructure utilization and ultimately improve the economy of the farmers. Through Market linkage, 3,200 Commodity Groups covering 15 major commodities were formed and 2,457 MoU have been made between Farmers and Traders.

Tamil Nadu Small Farmers' Agribusiness Consortium (TNSFAC) is the nodal agency for promoting FPOs in Tamil Nadu. During 2014-15, for the following lead commodities under National Agriculture Development Programme and National Mission for Sustainable Agriculture, 20 Farmer Producer Organizations are being promoted over a period of 3 years by TNSFAC in coordination with Agro Marketing Intelligence and Business Promotion Centre, Trichy.

| Commodity for FPO | Districts |
|---|---|
| Millets | Dharmapuri, Virudhunagar, Tiruvannamalai, Cuddalore |
| Vegetables | Coimbatore |
| Mango | Krishnagiri |
| Guava | Dindigul |
| Banana | Trichy |
| Chillies | Ramanathapuram |
| Pulses | Dharmapuri, Krishnagiri, Vellore, Tiruvannamalai, Thanjavur, Nagapattinam, Salem, Madurai, Pudukottai, Villupuram |
| Pulses and Millets | Villupuram |

The projects implemented to promote commodity groups and FPO are given below.

- Technical Assistance is being provided to Agro Marketing Intelligence and Business Promotion Centre, Trichy for forming commodity groups and producer organization for important commodities. (Establishment of Back office at TNAU to interface with e-Resource division of (AMI&BPC), Trichy)
- Five tapioca commodity groups have been formed in Attur Taluk of Salem district. Training on production and value addition of Tapioca have been given and the results are presented in the research highlights (Dissemination of improved tapioca production technologies and value addition techniques among SC/ST tapioca growers for their economic upliftment in Salem district of Tamil Nadu.
- Farmers Preference and perception towards commodity group was assessed for vegetable crops. (A study on preferences and perceptions towards covai pandal vegetables growers association in Coimbatore district).
- Organisation functions and strategic analysis of Farmer Producer Organisation in Tamil Nadu has been taken up and is in progress.
- A proposal on Functioning of Farmers Commodity Groups: A Performance Analysis was sent to NABARD for funding.

**32. Encouraging private players in marketing, value addition, infrastructure facilities and food processing under Public Private Partnership mode**

The Department of Agrl. Marketing has taken initiatives for setting up of Modern Terminal Market Complex for fruits, vegetables and other perishables in important regions by encouraging private investment on Build, Own and Operate (BOO) basis in PPP mode. Terminal Markets at Chennai, Madurai and Coimbatore regions are being established in Tamil Nadu. For Coimbatore region, Terminal Market Complex is being established in Perundurai by the selected Private Enterprise M/s.SPAC Terminal Market Complex Ltd with a project cost of Rs.120.62 crore.

- Terminal Market Complex for Chennai region is to be established in 35 acres of land in Navalur village, Sriperumbudur taluk, Kanchipuram District with a project cost of Rs.135.00 crore by the selected Private Enterprise M/s URC Construction Private Ltd who have formed a special purpose vehicle namely Ulavar Kalanjiam Limited for implementation of the project.
- For establishment of Terminal Market Complex in Madurai Region with a project cost of Rs.120.06 crore, 50 acres of land has been selected in Mukkampatty and Thiruvathavur villages in Melur Taluk, Madurai District. The selected private Enterprise M/s.R.R Industries Limited and consortium partners have formed a Special Purpose Vehicle namely M/s Bhumi Agri Markets Pvt Ltd.
- In order to encourage private players in marketing, the existing situation were studied. Research studies, capacity building programmes, awareness campaign etc. were conducted. The details are given below:
- Banana Producer Organisation in Theni district was studied and the results are presented in the Research highlights (A study on value chain of banana in Tamil Nadu.)
- Value chain analysis on potato, guava were carried out and assessed the infrastructure requirement.
- Production, post harvest value chain and export competitiveness of potato.
- Value chain analysis of guava in Dindigul district of Tamil Nadu.
- Capacity building programme on commodity futures market was conducted in Cuddalore, Virudhachalam, Paiyur, Vamban and Ooty. A total of 365 scientists including department officials and research scholars were sensitised regarding the commodity futures market. It was sponsored by Forward Market Commission, Government of India.
- Three awareness campaigns and 8 trainings on tapioca production and 10 trainings on value addition were conducted. (Dissemination of improved tapioca production technologies and value addition techniques among SC/ST tapioca growers for their economic up liftmen in Salem district of Tamil Nadu.
- Two days training on organic farming was conducted at Madurai during 25$^{th}$ & 26$^{th}$ Nov. 2014.
- Training on organic management and production / quality control of organic inputs (bio-fertilizers and organic fertilizers)" conducted at Madurai 9$^{th}$ to 13$^{th}$ March 2015.
- Value chain mapping and value chain analysis of maize used in poultry feed industry in Tamil Nadu

**33. Increasing food processing and value addition facilities through National Mission on Food Processing and through incubation cum training centre**

- National Mission on Food Processing is a centrally sponsored scheme implemented from the year 2012-13 to 2014-15 by Ministry of Food Processing Industries and Government of Tamil Nadu in the ratio of 75:25.Department of

Agricultural Marketing and Agri Business is the State Nodal Agency for the implementation of the scheme. So far, grant-in aid of Rs.17.44 Crore has been sanctioned to 47 Food Processing Projects. National Mission on Food Processing is now delinked from GOI for funding.

- Further, to encourage Private Entrepreneurs in Food Processing venture, Food Processing Incubation-cum-Training Centres are established in Srirangam region, Trichy Dist and in Kinathukadavu region, Coimbatore Dist at a total cost of Rs.2.20 crore.

**34. Linkage between production, market, producer and consumer**

Farmers are mobilized into groups and federated as Farmer Producer Organizations to plan and implement product-specific cluster / commercial crop cycles for enhanced productivity. Facilitated access to fair and remunerative markets including linking of producer groups to marketing opportunities through market aggregators are undertaken with support from the Department. During 2014-15, promotion of 20 Farmer Producer Organizations is in progress.

**35. The barren and fallow land to be brought under the cultivation to avoid shrinking land area under cultivation (Director of Agriculture, Chennai / CARDS)**

The issue on bringing barren and fallow land under cultivation was addressed by the following projects.

- Agribusiness models for effective utilization of wasteland of Villupuram district was proposed. Baseline survey was conducted in Alanguppum village, Marakkanam block and Melathanur village, Olakkur block. IFS, agro forestry and agribusiness models were proposed for the selected villages.
- Dynamics of land use and agricultural performance in Tamil Nadu
- Impact of land use change on the livelihoods of farmers in Coimbatore and Dharmapuri districts

The Ongoing studies are

- Techno-economic empowerment of dry land farm women for livelihood security under Millet based eco-system-whole farm approach (GOI - DST – SEED Sponsored: Rs. 14,18,000)
- Sustainability analysis of dryland agro-ecosystem in Madurai district

**36. Taking up assessment of impact of area under micro irrigation**

- In view of increasing demand for water for farming, an assessment made during 2011 revealed that a total area of 5,28,440 ha could be brought under MIS out of the total irrigated area of 9,90,794 ha in Tamil Nadu.

- The potential for expanding the MIS was 52 percent and the achievement was 32 percent as on March 2011.
- Among different crops, the coverage of MIS was faster in perennial crop coconut(63%) followed by vegetables, turmeric and tapioca(20% each).
- The potential for MIS was the highest in mango(100%) but the coverage was meagre(5%).
- In banana, out of 16% potential for MIS expansion, 12% was achieved.
- In sugarcane, only 13% of the area was covered with MIS against 60% of potential identified for expansion under MIS.
- It was observed that there was vast potential available for expansion of MIS provided with empowering the farmers with financial support.

**37. Construction of proper storage godowns to avoid wastage of perishable horticulture produce**

In the last four years, the Department has constructed 88 modern storage godowns with the capacity of 2.40 Lakh MT and 70 cold storage units with the capacity of 1,750 MT at a cost of Rs.150.56 Crores under NABARD-RIDF to minimize the post-harvest losses and to increase the shelf-life of farm produce.

## DEPARTMENT OF AGRICULTRUAL ENGINEERING, CHENNAI

**38. Development of agro processing industry in each district**

With the goal of promoting mechanization in post harvest management system, reducing the losses of perishable farm produce during storage period, implementing latest technologies for value addition of farm product and preserve its quality, disseminating and adoption of new technologies among farmers, and also for popularising the agricultural machinery/implements among the small/marginal/SC/ST/women/ other farmers through demonstration, the "Post Harvest Technology and Management" scheme was implemented in Tamil Nadu from the year 2014-15 with 100 percent Central Government assistance under the Central Sector Scheme.

The Government has sanctioned the Central Sector Scheme of "Post Harvest Technology and Management" for the year 2013-14 with a financial outlay of Rs.186.00 Lakhs towards the purchase of 22 Nos.of multi crop thresher, 27 nos.of maize husker sheller and 32 nos.of mini dhal mill and for conducting 109 nos.of demonstrations using multi crop thresher, 108 nos.of demonstrations using maize husker sheller and 110 nos.of demonstrations using mini dhal mill. The administrative sanction was issued by the Government vide G.O.(Ms).No.250 Agriculture (AE.1) Department dated:17-12-2013. The financial

sanction was issued vide Government, Agriculture (AE.1) Department, Chennai Letter (Ms) No.65 dated:04-06-2014.

Out of the sanctioned amount, Rs.176.20 lakhs towards the purchase of 22 nos.of multi crop thresher, 27 nos.of maize husker sheller and 32 nos.of mini dhal mill, an amount of rs.34.54 lakhs and rs.26.08 lakhs were incurred towards the settlement of bills for 22 nos.of multi crop thresher and 16 nos.of maize husker shellers respectively. The remaining machineries namely 11 Nos.of maize husker sheller and 32 nos.of mini dhal mill for a total amount of Rs.55.84 lakhs will be settled during the year 2015-16 towards the purchase to the firms.

Out of the sanctioned amount of Rs.9.80 lakhs towards the demonstrations of the above machineries, totally 71 nos.of demonstrations have been conducted upto 31-03-2015 and the balance will be conducted during the year 2015-16 for an amount of Rs.7.6728 lakhs.

This scheme is being implemented in Agricultural Engineering Department from the year 2014-15 in 30 districts of Tamil Nadu. After the completion of demonstration, for at least 12 months, the above machineries will be handed over to the SHG / TANWABE/ User Group/Farmers group/WUA/Commodity group in each district at 50% of the cost price of the machinery. The above said groups may in turn develop suitable agro processing industry in their respective districts in near future.

Model agro processing industries are to be established in 10 Backward districts viz.,Ariyalur, Dharmapuri, Krishnagiri, Perambalur, Ramanathapuram, Sivagangai, Thoothukudi, Tiruvannamalai, Viruthunagar and Salem for which preparation of Detailed Project Report is in progress.

**39. Strengthening of agricultural mechanization through financial assistance from NADP**

For promoting agricultural mechanization in a massive way the Agricultural Engineering Department has proposed the scheme of “Agricultural Mechanization in Tamil Nadu” under National Agricultural Development Programme during the year 2014-15 with an amount of Rs 3000.00 lakhs and for which the Government order was issued vide G.O.(Ms)No.118 Agriculture (AP1) Department dated: 28-08-2014. Out of the sanctioned amount of Rs.3000.00 lakhs, an amount of Rs.2999.67 lakhs was spent towards the distribution of 10653 nos. of agricultural machinery / Implements during 2014-15.

During the year 2014-15, to help the farmers to increase the area under kuruvai and also to increase the agricultural production and productivity, as per G.O.Ms.No.68 Agriculture (AP.1) Department dated:10.06.2014, totally 200 nos.

of paddy transplanters and paddy power weeders were purchased at a total cost of Rs.392.20 lakhs and Rs.48.40 Lakhs respectively and handed over freely to the farmers group formed in delta districts namely Thanjavur, Tiruvarur, Nagapattinam, Cuddalore, Trichy and Ariyalur districts. The farmers group will in turn hire out the paddy transplanter and paddy power weeders to the needy farmers on nominal hire charge basis besides their own farm use.

During the year 2014-15, an amount of Rs.410.00 lakhs was allotted as per G.O.Ms. No.28 Agriculture (AP.1) Department dated: 11.02.2014 under NADP to Vellore district towards the implementation of the scheme of "Promoting rural youth groups in farm mechanization in Vellore district" for the supply and distribution of agricultural machinery and implements which include capacity building, so that more area could be brought under mechanized cultivation. Out of the sanctioned amount of Rs.410.00 lakhs, an amount of Rs.409.92 lakhs was spent during 2014-15 for the distribution of agricultural machinery and implements and capacity building to the 50 nos.of rural youth groups.

During the year 2014-15, as per G.O.(Ms) No.118 Agriculture (AP1) Department dated: 28.08.2014 and G.O.(Ms) No.52 Agriculture (AP1) Department dated: 05.03.2015, the Government Orders were issued for giving a set of sugarcane cultivation machinery to 18 Nos of entrepreneurs with 40 % subsidy assistance for promoting mechanization in a custom hiring mode towards the implementation of the scheme of "Mechanized sugarcane cultivation through entrepreneur development in Tamil Nadu" with a financial outlay of Rs.997.88 lakhs under NADP. The scheme is to be implemented in co-ordination with Sugar Department / Sugar mills.

Totally 13 nos.of entrepreneurs have been selected by the District Level Executive Committees (DLECs) headed by the district collector in the districts namely Thanjavur, Trichy, Villupuram, Kanchipuram, Perambalur and Cuddalore. The identification of other entrepreneurs is also under progress. After getting the revalidation order from the Government, the scheme will be implemented during the year 2015-16.

# QUERIES AND ANSWERS

## CROP IMPROVEMENT

## PADDY

**Required quantity of breeders' seed of NLR34449 may be supplied to replace BPT 5204 which is being grown during samba season (Thiruvallur).**

NLR 34449, otherwise known as Nellore Mashuri, is a variety very popular in Andra Pradesh. Breeder Seeds of NLR 34449 is not produced since there is no indent from the Department of Agriculture. From TNAU, TKM 13, an alternative variety to BPT 5204 has been released during 2015. Breeder seed of TKM 13 will be made available after the notification. The department officials may provide the details about the spread of NLR 34449 in Tamil Nadu.

**Drought tolerant and less water requiring varieties shall be suggested (Vellore).**

The rice variety Anna (R) 4 and CO 51 are suggested for drought tolerant and less water recurring situations. The promising cultures: C8 06 803, CB 08702 and TM 09135 are found to be drought tolerant which are in testing under Adoptive Research Trials.

**Less than 10 year old short duration varieties suitable for *Sornavari, Samba, Navarai* Seasons shall be provided which shall be above or on par with the following ruling varieties viz. ADT 37, ADT 43, ADT 39, ADT 45 (Vellore).**

The newly released variety CO 51 is recommended for *Sornavari* and *Navarai* seasons which can replace ADT 43 and ADT 45. The variety TPS 5 is recommended to replace ADT 37.

**Varieties equivalent to improved white ponni shall be evolved (Vellore).**

Rice variety TKM 13 is suggested for replacing Improved white ponni. An improved rice culture viz. CBMAS14065 is found to have the attributes of Improved white ponni.

**Lesser duration varieties with fine grain quality shall be suggested (Vellore).**

CO 51, an early duration variety with fine grain quality can be recommended

**Farmers of Vellore District need a suitable scented paddy variety for *Samba* (July-September) sowing season with high yield potential (Vellore).**

CBMAS 14142, an aromatic rice culture with medium duration under MLT can be an alternative if it proves it's potential.

**Saline tolerant paddy variety suitable for this district may be suggested (Vellore).**

Rice varieties *viz.*, TRY 3 and CO 43 are suitable for salt affected areas of Vellore district. Another medium duration culture TR 09030 is under testing.

**Non-lodging paddy variety is in demand for samba season (Thiruvannamalai).**

Non lodging, rice varieties *viz.,* CO (R)50, ADT 49 and TKM 13 can be recommended for samba season. A fine grain culture CB 09123 which is under $2^{nd}$ year of testing in ART can be adopted.

**Performance of Improved White Ponni, ADT 37, ADT 43 and ADT 45 are performing well in Tiruvannamalai District hence these varieties are requested to be re-notified (Thiruvannamalai).**

Notifications of all the above mentioned varieties are still valid and can be recommended for the cultivation. Rice varieties *viz*. TKM 13, TPS 5 and CO 51 can be considered as alternatives to Improved White Ponni, ADT 37 and ADT 43/ADT 45 respectively.

**High yielding superfine paddy varieties resistant to blast and stem borer needed for samba season (Thiruvannamalai).**

Rice varieties *viz*. TKM 13 and ADT 49 are moderately resistant to blast and stem borer. These varieties can be recommended for samba season.

**For consumers' preference, white, short bold grain and medium slender grain varieties are preferred (Thiruvannamalai).**

CO 51 with medium slender grains and TPS 5 with short bold grains are suited for *navarai* season

**Restoration of original vigour of ruling varieties (*e.g.* IR 20, ADT 39, Improved white ponni and ADT 43) may be ensured and released as improved varieties (Dharmapuri)**

The genetic purity and yield potential of rice varieties *viz*. IR 20, ADT 39, Improved white ponni and ADT 43 and are maintained through regular maintenance breeding programmes. The best parameter for assessing the

adoption and spread of these varieties is breeder seed indent received from the Department of Agriculture. The year of release and the indents received for the above mentioned varieties are given below.

| Variety Name | Year of Notification | Breeder Seed Indent in Kgs (2014) | Breeder Seed Indent in Kgs (2015) |
|---|---|---|---|
| IR 20 | 19.12.78 | 1505 | 4000 |
| ADT 39 | 13.04.89 | 8485 | 10030 |
| I.W. Ponni | 13.04.89 | 4545 | 11610 |
| ADT 43 | 18.06.99 | 14250 | 4015 |

Considering the breeders' seed indents, it is very clear that these varieties are still popular among the farmers provided the seed production chain is maintained by the Department of Agriculture. Improved versions to the above mentioned varieties are developed and released through our regular breeding programmes.

**Varietal replacement for BPT 5204 (Sambha Mushri) (Krishnagiri)**

The rice varieties *viz.,* ADT 49, CO 49 and TKM 13 can be adopted for the replacement of BPT 5204. Besides the above mentioned varieties, rice culture CB 09 123 is in pipeline for the release.

**Paddy variety suitable for rainfed cultivation in the hilly tracts needs to be evolved (Salem).**

Anna (R) 4, a drought tolerant short duration variety can be popularized among the farmers.

**Paddy variety suitable for area (Veerapandi and Panamarathupatti blocks) affected by sewage water may be identified (Salem).**

Already available rice varieties *viz*. TRY 1, TRY 3, CO 47 and CO 43 can be tried for these blocks.

**Karur District receives water from Amaravathi only for three months. Hence, suitable short duration variety may be suggested (Karur)**

The rice variety CO 51 maturing in 105 days duration can be tried.

**Alternate varieties for ADT 45 and Improved White Ponni may be suggested (Perambalur)**

The rice variety CO 51 is the alternate one for ADT 45. Likewise the varieties *viz*. TKM 13, and ADT 49 with good cooking qualities and a remunerative market price are the best replacements for Improved White Ponni. An improved rice culture, CB MAS 14065 is under evaluation as an alternative to Improved White Ponni

**Alternate variety for CR 1009 may be suggested. Varieties with false smut tolerance may be evolved (Thanjavur).**

The rice variety CR 1009 is still popular in Thanjavur district. The recently released improved version of CR 1009 *Sub 1* with early submergence tolerance can also be tried. Evolution of false smut tolerant paddy variety is in progress

**High yielding, non lodging, pest and disease tolerant, photo insensitive paddy variety with less than 100 days duration and consumer preference is needed (Nagapattinam).**

The rice variety CO 51 is best suited for Nagapattinam district. However extra early rice varieties *viz.,* Anjali and Prasanna are recommended for the situation where less than 100 days variety is needed.

**Alternate varieties for ADT 43 and ADT 45 are needed (Thiruvarur).**

The rice variety CO 51 is suggested. The promising cultures *viz.,* CB 08504, TM07 335, AS 10024, TM 10085 may be suitable for Thiruvaur district considering their performance under two years of ART evaluation.

**Short duration paddy varieties with slender grains and consumer preference may be evolved (Pudukkottai).**

The promising cultures *viz.,* CB 08504, TM07 335, AS 10024, TM 10085 may be suitable for Thiruvaur district considering their performance under two years of ART evaluation.

**Short duration, drought tolerant, fine grain rice variety with good cooking quality suitable for direct sowing is needed (Sivagangai).**

The rice variety, Anna R 4 is suggested for Sivagangai district. Three promising drought tolerant rice cultures, TM 09 132, TM 09 135, CB 06 803 and CB 08702 will be evaluated in ART in the coming years.

**Paddy MDU 5 is best suited for Ramanathapuram with only 95 days duration and drought tolerance. But the cooking quality of MDU 5 paddy rice is sticky and not preferred by consumers (Ramanathapuram)**

The rice varieties *viz.* Anjali and Prasanna may be evaluated as they mature in less than 100 days. Anna (R) 4 is another drought tolerant rice variety suitable for Ramanathapuram district. The rice variety, CO 51 is a fine grain short duration rice variety suited to this district.

**In Thiruvadanai taluk of Ramanathapuram district, nearly 45,000 hectares are with BPT 5204. NLR 34449 is another variety grown in this taluk. Alternative varieties may be suggested. Short duration hybrid rice may be recommended (Ramanathapuram).**

The varieties TKM13, ADT 49 and CO 49 are recommended as replacement for BPT 5204 and NLR 34449. The rice hybrid CORH 3 may be evaluated in this district which has a shorter duration of 115 days with a high yield of 6500 kg/ha.

**The drought tolerant variety *viz.* Anna (R) 4 is being planned for cultivation during *Samba* season of 2015-16. For this, a total of 1000 kg of foundation seeds and 500 kg of Breeders' seed of Anna (R) 4 paddy is required. The breeders' and foundation seeds of TKM 13, ADT 49, CO 50, CO 51 and NLR 34449 (1100 kg Breeders' seed and 9500 kg of foundation seeds) are required (Ramanathapuram).**

Breeders' seed indent received from the Department of Agriculture and private agencies for the above varieties are given below. The production of foundation seeds is with State Seed Farms and other private seed producing agencies. Foundation seeds are not produced by the Research Stations of TNAU. Truthfully labeled seeds of these varieties will be made available to the farmers from the Research Stations of Tamil Nadu Agricultural University if produced.

| Variety Name | Year of Notification | Breeder Seed Indent in Kgs (2014) | Breeder Seed Indent in Kgs (2015) |
|---|---|---|---|
| Anna (R) 4 | 31.8.2010 | 2200 | 690 |
| ADT 49 | 26.6.2012 | 1550 | 2710 |
| CO 50 | 27.8.2009 | 500 | 2030 |
| CO 51 | 28.1.2015 | 5500 | 5960 |

Breeders' seeds of TKM 13 is not available since the variety is recently released and is under notification process. NLR34449, Nellore Mashuri is variety released from Andra Pradesh.

**The performance of ADT 49 and CO 49 (replacements for BPT 5204) is well in certain blocks of Madurai district. Foundation seeds of these varieties are required for further multiplication. The performance of CO 51 (alternate to ADT 45) is good under ART. Breeders' and foundation seeds of CO 51 is required for multiplication (Madurai).**

Breeders' seed indent received from the Department of Agriculture and private agencies for the above varieties are given below. The production of Foundation seeds is with State Seed Farms and other private seed producing agencies. Truthfully labeled seeds of these varieties will be made available to the farmers from the Research Stations of Tamil Nadu Agricultural University if produced.

| Variety Name | Year of Notification | Breeder Seed Indent in Kgs (2014) | Breeder Seed Indent in Kgs (2015) |
|---|---|---|---|
| CO 49 | 31.8.2010 | 150 | 1340 |
| ADT 49 | 26.6.2012 | 1550 | 2710 |
| CO 51 | 28.1.2015 | 5500 | 5960 |

**ASD 16, a short duration bold grain variety, non lodging nature is highly preferred by the farmer of T. Kallupatti and Sedapatti Blocks. An alternate short bold grain variety may be recommended (Madurai).**

The variety TPS 5 is an alternate short bold variety for ASD 16.

**Atchaya a private improved fine rice variety with high market preference occupies 40 percent of the area in Madurai District (especially Usilampatti, Madurai North and Thirumangalam Taluks). Eventhough this variety is highly susceptible to blast and sheath blight farmers are cultivating this for its higher price. A Separate study may be evolved regarding this variety and a new fine variety may be evolved (Madurai).**

Early duration fine grain rice culture AD 09219 and medium duration rice culture AD 08142 are under Adoptive Research Trials for testing.

**Paddy hybrid to replace the private commercial hybrids for *Samba* and *Navarai* seasons may be suggested (Dindigul).**

The rice hybrid CO RH 4 with 135 days duration is suited for samba season and CO RH3 with 115 days duration is suited to *Navarai* season. Hybrid cultures *viz*. TNRH 280, TNRH 241 and TNTRH 40 are under testing.

**A high yielding rice variety having the terminal drought tolerance may be suggested (Virudhunagar).**

The recently released MDU 6 is suitable with terminal drought tolerance. Anna (R) 4 can be another suitable variety for this district.

**Short and medium duration rice varieties with blast resistance and superior grain quality may be evolved to replace IR 50, ASD 16 and ADT 45. Recently released varieties viz. ADT 49, CO 50 and CO 51 may be promoted (Tirunelveli).**

TKM 13 is a superfine variety with moderate resistance to blast. TPS 5 is suited to this district to replace ASD 16. The variety CO 51 is suggested for replacing IR 50. Seeds of the varieties ADT 49, CO 50 and CO 51 will be supplied for promotion.

**Paddy ASD 16 is being cultivated in larger area irrespective of seasons in Tirunelveli District. Severe blast incidence was observed in most of the ASD 16 cultivated fields (During *pishanam* 2004-05, 2006-07, 2007-08 and 2008-09). Suitable short duration Blast and tungro resistant short bold paddy variety to substitute ASD 16 may be evolved to overcome the blast susceptibility (Tirunelveli).**

The variety TPS 5 can be used as a substitute for ASD 16.

**The ruling variety during *Kharif* season is ASD 16 and during *Rabi* are TPS 3 and CR 1009. Alternate short bold grain type variety may be evolved to replace these varieties. Stem borer incidence is high during second season in rice varieties TPS 3 and CR 1009 (Kanyakumari).**

The variety TPS 5 can replace ASD 16 during *Kharif* season. TKM 13 is a fine grain rice variety with 135 days duration has moderate resistance to stem borer.

**Blast resistant superfine grain medium duration variety with to replace BPT 5204 needs to be evolved (Trichy).**

The rice variety TKM 13 and ADT 49 with medium duration are the best replacements for BPT 5204.

**ADT36 and ADT43 are widely cultivated in Trichy District both under *Kuruvai* and *Navarai* seasons respectively. Since these varieties show heavy lodging, alternative non-lodging varieties need to be evolved (Trichy).**

The rice variety CO 51 is the best alternative for ADT 36, ADT 43 and ADT 45 for both *Kuruvai* and *Navarai* seasons at Tamil Nadu

**Traditional Seeragasamba varieties are widely cultivated in Trichy District in Uppiliyapuram block. These varieties have low yield potential. Hence a suitable alternate variety with same grain quality of Seeragasamba coupled with high yield may be evolved (Trichy).**

The promising rice culture VG 09006 with duration of 132 days and a grain yield of 5343 kg/ha is identified with grain qualities of Seeragasamba and the culture is under the advanced stages of evaluation

**In Namakkal District nearly 4500 hectares (11 Revenue Villages of Pallipalayam block covered by Mettur canal system) is under IR20 rice variety though several other medium duration varieties are available. Considering the situation, the yield potential of IR 20 may be improved in the form of Improved IR 20 similar to the release of Improved white ponni (Namakkal).**

Efforts to improve IR 20 will be taken up based on the negativities of IR 20 in the areas of Namakkal district.

**During early *samba* season, farmers of Kolli hills block (1200 MSL) of Namakkal District are growing paddy variety "Wyanad II" which is having more than five months duration and with low yield potential. This variety is non lodging with poor tillering and red bold grains and is preferred by tribal community of this tract. An alternative variety may be suggested for the tribal farmers of Kolli hills (Namakkal).**

Seeraga samba is another variety grown in certain areas of Kolli hills. Considering this, VG 09006, a promising rice culture in the advanced stages of evaluation with duration of 132 days and a grain yield of 5343 kg/ha having the grain qualities of Seeragasamba can be tried as an alternative to Wyanad II.

**Among the ruling varieties, the varieties *viz*. ADT 36, ADT 39, ADT 43, ADT 45, CR 1009, CO43, and BPT 5204 were released more than ten years before. These varieties may be replaced with suitable varieties with superior grain quality, consumer preference and marketability (Ariyalur).**

The rice variety CO 51 can replace ADT 36, ADT 43, ADT 45, CO 47 to replace ADT 39, ADT 49, CO 49 and TKM 13 to replace BPT 5204, CO 43 Sub 1 to replace CO 43 and CR1009 Sub 1 to replace CR 1009 are recommended.

**BPT 5204 is ver popular among the farmers of Thoothukudi because of its superior grain quality and market price. However, this variety is susceptible to balst disease. Condisering this problem, an alternative variety to BPT 5204 may be suggested. Similarly, a blast resistant short duration variety to replace ASD 16 may be suggested (Thoothukudi)**

The rice varieties ADT 49 and TKM 13 will meet all the requirements as requested. The promising rice culture, CB 09123 is also found to be high yielding and blast resistant as revealed by two years of ART. Short duration rice variety TPS 5 is a substitute for ASD 16.

## MILLETS

**Suitable high yielding varieties of Cumbu, Ragi and Maize for both *Kharif* and *Rabi* seasons may be suggested (Thiruvallur).**

CO (cu) 9 variety and CO 9 hybrid in Cumbu , CO 14 and CO 15 in Ragi and CO 6 hybrid in Maize are suited for *Kharif* and *Rabi* seasons

**Recently released maize hybrids on par with private hybrids may be suggested (Vellore, Tiruppur, Perambalur, Pudukkottai, Namakkal, Ariyalur, Tuticorin).**

Four high yielding single cross maize hybrids *viz.*, CO6 (105days), COH (M)7 (110days), COH(M)8 (90-95days) and COH(M)10 (90-95 days) have been released by Tamil Nadu Agricultural University during 2012 and 2013. These hybrids are highly suitable for cultivation both under irrigated and rainfed conditions.

**Any new high yielding variety of maize (not hybrid) released from any Research Institute/ICRISAT to take up seed production by the farmers (Coimbatore)**

CO 1 maize was the only variety released. All the public and private agencies release only the single cross hybrids for cultivation.

**Short duration Hybrid maize suitable for Cauvery delta may be suggested (Thanjavur).**

Two hybrids COH(M) 8 and COH(M) 10 with 90-95 days duration and high yield are suited for Cauvery delta

**Recently released high yielding varieties in Sorghum for the *Kharif* season may be suggested (Vellore, Salem, Thiruppur, Karur and Thoothukudi ).**

TNAU sorghum variety CO 30 is dual purpose variety with an average grain yield of 2800 and 3600 kg /ha and fodder yield of 7 and 9 tonnes/ha in rainfed and irrigated conditions respectively is recommended. Another dual purpose sorghum variety K 12 is also recommended.

**Recently released high yielding varieties in Cumbu for the *Kharif* season may be suggested (Vellore and Thoothukudi)**

Cumbu composite CO (cu) 9 and hybrid CO 9 are high yielding and suited for both rainfed and irrigated situations. The required quantity of breeder seeds will be supplied based on the indents placed.

**The varieties of Panivaragu, Varagu and Kudiraivali suitable for the plain areas of Thiruvannamalai District (Thiruvannamalai).**

CO 3 in Varagu, CO (PV) 5 in Panivaragu and CO (KV) 2 in Kudiraivali and are the high yielding varieties suited for plains of Thiruvannamalai District.

**The existing CO4 samai variety may be replaced with new variety suitable for kharif season with drought tolerance (Dharmapuri)**

Samai variety CO 4 was released during 2006 is the ruling variety with high yield potential. This variety is also suited for rainfed conditions of Dharmapuri district. TNAU 142, an advanced culture is under advance testing in ART.

**Suitable drought resistant ragi variety for direct sowing in rain fed areas may be released to replace GPU 28 and GPU 67 which are highly preferred by the farmers (Salem)**

Variety CO 14 with 110 days duration and CO 15 with 125 duartion are suitable for Salem district for direct sowing under rainfed situations. Ragi variety CO 15 is released during 2013 to replace GPU 28 in ragi growing areas. The average grain yield of CO 15 under rainfed condition over 78 trials is 2950 kg which is 22 per cent increase over GPU 28 (2425 kg/ha). Both the varieties are suited for rainfed conditions.

**K-6, a pure line selection variety from 'sencholam' notified during the year 1982 is the major variety for rainfed condition in Madurai District. A new variety may be evolved to replace K-6 Cholam variety (Madurai)**

Recently released dual purpose sorghum variety K 12 is also recommended. It has recorded an average grain yield of 3000 kg/ ha which was 16.90% and 24.70% increase over the checks K 8 and CSV 17, respectively. It also recorded dry fodder yield of 11.50 t/ha which is 34.20 % increase over K8 sorghum variety. K 12 sorghum variety is shorter in duration which matures in 95 days.

**Suitable sorghum hybrid for rainfed and irrigated conditions of Trichy district may be suggested (Trichy)**

TNAU hybrid Sorghum Co 5 is suitable for cultivation all over Tamilnadu both under rainfed and irrigated conditions with grain yield potential of 2792 kg/ha and 4355 kg/ha respectively.

## PULSES

**The required quantity of Breeders' seed of CO 8 Greengram may be supplied (Thiruvallur)**

The variety CO 8 was notified during March 2015. The required quantity of Breeders' seed will be made available based on the indents placed. However, truthfully labeled seeds of this variety are available in the Department of Pulses, CPBG, Coimbatore.

**LRG 41 variety of redgram has been widely popularized in Vellore for the past few years to replace SA1. Any other alternate variety on par with LRG 41 shall be suggested/evolved. Varieties suitable for Red gram transplantation shall be suggested with recommendations on spacing and seed rate (Vellore)**

Redgram CO 6 is suitable for cultivation in Vellore district as an alternative to LRG 41. CO 6 is also suitable for transplanting with spacing of 120cm x 60cm.

**Short duration redgram variety is needed for replacing VBN3. High yielding varieties with synchronized maturity are to be evolved in cowpea and greengram suitable for Tiruvannamalai District (Thiruvannamalai)**

- The redgram CO(Rg) 7 is a popular short duration variety suitable for cultivation throughout Tamil Nadu. The short duration cultures *viz*., CRG 11-03, CRG 2013-10, CRG 2012-20 are under advanced stages of evaluation.
- The greengram CO 8 possessing synchronized maturity and non shattering pods is a suitable variety for Tiruvannamalai.
- Cowpea varieties namely CO(Cp) 7 and VBN 1 were released for cultivation in Tamil Nadu. VCP 09-019, VCP 12-007 and ACM 55 are the promising cultures in cowpea which are under the advanced stages of evaluation.

**Redgram variety suitable for August-September late sowing may be suggested (Dharmapuri and Krishnagiri).**

The short duration (130-140 days) redgram CO(RG) 7 is suitable for late sowing condition of Dharmapuri district.

**The locally known *Kona kai* cowpea with resistance to rust and drought can be improved by adopting suitable breeding method (Dharmapuri).**

Local cowpea type *Kona kai* seeds from Dharmapuri area were collected and evaluated along with Paiyur 1 variety at RRS, Paiyur. The performance of the local type was not found to be superior to Paiyur 1. However, the local *Kona kai* cowpea will be exploited for its resistance to rust and drought.

**Red gram variety well suited for transplanting technique may be evolved for both vegetable and grain purpose like Bangalore Redgram-1 (Salem).**

The advanced vegetable type redgram culture *viz*. BSTR found to be superior in terms of yield based on the evaluation at RRS, Paiyur. The culture needs further evaluation to prove its superiority over other varieties.

**Yellow mosaic disease resistant pulse varieties with high yield potential may be evolved to increase the pulses production and income of the farmers (Salem, and Kanyakumari and Thoothukudi)**

High yielding varieties *viz*. CO 6, CO (Gg) 7, CO 8, VBN (Gg) and VBN (Gg) 3 in greengram and VBN 3 , VBN (Bg) 4 , VBN (Bg) 5 and VBN (Bg) 6 in blackgram are with resistance to yellow mosaic virus disease and hence may be recommended.

**New improved varieties for rice fallow pulses may be evolved (Only black gram variety available is ADT 3; notified in 1984 and completed 30 years ) (Thanjavur)**

Breeding work has been intensified to develop new rice fallow pulse varieties to replace black gram ADT 3 and greengram ADT 3. Black gram cultures *viz.,* TADT26 and ADBG 13-0041 have been identified and are being tested under rice fallow conditions. Till then, VBN 4 blackgram may be adopted.

**New improved pulse varieties suitable for irrigated conditions need to be evolved. The available blackgram variety ADT 5 completed 23 years of its notification (Thanjavur)**

The blackgram variety VBN 5 and TNAU Co 6 may be adopted which are suitable alternatives for ADT 5. The blackgram cultures TNJ 11029 and PBG 11-022 suitable for summer irrigated are under MLT.

**Red Gram variety with 90 days duration suited for January-February sowing season is needed (Thiruvarur)**

The super early varieties (90 days) are available from ICRISAT. ICPL 88039 and ICPL 87091 are extra early varieties. Redgram APK 1 was released for extra earliness.

**Black gram varieties to replace ADT 3 and ADT 5 may be evolved (Thiruvarur)**

The alternate variety for ADT 3 is VBN 4 blackgram and the alternate variety for ADT 5 is VBN 5. TNAU Co 6 may also be adopted. Blackgram cultures *viz*., TADT26 and ADBG 13-0041 alternate for ADT 3 and TNJ 11029 and PBG 11-022 alternate for ADT 5 are under the advanced stages of evaluation.

**VBN 6 is the only blackgram variety available with resistance to YMV. Non availability of breeders and foundation seeds is a problem (Pudukkottai)**

A total indent of 800kg VBN 6 breeder seed was produced and supplied as per the despatch instructions from breeder seed unit of CPBG. The responsibility producing foundation seeds rests with State Seed Farms under the Department of Agriculture.

**Among the ruling pulse varieties, VBN 5 is the only variety tolerant to Yellow Mosaic Virus disease. A suitable rice fallow pulse variety resistant YMV disease may be evolved (Tirunelveli)**

The advanced blackgram culture *viz.* KKB 05-011 is being tested in OFT under rice fallow conditions.

**In Thoothukudi district rice fallow pulses (Black gram) is cultivated in around 1000 hectares. ADT 5 is best suited and accepted by the farmers. Since the variety is released more than 10 years back, no scheme is available to support the variety. A variety with similar characters of ADT 5 may be evolved (Thoothukudi).**

The blackgram varieties viz. VBN 5 and TNAU Co 6 may be adopted as alternative to ADT 5.

## OILSEEDS

**In Vellore District Groundnut is being cultivated widely during *Kharif* season. The farmers are cultivating TMV 7 variety to a larger extent. An alternative variety for TMV 7 with drought tolerance may be evolved (Vellore, Salem, Thanjavur, Ramanathapuram Ariyalur, Tirunelveli and Permabalur).**

Breeding efforts for replacing the TMV 7 with high yielding ground nut variety is in progress. Varieties TMV Gn 13 and CO 7 has drought tolerance with high yield potential may be recommended. Semi spreading variety CO 6 may be recommended for rainfed situation.

**In parts of Arakkonam and Gudiyatham taluks red kernel variety is popular and was introduced from nearby parts of Andhra pradesh is being cultivated and it suits very well to the local agro-climatic conditions. This variety may be exploited in breeding programmes (Vellore).**

The Department officials are requested furnish the source material and details so that it can be suitably exploited in breeding programmes. The red kernel drought tolerant variety TMVGn 13 with high yield potential may be recommended.

**Groundnut varieties with bold kernels, high oil content and resistance to Tikka leaf spot disease is needed (Thiruvannamalai).**

Drought tolerant varieties TMV Gn 13 and CO 7 with high yield potential can be recommended. Bold seeded and high oil variety COGn 4 may be recommended.

**A suitable variety for the late sowing (*i.e*. August sowing) under both rainfed and irrigated conditions may be recommended (Dharmapuri, Krishnagiri and Salem).**

Bunch variety VRIGn 6 (2006), (CO 7 (2013) and semi spreading variety CO 6 (2010) may be recommended.

**Suitable alternate high yielding white gingelly variety to replace existing SVPR-1 variety may be evolved (Salem and Erode).**

High yielding culture VS 07-023 with white seed colour is under ART evaluation.

## COTTON

**In Vellore 100 percent of the cotton area is under BT cotton. Hence, suitable variety/hybrid shall be evolved/suggested for Vellore district since the private company hybrids such as DCH 32, RCH2, and TCHB 213 were found to be low performing in nature (Vellore and Dharmapuri).**

Tamil Nadu Agricultural University is not undertaking any attempt to evolve hybrids/varieties with Bt gene as per the policy of Government of Tamil Nadu

**Cotton varieties with synchronous suitable for single picking may be evolved (Dharmapuri, Virudhunagar and Thoothukudi).**

Research work is in progress to develop varieties with synchronous maturity suitable for single picking. TCH 1819 is currently under multi-location trials.

## SUGARCANE

**Sugarcane varieties with resistance to red rot and drought tolerance may be recommended (Vellore).**

- The following are the potential red rot resistant varieties suitable for cultivation: Co 86032, CoG 93076, CoG 94077, CoG 5, CoC (Sc) 22, CoC (Sc) 23 and TNAU SC Si 8.
- The following are the potential varieties with drought tolerance suitable for cultivation: CoSi6, CoG 93076, CoG 94077, CoG 5, CoC (Sc) 22, CoC (Sc) 23 and CoC (Sc) 24.

## CROP MANAGEMENT

## PADDY

**Physiology: Studies on importance of silica nutrition in rice (Thanjavur)**

Foliar spray of Na silicate (0.5%) and silicon solubilizer-carrier molecule imidazole (0.2%) in combination at vegetative and panicle initiation stages resulted in higher leaf silicon content(1.26 mg $SiO_2$ $g^{-1}$ dry weight), increased photosynthetic rate (31.4 µ mole of $CO_2$ $m^2$ $s^{-1}$) and there by higher grain yield in variety CO (R) 50 (7536 kg/ha registering 8.5 % increase over control (6893 kg/ha).

**Monocropping of rice in the delta region coupled with unfavorable weather condition in an year lead to heavy incidence of pests/diseases. Suitable alternate cropping pattern may be recommended (Nagapattinam)**

Whenever water is not available for raising rice crop during *kuruvai* season, minor millets like *kuduraivalli* and *thenai* can be cultivated.

**Promoting Anna 4 variety under direct sowing condition** ( **Virudhunagar)**

Rice variety Anna 4 is already in recommendation specially for direct sowing condition

**Since there is an intrusion of sea water into the borewells / in seashore areas of Cuddalore, Kurinjipadi, Parangipettai, the electrical conductivity of this water ranges from 4-7 which leads to crop withering if irrigated with this water. Suitable remedial measures may be suggested (Cuddalore)**

- Mixing of good quality irrigation water with poor quality water
- Impounding of rain water and leaching before planting.

- *In -situ* incorporation of dhaincha (6.25 t/ha).
- Planting salt tolerant rice varieties viz., TRY-1 and TRY-2
- Excess application of nitrogenous fertilizers (25%)
- Foliar spraying of 2% urea and 0.2% zinc sulphate during $25^{th}$ and $35^{th}$ day after planting
- Foliar spray of 2% DAP + 1% KCl (MOP) during critical stages
- Seed treatment + soil application +foliar spray of Pink Pigmented Facultative Methylotrops (PPFM)

**Suitable weed management practice for machine transplanted rice cultivation (Villupuram)**

The existing weed management practices for conventional method of rice cultivation viz., pre emergence application of Pretilachlor / Butachlor 1.0 kg /ha followed by one hand weeding on 30 DAP holds good for machine planting situation as well.

**Recommendation of Granulated NPK pellets for SRI (Thiruvallur)**

Granulated NPK pellets have not been tried for rice under SRI.

**Studies on Zinc use efficiency for rice, since almost the entire region of CDZ is deficient in available zinc (Thanjavur).**

Tracer studies with $^{65}Zn$ in rice varieties have been carried out and the results showed that the Zinc use efficiency (ZUE) in rice did not exceed 1% of applied zinc sulphate in major rice grown soils of Tamil Nadu. Nearly 90% of applied zinc gets fixed in the surface soil.

Among the different sources of zinc tried, the zincated urea (3.54% ZUE) was better for rice due to the complemenary effect of accompanying Nitrogen.

Application of zinc sulphate in the form of enriched FYM at the ratio of 1:10 ($ZnSO_4$: FYM) incubated for 30 days at friable moisture, just before transplanting, is another way of increasing ZUE in rice.

**Management of heavy and fluffy rice soils of CDZ (Thanjavur).**

For fluffy paddy soils, compact the soil by passing 400 kg stone roller or oil-drum with stones inside 8 times at friable moisture level (13 to18%) in a cris-cross manner once in three years, to prevent sinking of draught animals and workers during puddling.

The heavy clay soils having poor permeability and higher nutrient fixation can be reclaimed by the addition of river sand at 100 t $ha^{-1}$, deep ploughing with mould board plough or disc plough during summer, forming contour and

compartmental bunds and adopting ridges and furrows to enhance the infiltration and percolation. Application of FYM or composted coir pith or pressmud at 25 t $ha^{-1}$ per year will improve the physical properties and internal drainage of the soil.

**Site and situation specific nutrient management in rice (Thanjavur).**

Site Specific Nutrient Management (SSNM) is plant based approach for feeding rice with nutrients as and when needed. The SSNM approach ensures application of fertilizers for location and season-specific conditions. With the SSNM approach, fertilizers are applied.

- at right time
- in optimum amount
- in the optimum ratio and
- with the appropriate method

to meet the deficit between rice demand for nutrients and the supply of nutrients from the soil and organic inputs.

**Components of SSNM**

The following tools and techniques are promoted for proper management of fertilizers.

- Leaf Colour Chart (LCC) to determine the correct time and amount of N fertilizer application
- Omission plot technique to calibrate the P and K fertilizer rate

**N management through LCC**

Application of 25 kg N / ha at 7 days after transplanting followed by 40 kg N / ha each time based on LCC – 4 for variety and hybrids and LCC-3 for white ponni from 14 days after transplanting in transplanted rice or 21 DAS in direct seeded rice. P & K through SSNM for Kuruvai and Thaladi season.

**Omission plot technique for P&K**

In the SSNM approach, fertilizer P and K rates are based on the yield difference between treatments with full fertilizer use of NPK and omission plots that receives all nutrients except for the omitted (0 P, 0 K). The main objective of this technique is to determine the soil indigenous P and K supplying capacity and develop fertilizer P and K recommendations for rice in a range of soils.

**P & K recommendation based on SSNM approach for different tract of Tamil Nadu**

| Location | Calibrated SSNM $P_2O_5$ | Fertilizer dose (kg / ha)* $K_2O$ |
|---|---|---|
| Cauvery old delta | 35 | 50 |
| Cauvery New delta | 35 | 80 |
| Coimbatore | 30 | 40 |
| Killikulam | 30 | 50 |
| Trichy | 35 | 50 |
| Ambasamudram | 40 | 50 |
| Bhavanisagar | 20 | 25 |
| Paiyur | 25 | 45 |
| Yethapur | 30 | 45 |
| Aruppukottai | 20 | 30 |
| Cuddalore | 30 | 50 |

**Technology to reduce Salinity of borewell water during Summer and Kuruvai (Thiruvarur).**

Reducing the salinity of borewell water is not possible. However, the salinity water can be managed by suitable crop, cultural and fertilizer practices.

**Reclamation of alkaline soil in direct sown paddy area of Sivagangai District (Pudukottai)**

The management strategies for reclaiming sodic soil are developed in a holistic manner not on specific situations. Hence the following technologies currently available may be used to overcome the problem. For the sodic soils (pH > 8.5, ESP > 15%, SAR >13), plough the soil at optimum moisture conditions, application of gypsum based on gypsum requirement, providing drainage and impounding water for leaching out soluble salts, green leaf manure application at 5 t $ha^{-1}$ 10 to 15 days before transplanting, addition of 25 % extra N along with 37.5 kg of zinc sulphate per ha.

**Proper Technology to maintain optimum C:N ratio in rice fields (Tirunelveli)**

- Application of high-quality residues like vermicompost and biocompost having C:N ratio below 25 promotes rapid decomposition and mineralization of N and increase active soil organic matter.
- Crop residues or any compost with narrow C:N ratio may be used.
- Incorporation of crop residues in soil after harvesting with bioinoculants or biomineralizers will maintain optimum C: N ratio in soils.

- Other ways to improve the organic matter content
- Regular Green manuring and Greenleaf manuring
- Practice of leaving residues of crops and cover crops in place, including root residues
- Annual crop rotation with a legume crop and legume residue incorporation is most effective in enhancing soil C. Tap root systems of legumes slowly decompose and build soil organic C considerably.
- Regular annual application of farmyard manure or organic amendments at 12.5 t $ha^{-1}$

**Since there is intrusion of sea water into the borewells / in seashore areas of Cuddalore, Kurinjipadi, Parangipettai, the electrical conductivity of this water ranges from 4-7 which leads to crop withering if irrigated with this water. Suitable remedial measures may be suggested (Cuddalore).**

The maximum tolerant limit for the EC in irrigation water is 1.50 dS $m^{-1}$ which is suitable for all crops and all types of soils. However if the EC of irrigation water exceeds 1.50 dS $m^{-1}$, dilution techniques may be adopted to bring down the EC to the desired level. As per the query, the EC of water is 4 to 7 dS $m^{-1}$ which is highly saline and suitable only for light and medium textured soils to grow tolerant crops such as Cotton, Brinjal, Curry leaf and Fodder grasses. For growing other crops, the water needs to be diluted with good quality water or rain water by 3 to 5 times (1:3 or 1:5). Aside, crops can be cultivated in ridges and furrows.

**Suitable Technology for foliar spray of micro nutrients (Tirunelveli)**

Similar to macronutrients, Soil testing for available micronutrients needs to be performed for micronutrient applications. When the soil test values go below the critical limit of the a particular micronutrient, there is a need for micronutrient fertilisation. Without soil testing, indiscriminate application of micronutrient fertilisers needs to be avoided. In addition to the soil application, foliar sprays are found to correct nutrient disorders in crop plants during the crop growth period. The details of foliar spray recommendations are given below.

**Generalized recommendation for foliar spray of micronutrient for crops**

| Element | Fertilizer | Concentration |
|---|---|---|
| Zinc | Zinc sulphate | 0.5 % |
| Iron | 1.0% Ferrous sulphate + 0.10 % Citric acid | |
| Manganese | Manganese sulphate | 0.2 % |
| Copper | Copper sulphate | 0.2 % |
| Boron | Boric acid / Solubor / Agribor | 0.2 % |
| Molybdenum | Sodium molybdate or Ammonium molybdate | 0.05 % |

Note: foliar spraying is to be given at 10 days interval in the morning or evening

## MAIZE

Fertigation schedule for Maize, Redgram and Cotton Crop is requested (**Erode)**

**1. Fertigation schedule for cotton with water soluble fertilizers**

| Crop stage | Dose (kg $ha^{-1}$) | | |
|---|---|---|---|
| | N | P | K |
| Initial stage (10 -30 days) | 35.0 | 61.0 | 0.0 |
| Development stage (31- 60 days) | 47.9 | 9.5 | 23.0 |
| Mid stage(61-90 days) | 47.6 | 4.7 | 22.7 |
| Late stage(91-110 days) | 19.9 | 0.0 | 29.2 |
| Total | 150.5 | 75.2 | 75.0 |

**2. Fertigation schedule for hybrid maize with water soluble fertilizers at (75 % RDF)**

| Stage(days) | Duration (days) | Fertilizer form | Fertilizer grade | | | Dose/ ha/day |
|---|---|---|---|---|---|---|
| | | | N | P | K | |
| Seedling (6 to 25 ) | 20 | MAP | 12 | 61 | 0 | 2.81 |
| | 20 | Urea | 46 | 0 | 0 | 0.93 |
| Vegetative (26-60 ) | 35 | PolyFeed | 19 | 19 | 19 | 2.14 |
| | 35 | Multi- K | 13 | 0 | 45 | 1.50 |
| | 35 | Urea | 46 | 0 | 0 | 2.14 |
| Reproductive (61-75) | 15 | PolyFeed | 19 | 19 | 19 | 2.75 |
| | 15 | Multi- K | 13 | 0 | 45 | 1.60 |
| | 15 | Urea | 46 | 0 | 0 | 4.50 |

Fertigation schedule for hybrid maize with normal fertilizers (100% RDF)

| Stage (days) | Duration (days) | Fertilizer form | Fertilizer grade | | | Dose / ha/day |
|---|---|---|---|---|---|---|
| | | | N | P | K | |
| Seedling (6 to 25 ) | 20 | DAP | 18 | 46 | 0 | 5.00 |
| | 20 | Urea | 46 | 0 | 0 | 2.50 |
| Vegetative (26-60 ) | 35 | DAP | 18 | 46 | 0 | 1.86 |
| | 35 | Urea | 46 | 0 | 0 | 4.29 |
| | 35 | MOP | 0 | 0 | 60 | 2.14 |
| Reproductive (61-75) | 15 | Urea | 46 | 0 | 0 | 4.13 |
| | 15 | MOP | 0 | 0 | 60 | 3.33 |

**3. Fertigation schedule for redgram at 75 % RDF through water soluble fertilizers**

| Stage (days) | Application time (DAS) | Quantity of nutrients (kg ha-1) | | |
|---|---|---|---|---|
| | | Urea | MAP | SOP |
| Seedling (1-30) | 10, 17 ,24 | 1.74 | 24.59 | 0 |
| Vegetative (31-90) | 31, 38, 45, 52, 59, 66, 73, 80 ,87 | 7.41 | 18.49 | 9.38 |
| Flowering (91-120) | 94, 101, 108 ,115 | 7.40 | 18.49 | 15.00 |
| Pod development (121-140) | 122, 129 ,136 | 8.14 | 0 | 13.13 |
| | Total | 24.68 | 61.46 | 37.50 |

**Fertigation schedule for redgram at 100 % RDF through conventional fertilizers**

| Stage (days) | Application time (DAS) | Quantity of nutrients (kg ha-1) | |
|---|---|---|---|
| | | Urea | MOP |
| Seedling (1-30) | 10, 17 and 24 | 10.85 | 0 |
| Vegetative (31-90) | 31, 38, 45, 52, 59, 66, 73, 80 and 87 | 16.28 | 10.38 |
| Flowering (91-120) | 94, 101, 108 and 115 | 16.28 | 16.60 |
| Pod development (121-140) | 122, 129 and 136 | 10.85 | 14.53 |
| | Total | 54.30 | 41.50 |

**Maize maxim spraying is tedious during flowering stage. Any other alternate to spray in early stages of maize growth may be suggested (Perambalur)**

It is recommended to have spraying of “Maize Maxim” at tassel initiation and grain filling stages to get maximum grain yield.

## MILLETS AND MINOR MILLETS

**Suggestions and recommendations on cultivation of minor millets in rice fallow condition is needed (Thiruvarur)**

Generally, minor millets are not recommended under rice fallow condition. In recent years, gingelly is suggested under rice fallow condition. Similarly, minor millets will be tested for their suitability.

**During the year 2014 Redgram sown in September in Erode District gave better yield than sown during August. Suitable sowing season for Redgram to Erode District may be suggested (Erode).**

Sowing time
a) Short duration varieties (Vamban 3, Co RG 7) :
Jan-May (Irrigated) , Sept – I fortnight ((Rainfed)
b) Long duration varieties (Vamban 2, Co 6, LRG 41) : July – August (Rainfed)

**Black gram: For Rice fallow pulses basal application of fertilizers may be studied and recommendations provided (Thiruvarur)**

For rice fallow blackgram, basal application of fertilizers are not recommended, to utilize the residual nutrients. However, foliar spray of DAP 2 % or pulse wonder @ 5 kg / ha can be sprayed twice at flowering and 15 days later.

## OILSEEDS

**Suitable high yielding varieties in paddy, millets, pulses and oilseeds that are highly responsive for organic farming may be recommended. Maintenance of coconut gardens under Moisture Stress Conditions may be suggested for Dindigul district (Dindigul)**

All traditional varieties in paddy, millets, pulses and oilseeds are well suited for organic farming. Drip irrigation can be done in coconut along with mulching with available coconut fronts and coconut coir pith.

## SUGARCANE

**To safeguard the farming community, standards and specification, active ingredient details to be regularized for organic pesticides, organic fertilizer and organic growth regulators. Sampling and testing procedure for the above organic products is required (Ariyalur).**

The suggestions made in respect to standards and specifications for organic pesticides, organic fertilizers and organic growth regulators will be addressed if the Organic Farming Policy of the State is approved (which is under consideration by Tamil Nadu Government). At the Department of Sustainable Organic Agriculture the suggested activities will be included in research agenda of the future.

Once the Organic Farming Policy of the State comes into force, the testing protocols for organic inputs and products will come in to practice. However,

establishment of a new Biofertilizer and organic fertilizer (organic manures) Quality Control Laboratory funded by the Government of India under NMSA scheme is in progress in the Department of Sustainable Organic Agriculture, TNAU, Coimbatore.

## COTTON

**Cotton, maize drought mitigation techniques during critical crop growth stage may be suggested. Post emergence herbicide for small onion and cotton (Perambalur).**

For small onion, no post emergence herbicide is recommended, since it is a short duration crop. For cotton, evaluation of past emergence herbicides under progress.

**In Tirunelveli District, farmers have started using water soluble fertilizers in paddy, pulses and cotton to increase the yield. Hence suitable recommendations for foliar spray of water soluble fertilizers in paddy, pulses and cotton crops may be evolved (Tirunelveli).**

Water soluble fertilizers are generally not recommended for paddy and pulses. For cotton, test verification of water soluble fertilizers like potassium nitrate (13 - 0 - 45) and All 19 (19 - 19 - 19) at different concentrations will be carried out.

**GENERAL**

Tannery effluent affected area:

1) Recommendation of remedial measures for leather tannery effluent affected areas of Vaniyambadi and Ranipet areas. Cropping system (or) pattern with short duration variety may be suggested for conducting on trial basis in the farmer's field before recommending as a package.
2) Vellore district often faces acute water scarcity due to monsoon failure both for crop cultivation and for drinking water, since there are no perennial rivers in this district. The following points may be discussed.
   a) Wherever possible the cultivation of water loving crops like Paddy, Sugarcane may be discouraged and short duration crops with minimum water requirement like pulses, maize, ragi, groundnut and gingelly may be encouraged. In this regard an alternate cropping strategy may be suggested.
   b) The latest cropping technologies on seed to seed, package of practices can be given for Vellore region.
   c) The improved water harvesting technologies and its utilization may be suggested.

3) At present pesticide firms are manufacturing new pesticides especially insecticides and fungicides for paddy and cotton crop. Now we are recommending very old out dated pesticides which will not fulfill the needs of the farmers. So suitable pesticides for paddy, cotton may be recommended.
4) Instead of spraying the pesticide to control pests a new practice of using the pesticide by dissolving them in irrigation channel water-suggestions, Recommendations on this technology- requested.
5) Farmers of Vellore block need pulses hybrids esp. in redgram, blackgram and greengram crops. Some private companies already have already introduced some. Suggestions, recommendations on the above may be discussed.
6) Farmers are interested in taking up tobacco and indigo cultivation in Vellore. Recommendations / suggestions are needed in this regard.
7) Marketing scope for organic products shall be suggested.
8) As Vellore is more prone to drought like situations, drought mitigation measures shall be suggested (Vellore).

Recommendation for tannery affected area were given in crop production guide, 2012, page no: 321.

The recommendations are as follows:

Crops and varieties suitable for Tannery waste affected soils
Based on the results of field trials conducted at Vellore district, the following crops, trees and their varieties are recommended for the tannery waste affected soils

| **Crops** | **Varieties** |
|---|---|
| Cereals | : Rice (TRY 1, CO 43, Paiyur 1, ASD 16) |
| Millets | : Ragi (CO 12, CO 13) |
| Oilseeds | : Sunflower (CO 4, Morden) and Mustard |
| Cash crops | : Sugarcane (COG 94076, COG 88123, COC 771) |
| Vegetables | : Brinjal, Bhendi, Chillies, Tomato (PKM 1) |
| Flower crops | : Jasmine, Neerium, Tuberose |
| Trees | : Eucalyptus, Casuarina and Acacia |

The crops like pulses, maize, ragi, groundnut and gingelly are already recommended as alternate crops.
Pulses, gingelly and vegetable crops like cluster bean which require lesser water requirement can be cultivated in the place of rice at times of water scarcity.
Available Agri Tech Portal
*In-situ* water harvesting technologies like compartmental bunding for red soil and broad bed furrow for black soils may be followed.
Water harvesting can also be done through farm ponds.

Supplemental irrigation (1 or 2) can be given through sprinkler irrigation by utilizing farm pond water.
Tobacco is not tested under vellore conditions.
Certified organic farmers in the Vellore district are growing paddy, turmeric, banana vegetables besides perennial crops such as coconut, mango, coffee, and pepper.

- Based on the enquiry it is learnt that at present organic farmers of Vellore district are marketing their produce in the following ways.
- Local marketing through sandies, super market and personal contact.
- On line marketing (eg. www.skorganicfarms.com Mobile 9841787425 and www.organictapovana.com Mobile 99625 96848).
- Social networks (eg.Nallakeerai, 9962653311 and Arockya santhai, Mobile 9710999333).
- Organic farmers market outlets across the city – Fridays, 3 p.m (Mobile 9790900887).
- Since Vellore District is well connected with Chennai city growing awareness about organic products generates ample scope for marketing with premium
  8) Muching with crop residues can be done and antitranspirants like kaolin 6 % or potassium nitrate 1 % can be sprayed.

**Labour cost is more in harvest. Hence, Low Cost Benefit Ratio is realised. Suggestions requested (Theni).**

Machine harvesting could be taken up when labour scarcity arises at harvesting stage.

**Government of India has decided to extend seed subsidy under all schemes only for the less than 10 year old varieties. In this context, TNAU has to provide enough Breeder seeds for less than 10 year old varieties. All the 20 Automatic Weather Stations (AWS) installed in the district needs maintenance. At least one year weather data should be made available online for view instead of one month (Salem).**

- Discussion on mode of operation of Annual Maintenance Contract (AMC) for the Automatic Weather Station (AWS) with the supplier is in progress.
- The AMC will be initiated at the earliest and the maintenance will be taken care by the supplier.
- We are providing current, weekly and monthly data in the web portal for the betterment of farming community. These data can be saved as and when.
- Providing one year weather data in the public domain web will give chances for misuse of data by some of commercial providers. Hence, we do not provide one year data on the web.

- The one year data could be obtained from Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore by the Dept. of Agriculture officials, if request is forwarded through Joint Director of Agriculture.

**Dosage for different liquid biofertilizers may be given ( Erode)**

***Rhizobium***

Seed treatment

Dose : 50 ml / seeds required for 1 acre

Mix 50 ml of *Rhizobium* liquid biofertilizer with 250 ml of rice kanji, add this slurry to seeds required for one acre uniformly, shade dry the seeds for 30 min and sow the treated seeds within 24 hrs.

***Azospirillum, Azotobacter* and Phosphobacteria**

Seed treatment

Dose : 50 ml / seeds required for 1 acre

Mix 50 ml of *Azospirillum, Azotobacter* and Phosphobacteria liquid biofertilizer with 250 ml of rice kanji, add this slurry to seeds required for one acre uniformly, shade dry the seeds for 30 min and sow the treated seeds within 24 hrs.

Seedling root dipping

Dose : 150 ml / seedlings required for 1acre

Mix 150 ml liquid biofertilizer with 10 lit of water, dip the roots of the seedlings meant for 1 acre for 20 min and transplant the treated seedlings.

Soil Application in the Nursery/ Main Field

Dose : 200 ml /nursery area or 1 ac mainfield

Mix 200 ml of liquid biofertilizer with one liter of water, thoroughly mix with 10 kg of powdered FYM/ soil and broadcast in the nursery area /one acre of main field.

**PPFM**

Foliar spray

Dose : 1 ml /lt of water

Mix 200 ml of PPFM liquid biofertilizer in 200 liters of water and spray on the leaves so that the leaves are thoroughly wet either in the early morning / late evening twice at flowering and grain / fruit setting stages.

**Biofertigation**

Dose : 1-5 ml /lt of water

Mix liquid biofertilizers @ 1–5ml/ litre in the fertigation tank and irrigate the field with sufficient quantity of water depending on the crops / soil type. Maximum 500 ml liquid biofertilizer may be required for 1 ha. An interval of one week or 10 days should be maintained between fertigation and biofertigation.

**Low cost technology at farm level to produce Pink Pigmented Facultative methylotrophs (PPFM) to mitigate drought conditions effectively (Ariyalur)**

PPFM cannot be produced at farm level, since it is a bacterium which has to be cultured under aseptic conditions by using autoclaves, Laminar Air Flow chambers, incubators, fermentors, liquid filling machines, capping and sealing machines, etc. The aseptic conditions for production of PPFM cannot be maintained at farm level.

**Tannery effluent affected area:**

**1) Recommendation of remedial measures for Leather Tannery effluent affected areas of Vaniyambadi and Ranipet areas. Cropping system (or) pattern with short duration variety may be suggested for conducting on trial basis in the farmer's field before recommending as a package..**

**d) Tannery effluent tolerant crop varieties may be suggested. (Vellore).**

Recommendation for tannery affected area were given in crop production guide, 2012, page no: 321. The recommendations are as follows

Crops and Varieties Suitable for Tannery Waste Affected Soils

Based on the results of field trials conducted at Vellore district, the following crops, trees and their varieties are recommended for the tannery waste affected soils

**Crops Varieties**

| | |
|---|---|
| Cereals | : Rice (TRY 1, CO 43, Paiyur 1, ASD 16) |
| Millets | :Ragi (CO 12, CO 13) |
| Oilseeds | : Sunflower (CO 4, Morden) and Mustard |
| Cash crops | : Sugarcane (COG 94076, COG 88123, COC 771) |
| Vegetables | :Brinjal, Bhendi, Chillies, Tomato (PKM 1) |
| Flowering crops | : Jasmine, Neerium, Tuberose |
| Trees | : Eucalyptus, Casuarinas and Acacia |

**The farmers of Madathukulam and Udumalpet blocks use coir pith for mulching. Some of the farmers feel that the quality of ground water has changed and water has become salty due to excessive use of coirpith for mulching. Research may be undertaken in this aspect ( Tiruppur)**

Research will be undertaken in this aspect.

**Marketing scope for organic products in Vellore district shall be suggested (Vellore).**

Certified organic farmers in the Vellore district are growing paddy, turmeric, banana vegetables besides perennial crops such as coconut, mango, coffee, and pepper. Based on the enquiry it is learnt that at present organic farmers of Vellore district are marketing their produce in the following ways.

- Local marketing through sandies, super market and personal contacts.
- On line marketing (eg. www.skorganicfarms.com Mobile 9841787425 and www.organictapovana.com Mobile 99625 96848) including perishables
- Social networks (eg.Nallakeerai, 9962653311 and Arockya santhai, Mobile 9710999333).
- Organic Farmers Market Outlets across the city (Eg. Fridays, 3 p.m (Mobile 9790900887).

  Since Vellore District is well connected with Chennai city growing awareness on organic products generates ample scope for marketing with premium price at present and in future also.

## PLANT PROTECTION

## PADDY

**Studies on the ecology and management of different pests and their threshold levels have to be developed in rice and rice fallow crops (Thanjavur)**

- The ecology of the major rice insect pests like thrips, stem borer, leaffolder, brown planthopper, green leafhopper, gall midge, earhead bug has been studied and based on their bio-ecology and damage potential the threshold level for each pest have been fixed.
- Depending upon the threshold, the ETL (Economic threshold level) has been calculated for major pest and recommended.
- The ETL for major insect pests has been given in the Crop Production Guide, 2012 under rice – crop protection section.

| Insect pests | Economic threshold level |
|---|---|
| Thrips | 60 numbers in 12 passess or rolling of the 1$^{st}$ and 2$^{nd}$ leaves in 10 % of seedlings |
| Green leafhopper | 5/ hill at vegetative stage, 10/hill at flowering stage, 60/25 net sweep, In tungro endemic area 2/hill |
| Stem borer | 2 egg masses/m$^2$ or 10 % dead hearts |
| Leaffolder | 10 % leaf damage at vegetative stage and 5 % flag leaf at flowering |
| Brown planthopper | 1 hopper / tiller if there is no spider and 2 hopper/tiller if spider is present 1/hill |
| Earhead bug | 5 bugs/100 earhead at flowering stage, 16/100 earhead at milky stage |
| **Rice fallow pulses- black gram, green gram** | |
| Pod borers | 10% pod damage |

**It is observed that combined spray of 1 liter *Pseudomonas* with 1 liter curd arrest the BLB and Bacterial leaf streak diseases in paddy. This may be studied and suitable recommendations may be given (Thanjavur).**

**Precautionary measures for the control of brown planthopper (BPH) to be given (Namakkal)**

- The compatibility studies have to be taken up.
- In endemic areas avoid growing susceptible varieties like BPT 5204
- Provide rogue spacing 30 cm at every 2.5 m during transplanting
- Avoid closer planting in BPH prone areas during the particular season
- Effective irrigation management by intermittent draining
- Set up light traps or yellow pan traps to monitor and collect BPH population
- Avoid excess use of nitrogenous fertilizers, apply 'N' in split application at 3-4 times
- Encourage natural enemy population like spiders, mirid bugs and coccinellids. The natural enemy population can be protected by avoiding use of broad spectrum insecticides
- Prophylactic use of botanical insecticides like azadirachtin 0.03 % @ 400ml/acre or neem oil 3 % @ 6 lit/acre
- Avoid use of resurgence causing chemicals like synthetic pyrethroids, acephate, carbofuran, fenitrothion, phosphomidan and quinalphos
- Spraying of insecticides should be directed towards base of the plants
- Before use of any insecticides the water in the field should be drained for BPH management
- Avoid repeated use of same insecticide
- Any one of the chemical insecticide listed in the Crop Production Guide 2012 can be used.

**Bacterial leaf blight and neck blast problem in paddy BPT variety and rarely in other paddy varieties and difficult to control in winter season throughout Villupuram (Villupuram)**

**Management of bacterial leaf blight**

Two sprays of copper hydroxide 77 WP @ 1.25 kg /ha 30 DAP & 45 DAP

**Botanical / others**

- Spray fresh cow dung extract 20% twice (starting from initial appearance of the disease and another at fortnightly interval)
- Neem oil 60 EC 3% or NSKE 5% is recommended for the control of sheath rot, sheath blight, grain discolouration and bacterial blight

**Management of neck blast**

**Cultural method**

- Remove collateral weed hosts from bunds and channels
- Use only disease free seedlings
- Avoid excess nitrogen

- Apply N in three split doses (50% basal, 25% in tillering phase and 25% N in panicle initiation stage)
- Use resistant variety CO 47.

**Chemical control**

- Spray after observing initial infection of the disease, carbendazim 50WP @ 500g/ha or tricyclozole 75 WP @ 500g/ha or metominostrobin 20 SC @ 500ml/ha or azoxystrobin 25 SC @ 500 ml/ha

**Biological control**

- Seed treatment with TNAU Pf 1 liquid formulation @ 10 ml/kg of seeds
- Seedling root dipping with TNAU Pf 1 liquid formulation (500 ml for one hectare seedlings)
- Soil application with TNAU Pf 1liquid formulation (500ml/ha)
- Foliar spray with TNAU Pf 1liquid formulation @ 5ml/lit

## MILLETS AND MINOR MILLETS

**Management of post flowering stalk rot in maize crop (Pudukkottai).**

Management of post flowering stalk rot

- Follow crop rotation
- Avoid water stress at flowering time to reduce disease incidence
- Avoid nutrient stress. Apply potash @ 80 kg/ha in endemic areas
- Soil application of *Pseudomonas fluorescens* or *Trichoderma viride* @ 2.5 kg / ha + 50 kg of well decomposed FYM at 30 days after sowing

**Management of Ergot diseases in cholam and cumbu in rainfed condition when they do not have sufficient water for spraying (Theni).**

- Sowing period to be adjusted so as to prevent heading during rainy season and severe winter.
- Spray any one of the following fungicides at emergence of earhead (5 - 10% flowering stage) followed by a spray at 50% flowering and repeat the spray after a week if Necessary
- Mancozeb – 1000g/ha or Propiconazole 500ml/ha

**White grub management in rainfed maize (Perambalur).**

- Deep ploughing during summer to expose the life stages of white grub for desiccation and vertebrate predators (birds)
- Setting up of light trap during monsoon showers. Attract and destroy the adult beetles by erecting branches of Neem / Ailanthus / Acacia
- Small Neem / Ailanthus / Acacia trees surrounding the maize field may be sprayed with chlorpyriphos @ 2ml/lit after the first summer rain to kill the adult beetles congregate on the trees in the following day

**Integrated packages needed for the control of downy mildew in maize crop (Dindigul).**

- Use resistant TNAU maize hybrid CO-6
- Rogue out affected plants.
- Spray Metalaxyl + Mancozeb @ 1000g, and mancozeb 1000g/ha at 20 days after sowing

**White grub management in irrigated maize (Dindigul).**

- Deep ploughing during summer to expose the life stages of white grub for desiccation and vertebrate predators (birds)
- Setting up of light trap during monsoon showers. Attract and destroy the adult beetles by erecting branches of Neem / *Ailanthus* / *Acacia*
- Small Neem / *Ailanthus* / *Acacia* trees surrounding the maize field may be sprayed with chlorpyriphos @ 2ml/lit after the first summer rain to kill the adult beetles congregate on the trees in the following day
- Application of carbofuran 3%G @ 1.0 kg a. i. /ha or phorate 10%G 1 kg a. i. /ha mixed with 1 kg of sand in the affected area and also surrounding area with healthy plants. Irrigation should be done immediately for dissolving the granules or
- Application of chlorpyrifos 20%EC @ 1125 ml/ha

## COCONUT

**Preventive measures for Tanjore wilt disease in coconut (Krishnagiri).**

- Soil application of *Pseudomonas fluorescens* (Pf1) @ 100 g/palm + *Trichoderma viride* @ 100 g/palm/year or *Bacillus subtilis* (TNAU-Bs 1 mixture) @300g/ palm at 3 months interval.
- Apply 200g phosphobacteria and 200g azotobactor mixed with 50 kg of FYM/palm
- Green manure crops must be raised and ploughed *in situ*
- Neem cake 5 kg/tree must be applied along with fertilizers
- Aureofungin-sol 2 g + 1 g copper sulphate in 100 ml water or 2 ml of tridemorph in 100 ml water applied as root feeding.
- Forty litres of 1% Bordeaux mixture should be applied as soil drench around the trunk in a radius of 1.5 metre

**Occurrence of major diseases like Kerala Wilt, bud rot, stem bleeding, leaf spot and button shedding are more common coconut problems in Coimbatore District. Yield loss and sudden death of trees is also noticed. Hence, an effective Integrated Disease Management recommendation may be prescribed to overcome the problems faced by coconut farmers (Coimbatore)**

**Coconut Kerala wilt is prevalent in the western blocks of Kanyakumari District. Now the recommendation in practice is cutting and removal of the disease affected palms only. A suitable alternate methodology has to be evolved or a suitable variety resistant to this disease may be evolved (Kanyakumari).**

**Integrated disease management**

- Application of organic manure – FYM @ 25 kg/palm
- Soil application of bioagent, *Pseudomonas fluorescens* @ 200 g/palm along with neem cake 5 kg/palm
- Basin management with sunhemp @ 50 g/palm
- Mulching the basin with coconut leaves
- Applying balanced dose of chemical fertilizers (Urea – 1.3 kg; superphosphate – 2.0 kg; muriate of potash – 2.0 kg/palm/year)
- Basin irrigation - 200 litres of water once in four days

**Bud rot management**

- The infected tissues from the crown region should be removed and dressed with Bordeaux paste.
- Spray 1% Bordeaux mixture or 0.25% copperoxy chloride on the crown region as pre-monsoon spray.

**Leaf rot management**

(Disease associated with root wilt)

- Cut and remove the rotten portions of the spindle and the adjacent two leaves
- Pouring 300 ml of fungicidal solution containing 2 ml of contaf 5% EC around the spindle leaf
- Applying 20 g phorate 10G mixed with 200 g fine sand around the base of the spindle leaf

**In coconut, plant protection measures for the control of eriophyid mite may be suggested (Kanyakumari).**

**Integrated management package of eriophyid mite**

- Application of recommended doses of urea and super phosphate and an increased dose of muriate of potash to increase the plant tolerance to the mite infestation.
- Urea – 1.3 kg; super phosphate – 2.0 kg; muriate of Potash – 3.5 kg/tree/year
- Application of well decomposed farm yard manure @ 50 kg and neem cake @ 5 kg/tree/year.
- Soil application of micronutrients viz., Borax – 50 g/tree/year; gypsum – 1.0 kg/tree/year; Magnesium sulphate – 0.5 kg/tree/year.
- Basin cultivation of green manures like sunnhemp, cowpea, calapagonium etc. and incorporating in situ.
- Judicious irrigation and mulching with coconut leaves and husk in the basin.

- Spot (Topical) application of the following eco-friendly agents on the nuts during non-rainy season three times a year during Sept/ Oct, Jan/ Feb and May/June.

| Round | Eco friendly pesticides | Quantity/tree |
|---|---|---|
| 1 | Azadirachtin 1% | 5 ml in one lit. of water |
| 2 | Neem oil + Teepol | 30 ml in one lit. of water |
| 3 | Azadirachtin 1% | 5 ml in one lit. of water |

- Botanicals are to be applied in sequence indicated above at 45 days interval using rocker sprayer. Spray fluid should be applied at the crown region covering only the top six bunches during non-rainy season.

**Root feeding of monocrotophos and installing pheromone traps does not give 100 per cent control of red palm weevil. Hence, other control measures may be suggested Effective control of red palm weevil (Erode/Dindigul).**

- Besides installing lures the following measures are to be taken up to manage the red palm weevil.
- Maintaining field sanitation by removal and burning of dead palms affected due to red palm weevil to prevent further spread of the pest.
- Avoiding wounds on the trunk of the tree as these wounds would invite the red palm weevil to oviposit. Cutting of green fronds to be avoided and if needed, the fronds to be cut 120 cm beyond the stem.
- While installing lures, the lures need to be monitored regularly and trapped adult weevils to be killed.
- The crown and the axils of top most three leaves to be filled with a mixture of fine sand and neem seed powder or neem seed kernel powder (2:1) once in three months to prevent the attack of rhinoceros beetle damage in which the red palm weevil lays eggs.
- Setting up of attractant traps (mud pots) containing sugarcane molasses 2½ kg or toddy 2½ litres + acetic acid 5 ml + yeast 5 g + longitudinally split tender coconut stem/logs of green petiole @ 30 numbers in one acre to trap adult red palm weevils in large numbers.

**Combined pheromone traps for rhinoceros beetle and red palm weevil may be evolved (Ramanathapuram).**

The rhinoceros beetle pheromone lures uses ethyl – 4 methyl octonoate as the active component while, the red palm weevil lures uses 4 – methyl 5-nonanol as the active component and hence, we have to use these lures separately. However, studies on the feasibility of combined placement of rhinoceros beetle and red palm weevil lures will be made in the future.

**Biocontrol agents for the management of coconut black headed caterpillar may be evolved wilt ecofriendly IPM packages (Namakkal/Dindigul)**

- The severely affected lower most fronds housing different life stages may be cut and burnt to reduce the population load.
- Light traps to be installed at 5/ha between 7 p.m. and 10 p.m. to monitor the activity of the pest.
- The larval parasitoids *Bracon brevicornis* and *Goniozus nephantidis* are successful biological control agents for the management of coconut black-headed caterpillar. These parasitoids can be released at 30 nos./ palm and 20 nos./palm, respectively, 5- 6 times at 21 days interval.

## SUNFLOWER

**White grub management in Sunflower (Dindigul).**

- Deep ploughing during summer to expose the life stages of white grub for desiccation and vertebrate predators (birds)
- Setting up of light trap during monsoon showers. Attract and destroy the adult beetles by erecting branches of Neem / Ailanthus / Acacia
- Small Neem / Ailanthus / Acacia trees surrounding the sunflower field may be sprayed with chlorpyriphos @ 2ml/lit after the first summer rain to kill the adult beetles congregate on the trees in the following day
- Application of carbofuran 3G @ 33.3 kg/ha or phorate 10G 25 kg/ha mixed with 1 kg of sand in the affected area and also surrounding area with healthy plants. Irrigation should be done immediately for dissolving the granules or
- Application of chlorpyrifos 20EC @ 1125 ml/ha

## SUGARCANE

**For the control of mealybug in sugarcane crop biocontrol agents may be suggested (Erode).**

- Avoid excessive use of nitrogenous fertilizers
- Drain the excess water
- Detrash as per schedule
- Conservation of natural enemies like coccinellids, spiders and parasitoids is essential.
- Intercropping with leguminous crops like daincha / cow pea will encourage the activity of coccinellids

**Biological control of Sugarcane woolly aphid (Thiruppur/Nammakkal).**

**Conservation**

- Natural enemies are found to control the woolly aphid effectively.
- The natural enemies like *Dipha, Micromus* and *Encarsia* multiply rapidly by devouring the woolly aphid preventing outbreak situations.
- Therefore, farmers are advised not to apply chemical insecticides particularly in areas where predators are abundant.

**Augmentation:**

- Early colonization by predators as the population of aphids begins to build up can control the pest successfully.
- Therefore frequent monitoring and if the natural enemies are not seen, the predators may be collected from areas of abundant occurrence and released for early suppression of the pest.

**Mass production of the predators:** A simple method for mass production of *Dipha* and *Micromus* on aphids grown in shade nets is suggested.

**Method:**

- Erect field cages of size 5 x 5 meters made up of 50 per cent shade net and bamboo poles on a six month old sugarcane crop colonized by the aphids.
- After the aphid has multiplied and covered the plant to an extent of 60 to 70 per cent, release 50 grownup larvae or pupae of *Dipha*/*Micromus*.
- The predators will multiply on the developing aphid populations and about 1500 to 2500 predators can be harvested from a single shadenet cage in about 60 days.
- The cages can be relocated to fresh locations for further production of the predators.
- Field release of either 1000 larvae of *Dipha* or 2500 larvae of *Micromus* per hectare as soon as the occurrence of woolly aphids can control the pest in 45-60 days.
- Cost of erecting field cage is around Rs.10000

**Screening for resistant donors (Thanjavur)**

Screening of resistant donors for major pests of all crops is being carried out regularly. The identified donors are being utilized for the development of resistant varieties

**To safeguard the farming community, standards and specification, active ingredient details to be regularized for organic pesticides, organic fertilizer and organic growth regulators.**

**Sampling and testing procedure for the above organic products is required (Ariyalur).**

- The suggestions made in respect to standards and specifications for organic pesticides, organic fertilizers and organic growth regulators will be duly

addressed if the Organic Farming Policy of the State is approved (which is under consideration by Tamil Nadu Government). Some of the suggestions will be included in the research agenda of the Department of Sustainable Organic Agriculture.

- Once the Organic Farming Policy of the State comes into force, the testing protocols for organic inputs and products will come in to practice. However, establishment of a new Biofertilizer and organic fertilizer (organic manures) Quality Control Laboratory funded by the Government of India under NMSA scheme is in progress in the Department of Sustainable Organic Agriculture, TNAU, Coimbatore.

## COTTON

**Cotton mealybug management (Ramanathapuram).**

- Removal of alternate weed host like, *Abutilon indicum* (Thuthi) and *Solanum nigrum* (Manathakkali) in the vicinity of cropped area.
- Monitoring emergence of crawlers at basal stem.
- Use of neem oil 2%, NSKE 5% and fish oil rosin soap 25g /l.
- Release of encyrtid parasitoid, *Acerophagus papayae* @ 100 per village.
- Spraying of dimethoate 30 EC or profenofos 50 EC 2ml / l thoroughly drenching the crop using high volume sprayer.

## GENERAL

**Wild boar management (Thiruvallur).**

- Closer planting of castor along the border of the main field will act as barrier to the entry of wild boar
- Raising of biofences by planting thorny plants like *Cactus* or *Karonda* will prevent the entry of wild boar
- Repellents treated jute ropes should be tied around the field to prevent the entry of wild boars.

**Recommendations of new pesticide molecules (Vellore).**

New pesticide molecules tested at Tamil Nadu Agricultural University (TNAU) and approved by Central Insecticide Board (CIB) are being recommended and the recommended molecules are available in Crop Production Guide (CPG). Every year it is being updated

**Peacock Management (Coimbatore)**

- No chemical and mechanical method can be adopted against peacock as it is a National bird
- Manual bird scarring is the only method resorted to manage peacock

## AGRICULTURAL ENGINEERING

## PADDY

**Modification of Power weeder with spacing adjustment.**
**Rice Transplanters for Heavy clay soil (Thiruvallur)**

The spacing of existing paddy power weeder can be adjusted from 21 cm to 25 cm according to the row to row spacing of paddy. Necessary holes are provided in the shaft for adjusting the row spacing of the weeding unit. Rotors for above adjustments are also supplied by the manufacturer.

**Four wheeled transplanters can be adopted for heavy clay soil.**
**Wet land laser leveller suitable for the respective zone (Thanjavur and Thiruvarur) .**

Wet land laser leveler is not available. Presently, research is in progress. However, four wheel drive tractor driven roto puddlers are now being used to obtain level puddled field.

**Water storage facilities must be increased. With the available water there is possibility for growing a short term crop during summer. Desilting the existing ponds and removing the encroachments should be taken up. Drainage system should be properly maintained. The channels should be lined and encroachment should be removed (Nagapattinam).**

To improve the water storage facilities, water harvesting through farm ponds and lining of ponds with polyethylene sheets can be taken up in order to arrest seepage. This will also help in non silting of the ponds.

**Ponds can be constructed in the subsidy scheme under "On Farm Water Management" of "National Mission for Sustainable Agriculture".**
**Machine planting is costly than normal planting. Cost-efficient machine planting method may be evolved (Theni).**

Transplanters are available through Custom hire centers.

**Cost effective paddy Transplanter to promote SRI-in paddy and its efficiency, cost and other economy may be suggested (Dindigul).**

Mechanical transplanter for planting single seedling per hill is not available. However, existing machines can be made to plant two to three seedlings by appropriate adjustment.

**Shortage of farm implements such as Paddy transplanter, Power Weeder, Laser Land Leveller with the farmers. Raising community nursery in tank irrigated areas of more than 200 Hec (Virudhunagar).**

Custom hiring centers for farm implements are being established by the Department of Agricultural Engineering under SMAM programme.
Raising of nursery may be taken up in large scale by the Department of Agriculture.

**Light weight mechanical seeder for paddy is needed (Tuticorin)**

The available four row and eight row direct paddy seeders are very light in weight.

## MILLETS AND MINOR MILLETS

**Demand for Minor Millet Thrashing cum processing machines (Pudukkottai).**

- Multicrop threshers are already available for threshing of the minor millets.
- Centrifugal dehuller developed by TNAU with a capacity of 75 kg/h is available for dehusking of the millets

**Grading and Packing machine for Minor millets (Virudhunagar)**

- Rotory grader / cleaner for millets are available.
- Packing machines are commercially available for packing millets in various quantities.

**Mini Combined harvester may be evolved for Minor Millets (Madurai)**

Commercially available Reaper binders can be adopted for harvesting minor millets. Maize combines are already available.

**After harvest of maize Cobs, the remaining maize stalks are being left unutilized. Hence suitable technology is required to convert maize stalks for palatable fodder preparation (Namakkal).**

Self propelled and tractor operated reaper harvesters can be adopted for harvesting the maize stalks and tractor PTO operated shredder can be used for shredding the stalks.

## PULSES

**Any Machinery to harvest Green gram, Black gram (Coimbatore)**

CLAAS combine harvesters have already been found to work for harvesting and threshing of pulse varieties with synchronous maturity.

## OILSEEDS

**Ground nut combined harvestor working in low soil moisture level for dry land condition may be suggested (Erode).**

Tractor drawn groundnut harvester can be adopted for rainfed groundnut. Groundnut combine harvester being developed at AMRC can be adopted for ridges and furrows system.

**Groundnut harvesting and removing pods from the plant is labour consuming. combined harvester in groundnut for both harvesting and removing pods is required (Thiruppur)**

A prototype groundnut combine is being developed for harvesting groundnut raised in ridges and furrows system.

**Low cost coconut harvesting devices may be evolved (Ramanathapuram).**

Coconut tree climber developed at AMRC costs only Rs.3000/- and is widely popular in small groves.

## SUGARCANE

**Popularisation of trashcutter to avoid burning of trashes in sugarcane field (Thiruvallur).**

Commercial tractor operated sugarcane trash shredder are available to shred the sugarcane trashes, which may be popularized by the line departments.

**Designing suitable combined harvester for sugarcane (Tirunelveli).**

Commercially available billet type harvesters are already in vogue.

**Low cost jaggery manufacturing machinery is required (Ariyalur).**

Semi automatic Jaggery production unit with rail system for transfer of the product is available.

## COTTON

**User friendly cotton weeder and Cotton kapaz picking machine (Perambalur).**

TNAU model power weeder can be adopted for weeding in cotton field. Pneumatic cotton pickers developed at TNAU can be used for picking cotton. The efficiency of the machine is low and also the quality of harvested cotton is poor due to high trash content. However, development of cotton varieties with synchronous maturity can promote the use of mechanical picker harvesters available with M/s. John Deere/ New Holland.

**Low cost technology is required for converting the cotton crop residues to briquette (Ariyalur).**

The biomass has to be powdered before making briquettes for easy handling and transportation. Since the cotton biomass is having energy content, there is no need to add any binding material for making briquettes. For installing a one ton capacity briquetting plant an amount of Rs. 12 lakhs is required.

**Picking cost of boll is high. suitable mechanical harvesting may be suggested (Nagapattinam).**

TNAU model power weeder can be adopted for weeding in cotton field. Pneumatic cotton pickers developed at TNAU can be used for picking cotton. The efficiency of the machine is low and also the quality of harvested cotton is poor due to high trash content. However, development of cotton varieties with synchronous matured can promote the use of mechanical picker harvesters available with M/s. John Deere/ New Holland.