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ICAR

वार्षिक प्रतिवेदन
Annual Report
2013-14

केन्द्रीय तम्बाकू अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
राजमन्द्री - 533 105, आन्ध्र प्रदेश

CENTRAL TOBACCO RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
RAJAHMUNDRY - 533 105, ANDHRA PRADESH, INDIA

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CTRI
CENTRAL TOBACCO RESEARCH INSTITUTE

Preface

The Central Tobacco Research Institute (CTRI), a national institute with the exclusive mandate on tobacco has been making impressive strides in the domain of tobacco research and extension year after year over the past 65 years. It has immensely benefited the tobacco farming community and other stakeholders dealing with tobacco in the country. I consider it my pleasure to present the CTRI Annual Report 2013-14.

In the context of emerging national and international tobacco scenario and to meet the specific research requirements of different tobacco growing regions of the country, the thematic research areas of the Institute are reoriented placing special emphasis on (i) Tobacco cultivar development, (ii) Development of agro-technology for sustainable tobacco production and strengthening transfer of technology, (iii) Integrated management of biotic stresses, (iv) Management of resource constraints for production efficiency and product quality and (v) Exploiting tobacco for non-traditional uses and identification of alternative crops.

The Annual Report 2013-14 embodies the important research and institutional activities and salient accomplishments during the reporting period. It is heartening to note that satisfactory progress has been made in all the priority areas. Varieties/hybrids with yield potential of about 3,000 kg/ha in FCV tobacco and 4,000 kg/ha in non-FCV tobacco have been developed. In FCV tobacco, one CMS hybrid, CH-3 and one improved variety, FCH-222 were approved for cultivation in the light soils region of Karnataka. In non-FCV tobacco, three varieties viz., DJ-1 (Chewing tobacco variety for West Bengal), NBD-119 (first Bidi variety for Andhra Pradesh) and GABT-11 (root-knot resistant bidi variety for Gujarat) were identified for release. Significant progress has been made in other important areas of tobacco research such as development of agro-techniques for yield optimization, improving the input-use-efficiency, understanding and management of abiotic stresses, adopting IPM strategies and experimenting with new chemicals with low active ingredient for efficient plant protection as well as reducing pesticide residues. Apart from the scientific achievements, the Institute has made very significant contribution to resource generation by way of supplying tobacco seed and seedlings and providing analytical services to farmers and other clients. Infrastructure development for research in frontier areas received special attention. Krishi Vigyan Kendra of CTRI has made significant contribution in agriculture, horticulture, animal husbandry and also rural crafts through on-farm testings, frontline demonstrations and also vocational training programmes.

The CTRI envisages fostering the established linkages with national and international organizations in the coming years to promote R & D activities. The close linkages with line-departments of the State Governments, Tobacco Board (Ministry of Commerce, GOI) and other agencies concerned with tobacco industry and trade are of particular interest to continuously refine location specific and need based research initiatives.

I acknowledge and appreciate the contribution of all the scientific, technical and other staff members in successful execution of different research and developmental programmes of the Institute and overall progress made during the reporting period. I extend special thanks to the Chairman and members of the Editorial Committee for their sincere efforts in meticulous editing of the report. I compliment the Nodal Officer, PME-Cell and his team for compilation of information and ensuring timely publication of this report. On behalf of the entire CTRI staff, I place on record our gratitude to Dr. S. Ayyappan, Honourable Secretary, DARE and Director General, ICAR; Dr. S. K. Datta, Deputy Director General (Crop Science) and Dr. N. Gopalakrishnan, Assistant Director General (Commercial Crops) for extending all needed support, guidance and encouragement from time to time in planning and execution of research, extension and other related activities of the Institute.

(T.G.K. MURTHY)
Director - Acting

Rajahmundry, 31 May, 2014

Executive Summary

The Central Tobacco Research Institute is mandated to conduct research on different types of tobaccos, with a special focus on productivity enhancement and product quality improvement. The research focus of the institute during the period has been on tobacco cultivar improvement, development of agro-technology for sustainable tobacco production, management of resource constrains for production efficiency and product quality, integrated management of biotic stresses, identification of alternative crops to tobacco and exploiting the tobacco for alternative uses. The salient research achievements are highlighted hereunder.

Tobacco Cultivar Development

- One FCV tobacco variety, FCH- 222 and a CMS FCV tobacco hybrid, CH-3 for cultivation in Karnataka were released.
- Release proposal on CMS hybrid, CH-1 was submitted to A.P. State sub-committee on variety release. Three varieties viz., DJ-1 (Chewing tobacco variety for West Bengal), NBD-119 (First Bidi variety for Andhra Pradesh) and GABT-11 (root-knot disease resistant variety for Gujarat) were identified for release.
- In the on-farm trials, one low tar line JS-117, two high yielding lines, Tobios-2 and NLST-2 were found promising under NLS area and TBST-2 in SBS and SLS areas.
- A total of 202 bidi, 80 natu and 73 rustica germplasm accessions were added to the germplasm bank, thereby increasing the CTRI genetic resources to 3167.
- In bulk evaluation trials, FCV entries TBST-2 (TMV resistant line); Tobios-2, Tobios-6, Tobios-7, NM & NLCR-10 (somaclones); JS-117 (low tar line), NLST-3, NLST-4 and NLSH-1 (low tar hybrid) were found significantly superior over respective check varieties.
- In various replicated yield trials conducted during 2010-13, 29 FCV advanced breeding lines, 18 FCV aphid resistant/ tolerant advanced inter-specific cross derivatives and two burley lines were found promising with 7 to 47% higher mean cured leaf yield over respective check varieties.
- CMS FCV hybrids, TBSH-99, TBSH-96, TBSH-101 TBSH-98, MSH-1 and MSH-15 recorded significant standard heterosis of 21-36% and hybrids, TBSH-81, TBSH-87 and TBSH-91 recorded 23-32% during 2012-13.
- Two advanced derivatives viz., SY-15 (1083 kg/ha), SY-14 (1046 kg), and one germplasm line, Coker 48#3 (1124 kg/ha) were identified as having high seed yield potential comparable to that of best check, A-145.
- One barcoding primer, trnH-psbA was identified to distinguish wild *Nicotiana* species.
- DNA fingerprints were developed for popularly grown Flue-Cured Virginia (FCV) tobacco cultivars and one Burley tobacco variety using SSR and ISSR markers.
- Complete ITS (Internally Transcribed Sequence) characterization was carried out for four isolates and the ITS gene regions comprising ITS1, 5.8S and ITS2 sequences were deposited in NCBI Gen Bank (Accession Nos. JX473000, KF425540, KF425541 and KF425542).
- A total quantity of 13,592.5 kg foundation seed of seven different varieties was produced.

Development of agro-technology for sustainable tobacco production and strengthening TOT

- Bulk trials conducted at three locations viz., CTRI RS, Guntur, CTRI RS, Kandukur and CTRI Farm, Katheru revealed that use of tray seedlings reduced the gap fillings (2-6%) compared to conventional seedlings (11-21%) and increased the yield by 3-19%.

- Advanced breeding line, TBST-2 required a spacing of 70 X 50 cm and a nitrogen dose of 45 kg/ha for optimum yield in Vertisols (NBS) of Andhra Pradesh.

- Coir waste briquettes alone or in combination with saw dust briquettes can be used for curing FCV tobacco as a substitute for wood/coal.

- Post-emergence application of Quizalofopethyl @ 60 g a.i./ha at 15 + 75 days after planting effectively controlled the grassy weeds and also gave higher yields when compared to weed-free check. Pre-emergence application of Pendimethalin @ 750 g a.i./ha 3 days before planting ensured field free of weeds (except nut grass). But the yields were reduced by 4% when compared to weed-free check.

- A nitrogen dose of 115 kg/ha and topping at 26 leaves were required for the optimum cured leaf yield and better grade index of advanced breeding lines, NLST-4 and JS 117 (low tar). Line NLST-4 produced more cured leaf yield and grade index than NLST-3 and Kanchan.

- A spacing of 100 X 60 cm and a nitrogen dose of 120 kg N/ha and topping at 26 leaves were required for the optimum cured leaf yield and better grade index of CMS hybrid, NLSH 1.

- First grade leaf yield and total cured leaf yield of chewing tobacco increased by 14 and 8 %, respectively with drip fertigation at 100% RDN over the furrow irrigation. Drip fertigation at 100% RDN and drip irrigation with 100% RDN recorded higher net returns over the furrow irrigation.

- Nitrogen @ 150 kg/ha would be optimum for the advanced breeding line, BSR-1 for higher cured leaf yield, net returns and B: C ratio.

- The advanced breeding line, HV.2009-3 recorded 10 and 3 % higher FGLY and TCLY, respectively over the check variety, Abirami. The spacing 90 x 75 cm and nitrogen at 125 kg/ha recorded higher FGLY, TCLY and net returns.

- Cured leaf yield, top grade equivalent and ripeness of the leaf can be optimized with 70 kg N /ha applied in 2 splits and topping at 20 leaves in wilt resistant variety, FCH 222 under KLS conditions.

- The trials on organic tobacco production at Hunsur demonstrated that organically grown tobacco yielded 10% higher bright grade leaf compared to the conventionally grown tobacco. Leaf nicotine was lowest in the organically grown tobacco compared to the inorganic tobacco.

- Application of K at higher dose (180 kg K_2O/ ha) positively increased the productivity of cued leaf yield by 16.5% and top grade equivalent by 21.5% with lesser incidence of root knot compared to control (no application of K) in the root knot sick red sandy loam soils.

- The use of 'turbo fan" in curing of FCV tobacco economized the total fuel wood requirement to an extent of around 8% under KLS conditions.

- In permanent manurial trial on Motihari tobacco, application of NPK @ 112 kg each recorded higher green (22090 kg/ha), cured (2773 kg/ha) and first grade (1378 kg/ha) leaf yields as compared to control with FYM @ 10 q/ha.

- Resource use analysis has revealed that technologies viz. application of organic manures, maintenance of 90% population, life saving irrigation and balanced application of N & K (SLS); use of tray seedlings for gap filling, balanced application of N & K, topping at 22-24 leaves and management of viral diseases (NLS) are contributing to remunerative cultivation of FCV tobacco in SLS & NLS regions, respectively.

- Technology adoption studies have indicated that 21% and 32% of recognized progressive farmers from NLS and SLS region,

respectively are not adopting the recommended technology package.

- Impact analysis of DBT project on "Empowerment of Tribals in East Godavari District" revealed that the adoption of technological interventions increased annual family income by 69% in the project area.

Management of Resource constraints for production efficiency and product quality

- Based on irrigation water quality index, the irrigation water quality spatial map of tobacco growing areas of *Kandukur* mandal of Andhra Pradesh was developed. About 53, 32, 11 and 4% of water samples fell, respectively, in suitable, moderately suitable, conjunctive use and unsuitable classes of water quality.

- Water quality evaluation of *chewing* tobacco growing soils of Tamil Nadu showed that majority of irrigation waters were saline with high chloride content, indicating the need to reduce the quantum of irrigation water to contain the soil salinity and chloride levels in tobacco.

- The biomass ashes resulting from combustion of crop residues and wood were characterized for their physicochemical properties and nutrient supply potential. All biomass ashes were highly alkaline with pH > 10.5. Biomass ashes differed widly in their calcium carbonate equivalence values (5 – 80) and contained appreciable quantities of K, Ca and Mg.

- Released varieties of different tobacco types were screened for excess water stress and the genotypes were characterized based on leaf chlorosis and drooping of the leaves. The characters associated with excess water stress included leaf chlorosis, Chlorophyll a/b, specific leaf weight, root shoot ratio, nitrogen uptake and activity of antioxidative enzymes.

- Abiotic stresses arising from single and multiple nutrient deficiencies reduced the plant growth considerably under nitrogen sufficient condition, while showing no or least effect under N deficient condition.

- A bio-consortia consisting of of *Azotobacter*, *B.subtilis* and *F. aurantia* proved to be best combination to supplement NPK nutrients in FCV tobacco production on Vertisols.

- A GC-MS-Single quadrupole quantifier-qualifier (m/z) ions based method has been developed and standardized for determination of multipesticide residues in tobacco. This method helps us to overcome the commonly encountered problem of false detection.

- The organochlorine pesticide residues in tobacco grown in different soil zones were below the GRL in most cases. The residues of phased-out pesticides (e.g DDT) were also detected in few samples, apparently due to previous history of application.

- For *lanka* tobacco, a nitrogen dose of 300 kg N/ha was found optimum for accumulation of maximum neutral volatile aroma constituents compared to farmer's practice of over-use of N i.e. 1000 kg N/ha.

Integrated management of biotic stresses

- Monitoring of tobacco caterpillar, *Spodoptera litura* in tobacco nurseries as well as planted crop with pheromone traps showed a highly significant and positive correlation between moth catch, incidence of the pest and crop damage. The weather parameters also had positive correlation with the moth catch during the season.

- Management of tobacco caterpillar *S. litura* with insecticide baits prepared with emamectin benzoate, novaluron and lufenuron was effective and economical with ICBR of 1:16.28, 1:14.83 and 1:11.48, respectively, in FCV tobacco (NLS).

- Chlorfenapyr 10 SC @ 0.01% and metaflumizone 22 SC @ 0.04% were found effective against *S. litura* in tobacco nurseries and planted crop. Metaflumizone was relatively safe to the egg parasitoid,

Telenomus remus and larval parasitoid *Glyptapanteles africanus*.

- New insecticides, flonicamid 50 WG, pymetrozine 50 WG and spirotetramet + imidacloprid 240 SC @ 0.018% effectively controlled tobacco aphid infestation in FCV tobacco and are relatively safe to the aphid predator, *Chielomenes sexmaculata.*

- A comparison of base line resistance of *S. litura* to contact insecticides showed that the lowest LC50 value was recorded with emamectin benzoate followed by chlorpyriphos, profenophos and quinolphos for populations from Rajahmundry and Guntur. The population of *H.armigera* from Guntur recorded higher LC 50 values of cypermethrin, methomyl, thiodicarb, profenophos, quinolphos, chlorpyriphos and triazophos, respectively as compared to its population from Rajahmundry.

- The base line resistance of *H.armigera* populations to insecticides with stomach action showed that the population from Guntur recorded higher LC 50 values of novaluron, thiodicarb, fipronil, rynaxypyr, acephate, chlorpyriphos, endosulfan and flubendiamide, respectively compared to the population from Rajahmundry.

- Application of spray fluid at 50 DAP through the Hi tech sprayer @ 550 cc/min was superior over the compression sprayer (Farmers' method) in terms of providing uniform coverage, reduced quantity of insecticide (36%) and operator's time (43%). At 65 DAP high pressure knapsack sprayer @1200 cc/min and5.5 to 6 kmph was superior to Hi tech sprayer

- Spray spectrum emitted through Hi tech sprayer at 35 DAP and high pressure knapsack sprayer at 80 DAP on plant canopy was superior as shown by spray characteristics *viz.,* high droplet density, low NMD and low VMD with lower deviation of droplet size.

- Among the three varieties for which age specific life tables were constructed, Kanchan recorded highest life expectancy of 9.52 at the beginning of life table followed by VT 1158 and N 98. The highest net reproductive rate was recorded on Kanchan followed by VT 1158 and N 98. The mean generation time was shortest in N 98 followed by VT 1158 and *Kanchan*.

- A survey covering 5 major tobacco growing *Taluks* of KLS region revealed that the infestation was below ETL for aphid, budworm and tobacco caterpillar, while it was above ETL for stem borer.

- Among 250 tobacco germplasm lines/ varieties screened against *Spodoptera litura* in nurseries, FCH-222 registered more seedling infestation (14.33%) followed by KLSH-10 (11.66%) and FCH-201 (8.00%) under natural infestation. In all the remaining lines, the caterpillar incidence was below 5%.

- The NSKS 5% spray + mixture of Spirotetreamat and Imidocloprid spray was found superior in controlling the white fly and gave higher tobacco yield.

- The advance breeding lines, FCR-12, FCJ-1, FCJ-8, FCJ-10, FCH 229 and FCH 231 recorded RKI of 0 — 1.5 and were found most promising against root-knot nematodes under sick field conditions.

- Intensive survey in FCV tobacco growing regions of KLS revealed the presence of five major plant parasitic nematodes viz., *Meloidogyne spp, Rotylenchulus reniformis, Helcotylenchus spp, Pratylenchus spp* and *Tylenchus sp,* associated with main field tobacco crop. Maximum mean population of root knot nematodes were found in Periyapatna region followed by Hunsur, Arkalgud and H.D.Kote.

Identification of Alternative Crops and Exploiting Tobacco for Alternative Uses

- Castor hybrids, DCH 117 and DCH 519 obtained from DOR, Hyderabad were cultivated in CTRI Black Soil Research Farm, Katheru as alternative crops to FCV tobacco on Vertisols. The Castor hybrids DCH 117

and DCH 519 recorded 1489 and 1870 kg/ha seed yield, respectively. However, the net returns from castor hybrids were lower than that of FCV tobacco.

- The oil content in 54 tobacco accessions varied from 28 to 41.7%, with the highest and lowest oil content associated with the Coker 1 and AR-53 accessions, respectively.
- Adsorption equilibrium studies revealed that tobacco stem biomass or biomass ash exhibited MB adsorption maximum of 169.5 and 35.7 mg/g, respectively. Relatively high adsorption capacities imply that tobacco stem biomass or biomass ash can be used as low-cost adsorbents for removal of cationic dye (pollutant) from aqueous systems.

Krishi Vigyna Kendra (KVK), Kalavacharla

- Krishi Vigyana Kendra under the administrative control of CTRI has conducted a large number of OFTs (15), FLD's (17), on and off campus training programs (58), vocational training programs (16) and capacity building programs (5) covering important technological interventions in the fields of Crop production, Crop protection, Horticulture, Animal Science, Home Science and Rural crafts.
- KVK organized state and district level seminars on cocoa, cashew and Research-Extension-Farmer Interface meetings on dairy development, and a Kisan Mela during the year.

Introduction

The Central Tobacco Research Institute (CTRI), established in 1947, is a constituent Institute of the Indian Council of Agricultural Research, New Delhi and has the exclusive mandate to undertake basic, strategic and applied research on various types of tobacco grown in India with special emphasis on exportable types of tobacco. Six regional stations situated at Guntur, Kandukur and Jeelugumilli in Andhra Pradesh; Vedasandur in Tamil Nadu; Hunsur in Karnataka; and Dinhata in West Bengal and a Research Centre at Kalavacherla in Andhra Pradesh are catering to the requirements of tobacco farmers in different agroclimatic zones by developing improved varieties and agro technologies. The All India Network Project on Tobacco with its main centres and sub-centres across the country is carrying out multi-locational trials on various types of tobacco.

The research perspectives concerning tobacco are undergoing a continuous change owing to emerging issues such as natural resource degradation, climate change, biotic and abiotic stresses and others related to society, trade and government policies at national and international level. The challenges confronting tobacco and the tobacco researchers are now more varied and complex than ever before and call for a paradigm shift in our research approach to make tobacco enterprise remunerative and profitable to the farming community. Against this background, the research programmes were reoriented at the beginning of XII plan. The mandate and the reoriented research programmes of the institute are furnished hereunder.

MANDATE

- To conduct research on different types of tobacco, with greater emphasis on exportable types, on all phases of production management with a view of attaining economic advantage / benefit to the tobacco growers through improvement in quality and quantity of tobacco.
- To collect tobacco germplasm from world over and to maintain and operate tobacco genetic resources which will be made available to scientists and National / International Institutions.
- To conduct research on economically viable and sustainable cropping systems alternative to tobacco.
- To conduct research on diversified uses of tobacco and development of value-added products viz., phytochemicals.
- To produce and distribute quality seeds of notified varieties of tobacco.
- To publish and disseminate research findings and recommendations of latest technology for the benefit of the tobacco growers, scientific community, policy makers and development agencies.

RESEARCH PROGRAMMES

I. Tobacco cultivar improvement

(A) Developing tobacco varieties / hybrids possessing higher leaf yield and resistance to biotic and abiotic stresses to stabilize productivity

(B) Tailoring of tobacco plant type for optimizing the seed yield and phytochemicals

(C) Production and distribution of foundation seed of ruling tobacco varieties

(D) Germplasm resource management

(E) Biotechnology for tobacco improvement

II. Development of agro-technology for sustainable tobacco production and strengthening TOT

(A) Healthy seedling production

(B) Optimization of water and nutrient use for productivity enhancement of different tobacco types

(C) Evolving site-specific cultural management practices in different agro-ecological sub-regions

(D) Post-harvest product management (PHPM)

(E) Analysis of socio-economics for stratification and to formulate appropriate strategies

(F) Technology outreach activities

(G) Technology assessment

III. Identification of alternative crops and exploiting tobacco for alternative uses

(A) Alternative crops to FCV and non-FCV tobacco in different agro-ecological sub-regions

(B) Agro-techniques for higher biomass and seed yield

(C) Identification of potential phytochemicals

IV. Management of resource constraints for production efficiency and product quality

(A) Evaluation of soil fertility, water quality and plant nutrition constraints for tobacco and their management

(B) Soil quality and nutrient-use-efficiency in relation to input management

(C) Characterization of soil biota and use of biofertilizers

(D) Evaluation of tobacco leaf and product quality

V. Integrated management of biotic stresses

(A) Screening for host plant resistance to insect pests and diseases

(B) Development of IPM technology

(C) Evaluation of new molecules and formulations of pesticides for bio-efficacy

(D) Monitoring of insect pests and diseases

(E) Weather forecasting and its influence on incidence of pests and diseases

STAFF POSITION AND FINANCIAL STATEMENT

STAFF POSITION AS ON 31.03.2014

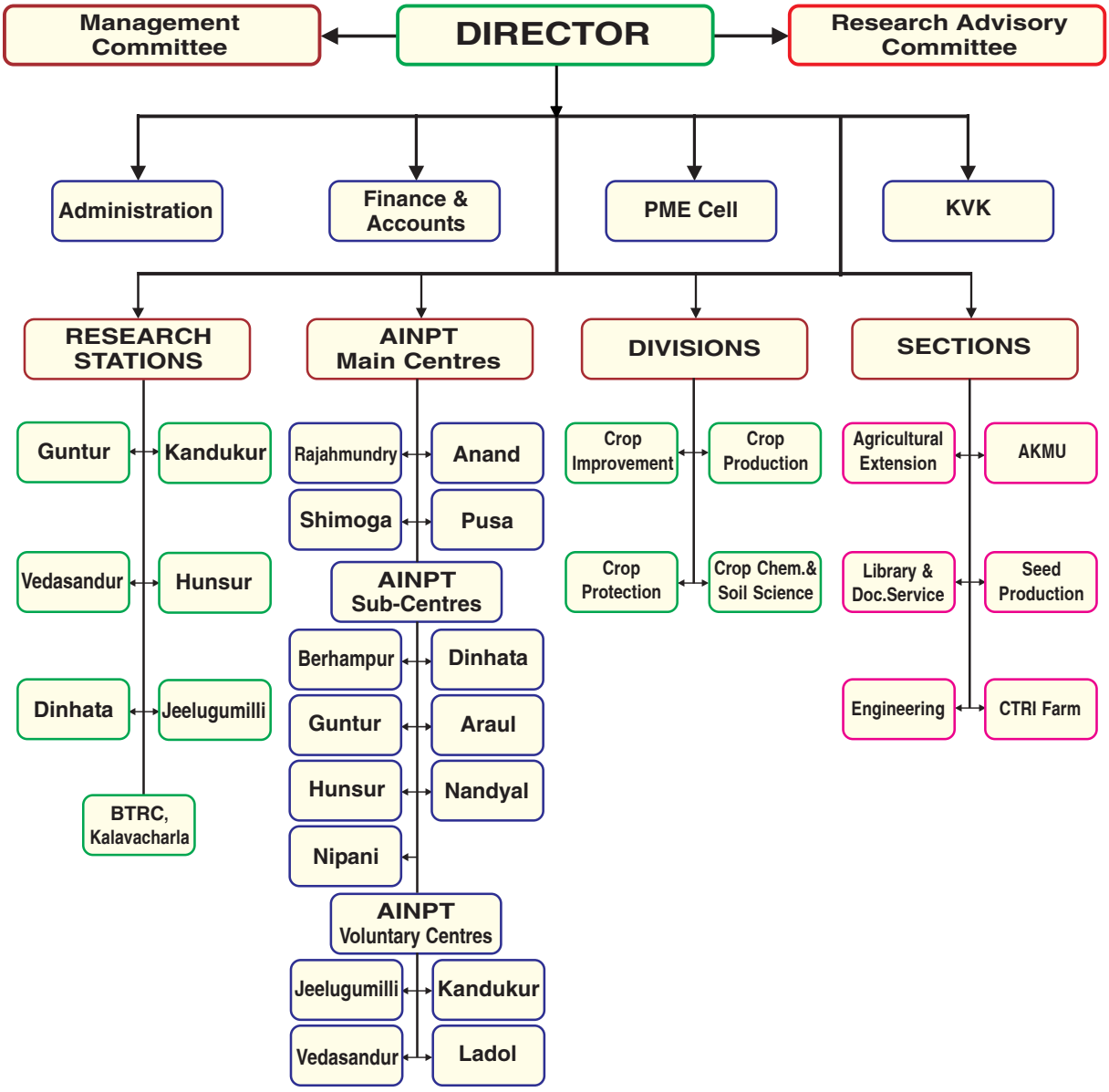
Sl. No.	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	54+1*	31	24
2.	Technical	147	115	32
3.	Administration	70	53	17
4.	Skilled Supporting Staff	158	104	54

* RMP position

FINANCIAL STATEMENT FOR THE YEAR 2013-14

Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	2183.35	2179.37
Plan	125.00	125.00
KVK	134.86	135.49
AINPT	270.00	270.00
Pension & Retirement Benefits	1300.00	1300.00
Personal Loans & Advances	17.00	17.00
Recurring Deposit Schemes	22.81	23.36
Revolving Fund Scheme	158.92	115.02
Internal Resource Generation	20.69	5.38
Total	4232.63	4170.62
Revenue Receipts	Target 204.60	Achieved 249.30

INSTITUTE ORGANOGRAM



Research Achievements

CH-1

CH-3

DJ-1

NBD-119

I. Tobacco Cultivar Development

I. (A) Developing Tobacco Varieties with Higher Leaf Yield and Quality

Evolving superior varieties of FCV tobacco [CTRI, Rajahmundry]

P.V. Venugopala Rao

Sub-project: Evaluation of advanced breeding lines for yield and quality

A replicated yield trial with fourteen advanced breeding lines viz., V-4994, V-4995, V-4996, V-4997, V-4998, V-4999, V-5000, V-5003, V-5015, V-5027, V-5029, V-5033, V-5039 and V-5041 and two controls viz., VT-1158 and Siri was conducted for the third Year. Significant difference between the treatments was recorded in all the four yield characters. Cured leaf yield was significant in V-5000 (1782 kg/ha) followed by V-4998 (1724 kg/ha), V-4995 (1609 kg/ha) V-4997 and V-4999 (1503 kg/ha) compared to the better control Siri (1309 kg/ha) and the yield improvement over the Siri ranged from 15 to 36 per cent.

Combined analysis (2009-10 to 2011-12): Pooled analysis for all the yield characters revealed that the treatments differed significantly. The seasons, treatments and seasons X treatments interaction were also differed significantly. Among the selections significant cured leaf yield was recorded in V-5000 (1870 kg/ha) with an improvement of 24 per cent over the better control Siri (1510 kg/ha), followed by V-4998 (1786 kg/ha) with 18% improvement over Siri. Bright leaf yield was significant in V-5000 (1129 kg/ha) with 22%, V-4998 (1071 kg/ha) with 16% improvement over Siri. Based on the performance of the selections over three years, it is concluded that among the selections, V-5000, V-4998, V- 4999 and V-5003 were the better entries and are proposed for testing under AINPT.

Evaluation of advanced breeding lines for yield and quality [CTRI, Rajahmundry]

K. Sarala, T.G.K. Murthy, P.V. Venugopala Rao and S.K. Dam

Evaluation of advanced breeding lines at Katheru Farm: Four somaclones and nine advanced breeding lines were tested in a replicated trial for the third year along with two controls, VT 1158 and Siri. Lines RS 16, RS 17and RS 18, respectively, recorded significantly higher green (19097-19653 kg/ha) and cured leaf yields (3135-3221 kg/ha), than the better control, Siri. The green leaf yield increase in these lines over Siri (c) ranged from 15-18%, cured leaf from 13-16%, bright leaf yields from 9-11% and grade index 11-12%.

Pooled analysis (2010-13): The pooled analysis of three consecutive years revealed that lines RS-16, RS-17 and RS-18 have recorded significantly higher green, cured and bright leaf yields, and grade index than Siri. Line RS-19 found to be promising with significant increase in green and cured leaf yields and grade index values than Siri and bright yields than VT-1158. Line RS-13 recorded significant green and cured leaf yields than Siri and bright leaf yield and grade index values than VT-1158. RS-16, RS-17, RS-18 and RS-19 found to be promising with significant increase in green leaf (12-19% increase over Siri), cured leaf (10-17%), bright leaf (9-15%) yields and grade index (9- 16%) values. Seasons, and Seasons and entries interaction found to be significant for all the leaf yields. Based on the overall performance, the lines RS-13, RS-16, RS-17, RS-18 and RS-19 are considered for multi-location testing under AINPT.

Evaluation of breeding lines at CTRI RS, Jeelugumilli: Twelve somaclones and two breeding lines were tested for first year in a replicated trial along with Kanchan (control) at CTRI RS, Jeelugumilli. Clones, NLCR-1-9-2-13, NLCR-7-11-1-4, NLCR-BT1-P2, NLCR-BT2-P9, VLCR-12-15-14-5 and NLCR-9-2 recorded significantly higher yields of all types than Kanchan. The green leaf yield in these lines ranged from 14083 to 19361 kg/ha, cured leaf yield from 2571 to 3360 kg/ha and grade index from 1554 to 2040 kg/ha; an increase of 24-71%, 23-61 % and 31- 72%, respectively, over control, Kanchan. With respect to Chemical quality characteristics, Nicotine at 'X' position found to range from 0.83-2.23% and 'L' position from 1.17-1.96%. Reducing sugars at 'X' position found to range from 5.57 to 14.16% and 'L' position from 4.39-12.43%.

Bulk Trial: Seven entries were tested in a bulk trial (200 plants each) along with Kanchan at CTRI Research Station, Jeelugumilli. All the entries viz., five somaclones (Tobios-2, Tobios-6, Tobios-7, NM & NLCR-10) and a breeding line, JS-117 recorded higher leaf yields than Kanchan. The increase in cured leaf yields in these lines ranged from 5% in JS-117 to 33% in NLCR-10 and grade index from 3% in JS-117 to 36% in NLCR-10. Among these The nicotine levels at 'X' position found to range from 0.72-1.47% and 'L' position from 0.68-1.61%. Reducing sugars at 'X' position found to range from 7.50 to 18.44% and 'L' position from 5.58-13.08%. Advanced breeding line JS-117 recorded lower tar (21.20 mg/cigarette) and CO (11.95 mg/cigarette) values than Kanchan (22.88 and 12.99, respectively) in bulk trial.

Screening of breeding lines in row trial: Entries VLCR-1-12-K, VLCR-5-10, VTCMV-1-P8, VTCMV-1-6-8, RS-12, RS-13, RS-14, RS-15, RS-17, RS-18 and RS-19 found to be resistant to TMV under artificial inoculation at Katheru Farm. Out of 72 breeding lines assessed for yield under row trial at Katheru farm, 12 lines found to be promising for yield. 170 advanced breeding lines were raised and seed collected for maintenance. Out of 14 lines tested at CTRI RS, Jeelugumilli in row trial, six entries recorded higher leaf yield than kanchan.

Disease resistance screening and maintenance: Two hundred sixty lines including breeding lines, germplasm lines and F_2S were screened for TMV resistance and resistant plants selfed in 189 entries and selfed seed collected. Out of 20 promising Kanchan somaclones and 12 VT-1158 somaclones tested for black shank reaction under artificial conditions at Katheru Farm, all the plants inoculated in 13 clones are found to be free from black shank infection.

Maintenance of transgenics: Two transgenics, each of Hema and Jayasri; and two transplastomic lines having Cry 9 Aa2 gene under Petit Havana background were maintained in transgenic screen house. The transgenics contains Cry1 A (b) and Cry 1 C genes, Cry 1 A (b) confirms resistance to *Heliothis armigera* and Cry 1 C to *Spodoptera litura.*

Evolving FCV tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh [CTRI RS, Jeelugumilli]

T.G.K. Murthy

Generation advancement & selection: Thirty F_6 progenies of crosses involving Kanchan as one of the parents were raised and single plant selections showing plant type suitable to NLS besides having high leaf number (35-45 per plant) and/or resistance to TMV were selfed for further testing.

Preliminary evaluation of advanced breeding lines: A progeny-row trial was conducted with 136 lines (F_8) along with the check variety Kanchan to identify selections suitable to NLS area. The lines varied for important morphological and agronomical traits. Seventeen lines with high yield potential (CLY 3900-4600 kg/ha against 2840 kg in Kanchan) and desirable leaf quality were identified. Twenty four of the lines were identified as resistant to TMV on artificial inoculation. Eighty six single plant selections showing good plant type and leaf characteristics suitable for NLS besides high yield potential, were advanced for further evaluation. In addition to high yielding selections, four semi-dwarf selections with compact plant type and very short internodes, suitable for close spacing were also identified and advanced for further study.

Replicated yield trials:

(1) Trial RYT-11: Nine medium green/ green cast advanced breeding lines along with check Kanchan were evaluated for yield and leaf quality traits in a RBD with three replications during three seasons. Three of the lines were 'flat' leaf types while others were 'Kanchan' type. Five of the lines viz., SM12-2, ABL10-1, ABL13-1, ABL24-1 and ABL 45-5 were resistant to TMV. Due to unfavorable conditions during 2010-11 season the yield levels were low. Hence combined analysis was carried out for two seasons data. Combined statistical analysis (2009-10 and 2011-12) revealed that all the nine advanced cross derivatives were significantly superior over check, Kanchan for all the three leaf yield traits. The increase was 9 to 43% for

green leaf yield, 11 to 42% for cured leaf yield and 10 to 47% for grade index, respectively, over check, Kanchan. Seasonal differences were significant for cured leaf yield and 2011-12 was the better season. The Season x entry interaction was not significant. Based on performance during the two years and suitability of plant type and leaf, lines viz., SM26-1, ABL8-1, ABL10-1 and ABL13-1 were found to be better than other entries.

(2) Trial RYT-12: Nine medium green/ green cast advanced breeding lines along with check Kanchan were evaluated for yield and leaf quality traits in a RBD with three replications three seasons. Four of the lines were 'flat' leaf types while others were 'Kanchan' type. Three lines viz., RT19-1, RT9-1 and RT31-1 were resistant to TMV. Seasonal differences were significant for cured leaf yield only. Due to unfavorable conditions during 2010-11 season the yield levels were low. Hence combined analysis was carried out for two seasons data. Combined statistical analysis (2009-10 and 2011-12) revealed that five lines (RT31-1, RT19-1, RT18-1, ABL48-1, RT11-1) were significantly superior over check, Kanchan for all the three leaf yield traits. The increase was 16 to 47% for green leaf yield, 14 to 44% for cured leaf yield and 10 to 46% for grade index, respectively, over check, Kanchan. Based on performance during the two years and suitability of plant type and leaf three lines viz., RT31-1, RT19-1 and RT18-1 were found to be better than other entries and selected for further studies.

(3). Trial RYT-13 (3rd year): Thirteen medium green/ dark green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications for the third year in succession. Six lines viz., F3-18-1, RT102-1, F3-20-2, RT57-1, F3-15-1 and RT30-1 showed significantly higher green leaf yield, cured leaf yield and grade index than the check, Kanchan. The increase for different traits over Kanchan was 14 to 44%, 17-57% & 21-42% for green leaf yield, cured leaf yield and grade index, respectively in these lines.

Pooled analysis: Due to unfavorable conditions during 2010-11 season the yield levels were low. Hence combined analysis was carried out for two seasons data (2011-12 and 2012-13) which revealed that nine test entries were significantly superior over check, Kanchan for all the three leaf yield traits. The increase was 12 to 41% for green leaf yield, 15 to 47% for cured leaf yield and 18 to 47% for grade index, respectively over check, Kanchan. Seasonal differences were significant for cured leaf yield, 2011-12 being the better. The Season x entry interaction was not significant. Based on performance during the two years and suitability of plant type and leaf, six lines viz., F3-18-1, F3-20-2, RT57-1, F3-15-1, RT30-1 and RT36-1 were identified as promising entries for multilocation trials.

Line F3-20-2

(4) Trial RYT-14 (3rd year): Thirteen medium/ green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications for the third year in succession. Six lines viz., RT6-1, RT16-2, RT51-2, RT62-1, RT67-3 and F3-9-1 showed significantly higher green leaf yield, cured leaf yield and grade index than the check, Kanchan. The increase over Kanchan was 14 to 44% for green leaf yield, 25-47% for cured leaf yield and 24-59% for grade index, respectively. Nicotine was lower and reducing sugars were within admissible limits

Pooled analysis: Due to unfavorable conditions during 2010-11 season the yield levels were low. Hence combined analysis was carried out for two seasons data (2011-12 and 2012-13) which

revealed that seven test entries viz., RT6-1, RT16-2, RT51-2, RT52-3, RT62-1, RT67-3 and F3-9-1 were significantly superior over check, Kanchan for all the three leaf yield traits. The increase was 13 to 41% for green leaf yield, 14 to 37% for cured leaf yield and 14 to 41% for grade index, respectively over Kanchan. Seasonal differences were significant for all the leaf yield traits; 2011-12 was the better season. The season x entry interaction was also significant. Based on performance during the two years and suitability of plant type and leaf five lines viz., RT6-1, RT51-2, RT62-1, RT67-3 and F3-9-1 were identified as promising entries for multilocation trials.

Line RT6-1

(5) Trial RYT-15 (1st year): New set of 13 green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications. Six lines (RT9-1, RT10-1, RT27-1, RT29-1, RT29-2 and RT33-1) showed significantly higher green leaf yield, cured leaf yield and grade index than check, Kanchan. The increase was 22 to 45% for green leaf yield, 15-41% for cured leaf yield and 16-42% for grade index. Cured leaf colour, size and body in the test entries viz., RT Nos.4-3, 10-1, 27-1, 29-1, 29-2 and 33-1 were better than or comparable with that of Kanchan. Nicotine was slightly lower and reducing sugars were within admissible limits.

Line RT29-1

(6) Trial RYT-16 (1st year): In a new replicated trial, 13 more medium/ green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality in a RBD with three replications. Five lines (RT66-1, RT91-1, RT92-1, RT94-1 and RT108-1) showed significantly higher green leaf yield, cured leaf yield and grade index than check, Kanchan. The increase was 17 to 32% for green leaf yield, 15-30% for cured leaf yield and 27-40% for grade index. Cured leaf colour, size and body in the test entries, RT Nos. 66-1, 88-1, 92-1, 108-1 and 91-1 were comparable with that of Kanchan. Nicotine and reducing sugars were within admissible limits

Bulk assessment trial: One bulk assessment trial was conducted with five entries viz., Tobios-2, NLST-3, NLST-4, NLSH-1 and Kanchan

Line NLST-4

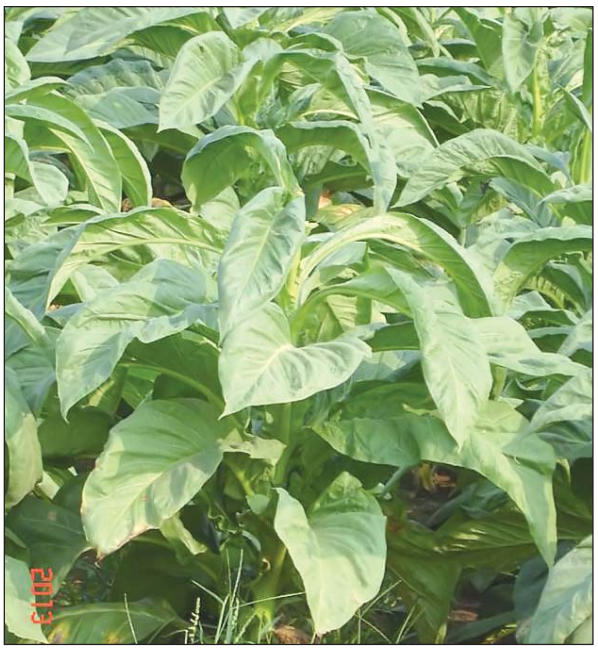
(check). All the test cultures showed desirable plant type and physical leaf quality. They recorded 2 to 15% more leaf yield than check variety, Kanchan. Levels of Nicotine and total reducing sugars were within desirable limits in all the cultures

Developing new varieties of irrigated natu tobacco for Andhra Pradesh [CTRI RS, Jeelugumilli]

T.G.K. Murthy

Bulk evaluation: Fourteen advanced breeding lines, identified as superior to checks in previous bulk assessment trials, were grown in progeny bulks along with check, Kommugudem. Among all the lines, Sel 47, Sel 45, and 45-90 were promising and recorded 12, 13 and 9% increase in cured leaf yield, respectively over Kommugudem (1475 kg/ha).

Evaluation of promising lines in replicated trial (2nd year): Sixteen green cast Natu type advanced breeding lines with high yield potential and / or TMV resistance, were evaluated in a RBD with three replications along with check Kommugudem for leaf yield and quality for the second year in succession. Ten lines (NF3-5-1, NF3-6-2, NF3-8-1, NF3-10-2, NF3-11-1, NF3-12-1, NF3-12-2, NF3-15-1, NF3-20-2, and PVM8-1) showed significantly higher total cured leaf yield than check, Kommugudem. The increase over Kommugudem ranged from 42 to 96% in these lines. Based on aroma, colour, leaf size, leaf blemish and weight, expert farmers identified the lines viz., NF3-5-1, NF3-6-2, NF3-12-2 and NF3-15-1 along with Kommugudem as suitable for irrigated condition. Nicotine levels varied from 1.04 to 2.20% while total reducing sugars varied from 0.74 to 1.39



Line NF3-20-2

Generation advancement and selection: F_5 generation of the crosses viz., Singarajupalem x Kommugudem and Kommugudem x 45-90 was grown and 33 single plant selections with desirable plant type (less height, close phyllotaxy, *Katta* type leaf shape, less internode length, dark green foliage and more leaf number), were selected for further studies.

Breeding TMV resistant irrigated Natu tobacco: Thirteen Natu type derivatives (F_8) of cross Pyruvithanam x JMR, identified as segregating for resistance to TMV during previous season, were grown in progeny rows for identifying desirable Natu lines with TMV resistance. Five of the lines showed uniform resistance to TMV. Six of the lines were found suitable as rainfed Natu types.

Evaluation of advanced burley breeding lines for productivity and quality [BTRC, Kalavacharla]

P.V. Venugopala Rao and T.G.K. Murthy

Replicated trial (Final Year): In a replicated trial, eleven advanced breeding lines (YB-15 to YB-25) and three check varieties (Banket A1 Burley-21 and BSRB-2) were evaluated. Significantly superior cured leaf yield was recorded in YB-19 (1402 kg/ha) and YB-22 (1227 kg/ha) over better control BA1. Next better performers were YB-18 and YB-24. The nicotine percentage ranged from 1.04 to 2.39, with maximum and minimum values associated with YB-22 and BY-21, respectively. Reducing Sugars ranged from 0.82 to 1.14%.

Results of combined analysis (2010-11 to 2012-13): Combined analysis of results revealed that highly significant cured leaf yield was recorded by YB-19 (1660 kg/ha) with 46%, YB-22 (1597 kg/ha) with 40%, followed by YB-23, YB-20 and YB-21 over better control Banket A1 (1139 kg/ha). The range of improvement over Banket A1 was 9 to 46 per cent. Interaction

effects are significant for both the yield characters. YB-19 and YB-22 recorded maximum green leaf yield and cured leaf yield in all the years and plastic over the years. YB-19 and YB-22 will be further evaluated in bulk trial.

Evaluation of segregating material: Progeny row trial was conducted with 27 lines and selections were made based on the morphological characters like leaf size, shape and colour, stem, veins, number of leaves, inter nodal length, spotting, etc., and these selections will be evaluated further during 2013-14.

Incorporation of Male sterility (CMS) in burley Varieties : The BC_8 crosses involving the male sterile hybrids viz., BRK-1, BRK-2, TN-97, NCBH-127 and NC-3 were raised and back crossed with the respective male fertile recurrent parent (Banket A1, Burley-21, VA-510 and Banket-127). The seed was collected to raise the BC_9 seedlings during 2013-14.

Development of high yielding TMV resistant FCV varieties suitable for cultivation in Andhra Pradesh [CTRI RS, Guntur]

C. Nanda and P. Venkateshwarulu

Evaluation of Advanced breeding lines replicated yield trial-1: In a replicated yield trial, 6 entries (from CTRI, Rajahmundry) and two checks were planted and evaluated for their yield potential in terms of green leaf, cured leaf and bright leaf yield as well as grade index. Analysis of data indicated no significant difference among the entries for all the four yield parameters

Replicated Yield Trial-2: In a replicated yield trial, six entries (from CTRI, Rajahmundry) and three checks were evaluated for their yield potential in terms of green leaf, cured leaf and bright leaf yield as well as grade index. Analysis of data indicated that the entry T-63 produced significantly high cured leaf yield of 2202 kg/ha with 28% improvement over check Siri followed by T-30 (2105 kg/ha) and T-60 (2024 kg/ha). The entry, T-63 also produced significantly highest bright leaf yield of 1008 kg/ha with 26% improvement over check Siri, followed by T-30 (914 kg/ha). Three entries *viz.,* T-63 (1524 kg/ha), T-30 (1486) and T-60 (1429) recorded significantly highest grade index with 26 %, 23% and 18% improvement over check Siri.

Crossing Programme: Twenty eight crosses involving eight superior lines (Siri, Hemadri, VT 1158, TBST-2, TBST 17, FCG 2, FCG 3 and V 4278) were made in half diallel pattern and F_1 seed collected for evaluation in next season.

Bulk Trial: New pipeline entries *viz.,* SH-1 and TBST-2 were raised along with the check Siri in bulk plots. Of the three, line TBST-2 has out yielded the check Siri in terms of green leaf yield (17407 kg/ha) by 7%, cured leaf yield (2721 kg/ha) by 9%, bright leaf yield (1240 kg/ha) by 13% and grade index (1921) by 10%. This was followed by SH-1.

Breeding FCV tobacco varieties for yield and quality characters under SLS conditions [CTRI RS, Kandukur]

A.R. Panda, K.C. Chenchaiah, P.V. Venugopala Rao, T.G.K. Murthy and A.V.S.R. Swamy

Maintenance of germplasm: Three hundred seventeen (317) accessions of FCV Tobacco germplasm were maintained at CTRI RS, Kandukur.

Generation advancement and selection: Five single plants selections from the F_3 single plant progeny rows of the crosses Siri X 15-2 and Siri X 10-1 with aphid resistant lines were made. Five single plants selections from the F_3 single plant progeny rows of the crosses Siri X 155-2 and Siri X 113-1 with caterpillar resistant lines were made. F_1 generation of Siri X 47-1, Siri X 62-2 and Siri X 151-2 were grown and F_2 seed collected. Three breeding lines from CTRI RS, Kandukur viz., FC-1 a dwarf variant of Siri with smaller internodes identified from the bulk population of Siri, FC-2 from the crosses of Hema X NC 3150 and FC-3 from Candle X Hema were contributed in the project KBr-9 to test their superiority over the check varieties.

Pedigree selection in chewing tobacco (*N. tabacum* L.) population with a broad genetic base [CTRI RS, Vedasandur]

A.V.S.R. Swamy

Bulk trial: Two promising selections viz., HV.2009-3 and HV.2009-5 derived from broad based populations of diallel selective mating series were grown in pre-release bulk trial at CTRI Research Station Farm as well as in four

out station centers viz., Semmadaipatty, Olagampatty, Kulipatty and Reddiarchatiram along with the control variety Abirami for assessment of yield and quality. Both the broad based selections HV.2009-3 and HV.2009-5 performed well at CTRI Research Station Farm Vedasandur recording cured leaf yield of 4376 and 4063 kg/ha respectively an increase of 13.1 and 5.0 per cent increase over the control variety Abirami. In four farmers' field also, the broad based selections HV.2009-3 and HV.2009-5 uniformly performed well recording mean cured leaf yields of 4347 and 4027 kg/ha respectively an increase of 15.9 and 7.4 per cent over the control Abirami. In chewing quality appraisal, the selections recorded higher scores of 72.5 and 70.3 respectively against the control Abirami (69.4).

Diallel analysis in *Motihari* (*N. rustica*) tobacco for breeding superior varieties [CTRI RS, Dinhata]

S. Roy

Leaf yield assessment: All pedigree selections (T1-T3), interse- crosses (T4) and inter-mating crosses (T5-T6) derivatives recorded significantly superior cured leaf yield over check, DD-437. Pedigree selection of cross, C-25 x Snuff-2 showed significant superiority over check Torsa whereas Black Queen (B.Q) x DD-437 exhibited significant superiority over all the three checks viz. DD-437, Dharla and Torsa. First grade leaf of pedigree selection from cross, C-25 x snuff-2 and one interse cross (B.Q x Manda) x (B.Q x Manda) indicated singnificant superiority yield over check, DD-437. In all the selections, quality leaf outurn ranged from 46-51% comparable to the two checks, Dharla and DD-437.

Improvement of Assam tobacco variety of *Motihari* tobacco (*N.rustica*) for yield by keeping the quality

S. Roy

Bulk trial: In a bulk plot trial, the three derivatives crosses Bengthuli sada x Torsa S-1, Bengthuli sada x Torsa S-2 & Bengthuli sada x Torsa S-3 recorded 400-1000 kg/ha more cured leaf yield over the local check Bitri and over and at par yield with check Torsa. All the crosses recorded about 2.5 - 4 times more yield than the Assam variety Bengthuli and Bengthuli sada. In the case of first grade leaf yield the crosses Bengthuli sada x Torsa & Bengthuli sada x Torsa recorded 300-500 kg/ha more yield than the check Bitri and at par yield with check Torsa.

Interspecific hybridisation for tobacco improvement

Incorporation of aphid resistance from *N. gossei*, *N. repanda*, *N. umbratica* - *nesophila* and *N. benthamiana* – *repanda* [CTRI, Rajahmundry]

T.G.K. Murthy, U. Sreedhar and K. Siva Raju

Maintenance of interspecific cross derivatives: During 2012-13 season, a total of 162 stabilized aphid and caterpillar resistant/ tolerant advanced lines and those having high yield potential, derived from crosses involving *N. tabacum* as one parent and aphid resistance donors viz., *N. gossei, N. excelsior, N. x benthamiana-repanda,* and *N. umbratica* as the other parents, were grown in progeny rows along with 8 check varieties. Also, 11 derivatives developed from crosses, *N. gossei x N. tabacum* and *N. umbratica x N. tabacum,* screened and identified as tolerant to leaf curl disease in collaboration with Entomologist, were maintained. Five Lanka type derivatives were grown for evaluation of their suitability for cultivation.

Preliminary evaluation for leaf yield potential: Seven of the selections were medium cast and possessed "Kanchan" plant type suitable for NLS area. Twenty four light cast derivatives with high leaf yield potential (CLY 2500 – 3290 kg/ha) as compared to check variety, Siri (CLY- 1940 kg/ha) were identified. After evaluation of plant type, leaf number, plant height, floral, fertility traits along with cured leaf colour, size and body, and seed bearing nature, the most promising uniform lines were retained for further evaluation.

Evaluation of advanced lines in RYTs

a) Trial TBL-4: A replicated yield trial was conducted for three seasons (2009-10 to 2011-12) with ten morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 32 to TBST 41) along with two checks,

Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature and were resistant to TMV also. Due to unfavorable conditions during 2010-11 season the yield levels were low. Hence combined analysis was carried out for two seasons data. Combined statistical analysis (2009-10 to 2011-12) of the yield data revealed that four advanced cross derivatives viz., TBST-36, TBST-33, TBST-41 and TBST-32 were significantly superior to best check, Siri for all the four yield traits. They showed 7 to 20% increase in green leaf yield, 7 to 22% in cured leaf, 9 to 28% in bright leaf and 10 to 26% for grade index, respectively over the best check, Siri. Seasonal differences were significant and yield levels during 2011-12 were higher than the other two seasons. Season x entry interaction was also significant for all the four yield traits Based on overall performance the four entries viz., TBST-36, TBST-33 and TBST-41 are selected for further studies

TBST-36

TBST-41

b) Trial TBL-5: A replicated yield trial was conducted for three seasons (2009-10 to 2011-12) with ten morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 42 to TBST 51) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. Four of the derivatives (TBST Nos. 43, 48, 49, 50 & 51) showed uniform resistance to TMV also. Combined statistical analysis of the yield data revealed that three advanced cross derivatives viz., TBST-48, TBST-49 and TBST-51 were significantly superior over best check, Siri for all the four yield traits. They showed 9 to 17% increase in green leaf yield, 11 to 18% in cured leaf, 19 to 23% in bright leaf and 12 to 20% for grade index, respectively over the best check, Siri. Season x entry interaction was also significant for all the four yield traits. Based on overall performance the entry TBST-51 was selected for further studies.

c) Trial TBL-7 (3rd year): A replicated yield trial was conducted for the third year in succession with twelve morphologically stable, aphid resistant/ tolerant, advanced cross derivatives (TBST 52 to TBST 63) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. All the breeding lines were light cast in nature. Nine entries viz., TBST Nos., 52, 53, 56 to 62 were resistant to TMV also. Differences among entries were significant for all the four yield traits. Five lines (TBST 57, TBST 60, TBST 53, TBST 62 & TBST 61) showed significant improvement over the best check, Siri for all the four leaf yield traits. They showed 21 to 46% increase in green leaf yield, 21 to 40% in cured leaf, 19 to 46% in bright leaf and 24 to 46% for grade index, respectively over the best check, Siri. The nicotine content varied from 1.36 to 1.87% while reducing sugars ranged from 8.43 to 13.60%.

Pooled analysis: Combined statistical analysis of the yield data revealed that six advanced cross derivatives viz., TBST-61, TBST-57, TBST-60, TBST-53, TBST-56 and TBST-58 were significantly superior over best check, Siri for all the four yield traits. The increase in these lines was 12 to 32% for green leaf yield, 13 to 34% for cured leaf yield, 12 to 40% for bright leaf yield and 10 to 34% for grade index, respectively over Siri. Season x entry interaction was also significant for all the four yield traits. Based on overall performance, five entries viz., TBST-53, TBST-57, TBST-60, TBST-61 and TBST-62 are selected for further studies.

d) Trial TBL-8 (3rd year): Another replicated yield trial was conducted for the third season in succession with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 64 to TBST 75) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. All the breeding lines were light cast in nature. Seven lines viz., TBST Nos. 64, 66 to 71 were resistant to TMV also. Three derivatives (TBST-71, TBST-73 and TBST-68) showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase in these lines was 30% to 35% for green leaf yield, 20 to 31% for cured leaf yield, 20 to 29% for bright leaf yield and 20 to 30% for grade index, respectively over Siri. The nicotine content varied from 1.15 to 1.97% while reducing sugars ranged from 10.38 to 18.53%

Pooled analysis: Combined statistical analysis of the yield data over three seasons (2010-113) revealed that eight advanced cross derivatives viz., TBST-73, TBST-71, TBST-68, TBST-69, TBST-70, TBST-72, TBST-67 and TBST-75 were significantly superior over best check, Siri for all the four yield traits. The increase in these lines was 15 to 39% for green leaf yield, 12 to 32% for cured leaf yield, 14 to 38% for bright leaf yield and 13 to 35% for grade index, respectively over Siri. Season x entry interaction was also significant for all the four yield traits. Based on overall performance the seven entries viz., TBST-73, TBST-71, TBST-68, TBST-70, TBST-72, TBST-67 and TBST-75 are selected for further studies.

e) Trial TBL-9 (3rd year): Another replicated yield trial was conducted for the third season in succession with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 76 to TBST 87) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. All the breeding lines were light cast in nature. Three lines viz., TBST Nos. 76, 83 and 86 showed resistance to TMV also. Only one line, TBST 80 showed significant improvement over the best check, Siri for cured and bright leaf yield and grade index. The increase was 21% for cured leaf yield, 17% for bright leaf yield and 18% for grade index. The nicotine content varied from 0.84 to 1.73% while reducing sugars ranged from 10.86 to 21.14%.

Pooled analysis: Combined statistical analysis of the yield data over three seasons (2010-113) revealed that two advanced cross derivatives viz., TBST-85 and TBST-77 were significantly superior over best check, Siri for all the four yield traits. The increase in these lines was 15 & 11% for green leaf yield, 17 & 16% for cured leaf yield, 20 & 10% for bright leaf yield and 16 to 9% for grade index, respectively over Siri. Season x entry interaction was also significant for all the four yield traits. Based on overall performance the entry TBST-85 is proposed for further studies.

f) Trial TBL-10 (1st year) : A new replicated yield trial was conducted with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 88 to TBST 99) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature. Eleven of the derivatives (except TBST-95) were resistant to TMV also. Derivatives TBST-89, TBST-93, TBST-97 and TBST-99 showed bigger leaf size than others. Ten lines, viz., TBST-93, TBST-94, TBST-91, TBST-97, TBST-98, TBST-90, TBST-92, TBST-99, TBST-89 and TBST-88 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 19 to 46% for green leaf yield, 18 to 44% for cured leaf yield, 16 to 36% for bright leaf yield and 16 to 37% for grade index, respectively. The nicotine content varied from 0.69 to 1.67% while reducing sugars ranged from 14.78 to 23.50%.

g) Trial TBL-11 (1st year): Another replicated yield trial was conducted for the first year with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 100 to TBST 111) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature. Ten of the derivatives (TBST100-105, 107-110) were resistant to TMV also. Four lines, viz., TBST-107, TBST-105, TBST-109 and TBST-100 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 15 to 47% for green leaf yield, 14 to 46% for cured leaf yield, 22 to 52% for bright leaf yield and 19 to 50% for grade index,

respectively. The nicotine content varied from 1.10 to 1.46% while reducing sugars ranged from 14.13 to 21.23%

h) Trial TBL-6 (3rd year): An yield evaluation trial was conducted with 12 'Lanka' type selections for the third year in succession. The lines were developed from the initial cross, *N. tabacum x N. gossei*. The derivatives were evaluated in a RBD with 3 replications along with check variety, Lanka Special for their yield potential and leaf quality. Six lines viz., LK4 LK7, LK8, LK11, LK3 and LK9 showed significant improvement in cured leaf yield over the check variety, Lanka Special. The nicotine content varied from 0.62 to 1.41% while reducing sugars ranged from 2.00 to 4.80%

Pooled analysis: Combined statistical analysis of the yield data over three seasons (2010-113) revealed three advanced cross derivatives viz., LK-4, LK7 and LK8 significantly superior over check, Lanka Special with 11-19% increase. Season x entry interaction was also significant for all the four yield traits. Based on overall performance the two entries viz., LK4 and LK8 are proposed for further studies

Bulk evaluation: Advanced breeding line TBST-2 which showed superiority over check varieties at Rajahmundry, Guntur and Kandukur in multilocation trials was evaluated against Siri for yield and quality in a bulk trial. The leaf yield potential of TBST 2 (CLY 2680 kg/ha, BLY 1634 kg, GI 2218) was higher than Siri (CLY 2011 kg, BLY 1247 kg and GI 1685).

On-farm trial: On-farm evaluation of TBST 2 in comparison with Siri as control was carried out in Pamidipadu village, Prakasham dist. (SBS zone). TBST 2 recorded higher cured leaf yield (2223kg/ha) as compared to check Siri (1950kg/ha) with 12.3% improvement. Plant height, leaf spread, leaf length and width of TBST 2 were superior to check, Siri. Chemical analysis of leaf samples indicated that line had 1% nicotine, 13.25% reducing sugars and 0.49% chlorides which is at acceptable limits.

Line TBST-2

Location specific evaluation of cross derivatives: Promising derivatives having resistance to tobacco aphid, caterpillar and those tolerant to leaf curl, identified under the project, were contributed to CTRI RS, Kandukur (29 FCV lines), CTRI RS, Guntur (11 FCV lines) and CTRI RS, Jeelugumilli (4) and CTRI RS, Hunsur (30) for further evaluation.

Maintenance of other important genotypes: Following genetic stocks/lines were also developed under the project and maintained for future use: (i) Corolla-split variants (digenic), (ii) Asynaptic line, (iii) Translocation heterozygotes, (iv) Variegated mutants, (v) Cream coloured testa (digenic recessive to brown), (vi) Probable genetic male sterile. (vii) CMS sources, (viii) Dwarf mutants (digenic recessive), (ix) Enation mutant

Developing hybrid tobacco suitable for Traditional black soils of Andhra Pradesh

T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala

Replicated yield trial with CMS hybrids

a) Trial Br. 7.9 (2nd year): The trial was conducted with 18 CMS hybrids along with check Siri in a RBD with 3 replications for the second successive year. Six hybrids viz., TBSH-81, TBSH-79, TBSH-91, TBSH-78, TBSH-90 and TBSH-82 showed significant standard heterosis over the check, Siri for all the four leaf yield traits.

Pooled analysis: Combined statistical analysis of the data collected on the yield trial over two seasons (2011-12 and 2012-13) revealed eight hybrids have significantly higher standard heterosis than variety, Siri for various yield traits. Four of the, viz., TBSH-79, TBSH-81, TBSH-87 and TBSH-91 showed 20% or more standard heterosis over Siri. Seasonal differences were significant for bright leaf yield and grade index. The Season x entry interaction

was also significant for yield traits except cured leaf yield. Based on overall performance three hybrids viz., TBSH-81, TBSH-87 and TBSH-91 are selected for further studies.

b) Trial Br 7.10 (1st year): The trial was conducted with 7 CMS hybrids and one check Siri in a RBD with 4 replications. Four hybrids viz., TBSH-99, TBSH-96, TBSH-101 and TBSH-98 showed significant standard heterosis over the high yielding check, Siri for all the four leaf yield traits. They recorded 20-34% standard heterosis for green leaf yield, 21-36% for cured leaf and 24-43% for bright leaf yield and 23-41% for grade index, respectively over Siri. The nicotine content varied from 1.41 to 1.87% and reducing sugars from 8.77 to 4.92%

Maintenance of CMS lines: A total of 63 CMS lines with varying cytoplasm sources were maintained. Details of CMS parental lines are furnished in Table I-1.

All the lines were crossed with respective maintainer lines for further maintenance and use. Four crosses viz., MS-58 x HDBRG, MS-58 x VT-1158, MS-58 x A-145 and MS58 x TI-163 (all in BC_6) were made to develop CMS parental lines with high biomass potential.

Developing hybrid FCV tobacco suitable for NLS area of Andhra Pradesh [CTRI RS, Jeelugumilli]

T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala

Maintenance of CMS lines: During the 2012-13 season, 15 CMS lines in genetic background of ruling variety, Kanchan and other improved lines were maintained and back crossed to recurrent parent.

Replicated yield trial (MSH): Sixteen CMS hybrids, produced from crosses involving identified promising CMS lines and high yielding breeding lines were evaluated along with the check, Kanchan in a RBD with 3 replications. Two hybrids (MSH-1 and MSH-15) showed significant standard heterosis for all the three yield traits over check, Kanchan with 14 &36 % increase in green leaf yield, 22 & 34% in cured leaf yield and 17 & 46% increase in grade index.

Line MSH-15

Evaluation of FCV tobacco hybrids for yield and quality under SLS conditions [CTRI RS, Kandukur]

A.R. Panda

A trial was conducted with ten promising FCV tobacco lines with three checks for the yield parameters under SLS conditions in RBD. The results indicate that the test entry, FC-1 (2147 kg/ha), R-11(2103 kg/ha), R-15 (2191 kg/ha), R-20 (1950 kg/ha) and R-57 (1904 kg/ha) are significantly superior to all check varieties

Table I -1. CMS parental lines maintained

S.No.	Cytoplasm	Genetic background
1.	*N. undulata*	MS Delcrest, MS SPG 28, MSVT1158, Hema, Kanchan, Hicks, Gauthami
2.	*N. plumbaginifolia*	MS 85, MSB, MS19
3.	*N. tabacum*	AP1-8, Hicks, Speight G 28, VT 1158
4.	*N. gossei*	6-6MS, MS34, CR73MS, 72-21MS, MS58, 140MS, 16-17-17MS
5.	*N. suaveolens*	MSH5, MSH3
6.	*N. megalosiphon*	7-9MS, 7-25MS
7.	Exotic sources	NC71, T-29, RGH-04, RGH-51, MS-87

Hema (898 kg/ha), Siri (1354 kg/ha), Kanthi (1117 kg/ha) in respect of all yield parameters.

Studies on heterosis in chewing tobacco (*N. tabacum* L.) [CTRI RS, Vedasandur]
M.Kumaresan

Replicated yield trial: During 2012-13, ten F_6 populations of promising hybrids (HV.2011-1 to HV.2011-10) were grown in a replicated yield trial along with Bhagyalakshmi and Abirami as controls for assessing their quality and yield. Significant differences were observed for whole leaf yield and total leaf. Even though, none of the selections were found significantly superior to the best check Abirami in whole leaf yield, the selections HV.2011-2, HV.2011-7 and HV.2011-1 recorded significant whole leaf yields of 3436, 3214 and 3170 kg /ha respectively against the control Bhagyalakshmi. In total leaf yield, selections HV.2011-2 and HV.2011-1 registered significant superiority recording 4130 and 4054 kg/ha respectively over the controls Bhagyalakshmi and Abirami. Selection HV.2011-7 recorded significant total leaf yield of 3900 kg/ha against the control Bhagyalakshmi.

Combined analysis: In the combined analysis for two years (2011-13), the selections exhibited significant differences for total leaf yield, plant height, leaf length, leaf width and intermodal length against the controls. In total leaf yield, selections HV.2011-2 and HV.2011-1 recorded significant superiority registering 4265, 4099 kg/ha respectively over the controls Abirami and Bhagyalakshmi. Selections HV.2011-5 HV.2011-7 and HV.2011-9 were significantly superior to the control variety Bhagyalakshmi recording 3994, 3864 and 3722 kg/ha total leaf yield respectively. Seasons x treatments exhibited significant differences for leaf length, leaf width, whole leaf and total leaf yield. Chewing quality score, selections HV.2011-2 recorded maximum score of 74.0 out of 80 followed by HV.2011-1(72.5/80). The trial will be conducted in the ensuing season also for confirmation of results.

Development and evaluation of F_1 hybrids suitable to Karnataka Light Soil region [CTRI RS, Hunsur]
C. Panduranga Rao, M. Mahadevaswamy, S. Ramakrishnan and S.S. Sreenivas

Eight advanced breeding lines developed from the crosses involving Kanchan, Rathna, Newdel, NC 12, PCT 8 and Yellow spl were evaluated in 2011-12 and 2012-13. None of the entries showed any superiority over check Kanchan. Pooled analysis of the data for two seasons also showed that yield increment over Kanchan was not significantly superior. The RKI of the entries was 1.5 - 4.5 and ranged between 0-4.The chemical quality parameters of the lines assessed were in acceptable range. Forty five progenies under sixth filial generation derived from the crosses involving Bhavya, Rathna, Kanchan with Coker 371 Gold & NC 89 were grown under progeny row trial and were advanced to seventh generation for further studies during the current season.

Developing tobacco cultivars resistance to biotic and abiotic stresses

Incorporation of disease resistance for tobacco mosaic virus (TMV)
P.V. Venugopala Rao and S.K. Dam

Incorporation of Black Shank resistance in FCV varieties/ advanced breeding lines: Black shank resistance incorporation in the recently released variety Siri and the advanced breeding lines N-98 and Cy-142 is in progress. These lines were crossed with the resistant donors Beinhart 1000-1 and 1129SR. During 2012-13, 667 progenies were evaluated under artificial inoculation with the pathogen and data were recorded on all the plants in each progeny. Based on the susceptibility and the plant type 103 progenies were rejected and the remaining will be tested under artificial inoculation during 2013-14.

Maintenance of the TMV resistant lines: Ten TMV resistant lines viz., VT-1158, JMR, HMR, 1099/2/4, L-1358, L-1359, L-1366, L-1416, L-1417 and L-1419 are being maintained under artificial inoculation. Twelve Natu TMV resistant Natu tobacco lines PVM 1 to 12 are also maintained.

I. (B) Tailoring of tobacco plant type for optimizing the seed yield and phyto-chemicals

Breeding for high seed and oil yield in tobacco
M. Kumaresan

Ninety eight F_3 populations of the following promising crosses for high seed yield

under 60cm x 60cm spacing were grown and selections were made with seed yield ranging from 1250 – 2200 kg /ha for advancement of generation and further study (Table I – 2).

Table I – 2. Promising crosses for seed yield

Sl. No.	Cross	No. of selections made and retained
1.	A.145 x Bhagyalakshmi	7
2.	A.119 x Bhagyalakshmi	12
3.	A.119 x Abirami	36
4.	A.119 x NP-19	7
5.	A.145 x NP-19	4
	Total	66

I. (C) Production and distribution of foundation seed of ruling tobacco varieties

Seed sale: During 2012, 13,592.5 kg foundation seed of seven different varieties was sold to farmers through CTRI, Rajahmundry and its Research Stations. An amount of Rs. 1,35,92,500/- was realized. Variety-wise distribution of seedlings to farmers and distribution of seed multiplication plots are as follows (Table I-3).

I. (D) Germplasm Resource Management

Germplasm acquisition, maintenance, evaluation and utilization [CTRI, Rajahmundry]

T. G. K. Murthy

Acquisition: During the season, 202 bidi, 80 natu and 73 *N. rustica* accessions were added to the germplasm bank, thereby increasing the CTRI genetic resources to 3167.

Maintenance of cultivated germplasm: A total of 1992 germplasm lines were maintained. They comprised 511 Flue-cured Virginia, 880 non-FCV lines and 601 elite lines for various important traits.

Maintenance of wild *Nicotiana* species: A total of 213 accessions of 56 wild *Nicotiana* species and two subspecies were maintained in pots / experimental micro plots. Also, 9 exotic interspecific hybrids, 5 hybrids developed at CTRI and 4 amphidiploids were maintained. Eleven non-flowering accessions were rescued through *in-vitro* micropropagation.

Germplasm enhancement: Interspecific hybrids., viz., *N. sylvestris x N. tomentosiformis* and *N. sylvestris x N. otophora* which are considered as the progenitor crosses of cultivated *N. tabacum* were synthesized and their back cross progenies (BC_2S_1) were

Table I – 3. Production and distribution of tobacco seedlings

S.No	Variety	Number of tobacco seedlings supplied		Total
		Seed plots	CTRI Farm & CTRI-RS Guntur	
1	Hema	29,000	4,07,000	4,36,000
2	VT-1158	5,76,000	1,61,600	7,37,600
3	Siri	2,16,450	33,18,750	35,35,200
4	Gauthami	—-	11,600	11,600
5	Kanthi	—-	12600	12600
6	Lanka spl.	—-	60,000	60,000
7	N-98	—-	2,29,600	2,29,600
8	Kanchan	——	70,000	70,000
	Total	8,21,450	42,71,150	50,92,600

advanced for infusing additional variation into the cultivated species and enhancing the scope for further genetic improvement of the crop.

Conservation: All the germplasm accessions maintained during the past five years have been stored at -10ºC in the walk-in cold storage chamber and in deep freezer. Also a sample of each line was stored under ambient conditions. So far about 1400 germplasm accessions of FCV, Burley, Jati, JAC, EAC, Oriental, Bulgarian, sources of root knot nematode resistance, and released varieties have been deposited at NBPGR for long term seed storage.

Distribution: During the year a total of 215 accessions of both wild and cultivated *Nicotiana* species were supplied to 20 different researchers/organizations.

Molecular Characterization

(**a) Molecular markers for CMS:** Ten gene specific primers, targeting the mitochondrial genome, were used to differentiate CMS and maintainer lines of tobacco. The primers were screened for their efficacy in 28 CMS lines and the 19 fertile counter parts. Two of the primers targeting the subunits of ATP synthase gene in mitochondrial genome could effectively differentiate CMS and fertile lines. The primer targeting atp1 subunit of ATP synthase gene amplified a 550bp and a 130bp fragments in fertile maintainer lines and a single 135bp amplicon in CMS lines. Another primer, targeting the atp6 subunit of ATP synthase gene amplified a polymorphic 400bp amplicon in the CMS lines and corresponding band is absent in the maintainer lines. The results were validated for their reliability and repeatability across different CMS and maintainer lines of tobacco and found consistent.

(b) Barcode markers for *Nicotiana* species: In order to identify the suitable barcode regions for characterization of *Nicotiana* species, three different bar coding loci namely rbcL (1430 bp) and matK (1500 bp) coding regions and one non coding spacers region of trnH-psbA (500-600 bp) were selected and screened in selective *Nicotiana* accessions using the Polymersae Chain Reaction. All the PCR amplicons were analysed by agarose and polyacrylamide gel electrophoresis. The trnH-psbA locus was able to resolve the variability and showed differential amplicon lengths among the *Nicotiana* accessions, whereas rbcL and matK loci didn't show length polymorphism. Therefore, trnH-psbA can be used as a potential barcode primer for grouping and cataloguing the accessions. Further, sequencing of trnH-psbA intergenic spacer region along with other potential bar code regions will be helpful in cataloguing the *Nicotiana* accessions based on barcodes and in generating the *Nicotiana* reference database.

Evaluation

(a) Screening against TMV disease: Thirteen lines, previously recorded as TMV resistant donors were screened against TMV disease under artificial inoculation for confirmation. All the lines were uniformly resistant

(b) Screening against damping off: Among the 18 accessions screened, lines GT-9 and GT-5 recorded reduced mycelial growth compared to others in leaf disc assay indicating their relative tolerance reaction against damping off pathogen.

(c) Screening burley germplasm against stem borer: Out of the 50 burley germplasm screened under artificial infestation, lines By 16 and By 30 were observed to be tolerant.

(d) Reaction to waterlogging: Eighty four released varieties of different types were screened by the Physiologist in the experimental farm at Katheru for excess water stress. Based on chlorosis and drooping of leaves, 3 varieties of FCV (Virginia Gold, CTRI Special and Hema), one burley (Banket A-1) two bidi (GT-8 and A-145) and 2 chewing varieties (Bhagyalakshmi and Jati-Podali) were identified as tolerant to water logging. Varieties viz., Gauthami, Swarna, Rathna, Burley 21, GT-5, Bhagyasree, Meenakshi(CR) and GC-1 were susceptible. Chlorophyll a-b ratio, specific leaf weight, root-shoot ratio and activity of antioxidative enzymes showed association with water logging tolerance.

(e) Evaluation for seed yield, oil content and biomass potential: Fourteen advanced derivatives of eight crosses and one pureline selection made within HDBRG population were evaluated along with three check varieties viz., HDBRG, A-145 and GT-7, for seed yield, seed oil

content, biomass potential and yield of phytochemicals for the second year in succession. Seed yield varied from 413 kg (in SY-4) to 1083 (in SY-15) among the test genotypes, while it varied from 396 to 1025 among the check varieties. Varietal differences were significant. Two genotypes viz., SY-15 and SY-14 possessed seed yield potential comparable to that of A-145. Pooled analysis (2011-13) of the results indicated that SY Nos. 2,3,5,10,14 and 15 were on par with better check, A-145. The seed oil content analysed by the NMR Spectroscopy showed narrow range (29.6 in HDBRG control to 31.2 in SY-8). Varietal differences were significant. Genotypes viz., SY-6, SY-8 and SY-10 showed significantly higher oil content than better check, GT-7. Results of pooled analysis indicated that genotypes SY-4, SY-6, SY-8, SY-10 and SY-12 showed higher oil content than better check, GT-7. Biomass potential of all the 18 genotypes evaluated in the experiment was evaluated for two years (2011-12 and 2012-13). In the check varieties it varied from 24.4 to 35.0 tonnes/ha, whereas in the test genotypes it varied from (SY-11) 23.9 to 36.4 t (SY-4). Although varietal differences were significant, no genotype possessed more biomass potential than check variety, HDBRG. In another trial, five germplasm selections three advanced breeding lines were evaluated for seed yield in a RBD with 3 replications. The seed yield in the test entries varied from 425 to 1124 kg whereas the check varieties A-145 and HDBRG produced 1281 and 429 kg seed per hectare. One germplasm selection, Coker 48#3 gave seed comparable with better check, A-145.

Germplasm Maintenance at CTRI RS, Guntur
C. Nanda

Maintenance of germplasm: Nine caterpillar resistant Natu lines (NG 54, NG 55, NG 58, NG 59, NG 60, NG 61, NG 65, NG 66 and DWFC) and five released varieties (Prabhat, Vishwanath, WAF, NATU Special, Bhairavi (NG 73)) were grown for seed regeneration. Seeds of 151 lines comprising of different tobacco types such as Natu/ Oriental/ HDBRG/Burley/ Motihari were sent to CTRI Rajahmundry for long term preservation. Seven CMS lines received from Rajahmundry were maintained by crossing with their maintainers. Apart from this, six hybrids based on CMS were synthesized (MS 70VT x Hema, MS 70VT x Siri, MS 85J x Hema, 6-6-MSVT x Siri, MS 19VT x Siri and MS 19VT x TBST 2).

Germplasm maintenance of *Nicotiana tabacum* varieties / lines [CTRI RS, Hunsur]
C. Panduranga Rao and S.S. Sreenivas

Maintenance of germplasm: Active stock of around 635 germplasm accessions was maintained. Under the periodical seed multiplication programme, 250 germplasm accessions were regenerated. Male sterile lines of Kanchan and Rathna were maintained. Incorporation of male sterility from varied sources into Kanchan, Rathna, Coker 371G, FCH 201, FCH 221 and FCH 222 was continued.

Evaluation and maintenance of germplasm [CTRI RS, Vedasandur]
M. Kumaresan

Maintenance of germplasm: Eighty five chewing and 60 cigar and cheroot germplasm accessions were raised, self pollinated and seed collected for maintenance at CTRI Research Station, Vedasandur.

Maintenance of Male sterile lines: Cytoplasmic male sterile lines of Bhagyalakshmi, Abirami, Maragadam, PV-7, I-115, and VR-2 were crossed with their respective fertile counterparts and seeds collected for maintenance of the male sterile lines.

Collection, evaluation and maintenance of *Jati*, *Motihari*, Cigar Wrapper & filler tobacco germplasm [CTRI RS, Dinhata]
S. Roy

Maintenance of germplasm: Seventy lines of *N. tabacum* (*Jati* tobacco) and 185 lines of *N. rustica* (*Motihari*) tobacco raised and selfed, seeds of each line were collected.

I. (E) Biotechnology for tobacco improvement

Micropropagation of elite lines and other selections [CTRI, Rajahmundry]
K. Sarala and K. Prabhakara Rao

A total of 571 plantlets of various tobacco entries were micropropagated under *in vitro* during 2012-13 (Table I – 4). Around 250 anther culture (colchicine treated) plantlets were

transferred to pots for further studies and 21 among them produced seed.

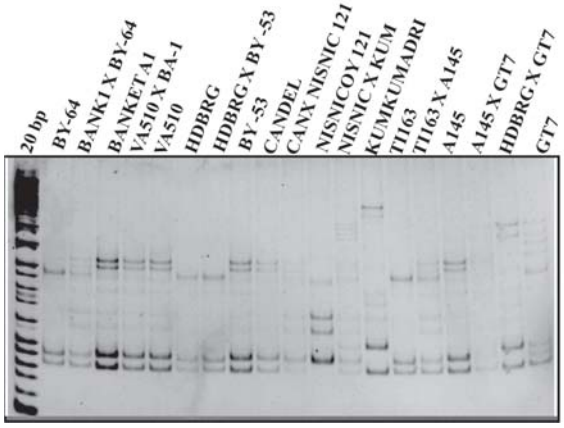
Table I - 4. Lines micropropagated under *in vitro*

Entry	No. of plantlets
Anther culture plants	
A -145 X GT-7	39
GT-7 X A- 145	30
HDBRG X GT-7	126
HDBRG X BY 53	10
Banket A1 X BY 64	25
VA510 X Banket A1	60
Nisnicotinony-121 X Kumkumathri	10
Candel X Nisnicotinony-121	170
Mid vein culture	
HDBRG X GT 7	12
HDBRG X BY 53	12
BANKET A1 X BY 64	12
VA510 X Banket A-1	8
Nisnicotinony-121 X Kumkumathri	4
Candel X Nisnicotinony-121	8
Direct organogenesis	
R-466	10
Seed culture	
Siri	20
HDBRG	15
Total	571

Molecular mapping of important tobacco traits [CTRI, Rajahmundry]

K. Sarala, K. Prabhakara Rao, T.G.K. Murthy, K. Siva Raju and P.V. Venugopala Rao

Characterization of parents used in developing mapping populations: Nine out of 20 SSR markers tested were found polymorphic among the parents of RIL populations of nicotine and solanesol. Attempts were also made to study the polymorphism using five ISSR and 10 SCOT primers. 14 SSR markers were found polymorphic among the parents and bulks of RIL populations related to nicotine and solanesol. DNA isolated from 258 lines from solanesol mapping population (HDBRG x BY 53 cross derivatives) and 249 nicotine mapping population (Candel x Nisnicotinony-121 cross derivatives) for further analysis. Nicotine content was estimated in a nicotine molecular mapping population. Nicotine in the mapping population was in the range of 0.18-2.96%. Out of 247 entries analyzed in the mapping population highest population found to be in the range of 0.6-1.0% and 1.0-1.5% nicotine range. This indicates that wide variation is created in the mapping population.



SSR Analysis of tobacco lines and hybrids

Development of mapping populations: For the development of mapping populations i.e. Recombinant Inbred Lines (RILs), 9 F_1s and 11 mapping populations viz., BY 64 x Banket A1 (F_7/ F_6), VA 510 x Banket A1 (F_7), HDBRG x BY 53 (F_6), HDBRG x GT-7 (F_7), TI 163 x A-145 (F_7/ F_6), Candel x Nisnicotinony 121, Kumkumathri x Nisnicotinony 121 (F_7), Nisnicotinony 121 x Kumkumathri (F_7), A 145 x GT 7 (F_8/ F_7), GT 7 x A 145 (F_7) and A 145 x Jayalakshmi-WS (F_7) (a total of around 2200 plants) were raised and selfed seed collected. Haploid plants developed from 9 crosses and the efforts are on to develop dihaploid lines through mid-vein culture and colchicine treatment. Developed and maintained 24 dihaploid lines from six crosses.

Transcript profiling and identification of candidate genes resistant to Damping-off in tobacco [CTRI, Rajahmundry]

K. Prabhakara Rao, K. Sarala, T.G.K. Murthy, S. K. Dam and K. Sivaraju

Molecular characterization of damping-off disease pathogen: Among the 20 pathogen isolates of damping-off pathogen collected from different research stations, complete ITS (Internally Transcribed Sequence) molecular characterization was carried out for four isolates. The ITS gene regions comprising ITS1,

5.8S and ITS2 sequences were deposited in NCBI and the following accession numbers were assigned by Gen Bank.

Testing of tobacco lines showing varied reactions to dampingoff pathogen under artificial condition: Twenty one selective tobacco genotypes (Yarda, Simmaba, Cocker 139, Dixie Bright 102, TI1029, Xanthi, Coker 1, Burley 21 KY14, K326, Kanchan, NC72, Hicks, Bhavya, AP-1, *N. gossei*, ABT-10, GT-9, GT-7, GT-5, Golden mammoth, Aurelius) were screened in nursery under natural conditions with dampingoff pathogen (*Pythium aphanidermatum*) and through leaf disc assay method under artificial conditions. Line Coker 1 was highly susceptible to *Pythium aphanidermatum* and GT-9, GT-5 recorded reduced mycelia growth. Further, time course experiments were conducted with lines Coker 1, GT9, GT5 and AP-1 by artificial inoculation with the pathogen and infected samples were collected at different time intervals for RNA isolation and subsequent transcript profiling.

Electrophoretic characterization of tobacco - DNA finger printing of ruling tobacco cultivars [CTRI, Rajahmundry]

K. Siva Raju and T.G.K. Murthy

DNA fingerprints were developed for popularly grown Flue-Cured Virginia (FCV) tobacco cultivars and one Burley tobacco variety using SSR and ISSR markers. The cultivars used in the present study were 1. Gauthami 2. Hema. 3. Siri, 4. Cy-79, 5. Bhavya., 6 Ratna, 7. Hemadri, 8. 16/103 , 9. N-98, 10. VT-1158, 11. CM-12, 12. Kanchan and 13. BanketA1.

Twenty six SSR markers, distributed at least one marker on each of 24 chromosomes were used for development of DNA fingerprints of the varieties. Out of 26 SSR markers, primers PT- 52931, PT-51706, 60080, PT-53418 and ISSR primer UBC-846 gave reproducible DNA finger prints.

Computational Algorithms for Micro-RNA Prediction in Plants [CTRI, Rajahmundry]

H. Ravisankar, K. Prabhakara Rao, K. Sivaraju and K. Sarala

An algorithm has been designed for prediction of miRNA. As a part of the pipeline, software modules for generating RNA secondary structure, structure of RNA in XML format, RNA structure in pictorial view was developed using shell scripting. These modules were executed with the representative tobacco genome survey sequences and we could able to retrieve the above structures which are considered as an input for predicting miRNA.

II. Development of Agro-technology for Sustainable Tobacco Production and Strengthening TOT

II (A) Healthy Seedling Production

Investigations on coir pith utilization in tobacco seedling production [CTRI, Rajahmundry]

C. Chandrasekhararao and K. Sivaraju

The experiment was initiated to standardize the technology for bulk production of tobacco seedlings in plastic trays using coir pith as the principle rooting medium. In the initial stages seedlings were raised on coir pith rooting medium enriched with major nutrients and blitox. The composition of medium is 75 kg decomposed coir pith + 25 kg FYM + 300 g Single super phosphate and 150 g potassium sulphate and 250 g Ammonium sulphate. After raising the seedlings for 20-25 days they are transplanted in plastic trays filled with above medium. In the initial three days they were kept in the shade. After establishment (3-4 days) they were transferred to the 50% shade net. Fertilizers were given as top dressing three times. Stock solution with 50 g each of potassium sulphate and calcium ammonium nitrate in 1000 ml was prepared. From the stock solution, 5 ml each of potassium sulphate and Calcium ammonium nitrate was taken and diluted to 500 ml and applied in trays at 5-7 days and 10 ml/500 ml of water at 20-25 days and 15 ml/500 ml of water at 30-35 days after application. After that seedlings are ready for transplantation within a week time.

Bulk trials: Bulks trials were conducted at CTRI FARM Katheru, CTRI RS Guntur and CTRI RS Kandukur. Some of the agronomy experiments at CTRI RS Jeelugumilli were supplied with tray seedlings. Similar procedure is also followed for maintenance of tobacco germplasm for better germination and seedling growth. In these trials less gap filling were recorded than those in conventional seedlings. Crop growth was uniform. Disease incidence in the seedling stage was minimum. Weather vagaries on seedling production can be minimized so that transplanting can be done in the main field at right time. Tray seedlings exhibited better performance over conventional seedlings at all the locations.

Growth Media: Tobacco seed germination was evaluated in different growth medium viz., T_1: 100% composted coir pith medium (CCP). T_2: 75% CCP + 25% FYM T_3: 50% CCP + 50% FYM, T_4: 25% CCP+ 75% FYM, T_5:100% FYM. Results revealed that on 5th day 26% seed germination was observed in 100% CCP compared to 0-4% in other media. Highest seed germination (62%) percentage was observed in 100% CCP. Percent seed germination and dry weight in different medium followed the order of T1>T2>T3>T4>T5. Experiments on evaluation of seedling growth in different media was done.

Tray Seedlings

FCV tobacco seed beds [CTRI, Rajahmundry]

S. Kasturi Krishna, S. V. Krishna Reddy and K. Nageswararao

The experiment was conducted to study the effect of pre-plant incorporation of three different doses of herbicides viz., pendimethalin, Alachlor and Metribuzin along with hand weeding on tobacco seed germination and in controlling weeds in nursery beds and production of transplantable seedlings.

Pendimethalin 15 days before and Alachlor and Metribuzin 5 days before sowing was incorporated in soil. Application of herbicides influenced the weed control efficiency and no. of transplantable seedlings. Alachlor @ 1000, 1500 Metribuzin @ 263 and 394 g ai /ha medium doses controlled the weeds and gave optimum no. of seedlings.

Pendimethalin @ 500 g a.i./ha gave optimum no. of seedlings than other doses. Other doses reduced the no. of seedlings. *Cyperus* could not be controlled by the incorporation of Alachlor and Metribuzin.

II (B) Optimization of Water and Nutrient Use for Productivity enhancement of Different Tobacco Types

Evaluation of set row planting in burley tobacco for efficient resource conservation and utilisation (BTRC, Kalavacherla).

C. Chandrasekhararao, D. Damodar Reddy and S. Kasturi Krishna

The experiment was conducted at BTRC Kalavacharla to study the effect of set row planting on yield and quality of burley tobacco (cv. Banket A1) in RBD with six treatments replicated five times. The six treatments were Set row (SRP) with 100% recommended fertilizer application (RDF), SRP with 75% RDF, SRP with 50% RDF, SRP with 25% RDF and SRP with no fertilizer and conventional planting with RDF . Application of 100% fertilizer application through SRP being at par with 75% RDF and conventional method of planting with RDF showed significantly higher green leaf yield and cured leaf yield over 50%, 25% RDF and also control. Application of 50% RDF showed significantly higher green leaf yield and cured leaf yield over 25% RDF and control. SRP with 100%, 75% RDF and Conventional planting with 100% RDF showed significantly higher P and K uptake over 25% RDF and Control.

Effect of fertiliser source of nutrients on yield and quality of burley tobacco grown in uplands [BTRC, Kalavacharla]

S. Kasturi Krishna, S.V. Krishna Reddy and K. Siva Raju

In the light soils of agency area calcium application is necessary for tobacco crop growth, hence CAN was recommended as source of nitrogen. But the farmers are using other sources of nutrients without calcium in the upland area. As farmers are using different source of fertilizers in the upland areas the present experiment was proposed to study the effect different source of fertilizers with and without calcium on yield and quality of burley tobacco and also to calculate the cost of cultivation. Ten treatments were taken with the combination of fertilizer source for N and P nutrients. Potassium was supplied through SOP. The experiment is formulated in RBD design with three replications.

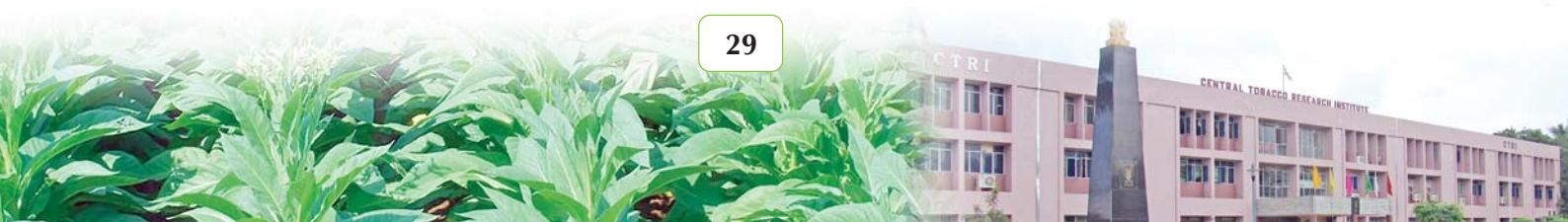
Continuous rains in August and September during growth period affected the growth and resulted in below average yields (Av. Yield 1000 kg/ha). Hence, the treatment differences were not marked and on par with each other. Sources of fertilizer affected the yield and quality of tobacco. Application of A/S in 1st and 2nd doses (A/S + DAP and A/S) gave significantly higher yield and on par with some of the treatments. The nicotine and reducing sugars are within in the desirable limits. Chlorides values are on higher side due to providing bore well irrigation.

Soil Properties: Soil pH values ranged between 4.40-5.25 and 4.44-5.01. Soil pH values are in higher side when CAN is used in two doses compared to A/S application. Av. K increased from 0-9 to 9-18" depth. Lower Cl values were observed when 28:28:0 and A/S was applied in both the depths.

Drip fertigation in chewing tobacco [CTRI RS, Vedasandur)

M. Kumaresan and C. Chandrasekhararao

The results of the second year revealed that the leaf length was significantly higher with drip fertigation at 100% RDN over the furrow irrigation First grade leaf yield (FGLY) significantly increased by 14% with drip fertigation at 100% RDN over the furrow irrigation. The FGLY recorded with 100% RDN through drip and surface irrigation was 3807 and 3345 kg/ha respectively. FGLY recorded with 80% RDN through drip and drip irrigation + 100 % RDN soil applied are comparable. Total cured leaf yield (TCLY) increased was 8 % with 100 % RDN through drip over the furrow irrigation. TCLY with 100% RDN, 80 % RDN through drip and drip irrigation + 100 % RDN soil applied are comparable. Cost of cultivation was higher with drip treatments as compared to furrow irrigation. Higher gross return and net return were recorded with drip fertigation with 100% RDN and drip irrigation + 100% RDN soil applied. B: C ratio was higher with furrow irrigation.



Crop productivity, soil quality and economic returns under chewing tobacco + Annual moringa intercropping system in response to nutrient management.[CTRI RS, Vedasandur]

M. Kumaresan and D. Damodar reddy

Annual moringa at different populations viz., 100, 75 and 50% was inter-cropped with 100% population of chewing tobacco with 3 levels of fertilizers (75, 100 and 125 % RDF). The experiment was conducted in a split plot design.The results of the experiment revealed that leaf length and width of chewing tobacco under intercropped situation with annual moringa was not affected. The leaf length and width was higher with 50% annual moringa population as compared to the sole tobacco crop. FGLY and TCLY of chewing tobacco significantly increased with 50% of annual moringa population as compared to the 100% annual moringa population. FGLY and TCLY increase with 50% annual moringa population was 16 and 4% respectively. The FGLY and TCLY with 50% annual moringa population over the sole tobacco crop was 12 and 4% respectively which indicated that there was no competition between the tobacco and annual moringa intercropping. The Gross return was higher with annual moringa intercropped with chewing tobacco at 50% population + 125 % recommended dose of fertilizer applied to both chewing tobacco and annual moringa. Net return and B: C ratio was higher with sole tobacco.

Chewing tobacco + Moringa intercropping

Feasibility of producing organic tobacco in KLS [CTRI RS, Hunur]

M. Mahadevaswamy, and S. Ramakrishnan

The II year results of the experiment on producing organic tobacco using various organics (vermicompost @ 6 t/ha, use of bio-fertilizers @ 10 kg/ha, green manuring in rabi season with sunnhemp, use of neem based organics and bio-pesticides etc.,) indicated that the reduction in the productivity of the organic tobacco was 42.3% compared to the reduction of cured leaf to an extent of more than 50% observed in the first crop season. The INM treatments involving organic and inorganic in 75:25 and 50:50 ratios resulted in comparatively lower reduction in the yield (25.4 and 13.5% respectively). Similarly, the top grade production reduced by 34.2% in the organic treatment while the same in the INM treatments (75:25 and 50: 50) resulted in 19.2 and 8.6% reduction, respectively. However, the bright grade production was higher by 10% in the organic treatment. With respect to the cured leaf quality characteristics, the nicotine in the X position was lower (0.71%) in the organic treatment when compared to the inorganic treatment (0.99%). The L position leaf also showed similar trends with recommended NPK treatment recording the higher nicotine value of 1.58% compared to 1.14% in the organic treatment There was reduction in the root knot incidence by about 35% in the fully organic treatment, while the incidence of wilt was very much negligible in the experiment.

Development and evaluation of Integrated Farming System model for rainfed eco-system of KLS (CTRI RS, Hunur).

M. Mahadevaswamy

The Integrated Farming System model initiated during 2005-06 crop season in 1.0 acre operational area at Hunsur Farm is being maintained and continued for the 2012-13 season also. The various agro-forestry systems

IFS Model for rainfed eco-system

like Agri-horticulture, silvi-pasture with fodder production were maintained. The proven rainfed cropping systems involving Red gram + finger millet intercropping system (2:8 ratio) and Hybrid cotton were raised in individual cropping systems blocks. The subsidiary components involving vermicompost, vegetable production and goat rearing were continued, while the border tree plantation was maintained. The IFS model developed is being demonstrated to several farmers including FCV tobacco growers for its sustainability and adoptability by the small and marginal farmers.

Effect of graded levels of K on the incidence of root knot & potassium uptake pattern of FCV tobacco in KLS (CTRI RS, Hunsur)

M. Mahadevaswamy and S. Ramakrishnan

The trials conducted with graded levels of K on the incidence of root knot, K uptake pattern and crop performance in the root knot affected soils showed that the productivity of cured leaf was significantly increased by 16.5 to 17.1% by application of higher levels of K_2O (180 and 240 kg/ha) compared to control (no K application). The recommended level of K_2O application at the rate of 120 kg/ha resulted in only 10.4% increase in the productivity of cured leaf compared to check (without K). In case of TGE also the application of K at the rate of 180-240 kg/ha resulted in significantly higher TGE with 19.8-21.0% increase, while the recommended level of K_2O at 120 kg/ha resulted in 16.7% increase, indicating higher level of K requirement for maximizing the productivity of both the cured leaf and the TGE in the root knot affected sandy light textured soils in KLS. Similarly the RKI was significantly reduced by the 35-55% by the application of K at higher doses of 180-240 kg/ha in these soils. Higher leaf nicotine in L position was observed at K dose of 120 and 180 kg/ha compared to control (No K application). The chloride contents tend to be reduced by the higher K applications in both X and L position. In general the cured leaf quality parameters were in the normal desired range even though the leaf NPK content in cured leaf samples did not show much variation due to increased K levels, higher leaf K content were noticed in higher K applied treatments.

Feeler trial: Bulk evaluation of complex fertilizer as source of N for FCV tobacco [CTRI RS, Hunur]

M. Mahadevaswamy and S. Ramakrishnan

The complex fertilizer 20:20:0 (Factomphos) was evaluated as an alternative source of N for FCV tobacco cultivation in red sandy loam soils at the Research farm. The block trail indicated that use of 20:20:0 complex fertilizer containing N and P as basal dose with CAN as top dressing was as effective as that of currently recommended CAN as N source. The use of complex fertilizer 20:20:0 resulted in cured leaf yield and top grade equivalent of 2048 and 1589 kg/ha while the recommended use of CAN as N source (both in basal and top dressing) resulted in 2082 and 1606 kg/ha, respectively. The complex fertilizer showed slightly higher leaf nicotine compared to CAN treatment (1.23 v/s 1.06) in X position, while the leaf nicotine in L position was more or less similar. However, in general the cured leaf quality in both the N sources was in the normal optimum range.

Permanent manurial trial on *Motihari* tobacco (CTRI RS, Dinhata)

S. Roy

The results of permanent manurial trial on motihari tobacco indicated that application of NPK @ 112 kg each recorded significantly highest green leaf (22090 kg/ha), cured leaf (2773 kg/ha) and first grade (1378 kg/ha) leaf yields of *Motihari* tobacco as compared to control with only FYM @ 10 q/ha. Application of 112 kg N + 112 kg K_2O/ha and 112 kg N + 112 kg P_2O_5/ha was comparable with each other and significantly superior to rest of the treatments for cured leaf yield. It was clear from data that the application of nitrogen is essential for yield and quality of *Motihari* tobacco. Application of phosphorus and potassium alone or in combination with each other and only 25 or 50 t FYM applied plots gave minimum first grade leaf yield as compared to application of nitrogen alone or in combination of phosphorus and potassium. The per cent recovery of first grade leaf was highest in NPK (49.7%) followed by NK (45.7%), NP (42.9%) and N (39.5%). Application

of 112 kg N + 112 kg P_2O_5 + 112 kg K_2O/ha recorded highest net returns (Rs.67,400 /ha) followed by 112 kg N/ha +112 K_2O (Rs. 58,300 / ha) and 112 kg N/ha + 112 kg P_2O_5 /ha (Rs. 50,111 /ha). Nitrogen content in the leaves of *Motihari* tobacco was significantly highest in N applied plot either alone or in combination with FYM @ 50 tonnes/ha also recorded N content at par to NK. Significantly higher content of potassium was observed in plot where potassium was applied either alone or in combination with phosphorus and nitrogen.

II (C) Evolving Site Specific Cultural Management Practices in Different Agro Ecological Sub- regions.

Effect of spacing and nitrogen on yield and quality of ABL TBST-2 [CTRI, Rajahmundry]

S. V. Krishna Reddy, S. Kasturi Krishna and T. G. K. Murthy

An experiment was conducted in a factorial RBD at Black Soil Research farm, Katheru CTRI, Rajahmundry with ABL TBST-2 with three spacings viz. 70 X 50 cm (28,571 plants/ha), 70 X 60 cm (23,809 plants/ha), 70 X 70 cm (20,408 plants/ha), and three nitrogen levels viz. 30, 45 and 60 kg/ha to find out optimum plant population/ plant spacing, optimum nitrogen dose and interaction effect of spacing and nitrogen if any for higher yield and better quality of ABL TBST 2.

Lower plant spacing of 70 X 50 cm recorded significantly higher green leaf yield and cured leaf yield as compared to higher plant spacings of 70 X 60 cm and 70 X 70 cm. Grade index at 70 X 50 cm spacing being on a par with 70 X 60 cm was significantly higher than that at 70 X 70 cm spacing. Bright leaf yield and green leaf /cured leaf were not influenced by plant spacing. Bright leaf/cured leaf and grade index/ cured leaf (%) were higher at lower plant population (higher plant spacing) and decreased with increase in plant population (lower plant spacing). Green leaf yield increased progressively and significantly with increase in N dose from 30 to 60 kg N/ha. Application of 45 and 60 kg N/ha being on a par recorded significantly higher cured leaf yield as compared to 30 kg N/ha. Differences between treatments were not significant for grade index, bright leaf yield and green leaf/ cured leaf with regard to N dose. Bright leaf/ cured leaf and grade index/ cured leaf (%) decreased with increase in N dose.

Integrated weed management in FCV tobacco grown under irrigated alfisols [CTRI, Rajahmundry]

S. Kasturi Krishna, S.V. Krishna Reddy and K. Nageswara Rao

Evaluation of Quizalofop ethyl and pendimethalin as herbicides: The experiment was conducted during 2009-12 at CTRI RS, Jeelugumilli in RBD with 10 treatments and replicated thrice. Predominant weed species are *Dactyloctenium aegyptium, Digitaria sanguinalis, Panicum sp, Cyperus rotundus, Cyperus iria, Cleome viscose, Portulaca oleraceae* and *Phyllanthus niruri* .

Pooled results indicated that the pre-plant incorporation of Pendimethalin kept the field weed free (cyperus spp) till 65-70 days after planting. Quizalofop-ethyl as post emergence application controlled only monocot weeds 6-10 days after its application. In Pendimethalin applied plots all the weeds were controlled but not Cyperus spp. Other weeds were *Cynodon dactylon, Euphorbia hirta, Mollugo disticha, Eupatorium* spp. Wherever herbicide application was done lower weed dry matter production was recorded at 30 days after planting. At 60, 90, and 150 days after planting all the treatments recorded lower weed dry matter production than un- weeded check. In general, weed control efficiency (WCE) was higher wherever integrated weed control was followed. WCE on the basis of weed dry matter production was higher in the treatments involved with spraying of Quizalofop-ethyl at 60, 75 days, 15+75 , 60+90 days and in 75+125 days after planting. Integrated weed management practices involving Quizalofop-ethyl recorded the green and cured leaf yields on par with that of weed free check. Spraying of Quizalofop-ethyl at 15+75, days after planting effectively controlled the grassy weeds and also gave higher yields when compared to weed free check. Spraying of Quizalofop-ethyl at 15, 60, 75 days after planting with hand weeding

and inter-culturing gave on a par yields with that of weed free check. Pendimethalin incorporation 3 days before planting maintained field weed free during crop growth period (except nut grass) and the yields were reduced by 9.3% and 11.0%, respectively when compared to hand weeding. Lower yields were observed in the un-weeded check

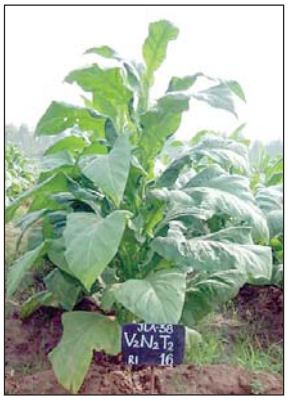
Chemical Quality parameters: Reducing sugars are within the acceptable limits in X and L position. Reducing sugars increased from X to L position. Weed free check recorded higher values than other treatments. Lower values were observed when two sprays of Quizalofop-ethyl were given. In general nicotine values were lower in X and L position. Nicotine content increased from X to L positions. The reducing sugar content for 'X' position was relatively low, apparently due to continuous rains coupled with low sunshine hours. Chlorides are within the acceptable limits (< 1.5%) and decreased from X to L position. The results of bulk trials conducted during 2012-13 season showed that two post emergence sprays of Quizalofop-ethyl @ 60 g a.i./ha at 15 and 75 DAP can be used in integrated weed management along with intercultures to control monocot weeds which are dominant in the irrigated alfisols .

Soil properties: Integrated nutrient management practices have not influenced the soil chemical properties significantly. pH values ranged between 5.21-5.69 in 0-9" and 4.54-4.93 in 9-18" and pH values decreased from top to bottom and much differences were not observed due to weed management practices in both the depths. Higher OC was observed in un-weeded check. Chlorides increased from upper to lowersoil layers and significant differences among the treatments were found in 9-18" only.

Effect of nitrogen and topping on yield and quality of advanced breeding line NLST- 3 and NLT-4. (CTRI RS, Jeelugumilli)

S.V. Krishna Reddy, S. Kasturi Krishna and T.G.K. Murthy

The experiment was conducted in a factorial RBD at the research farm of CTRI Research station, Jeelugumilli with two advanced breeding lines viz. NLST- 3 and NLT-4 along with control cv. Kanchan and consisted of three nitrogen doses viz. 100, 115 and 130 kg N/ha and two topping levels viz. topping at 24 and 26 to find out most suitable advanced breeding line with optimum nitrogen dose, topping level and the interaction effect of nitrogen and topping level if any, for higher yield and better quality.



Line NLST-4

Yield and quality: ABL NLST-4 recorded significantly higher green leaf yield, cured leaf yield, grade index and grade index/cured leaf (%) as compared to ABL NLST-3 and control cv. Kanchan. Green leaf/cured leaf was higher with NLST-4 followed by NLST-3 and cv. Kanchan. Green leaf yield increased progressively and significantly with increase in N dose from 100 to 130 kg N/ha. Application of 115 and 130 kg N/ha being on a par recorded significantly higher cured leaf yield and grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 130 kg N/ha. Grade index/cured leaf (%) increased from 100 to 115 kg N/ha and decreased with further increase in nitrogen dose. Green leaf yield, cured leaf yield, grade index and grade index/cured leaf (%) were not influenced by topping levels. Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping. It can be inferred that ABL NLST-4 performed well and gave significantly higher yield than NLST-3 and control cv. Kanchan. A nitrogen dose of 115 kg N/ha and topping at 26 leaves are optimum for both NLST -3 and NLST - 4.

Effect of nitrogen and topping on yield and quality of advanced breeding line JS117 (CTRI RS, Jeelugumilli)

S.V. Krishna Reddy, S. Kasturi Krishna, T.G.K. Murthy and K. Sarala

The experiment was conducted in a factorial RBD at the research farm of CTRI Research station, Jeelugumilli with two

varieties i.e. low tar advanced breeding line JS 117 along with control cv. Kanchan and consisted of three nitrogen doses viz. 100, 115 and 130 kg N/ha and two topping levels viz. topping at 24 and 26 leaves to find out optimum nitrogen dose, topping level and the interaction effect of nitrogen and topping if any, for higher yield and better quality of JS117.

JS-117

Yield and quality: There were no significant differences with regard to green leaf yield and cured leaf yield between low tar ABL JS 117 and control cv. Kanchan and were on a par with each other. Grade index and grade index/ cured leaf (%) with cv. Kanchan was significantly higher than with JS 117 while green leaf/ cured leaf with JS 117 was higher than that of cv. Kanchan. Green leaf yield increased progressively and significantly with increase in N dose from 100 to 130 kg N/ha. Application of 115 and 130 kg N/ha being on a par recorded significantly higher cured leaf yield and grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 130 kg N/ ha. Grade index/cured leaf (%) increased from 100 to 115 kg N/ha and thereafter decreased with increase in nitrogen dose. Green leaf yield, cured leaf yield and grade index were not influenced by topping levels. Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping. Grade index/cured leaf (Percentage) was higher than 26 leaves topping than at 24 leaves. It can be inferred that the low tar ABL JS 117 performed on a par with control cv. Kanchan with regard to green leaf yield and cured leaf yield. A nitrogen dose of 115 kg N/ha and topping at 26 leaves are optimum.

Effect of nitrogen and spacing on yield and quality of hybrid NLSH-1 (CTRI RS, Jeelugumilli)

S. V. Krishna Reddy, S. Kasturi Krishna and T.G.K. Murthy

The experiment was conducted in a factorial RBD at the research farm of CTRI Research station, Jeelugumilli with CMS hybrid NLSH 1 and consisted of two spacings viz. 100 X 60 cm (16,666 plants/ha) and 100 X 70 cm (14,285 plants/ha), three nitrogen levels viz. 100, 120 and 140 kg/ha and two topping levels viz. topping at 24 and 26 leaves to find out optimum plant population/ plant spacing, nitrogen dose, topping level and the interaction effect of spacing and nitrogen if any for higher yield and better quality of NLSH 1.

NLSH 1

Yield and quality: Lower plant spacing of 100 X 60 cm recorded significantly higher green leaf yield, cured leaf yield and grade index as compared to higher plant spacing of 100 X 70 cm. Green leaf/ cured leaf was not influenced by plant spacing. Grade index/ cured leaf (%) was higher at lower plant population/ at higher plant spacing and decreased with increasing plant population/ decrease in plant spacing.

Green leaf yield increased progressively and significantly with increase in N dose from 100 to 140 kg N/ha. Application of 120 and 140 kg N/ha being on a par recorded significantly higher cured leaf yield and grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 140 kg N/ha. Grade index/cured leaf (%) increased from 100 to 120 kg N/ha and thereafter decreased with in nitrogen dose. Green leaf yield, cured leaf yield and grade index were not influenced by

topping levels. Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping and Grade index/ cured leaf (%) was higher with 26 leaves topping than at 24 leaves topping. It can be inferred that for CMS hybrid NLSH 1 a spacing of 100 X 60 cm, nitrogen dose of 120 kg N/ha and topping at 26 leaves are optimum.

Assessment of topping response of FCV tobacco varieties and advanced breeding lines in NLS (CTRI RS, Jeelugumilli)
K.Nageswararao

Seven FCV tobacco varieties and advanced breeding lines were assessed for their response to three topping levels. NLST-4 and A3 are on par and gave significantly higher green leaf yield, cured leaf yield and grade index as compared to other five varieties Kanchan, LV 6, LV 7, JS 117 and NLSH 1. Topping at 24 leaves gave higher green leaf yield, cured leaf yield and grade index compared to 20 and 22 leaves.

Agronomic evaluation of promising FCV tobacco varieties (CTRI RS, Hunsur)
M. Mahadevaswamy

The large scale bulk trials were conducted during 2012-13 season to standardize the optimum level of topping and N levels to optimize the leaf ripeness, maximize the cured leaf yield and top grade equivalent in the wilt resistant variety FCH 222 on red sandy loam soils at the research station. Three Levels of N and Three levels of topping were evaluated with recommended plant population. The results revealed progressive increase in the productivity of cured leaf and top grade equivalent yield up to 70 kg N/ha beyond which the productivity reached plateau. Topping at 20 leaves increased the CLY by 30.1% and TGE by 31.0 % indicating that topping at 20 leaves is ideal rather than 18. Higher productivity of both CLY and TGE were recorded at N application rate of 70 kg/ha and topping level at 20 leaves followed by N application at 80 kg/ha with 22 leaves topping indicating that high N application rates would require higher topping levels to optimize the ripenes and to get desired leaf quality. Very low topping with higher N levels at 80 kg N/ha resulted in lower cured leaf and top grade equivalent indicating that medium caste variety like FCH 222 requires topping at 20-22 leaves with optimum N application of 70 kg/ha for optimizing the ripeness and maximizing the yield and quality under KLS conditions. With respect to the cured leaf quality parameters, the lower topping at 18 leaves resulted in comparatively higher nicotine compared to higher toping at 22 leaves. Increase in N doses slightly increased the nicotine content. However the leaf quality parameters were well within the desirable range.

Performance of advance breeding lines of chewing tobacco under different levels of nitrogen under vedaranyam condition. (CTRI RS, Vedasandur)
M. Kumaresan and M. Mohan

The advance breeding line BSR-1 was tested with a check variety Kaviri under 3 levels of N (100,150 and 200 kg /ha) in a FRBD with 4 replications. The results of second year releaved that the cured leaf yield (CLY) was significantly higher with BSR-1 as compared to the check variety Kaviri. The yield recorded was 2624 kg/ha with BSR-1. Nitrogen levels significantly influenced the CLY. Nitrogen at 200 kg /ha increased the CLY by 8% over the 100 kg N/ha. Nitrogen at 200 kg /ha and 150 kg/ha recorded

FCH-222

BSR-1

a comparable cured leaf yield. Higher gross returns and net returns were recorded with BSR-1 under 200 kg N /ha. Pooled results across years did not exhibit significant differences among the advanced breeding line BSR-1 and Kaviri. N at 200 kg/ha significantly increased the cured leaf yield by 10% over the N at 100 kg/ha. Nitrogen at 150 kg/ha and 200 kg/ha recorded a comparable cured leaf yield. Higher gross return and net return were recorded with BSR-1 under N 200 kg/ha. Higher B: C ratio was recorded with BSR-1 under 150 kg N/ha. It can be concluded that application of Nitrogen @ 150 kg/ha would be optimum for the advanced breeding line BSR-1 for higher cured leaf yield, net return and B:C ratio.

Performance of broad based selections of chewing tobacco under different levels of spacing and nitrogen. (CTRI RS, Vedasandur)
M. Kumaresan and M. Mohan

Two advanced breeding lines HV.2009-3, HV.2009-5 with a check variety Abirami was tested under two levels of spacing (90 x 75 and 90 x 90 cm) and 3 levels of nitrogen viz., 75,125 and 175 kg/ha. The leaf length and width significantly increased with HV.2009-3 and HV.2009-5 over the variety Abirami. FGLY and TCLY significantly increase with HV.2009-3 over the variety Abirami. The FGLY and TCLY increased with HV.2009-3 was 10 and 13%, respectively over the variety Abirami. The spacing did not influence the leaf length and width. Whereas the FGLY and TCLY significantly increased with levels of spacing. The spacing 90 x 75cm significantly increased the FGLY and TCLY over the wider spacing 90 x 90 cm. Nitrogen levels did not significantly influence the leaf length, width or yield. However, nitrogen at 125 kg/ha is sufficient for higher FGLY and TCLY. Higher gross returns and net returns and B: C ratio was recorded with HV.2009-3 under the spacing 90 x 75 cm and nitrogen at 125 kg/ha.

II (D) Post-Harvest Product Management

Investigations on coir pith utilization in tobacco curing [CTRI, Rajahmundry]
C. Chandrasekhararao and K. Sivaraju

Agri-waste briquettes as alternative fuel for curing tobacco: Briquettes prepared with coir pith alone, coir fibre waste alone and also combination of coir fibre waste and coir pith using the briquetting facilities available at Banapuram village in Mummaduvaram mandal. These three types briquettes were tried initially for their burning capacities at CTRI black soil research farm, Katheru. Coir waste briquettes showed good burning capacity compared to the briquettes made of coir pith alone. These coir waste briquettes were evaluated alone and also in combination with saw dust briquettes at CTRI farm Katheru in comparison with coal and wood. In addition to that the efficacy of coir waste briquettes in combination with saw dust briquettes were evaluated in comparison with wood for curing FCV tobacco in the farmer's field of Yarnagudem village in Northern light soils of Andhra Pradesh. Results revealed that coir waste briquettes alone or in combination with saw dust briquettes can be used for curing FCV tobacco as a substitute for wood/coal.

Coir waste briquettes

Reducing wood fuel usage in curing of FCV tobacco in KLS (Funded by Western Ghats Task Force, Department of Forest, Govt. of Karnataka)
M. Mahadevaswamy

Turbo Fan: The studies on the usage of turbo fan for curing FCV tobacco in KLS indicated saving of about 8% fuel wood requirement in 16'X16'x 16' barn compared to control barn. While control barn without the use of turbo fan required 3.70 kg of wood for cuing every kg of cured leaf, the turbo fan barn required only 3.40 kg of wood to produce one kg of cured leaf. The cured leaf quality parameters and the physical quality characters were normal.

Use of Alternative fuels for curing: Alternative fuels like coconut fronds, coconut husks and maize rinds were evaluated as sources of fuel for curing of FCV tobacco during 2012-13 season

in 13'X13'x 13' barn at the Research station. While the use of alternative fuels in combinations with wood fuel (80% alternative fuels + 20% wood fuel) at different stages of curing resulted in fuel consumption of 4.65 to 6.62 kg per kg of cured leaf, the control barn with only fire wood as fuel source resulted in on an average of 4.50 kg consumption/kg of cured leaf. The study revealed that coconut husks can be effectively utilized as alternative source in combination with fuel wood (consumption of 4.65 kg per kg of cured leaf). However the use of coconut fronds or the maize rinds as an alternate source along with the wood required 38-47% higher total fuel requirement. Depending upon the cost factor and availability of the various agri wastes/ byproducts in the area, they can be effectively utilized as alternative fuels for the curing of FCV tobacco in an integrated approach.

Coconut fronds

Farm mechanization: A new initiative was undertaken to evaluate the vegetable transplanter developed by CIAE, Bhopal for transplanting tobacco.

II (E) Analysis of Socio-Economics for Stratification and to formulate Appropriate Strategies

Resource utilization by the FCV tobacco farmers in NLS and SLS regions. [CTRI, Rajahmundry)

Y. Subbaiah

The project was implemented in Northern Light Soil and Southern Light Soil regions. A sample of 60 respondents comprising recognized progressive farmers (30) and other farmers relatively less progressive (30) were selected. Thus, 120 farmers constituted as sample size of the study. Progressive farmers were selected based on purposive sampling and other farmers were selected adopting stratified random sampling procedure. A structured schedule was developed and pre-tested to ascertain the data. The data were collected through formal personal interviews and secondary sources like Tobacco Board.

Northern Light soil: The technologies viz. quality seedlings, tray seedlings for gap filling, organic manures, balanced application of N &K, time of N & K application, topping level, No. of irrigations, management of viral diseases, management of brown spot, management of orabanche, management of *Spodoptera*, ripe leaf harvest, optimum loading of barn, scientific curing and grading showed significant difference in the adoption status of recognized and other farmer groups of NLS region. The mean adoption of identified technologies was found to be 78.45 and 48.70 for recognized farmers and other farmers respectively.

Southern Light Soil: The technologies viz. Organic manures, quality seedlings, maintenance of90% population. Early plantation, use of SOP, balanced application of N &K, one or two life saving irrigations, use of recommended insecticides, management of viral diseases, management of brown spot, management of Orabanche and management of stem borer depicted significant difference in the adoption status of recognized and other farmer groups of SLS region. The mean adoption of identified technologies was found to be 67.8 and 34.4 for recognized farmers and other farmers respectively.

An in depth analysis of success stories of recognized farmers highlighted the technologies viz. tray seedlings for gap filling, balanced application of N & K, topping at 22-24 leaves and management of viral diseases in NLS region; application of organic manures, maintenance of 90% population, balanced application of N & K and life saving irrigations which were found to be having high technical efficiency in determining the yields and quality at real farm situation.

Contribution of independent variables to the total variation in respondents' extent of adoption: In order to study the relationship between the independent variables and adoption, the data was subjected to correlation analysis. To identify the significant cause and effect relationship t- test was applied to respective r values. The independent variables viz. Knowledge, Availability of permanent labour, Exposure to scientists / specialists, Farm size, Innovativeness, Previous experience and Irrigation facility depicted positive and significant relation with adoption in both the NLS and SLS regions. The regression coefficients of all the independent variables taken together explained about 55.10% and 69.40% of total variation in respondents' extent of adoption in NLS and SLS regions respectively.

Situational analysis of tobacco farmers and changing scenario of cropping pattern of A.P. [CTRI, Rajahmundry]

K.Suman Kalyani and Y. Subbaiah

The objective of the study is to know the extent of the cultivation of alternative crops by the tobacco farmers in SLS and SBS regions. A total of 320 farmers i.e. 160 from SLS and 160 from SBS were randomly selected. Selected 40 farmers from each of Kandukur I & II, DC Palli, and Podili, Tangutur I &II, Ongole and Kondepi auction platforms. The study revealed that the farmers were cultivating the following alternative crops viz., paddy, bengalgram, blackgram, chillies, maize, vegetables, sesamum, redgram, groundnut, cotton and greengram.

SLS: The area planted under SLS is 58213.70 ha with 20249 tobacco growers (Tobacco Board, 2012-13). Soil potassium (30-100%) and carbon (0.1 – 0.3%) levels have come down in SLS region. Bengalgram (57%), blackgram (18%), paddy (6%), chillies (3.1%) and eucalyptus (19%) were the other alternative crops grown in this region in proportion to tobacco area. This year *Spodoptera*, budworm and aphids were the major pests observed. The land lease increased from Rs.6000/- to Rs.10,000/- per acre. The cost of cultivation increased to the extent of Rs. 25,000/acre. The farmers got net yield of 4 to 5 quintals per acre. By cultivating eucalyptus and subabul the farmers were getting an additional income of Rs. 10,000/- to 15,000/- per acre. The Bengalgram gave an average yield of 4 to 6 quintals per acre.

SBS: The area planted under SBS is 29864.12 ha with 13250 tobacco growers in this region (Tobacco Board, 2012-13). On an average, 10% of the farmers have opted for crop rotation. Spodoptera, aphids and stem borer were the major pest problems observed. Crop damage by forest pigs was a major problem as reported by the farmers.

The study revealed that 43% of the area is occupied by Bengal gram, 11.5% by Maize, 15% by Paddy, 7.7% by Redgram, 6.9% by Cotton and 6% by Groundnut in proportion to tobacco when a sample of 160 farmers was selected. The nursery growers of Kondepi region are opting for chickpea, groundnut and watermelon in the nursery area after lifting the seedlings. It was observed that the area occupied by chickpea and groundnut is equal to the nursery grown area. The SBS farmers are taking up other alternative crops (chickpea and groundnut) in addition to the tobacco without reducing the tobacco area.

Nutritional Security in Tribal Areas of East Godavari District, Andhra Pradesh through Community Based Approaches. (CTRI, Rajahmundry).

K. Suman Kalyani and T.G.K. Murthy.

A). Health Status of Tribal Women and Children in East Godavari District of Andhra Pradesh

The objective of the study is to analyze the existing health and nutritional status of women and children. A socio-economic survey was carried out on health and nutritional problems in tribal communities of East Godavari district. Health and nutritional problems and deficiencies of vulnerable groups were identified along with clinical manifestations and disabilities in tribal areas.

B). Skill based nutri-preneurial activities

1. Soya based food products unit: In tribal area, about 70% of the children are suffering from protein energy malnutrition (PEM), vitamin-A deficiency, iodine deficiency, worm infestations and scabies. The residential ashram

school (tribal) children were selected for providing soya milk as protein supplement. At the same time, these women groups inturn are provided employment by processing soya milk. Milk extraction unit is established in Ashram Schools for preparation of flavoured soya milk, paneer and other milk based products. The soya milk is provided as supplementary diet for the school going children and SHGs in turn are getting benefitted by marketing the milk to the hostels with the help of ITDA. One SHG group consisting of 5 members get an additional income of Rs. 15,000 per month by investing 2-3 hours per day. This unit was established at Govt. Tribal Welfare Ashram High School, Devarapalli.

2. Solar dried food products unit: This is proposed for providing employment for SHGs among tribal women at Rampachodavaram. Solar dried food products viz., fruit jellies (mango, sapota, pineapple, papaya) dessicated coconut powder, palm products, vegetables chips, mushroom chips, aamchur, herbal powder, etc., are prepared with the help of solar driers. SHGs are benefitted by marketing these products in the local shandys and super markets. One SHG consisting of 5 members will get an additional income of Rs. 10,000 per month by investing leisure time during sunny days. At present research trails are going on to derive acceptability, nutrient retention, and performance of the solar dryers.

III. Identification of Alternative Crops and Exploiting Tobacco for Alternative Uses

III (A). Identification of Alternative Crops to FCV and Non-FCV Tobaccos

Performance of Castor hybrids in Vertisols at Katheru farm (CTRI, Rajahmundry)
S. Kasturi Krishna

Castor hybrids viz. DCH 117, DCH 519 were cultivated as an alternative crop to FCV tobacco in Vertisols at CTRI farm, Katheru, Rajahmundry. These Castor hybrids viz. DCH 117 and DCH 519 gave 1489 and 1870 kg/ha seed yield, respectively. However, the net returns received from castor hybrids were lower than that of FCV tobacco.

DCH-519

Maize as an alternative crop to FCV tobacco in NLS (CTRI RS, Jeelugumilli)
K. Nageswara Rao

The net returns obtained from maize in Northern Light Soils of Andhra Pradesh in *Kharif* and *Rabi* were Rs 4,325 and Rs 16,529 respectively compared to Rs. 24,985 in FCV tobacco.

III (B). Identification of Potential Phyto-chemicals

Biochemical characterization of tobacco seed oil [CTRI, Rajahmundry]
K.Siva Raju and T.G.K. Murthy

The oil content of 54 accessions was estimated. The oil content varied from 28 to 41.7% among the accessions. The accession Cocker 1 showed maximum content of oil whereas the accession AR-53 showed the lowest quantity of oil (28%). The conditions for transesterification of tobacco seed oil for bio-fuel were standardized. The molar ratio of 6:1 (methanol to oil) was found to be the best with excess of 10% methanol, heating at 60°C for 80 min found to be optimum for the complete transesterification.

Valorization of tobacco stem biomass (CTRI, Rajahmundry)
D. Damodar Reddy, R.K. Ghosh, S. Kasturi Krishna, M. Mahadeva Swamy, L.K. Prasad and K. Nageswara Rao

Tobacco stems biomass (TSB) is an agro-waste with little economic value. Technical feasibility of valorization of TSB or tobacco biomass ash (TBA) as an adsorbent for cationic dye (methylene blue, MB) removal from aqueous system was assessed through batch adsorption studies. Adsorptive removal of MB by TSB or TBA was influenced by the process variables including contact time, initial adsorbate concentration, pH, adsorbent dose etc.

The adsorption kinetics followed pseudo-second order, with intraparticle diffusion as one of the rate limiting steps. The Langmuir isotherm described adsorption equilibrium better than the Freundlich isotherm. The MB adsorption onto TSB and TBA was favourable and spontaneous, with the maximum adsorption capacity 169.5 and 35.7 mg g-1, respectively. The TSB proved superior to TBA. The quantity of TSB required for treating unit volume (m3) of stained water varied (0.73-2.93 kg) with the initial dye concentration and the dye removal target. These results demonstrate a novel application of TSB waste in remediation of cationic dye-bearing waste water.

IV. Management of Resource Constraints for Production Efficiency and Product Quality

Knowledge of natural resources and their production potentials and constraints is of paramount importance for optimizing resource use in an agro-ecosystem. The resource characterization and identification of soil and water related constraints to tobacco is critical not only for evolving soil and water management techniques but also for improving input use efficieny under tobacco production. Further, resource management is one of the important factors that determine the product quality.

IV (A). Evaluation of soil fertility, water quality and plant nutrition constraints for tobacco and their management

Investigations on soil fertility and ground water quality in SLS and SBS regions of Andhra Pradesh [CTRI-RS, Kandukur]

L.K. Prasad and D. Damodar Reddy

Water quality studies of *Tangutur* mandal (Post-monsoon): Mean values of pH of different villages of Tangutur mandal varied from 7.85 to 8.89 (mildly alkaline to alkaline). Electrical conductivity of the samples ranged from 1.18 to 4.08 dS m^{-1}. Chloride content varied from 2.0 (Konijedu) to 68.3 meq/l(TN Palem). Highest bicarbonates recorded in Vasepallipadu village (7.50 meq/l) and lowest in Konijedu village (2.50 meq/l). Potassium concentration ranged from 0.06 meq/l to 0.56 meq/l (Marlapadu). Highest sodium content was observed in TN palem (89.5 meq/l). Comparison of pre-monsoon and post-monsoon observations indicated that the concentrations of Chloride, E.C, Potassium and Sodium in the post-monsoon samples were low as compared to their respective values for pre-monsoon. There was a negative relationship observed with pH and chloride content.

Soil quality of villages of Tanguturu mandal: Surface and sub-surface soil quality of different villages under *Tanguturu* mandal was studied. The soil reaction varied from 7.20 (near neutral) to 8.8 (alkaline) and it increased with depth. The mean pH of the area is 8.11. Electrical conductivity ranged from 0.075 (Jayavaram) to 0.979 (Karumanchi) dS/m. Organic carbon content of the soil is low and it decreased with depth. It ranged from 0.19 to 0.38 per cent.

Water quality index of *Kandukur* mandal: Irrigation water quality index was calculated with the help of WQI equation after modifying the rating pattern for quality parameters related to irrigation water meant for tobacco. Irrigation water quality spatial map of *Kandukur* mandal was developed with the help of WQI values of the area. The irrigation water of the area is classified according to the suitability based on IWQI values. About 53, 32, 11 and 4% of water samples fell respectively in the suitable, moderately suitable, conjunctive use and unsuitable classes of water quality.

Soil Fertility Investigations: Preparation of Soil Test Summaries, Nutrient Indices and Soil Fertility Maps of Tobacco Growing Soils of India [CTRI, Rajahmundry]

C. Chandrasekhararao and A.V.S.R. Swamy

Soil Fertility status of chewing tobacco growing soils of Tamil Nadu: Soil fertility survey and water quality evaluation of Chewing tobacco growing soils of Tamil Nadu was completed. A total no of 507surface as well as sub-surface soils and 81 water samples were collected from 76 and 39 villages respectively, covering 6 districts viz., Dindigul, Nagapattanam, Cuddalore, Erode, Karur and Tirupur. Soil fertility and water quality evaluation was done. Soil test summaries were prepared district wise and nutrient index values were calculated. Based on water analysis water classes were determined. The data base will be of immense help in preparation of fertilizer schedules of different districts. Majority soils were low in organic carbon, hence its improvement through addition of bulky organic manures/green manures is needed for sustainable chewing tobacco production. Soil available P content is high in majority soils. Wherever soils are high in available P, Phosphorus feriliser dose can be reduced at least by 30% of its present recommended dose. Available potassium content of Nagapattanam district is medium and hence its application is

to be continued in this district, where as in other districts viz., Dindigul, Cuddalore and Erde the available potassium was high. Majority of irrigation waters were saline with high chloride content and hence there is need to reduce the quantum of irrigation water to contain the salinity and chloride levels in soil and tobacco plant

IV (B). Soil quality and nutrient use efficiency in relation to input management

Evaluation of Crop Residue and Wood Ashes - Effects on Soil Fertility and Potassium Nutrition of Tobacco [CTRI, Rajahmundry]

D. Damodar Reddy, R.K. Ghosh, S. Kasturi Krishna, M. Mahadeva Swamy, L.K. Prasad and K. Nageswara Rao

An investigation on the use of plant/wood ashes as soil amendments and as nutrient supplements, particularly for K in FC tobacco production was initiated with the objectives (i) To characterize the biomass ashes from burning of crop residues and wood ash from tobacco curing barns, (ii) To assess effects of crop residue and wood ashes on soil acidity and fertility and (iii) To evaluate agronomic efficiency of crop residue and wood ashes as K supplements for tobacco grown on acidic Alfisols.

Collection of crop residue and wood ashes: The crop residues including stalks of tobacco, cotton, redgram, sunflower, sorghum and maize which the farmers generally dispose off by burning were collected, dried and subjected to burning in open air to get the respective biomass ash. The ashes (bottom ashes) of maize rind, coconut husk, coffee husk, eucalyptus wood, acacia wood and mixed wood (mango and cashew) were collected directly from tobacco curing barns (from KLS and NLS).

Burning induced nutrient losses from crop residues: The biomass of selected crop residues had more or less similar C content, but showed wide variation with respect to N, P and K concentration. On average, the crop residue biomass contained 42.96% C, 1.16% N, 0.15% P and 1.79% K. The biomass ash resulting from burning varied considerably between crop residues from 5.86% (cotton) to 11.34% (sunflower), with a mean value of 8.03%. Burning of residues resulted in major loss of C and N (> 90%) for all residues. In contrast the losses in P and K were relatively small but variable among residues, with actual extent of loss being dependent on residue type. On average, the burning induced losses in C, N, P and K accounted for 98.0, 95.4, 15.9 and 13.6%, respectively.

Characterization of crop residue and wood ashes: The biomass ashes resulting from combustion of crop residue stalks (tobacco, cotton, redgram, sunflower, sorghum and maize), maize rind, coconut husk, coffee husk, eucalyptus wood, acacia wood and mixed wood (mango + cashew) were characterized for their physicochemical properties and nutrient supply potential (Table IV-1).

- All the biomass ashes without exception were highly alkaline in reaction and had pH values ranging from 10.49 to 12.41, with a mean of 11.23. The biomass ashes differed very widely with respect to their EC, total organic carbon and calcium carbonate equivalent (CCE). The FTIR analysis of biomass ashes revealed the presence of silicate backbone along with carbonates
- The CCE, an index of lime potential, ranged from a low of 5% (sorghum stalk ash) to as high as 80% (eucalyptus wood ash), with an average value of 58%. The biomass ashes of cotton, redgram, eucalyptus, acacia and mixed wood with CCE of > 50% can act as potential liming material and influence the pH dependent changes in availability of nutrients, particularly of P.
- The biomass ashes contained appreciable quantities of K, Ca and Mg. The K content of crop residue ashes was relatively greater than that of wood ashes. In contrast, the Ca content was greater in wood ashes than in crop residue ashes. The biomass ashes rich in K, Ca and Mg can potentially supplement these nutrients for crops grown on light textured soils.
- The biomass ashes and unburned tobacco stem biomass (TSB) differed widely in their cation (MB) adsorption behavior. The MB adsorption was strikingly higher for the TSB as compared to that for biomass ashes. The maximum adsorption capacity of different material followed the order: TSB (169.5 mg

g-1) > SBA (62.5 mg g-1) > RBA (58.8 mg g-1) > TBA (35.7 mg g-1) > CBA (20.4 mg g-1). This implies that the biomass ashes with large cation adsorption capacity may play a potential role in retaining cationic nutrients like K and thereby retarding the nutrient leaching loss in light textured soils.

Impact of excess water stress and adaptive strategies to minimize its negative effects on productivity and quality of tobacco [CTRI, Rajahmundry]

M. Anuradha, D. Damodar Reddy, T.G.K. Murthy and K. Sivaraju

Field and pot culture experiments were conducted to study the influence of excess water stress in different varieties of different tobacco types (FCV, Burley, Bidi, Chewing, Cherrot, Cigar, Hookah) and to find out the possible mitigation measures to alleviate the effects of excess water stress in flue-cured tobacco.

Screening for excess water stress: Released varieties of different tobacco types were imposed with excess water stress and studied for different physiological and biochemical characters. Based on leaf chlorosis and drooping of the leaves, the genotypes viz., Virginia gold, CTRI Spl, Hema (FCV tobacco), Banket A-1 (Burley), GT-8, Anand-145 (Bidi) Bhagyalakshmi, Jati podali (chewing) were selected as tolerant lines and Gauthami, swarna, Ratna (FCV tobacco), Burley-21 (Burley), GT-5, Bhagyasree (Bidi), Meenakshi-CR, GC-1 (Chewing) were selected as susceptible lines. The characters associated with excess water stress are leaf chlorosis, Chlorophyll a/b, specific leaf weight, root shoot ratio, nitrogen uptake and activity of antioxidative enzymes.

Evaluation of possible mitigation measures to alleviate the excess water stress: Tray seedlings of flue-cured tobacco variety Kanchan were planted in 150 kg capacity earthen pots filled with light soil. The plants were grown using recommended package of practices. At 60 days after planting the pots were satured and then imposed excess water stress for 30 hours. Later the stress was relieved. One day after relieving stress the plants were treated with different nutrients/growth harmones/ polyamines. The treatments comprised T1 Control, T2 - Excess water stress + water spray, T3 – Kinetin spray + Soil application of KNO_3, T4 – Putriscine spray + Soil application of KNO_3, T5 - Foliar spray of salicylic acid + Soil application of KNO_3 and T6- Hoagland solution spray + Soil application of KNO_3. The foliar treatments were imposed again at 10 days after

Table IV-1. Characteristics of plant residue and wood ashes

Biomass ash	Characteristics			
	pH	EC (dS m^{-1})	TOC (%)	CCE (%)
Tobacco stalk	11.16	7.08	7.62	27.5
Cotton stalk	11.34	7.43	15.45	57.5
Redgram stalk	11.06	6.73	9.59	65.0
Sunflower stalk	10.98	9.56	7.10	40.0
Sorghum	10.89	7.79	15.15	5.0
Maize	10.49	8.38	9.95	12.5
Maize rinds	10.74	7.43	6.79	12.5
Coconut husk	11.00	8.50	4.42	37.5
Coffee husk	11.09	9.09	2.67	45.0
Eucalyptus wood	12.41	5.07	8.28	80.0
Acacia wood	12.31	6.25	5.2	72.5
M.Wood	11.23	4.36	7.21	58.5
Range	10.49 – 12.41	4.36 – 9.56	2.67 – 15.45	5.0 – 80.0
Mean	11.23	7.31	8.29	42.79
CV (%)	5.13	21.16	46.62	57.94

CCE = Calcium carbonate equivalence

spray. The plants were allowed to grow and at the stage of harvest the leaves were harvested and cured in an electric barn. The cured leaf was processed and analysed for nicotine and reducing sugars. Excess water stress for a period of 30 h reduced the yield and quality. Among the nutrients/growth hormones / polyamines tested to mitigate the ill effects of excess water stress, KNO_3 soil application in combination with kinetin spray @ 50 ppm performed better followed by putriscine spray.

Secondary nutrient deficiency effects on tobacco plant nutrition [CTRI, Rajahmundry]
M. Anuradha, D. Damodar Reddy and K. Sivaraju

Secondary nutrient deficieny effects on nitrogen nutrition: Sand culture experiments were conducted to study the single and multiple nutrient deficiencies under sufficient and deficient conditions of nitrogen on plant growth, development and nutrient uptake. Single and multiple nutrient deficiencies reduced all the growth characters, net photosynthetic rate, chlorophylls and carotenoids and under nutrient stress the concentration of anti-oxidative enzymes increased to counteract the ill effects of stress. Under no nitrogen condition the plant growth is less and omission of secondary nutrients didn't show much effect. Under sufficient N supplied condition omission of single and multiple nutrients showed visual deficiency symptoms, reduction in plant growth and showed variation in uptake of nutrients.

IV(C). Characterization of soil biota and use of biofertilisers

Development of bioconsortia for optimizing nutrient supplementation through microbes for tobacco crop production [CTRI, Rajahmundry]
D.V. Subhashini, M. Anuradha, D. Damodar Reddy

Utility of microorganisms that improve soil fertility and enhance plant nutrition has continued to attract attention due to the increase in cost of fertilizers and their negative impact on environment. The objective of this study was to supplement part of inorganic fertilizers with microbial consortia. A Bulk trial was carried out during 2012-13 with two best treatements viz., 75%RDF + *Azospirillum* + *B. subtilis* + *F. aurantia* and 75%RDF + *Azotobacter* + *B.subtilis* + *F. aurantia* along with absolute control and 100% RDF. The treatment 75%RDF + *Azotobacter* + *B.subtilis* + *F. aurantia* proved to be best combination to suppplement NPK nutrients.

Isolation of K-mobilizing bacteria: Potassium availability to tobacco crop plants in vertisols is generally low since 98% of total K in soil is in mineral forms. Attempts were made to isolate different K solubilizing bacteria from rhizosphere soil samples. The efficiency of the isolates to solubilize insoluble potassium mineral, production of plant growth promoting substance and other agronomically beneficial traits were studied under laboratory and field conditions. The *in vitro* efficient K-solubilizing bacteria were evaluated for further studies. The rhizosphere soil samples of different locations were used in the study for the isolation of potassium solubilizing bacteria. A total of 15 KSB isolates were isolated on media supplemented with mica as potassium source. All bacterial cultures were identified at genus level and were found to belong to the genera *Bacillus* and *Pseudomonas*. All the isolates were able to solubilize (mica) potassic mineral under *in vitro* condition. Among the strains 5 isolates were found to be efficient strains.

Isolation, Characterization and antimicrobial activity of novel *Streptomyces spp:* The *Streptomyces* are prolific, producing around 80% of total antibiotic products. In addition to antibacterial components they also produce secondary metabolites with biological activities of which the *Streptomyces* spp. amounts for 80% of the total production by Actinomycetes. The strain *Streptomyces spp.* isolated from mangrove strptomyces showed good antimicrobial activity and its secondary metabolites contain good antibiotic molecules having industrial value. The results obtained here in normal conditions and enrichment of secondary metabolites production may give good inhibition towards fungal pathogens and other microbes also.

IV (D). Evaluation of tobacco leaf and product quality

Studies on chemical constituents responsible for smoke flavour in tobacco grown under different agro-climatic zones

K. Sivaraju, R.K. Ghosh, T.G.K. Murthy and D. Damodar Reddy

Neutral volatile aroma constituents of *Lanka* tobacco (*Nicotiana tabacum* L.) in relation to nitrogen supply and leaf position: A field experiment was conducted in Rekhapalli, Khammam district, Andhra Pradesh to study the effect of nitrogen levels (Recommended practice; N1=300 kg/ha and farmers' practice; N2=1000 kg/ha) and leaf position (bottom, middle and top) on neutral volatile aroma constituents in *lanka* tobacco by GCMS. The neutral volatile compounds detected include degradation products of carotenoids, thunberganoids, neophytadiene and terpenoids. The neophytadiene (36%), thunbergol (2.35%), megastigmatrienone isomers (6.86%), 3-hydroxysolavetivone (8.47%), solavetivone (1.44%), solanone (1.41%) and Z-Abienol (1.37%) were some of the major compounds that significantly contribute to smoke flavour. The neophytadiene content was higher in N1 treatment (11.8%) over N2 treatment. The four isomers of megastigmatrienone were present in all leaf positions in both nitrogen treatments and the megastigmatrienone isomer-2 was in maximum content. The megastigmatrienone content increased with increase in leaf position from bottom to top with exceptions. The total phenylalanine related compounds were more in N1 over the N2 treatment. Maximum content of neutral volatiles were present in the middle (98.53%) and top position (98.88%) leaves compared to bottom leaves (70.41%) at N1 treatment. Thus the leaf position showed significant effect on neutral volatile compounds, whereas the variation between two nitrogen levels in aroma compounds was significant only in bottom leaf position. Results revealed that tobacco from both middle and top position showed maximum accumulation of neutral volatile aroma constituents at 300 kg N/ha. The recommendation of 300 kg N/ha for *lanka* tobacco was found to be optimum for accumulation of maximum neutral volatile aroma constituents.

Monitoring of agrochemical residues in tobacco samples from different areas [CTRI, Rajahmundry]

Rakesh Kumar Ghosh

Gas chromatography-single quadrupole mass spectrometry for multiresidue analysis of 11 Organochlorine pesticides in tobacco: This study aimed to monitor residue levels of 11 chlorinated pesticides (á-HCH, â-HCH, ã-HCH (lindane), ä-HCH, 2,4-DDT, 4,4-DDT, chlorpyriphos, endrin, á-endosulfan, â-endosulfan and endosulfan sulphate) in tobacco leaves from two major tobacco growing states of India. Since accurate estimation of residue is pre-requisite for effective monitoring and foumulating strategies, a gas chromatography-single quadrupole mass spectrometry (GC-MS) method based upon quatifier-qualifier ions were employed for detection of these pesticides. It is fast, easy, efficient and user friendly and reduces the changes of false detection of pesticide. In addition methods for analysis of 52 pesticides by GC/MS and GC-MS/MS in tobacco matrix and analysis of pesticide residue by LC-MS were developed and tested at at NRC-Grapes (ICAR), Pune.

Agrochemical residues in tobacco samples from different areas: Samples received from different tobacco growing regions of SLS, SBS, NLS, CBS, NBS and KLS were analysed by the newly developed GC-MS-Singlequadrupole qualiflier-quantifire ions method. These regions covers two major tobacco growing states, Karnataka (12.97°N 77.56°E) and Andhra Pradesh (17.36°N 78.47°E), of India. Specifically, these samples covers Mysore (12.08°N 76.32°E) and Hassan (13°N 76°E) districts of Karnataka, and Prakasam (15.50°N 80.05°E), Krishna (16.17°N 81.13°E), Nellore (14.43°N 79.97°E), East Godavari (16.57°N 82.15°E) and West Godavari (16.43°N 81.09°E) districts of Andhra Pradesh. The results indicated that the pesticide residue levels in most of the collected tobacco samples complied with the GRL specifications issued by the CORESTA (2008). Very few samples showed positive detection of the studied organochlorine pesticides. The detection of phase out pesticides like DDT/ á-HCH/ â-HCH/ ä-HCH which might be due to transfer of persistent residues of these pesticides from environmental components to tobacco plant.

V. Integrated Management of Biotic Stresses

V (A). Monitoring of Insect pests and Diseases

Monitoring of insect pests of tobacco with pheromone traps [CTRI, Rajamundry]
U. Sreedhar

An experiment was conducted to monitor tobacco caterpillar, *S. litura* with pheromone traps to ascertain the influence of weather parameters on trap catch and to study its role in predicting pest incidence and damage due to the pest in tobacco nurseries.

Tobacco nursery: Perusal of correlation matrix shows that there was a highly significant and positive correlation between trap catch, egg masses, larvae and percent seedlings damaged. The fitted multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains 68.1 per cent of variation in the moth catches. The linear regression equation fitted for per cent seedlings damaged vs. moth catch in the pheromone traps showed that 68.8 per cent variability of the seedlings damaged was explained by pheromone trap catch. The fitted multiple linear regression equation for per cent seedlings damaged vs. moth catch and weather parameters explains 83.9 per cent variability of the dependent variable by pheromone trap catch together with weather parameters

Tobacco field crop

The results indicated that with the increase in the trap catch (lagged variable) there was an increase in the egg masses on the tobacco in the following week and subsequent increase in the larval population and damage two weeks after.

During the crop season the trap catch started increasing form 6th standard week (12.75/trap) and remained more or less stable up to 11th standard week (11/trap). It was highest in the 8th standard week (20.5/trap) followed by 9th (16.750/trap). The incidence of the pest and damage was low during the season. The highest damage recorded was 5.85 %. The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was positive and highly significant. During the season the correlation between the weather parameters and trap catch was highly significant. The multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains 80.2 per cent of variation in the moth catches in pheromone traps. The linear regression equation fitted for per cent increase in plant damage vs. moth catch in the pheromone traps showed that 64.2 per cent variability of the seedlings damaged was explained by pheromone trap catch

The fitted multiple linear regression equation for increase in per cent plants damaged vs. moth catch and weather parameters explains 76.1 per cent variability of the dependent variable by pheromone trap catch together with weather parameters

Monitoring of *Spodoptera litura* in tobacco nurseries

Three years (2009-12) data on weather parameters, trap catch, seedling damage was correlated, and the correlation matrix clearly showed a highly significant and positive correlation between trap catch and the seedlings damaged. However, no correlation was observed between the weather parameters and trap catch or the damage in the nursery. The linear regression equation fitted for per cent seedlings damaged vs. moth catch in the pheromone traps showed that 47.4 per cent variability of the seedlings damaged was explained by pheromone trap catch. The multiple linear regression equation for per cent seedlings damaged vs. moth catch and weather parameters explains 60.2 per cent variability of the dependent variable by pheromone trap catch together with weather parameters

Survey for assessment of insect pest incidence in KLS tobacco [CTRI RS, Hunsur]
P. Venkateswarlu and S. Ramakrishnan

Insect pest incidence in Nursery: Survey of nurseries infested by tobacco caterpillar, *Spodoptera litura* revealed 0-12%. Among the nurseries 14% showed above ET level (> 5%). The overall infestation of the pest in the entire

area was 0.8% which is much below the ETL. Among the five *Taluks* surveyed, the overall infestation of the caterpillar was more in Hunsur (1.0%) followed by Periyapatna (0.9%).The caterpillar infestation in the entire KLS region was remained same as compared to the previous year.

Insect pest incidence in main field:

Four major pests of tobacco viz., aphid, *Myzus nicotianae*, budworm, *Helicoverpa armigera,* stem borer, *Scrobipalpa heliopa* and tobacco caterpillar, *Spodoptera litura* were recorded in all the five *Taluks* of KLS. The per cent fields infested by aphid, stem borer, budworm and caterpillar were 13.3, 46.6, 16.3 and 7.6, respectively. The average infestations of these pests in the infested fields were 8.0, 13.7, 8.9 and 6.3%, respectively. The overall infestations by these four pests in the area were 1.1, 6.5, 1.5 and 0.5%, respectively. It revealed that incidences due to aphid, budworm and caterpillar were reduced approximately by 30% than the previous year. In contrast stem borer incidence was increased by five times.

Survey for plant parasitic nematodes associated with tobacco [CTRI RS, Hunsur]
S.Ramakrishnan

Five major plant parasitic nematodes viz., *Meloidogyne spp, Rotylenchulus reniformis, Helcotylenchus spp, Pratylenchus spp* and *Tylenchus sp,* were associated with main field tobacco crop. Maximum mean population of root knot nematode, *Meloidogyne spp* was found in Periyapatna region (101.3 J_2 per 100g soil) followed by Hunsur (69.0 J_2 per 100g soil), Arkalgud (45.0 J_2 per 100g soil) and H.D.Kote (42.6 J_2 per 100g soil). Reniform nematode, *Rotylenchulus reniformis* was found in large numbers in almost all the soil samples collected in KLS. But, they are not pathogenic to tobacco as compared to root knot nematodes. Severe galls with attached slimy egg masses were found in crop infected with root knot nematodes.

Weather based disease prediction model for brown spot of Motihari tobacco [CTRI RS, Dinhata]
S. Roy

Studies indicate that rise in AUDPC was related to higher total canopy RH (AUCRHPC) and temperature (AUCTPC) progress curve under early date of planting followed by normal and late planting. For macro-weather variable, AUDPC in relation to area under relative humidity progress curve (AURHPC) and area under temperature progress curve (AUTPC) also exhibited similar trend. The AUDPC was recorded higher under early date of planting as AURHPC and AUTPC was also high in comparison to normal followed by late planted crop. Maximum area under infection was recorded in temperature range of 20 – 28Ú C whereas for RH it was in between 40 – 60%.

V. (B) Development of IPM technology

Management of tobacco caterpillar, *S.litura* with insecticide baits [CTRI Rajahmundry]
U. Sreedhar and K. Nageswara Rao

Emamectin benzoate bait treated plots found superior in exhibiting least infestation both at 4 (4.60 %) and 10 (4.80 %) days after

Table V-1. Management of tobacco caterpillar, *Spodoptera litura* with baits in NLS Bulk Trial

Treatment	Per cent plants infested		Mean no. of Leaves damaged/plant				Per cent leaf area damaged			
	4 DAT	10 DAT	4 DAT	z value	10 DAT	zvalue	4 DAT	z value	10 DAT	z value
Lufenuron bait	6.60	6.80	2.10	1.639	2.50	1.647	3.40	1.660	5.16	1.785
Novoluron bait	5.40	6.00	1.86	1.678	2.20	1.737	3.16	1.678	4.20	2.055
Emamectin benzoate bait	4.60	4.80	1.26	1.726	1.40	1.954	2.19	1.853	2.80	2.355
Control (untreated)	16.20	20.8	5.26		6.40			10.2	16.8	

treatment (DAT) and maximum protection to tobacco (Table V-1). Yield parameters showed that emamectin benzoate bait treated plots recorded highest cured leaf yield (2339/ha) and grade index (1401 kg/ha).The pooled data of three years (2009-12) showed that the emamectin benzoate bait treatment recorded highest cured leaf yield (1982 kg/ha) and net returns (Rs 1,39,966/ha) with an ICBR of 1:16.28 where as novoluron and lufenuron bait treated plots recorded 1931 & 1812 kg cured leaf yields per hectare with net returns of Rs 1,34,203 & 1,20,756 and ICBR of 1:14.83 and 1:11.48 respectively.

Bio-efficacy and field evaluation of new insecticides against tobacco pests [CTRI, Rajahmundry]

U.Sreedhar, R.K.Ghosh and S.Gunneswara Rao

(i) Evaluation of new insecticides against *S.litura* in tobacco nurseries

New insecticides viz. Chlorfenapyr 10 SC @ 0.01%, metaflumizone 22 SC @ 0.04% novoluron 10 EC @ 0.01%, spinosad 48 SC 0.01%, lufenuron 5 EC @ 0.006% were evaluated against *S.litura* in tobacco nurseries and compared with emamectin benzoate 5 SG @ 0.0025% and untreated control. At 2 DAS emamectin benzoate 0.0025% recorded least (5.63%) seedling damage followed by chlorfenapyr 0.01% (6.39), similar trend was observed at 4 and 8 DAS (Table V-2).

(ii) Evaluation of new insecticides against tobacco aphid *Myzus nicotianae* on FCV tobacco

a. Spirotetramet 150 OD @ 0.006%, 0.012%, 0.024%, Spirotetramet+ imidacloprid 240 SC @ 0.009%, 0.018% & 0.036% were evaluated against tobacco aphid, *M.nicotianae* on FCV tobacco in comparison with imidacloprid 200SL @0.005%. The results showed that aphid population at 2 and 4 DAS was significantly low in plots treated with spirotetramet + imidacloprid@ 0.036% and it remained on par (4.01) with its lower dose 0.018% .Similar trend was observed at 8 and 15 days after spray. The yield data showed that all the yield parameters viz: cured leaf, bright leaf and grade index was significantly high in plots treated with spirotetramet+ imidacloprid @ 0.036%

b. Flonicamid 50 WG @ 0.02%, pymetrozine 50 WG @ 0.02%, spiromesifen 240 SC @0.02% and spirotetramet+ imidacloprid 240 SC @ 0.018% were evaluated against tobacco aphid, *M.nicotianae* on FCV tobacco in comparison with imidacloprid 200 SL and thiamethoxam @ 0.005%. At 2 DAS flonicamid recorded the lowest aphid population (2.76) followed by pymetrozine (3.05) and spirotetramet + imidacloprid 240 SC (0.018%). At 4 DAS all the treatments except spiromesifen recorded cent per cent mortality of the aphids. Similar trend continued at 8 and 16 days after spray. Data

Table V-2. Efficacy of new insecticides against *S. litura* in tobacco nurseries

Treatments	Percent seedlings damaged		
	2DAS	4DAS	8DAS
Novoluron 10 EC @ 0.01%	7.76 (1.83)	7.02 (1.50)	7.56 (1.75)
Emamectin benzoate 5 SG @ 0.0025%	5.63 (1.00)	4.92 (0.75)	4.36 (0.58)
Metaflumizone 22SC @ 0.04%	7.76 (1.83)	7.19 (1.58)	6.39 (1.25)
Chlorfenapyr 10 SC @ 0.01%	6.39 (1.24)	5.96 (1.08)	5.14 (0.83)
Spinosad 48 SC @ 0.01%	10.62(3.40)	9.65 (2.83)	10.08 (3.08)
Lufenuron 5 EC @ 0.006%	9.67 (3.42)	8.45 (2.17)	7.76 (1.83)
Untreated control	32.97(29.66)	33.29(30.17)	31.81 (27.83)
S.Em±	0.63	0.49	0.59
CD *(p=0.05)*	1.94	1.52	1.82
CV %	9.50	7.84	9.87

Figures in parentheses are original treatment means

on yield parameters showed that flonicamid recorded highest cured leaf yield (2040 kg/ha), bright leaf yield (1120 kg/ha) and grade index (1720) followed by pymetrozine (2025, 1098 & 1700)).

c. The persistent residual toxicity of three new insecticides viz., Pymetrozine 50 WG @ 0.02%, flonicamid 50 WG @ 0.02% and spirotetramet + imidacloprid 240 SC @ 0.018% was studied in comparison with the recommended insecticides for aphid control, imidacloprid 200SL @ 0.005% and thiamethoxam 25 WG @ 0.005%. Flonicamid recorded 100 % mortality up to 16 days after treatment (DAT) and the toxicity was (74.6) up to 20 DAT. All other insecticides recorded cent per cent mortality up to 14 DAT except thiamethoxam which recorded cent per cent mortality up to 12 DAT. The PT values were higher for pymetrozine (81.30) and Spirotetramet + Imidacloprid 240 SC @ 0.018% (81.20) compared to flonicamid (80.47). The lowest PTI (1844.64) was observed in thiamethoxam treatment. The order of relative persistent toxicity was flonicamid > pymetrozine > spirotetramet + Imidacloprid > imidacloprid > thiamethoxam

d. An experiment was conducted in laboratory with new insecticides for aphid control to determine their safety to the predatory coccinellid beetle *C. sexmaulata.*

The mortality of *C.sexmaculata* larvae at 72 hrs after treatment was highest (67.32%) in case of imidacloprid which was at par with thiamethoxam (53.59%). Flonicamid and pymetrozine with 26.28 per cent mortality were equal to the mortality in control (26.28) (Table V-3). In another experiment larvae exposed to spiromesifen and spirotetramet+ treated leaf surface recorded 100 per cent survival during the experimental period. It was concluded that spriomesifen, spirotetramet+, flonicamid and pymetrozine were harmless to *C. sexmaculata*. Imidacloprid and thiamethoxam were slightly harmful according to IOBC classification. When females of *C. sexmaculata* were *exposed* to different insecticides, highest fecundity was recorded with pymetrozine followed by flonicamid. The lowest fecundity was recorded with imidacloprid. Hence, it was observed that pymetrozine followed by flonicamid are safe to the predator.

LM(%)=larval mortality: E(%)=(1-Vt/Vc)/ 100, where E is the effect of pesticide measured as the larval mortality compared to the un treated, Vt is the larval survival observed in the treatment and Vc is the larval survival observed in the untreated (control). Class: 1=harmless (<30 %); 2=slightly harmful (30 to <79 %); 3=moderately harmful (80 to <99 %); 4=harmful (>99 %).

(iii) Evaluation of new insecticides against tobacco whitefly *Bemisia tabaci* on FCV tobacco

New insecticides viz., Flonicamid 50 WG @ 0.02%, spiromesifen240 SC @ 0.02%, pymetrozine 50 WG @ 0.02%, diafenthiuron 50WP @ 0.05% and buprofezin 25 SC @ 0.05% along with imidacloprid 200 SL @ 0.005% and thiamethoxam 25 WG @ 0.005% were evaluated

Table V-3 . Mortality of *Chielomenes sexmaculata* larvae

Treatment	Per cent mortality (LM)	E(%)	Class
Flonicamid @ 0.02%	24.75 (26.28)	0.0	1
Pymetrozine @ 0.02%	24.75 (26.28)	0.0	1
Thomethoxam @ 0.005%	58.0 (53.59)	38	2
Imidacloprid @ 0.005%	74.75 (67.32)	56	2
Control	24.75 (26.28)	0.0	
CD (p=0.05 %)	28.9		
S.Em±	9.4		
CV %	4.7		

Figures in parentheses are arc sign transformed values

against whitefly, *B. tabaci* on FCV tobacco. Plots treated with diafenthiuron 50 WP @ 0.05% recorded least whitefly population at all the observations. At 15 DAIS pymetrozine (1.41) was found to be on par with imidacloprid (1.39), thiamethoxam (1.42), flonicamid (1.43) and spiromesifen (1.50). At 7 DAIIS diafenthiuron (0.57) and pymetrozine (0.81) recorded significantly less population than all other treatments except for spiromesifen (0.92) which remained on par with pymetrozine. The treatments of spiromesifen, flonicamid (1.00), imidacloprid (1.02) and thiamethoxam (1.06) recorded more or less equal number of whiteflies/plant. At 15 DAII spray, diafenthiuron recorded least population (0.62) followed by pymetrozine (0.96), spiromesifen (0.99) and flonicamid (1.03). At 30 DAII spray diafenthiuron a continued to be the most effective with least whitefly population (0.72) followed by pymetrozine (1.03) which was on par with that in spiromesifen (1.05), flonicamid (1.09) and imidacloprid (1.24). Buprofezin recorded highest population (1.45) and remained on par with thiamethoxam (1.29). Data in per cent leaf curl infected plants showed that all the treatments recorded significantly less leaf curl infected plants as compared to control (18.43). Diafenthiuron recorded significantly less (3.50) leaf curl infected plants as compared to all other treatments at all the observations. At 7, 15 DAIS and 7 DAII S rests of the treatments remained on par with each other At 15 DAIIS similar trend continued except that Buprofezin recorded significantly higher population (18.27) than all other treatments except spiromesifen (13.21).Similar trend was observed at 30 DAIIS. The data on yield parameters showed that pymetrozine recorded highest cured leaf yield (1990 kg/ha) and it was significantly higher than only buprofezin (1740) which remained on par with all other treatments. Similar trend was observed for bright leaf yield and grade index

(iv) Field efficacy of new insecticides against tobacco caterpillar *S.litura* on FCV tobacco

New insecticides, Chlorfenapyr 10 SC @ 0.01%, metaflumizone 22 SC @ 0.04% were evaluated for their field efficacy along with IGRs, novoluron 10 EC @ 0.01%, lufenuron 5 EC @ 0.006%; spinosad 48 SC 0.01%, and emamectin benzoate 5 SG @ 0.0025% were evaluated in a replicated field trial in comparison with untreated control. Five plants per plot were artificially infested with ten second instar larvae (10 days old) and after 24 hrs the plots were treated with respective insecticides. Observations were recorded on mean number of leaves/plant, per cent leaf area damaged and per cent plants infested at 15 days after spray. Data on yield parameters were recorded. The results showed that emamectin benzoate and chlorfenapyr recorded no damage at 2, 4 and 8 days after spray (DAS) and are significantly superior than all other treatments the next best treatment was metaflumizone and was on par with the IGR novoluron, which in turn was on a par with lufenuron at all the observations. Among the treatments spinosad recorded significantly higher number of leaves damaged than all other treatments except lufenuron at 2 and 4 DAS. Similar trend was observed for leaf area damaged by the pest. The mean per cent plants infested at DAS was nil in emamectin benzoate and chlorfenapyr treatments. Among others least (11.99%) was recorded in metaflumizone which was significantly less than others. Novoluron (14.95%) and lufenuron (16.11% remained on par with each other and were significantly superior to spinosad (20.41%). All the treatments recorded significantly higher cured leaf, bright leaf and better grade index than control. Emamectin benzoate recorded higher cured leaf, bright leaf and grade index followed by chlorfenapyr and metaflumizone.

(v) Effect of new pesticides on the survival of *Glyptapanteles africanus* an early larval parasitoid of *S. litura*

i. An experiment was conducted in the laboratory to find out the effect of new insecticides on the survival of the parasitoid *G.africanus*. Minimum mortalities of *G.africanus* adults were observed at 5 DAS of flubendiamide, metaflumizone and novaluron and these were therefore ranked as "short lived" (IOBC persistency Class A). Chlorfenapyr, rynaxypyr and emamectin benzoate though recorded considerable decrease in their toxicities but were still potent enough to be classified as "moderately persistent" (IOBC persistency Class C). All of the insecticides were safe after 25 days after application to the parasitoid.

Cent per cent mortality of *S.litura* larvae parasitized by *G. africanus* was observed when the larvae were fed with tobacco leaves treated with Chlorfenapyr 10 SC 0.01%, rynaxypyr 0.0075 %, flubendiamide 480 SC 0.0012%, emamectin benzoate 5G 00025%, metaflumizone 22 SC 0.04% and spinosad 48 SC .0.01%. Till 25th days after spraying. According to IOBC classification they are all classified as harmful to the parasitoid development in *S.litura* larvae. In case of novaluron the mortalities were 9.24, 8.05, 5.83 and 1.66 per cent at 3,5,10 and 15 days after spraying and at par with control from 10 days after spraying. According to IOBC classification novaluron was found to be harmless

(vi) Effect of new pesticides on the survival of *T. remus* an egg parasitoid of S.litura

ii. The mean per cent mortality of *T.remus* adults was 24.77 and 18.76, respectively with respect to metaflumizone and novaluron at 24 hrs after spray Mortalities were significantly high in case of these insecticides compared to control. However according to IOBC classification metaflumizone and novaluron were classified as "Class 1" harmless to *T.remus* adults as they recorded less than thirty per cent reduction of mortality over control.

Emergence of adults from parasitized eggs was significantly high in control compared to the insecticide treatments. Among the treated ones the emergence was significantly higher in novaluron treatment and per cent reduction over control was 24 compared to 42 in metaflumizone. Hence according to IOBC classification at 24 hrs after parasitisation novaluron was classified as harmless and metaflumizone was slightly harmful. At 3 days after parasitisation, novaluron was as good as control and metaflumizone treated eggs showed significant reduction in emergence over control but at par with novaluron. Both these insecticides are classified as "harmless" to the parasitoid emergence at this stage. At seven days after parasitisation both the insecticide treatments were are par and significantly inferior to control. However they are harmless as the per cent reduction over control was less than 30% in both the cases. It was concluded that novaluron and metaflumizone are harmless to the parasitoid *T.remus.* It was concluded that novaluron and metaflumizone did not exhibit any side effects on the life cycle of *T.remus*

Studies on *Helicoverpa armigera* in tobacco with special reference to influence of plant variety, field ecology, eco toxicology and seed production [CTRI, Rajamundry]

S. Gunneswara Rao and U.Sreedhar

Studies on demographic characters of *H. armigera* on different tobacco varieties

A comparison of life parameters of *H.armigera* on the three varieties showed that highest net reproductive rate was recorded on Kanchan followed by VT 1158 and N98. Similar trend was observed in terms of potential fecundity, intrinsic rate of increase, annual rate of increase, mean generation time and weekly multiplication rate. Mean generation time was shortest in N 98 followed by VT 1158 and Kanchan. Doubling time was shortest in Kanchan followed by VT 1158 and N 98. It was observed that under choice conditions Kanchan attracted significantly highest oviposition by *H.armigera* (52.0) followed by VT 1158, N98 and Siri. TI 165 had the lowest oviposition by the bud worm .Under no choice conditions, on Kanchan and VT1158 highest number of eggs were deposited by *H.armigera* (149 and 120 respectively) which were at par and followed by N98(106), Siri (85.25) and TI165(69.75) without significant differences among them. It was concluded that Kanchan and VT 1158 were most favourable hosts for oviposition by *H.armigera.* It was concluded that Kanchan and VT 1158 attracted highest oviposition of *H.armigera* and Kanchan supported the best growth of *H. armigera.*

Ecotoxocology of Insecticides against *H. armigera* on parasitoid, *G. africanus*

At 5th day after treatment, the parasitization of *H.armigera by* females of *G.africanus* was highest in control (17.52) followed by novaluron (16.91). Among others, metaflumizone with 15.26 cocoons was significantly superior to flubendiamide (10.49). In case of chlorfenapyr, rynaxypyr, emamectin benzoate and spinosad, the adults failed to parasitize. At 15th day after treatment the cocoons recovered were highest in control

(19.33). Among the insecticide treatments, novaluron with 15.66 cocoons was significantly superior to metaflumizone and flubendiamide which had significant differences. Metaflumizone with 14.77 cocoons was superior to flubendiamide (10.62). In case of chlorfenapyr, rynaxypyr, emamectin benzoate and spinosad, the adults failed to parasitize even 15 days after treatment. At 25th day after treatment, highest parasitization was observed in case of control (23.14 cocoons) among the different insecticide treatments the differences were significant. Least parasitization was observed in case of spinosad (3.72) followed by emamectin benzoate, rynaxypyr, chlorfenapyr, flubendiamide, metaflumizone and novaluron in the ascending order.

Evaluation of insecticide application technology for effective spray coverage on FCV tobacco in NLS

G. Raghupathi Rao, U. Sreedhar, K. Nageswara Rao

Leaf area index and plant growth characters as influenced by crop age

Plant characters were recorded, commenced from 35 days after planting (DAP) and continued till 95 DAP at 15 days interval. Correlation between crop age and plant height (r = 0.94), number of leaves(r = 0.84) and swath width of the crop (r = 0.96) were highly positive and significant. Regression analysis showed that there were 0.03, 1.15, 0.26 and 0.94 increases in LAI, plant height, number of leaves and swath width, respectively for a unit increase in crop age.

Assessment of spray volume requirements applied through different sprayers on FCV tobacco at different growth stages of the crop

Spray fluid applied through high volume sprayers viz., compressed, knapsack and Hi tech and two low volume sprayers viz., motorized knapsack (MKS) and high pressure knapsack sprayers (HPKS) were assessed at different stages of the crop growth commenced from 35 DAP and subsequent four stages at 15 days interval.

Spray fluid requirement applied through different sprayers at 35 DAP

Spray fluid required through low volume sprayers viz, high pressure knapsack (HPKS) and motorized knapsack sprayer (MKS) was low of 120 and 130 l/ha, respectively as against Hi tech sprayer (150 l/ha) with considerable saving of time to a tune of 61% over Hi tech sprayer. However, it was found to be not economical due to higher quantity of emamectin benzoate to an extent of 38 % over Hi tech sprayer. At 35 DAP, Hi tech sprayer was more efficient in providing uniform coverage with considerable saving of insecticide and time over compression sprayer- farmer's method, and compression sprayer.

Spray fluid requirement applied through different sprayers at 50 DAP

Spray fluid applied through compression sprayer-farmers method followed by compression and knapsack sprayer was very high of 320, 280 and 260 l/ha, respectively as against Hi tech sprayer (235 lit/ha). Application through Hi tech sprayer reduced the insecticide quantity to an extent of 36, 19 and 11 % over compression sprayer- farmers' method, compression and knapsack sprayer, respectively. Further, Hi tech sprayer reduced the operation time to an extent of 43 and 21 % over compression sprayer- farmer's method, and compression, respectively. Though spray fluid required through low volume sprayers viz, HPKS and MKS was low of 145 and 140 l/ha, respectively as against Hi tech sprayer (235 l/ha) with considerable saving of time to a tune of 64% over Hi tech sprayer, it was not economical due to higher insecticide requirement to a tune extent of 18.3 % over Hi tech sprayer. It was evident that at 50 DAP, application of spray fluid through Hi tech sprayer was more effective in providing uniform coverage with considerable saving of time and quantity of insecticide. It revealed that up to 50 DAP by considering plant canopy and quantity of spray fluid and insecticide requirement, application through Hi-tech sprayer was more economical over low volume sprayers HPKS and MKS.

Spray fluid requirement applied through different sprayers at 65 DAP

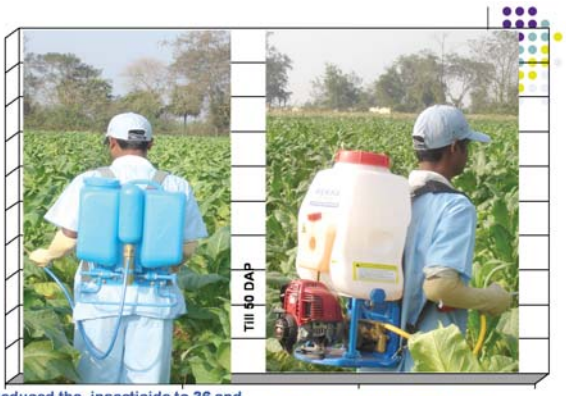
Spray fluid applied through low volume sprayers viz., HPKS and MKS was low of 150 and 155 l/ha as against Hi tech sprayer (280 l/ha). Though the quantity of insecticide required through HPKS was 3.3 % high over Hi tech, it was economical to use HPKS due to saving of application time to an extent of 83 % over Hi tech sprayer. Further, it was evident that as the crop grew , the loss of insecticide due to the application of spray fluid through HPKS over Hi tech was declined from 38% at 35 DAP 5% at 95 DAP

Spray fluid requirement applied through different sprayers at 80 DAP

Application of spray fluid through HPKS further reduced the insecticide quantity to an extent of 3.1% over Hi-tech sprayer with a drastic reduction in operator time to a tune of 78% and economical over Hi tech sprayer. Correlation and regression studies between spray fluid requirement through different sprayers and crop age indicated that the rate of increase in spray fluid requirement was low with Hi- tech sprayer (3.28) followed by knapsack sprayer (3.34) in contrast with compression sprayer.(3.88). In contrast rate of increase with HPKS and MKS was 1.52 and 1.60, respectively.

Spray fluid requirement applied through different sprayers at 95 DAP

Quantity of insecticide required through HPKS was slightly high of 5% over Hi tech sprayer, HPKS was preferred due to saving of operator's time to an extent of 91% and 8 % over Hi tech and MKS, respectively. It is evident that as the crop advanced, the other parameters viz., swath width of canopy, plant height and LAI also increased gradually and thus the loss of insecticide due to the application of spray fluid through HPKS followed by MKS was declined from 38% at 35 DAP to 5% at 95 DAP over Hi tech sprayer.



Reduced the insecticide to 36 and 19 % and Operation time to an extent of 43 and 21 % over CS - farmers method and compression, respectively

Resulted in drastic reduction in operator time to a tune of 78% over Hi tech sprayer

Quantification of spray deposition:

Potassium applied through various sprayers on leaf surface (µg/ sq.cm) at top, middle and bottom canopy was quantified and the results Indicated that at 35 DAP among the sprayers, Hi tech sprayer (40 PSI, 3.6 kmph) was superior over all other sprayers in depositing maximum quantity of potassium 1.89, 0.92 and 0.60 µg/ sq.cm on top, middle and bottom canopy, respectively as against 0.45, 0.50 and 0.60 µg/ sq.cm through MKS. Lowest quantity deposited through MKS and HPKS was mainly attributed to application of same concentration as was applied for high volume sprayers with double the operator's speed (6.5 KMPH). Further, it resulted in higher run off losses due to low LAI, plant height and swath of the crop. The spray deposition through HPKS at 95 DAP showed superior performance with uniform coverage by showing 4.32, 2.26 and 2.82 µg/ sq.cm on top, middle and bottom canopy, respectively followed by MKS. It is evident that during early stages of the crop, as the crop was characterized by low LAI, swath. And plant height, application of spray fluid through Hi tech sprayer was superior in order to avoid higher losses on ground, in contrast at latter stages, superior performance of the sprayers was achieved by using HPKS at 6.5 kmph with double the normal concentration in order to achieve uniform coverage on the crop canopy.

Analysis of spray characteristics emitted through different sprayers

(i) Spray characteristics as influenced by different sprayers at 35 days after planting

Top canopy: The droplet density varied between 55 through compression sprayer and 86 through Hi tech sprayer. Highest VMD was recorded with compression sprayer. As it was advanced pressurizing type, it emits finer droplets initially, later on the droplet size gets bigger and hence higher VMD was obtained. Spray spectrum emitted through Hi tech sprayer was superior as it was characterized by higher droplet density, lower VMD, higher coverage and low uniformity coefficient. For MKS and HPKS the strips could not be analyzed as the strips were completely flooded.

Middle canopy: Hi tech sprayer was efficient in emitting the spray spectrum with higher droplet density, lower VMD and high coverage. The deviation of droplet size was maximum with compression sprayer as against Hi tech sprayer. The spray spectrum emitted through HPKS was characterized by high droplet density, lower VMD, higher coverage with lower deviation of droplet size.

Bottom canopy: Superior performance of Hi tech sprayer was evidenced with high droplet density, low VMD, VMD. Data based on over all performance of sprayers on top, middle and bottom canopy, Hi tech sprayer was found to be superior and characterized by higher droplet density, lower VMD, high coverage with lower deviation of droplet sizes at 35 days after planting. Use of HPKS and MKS were found to be undesirable during early stages of crop growth.

(ii) Spray characteristics as influenced by different sprayers at 80 days after planting

Eighty days after planting application through HPKS was more effective over MKS and Hi tech sprayers in providing superior spray characteristics viz., high droplet density, low VMD, high coverage with low deviation of droplet sizes.

(iii) Efficacy of different spray systems against the incidence of major insect pests of FCV tobacco

Incidence of leaf eating caterpillar, *Spodoptera litura* was lowest of 4.91 in the plots received initial two sprayings through Hi tech and rest two through HPKS and superior in minimizing the infestation. Incidence of aphids, *Myzus nicotianae* was lowest of 11.48 in the plots received initial two sprayings through Hi tech and rest two through HPKS and superior in minimizing the infestation. Incidence of tobacco budworm / capsule borer, *Helicoverpa armigera* was low in plots treated through Hi tech sprayer and showed superior performance up to 50 DAP in suppressing the insect pest infestation and there after HPKS was more effective in minimizing the pest incidence on tobacco crop.

(iv) Influence of pressure, disc and swirl plate aperture size on discharge rate of different nozzles

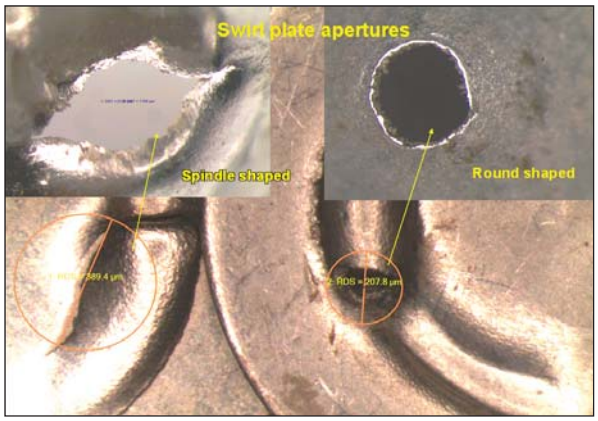
In the early stages of crop growth, as the crop size was comparatively smaller, it requires smaller quantities of spray fluid. This can be achieved by proper selection of nozzle with lower discharge rate and cone angle.

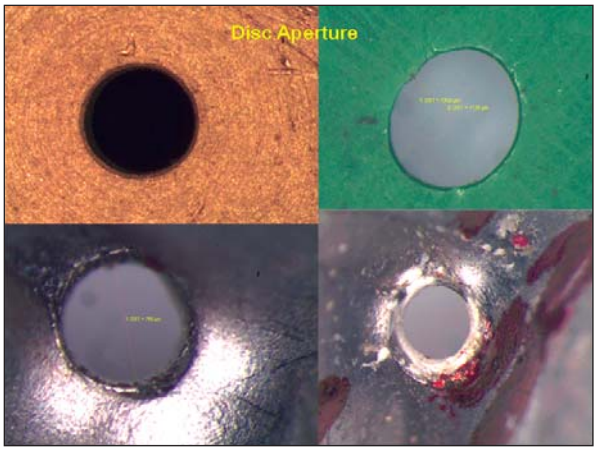
a) Discharge rate through Disc plate vs different sizes of swirl plates

Locally available brass nozzles having different diameters of disc apertures viz: 867, 955, 1094, 1109, 1212 and 1576 µm were selected for the study. The discharge rate of spray fluid through each disc in combination with swirl plates having different sizes 745, 761, 786,1174/395, 1453/545, 1688/798, and 2230/1000 µm were calibrated at three operating pressures of 10,30 and 40 PSI. It is evident that an increase in discharge rate was recorded with increase in diameter of disc, swirl plate and pressure. Hence, the discharge rate varied from 220 to 1260 cc/min. due to the combination of discs and swirl plates of different diameters at varied pressure.

b) Discharge rate through swirl plate vs different disc sizes:

Locally available brass nozzles having different diameters of swirl plates viz: 745, 761, 786, 1174/395, 1453/545, 1688/798, and 2230/1000 µm were selected for the study. The discharge rate of spray fluid through each swirl plate in combination with disc plates having different diameters of 867, 955, 1094, 1109, 1212 and 1576 µm were calibrated at three operating pressures of 10,30 and 40 PSI. It is





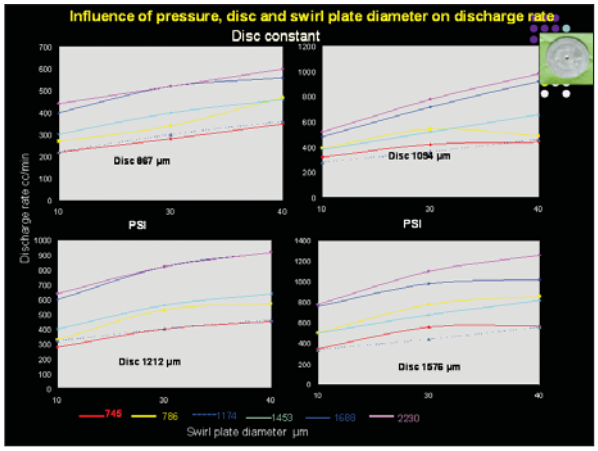


Table V-4. Yield of FCV Tobacco as influenced by border crops and insecticide spray.

Treatments	Green leaf	Cured leaf	Bright leaf	Grade index
Main plots				
Jowar	10933	1895	1072	1562
Non-jowar	8600	1485	841	1227
Sub-plots				
T1: NSKS 5%spray + Imidocloprid	9456	1781	1040	1495
T2: NSKS 5%spray + Thiamethoxam	9830	1732	910	1401
T3: NSKS 5%spray + Diafenthiuron	9966	1762	968	1411
T4: NSKS 5%spray + Spirotetramat and Imidocloprid	11414	1894	1166	1628
T5: Control	8165	1281	699	1039
General Mean	9766	1690	957	1395
SEm ± Main plots	455	82	44	65
Sub plots	412	69	43	54
Interaction	583	97	62	77
CD at5% Main plot	1790	323	172	256
Sub plots	1196	200	127	158
Interaction	NS	NS	NS	NS
CV % Main plots	20.8	21	20.5	20.9
Sub plots	11.9	11.5	13	11

evident that an increase in discharge rate was recorded with increase in diameter of swirl and disc plates, and pressure. Hence, the discharge rate varied from 260 to 1200 cc/min. due to the combination of swirl and disc plates of different diameters at varied pressure.

- Discharge rate increased with pressure nonlinearly.
- Discharge rate increased with disc and swirl hole diameter
- Discharge rate affected by rusting of the aperture and irregular shapes of the
- Disc and swirl hole diameter

It is evident that selection of discharge rate from 230 to 1200 cc/ min depending on the target i.e., Pest, pest stage at nursery or field crop at different ages is most important in achieving uniform spray coverage on plant canopy. Irregularities in discharge rate was due to irregular shapes of the aperture (round, oblong, oval or spindle shaped). Hence, it is prerequisite to calibrate the nozzles for desired discharge rate in order to save quantity of spray fluid and there by insecticide. By considering crop growth, LAI, plant height, swath of the crop, nature of pest and damage, nozzle discharge rate can be selected accordingly for obtaining optimum coverage.

Management of *Bemisia tabaci* in FCV Tobacco [CTRI RS, Kandukur]

K.Ch.Chenchaiah

Jowar, as a border crop with need based application of NSKS 5% spray + Spirotetramet and Imidocloprid significantly reduced the whitefly infestation with higher yield parameters, as compared to other treatments without border crop **(Table V-4)**.

Integrated disease management of hollow stalk of Motihari tobacco in terai region of West Bengal (CTRI RS, Dinhata)

S. Roy

The disease reaction was significantly low in Immuno- modulant (Bactrinashak) treated plots (**Table V-5)**

V. (C) Screening for host plant resistance to insect pests and diseases

Screening of burley tobacco germplasm against tobacco stem borer, *Scrobipalpa heliopa* under natural conditions (BTRC, Kalavacharla)

G. Raghupathi Rao

A total of 116 burley tobacco germplasm lines were screened under natural conditions

Table V-5. integrated disease management of hollow stalk of Motihari tobacco

S.No	Sub-Plot	Disease reaction (linear soft rot in cm) Main Plot			Mean
		Bio- primed	SAR	Control	
1.	Kocide	2.09	3.48	2.46	2.68
2.	Blitox	3.08	3.61	3.00	3.23
3.	Bio -inoculants (Pf)	3.06	2.85	2.83	2.91
4.	Methyl- Salicylate (SAR)	2.47	3.31	2.40	2.73
5.	Immuno-modulant (Bactrinashak)	2.47	2.15	3.21	2.61
6.	Bactericide (Plantomycin)	2.27	3.31	2.50	2.70
7.	Control	5.50	6.11	6.00	5.86
	Mean	3.00	3.55	3.20	
		S Em ±	CD at 5%	CV (%)	
	Main -Plot	0.35	0.98	27.83	
	Sub-Plot	0.30	0.83	27.83	
	Interaction	0.52	1.44	27.83	

for incidence of tobacco stem borer. As the incidence of stem borer was negligible under natural conditions, the same were raised under green house conditions and screened under artificial conditions. Studies indicated that none of the germ plasm was resistant to stem borer.

Evaluation of FCV tobacco germ plasm for the tobacco caterpillar tolerance under SLS conditions [CTRI RS, Kandukur]

K.C. Chenchaiah

Thirteen entries were evaluated under natural infestation and artificial inoculation for tolerance to aphid. The test entry R-148 and R-149 showed lowest infestation as compared to other entries and checks. Under artificial inoculation, the entire test plants higher infestation rating. The test entries, R-148, R-149 and R-152 were selected for yield evaluation trial.

Evaluation of two promising Aphid tolerant lines (Trial-1)

The test line R-178-2 was free of aphid infestation and yielded significantly higher yield over Hema, VT-1158 and Siri with respect to all yield parameters. Pooled analysis 2011-13 also confirmed the superiority of R-178-2.

Evaluation of two promising Aphid tolerant lines (Trial-2)

The test line R-118 showed higher bright leaf yield and grade index. The chemistry of the leaf in the test entries is in the optimum limit

Evaluation of FCV germ plasm for tolerance to *S. litura*

The test line R-149 showed lowest damage by S.litura. R-149 was significantly less damaged by the caterpillar. However, when compared to Hema, lines R-148 and R-152 also showed lower infestation and hence, selected for further yield evaluation.

Evaluation of two promising Caterpillar Tolerant lines for yield (Trial-2)

Two promising caterpillar tolerant lines identified during 2010-11 were evaluated for yield parameters. The test line 143-2 was significantly superior to *Hema* with respect to lower damage and higher yield parameters. Pooled analysis of 2011-13 also confirmed the superiority of 143-2

Evaluation of two promising Caterpillar Tolerant lines- (Trial-3)

The test line R-130 was significantly superior to Hema with respect to lower infestation and all the yield parameters and grade index. The chemistry of the leaf in the test entries is in the optimum limit.

Screening of tobacco germplasm against root-knot Nematodes [CTRI RS, Hunsur]

S. Ramakrishnan

Thirty three advanced breeding lines were screened against root-knot nematodes, *Meloidogyne spp* under sick field condition and the results revealed that FCR-12, FCJ-1, FCJ-8, FCJ-10, and FCH 229 & FCH 231 recorded RKI of d" 1.5 on 0 – 5 Scale and hence were found most promising against root-knot nematodes.

Screening for resistance to brown spot and hollow stalk in germplasm accessions of *N. tabacum* and *N. rustica* in North Bengal 2012-13 [CTRI RS, Dinhata]

S. Roy

N. tabacum accessions were screened for resistance to brown spot and revealed that 4a-7- 86, II – 1a – 7-80, Vaishali special and GT- 7 were highly resistant to brown spot. In another screening test for resistance to hollow stalk in *N. rustica* germplasm revealed that out of six crosses, the crosses Bengthuli x DD-437 and Bengthuli x White. Pathar exhibited resistant to disease

Screening for resistance against brown spot and hollow stalk in germplasm accessions of Jati (*N. tabacum*) & Motihari (*N. rustica*) tobacco in North Bengal [CTRI RS, Dinhata]

S. Roy

Screening for resistance to brown spot: For ascertaining resistance to brown spot in germplasm accessions of *N. tabacum and N.*

rustica , the experiment was carried out in sick plot zone with inoculation under artificial conditions succumbed to brown spot disease with disease reaction ranging from 52. 0 - 75. 9 %. Hence none of the accessions proved resistant to brown spot. In *N. tabacum* accessions, the level of disease reaction was variable. Four accessions viz. II- 4a-7- 86, II – 1a – 7-80, Vaishali special and GT- 7 proved to be highly resistant as the disease reaction was nil in these accessions. However, in other accessions the disease reaction varied from 3.4 – 51%. These lines should be tested for one more year under artificial condition before they source it to breeders as resistant source to brown spot.

Screening for resistance to hollow stalk in *N. rustica* germplasm accessions: Screening for resistance to hollow stalk under artificial conditions was carried out in sick plot zone for six crosses viz. Bengthuli x Dharla, Bengthuli x Dd-437, Bengthuli x Whit Pathar, White Pathar x DD-437, White Pathar x Dharla and White Pathar x Bengthuli. The crosses Bengthuli x DD-437 and Bengthuli x White Pathar exhibited resistant disease reaction as the linear soft rot was measured 3 cm. Two crosses viz. White Pathar x DD-437 and White Pathar x Dharla measured up to 4.0 and 4.1 cm. The crosses exhibiting moderate disease reaction viz. Bengthuli x DD-437 and Bengthuli x White Pathar shall be tested in ensuing season to assess the consistency of disease reaction.

V (D) Monitoring and management of pesticide resistance and pesticide residues

Development of baseline-resistance data of lepidopteran pests of tobacco against conventional insecticides and insecticides with novel mode of action [CTRI, Rajahmundry]

J.V. Prasad and U. Sreedhar

Base line resistance data of *S.litura* populations from Rajahmundry and Guntur *were* generated for contact insecticides was computed and the lowest LC50 value was recorded with emamectin benzoate followed by chlorpyriphos, profenophos and quinolphos in both the populations. The Guntur population recorded 1.46, 1.31, 1.19, 4.76, 1.27, 3.46 and 1.25 times higher LC 50 values of cypermethrin, methomyl, thiodicarb, profenophos, quinolphos, chlorpyiphos and triazophos respectively compared to Rajahmundry population.

Of the eleven insecticides with stomach action for which base line resistance data of *H.armigera* (Guntur) were generated, the lowest LC50 value was recorded with emamectin benzoate followed by indoxacarb, spinosad and rynaxypyr. In a similar study involving *H.armigera* population from Rajahmundry, lowest LC50 value was recorded with rynaxypyr followed by emamectin benzoate, spinosad and fipronil.The Guntur population of *H.armigera* recorded 1.41, 1.33, 1.08, 33.06, 12.08, 1.41, 1.21 and 1.14 times higher LC 50 values of novaluron, thiodicarb, fipronil, rynaxypyr, acephate, chlorpyriphos, endosulfan and flubendiamide respectively compared to Rajahmundry population.

The baseline resistance data of *H.armigera* populations from Guntur and Rajahmundry were generated for eleven insecticides with contact action. In case of Guntur population, the lowest LC50 value was recorded with rynaxypyr followed by thiodicarb, spinosad and profenophos. The lowest LC50 value was recorded with rynaxypyr followed by spinosad, profenophos and thiodicarb in case of *H. armigera* population from Rajahmundry. The Guntur population of *H.armigera* showed 5.56, 1.40, 1.96, 2.38, 1.13, 1.39, 1.25 and 1.81 times higher LC50 values of spinosad, rynaxypyr, acephate, chlorpyriphos, endosulfan, cypermethin, triazophos and profenophos respectively compared to Rajahmundry population. The Rajahmundry population of *H.armigera* recorded 26.75, 1.94 and 1.27 higher LC50 values of thiodicarb, methomyl and quinolphos respectively compared to Guntur population.

Technology Assessed and Transferred

On-farm demonstration of identified alternative crops to FCV tobacco in Vertisols of Andhra Pradesh. [CTRI, Rajahmundry]
Y. Subbaiah

Implemented on-farm demonstrations on maize (seed & commercial purpose) at Katavaram village and bengal gram at Kunavaram village to demonstrate as an alternative crop to FCV tobacco in NBS area. The obtained yields from seed maize and commercial maize are 8750 kg / ha and 10750 kg/ha, respectively and the obtained chickpea yield was 2450 kg / ha. Analysis of data showed that the tobacco provided higher net returns from unit of land. Though the BCR is more in the case of maize and chickpea, these crops may not remain remunerative as the prices fall consequently when the supply to the same increases to market. From the results of B: C ratio, it can be concluded that maize and chickpea recorded markedly higher BCR i.e. 1.66 and 1.96, respectively over FCV tobacco (1.55).

Farmers' feedback: FCV tobacco in NBS is a late planted crop during 2012-13. The unexpected rains received after 3rd harvest has damaged the tobacco crop which resulted in reducing the bright grades. In general, 2012-13 climate is not congenial for tobacco in NBS. However, maize (seed/commercial) and chickpea yields are good. Farmers expressed that farm planning assessment indicated the FCV tobacco as the only crop suitable to their situations. Small farmers taken up tobacco cultivation as something inevitable because of the failure of other crops raised in the past. Only farmers with big holdings are going for other crops.

On-farm evaluation of advanced breeding lines in NLS region. [CTRI, Rajahmundry]
Y. Subbaiah, T.G.K.Murthy and K. Sarala

On-farm trials were conducted for two consecutive seasons to evaluate the performance of ABL JS-117 with Kanchan as better check. Adopted all the good agricultural practices in both the experimental and control plots. Data were collected on incidence of pests and diseases, morphological characters, yield, quality, acceptability to the farmer, benefit-cost ratio and elicited farmers' opinion.

Cured leaf yield: Superior cured leaf yield was recorded in JS-117 (2387 kg/ha). The yield improvement over better control Kanchan (2009 kg/ha) was 18.82%. Data on yield parameters over the two seasons indicated that ABL JS-117 out yielded the better check Kanchan by 23.16%. JS-117 recorded higher leaf length, leaf width and specific leaf weight than that of Kanchan. Examination of data on **leaf quality parameters** indicated that there are perceptible variations in leaf quality parameters (nicotine, reducing sugars and tar) of ABL JS-117 and better check Kanchan. From the results of **benefit-cost ratio**, it can be concluded that ABL JS-117 recorded markedly higher BCR i.e. 1.625 over Kanchan (1.345).

Low tar high yielding line, JS-117 in on-farm trial

Farmers' feedback: As perceived by the farmers, the advantageous characteristics of JS-117 are as follows:

1. Short inter-nodal length
2. Relatively preferred colour
3. More oiliness in the leaf
4. More leaf length and more leaf width
5. Required 10% additional dose of nitrogen
6. Acceptable to all situations

Decision support system for Transfer of technology [CTRI, Rajahmundry]
H. Ravisankar, Y. Subbaiah and T. G. K. Murthy

The software was developed in the form of website where it was classified mainly into two modules 'Specific to region' and 'General'.

In 'Specific-to-region' module, NLS, NBS, SLS, SBS and KLS regions are considered as sub modules. In each region, the parameters included are 'Varieties, Cultural practices, Manures & Fertilizers, Irrigation, Topping and sucker control, Harvesting, Grading, Quality of tobacco and Alternative crops to FCV tobacco'. In 'General' module, 'Nursery Management, Pests & Diseases in field, Green leaf management, Curing, PHPM, Crop rotation and High value phytochemicals' are included as sub modules. Nursery management sub module consists of 'Cultural Management, Management of insect pests, Management of diseases' as parameters. Pest and Diseases in field crop sub module includes 'IPM, IDM and management of viral diseases' as parameters. Curing sub-module includes 'Curing and Fuel saving techniques in curing' as parameters. The knowledge base contains 57 data sheets with 21 parameters, which are stored as various web pages. The information and images for each web page was incorporated and hyperlinks were provided to make connectivity of all the pages.

Expert System for Dairy Cattle Management [CTRI, Rajahmundry]

H. Ravisankar and V.S.G.R. Naidu

System analysis for designing the knowledge base has been completed. Information for 55 parameters was collected and they are clustered into 7 modules viz., Feeding, Breeding, Disease, Management, Milking, Cultivation and Health Management. The Module 'Feeding' consists of Calf feeding, Heifer feeding, Pregnant feeding and Animal feeding as sub modules; 'Breeding' module includes 'Breeds, Selection of milch animal, Natural service and Reproduction problems' as sub modules; Management modules consists of 'Housing, Watering and Cleaning' as sub modules; 'Milking' module includes 'Types of hand milking and Mechanical milking' as sub modules. The information for all the parameters was collected and documented. Designing of knowledge base and development of software with user friendly menus for storing and retrieval of the information is in progress.

Education and Training

Central Tobacco Research Institute has organized different extension activities viz, training programmes, Scientist-farmer interface meetings, field days, kisan melas, exhibitions, workshops and group meetings. Added emphasis has been accorded for collaborative activities with Tobacco Board, Tobacco Industry and State Agricultural Universities to achieve enhanced productivity, quality and profitability. The following programmes were conducted during the period under report.

- Training to farmers - 13
- Training to Extension workers - 1
- Field visits - 16
- Diagnostic visits - 4
- Interactive meetings - 4
- Farmer discussions - 2
- Demonstrations - 15

Particulars of these educational and training activities and the staff involved are furnished hereunder.

S.N.	Training imparted	Resource person	Date and place
1.	Workshop on FCV tobacco production for technical staff of Tobacco board	Dr. M. Mahadevaswamy	14.05.2013 at Rani Bahadur Institute of Management, Mysore Univ., Mysore
2.	FCV tobacco training programme in collaboration with Kaveri Grameena Bank and NABARD	Dr. M. Mahadevaswamy	27.05.2013 at Hunsur, Karnataka
3.	PHPM in FCV tobacco	Dr. M. Mahadevaswamy	15.07.2013 at Bhuvanahally and Billenahally (PF 4), Karnakata
4.	Field day programme	Dr. S. Ramakrishnan Dr. C. Mahadeva	17.7.2013 at Sunduvalu,(PF 5), KLS
5.	Training programme in PHPM	Dr. S. Ramakrishnan Dr. C. Mahadeva	18.07.2013 at Sundval (PF5), KLS
6.	Training programme in PHPM	Dr. M. Mahadevaswamy	19.07.2013 at Hareenahally and Alaganahally (PF 6), KLS
7.	Training programme in PHPM	Dr.C.Mahadeva	22.07.2013 at J. Koppolu (PF3), KLS
8.	Field day and OFT programme	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	26.07.2013 at Poonadahally B.T. M Koppalu (PF4 & 6), KLS
9.	On-farm training on PHPM	Dr. C. Mahadeva	27.07.2013 at B. K. Hally & Hindanahally (PF7), KLS
10.	Training programme on PHPM	Dr. C. Mahadeva	05.08.2013 at Uthhenahally(PF-2), KVK

S.N.	Training imparted	Resource person	Date and place
11.	Field day and OFT programme	Dr. C. Mahadeva	06.08.2013 at Meeddenahally (PF-4), KLS
12.	Field day and OFT programme	Dr. C. Mahadeva	06.08.2103 at Kellur (PF-5), KLS
13.	Field day and OFT programme	Shri S. Ramesh	07.08.2013 at Hirekhythanally (PF-3), KLS
14.	Field day and OFT programme	Dr. C. Mahadeva	08.08.2103 at N D G. Koppalu (PF-6), KLS
15.	Attended Tobacco Institute of India award function	Dr. S. Ramakrishnan	18.08.2013 at Mysore
16.	Field day and OFT programme	Shri S. Ramesh	23.08.2013 at Kelaginahally (PF-5), KLS
17.	Field day and OFT programme	Dr. S.S.Seenivas	22.08.2013 at Ramanathapura (PF6.3), KLS
18.	Field day and OFT programme	Shri S. Ramesh	23.08.2013 at Kelaginahally (PF-5), KLS
19.	Field day and OFT programme	Dr. S.S.Seenivas	22.08.2013 at Ramanathapura (PF6.3), KLS
20.	Field day and OFT programme	Dr. C. Mahadeva Dr. S.S.Sreenivas	17.09.2013 at Harnahally (PF-6.1), KLS
21.	Field day and OFT programme	Dr. C. Mahadeva Dr. S.S.Sreenivas	18.09.2013 at Handithanahally (PF-6.1), KLS
22.	Field day and OFT programme	Dr. C. Mahadeva Dr. S.S.Sreenivas	23.09.2013 at Salhyagala (PF-6.2), KLS
23.	Interagency team visit to KLS	Dr. C. Mahadeva	26.09.2013 at H D. Kote PF1,2,36 and 4), KLS
24.	Interagency team visit to KLS	Dr. C. Mahadeva	27.09.2013 at Periyapatana, Kamalapura and Ramnathapura (PF 4,5,6,7 61 62 and 63), KLS
25.	Field day and OFT programme in PHPM	Dr. S. Ramakrishnan Shri S. Ramesh	27.09.2013 at Hitgally (PF-2), KLS
26.	1st phase training programme on 'Nursery management'	Dr. K. Nageswara Rao Dr. S.K. Dam	01.10.2013J.R. Gudem – I J.R. Gudem - II

S.N.	Training imparted	Resource person	Date and place
27.	1st phase training programme on 'Nursery management'	Dr. Y. Subbaiah Dr. S. Gunneswara Rao	04.10.2013 at Koyyalagudem
28.	1st phase training programme on 'Nursery management'	Dr. S.V.Krishna Reddy Dr. G. Raghupathi Rao	07.10.2013 at Devarapalli, Gopalapuram
29.	1st phase training programme on 'Nursery management'	Dr. S. Kasturi Krishna Dr. J.V. Prasad	10.10.2013 at Thorredu
30.	1st phase training programme on 'Nursery management'	Dr. S.V.Krishna Reddy Dr. S. Gunneswara Rao	23.10.2013 at Devarapalli, Gopalapuram
31.	1st phase training programme on 'Nursery management'	Dr. K. Nageswara Rao Dr. G. Raghupathi Rao	24.10.2013 at J.R. Gudem – I & II
32.	1st phase training programme on 'Nursery management'	Dr. Y. Subbaiah Dr. S.K. Dam	25.10.2013 at Koyyalagudem
33.	1st phase training programme on 'Nursery management'	Dr. J.V. Prasad Dr. M. Nageswara Rao	06.11.2013 at Thorredu
34.	International Krishi Mela	Scientists and technical staff/officers of CTRI RS, Hunsur	07.11.2013 to 11.11.2013 at UAS, Bangalore
35.	Growers Awareness programme on Good Agricultural Practices, Crop Protection Agents, NTRM, PHPM in tobacco cultivation	Dr. U. Sreedhar Dr. S. Kasturi Krishna	13.11.2013 at Koyyalagudem
36.	GAP in SLS & SBS	Dr. P. Venkateswarlu	27.11.2013 at Bodduvaripalem of Ongole-1
37.	Field day on TBST-2	Dr. P. Venkateswarlu	04.12.2013 at Mangamuru
38.	Regional Agricultural Mela	Dr. M. Kumaresan	5-7 Dec., 2013 at TNAU, Madurai
39.	Field day on TBST-2	Dr. P. Venkateswarlu Dr. K. Sarala Dr. Y. Subbaiah	21.01.2014 at Mallavarappadu

S.N.	Training imparted	Resource person	Date and place
40.	Field day on TBST-2	Dr. P. Venkateswarlu Dr. K. Sarala Dr. Y. Subbaiah	22.01.2014 at Mynampadu
41.	Training on IPM in tobacco	Dr. P. Venkateswarlu	12.02.2014 at Tobacco Board, Guntur
42.	3rd phase training programme on 'Topping & De-suckering, Harvesting & Curing, Grading & PHPM'	Dr. M. Anuradha	19.02.2014 at Tobacco Board, Thorredu
43.	Field day on TBST-2	Dr. A.R. Panda Dr. P. Venkateswarlu Dr. P.V. Venugopala Rao	20.02.2014 at Rudravaram
44.	Field Day on TBST-2	Dr. S.V. Krishna Reddy	28.2.2014 at Munikudali village
45.	Field day programme at on-farm varietal trial	Dr. Y. Subbaiah	7.3.2014 at J.R. Gudem.I

Field Friends Programme: A total of 45 Field Friends Programmes were organized. These programmes were undertaken to sensitize the farmers on adoption of good agricultural practices in general and to suggest scientific interventions for efficient soil and water management, pest & disease management, topping and de-suckering, curing and PHPM.

RADIO TALKS

S.No.	Name	Topic, Date of broadcast & Station
1.	Dr. B. Johnbabu	Management of Turkey birds 20.4.2013, AIR, Visakhapatnam
2.	E. Vijayaprasad	Plant protection in Chillies 24.4.2013, AIR, Visakhapatnam
3.	Dr. V.S.G.R. Naidu	Impact of climate change on Agriculture 28.4.2013, AIR, Visakhapatnam
4.	Smt. V.V. Lakshmi Kumari	Value-added products from fruits 15.5.2013, AIR, Visakhapatnam
5.	Dr. P.Venkateswarlu	Pesticide application appliances and precautions while using pesticides 23.5.2013; AIR, Vijayawada
6.	Dr. P.V.V.S. Siva Rao	Care and maintenance of cattle during summer 9.6.2013 AIR, Visakhapatnam

S.No.	Name	Topic, Date of broadcast & Station
7.	Dr. A.V.S.R.Swamy	Tobacco varieties suitable to Southern light and Black soils 16.6.2013, AIR, Vijayawada
8.	R. Sudhakar	Coir industry as a self-employment avenue for rural women 20.6.2013, AIR, Vijayawada
9.	Smt. J.V.R. Satyavani	Management of orchards in rainy season 2.7.2013, AIR, Vijayawada
10.	Smt. V.V. Lakshmi Kumari	Tips for nutritional enhancement of daily diet 6.7.2013; AIR, Vijayawada
11.	Smt. J.V.R.Satyavani	Kharif vegetable cultivation 25.7.2013 at AIR, Visakhapatnam
12.	Dr.S. Kasturi Krishna	Improved production practices for higher yield in Burley tobacco 26.7.2013; AIR, Visakhapatnam
13.	R. Sudhakar	Coir industry as a self-employment avenue 18.8.2013 at AIR, Visakhapatnam
14.	Dr. P. Venkateswarlu	*Spodoptera litura* and *Helicoverpa armigera* NPV preparation, usage and precautions while using 20.08.2013; AIR, Vijayawada
15.	Dr. U. Sreedhar	Integrated Pest Management for the control of pests and diseases in tobacco nurseries 21.8.2013; AIR, Visakhapatnam
16.	Smt. V.V. Lakshmi Kumari	Health and nutrition for adolscent girls 7.11.2013 at AIR, Visakhapatnam
17.	Smt. J.V.R. Satyavani	Management of mango orchards at flowering and fruit setting stages 10.12.2013 at AIR, Visakhapatnam
18.	Dr. S. Gunneswara Rao	Integrated Pest Management for the control of pests and diseases in tobacco crop 17.12.2013 at AIR, Visakhapatnam

TV Programme

Dr. P. Venkateswarlu, Principal Scientist & Head I/c delivered a talk on "Good agricultural practices and remedial measures for in-undated tobacco fields of SLS and SBS" on 04.12.2013 through ETV2.

Krishi Vigyan Kendra, Kalavacharla

The salient achievements and other activities of KVK of CTRI working under the aegis of Indian Council of Agricultural Research during the period under report are enlisted below:

On-Farm Testings & Frontline Demonstrations

- A total number of 15 On-Farm Testings (OFTs) and 17 Front-line Demonstrations (FLDs) were conducted during the period under report.

Crop Production

- In sugar cane, use of single budded bud chips as seed material recoded yield improvement by 41% and also reduced the cost of cultivation by 17,250/-/ha and also Rs.5,750/- was saved in transplanting operation. planting.
- Rice Variety MTU-1112 (16%) and Improved Samba (14%) recorded higher yields over local check BPT-5204.
- Blackgram var.PU-31 yielded 6.25 q/ha and 71% increase in yield was recorded over local check, under Pulse Production Programme.
- Greengram var.LGG-460 yielded 4.55 q/ha and 99% increase in yield was observed over check.
- In zero tillage maize an yield increase of 11.42% recorded.

Zero tillage maize after Kharif rice

- In upland, paddy variety MTU-1064 recorded 5063 quintals per ha and 8% increase in yield over MTU-7029.
- Refined and popularized paddy five drum seeder for direct seeding and documented more transplanting acreage in less time (5 acres in 7 hours).

Horticulture

- Artificial ripening of mangoes by dipping in Ethrel solution and also by spraying resulted in quality fruits and fetched good market price.
- Cocoa beans were dried in three methods i.e., open drying, solar drying and polychamber drying. Polychamber dried beans retained quality parameters.
- Coccinia seed material (stem cuttings) selected from farmers field for resistance to viral disease, performed well with an average yield of 3.5 t/ha in five months against viral disease affected crop (1.2 t/ha).
- Skirting of banana bunches with non-oven bags resulted in to early maturity by 8 to 10 days with improved quality of fruits and increased weight of bunches.
- Trelly method of tomato cultivation increased yields (36 t/ha) with benefit cost ratio of 1:2.8 compared to farmers practice (22.5 t/ha) and B:C ratio 1:2.0.

Tomato in Trelly method cultivation

- China Aster 'Kamini' variety performed well (6.4 t/ha) compared to local asters (6.0 t/ha).

Kamini variety of China Aster

- Direct feeding of nutrients (Cow dung, urea, sulphate of potash) to banana bunches resulted in quality bananas upto distal end of bunch.
- Cultivation of 'Agakara' (Teasle Gourd) alternate to Coccinia resulted in good market price for a period of 4 months with net income of Rs.65,000/- per acre.

Crop Protection

- Management of stem borer in paddy was conducted in 10 farmers fields of Jonnada village. Pesticide spray schedule was adopted from nursery stage to late tillering stage. An yield improvement of 9.64% was observed with Cost benefit ratio of 1:1.17 compared to 1:1.07.
- BPH management in paddy was implemented in Penikeru village in 10 farmers fields. An yield improvement of 6.70% recorded with cost benefit ratio of 1:1.16.

Animal Science & Production

- Supplementation of Azolla reduced the feed cost of rupees 200/- per 100kg poultry feed.
- Jodipi sheep introduced in the local flocks to reduce inbreeding. The weight gain in progeny was 6-10 kg over local breed.
- Assessed the performance of Black Bengal for quality meat and higher milk yield and observed production of twin kids in each conception. Six pairs were distributed to farmers for flock maintenance.

Twin kidding in Black Bengal Goats

- Heat Synch protocol was implemented in cattle. All the animals treated with harmones have come to heat but none has conceived.
- Phule Jayawant vareity of Napier bajra performed well with profused tillering and yielded 150 t/ha green fodder . It is succulent and palatable.
- Mineral mixture was given to poultry birds and observed no shell less egg production.
- Increase of 14% weight observed in sheep and goat fed on mineral licks.
- DHM 117 variety of maize remained green for one week after harvest of cobs and the stalks were used as green fodder.

Home Science & Rural Crafts

- Vanaraja poultry birds were distributed for backyard poultry in rural areas.
- Implemented kitchen gardening in schools.
- Value added traditional recipes with cocoa powder were demonstrated to rural women.

Value added receipes of Cocoa

Production of Seed & Seedlings/ Others:

- Produced and supplied 25 quintals of rice seed and 6.2 t of fodder slips.
- A total number of 1,345 mango grafts and 4,752 cashew grafts were prepared supplied to needy farmers.
- Supplied 1, 14 000 hybrid vegetable seedlings (Brinjal, Tomato and Chillis) to needy farmers under ATMA demonstration programme.
- Supplied 4,158 fertile eggs of poultry, turkey to popularize backyard poultry in the district.
- A total no. of 4 Banana Fibre Extraction machines and 3 Palm Fibre Separator machines were supplied to different Entrepreneurs.

Field Demonstration

- RP BIO (Improved Samba) variety of rice was demonstrated in the farmers fields (120 ac).

Mobile Advisory Services

- In association with 'Reliance Foundation' provided mobile advisory services to farmers and others on various agricultural and allied aspects.

Organized Farmers' Field Schools (FFS):

- On 'Cultivation of Improved Samba variety of Rice' at Ponnada village of U. Kothapalli mandal during Kharif 2013.

Distribution of Paddy variety (Improved Samba)

- On 'Zero tillage Maize Cultivation' at East Ganugudem village of Rajanagaram mandal during Rabi 2013.

Zero tillage maize demonstration in the field

Technology inventories prepared:

- **V.S.G.R. Naidu,** J. V. R. Satyavani, E. Vijay Prasad and T. G. K. Murthy (2014) ***Technology Inventory on Cashew Production*** **(**(Telugu-Jeedi Mamidi**)**. Pub. KVK, CTRI. Pp: 52.
- **V.S.G.R. Naidu** and T. G. K. Murthy (2014) ***Self Employment opportunities through KVK sponsored Programmes***. (Inventory of Technologies which support the self employment for rural women and youth) Pub. KVK, CTRI. Pp: 40.

Agri Tech Refinement Programme

- Under Agritech refinement programme of ATMA, East Godavari Dist., two palmyrah Fibre Extraction Home stead units were promoted at Tativada village of Rampachowdavaram mandal for Ten Tribal women beneficiaries.

Tribal women with Palmyrah Fibre Machine

- One paper plate and Buffet plate making unit was promoted at K.Surampalem village of Gandepalli mandal for the benefit of 6 rural women.

ATMA capacity building programme organized:

S.No.	Date & Venue	Title of Programme	Name & Designation
1	10.12.2013 Amalapuram @ Uppalaguptam	Rice production technologies Nutritional Awareness / Women Empowerment	Dr.V.S.G.R. Naidu, PC, KVK S. Jitendranath, SMS V.V. Lakshmi Kumari, SMS R. Sudhakar, SMS
2	11.12.2013 Daksharamam	Pickle Making / Women Empowerment	V.V.Lakshmi Kumari, SMS R.Sudhakar, SMS
3	21.12.2013 Rangampet	Protray Vegetable Seedlings Production	JVR Satyavani, SMS
4	27.12.2013 Madiki, Alamuru Mandal	Rabi vegetables cultivation	JVR Satyavani, SMS
5	30-10-2103 to 01-11-2013ABIRD, Dhavaleswaram	Organic farming	E.Vijaya Prasad, SMS

Awards and Recognitions

Best ICAR Publication Award

Dr. V.S.G.R. Naidu, Programme Co-ordinator, KVK has been conferred with the Rajendra Prasad Puraskar award for the technical publication in Hindi on "Medicinal importance of weeds' by Mr. Chandrabhanu and Dr. V.S.G.R. Naidu, for the year 2012 by ICAR during its 85th Foundation Day Celebrations held at New Delhi on 16th July, 2013.

Best Book Award-2012

Dr. V.S.G.R. Naidu, Programme Co-ordinator, KVK received ISWS Best Book Award-2012' for his contribution to 'Hand Book on Weed Identification' at Biennial Conference of Indian Society of Weed Science(ISWS), Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur held at Directorate of Weed Science Research, Jabalpur on 15.2.2014.

Life Fellow Entomological Society of India - 2013

Dr. U. Sreedhar, Principal Scientist & Head, Division of Crop Protection was elected as Life Fellow Entomological Society of India for his devotion to the promotion of research in Entomology on December 31, 2013.

Fellow of SAB

Dr. K. Sarala, Principal Scientist and Dr. K. Prabhakara Rao, Scientist have been conferred with Fellow of Society for Applied Biotechnology (FSAB), Chennai in recognition of the outstanding achievements and contributions to the field of plant biotechnology.

Best Poster Award

Dr. H. Ravisankar and Dr. V.S.G.R. Naidu received Best Poster Presentation Award for the paper entitled "Expert system for dairy cattle management" at the International Conference on Extension Educational Strategies for sustainable agricultural development – A Global perspective, held at UAS, Bangalore during 5-8th December, 2013.

Md. Elias and Dr. M. Anuradha received the third Best Poster Presentation for the paper entitled "Present practices for future strategies of CTRI Library in Digital Era" at the National Conference on 'Agricultural Information Management in Digital Era' held at Indira Gandhi Krishi Vishwavidyalaya, Raipur during 4-5th February, 2014.

Linkages and Collaborations

CTRI has developed strong linkages with various organisations at regional, national and international level. At regional level, linkage between CTRI and various state government departments and Agricultural Universities in Andhra Pradesh, Tamil Nadu, Karnataka, Bihar, Gujarat and West Bengal was established to provide an effective thrust to Indian tobacco development. Central organisations like Tobacco Board and Department of Biotechnology are associated with different tobacco development programmes. CTRI has also developed linkages with ICAR organistions like NBPGR, New Delhi, CIAE, Bhopal and PDPC, Bangalore.

Sl. No.	Name of the Collaborating Agency	Project title/Activity
a) National Institutes/Agricultural Universities		
1.	Bureau of Indian Standards, New Delhi	Development of Indian standards for tobacco and tobacco products
2.	Department of Biotechnology, New Delhi	Empowerment of tribals through agro-ecological conservation and bio-technological approaches in East Godavari district of Andhra Pradesh
3.	Tobacco Board, Guntur	Field Friends Programmes and on-farm trials for improving yield and quality of FCV tobacco in different zones
4.	National Bureau of Plant Genetic Resources, New Delhi	National Active Germplasm Site (NAGS)
5.	Department of Agriculture in different states	Transfer of technology in non-FCV types and supply of inputs
6.	Indian Meteorology Dept., Pune	Maintenance of meteorological observatories at different Stations
7.	M/s ITC Ltd. ABD-ILTD M/s. Godfrey Phillips India Ltd., M/s. VST Industries Ltd. and ITA, Guntur	Research and development activities, organising training programmes, field trials on latest packages, variety release proposals, manufacturing tests and storage tests
8.	PDBC, Bangalore	Coordinated trials in Biological control
(b)	**International Institutions**	
1.	ISO-TC126, Berlin, Germany	Development of international standards for tobacco and tobacco products

All India Network Project on Tobacco

Salient achievements from experiments conducted at different AINPT centres during 2013-14 are summarized as follows:

Varieties Released / Identified

One FCV CMS hybrid variety, CH-3 was recommended for Light soils of Karnataka State during the 45th State Level Variety Evaluation Committee meeting held at University of Agricultural Sciences, Bangalore, on 08.08.2013.

Release proposal on another CMS hybrid variety, CH-1 was submitted to the State Sub-committee on Variety Release of the A.P. Government.

Three varieties viz., DJ-1 (Chewing tobacco variety for West Bengal), NBD-119 (First Bidi variety for Andhra Pradesh) and GABT-11 (root-knot disease resistant variety for Gujarat) were identified for release.

Coordinated Varietal Trials

The most promising lines identified in Co-ordinated varietal trials conducted at different Centres were as follows:

Table 1. Initial Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCR-10, FCR-11, FCR-12, FCR-13 and FCS-1
Kandukur	FCR-10, FCR-11 and FCR-12
Jeelugumilli	FCJ-5, FCJ-6 and FCJ-7
Rajahmundry	FCR-9, FCR-10, FCR-12 and FCR-13
Shimoga	FCR-11, FCJ-6 and FCJ-9
Bidi tobacco	
Araul	ArBD-08, ArBD-09, ABD-130 and NBD-239
***Rustica* tobacco**	
Araul	ArR-29 and LR-72
Dinhata	AR-110, AR-24 and AR-29
Ladol	AR 110 and LR-72
Pusa	AR-110, AR-111, LR-72, LR-73, LR-74 and ArR-28 and ARR-29

Table 2. Advanced Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCG 2 AND TBST 17
Kandukur	FCR-8
Jeelugumilli	FCJ-1 and FCJ-4
Bidi tobacco	
Anand	ABD 119 and ABD 122ABD 124, ABD 126, ABD 127, ABD 128, and ABD 129
Araul	ArBD-04, ArBD-07 and ArBD-06
***Rustica* tobacco**	
Ladol	AR –106

Table 3. Bulk Evaluation Trials

Centre	Promising line(s)
FCV tobacco	
Jeelugumilli	Tobios-6, Tobios-7 NLST-5 and NLST-6
Rajahmundry	TBST-2B
Bidi tobacco	
Anand	ABD 119 and ABD 122ABD 124, ABD 126, ABD 127, ABD 128, and ABD 129
Araul	ArBD-04, ArBD-07 and ArBD-06
Nandyal	ABD 115, ABD 116 and ABD 117

Recommendations to Tobacco Farmers

- Flubendiamide @ 0.25 ml/l or Novoluron @ 1 ml/l are recommended for the management of budworm in tobacco.
- For the management of damping off disease in tobacco nursery, spraying fenamidone 10% + mancozeb 50 WP @ 0.3% (3 g/l) or azoxystrobin @ 0.1% (1 ml/l) are recommended from Shimoga, Nippani and Anand centres.
- For management of Frog eye spot disease in bidi tobacco nursery, two sprays of hexaconazole @ 0.1% or propeneb @ 0.225%

or carbendazim 12%+ mancozeb 63%@ 0.225% are recommended from Anand centre.

- Potential cropping systems/ Alternative crops were identified for 1. Pikka tobacco in Odisha and 2. Bidi tobacco at Nandyal, Andhra Pradesh and most of the centres has been conducting experiments in this area.

- Coffee Husk and maize rinds can be used as alternative fuels for curing FCV tobacco by Shimoga Centre.

Centre-wise Research Achievements

ANAND

- Advanced Bidi breeding line 121-9...35-35 in normal planting showed significant superiority for cured leaf yield over better checks.

- ABLs ABD 101, ABD 124 and Line 457-11....28-29 showed significant superiority for cured leaf yield over both the checks in drought trial.

- Line F5 (GT 7 x A 145) 203-35-6-4 showed significant superiority for seed yield over better check.

- Farmers of middle Gujarat are advised to apply 8 irrigations to bidi tobacco variety ABT 10 and topping at 18 leaves for getting maximum benefit with higher CBR without affecting the quality of produce.

- Farmers of middle Gujarat are advised to cover the bidi tobacco nursery with 90% agro shade green net for higher germination and maximum transplantable seedlings.

- The genotype F5 (GT 7 x A 145) 203-35-6-4 was found promising for high seed yield and oil yield potential, while pipeline variety, GABT-11 was the most promising line for green leaf biomass production.

- Bidi tobacco variety MRGTH 1 fertilized with 220 kg N/ ha and harvested at 90 DAT produced higher protein yield from green leaf of tobacco and suitable to take wheat crop in rabi season in same field with recommended dose of fertilizers.

- The seed yield and oil yield potential were highest with variety A 145, while the *khakhari* yield and nicotine yield potential were significantly high with GABT 11.

- *Bledius latiusculus* and *Spodoptera* were observed under nursery conditions, whereas population of whiteflies were found during the entire crop period with maximum number during 51st std. week (270/50 plants) under field conditions.

- In nursery frog-eye spot disease appeared from 34th standard week and increased till 37th standard week. Correlation coefficients worked out between frog-eye spot disease and weather parameters in nursery revealed significant positive correlation for relative humidity for morning (RH 1) and cumulative rainfall (CUMRF).

- Looking to the effectiveness and yield of transplants and economics on the basis of results of pooled analysis, application of hexaconazole @ 0.1%, propeneb @ 0.225%, carbendazim 12%+ mancozeb 63% @ 0.225% in addition to carbendazim @ 0.025% to the nursery seedlings can be recommended.

ARAUL

- In a Preliminary Yield Evaluation Trial conducted at the Station, Bidi entries ArBD-32, ArBD-31, and ArBD-33 showed significant superiority over the check K-Local and A-119 for cured leaf yield.

- *Hookah* tobacco entries ArR-27 and ArR-26 proved superior in yield over the check SK-417 in AVT-I, while in AVT-II entry ArR-24 was superior to the better check, Azad Kanchan.

- In PYET with *Hookah* tobacco, entries ArR-46, ArR-40 and ArR-45 were superior to the better check Azad Kanchan.

BERHAMPUR

- In the Station Varietal Trial on Pikka tobacco, the entries '62-90' and 'Sel-47' were significantly superior to the check variety 'Gajapati'. The entry '62-90' produced 1310 kg of cured leaf/ha and 'Sel-47' produced 1249 kg of cured leaf/ha which is 10.4% & 5.2% higher yield than the check variety 'Gajapati' respectively.

- Under bulk Evaluation Trial during Kharif, 2012, pikka tobacco variety 'Sel-47' recorded higher cured leaf yield of 1360 kg/ha which is 10.8% higher yield than the check variety 'Gajapati'.

- Among different alternative crops brinjal recorded highest tobacco cured leaf equivalent yield 24.43q/ha and net return of Rs. 58, 420/ha with B : C ratio 2.13. Tobacco recorded cured leaf yield (16.81 q/ha) net return of Rs. 41, 980/ha and the highest B : C ratio 2.24.

DINHATA

- *Fusarium* wilt disease in Jati tobacco was observed in the farmer's field at Boro Natabari village in Dinhata sub-division of Cooch Behar district in the range of 8-10%.

- Transfer of technology (Nursery management, fertilization, planting, harvesting and curing operations) related to pipeline Jati tobacco variety, DJ-1 has been disseminated to the farmers under minikit trials.

HUNSUR

- In bulk evaluation trial, two hybrids viz., KLSH-10 and CH-96 performed well with 2700 kg/ha cured leaf yield and 80% bright grade out turn.

- The yield gap of around 36% in the initial years between the organic and inorganic could be brought down to 10.5% after 4-5 years of continuous application of organic manures. However, there was increase in the bright grade production of tobacco by 6-10%.

- Marked reduction in the harmful smoke constituents like Tar, Carbon monoxide, TSNA etc., were observed in the organic tobacco compared to inorganically grown tobacco. Leaf nicotine tend to be low in the organic tobacco from the first season itself.

- Soil borne *Fusarium* wilt disease as well as Root-knot incidence reduced by 87 and 61%, respectively in the organic treatment.

- The soil nutrient status indicated improvement of organic carbon status in the organic plot with the reduction of available K status over four year's period.

- *Pochania chlamydosporia* + neem cake and *Pochania chlamydosporia* + poultry manure were on par with each other in causing 53.3 per cent reduction in root knot index compared to check in solarized FCV tobacco nursery beds. Subsequent increase in root knot free healthy transplants count was to the tune of 49.1 and 48.7 per cent respectively compared to check.

JEELUGUMILLI

- In the bulk assessment trial conducted with five entries viz., Tobios-2, NLST-3, NLST-4, NLSH-1 and Kanchan (check), all the test cultures showed desirable plant type and physical leaf quality. They recorded 2 to 15% more leaf yield than check variety, Kanchan.

- In on-farm trial both the pipeline varieties, JS-117 (low tar variety) and NLST-2 showed superiority over check Kanchan.

NANDYAL

- In On Farm Trial of Bidi tobacco line NBD 119 recorded higher cured leaf yield of 3082 kg/ha compared to its check A 119 (1896 kg/ha).

- Among different cropping systems tried as alternative cropping systems for Bidi tobacco growing areas, Maize - Bengal gram recorded significantly higher tobacco equivalent yields (3401 kg/ha) and higher Net returns (Rs. 1,00,833 /ha) with B.C. ratio of 4.0 followed by Soybean- Bengal gram with TEY of 2,942 kg/ha and Net Returns of Rs. 86,340 /ha.

- Application of 150 kg N/ha and topping at 15 leaf stage recorded significantly higher leaf length, leaf width (20.56 cm) and cured leaf yield (2106 kg/ha).

- New insecticides Rynaxypyr, Novaluran and Emamectin benzoate could effectively control *Spodoptera litura* infestation in bidi tobacco

- Significantly higher plant height (77.2 cm), leaf length (44.1 cm) leaf width (17.3 cm) and cured leaf yield (1564 kg/ha) was recorded with transplanting of Tobacco during second week of September.

- The incidence of grass hopper population was significant and positively correlated with rainfall (r = 0.488) whereas S.litura larval population was significant and negatively correlated with RH (evening) (r = -0.487).

NIPANI

- In IVT, genotypes ABD 123 and ABD 127 (3060 Kg CLY) were significantly superior to the best checks Vedaganga-1 (1860 kg/ha)

- Among varieties tested under station trials, NBD 276 (2,165 kg/ha) and NBD 277 (2,055 kg/ha), NBD 260 (2,090 kg/ha), and NBD 261 (1,925 kg/ha) were found promising for tobacco leaf yield by producing significantly superior leaf yield than the high yielding checks.

- Among the vegetable crops grown along with tobacco as intercrops Bhendi, Radish, Cabbage, Cucumber and Beans recorded maximum vegetable yield. However, these intercrops suppressed the growth and yield of tobacco drastically.

- Application of new fungicide Fenamidone 10% + Mancozeb 50 WG (Sectin 60 WG) @ 0.3% (3 g/l) was most cost effective in reducing the incidence of damping off disease in tobacco nursery and thereby increased the healthy transplantable seedlings. The pooled analysis over three years (2010-2012) revealed that significantly least disease incidence of 9.17% with maximum transplantable seedlings of 1505/ m^2 and the maximum Benefit Cost ratio of 4.52 were noticed with Fenamidone 10% + Mancozeb 50 WG (Sectin 60 WG) @ 0.3% (3 g/l). This technology is proposed for national recommendation as a cost effective technology for the management of damping off of bidi tobacco disease in nursery.

- Triazole fungicides such as Hexaconazole 5% EC @ 0.1%, Propiconazole 25% EC @ 0.1%, Difenoconazole 25% EC @ 0.1% and combiproducts such as Tebuconazole 25% EC @ 0.1%, Hexaconazole 5% + Captan 70% @ 0.2%, Hexaconazole 4% + Zineb 68% @ 0.2%, Mancozeb 63% + Carbendazim 12% @ 0.2%, Azoxystrobin 23% SC @ 0.1%, Trifloxystrobin 25% + Tebuconazole 50% WG @ 0.05% along with Mancozeb 75% WP @ 0.2% were effective in vitro in inhibiting the growth of brown leaf spot pathogen. The field application of these fungicides was effective in reducing the severity of the brown leaf spot disease and enhancing cured leaf yield.

SHIMOGA

- Efforts to integrate local bio-sources as a fuel for tobacco curing, was tried. Results indicate that integration of areca husk (585kg) + maize rinds (846 kg) was found successful.

- The new system of heat conveyance inside the curing chamber was found very efficient for curing tobacco leaves. The quantity of wood used was approximately 584 kg with 78 hrs of curing, thereby it saved wood to the extent of 45 per cent.

- Combination of Coffee husk (30 kg) + areca husk (560 kg) + maize rinds (736 kg) and areca husk (565kg) + maize rinds 846kg) were used successfully in place of wood for curing FCV tobacco.

- Out of 34 entries screened against frog eye leaf spot disease, Tobios – 6 and NLST – 6 were found resistant, while other FCV tobacco entries expressed moderate resistance.

- Among the 25 germplasm and advanced breeding lines screened against root-knot nematode, FCG-3 recorded least root-knot index (2.0).

- Twelve chewing tobacco germplasm lines / advanced breeding lines were screened against RKN for resistance. Podali entry recorded least RKI (1.30) indicating resistance followed by DJ-1 (1.60).

- The treatment combination of *Paceliomyces* and Poultry manure yielded maximum transplants (562) with least root-knot index closely followed by treatment *Trichoderma* and poultry manure.

- New chemical molecules such as emamectin benzoate, spinosad and novaluron were found promising for the control of larval number, leaf damage and per cent infestation of leaf eating caterpiller *Spodoptera litura* in chewing tobacco.

- Spot application of well decomposed poultry manure at 50 g/plant, 4 inches away from the plant at the time of planting was found effective for management of root knot nematode in FCV Tobacco main field.

- For effective management of black shank disease of tobacco in field, application of 2.5 kg *Trichoderma harizianum* along with 4.5 tonnes of farm yard manure before transplanting to soil @ 250 g/plant was found promising.

- Application of K @ 100 kg/ha produced highest cured leaf yield (2356 kg/ha) as well as quality in terms of TGE (955 kg/ha) than present recommendation of 80 kg/ha.

VEDASANDUR

- In the bulk trial, the entry HV.2009-3 recorded the highest whole leaf and total leaf yields of 3415 and 4312 kg/ha registering 28.4 and 16.2 percent increase respectively over the control variety Abirami.

AINPT Workshop

The XXI Tobacco Workshop of AINPT was held at University of Agricultural & Horticultural Sciences, Shimoga during 28th and 29th June, 2013. All the scientists from various AINPT centres and other delegates from all over India participated and presented the research results of 2012-13 and finalized the technical programme for 2013-14.

Three varieties viz., DJ-1 (Chewing variety for West Bengal), NBD-119 (Bidi variety for Andhra Pradesh) and GABT-11 (Bidi variety for Gujarat) were identified for release during the Workshop.

Empowerment of Women in Agriculture

The following vocational training programmes were organized in different villages of East Godavari District for empowerment of rural women:

Sl. No.	Programme	Duration	Venue	No.of parti-cipants
1	Tally and Office Automation Softwares	26-04-2013 to 16-05-2013	CTRI, Rajahmundry	12
2	Lucknow Work Embroidery	12-06-2013 to 11-07-2013	Chagallu	30
3	Sisal fibre production and its value addition by different decorative articles	29-07-2013 to 03-09-2013	Kalavacharla	10
4	*Garment making*	04-09-2013 to 03-11-2013	Kandikoppa	55
5	Value addition to fish/prawn, Sponsored by Dept. of Agro Forestry	29-09-2013 to 09-11-2013	Chollangi,Matlapalem and korangi	20
6	Palmyrah Fibre Extraction'	29-09-2013 to 11-11-2013	Tatiwada	10
7	Long term vocational training programme on Garment making for rural women	18-11-2013 to 10-01 2014	Katrnikona	50
8	Leaf plate making	11-11-2013 to 25-11-2013	Surampalema	6
9	Garment making	01-02-2014 to 31-03-2014	Georgepet, Tallarevu	33
10	Coir to ply Yarn making, Sponsored by Coir Board	01-02-2014 to 31-03-2014	Balavaram and Kalavacharla	20
11	Value added products with coir, Sponsored by Coir Board	01-02-2014 to 31-03-2014	Kalavacharla	20
12	Garment making	01-02-2014 to 31-03-2014	Rollapalem	30
13	Garment making, Sponsored by Dept. of Forest(UNDP)	09-02-2014 to 10-04-2014	Matlapalem	25
14	Leaf plates, paper Plates and Buffet plates making,	20-02-2014 to 01-03-2014	Gadarada	12
15	Leaf plates, paper Plates and Buffet plates making Sponsored by ABIRD	11-03-2014 to 21-03-2014	Kalavacharla, Gadarada	25

An externally funded project entitled 'Nutritional Security in Tribal Areas of East Godavari District, Andhra Pradesh through Community Based Approaches' with an outlay of Rs.33.98 lakhs was sanctioned by the Department of Bio-technology, New Delhi for a period of three years (2012-2015). The following women empowerment activities were organized under this project.

Value added products: The tribal women were trained in the nutritional awareness and enrichment of local diets by adding nutritional value to the existing local fruits, vegetables, and minor millets.

Fruit and vegetable preservation and processing: Tribal women were trained in processing and preservation of local fruits & vegetables. The tribal women were trained in preparation of pineapple juice, amla sharabath, mango juice, grape juice, mixed fruit juice, mixed fruit jam, mango jam and papaya jam etc.

Training of Tribal women in processing and preservation of local fruits & vegetables.

Supplementary weaning foods: The tribal women were trained in introducing easily digestible and nutritionally rich weaning foods. Ragina (ragi, bengalgram, gingelly, sugar, elachi), Gehuna (wheat, greengram, groundnut, jaggery, elachi) & sagina (bajra, greengram, gingelly, sugar, elachi) were the different food products that were introduced for the children below 5 years. SHGs have introduced these products in local Anganwadis.

Improved agricultural implements and nutritional kitchen gardens: Tribal women were trained in improved agricultural implements in weeding. These weeders saved the time and labour cost (Rs.1000/-per acre) in vegetable crops *viz*., chillies, brinjal, papaya, cotton and tomato for the small farmers.

Adda leaf plate & cup making unit: Tribal women were formed in to self help groups (SHG) of 20 members (CTRI-MITRA group, Devarapalli) in Maredumilli mandal and were trained in collection of adda leaf, leaf processing, stitching, plate preparation, packing and marketing the finish products and they were earning an additional income of Rs. 50,000/ month by investing 5-6 hours per day during off-season.

Tribal women making adda leaf plates and cups

Animal husbandry & poultry programmes for tribal farm women: Tribal farm women were trained in cattle and poultry management programmes. 8 poultry units (7 vanaraja and 2 turkey units) were established for tribal SHGs. The women were earning an amount of Rs. 10,000/- per each group after establishment of poultry units and the diets were enriched and supplemented with poultry eggs & meat.

Training of Tribal women in poultry management

Solar dried food products unit: Self help groups (SHG) were trained in solar dried food products *viz.,* desiccated coconut powder, vegetables chips, fruit jellies, mushroom chips, papads, aamchur, herbal powders etc., SHGs were benefitted by marketing these products in the local shandys and super markets. One SHG consisting of 5 members is getting an additional income of Rs. 10,000 per month by investing leisure time during sunny days.

Soya based food product unit: Self help groups (SHG) were trained in processing soya milk. The residential ashram school (tribal) children were provided the milk as protein supplement by these SHGs with the help of ITDA. The SHG group consisting of 5 members is getting an additional income of Rs. 10,000 per month by investing 2-3 hours per day.

Millet based baked food products unit: In order to provide self employment for SHGs, tribal women at Rampachodavaram mandal, were trained in millet based products viz., 3G (green, gram, grain) *ragi* biscuits, jowar biscuits, tadi biscuits, cakes, buns, *etc*., with the help of baking ovens. The SHGs were benefited by marketing the products locally through Girijan Co-operative Corporation (GCC) and Anganwadi centers. One SHG group consisting of 5 members is getting an additional income of Rs. 12,000/- per month by investing 4-5 hours per day.

Capacity Building programme

Capacity building programme for SHGs in the adopted tribal villages was conducted from **08-11.2013 to 09.11.2013**.

Scientific advisor, Department of Biotechnology, New Delhi, Dr. S. A. Ninawe visited CTRI on 08.11.2013. The programmes and activities taken up under the externally funded project were monitored.

List of publications

Chandrasekhararao, C., K. Siva Raju, H. Ravisankar, M. Anuradha and S. Kasturi Krishna. 2013. Effect of different levels of nitrogen and leaf position on biochemical quality constituents of FCV tobacco (*Nicotiana tabacum*) grown in northern light soils of Andhra Pradesh. Indian J. Agrl. Sci. 83(10):1-52-7.

Damodar Reddy, D., S. Kushwaha, S. Srivastava, and R.S. Khamparia. 2014. Long-term wheat residue management and supplementary nutrient input effects on phosphorus fractions and adsorption behaviour in a Vertisol. Comm. Soil Sci. and Plant Analysis 45: 541-54.

Ghosh, R.K. and D. Damodar Reddy. 2013. Crop residue ashes as adsorbents for basic dye (methylene blue) removal: Adsorption kinetics and dynamics. Clean- Soil Air Water, 41. DOI: 10.1002/clen.201300386.

Ghosh R.K. and D. Damodar Reddy. 2013. Tobacco stem ash as an adsorbent for removal of methylene blue from aqueous solution: Equilibrium, kinetics and mechanism of adsorption. Water Air Soil Pollution, 224(6). DOI: 10.1007/s11270-013-1582-5.

Ghosh R.K., Z.S. Khan, C.V.N. Rao, K. Banerjee, D. Damodar Reddy, T.G.K. Murthy, N. Johnson and D.P. Ray. 2014. Assessment of organochlorine pesticide residues in Indian flue-cured tobacco with gas chromatography-single quadrupole mass spectrometer. Environmental Monitoring & Assessment, DOI:10.1007/s10661-014-3760-3.

Kumaresan, M. and C. Chandrasekhararao. 2013. Production potential and economic feasibility of chewing tobacco (*Nicotiana tabacum*) based intercropping system. Indian J. Agrl. Res. 47(1):66-72.

Kumaresan, M., C. Chandrasekhararao and T.G.K. Murthy. 2013. Effect of drip irrigation on productivity and quality of chewing tobacco (*Nicotiana tabacum*). Indian J. Agron. 58(3):402-7.

Naidu, V.S.G.R., H. Ravisankar, Sandeep Dhagat, Virendra Kamalvanshi and A.R. Sharma. 2013. Expert system for identification of weed seedlings. Indian Journal of Weed Science 45(4):278 -281.

Ramakrishnan, S. and C. Panduranga Rao. 2013. Evaluation of *Paecilomyces lilaciness* for the management of root-knot nematode, *Meloidogyne incognita* in flue cured Virginia (FCV) tobacco nursery. Indian J. Nematology 43(1):65-70.

Ravisankar, H., C. Chandrasekhararao and K. Sivaraju. 2013. Decision support system for soil and water analysis and fertilizer recommendation for fluecured Virginia (FCV) tobacco. African J. Agril. Res. 8(44): 5550-4.

Sarala, K. and H. Ravisankar 2013. Explant autonomy in Indian Tobacco cultivars under *in vitro*. Access International J. Agrl. Sci. 1(3):30-6.

Subhashini, D.V. 2013. Effect of bio-inoculation of AM fungi and PGPR on the growth, yield and quality of FCV tobacco (*Nicotiana tabacum*) in Vertisols. Indian J. Agrl. Sci. 83(6):667-72.

Subhashini, D.V. 2013. Effect of sheared-root inoculum of *Glomus fasciculatum* on tobacco grown at different phosphorus levels in alfisols. Indian Phytopath. 66(1):98-100.

Subhashini, D.V. 2013. Isolation of Rhizospheric bacteria and their effect on germination on tobacco seed and growth of seedlings. Agric. Sci. Digest 33(2):127-30.

Subhashini, D.V. and S. Ramakrishnan. 2013. Effect of VA Mycorrhizae on root disease (*Pythium aphanidermatum* and *Meloidogyne incognita*) in tobacco. Indian J. Nematology 43(1):13-6, 2013.

Suman Kalyani, K., T.G.K. Murthy and C. Chandrasekhararao. 2014. Innovative approaches for sustainable productivity among tribal families of East Godavari

district. Journal of Agricultural Extension and Rural Development 6(1):5-10.

POPULAR ARTICLES

Murthy, T.G.K. and K. Suman Kalyani. 2013. Techniques in tobacco nursery management (in Telugu). Swarnasedyam 16(12):22-4.

Sudhakar, R., C. Chandrasekhararao and T.G.K. Murthy. 2013. Preparation of cups and plates with bamboo waste (In Telugu). Annadata 45(4):20-1.

Suman Kalyani, K. and C. Chandrasekhararao. 2013. Agro climatic situation and livelihood of tribal farmers in agency area of East Godavari district. Yojana 41(7):47-50.

Suman Kalyani, K. and T.G.K. Murthy. 2013. Omega-3 oil - A wonderful medicine for heart diseases (in Telugu). Annadata 45(10):50-2.

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Suman Kalyani, K. and T.G.K. Murthy. 2013. Prevention of vision problems with carrots (In Telugu). Annadatha 45(5):42-3.

Suman Kalyani, K. and T.G.K. Murthy. 2013. Self employment through the preparation of adda leaf plates and cups (in Telugu). Annadata 45(12):44-5.

Suman Kalyani, K. and T.G.K. Murthy. 2014. Krishi Vasant. Annadata 46(3):31-2.

Suman Kalyani, K. and T.G.K. Murthy. 2014. Uses of neem in tobacco. Swarna Sedyam ....: 20-1.

Suman Kalyani, K., T.G.K. Murthy and V.S.G.R. Naidu. 2014. Soya as intercrop in banana for higher yields. Annadata 46(2):22-3.

Suman Kalyani. K., C. Chandrasekara Rao and T.G.K. Murthy. 2013. Impact Analysis of Empowerment Programmes of Tribal Community in East Godavari, Andhra Pradesh, India, Asian Journal of Agricultural Extension, & Sociology, AJAEES.2013.003. 2(2): 128-139.

BOOKS/ BOOK CHAPTERS

Girija, T., V.C. Vijaya and V.S.G.R. Naidu. 2014. Medicinal Uses of Parasitic Weeds. In: Parasitic weeds- Biology and Management (Eds: V.S.G.R. Naidu and J. S. Mishra), Today and tomorrow's Printers & Publishers, New Delhi, India. Pp: 105-114.

Naidu, V.S.G.R. and J.S. Mishra. 2014. Parasitic Weeds- Biology and Management. Today and tomorrow's Printers & Publishers, New Delhi, India. pp: 115.

Naidu, V.S.G.R., A. Dixit, P.K. Singh and A.R.G. Ranganatha. 2013. Crop-Weed Interactions and weed management under Changing Climate. In: Climate Change and Crop Production (Eds: J. C. Dagar, A. Arunachalam and A. K. Singh), Aavishkar Publishers, Jaipur, India. Pp: 157-165.

Naidu, V.S.G.R., S. Kasturi Krishna, R.P. Dubey, C. Chinnusamy and C. Kannan, C. 2014. Broomrape-Orobanche spp. In: Parasitic weeds- Biology and Management (Eds: V.S.G.R. Naidu and J. S. Mishra), Today and tomorrow's Printers & Publishers, New Delhi, India. Pp: 63-80.

BROCHURES

Naidu, V.S.G.R., J.V.R. Satyavani and T.G.K. Murthy. 2013. Cocoa – Cultivation Practices (in Telugu), KVK, CTRI, Rajahmundry.

Naidu, V.S.G.R., J.V.R. Satyavani and T.G.K. Murthy. 2013. Raising Vegetables in Protrays (in Telugu), KVK, CTRI, Rajahmundry.

Naidu, V.S.G.R., S. Jitendranath and T.G.K. Murthy. 2013. B.t. Cotton Cultivation (in Telugu), KVK, CTRI, Rajahmundry.

List of Approved On-going Projects

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP IMPROVEMENT		
1.	G.S.1	Germplasm acquisition maintenance, multiplication, evaluation and utilization T.G.K. Murthy
2.	Br.6.1.4(a)	Incorporation of disease resistance for tobacco mosaic virus (TMV) P.V. Venugopala Rao and S.K. Dam
3.	Br.2	Evolving superior varieties of FCV tobacco through hybridization P.V. Venugopala Rao
4.	Cy.7(iii)	Tissue culture studies in tobacco (III) Micropropagation of elite lines and other selections. K. Sarala and K. Prabhakara Rao
5.	Cy.2.1 (f)	Incorporation of aphid resistance from *N. gossei. N. repanda, N x. umbratica-nesophila and N x benthamiana -repanda* T.G.K. Murthy, U. Sreedhar and K. Siva Raju
6.	Br.7	Developing hybrid FCV tobacco suitable for traditional black soil area of Andhra Pradesh. T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala
7.	MB-9	Evaluation of advanced breeding lines for yield and quality K. Sarala, T.G.K. Murthy, P.V. Venugopala Rao and S.K. Dam
8.	Biotech-6	Molecular Mapping of tobacco traits: Tobacco specific nitrosamines in burley K. Sarala, K. Prabhakara Rao, T.G.K. Murthy, K. Siva Raju and P.V. Venugopala Rao
9.	Biotech 9	Transcript profiling and identification of candidate genes resistant to Damping-off in tobacco K. Prabhakara Rao, K. Sarala, T.G.K. Murthy, S.K. Dam and K. Siva Raju
10.	Br-8	Developing tobacco cultivars for high seed yield, oil content, high biomass and other phyto chemicals A.V.S.R. Swamy, T.G.K. Murthy, S. Kasturi Krishna and K. Siva Raju
CROP PRODUCTION		
1.	A-80	Investigations on Coirpith utilization in tobacco production C. Chandrasekhararao, K. Siva Raju and Seeta Ram Meena
2.	A-81	Performance of advanced breeding lines with different plant populations and N levels for leaf biomass production in vertisols S. Kasturi Krishna, T.G.K. Murthy, K. Siva Raju and S.V. Krishna Reddy

Sl. No	Institute Code	Title of the project and Investigator(s)
AGRL. EXTN., AGRL. ENGG. & AKMU		
1.	Ag. Extn. 36	Stress analysis of tobacco farmers and changing scenario of the cropping pattern K. Suman Kalyani
2.	Ag. Extn. 48	Critical analysis of resource Utilization by the FCV tobacco farmers Y. Subbaiah
3.	Ag. Extn-49	On- farm demonstration of identified alternative Crops to FCV tobacco in vertisols of Andhra Pradesh. Y. Subbaiah and S. Kasturi Krishna
4.	Ag. Extn-50	On-farm evaluation of identified ABLs in NLS area of Andhra Pradesh Y. Subbaiah, T.G.K. Murthy and K. Sarala
AKMU		
1.	ARIS-12	Decision support system for transfer of technology H. Ravi Sankar and Y. Subbaiah
2.	ARIS-13	Computational Algorithm for micro RNA prediction in plants H. Ravi Sankar, K. Prabhakara Rao, K. Siva Raju and K. Sarala
3.	ARIS 14	Expert system for dairy cattle management H. Ravi Sankar and V.S.G.R. Naidu
CROP CHEMISTRY AND SOIL SCIENCE		
1.	Ag.SS-2	Soil fertility Investigations: Soil fertility survey of tobacco growing soils of India: a) Soil fertility survey of chewing tobacco growing areas of Tamil Nadu C. Chandrasekhararao and A.V.S.R. Swamy
2.	OC-10	Evaluation of smoke constituents in materials from some plant breeding experiments. R.K. Ghosh
3.	PR-1	Monitoring of pesticide residues in .tobacco samples collected from different areas R.K. Ghosh
4.	BC-8	Electrophoretic characterization of tobacco cultivars K. Siva Raju and T.G.K. Murthy
5.	SSMB-11	Development of bio-consortia for optimizing nutrient supplementation through microbes for tobacco crop production D.V. Subhashini, M. Anuradha and D. Damodar Reddy
6.	OC-24	Studies on chemical constituents responsible for smoke flavour in FCV tobacco grown under different agro climatic zones K. Siva Raju, T.G.K. Murthy and D. Damodar Reddy

Sl. No	Institute Code	Title of the project and Investigator(s)
7.	Phy-76	Impact of excess water stress and adaptive strategies to minimize its negative effects on productivity and quality of tobacco M. Anuradha, D. Damodar Reddy, T.G.K. Murthy and K. Siva Raju
8.	SS-31	Evaluation of crop residue and wood ashes effects on soil fertility and potassium nutrition of tobacco D.damodar Reddy, S. Kasturi Krishna, M.M. Swamy, L.K. Prasad, K. Nageswara Rao and Jana Poorna Bindu
9.	Phy-77	Secondary nutrient deficiency effects on tobacco nutrition M. Anuradha, D. Damodar Reddy and K. Siva Raju
10.	BC-11	Biochemical characterization of tobacco seed oil K. Siva Raju and T.G.K. Murthy
CROP PROTECTION		
1.	E 74	Monitoring of insect pests of tobacco with pheromone traps U. Sreedhar
2.	E-78	Management of tobacco caterpillar, insecticide baits U. Sreedhar and K. Nageswara Rao
3.	E-80	Studies on *Helicoverpa armigera* with special reference to influence of plant variety, field ecology, eco-toxicology and seed production S. Gunneswara Rao and U. Sreedhar
4.	E-81	Bio efficacy and field evaluation of new insecticides against tobacco pests U. Sreedhar, R.K. Ghosh and S. Gunneswara Rao
5.	EG-13	Development of base line resistance data of *H. armigera S. litura* and *S. exigua* to conventional insecticides and insecticides with novel chemistries J.V. Prasad and U. Sreedhar
CTRI RESEARCH STATION, JEELUGUMILLI		
1.	JL. Br.2.1	Evolving flue cured tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh. T.G.K. Murthy
2.	JLN-2	Developing new varieties of irrigated Natu tobacco for A.P. T.G.K. Murthy
3.	JL Br.3	Developing hybrid FCV tobacco suitable for northern light soils (NLS) of Andhra Pradesh T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala
4.	JLA-35	Integrated weed management in FCV tobacco grown under irrigated alfisols S. Kasturi Krishna, S.V. Krishna Reddy and K. Nageswara Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
5.	JLA-36	Indices for N and K nutrient use efficiency in FCV tobacco grown in irrigated Alfisols S.V. Krishna Reddy, S. Kasturi Krishna, D. Damodar Reddy, C. Chandrasekhararao and K. Nageswara Rao
6.	JLA-37	Effect of drip irrigation and tray seedlings on the productivity of NLS tobacco. S.V. Krishna Reddy, C. Chandrasekhararao, S. Kasturi Krishna and S.R.Meena
7.	JLA-38	Development of agro-technology for advanced breeding lines and CMS hybrids S.V. Krishna Reddy, S. Kasturi Krishna, T.G.K. Murthy and K. Sarala
8.	JL Phy-1	Assessment of topping response of FCV tobacco varieties and advanced breeding lines K. Nageswara Rao
9.	JL Phy-2	Maize, as an alternative crop to FCV tobacco in NLS K. Nageswara Rao
10.	E-82	Evaluation of insecticide application technology for the effective spray coverage on FCV tobacco in NLS G. Raghupathi Rao, U. Sreedhar and K. Nageswara Rao
BTRC, KALAVACHARLA		
1.	By.Br.1	Evaluation of advanced burley breeding lines for productivity and quality P.V. Venugopala Rao and T.G.K. Murthy
2.	By.Br.2	Evaluation of burley tobacco hybrids suitable for burley growing areas of Andhra Pradesh P.V .Venugopala Rao and T.G.K. Murthy
3.	AB-30	Set row planting in burley tobacco C. Chandrasekhararao, D. Damodar Reddy and S. Kasturi Krishna
4.	AB 31	Effect of fertilizer sources of nutrients on yield and quality of burley tobacco grown in uplands. S. Kasturi Krishna, S.V. Krishna Reddy and K. Siva Raju
CTRI RESEARCH STATION, GUNTUR		
1.	Br.14	Development of FCV tobacco varieties suitable for cultivation in SBS of AP C. Nanda
2.	Br-15	Development of high yielding FCV varieties with good leaf quality suitable for cultivation in SBS and CBS area of Andhra Pradesh C. Nanda and P. Venkateswarlu
CTRI RESEARCH STATION, KANDUKUR		
1.	K.Br.6	Breeding FCV tobacco variety for yield and quality under SLS conditions A.R. Panda, K.C. Chenchaiah, P.V. Venugopala Rao, T.G.K. Murthy and A.V.S.R. Swamy

Sl. No	Institute Code	Title of the project and Investigator(s)
2.	EK-14	Evaluation of FCV germplasm for Aphid tolerance under SLS conditions K.C. Chnachaiah
3.	EK-15	Evaluation of FCV tobacco germplasm for the tobacco caterpillar tolerance under SLS conditions K.C. Chnachaiah
4.	SSK-1	Investigations on soil fertility and irrigation water quality in SLS and SBS regions of Andhra Pradesh L.K. Prasad and D. Damodar Reddy
5.	EK-18	Management of *Bemisia tabaci* in FCV tobacco K.C. Chanchaiah
6.	K.Br-9	Evaluation of FCV Tobacco lines for yield and quality under SLS conditions A.R. Panda
CTRI RESEARCH STATION, HUNSUR		
1.	BR.12	Germplasm maintenance of *Nicotiana tabacum* varieties/lines. C.Nanda
2.	P.3.2	Screening of tobacco germplasm against root knot nematode. S. Ramakrishnan
3.	N 1.1	Survey for plant parasitic nematodes infecting tobacco S. Ramakrishnan
4.	BR-19	Development and evaluation of F1 hybrids of FCV tobacco suitable to Karnataka Light Soil region. C. Nanda, M.M. Swamy and S. Ramakrishnan
5.	A.37	Agronomic evaluation of promising pipeline varieties (FCH 196 and FCH 201) of FCV tobacco in KLS M. Mahadeva Swamy
6.	A.38	Feasibility of producing organic tobacco under KLS situation M. Mahadeva Swamy and S. Ramakrishnan
7.	A-39	Effect of graded levels of K on the occurrence and intensity of root-knot incidence and K utilization pattern of FCV tobacco in KLS M. Mahadeva Swamy and S. Ramakrishnan
8.	EH-1	Survey for assessment of insect pest incidence in KLS tobacco P. Venkateswarlu and S. Ramakrishnan
9.	P-21	Monitoring the incidence and severity of pests and disease in nursery and field crop of KLS tobacco at different intervals of sowing and transplantation S. Ramakrishnan
10.	N-20	Integrated management of root-knot nematodes and soil borne fungal diseases in FCV tobacco nurseries S. Ramakrishnan

Sl. No	Institute Code	Title of the project and Investigator(s)
11.	N-21	Evaluation of bio-agents enriched tray seedlings against root-knot nematode - Fusarium wilt disease complex in FCV tobacco field crop S. Ramakrishnan
CTRI RESEARCH STATION, VEDASANDUR		
1.	G.S.1	Evaluation and maintenance of germplasm M. Kumaresan and A.V.S.R. Swamy
2.	B.48	Studies on heterosis breeding in chewing tobacco (*N. tabacum*) M. Kumaresan and A.V.S.R. Swamy
3.	B.49	Synthesis of broad-based gene pool in chewing tobacco (*N. tabacum*) enhancing selection gain. M. Kumaresan and A.V.S.R. Swamy
4.	B.50	Breeding for high seed and oil yield in tobacco M. Kumaresan and A.V.S.R. Swamy
5.	A-101	Drip fertigation in chewing tobacco M. Kumaresan, A.V.S.R. Swamy and C. Chandrasekhararao
6.	A 102	Crop productivity, soil quality and economic returns under chewing tobacco + Annual Moringa intercropping system in response to nutrient management M. Kumaresan and D. Damodar Reddy
7.	BA 55	Performance of broad based selections of chewing tobacco under different levels of spacing and nitrogen M. Kumaresan and A.V.S.R. Swamy
CTRI RESEARCH STATION, DINHATA		
1.	A-10	Permanent manurial experiment with Motihari tobacco S. Roy
2.	B-17	Dialliel analysis in Motihari tobacco (*N.rustica*). S. Roy
3.	DBP-1	Screening for resistance against brown spot and hollow stalk in germplasm accessions of Jati (*N. tabacum*) & Motihari (*N. rustica*) tobacco in North Bengal S. Roy
4.	PP-10	Weather based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions S. Roy
5.	PP-12	Management of hallow stock of Motihari tobacco in Terai region of West Bengal S. Roy

RAC, QRT, IRC and IMC Meetings

RESEARCH ADVISORY COMMITTEE

Dr. P. Murugesa Boopathi Vice-Chancellor, Tamil Nadu Agril. University, Coimbatore – 641003 Tamil Nadu	CHAIRMAN	Dr. N. Gopalakrishnan Asst. Director-General (CC), Indian Council of Agril. Research, Krishi Bhawan, New Delhi 110 114	MEMBER
Dr. V.S. Korikanthimath (Retd. Director, ICAR Research Complex, Goa) House No. 33, Sangamma, Opposite Bandemma Temple, 2nd Main Road, Gandhi Nagar, Dharwad 580004, Karnataka	MEMBER	Dr. T.G.K. Murthy Director – Acting, Central Tobacco Research Institute, Rajahmundry – 533 105	MEMBER
Dr. R. Sridhar [Former Principal Scientist (Plant Pathology), CRRI, Cuttack] Plot 54, Orchid, Padmavathi Street, Santosh Nagar Ext., Madanandapuram Porur, Chennai – 600 116, Tamil Nadu	MEMBER	Shri Cherukuri V. Swami, Member – IMC – CTRI Peda Alvala Padu P.C. Palli-Mandalam, Prakasam district Andhra Pradesh	MEMBER
Dr. V. R. Rao [Former Principal Scientist (Microbiology) & Head, Crop Production Division, CRRI, Cuttack], F-4, Annapurna, KRV Towers – I Narayana Street, Alcot Gardens, Rajahmundry – 533101, Andhra Pradesh	MEMBER	Shri Ch. Suryanarayana, Member – IMC – CTRI Dappalampadu Village & PO, Gudluru Mandal, Prakasam district, Andhra Pradesh	MEMBER
		Dr. C. Chandrasekhararao, Principal Scientist & Nodal Officer, PME Cell, CTRI, Rajahmundry - 533 105	MEMBER-SECRETARY

The second meeting of the Research Advisory Committee (RAC) of CTRI was held during June 15-16, 2013 at CTRI, Rajahmundry under the Chairmanship of Dr. P. Murugesa Boopathi, Former Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore. Dr. T.G.K. Murthy, Director-Acting, CTRI, Dr. V. S. Korikanthimath, Dr. V. R. Rao and Dr. R. Sridhar, Members of RAC, Dr Dr. C. Chandrasekhararao, Member-Secretary, RAC and Sri Ch. Venkataswamy, Member of IMC attended the meeting besides Heads of Divisions, Heads of Research Stations and Scientists of CTRI.

QUINQUENNIAL REVIEW TEAM

Indian Council of Agricultural Research, New Dlhi constituted the Quinquennial Review Team (QRT) for CTRI. (Vide council's letter no. CS.1/5/2008-IA.III dated 17th Feb., 2014).

Dr. R.R. Hanchinal, CHAIRMAN
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Prof. Satyendra Chandra Sarker, MEMBER
Agricultural Economics,
Dept of Agricultural Economics,
UBKV,
Cooch Behar-736165
West Bengal

Dr. C. Chandrasekhararao, MEMBER-SECRETARY
Principal Scientist &
Nodal Officer, PME Cell,
CTRI, Rajahmundry - 533 105

INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

Institute Research Committee (IRC) Meetings of Central Tobacco Research Institute were held during 1-3 August, 2013 at Rajahmundry. Scientists of CTRI, its Research Stations, Tobacco Board officials and representatives of tobacco trade and industry participated in the meetings. The progress of research work carried out during the year 2012-13 was reviewed and the technical programme for the crop season 2013-14 was discussed and finalized during the deliberations.

INSTITUTE MANAGEMENT COMMITTEE

Dr. T.G.K. Murthy
Director-Acting & Chairman

Dr. N. Gopalakrishnan Asst. Director General (CC) ICAR, New Delhi.	MEMBER
Director of Agriculture, Govt. of Andhra Pradesh, Hyderabad.	MEMBER
Director of Agriculture, Agriculture Directorate, Dept. of Agriculutre, Chepauk, Chennai, Tamil Nadu.	MEMBER
Dr. R. Veera Raghavaiah, Associate Dean, Agricultural College, ANGRAU, Rajahmundry	MEMBER
Finance & Accounts Officer, NAARAM, Hyderabad	MEMBER
Dr. C.V. Narasimha Rao, Principal Scientist (Retd.) CTRI, Rajahmundry	MEMBER
Dr. S.V. Rao, Principal Scientist, Directorate of Sorghum Research, Hyderabad	MEMBER
Dr. I. Srinivas Sr. Scientist, CRIDA, Hyderabad	MEMBER
Dr. K. Sivanarayana Varaprasad, Director, Directorate of Oil Seed Research, Hyderabad	MEMBER
Sri Cherukuri V. Swamy Peda Alvala Padu, P.C. Palli Mandalam, Prakasam Dist.	MEMBER
Sri Ch. Suryanarayana, Dappalampadu village & P.O. Gudluru mandal, Praksam Dist.	MEMBER
Sri S.L.V. Prasad, Senior Administrative Officer, CTRI, Rajahmundry	MEMBER-SECRETARY

Institute Management Committee meeting was held on 06.08.2013 at the Institute.

Participation of Scientists in Conferences, Meetings, Workshops and Symposia

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. T.G.K. Murthy	135th meeting of the Tobacco Bard	02.04.2013 at Tobacco Board, Bangalore
2.	C.V. Krishna Reddy Ch. Sudhakar Babu	Training programme on "Database Management System"	8-12 April, 2013 at IASRI, New Delhi.
3.	Dr. R.K. Ghosh	Technical Specification Committee meeting on 'Specifications of the equipments for establishing tobacco testing lab'	16.04.2014 at New Delhi
4.	Dr.C.Chandrasekhararao	76th meeting of the Registration Committee for Growers and Others	22.4.2013 at Tobacco Board, Guntur
5.	Dr. S. Kasturi Krishna	3rd meeting of the Committee constituted to study the compensation payable to the growers for surrendering their licensed barns and other related matters	15.05.2013 at Tobacco Board, Guntur
6.	Dr. K. Suman Kalyani	Work shop on 'Sensitization of Biotechnology programmes'	17-18th May, 2013 at ANGRAU, Hyderabad.
7.	Dr. T.G.K. Murthy	Meeting on XII Plan EFC document	16.05.2013 at ICAR, New Delhi
8.	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	Scientific Advisory Committee Meeting of KVK', Suttur	24.05.2013 at KVK, Suttur, Mysore Dist.,
9.	Dr. Y. Subbaiah Smt.V.V.Lakshmi Kumari	Farm & Home Unit Rural Programme Subject Committee meeting	6.6.2013 at AIR, Visakhapatnam
10.	Dr. M. M. Swamy	Meeting of Input Committee	13.6.2013 at Tobacco Board, Bangalore
11.	Dr. Y. Subbaiah	Meeting of the Committee constituted to assess the cost of cultivation of FCV tobacco in Andhra Pradesh	14.06.2013 at Tobacco Board, Guntur
12.	Dr. D. D. Reddy	Meeting of Technical Specification Committee	17.6.2013 at Min. of Health & Family Welfare, New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
13.	Dr. M. Mahadevaswamy	Input Committee Meeting of Tobacco Board	24.06.2013 at Directorate of Auctions, Tobacco Board, Bangalore
14.	Dr. T.G.K. Murthy Dr. K. Prabhakara Rao	First International and Third National Conference on Biotechnology, Bioinformatics and Bioengineering	28-29th June, 2013 at Tirupathi
15.	Dr. T.G.K. Murthy Dr.C.Chandrasekhararao Dr. U. Sreedhar Dr. K. Sarala Dr. A.V.S.R. Swamy Dr. P.V.V.G. Rao Dr. M. Kumaresan Dr. A.R. Panda Dr. K. Nageswara Rao Dr. S. Roy Dr. C. Panduranga Rao Dr. S. Ramakrishnan Dr. M. Mahadevaswamy Dr. C. Nanda Dr. P. Venkateswarlu M. Appa Rao B. Krishna Kumarl	XXI National Tobacco Workshop of All India Network Research Project on Tobacco	28-29th June, 2013 at Shimoga
16.	Dr. D. Damodar Reddy	Soil Testing Laboratory visit	4-6 July, 2013 at Ongole
17.	Dr. S. Ramakrishnan	First meeting of the Committee constituted to assess the cost of cultivation of FCV tobacco in Karnataka	10.07.2013 at Directorate of Agriculture, Tobacco Board, Bangalore
18.	Dr. T.G.K. Murthy	Meeting of the Directors of the Institute under Crop Science and Horticulture Division	15.07.2013 at NCAP, New Delhi
19.	Dr. T.G.K. Murthy	Interaction meeting with Project Director, PDFSR, Modipuram	15.07.2013 at NASC Complex, New Delhi
20.	Dr. K. Sarala	Meeting of Crop Science Division on Performance Indicators	15.07.2013 at NCAP, New Delhi
21.	Dr. K. Sarala	Interaction Meeting with team of North Carolina State University	16.07.2013 at NASC Complex, New Delhi
22.	Dr. T.G.K. Murthy	Foundation day celebrations of ICAR	16.07.2013 at ICAR, New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
23.	Dr. V.S.G.R. Naidu	Annual Zonal Work Shop of KVK's	29-31 July, 2014 at P.D.K.V., Akola
24.	SMS Crop Production	Training programme on ITK's for sustainable Agriculture and Lively hood	29-31 July, 2014 at NIRD, Hyderabad
25.	Dr. A.V.S.R. Swamy	Meeting to finalise draft guidelines of AICRPs	31.07.2013 at IARI, New Delhi
26.	Dr. T.G.K. Murthy Dr. U. Sreedhar	Variety evaluation committee meeting	8.8.2013 at UAS Bangalore
27.	Dr. P. Venkateswarlu	77th Meeting of the Registration Committee for Growers	14.8.2013 at Tobacco Board, Guntur
28.	Md. Elias	National Conference on "Next Generation Library Services"	16-17th August, 2013 at Chennai
29.	Smt.V.V.Lakshmi Kumari R. Sudhakar	1st National Seminar on "Revitalising Indian Agriculture (RIA 2013) – Innovations in agro processing and value chain	23-24 August, 2013 at NIFTEM Campus, Kundi, Sonipat
30.	Dr. A.V.S.R. Swamy Dr. D.V. Subhashini Dr. S. Kasturi Krishna	Programme on Leadership Development (a pre-RMP Programme)	26 August - 6 September, 2013 at NAARM, Hyderabad
31.	Sri Md. Elias	Workshop on KOHA Integrated Library system	29-30 August, 2013 at CPCRI, Kasaragod
32.	Dr. T.G.K. Murthy	AINRPs/AICRPs of Crop Science Division meeting	30-31 August, 2013 at ICAR, New Delhi
33.	Dr. P.V.V.S. Siva Rao	Training Programme on NIFTD	22-23 September 2013 at IGFRI, Jhansi
34.	Dr. T.G.K. Murthy	Briefing meeting of ISO/TC 126 and its Sub-Committees and Working Groups	25.09.2013 at F&Ag. Dept., New Delhi
35.	Dr. V.S.G.R. Naidu	Review meeting of DCCD	25.09.2013 at Cochin
36.	Dr. U. Sreedhar	Second National Knowledge Network Annual Workshop – Enhancing Research Collaborations through NKN	17-19 October, 2013 at IISC, Bangalore
37.	Dr.C.Chandrasekhararao S. Jitendranath	2nd International Conference on Agriculture, Food Technologies and Environment – New approaches	19-20 October, 2013 at New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
38.	Dr. Y. Subbaiah	Core Committee meeting on 'FCV tobacco cost of cultivation"	21.10.2013 at Tobacco Board, Guntur
39.	Dr. U. Sreedhar	Review meeting on CPAs Management in FCV tobacco	22.10.2013 at Tobacco Board, Guntur
40.	Dr. V.S.G.R. Naidu	National Conference of KVK's	23-25 at UAS, Bangalore
41.	Dr. S. Ramakrishnan	National Symposium on "Pathogenomics for diagnosis and Management of Plant Diseases"	24-25, October, 2013 at CTCRI, Thiruvananthapuram
42.	Dr. A.R. Panda	8th National Conference of KVK	23-24 October, 2013 at Bangalore
43.	Dr. P. Venkateswarlu	Meeting on " FCV tobacco- Soil conversion from Black soil to light soil of Thorredu region	30.10.2013 at Tobacco Board, Guntur.
44.	Dr. T.G.K. Murthy Dr. U. Sreedhar	World Agriculture Forum Congress (WAFC), 2013	4-7 November, 2013 at Hyderabad.
45.	Dr. T.G.K. Murthy	Inspected the projects and on-farm trials along with the Project Monitoring and Evaluation Team of CTRI	8-11 November, 2013 at AINPT Centre, Nipani, Dharward
46.	Dr. M. Kumaresan	1st Screening Committee meeting of Regional Agricultural Mela	13.11.2013 at TNAU, Madurai
47.	Dr. T.G.K. Murthy	Inaugural meeting of the ICAR funded KVK	16.11.2013 at V.R. Gudem
48.	Dr. T.G.K. Murthy	Interface Meting of Line Departments in Agriculture & ICAR Institutes	17.11.2013 at Bapatla
49.	Dr. D.V. Subhashini	54th Annual Conference of AMI (AMI-2013)	17-20th November, 2013 at M.D. University, Rohtak
50.	Dr. A.R. Panda	Meeting to review the technical programme of extension centres of RARS of Lam and Maruteru zones	25.11.2013 at Lam farm, Guntur
51.	Dr.C.Chandrasekhararao	Input Committee meeting	26.11.2013 at Tobacco Board, Guntur
52.	Dr. S. Ramakrishnan	Symposium on spices and Aromatic Crops (SYMSAC-VII)	27-29 November, 2014 at Madikeri

Sl. No.	Participant (s)	Programme attended	Date and place
53.	Dr. K. Sivaraju Dr. K. Suman Kalyani,	21st National Children's Science Congress 2013	28th November at Rajahmundry
54.	Dr. U. Sreedhar	IX Biopesticide International Conference (BIOCICON 2013)	28-30th November, 2013 at St. Xavier's College, Palaymkottai
55.	Dr. T.G.K. Murthy	Interactive workshop on Admn. and Financial matters for the ICAR Institutes located in Southern Region	9-10 December, 2013 at NAARM, Hyderabad
56.	Dr. K. Prabhakara Rao	21 days ICAR sponsored winter school on "Frontier technologies in the area of biotechnology on gene isolation characterization and breeding with reference to abiotic stress related genes".	10-30 December, 2013 at NRC on Plant Biotechnology, New Delhi
57.	Dr. K. Nageswara Rao	Meeting on suckericides	13.12.2013 at tobacco Board, Guntur
58.	Dr. D. D. Reddy	19th Meeting of FADC (BIS), New Delhi and TSC meeting at MH&FW, New Delhi	23.12.2013 at New Delhi
59.	Dr. T.G.K. Murthy	XII Plan EFC/SFC meeting for consideration of plan schemes of DARE/ICAR	24.12.2013 at New Delhi
60.	Dr. U. Sreedhar	Workshop to revise IPM packages	8.1.2014 at NIPHM, Hyderabad
61.	Dr. T.G.K. Murthy	Annual Conference of Vice Chancellors of Agril.Universities and Directors of ICAR	19-20 January, 2014 at Baramati & Pune
62.	Dr. K. Nageswara Rao Dr. M. Anuradha Ms. J. Poorna Bindu	ISPP South Zonal Seminar on 'Physiological and Molecular Interventions for Improving Crop Productivity"	23.01.2013 at Agril. College, Bapatla
63.	Dr. K. Siva Raju	Reassessment for Testing & Calibration Insight Tobacco Craft Institute, Godfrey Phillips India Ltd., Bombay	23-24 January, 2014 at Bombay
64.	Sunil Mandi	Midterm Review meeting of ICAR Regional Committee II	24.01.2014 at CFRI, Barrackpore, Kolkata
65.	Dr. P. Venugopala Rao	Interaction meet on the presently used FCV tobacco seed varieties	28.1.2014 at Tobacco Board, Guntur

Sl. No.	Participant (s)	Programme attended	Date and place
66.	Dr. K.Siva Raju	Reassessment of ITC Life Sciences & Technology Centre, ITC Limited, Bangalore as Technical Expert in the committee constituted by National Accreditation Board for Testing & Calibration of Laboratories, Dept. of Science and Technology, New Delhi	30-31st January, 2014 ITC Limited, Bangalore
67.	Dr. K. Siva Raju Dr. Y. Subbaiah Dr. H. Ravisankar	101st Indian Science Congress	3-7 February, 2013 at Jammu University, Jammu
68.	Dr. K. Suman Kalyani	Workshop on 'Policies for Infant & Young child feeding'	3.2.2014 at NIN, Hyderabad
69.	K. Padmaja	Training programme on 'Competency enhancement programme for Technical Officers of ICAR".	3-12 February, 2014 at NAARM, Hyderabad
70.	Dr. K.Suman Kalyani	Workshop on "Mapping of current policies that support counseling for infant and young child feeding (IYCF) in India using the Net-Map methodology"	4th February, 2014 at National Institute of Nutrition, Hyderabad.
71.	Md.Elias	National Conference on 'Agricultural information management in digital era'	4-5 February, 2014 at IGKV, Raipur
72.	Sunil Mandi	KVK Advisory Committee meeting	07.02.2014 at UBKV, Pundibari, Cooch Behar
73.	Dr. T.G.K. Murthy	Reviewed the experiments/ projects of AINPT and farmers'fields along with the Member, Project Monitoring and Evaluation of Team of CTRI	8-9 February, 2014 at AINPT Centre, Anand
74.	Dr. P.V.Venugopala Rao	Annual Breeder Seed Review Meeting	12th February, 2014 at NBPGR, New Delhi
75.	Dr. V.S.G.R. Naidu	Biennial Conference of Indian Society of Weed Science	15-17 February, 2014 at Jabalpur
76.	Sunil Mandi	Advisory Committee meeting organized by ACMART	17.02.2014 at Cooch Behar
77.	Dr. S.K. Dam	International Symposium on Role of fungi and microbes in the 21st Century – A Global scenario	20-22 Feb., 2014 at Kolkata
78.	Dr. T.G.K. Murthy Dr.C.Chandrasekhararao	XII Plan EFC meeting of DARE/ICAR	21.2.2014 ICAR, New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
79.	Dr. U. Sreedhar	International Conférence on Entomology	21-23 February, 2013 at Patiala, Punjab
80.	Sunil Mandi	Midterm meeting of ICAR Regional Committee- II	24.02.2014 CIFRI Barrackpure
81.	Sunil Mandi	Advisory Committee meeting	24.02.2014 at UBKV, Pundibari.
82.	Dr.C.Chandrasekhararao	First and Third meeting of the Committee constituted to study the environmental impact of FCV tobacco cruing in India – Alternative fuels to substitute the firewood usage in curing of FCV tobacco	24.02.2014 at Tobacco Board, Guntur
83.	Dr. H. Ravisankar	Sensitization workshop on Internet Protocol Version 7 (IPV 6)	27.02.2014 at New Delhi
84.	Sunil Mandi	Workshop on Jute and Allied Fibers	28.02.2014 to 01.03.2014 at UBKV, Pundibari
85.	Dr. S. Ramakrishnan	Input Committee meeting	28.2.2014 at Directorate of Auctions, Tobacco Board, Bangalore
86.	Dr. M. Mahadeva Swamy	International symposium on Potassium nutrition and crop quality	4-5 March, 2014 at BAU, Ranchi
87.	Dr. D.V. Subhashini	National training on Microbial Characterisation and Nanoformulations : Methods and Applications"	4-13 March, 2014 at NBAIM, Kushmaur, Mau, Uttar Pradesh
88.	Dr. U.Sreedhar	CORESTA Infestation Control Conference	10-11 March, 2014 at the ITC Gardenia Hotel, Bangalore
89.	Dr. S. Ramakrishnan	137th meeting of the Tobacco Board	21.03.2014 at Directorate of Auctions, Tobacco Board, Bangalore

Workshops, Seminars and Farmers' Days organised by the Institute

District Level seminar on Cocoa: KVK,CTRI organised 'District Level seminar on Cocoa' sponsored by Directorate of Cashew nut and Cocoa Development on 22nd November, 2013 at Annavaram, Shankavaram mandal, E.G.Dist. Dr. T.G.K.Murthy, Director, CTRI, Rajahmundry, Dr. V.S.G.R.naidu, Programme Coordinator, KVK, Sri G. Shiva Kumar, Manager, M/s. Cadbury India Limited and officials from Department of Horticulture, Ruchi Soya Limited, Palmtech Limited, participated in the Programme. Two hundred farmers from Sankhavaram, Tuni, Thondangi and Prathipadu mandals participated in the programme. A broucher in Telugu entitled 'Cocoa – Cultivation Practices' was released on this occasion for the benefit of cocoa farmers.

District level Seminar on Cashew: A district-level Seminar on Cashew was organized at KVK, Kalavacharla in collaboration with Directorate of Cashewnut and Cocoa Development (DCCD), Cochin on 4.1.2014. Dr. V.S.G.R. Naidu, PC, KVK, Chaired the inaugural session and addressed the gathering. Sri A. Durgesh, Assistant Director of Horticulture, Dr.K. Rajendra Prasad, Scientist (Horticulture) participated in the Seminar. A total of 150 farmers from Tuni, Rangampet, Korukonda and Rampachodavaram mandals of East Godavari District attended the programme. Brochure in Telugu entitled **'Cashew - Cultivation Practices'** was released during this occasion for the benefit of cashew farmers.

Cocoa Training Programm: A three day training programme on Cocoa was organised at KVK, Kalavacharla from 5.1.2014 to 7.1.2014 in collaboration with DCCD, Cochin. 50 farmers from Ambajipet, Tuni, Annavaram, Nidigatla villages were trained in Cocoa orchard management, pest and disease control and harvesting methods. Dr. T.G.K. Murthy, Director, CTRI, Dr. V.S.G.R. Naidu, Programme Co-ordinator, KVK, Kalalvacharla, Dr. N.B.V. Chalapathi Rao, Sr.Scientist (Entomology), Dr.K.Ravindra Kumar, Scientist (Horticulture), PC, KVK, Pandirimamidi, Technical Executive Sri G.Subrahmanyam from M/s.Cadbury India Limited, Officials from Department of Horticulture, ATMA (East Godavari district) have participated in the programme.

Visit to cocoa fields

Research-Extension-Farmers Interface meeting(24.01.2014): In collaboration with Kamadhenu foundation (NGO), Kakinada, an interface meeting **'**Training Needs for Village Based Dairy Development' was organised to 70 trainees / Dairy officials of different Co-operative Societies of Milk Federation and discussed on 'Quality milk production, problems and prospects of dairy units'. The brochures on **'**Azolla – Cultivation' and 'Co-4 fodder – Cultivation' were reeased for the benefit of dairy farmers.

Interface meeting on village based dairy development

Kisan Mela: In collaboration with ATMA-East Godavari district, KVK of CTRI organised 'Kisan Mela' from 28-01-14 to 29-01-14 at KVK,

Director, CTRI addressing the farmers

Kalavacharla. Dr.T.G.K.Murthy, Director, CTRI, Dr. V.S.G.R. Naidu, Programme Co-ordinator, KVK, Dr. K. Sitaramaraju, Sri A.Durgesh, ADH-I, Deputy Project Director, APMIP, Sri M.V.Rama Rao, Deputy Director of Agriculture, Dr.K.S.S.Somayajulu, AGM, NABARD, Project Director, ATMA and Farmers' Representative Sri Veera Reddy and 550 farmers from different mandals of East Godavari participated in the Mela. An exhibition was arranged with 15 stalls displaying improved technologies in agriculture and allied aspects. Literature developed in Telugu entitled 'Self Employment Opportunities through KVK Programmes' was released by the dignitaries.

State-level Seminar on Cashew: State-level Seminar on Cashew was organized by KVK-CTRI in collaboration with DCCD, Cochin on 7th and 8th March, 2014 at CTRI, Rajahmundry. The inaugural session was presided over by Dr.T.G.K.Murthy, Director, C.T.R.I., Rajahmundry; Dr.N.Venkatesh Hubballi, Director, DCCD, Cochin; Dr.K.Sitaramaraju, Project Director, ATMA; Sri A.Durgesh, ADH-1,Rajahmundry; and Dr. V.S.G.R. Naidu, Programme Coordinator, KVK participated in the Seminar. A total of 300 farmers have participated in the seminar. Programme Coordinator, Krishi Vigyan Kendra, Amdalavalasa, and PC, KVK, Rastakuntubai, attended and explained the house the cashew scenario of Srikakulam and Vizianagaram districts. Brochure in Telugu entitled 'Technology Inventory on Cashew Production' was released during this occasion for the benefit of cashew farmers.

State-level seminar on Cashew

Technology Week: A Technology Week was organised at Krihi Vigyan Kendra with the financial support of ATMA, East Godavari Dist. during 26-11-2013 to 30-11-2013. The event focused on different themes and popularised improved production technologies on various crops. A total no. of 750 farmers/farm women/ tribal youth from different mandal participated in the programme.

PC, KVK addressing the farmers

Training on Good Agricultural Practices: A training programme on Good Agricultural Practices of FCV tobacco cultivation during 7-9 Jan., 2014 to the Newly recruited Field Officers of Tobacco Board, Alliance One International India Pvt. Ltd., Pottur, Guntur.

Workshop on Tobacco Production Technologies: A workshop on "Tobacco Production Technologies" to the growers of Auction Platforms under Rajahmundry Regional Office jurisdiction at CTRI, Rajahmundry on 04.03.2014.

Workshop on CeRA: A workshop cum training programme on CeRA was conducted at CTRI on 13.12.2013 at CTRI, Rajahmundry.

Distinguished visitors

S.No.	Date	Visitors
CTRI, Rajahmundry		
1.	23.04.2013	Mr. Adham El Raffie, Mr. Mohamed Attia and Mr. Ahmed Naguib, Trade members from Eastern Company, S.A.E. Egypt
2.	11.04.2013 & 12.04.2013	Dr. S.S. Sandhu, Agricultural Commissioner, Govt. of India
3.	12.06.2013	Dr. K. Gopal, IAS, Chairman, Tobacco Board
4.	30.01.2014	Dr. Leonardo Caruso and Dr. Marco Prat, Japan Tobacco Interactional (JTI)
CTRI RS, Guntur		
5.	09.05.2013	H.M.Ssein Hassan, Abd. Vaouf Mohammed and Eissa Mohammed, Eastern company, Egypt
CTRI RS, Hunsur		
6.	15.09.2013	Scientists from National Instiute of Plant health management
7.	26.02.2014	Sixty FCV tobacco growers from Andhra Pradesh
CTRI RS, Dinhata		
8.	22.12.2014	Sri Pratap Singh, ADA Suti-II District Murshidabad and Sri Amrit Hansda, ADA, Raghunathganj –II Murshidabad
9.	01.03.2014	Dr. N. Gopalakrishnan, ADG (CC) and Dr. G.N. Mistra, Principal Scientist (CC), ICAR, New Delhi

Visit of Dr.S.S. Sandhu, Agricultural Commissioner, Govt.of India

Visit of Dr. K. Gopal, IAS, Chairman, Tobacco Board

Visit of Trade members from Eastern Company, S.A.E. Egypt

Personnel (As on 31.03.2014)

Dr. T.G.K. Murthy, Director-Acting

DIVISION OF CROP IMPROVEMENT

Dr. T.G.K. Murthy, Principal Scientist & Head i/c
Dr. A.V.S.R. Swamy, Principal Scientist
Dr. K. Sarala, Principal Scientist
Dr. P.V. Venugopala Rao, Senior Scientist
Dr. K. Prabhakara Rao, Scientist
Smt. K. Santhinandivelu, Sr. Technical Officer
Sri B.S.N. Reddy, Sr. Technical Officer
Sri J. Sivasai, Sr. Technical Officer
Sri A.D.V. Prasad, Technical Officer
Sri M. Trinadh, Sr. Technical Assistant
Sri T. Lakshmana Rao, Technical Assistant
Sri M.M. Ali, Technical Assistant
Sri S. Ramaraju, Technician
Sri Y.N.V.V.S.N. Murthy, SSS

DIVISION OF CROP PRODUCTION

Dr. C. Chandrasekhararao, Pr. Scientist & Head i/c
Dr. S. Kasturi Krishna, Principal Scientist
Dr. S.V. Krishna Reddy, Principal Scientist
Dr. Seetaram Meena, Scientist
Dr. M. Nageswara Rao, Asst. Chief Technical Officer
Sri P.S.S. Prakasa Rao, Sr. Technical Assistant
Sri Ch. Sudhakara Babu, Technical Assistant
Sri D.S.R. Sastry, Sr. Technician
Sri S. Ganga Raju, SSS
Smt. Y. Jaya Lakshmi, SSS
Sri K.V.S.S. Bhaskara Rao, SSS

DIVISION OF CROP PROTECTION

Dr. U. Sreedhar, Principal Scientist & Head i/c
Dr. J.V. Prasad, Principal Scientist
Dr. G. Raghupathi Rao, Senior Scientist
Dr. S. Gunneswara Rao, Senior Scientist
Sri K. Sesha Sai, Sr. Technical Officer
Dr. S.K. Dam, Sr. Technical Officer
Sri N. Veerraju, Sr. Technical Assistant
Sri V. Narasimha Murthy, Sr. Technical Assistant
Sri V.V. Ramana, Technical Assistant
Sri A. Nageswara Rao, SSS
Sri V.V.P.L. Acharyulu, SSS
Sri B. Koteswara Rao, SSS

DIVISION OF CROP CHEMISTRY & SOIL SCIENCE

Dr. D. Damodar Reddy, Principal Scientist & Headi/c
Dr. K. Siva Raju, Principal Scientist
Dr. D.V. Subhashini, Principal Scientist
Dr. M. Anuradha, Principal Scientist
Ms. Jana Poorna Bindu, Scientist
Smt. Y. Ramabai, Sr. Technical Officer
Smt. D.V.L. Satyavathi, Sr. Technical Officer
Smt. K. Padmaja, Sr. Technical Officer
Smt. J. Vasanthi, Technical Officer
Sri G. Srinivasa Rao, Sr. Technical Assistant
Sri M. Satyanarayana, Technical Assistant
Sri N. Johnson, Technical Assistant
Smt. P. Satyavathi, SSS
Smt. P. Subbayamma, SSS
Smt. M. Srilatha, SSS
Sri K.V. Narasimha Raju, SSS
Sri B.S.S. Sai, SSS
Sri E. Radhakrishna, SSS
Sri Ch. Subba Rao, SSS
Sri A. Daniel Raju, SSS

AGRICULTURAL EXTENSION

Dr. Y. Subbaiah, Principal Scientist & OIC
Dr. K. Suman Kalyani, Principal Scientist
Smt. N. Aruna Kumari, Asst. Chief Technical Officer
Sri I. Jagadish Chandra, Sr. Technical Officer
Sri P.E. Jemmy, Technical Officer
Sri D.V.S.C. Sastry, Technical Assistant
Sri P. Girija Sankar, Technical Assistant
Smt. K. Pushpa, SSS
Sri G. Sarveswara Rao, SSS
Sri Y.V. Narayana, SSS

AKMU

Dr. H. Ravisankar, Scientist-in-charge
Sri Md. Bajuddin, Technical Officer
Sri M.N.P. Kumar, Technical Officer
Sri K. Satyanarayana, SSS

PME CELL

Dr. C. Chandrasekhararao, Nodal Officer
Dr. K. Sarala, Principal Scientist
Sri C.V.K. Reddy, Asst. Chief Technical Officer
Smt. Ch. Lakshminarayani, Personal Assistant
Sri Y. Subrahmanyam, SSS
Sri N. Srinivasa Rao, SSS

ITMU

Dr. T.G.K. Murthy, Nodal Officer
Smt. A. Aruna Kumari, Research Associate
Sri Ch.V. Srihari, Research Associate

LIBRARY

Dr. M. Anuradha, OIC
Sri Md. Elias, Sr. Technical Assistant
Sri P.N.M. Swamy, SSS

CTRI FARM, KATHERU

Dr. S.V. Krishna Reddy, OIC
Sri T. Krishna Reddy, Asst. Chief Technical Officer
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