वार्षिक प्रतिवेदन
Annual Report
2009-10

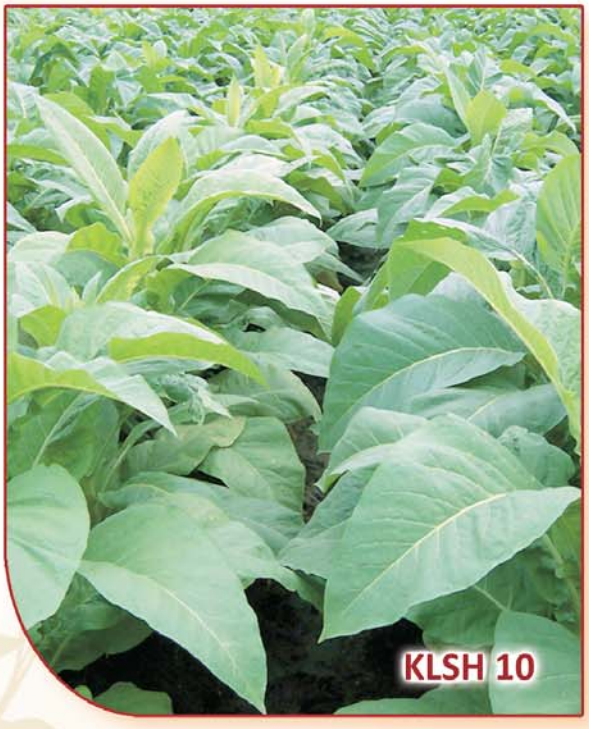
केन्द्रीय तम्बाकू अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
राजमन्द्री - 533 105, आन्ध्र प्रदेश

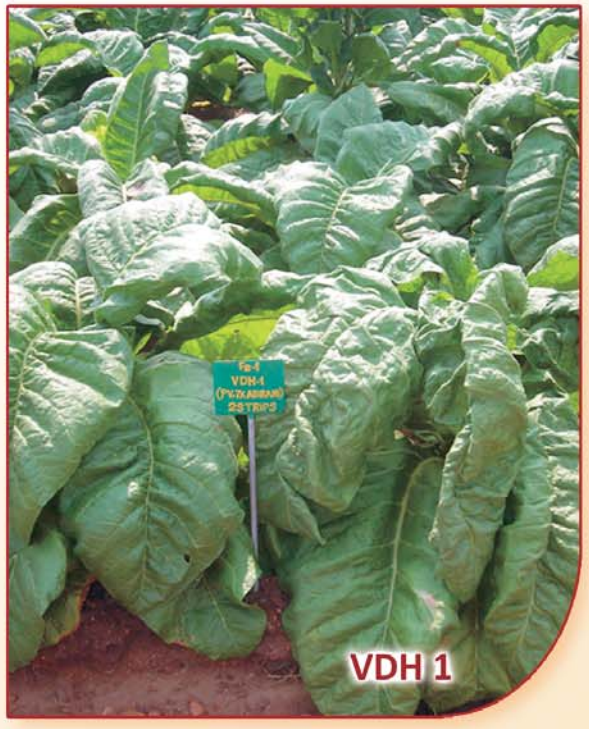
CENTRAL TOBACCO RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
Rajahmundry - 533 105, Andhra Pradesh

Tobacco hybrid lines


TBSH 1


NLSH 1


KLSH 10


VDH 1

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CTRI ANNUAL REPORT 2009-10

Published by

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ICAR

Preface

At present, the annual world tobacco production is ~ 6 billion kg. China with 2,350 million kg is the largest producer while Brazil with 635 million kg and USA with 227 million kg are the other major FCV tobacco producing countries. India is the second largest producer of tobacco with 750 million kg leaf production. Further, India occupies third place in flue-cured tobacco production with 315 million kg after China and Brazil. The export earnings have reached Rs. 4,381 crores and excise revenue receipts have touched Rs. 14,000 crores during 2009-10.

Keeping in view the key recommendations of the Research Advisory Committee (RAC) and the Quinquennial Review Team (QRT) - 2003-08, several initiatives have been taken in the priority areas of tobacco research to sustain the productivity and profitability of the crop. In FCV tobacco, a local selection, N-98 with a yield potential of 2,500 kg/ha has been identified for release in Southern Light Soils (SLS) of Andhra Pradesh. It is hoped that this line would improve the yield and the socio-economic conditions of the tobacco farmers in the drought-prone area of SLS where the yields are low. In order to facilitate the vertical growth, efforts are made to develop the hybrids in different tobacco types. The FCV tobacco hybrids viz., TBSH1, NLSH1, SH12 and KLSH10 with a yield potential of ~3,000 kg/ha and the chewing tobacco hybrid VDH-3 with a yield potential of ~4,000 kg/ha have been developed.

Concerted efforts are made in improving the input-use-efficiency to bring down the cost of cultivation and also to conserve the precious natural resources. In the trials under progress in NLS, a saving of 50% irrigation water was achieved with a concomitant yield increase of 25%, while fertigation with the recommended dose increased the yield by 45% and fertigation with 80% recommended dose increased the yield by 36% with 20% saving in fertilizers. Similarly, the drip irrigation adopted for chewing tobacco in Tamil Nadu resulted in 43% reduction in water requirement. In an attempt to promote tobacco as an oil seed crop, high seed-yielding lines A-119 x Abirami (2,213 kg/ha) and HDBRG x A-145 (1,666 kg/ha) besides leaf yields have been identified at Vedasandur and Rajahmundry, respectively. Efforts are in progress to explore the possibility of extracting flavour compounds from tobacco to broaden its scope for alternative uses.

It is heartening to inform that the Bureau of Indian Standards (BIS) has sponsored an Indian delegation to the 28th Meeting of the International Organization for Standardisation (ISO)/Technical Committee (TC) 126 on Tobacco and Tobacco Products held at Madrid, Spain during May 12-13, 2009 with Dr. V. Krishnamurthy, Director, CTRI as the Leader and Dr. C. V. N. Rao and six others as members of the delegation. Issues of particular relevance

to India viz., International standards for *Bidi* and water-pipe (*Hookah/Sisha*) smoking procedures were deliberated in the ISO/TC 126 meeting. Further, the Indian delegation comprising the Director, CTRI, officials of Tobacco Board and representatives of FCV tobacco growers visited the Yunnan Province in Peoples' Republic of China (PRC) to study the FCV tobacco production practices and marketing systems in China. It is felt that there is a scope for adopting some of the production practices like, use of pelleted seed, production of seedlings in ploy-houses, computerised bulk curing, rotary curing barns and curing with solar energy coupled with coal/wood in FCV tobacco production in India.

I am happy to state that a record amount of Rs. 202.45 lakhs was realized through the sale of tobacco leaf and tobacco seeds and Rs. 27.59 lakhs was generated through internal resource generation as against the target of Rs. 99 lakhs fixed by the Council for 2009-10. This could be possible due to the sincere efforts of all the staff members of the Institute and its Regional Stations. The infrastructure/equipment required to conduct research in the frontier areas have been upgraded with the XI plan funds. Sophisticated equipments like Gas Chromatograph-Mass Spectrometer, NMR Spectrometer, Microscope Documentation System with FISH-GISH and Real Time PCR Machine have been procured and put to use. The crop year 2009-10 has also been a 'Golden Year' in the tobacco cultivation as the market prices touched an all-time high in the history and the farmers are happy with the returns.

I take this opportunity to express my deep sense of gratitude to Dr. S. Ayyappan, the Secretary, DARE & Director-General, ICAR, New Delhi for his dynamic leadership and strong support for the overall development of the Institute. I place on record my sincere thanks to Dr. Mangala Rai, Former Director-General, ICAR, Prof. Swapan K. Datta, Deputy Director-General (CS) and Dr. K.C. Jain, Assistant Director-General (CC), ICAR, New Delhi for their valuable suggestions and encouragement in our endeavours.

Date : 07.06.2010

(V. KRISHNAMURTHY)
Director

अनुसंधान विशिष्टताएं (झलकियाँ) 2009-10

- एन. टबाकम एवं रसटिका की कुल 1603 जननद्रव्य प्राप्तियों के अलावा 61 देसी निकोटिन प्रजातियों की 202 प्राप्तियाँ एवं नौ विदेशी अंतरविशिष्ट प्रजातियों का रख-रखाव किया गया।

- फ्यूजेरियम मुरझान प्रतिरोधी अग्रिम प्रजनन वंशावली एफ.सी.एच.-222 ने 3000 कि.ग्रा. प्रति हेक्टेयर से अधिक संसाधित पत्ता उत्पादन दर्ज किया।

- संकर वी.डी.एच.-3 (अभिरामी x के.वी.-1) ने सी.टी.आर.आई. अनुसंधान केंद्र, वेदसंदूर में बड़े पैमाने पर आयोजित परीक्षण मूल्यांकन में एकसमान अच्छा प्रदर्शन किया एवं फार्म के भीतर एवं बाहर के परीक्षणों में श्रेष्ठ वंशावली अभिरामी से 9.9 प्रतिशत वृद्धि सहित 4131 कि.ग्रा. प्रति हेक्टेयर औसत संसाधित पत्ते का उत्पादन प्राप्त हुआ। विभिन्न केंद्रों की संकरों का संपूर्ण निष्पादन एवं 2006-09 तक के सी.टी.आर.आई. अनुसंधान केंद्र में वी.डी.एच.-3 ने श्रेष्ठ वंशावली अभिरामी की तुलना में 13.3 प्रतिशत अधिक वृद्धि सहित 3,962 कि.ग्रा. प्रति हेक्टेयर अधिकतम औसत संसाधित पत्ता उत्पादन दर्ज किया। वी.डी.एच-3 के सस्यीय मूल्यांकन के बाद किस्म विमोचन प्रस्तावों को प्रस्तुत करने का प्रस्ताव किया गया।

- तीन वर्षों के औसत आंकडों से निष्कर्ष निकाला गया कि एच.डी.बी.आर.जी., एच.डी.बी.आर.जी. X जी.टी.-8 एवं जी.टी.-8 X एच.डी.बी.आर.जी. ने 30 कि.ग्रा. प्रति हेक्टेयर सोलनेसाल से अधिक उत्पादन दर्ज किया। ए-145, टी.आई.-163, टी.आई.-163 X जी.टी.-7 एवं एच.डी.बी.आर.जी. X जी.टी.7 में 80 कि.ग्रा. प्रति हेक्टेय से अधिक निकोटिन दर्ज किया गया। संकर जी.टी.-8 X एच.डी.बी.आर.जी. ने अत्यधिक प्रोटीन दर्शाया उसके बाद एच.डी.बी.आर.जी. X जी.टी.-7 का स्थान रहा।

- विभिन्न संकर प्रजातियों में एच.डी.बी.आर.जी. X ए-145 एवं ए-145 X एच.डी.बी.आर.जी. ने क्रमशः 1,832 एवं 1.641 कि.ग्रा. प्रति हेक्टेयर बीज उत्पादन दर्ज किया। जबकि, संकर प्रजाति ए-145 X जी.टी.-7 ने बीज उत्पादन में पिछले तीन सालों से 1,452 कि.ग्रा. बीज प्रति हेक्टेयर की स्थितता दर्शाई। टी.आई.-163 X ए-145 ने 602 कि.ग्रा. प्रति हेक्टेयर का अधिकतम तेल उत्पादन दर्ज किया उसके बाद 598 कि.ग्रा. तेल प्रति हेक्टेयर सहित एच.डी.बी.आर.जी. X ए-145 का स्थान था। 2008-09 के दौरान, वैकल्पिक फसलों में मक्का एवं चना ने अत्यधिक सकल आय दर्ज की। उसके बाद वर्टीसोल्स में मृदा नमी संरक्षण के अंतर्गत सरसों जिनजिली एवं धनिया का स्थान था।

- गांठ दबाव यंत्र में गांठे के भार को मापने एवं इसके साथ ही साथ गांठ तैयार करते समय प्रयोग किए गए दबाव को मापने के लिए नीचे भार मापक को जोड़कर इसे संशोधित किया गया। गांठ दबाव यंत्र एवं एल बी वाइड-1, एल बी वाई-2, डी.बी.डी.जी.पी.एल. श्रेणियों से हाथ से तैयार की गई गांठों में नमी हानि एवं फफूंदी..कवकीय वृद्धि नहीं पाई गई। एक महीने के बाद परिवेश तापमान के अंतर्गत नमी हानि का विस्तार 0.9-2.6 प्रतिशत था।

- तंबाकू नर्सरी में फर्टीगेशन पर किए गए प्रयोगों ने स्पष्ट किया कि तुलना में 100 एवं 80 प्रतिशत आर.डी.एफ. फर्टीगेशन सहित भार एवं रोपणयोग्य पौधों की संख्या महत्वपूर्ण रूप से अधिक था। वपनीय खेतों में फर्टीगेशन से उर्वरकों में 20 प्रतिशत तक की बचत की जा सकती है।

- ड्रिप सिंचाई एवं वैकल्पिक कूंड सिंचाई से क्रमशः 50 एवं 17 प्रतिशत सिंचाई जल की बचत हुई।

- फर्टीगेशन से महत्वपूर्ण रूप से बेहतर हरे पत्ते, संसाधित पत्ते एवं ग्रेड सूचकांक दर्ज किए गए। सिफारिश की गई मात्रा सहित फर्टीगेशन से उत्पादन में 44 प्रतिशत तक की वृद्धी हुई। जबकि सिफारिश की मात्रा सहित सिंचाई से उत्पादन में 25 प्रतिशत तक की वृद्धी हुई। फसल में फर्टीगेशन से ऊर्वरकों में 40 प्रतिशत तक की बचत की जा सकती है।

- फुनगियाना एवं अंतः भूस्तारी नियंत्रण से संसाधित पत्ता में 9.9 प्रतिशत एवं 4.6 प्रतिशत उजला पत्ता उत्पादन में वृद्धी हुई। एस.एल.एस. परिस्थितियों के अंतर्गत अंतः भूस्तारी नियंत्रण के लिए 1.25 प्रतिशत प्राइम + (फ्लूमेट्रालिन) तथा 1.5 प्रतिशत स्टोंप (पेंडीमेथालिन) आशाजनक पाया गया।

- बेहतर उर्वरक उपयोग के लिए रोपण समय को बढ़ाने के लिए किए गए अध्ययनों से स्पष्ट हुआ कि एस.एल.एस. परिस्थितियों के अंतर्गत अगेती रोपण, सिरी या एन्-98 सहित उर्वरक मात्रा को 60-60-60 से बढ़ाकर 80-60-70 कि.ग्रा. करने से बेहतर उत्पादन प्राप्त किया जा सकता है।

- मूल्यांकित किए गए विभिन्न जैविक माध्यम में, वर्मीकंपोस्ट अधिक प्रभावी पाया गया।

- आशाजनक विमोचन पूर्व वंशावली एफ.सी.एच-201 में बेहतर संसाधित पत्ता उत्पादकता साथ ही साथ उच्च श्रेणी पत्ता उत्पादन के लिए सिफारिश किया गया अंतराल 100X55 सेंटीमीटर एवं 60 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर से 22 पत्तों के समय फुनगियाना श्रेष्ठ सस्ययन पैकेज पाया गया।

- तना बेधक के प्रबंधन के लिए, स्क्रोबीपलपा हेलिओपा के लिए रिनाक्सिपाइर-25 एस.सी. 0.0075 प्रतिशत कि दर से या फ्लुबेनाडियामाइड-480 एस.सी. 0.012 प्रतिशत की दर से या स्पिनोसेड-45 एस.सी. 0.018 प्रतिशत की दर से छिडकाव (नर्सरी से पौधे को निकालने के 10 दिन पहले एक

छिड़काव एवं दूसरा रोपण के 10 दिनों के बाद) या उपरोक्त कीटनाशकों का क्रमिक छिड़काव, पहला रोपण के 10 दिन के बाद एवं दूसरा रोपण के 20 दिनों के बाद के छिड़काव ने एफ.सी.वी. तंबाकू की रोपित फसलों में तना बेधक संदूषण से पौधों को अच्छा संरक्षण दिया।

- तंबाकू माहूँ माईज़स निकोषियाना के खिलाफ लासर गोल्ड (एसेफेट 50% + इमिडाक्लोप्रिड 1.8% एस.पी.) 518 जी.ए.आई. की दर से प्रति हेक्टेयर छिडकाव प्रभावी पाया गया।

- के.एल.एस. में ई.सी. एवं. सी.आई. की कमी सहित पृष्ठ परत में मृदा प्रतिक्रिया पूरी तरह अम्लीय एवं उपपृष्ठ परत में मध्यम अम्लीय थी। पृष्ठ एवं उपपृष्ठ परत दोनों में औसत जैविक कार्बन की मात्रा कम थी। उपलब्ध पोटोशियम स्तर पृष्ठ परत में मध्यम से उच्च एवं उपपृष्ठ परत में निम्न से उच्च था।

- एस.बी.एस. एवं के एल.एस. क्षेत्रों में उगाए गए एफ.सी.वी. तंबाकू पत्ता में लोहा एवं मेगनीस की मात्रा सभी स्तरों पर उपयुक्त मात्रा में था। एस.बी.एस. पत्ता में लोहे की मात्रा 561 से 4129 मि.ग्रा. प्रति कि.ग्रा. एवं. के एल.एस.में पत्ता में 289 से 2204 मि.ग्रा. प्रति कि.ग्रा. तक था। एस.बी.एस. पत्ता में मेगनीस 65 से 244 मि.ग्रा. प्रति कि.ग्रा. तक एवं के.एल.एस. पत्ता में 43 से 216 मि.ग्रा. प्रति कि.ग्रा. तक था।

- परिणामों से यह निष्कर्ष निकाला गया कि धुआं तार, निकोटिन, सी.ओ. एवं सोलनेसोल पर निकोटिन, पी.ई.ई. एवं. सोलनेसोल का सकारात्मक प्रभाव था। जबकि धुआं अवयवों पर पत्ता पोटाशियम एवं घटती चीनी का नकारात्मक प्रभाव था। धुआं अवयवों पर चीनी..निकोटिन एवं. पोटाशियम/क्लोराइडों के घटते अनुपातों का नकारात्मक प्रभाव पड़ा।

- खम्मम जिले के वेलेरूपाडु पर दो समान वंशावलियों के निष्पादन की जांच की गई और सी.टी.आर.आई. अनुसंधान फार्म ने उत्पादन लक्षण में सिरी के मुकाबले श्रेष्ठ प्रदर्शन किया तथा वेलेरूपाडु में तुलना की गई किस्म यानि सिरी के मुकाबले में क्रमशः 20 एवं. 1.5 प्रतिशत संसाधित पत्ता उत्पादन दिया।

- नई संकर वंशावली सी.एच.1 एवं सी.एच.3 ने जांची गई किस्म कंचन की तुलना में तीन स्थानों पर यानि उपरी एन.एल.एस., मध्य एन.एल.एस. एवं निचले एन.एल.एस. के फार्म जांचों में बेहतर प्रदर्शन किया।

EXECUTIVE SUMMARY

As envisioned in the mandate of the Institute, research work is carried out by the four major Divisions under ten broad research programmes viz., 1. Germplasm Resource Management, 2. Tobacco Cultivar Development, 3. Biotechnology in Tobacco Improvement, 4. Crop Production Technology, 5. Cropping Systems for Sustainable Production, 6. Bio-ecological and pathological Studies on Pests and Diseases, 7. Integrated Pest and Disease Management, 8. Soil Fertility, Water Quality and Nutrient Management, 9. Alternative Uses of Tobacco and Reduction of Harmful Substances and 10. Agricultural Extension and Information Technology.

Mission

Developing economically viable and eco-friendly agro-technologies for enhancing productivity and quality, reducing harmful substances, developing value-added products for promoting exports and generating revenue and employment on a sustainable basis.

Vision

Enhancing productivity and quality of Indian tobacco to make it more remunerative, globally competitive and promoting alternative uses to sustain the crop in the country.

An overview of the research work carried out during the period is presented hereunder.

Crop Improvement

In the gene bank, 1603 germplasm accessions of *N. tabacum* and *N. rustica* besides 202 accessions of 61 wild *Nicotiana* species and nine exotic interspecific hybrids were maintained. Wild *Nicotiana* species viz., *N. stocktonii*, *N. repanda*, *N.* x *benthamiana-repanda*, *N.* x *umbratica-nesophila*, *TW-101* and *N. Nesophila* were identified as resistant to *Orobanche*. Polymorphism for isozymes of peroxidase, acid phosphatase, malate dehydrogenase, superoxide dismutase, catalase and polyphenoloxidase was brought out among the newly collected landraces of *N. rustica* from Haryana, Meghalaya and Assam. Their interrelationships with cultivated *N. rustica* varieties of West Bengal were also tested.

Results of two replicated yield trials at Rajahmundry indicated promise of four lines viz., V-4263, V-4270, V-4278 and V-4280 over the best check variety, Siri. In the bulk evaluation trial, two CMS hybrids viz., CH-1 (cured leaf 2,220 kg/ha), CH-3 (2,410 kg/ha) and NLSH-1 (2,280 kg/ha) exhibited 10 to 20% standard heterosis over the check, Kanchan (2,012 kg/ha). Performance of both the hybrids was promising in the on-farm trials. The hybrid CH-1 is proposed for release for NLS.

At Jeelugumilli lines, NLST-3 and NLST-4 were significantly superior to the check, Kanchan. The lines are undergoing multi-location trial under AINRPT. Two somaclones viz., NLCR-7(k) and NLCR-10 showed about 27-33% improvement in yield over Kanchan and were recommended for multi-location testing under AINRPT.

In Tamil Nadu, the hybrid VDH-3 (Abirami x KV-1) uniformly performed well in the bulk evaluation trial conducted at CTRI Research Station, Vedasandur and in on-farm trials with 4,131 kg/ha mean cured leaf yield an increase of 9.9% over the best check Abirami. It is proposed to submit the variety release proposals of VDH-3 after completion of agronomic evaluation.

Advanced lines having uniform resistance to TMV, tobacco aphid, *S. litura* and tolerance to LCV coupled with high productivity, have been developed from intra- and inter-specific (N. *tabacum x N. gossei*, *N. umbratica x N. tabacum*) crosses. *Fusarium* wilt disease

resistant advanced breeding line FCH 222 recorded more than 3,000 kg/ha cured leaf yield in Karnataka. Scar marker was prepared and validated in *Fusarium* wilt susceptible parents (Kanchan and Rathna), resistant line (SG 33) and one breeding line (Rathna x Kanchan) x SG 33(F4). This marker will be used in breeding material for the selection of resistant lines.

About 22,000 kg of foundation seed of 7 varieties was produced during 2008-09 from 400 ha of seed plots.

Crop Production

Studies on nutrient dynamics in Alfisols revealed that available N and K values in soil increased with increase in depth from 0-20 to 40-60 cm. Available N and K decreased with the age of the crop from 45 days onwards. The available N in the soil at harvest of the crop was less than the initial value in 0-20 cm soil layer but higher at 20-40 and 40-60 cm depth.

A 20% saving in fertilizers was achieved with fertigation in seed beds. In the field crop, drip irrigation and alternate furrow irrigation saved 50 and 17 % of irrigation water, respectively. A 44% increase in yield was recorded with fertigation and recommended fertilizer dose, whereas drip irrigation with recommended dose increased the yield up to 25 %. A 40% saving in fertilizers was achieved through fertigation in the field crop.

In Tamil Nadu, drip irrigation at 100 ETc produced 13% higher cured leaf with 43% saving in water compared to the conventional method of irrigation.

In SLS, topping and sucker control improved the yields of cured leaf by 9.9% and bright leaf yield by 4.6%. Prime + (Flumetralin) @ 1.25% and Stomp (Pendimethalin) @ 1.5% were found promising for sucker control under SLS conditions. Studies on augmenting planting time for higher fertilizer utilization indicated that higher yields can be achieved under SLS conditions by early planting, increasing fertilizer dose from 60-60-60 to 80-60-70 kg NPK/ha with Siri or N-98. Recommended spacing of 100 x 55 cm and topping at 22 leaves with 60 kg N/ha was found to be ideal agronomic package for realizing higher cured leaf productivity as well as top grade leaf production in promising pre-release line FCH 201 in KLS.

Based on three years experimentation, it has been established that HDBRG, HDBRG x GT-8 and GT-8 x HDBRG recorded more than 30 kg/ha solanesol. More than 80 kg/ha nicotine was recorded in A-145, TI-163, TI-163 x GT-7 and HDBRG x GT-7. Hybrid GT-8 x HDBRG showed highest protein followed by HDBRG x GT-7. Among the different hybrids, HDBRG x A -145, and A-145 x HDBRG recorded a seed yield of 1,832 and 1,641 kg/ha, respectively. However, the hybrid A-145 x GT-7 showed stability in seed yield over three years with 1,452 kg seed/ha. The cross TI-163 x A-145 recorded a maximum oil yield of 602 kg/ha followed by HDBRG x A-145 with 598 kg oil/ ha.

Among the alternate crops, maize and chickpea recorded highest gross income followed by mustard, gingelly and coriander under conserved soil moisture in Vertisols.

Crop Protection

For the management of stem borer, *Scrobipalpa heliopa* two sprays of Rynaxypyr 25 SC @ 0.0075% or Flubendiamide 480 SC @ 0.012% or Spinosad 45 SC @ 0.018% {one spray 10 days before pulling the seedlings in the nursery and one 10 days after transplanting (DAT)} or sequential spray of the above insecticides twice, one 10 DAT and another 20 DAT gave good protection from the stem borer infestation in the planted crop of FCV tobacco. Lancer gold (Acephate 50 % + Imidacloprid 1.8 % SP) @ 518 g a.i/ha was found effective against tobacco aphid *Myzus nicotianae*.

In Karnataka, growing resistant varieties with bio-agents viz., *Pseudomonas fluorescens, Paecilomyces lilacinus, Trichoderma viride* and *Aspergillus niger* in commercial formulations in a rational combination through fortified

vermicompost is found to be the answer for eco-friendly, non-chemical management of wilt disease in FCV tobacco crop. FYM enriched with bio-agents recorded significant decrease in damping-off at 35 DAS (41.1 to 52.4%), damping-off + blight at 45 DAS (44.1 to 52.9%) and black shank (45.7 to 58.3%) compared to untreated check. But the treatments differed significantly from chemical schedule, which was superior in decreasing the damping-off by 90%, damping-off + blight by 93.9% and black shank by 93.4% compared to untreated check.

Combined application of *P. lilacinus* with neem cake @ 1kg/m^2 recorded 34.4% increase in healthy transplants count and was on par with *P. lilacinus* with vermicompost @ 1 kg/m^2. The two treatments recorded significantly reduced RKI of 1.89 compared to 2.05 in Carbofuran @ 50g/m^2 treated beds (standard chemical check) and 3.86 in untreated check. Two bio-agents viz., *Bacillus thuringiensis Var. Kurstaki* and *Sl* NPV proved better in reducing the damage due to tobacco caterpillar, *Spodoptera litura* and increasing the transplantable seedlings over control.

Foliar application of *Trichoderma viride* and *Pseudomonas fluorescens* in combination was more effective in checking the infection of brown spot of *Jati* tobacco var. Manasi than their application alone in West Bengal.

Crop Chemistry and Soil Science

Soil fertility survey of chewing tobacco growing light soil areas of Dindigul district in Tamil Nadu revealed that the soils are alkaline in reaction, low in soluble salts and but high in chlorides. The soil organic carbon status is medium and available P and K status are high. A balanced dose of 100:50:50 NPK/ha with 10 t FYM /ha is essential to sustain higher yields.

Iron and manganese were present in the range of sufficiency at all the locations in the FCV tobacco leaf grown in SBS and KLS areas. Iron content ranged from 561 to 4129 mg/kg in SBS leaf and from 289 to 2204 mg/kg in KLS leaf. Manganese ranged from 65 to 244 mg/kg in SBS leaf and from 43 to 216 mg/kg in KLS leaf.

It is found that leaf nicotine, petroleum ether extractives (PEE) and solanesol have a positive influence on smoke tar, nicotine, CO and solanesol. However, leaf potassium and reducing sugars have a negative influence on smoke constituents. The ratios of reducing sugars/nicotine and potassium/ chlorides have a negative influence on smoke constituents.

Extension and TOT

In the on-farm trials conducted, performance of the two pipe line selections V-4219, V-4230 at Velerupadu in Khammam district and CTRI Research Farm exhibited superiority over the check Siri in yield characteristics and outscored the yield of Siri by 20 and 12.5 %, respectively in cured leaf yield at Velerupadu. The new hybrids CH-1 and CH-3 have performed better at three locations i.e., in upper NLS, middle NLS and lower NLS as compared to the check variety Kanchan.

To sum up, satisfactory progress has been made during the period in the important areas of tobacco research viz., development of high yielding varieties/hybrids with a yield potential of ~3,000 kg/ha in FCV tobacco and 4,000 kg in non-FCV tobacco, improving the input-use-efficiency which are the pre-requisites for sustaining the crop, apart from adopting IPM strategies and experimenting new chemicals for plant protection to reduce pesticide residues and identifying high seed yielding lines. A significant contribution has been made in the resource generation through realization of a record amount of Rs. 202.45 lakhs by way of revenue receipts (sale of tobacco leaf and seeds) and Rs. 27.59 lakhs through internal resource generation (analysis of soil, water, pesticide residues and leaf constituents).

INTRODUCTION

It is projected that the total world tobacco production is likely to increase from 6,002 million kg in 2008 to 6,210 million kg in 2009. Likewise, a 2.4% increase in the world flue-cured tobacco production is expected in 2009. Production has increased in most of the FCV tobacco growing countries except Brazil, Argentina and Zimbabwe. In the last two years, China has increased its flue-cured tobacco production by 350 million kg. However, in European Union, only a slight increase in production is envisaged. There is a significant increase in cigarette production in China, Vietnam, Indonesia, South Korea, Poland and Ukraine, while cigarette production has reduced in developed countries like USA, UK and Japan. In the present context, cigarette manufacturers are looking for markets other than Brazil and China and India has a such certain advantage.

The trends in tobacco area and production in India are summarised in Table 1. In Andhra Pradesh, 208.45 million kg of FCV tobacco was

Table 1: Area, Production and Productivity of different tobaccos in India (2008-09)

State	Type of tobacco	Area (ha)	Production (M kg)	Productivity (kgfha)
Flue-Cured Virginia Tobacco				
Andhra Pradesh	FCV	1,41,000	204	1,447
Karnataka	FCV	90,000	114	1,267
Non Flue-Cured Virginia Tobacco				
Karnataka	*Bidi*	15,000	15	1,000
Andhra Pradesh	*Bidi*	5,000	5	1,000
Maharastra	*Bidi*	5,000	5	1,000
Gujarat	*Bidi*	50,000	125	2,500
	Chewing	10,000	30	3,000
Tamil Nadu	Chewing	15,000	38	2,530
	Cheroot	1,500	2.5	1,670
West Bengal	*Motihari*	10,000	15	1,500
	Jati & *Podali*	4,000	6	1,500
Bihar	Chewing & Hookah	15,000	38	2,530
Uttar Pradesh	Chewing & Hookah	15,000	30	2,000
Andhra Pradesh	Irrigated *Natu*	10,000	25	2,500
	Rainfed *Natu*	10,000	10	1,000
Andhra Pradesh	HDBRG	4,000	10	2,500
Andhra Pradesh	*Lanka*	4,000	10	2,500
Orissa	*Pikka*	5,000	5	1,000
A.P. and Orissa	L.S. Burley	10,000	12	1,200
A.P and Karnataka	Oriental	1,000	0.5	500
Total for all Tobaccos		**4,20,500**	**700**	**1,665**

- Ten types of tobaccos are grown in the country.
- About 4.20 lakh ha of area is under tobacco cultivation.
- The total tobacco production in the country is 700 million kg.
- The average tobacco productivity in the country is 1665 kgjha.
- Around 225 M kg tobacco and tobacco products are exported to 100 countries, fetching Rs 3,383 crores of foreign exchange.

produced from an area of 1,40,875 ha in the 2008-09 crop season. Farmers realized an average price of Rs. 103.20 per kg as compared to Rs.84.75 per kg in 2008.

In Karnataka, 112.62 million kg was produced from an area of 1,06,602 ha in the 2009 crop season and marketed at an average price of Rs. 110.64. In 2009-10, the total exports touched Rs. 3,585.43 crores compared to Rs. 3,383.31 crores during 2008-09, accounting for a growth of 6% in terms of value. Thus, the situation provides an opportunity to increase exports from India in view of lower farm and export prices (Table 2).

Table 2: Tobacco Farm and Export prices in 2008-09

Country	Farm price (US $ per kg)	Export price (US $ per kg)
USA	3.42	6.94
Zimbabwe	3.24	3.02
Brazil	3.24	5.11
India	2.11	2.90

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 tobacco seeds of notified varieties
- 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

Major Research Programmes

1. Germplasm Resource Management
2. Tobacco Cultivar Development
3. Biotechnology in Tobacco Improvement
4. Crop Production Technology
5. Cropping Systems for Sustainable Production
6. Bio-ecological and Pathological Studies on Pests and Diseases
7. Integrated Pest and Disease Management
8. Soil Fertility, Water Quality and Nutrient Management
9. Alternative Uses of Tobacco and Reduction of Harmful Substances
10. Agricultural Extension and Information Technology

Analysis of the global and Indian tobacco situation has projected on the following challenges in the immediate future:

- Ever increasing need for quality FCV tobacco with less harmful substances
- Rational management of soil resource base
- INM, IPM for sustaining tobacco production
- Need for higher input-use-efficiency especially SOP
- Rational use of irrigation water
- Exploring the low-cost eco-friendly pest management options
- Reduction of harmful substances
- Non-availability of labour-saving farm machinery
- Scarcity of fire-wood for curing
- A strong anti-tobacco lobby in the post FCTC regime

To address the challenges ahead, emphasis is laid on the critical areas viz., improving the yield and quality and to reduce the area; to reduce the cost of cultivation; integrated soil and water management; input-use-efficiency, farm mechanization and energy conservation for enhancing profitability. Accordingly, the following **"Immediate Research Priorities"** have been identified, keeping in view the recommendations of the Research Advisory Committee (RAC), Quinquennial Review Team (QRT) - 2003-08 and the Institute Research Committee (IRC).

- Increasing the vertical growth through productivity enhancement
- Reduction of harmful substances through genetic and agronomical manipulation
- Micro-irrigation to increase water and nutrient-use-efficiency
- Increasing nitrogen and potassium use-efficiency
- Alternative crops/ cropping systems for *Bidi* and chewing tobaccos
- Exploiting tobacco for alternative uses
- Tobacco as a source of flavour compounds viz. Solanone, Megastigmatrienone, Damascenone etc.
- To identify the nature and quantity of flavour imparting compounds in tobacco, since tobacco flavour is sum total of aroma and taste

In this background, the following new projects have been approved by the Institute Research Committee (IRC) in 2009.

1. Evaluation of FCV tobacco hybrids for yield and quality under SLS conditions'
2. Investigations on coirpith utilization in tobacco production
3. Development and testing of bio-dynamic manure suitable for Burley tobacco production
4. Integrated weed management in FCV tobacco grown under irrigated Alfisols
5. Effect of graded levels of K on the occurrence and intensity of root-knot incidence and K-utilization pattern of FCV tobacco crop in KLS
6. Monitoring the incidence of pests and diseases in KLS tobacco
7. Bio-intensive management of nematodes in FCV tobacco of KLS using tray nurseries
8. Weather-based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions
9. Nursery and field evaluation of *Trichoderma viride* and *Pseudomonas fluorescens* to brown spot disease and yield and quality of *Motihari* tobacco
10. Management of tobacco caterpillar, *S. litura* in tobacco with eco- friendly insecticide baits
11. Spatial distribution and pest succession of insect pests as influenced by cultural practices in Burley tobacco in the plains of East Godavari
12. Studies on monitoring resistance in *Helicoverpa armigera* to *Bt* toxins and other insecticides on cotton, tobacco and chickpea
13. On-farm testing of new lines/selections (YB-4, YB-10) in Burley tobacco
14. On-farm demonstration of production technology for Sabari *Lanka* tobacco in Khammam District

Infrastructure

The infrastructure/equipment required to conduct research in the frontier areas have been upgraded with XI plan funds. Sophisticated equipment like Gas Chromatograph-Mass Spectrometer (Rs. 38.60 lakhs), NMR Spectrometer (Rs. 23.00 lakhs), Microscope Documentation System with FISH-GISH (Rs. 16.50 lakhs) and Real Time PCR Machine (Rs. 11.70 lakhs) have been procured and put to use.

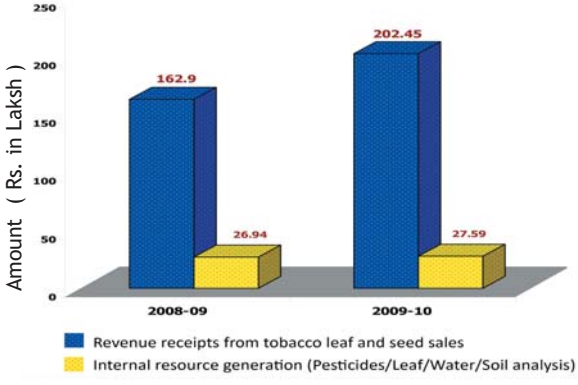
STAFF POSITION AS ON 31.03.2010

Sl. No	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	70+1	37+1	33
2.	Technical Category-III(T-6 to T-9) Category-II(T-II-3 to T-5) Category-I(T-1 to T-I-3)	 04 53 93	 03 44 86	 1 9 7
3.	Ministerial	74	65	9
4.	Skilled Support Staff	160	134	26
5.	Casual Workers on Temporary Status	-	160	-
	Total	455	370	85

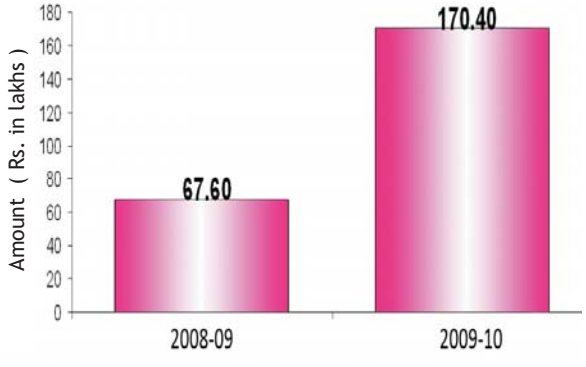
FINANCIAL STATEMENT FOR THE YEAR 2009-10

Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	2,132.69	2,132.69
Plan	200.00	200.00
KVK	102.25	102.25
NATP	200.00	200.00
AP Cess Fund Schemes	—	—
Pension & Retirement benefits	650.00	650.00
Personal Loans & Advances	13.20	13.20
Recurring Deposit Schemes	20.08	18.88
Revolving Fund Scheme	72.04	143.63
Internal Resource Generation	27.77	3.38
Total	3,418.03	3,464.03
Revenue Receipts	Target 99.00	Achievement 202.45

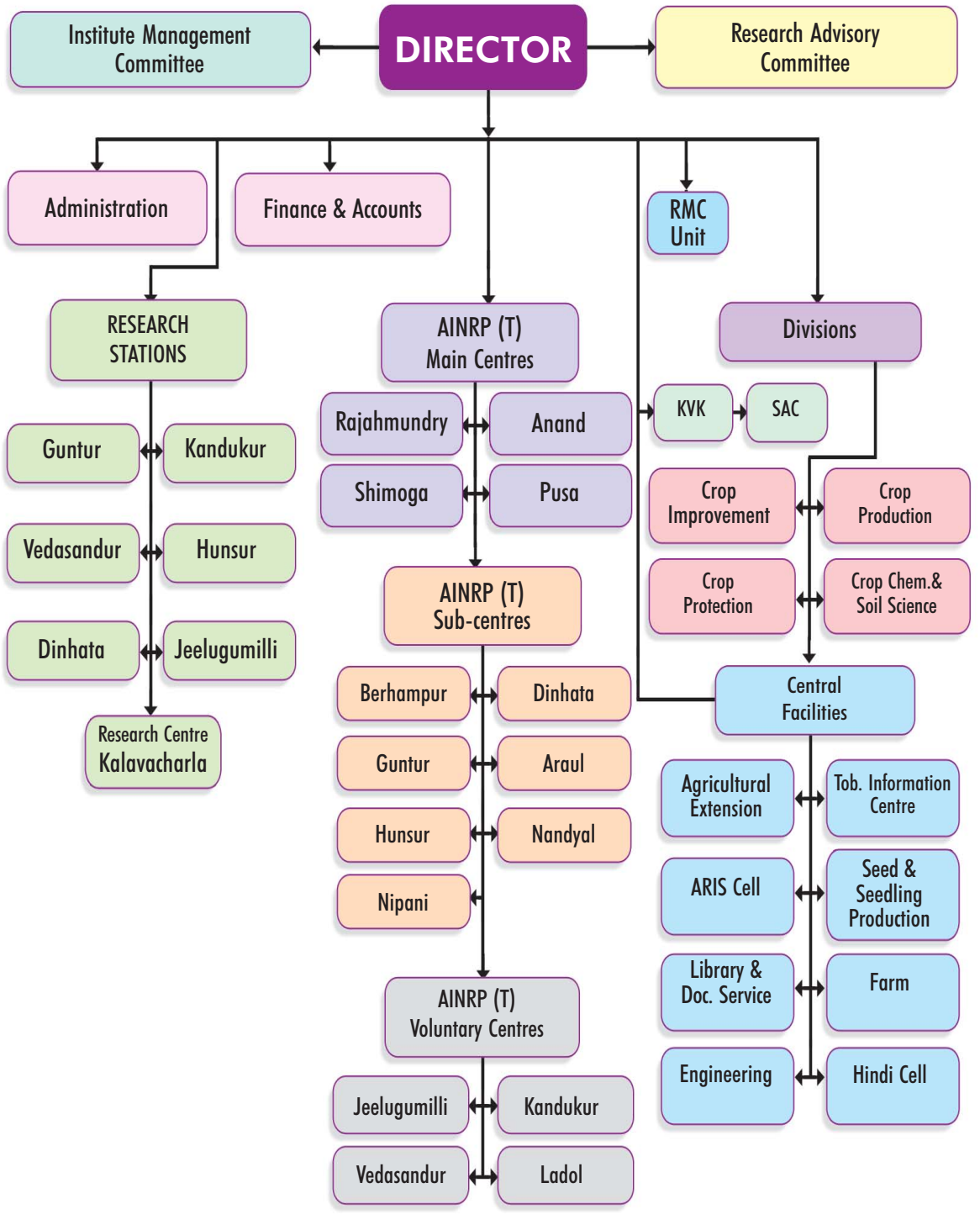
RESOURCE GENERATION DURING 2009-10



AMOUNT REALIZED THROUGH SALE OF TOBACCO SEED AND SEEDLINGS IN A.P.



INSTITUTE ORGANOGRAM



Research Achievements

PROGRAMME 1

GERMPLASM RESOURCE MANAGEMENT

CTRI, Rajahmundry
Germplasm acquisition, maintenance, evaluation and utilization

(T.G.K. Murthy)

Acquisition

During the year, 12 land races collected in Assam and Kerala were rejuvenated. Out of them, 10 belonged to *N. rustica* while two are *N. tabacum*.

Maintenance of cultivated germplasm

Out of the **2460** accessions available with CTRI, **1286** lines that comprised 453 flue-cured Virginia (FCV) and 516 non-FCV lines were rejuvenated. Also, a total of 317 identified elite lines for various important traits (varieties 83, NRPT entries 70; insect resistance 39, high seed oil 11, low nicotine 9, root-knot resistance 9, TMV resistance 6, CMS 6; multiple resistance 42, flavour 9) were maintained.

Maintenance of wild *Nicotiana* species

During the season, **202** accessions of **61** wild *Nicotiana* species and two sub-species were maintained in pots or experimental micro-plots. This is the largest number maintained ever. Besides the wild species, 9 exotic interspecific hybrids, 5 hybrids produced at CTRI and four amphidiploids were also maintained. Fifteen non-flowering/non-seed setting species were rescued through *in vitro* micropropagation.

Conservation

All the germplasm accessions maintained during the past five years have been kept for medium term storage in the cold storage.

Seed supply

During 2008-09, a total of 364 accessions of both wild and cultivated *Nicotiana* species were supplied to 29 different researchers in the country.

Evaluation

1. Identification of plant type suitable for seed yield

Among the non-FCV tobacco germplasm, 19 lines with compact plant type, large and compact inflorescence and large capsule size were selected for evaluation during the next season for seed yield related traits in a separate experiment. The lines were: Debricane B, Montgomery Dwarf, Kefee, Kozarsko 240, Marox, Simmamba, Tance, Trapizond-7, Visoka, V-160, Connecticut 7-D, Katsuy, Madras-T, Miurahazamond, NC39385, RK-70, Erzegovina-93, Harmanli-163 and Tekne-61.

2. Biochemical/molecular characterization

Fifty one wild *Nicotiana* species were submitted for estimation of seed oil content and fatty acid profile.

Eighteen Burley germplasm samples were submitted for biochemical characterization.

Reaction of *Nicotiana* germplasm to *Orobanche* infestation

Thirty seven *Nicotiana* species accessions were raised under high natural infestation pressure of *Orobanche* at Katheru farm. Screening of the accessions in collaboration with Plant Pathologist revealed no infestation in *N. stocktonii*, *N. repanda*, *N. x benthamiana-repanda*, *N. x umbratica-*

nesophil, TW-101 and *N. nesophila*. Two species viz., *N.* sp. EC554935 and *N. nudicaulis* showed very low infestation.

Among the species studied, number of *Orobanche* spikes per infested plant varied from 1.0 to 20.2. In general, accessions of *N. tabacum* supported high number of *Orobanche* spikes as compared to wild species. Out of 41 species screened under artificial field inoculation by the Plant Pathologist, the infestation was very low in general and 36 species were free from infestation. .

Results of studies made under natural and artificial inoculation conditions during the last four seasons revealed that species viz., *N. repanda, N. stocktonii, N. trigonophylla, N. rotundifolia, N. palmeri, N. undulata, N. nudicaulis, N.* sp. *EC554935; species hybrids B. x benthamiana-repanda and N. x umbratica-nesophila* were promising against *Orobanche* infestation.

Thirteen of the wild species that showed varied reaction to *Orobanche* infestation were submitted to the Biochemist for molecular and biochemical characterization.

3. Molecular characterization of land races and exotic germplasm of *N. rustica*

Six land races of *N. rustica*, collected from Haryana, Assam and Meghalaya (NGP07/18, NGP07/20, NGP07/21, NGP08/8, NGP08/9, Bawal), three lines imported from USA (TR-70, TW-117, Coker-1) and three ruling varieties (Dharla, DD-737, HD65-40), were characterized for polymorphism in isozyme loci of peroxidase, acid phosphatase, malate dehydrogenase, superoxide dismutase, catalase and polyphenoloxidase. The genetic similarity among the genotypes, varied between 20% (NGP07/18 & NGP08/8) and 60% (NGP08/9 & Dharla).

Among the three varieties, the similarity was 69% (DD-437 & Dharla) to 86% (Dharla & HD 65-40). The three released varieties along with 3 exotic accessions and 3 land races constituted one cluster, whereas the other three land races constituted the second distinct cluster. Within cluster 1, the 3 varieties formed a sub-cluster. Two land races, NR Tura (NGP08/9) and NR Damalgere (NGP08/8) were genetically close to the 3 released varieties. Land races collected from Assam and Haryana were genetically distant from cultivated varieties of West Bengal. Land races of *Jati* (*N.tabacum*) tobacco from Tripura were collected during 2010 for characterisation.

4. Evaluation of yield and quality

Trial VT- 13 (2006-09)

Nine advanced cross derivatives were evaluated along with three check varieties viz., Siri, VT-1158 and Hema in a RBD with 3 replications for leaf yield characteristics and leaf quality.

Combined statistical analysis of the data collected on the yield trial over three seasons (2006-09) was done for identifying promising lines. One advanced line, R 2-3 exhibited significantly superior performance over the best check, Siri with 31% increase in green leaf yield, 26% for cured leaf, 27% for bright leaf and 28% for grade index, respectively. Also, another derivative, R55-1 showed significant increase for green leaf (15%), cured leaf (9%) and bright leaf yield (14%) over Siri. Seasonal differences among yield traits were significant and yield levels during 2007-08 were lower than other two seasons. Season x entry interaction was also significant for all the four yield traits.

Chemical quality parameters like nicotine, reducing sugars and chlorides analyzed during the first 2 years of the trial were well within acceptable limits.

Based on the overall performance, the advanced interspecific cross derivative, R2-3 will be proposed for multi-location testing under AINRPT.

CTRI Research Station, Guntur

Rejuvenation of *Natu* germplasm

(A.V.S.R. Swamy)

About 151-*Natu*/Oriental/ HDBRG/Burley/ *Motihari*/tobacco germplasm lines were maintained and nucleus seed was collected for the next year.

CTRI Research Station, Kandukur

Rejuvenation of *FCV* germplasm

(A.R. Panda)

Three hundred sixty (360) accessions of FCV tobacco germplasm were maintained.

CTRI Research Station, Vedasandur

Maintenance of germplasm

(A.V.S.R. Swamy)

As a regular programme, 85 chewing and 60 cigar and cheroot germplasm accessions were raised, self pollinated and seed was collected for maintenance.

Maintenance of Male sterile lines

Cytoplasmic male sterile lines of Bhagyalakshmi, Abirami, Maragadam, PV-7, I-115, VTK-1 and VR-2 were crossed with their respective fertile counterparts and seeds collected for maintenance of the male sterile lines.

CTRI Research Station, Hunsur

Germplasm maintenance of *Nicotiana tabacum* varieties/ lines

(K.N. Subrahmanya and M.M. Shenoi)

Active stock of 627 germplasm accessions is maintained. Under the periodical seed multiplication programme, 240 germplasm accessions were regenerated. Five new genotypes were added to the gene bank during the year. All the five new accessions showed susceptible reaction to *Fusarium* wilt disease. Two accessions showed susceptible reaction to root-knot disease recording >2 RKI.

CTRI Research Station, Dinhata

Germplasm resource management

(S. Amarnath)

Ten plants of each of 240 lines of *N. tabacum* (*Jati*, Cigar Wrapper and Cigar Filler) and 185 lines of *N. rustica* (*Motihari*) tobacco were grown and 3 healthy plants in each line were selfed and seeds of each line were collected for use in the ensuing season.

PROGRAMME 2

TOBACCO CULTIVAR DEVELOPMENT

CTRI, Rajahmundry

Evolving superior varieties of FCV tobacco through hybridization

(P.V. Venugopala Rao)

Sub-project: Br 2(a) VIII: Evaluation of advanced breeding lines for yield and quality

Final year of replicated trial was conducted with nine advanced breeding lines viz., V-4339, V-4340, V-4343, V-4344, V-4350, V-4351, V-4361, V-4362 and V-4367 along with the check varieties VT-1158, Hema and Siri. Results of combined analysis revealed that the treatments differed significantly for all the yield characters studied. The seasons, treatments and seasons x treatments interaction also differed significantly.

Green leaf yield was highly significant in V-4344 and V-4343 compared to the better control Siri. V-4344 (12,364 kg/ha) recorded maximum green leaf yield with an improvement of 13% over the better control Siri (10,815 kg/ha). Next better performer was V-4343 (11,994 kg/ha) with an improvement of 10% over Siri.

Among the selections evaluated, significantly higher cured leaf yield was recorded in V-4344 and V-4343. The yield was highest in V-4344 (1,805 kg/ha) with an improvement of 10% over the better control Siri (1,644 kg/ha), followed by V-4343 with an improvement of 8%.

Bright leaf yield was significant in V-4367, V-4344 and V-4343. V-4267 recorded maximum bright leaf yield of 1,137 kg/ha with 11% improvement over the better control Siri (1,027 kg/ha), followed by V-4344 (1,110 kg/ha) and V-4343 (1,103 kg/ha) and the improvement over the better control Siri was 8 and 7%, respectively.

Grade index was also significant in V-4344, V-4367 and V-4343. V-4344 (1,456/ha) recorded maximum grade index with an improvement of 9% over the better control Siri (1,336/ha), followed by V-4367 (1,446/ha) and V-4343 (1,443/ha) with an improvement of 8%.

Seasons differed significantly for all the four yield characters studied. The best season for all the yield characters was 2007-08 with an over all means of 12,635 kg/ha green leaf, 1,820 kg/ha cured leaf, 1,119 kg/ha bright leaf and 1,434/ha grade index.

Nicotine content in the entries ranged from 0.91 to 2.79%. Higher nicotine of 2.79% was recorded in V-4351. Reducing sugars ranged from 14.71 to 21.86% and V-4340 recorded maximum reducing sugars (21.86%). Chlorides ranged from 0.66 to 1.26% with lowest chlorides being recorded in V-4344.

Based on the performance of the selections over three years, it is concluded that among the selections V-4344 and V-4263 with significantly superior yields of all kinds and V-4367 with significantly superior bright grade and grade index were proposed for testing in the Initial Varietal Trial (IVT) under the All India Network Research Project on Tobacco (AINRPT).

Sub-project: Br 2(a) IX: Evaluation of advanced breeding lines for yield and quality

Yield parameters

In the replicated yield trial, nine advanced breeding lines viz., V-4377, V-4379, V-4380, V-4388, V-4391, V-4392, V-4393, V-4404 and V-4405 were evaluated against three controls VT-1158, Hema and Siri for the second consecutive year. Significant differences were recorded in all the four yield characters.

Line V-4388 recorded highly significant green leaf yield with 11,674 kg/ha, followed by V-4380 with 11,573kg/ha. The yield improvement of V-4388 and V-4380 over the better control, Siri (10,395 kg/ha), was 12 and 11%, respectively.

Cured leaf yield was highly significant in V-4388 (1,881 kg/ha) followed by V-4380 (1,827kg/ha) compared to the better control Siri (1,636 kg/ha) and the yield improvement over Siri was 15 and 12%, respectively.

Bright leaf yield was significant in V-4388 (1,168 kg/ha) followed by V-4380 (1,154kg/ha) and V-4392 (1,149kg/ha) compared to the better control Siri (993 kg/ha) and the yield improvement was 17, 16 and 16%, respectively.

Grade index was significant only in V-4388 (1,570/ha) compared to the better control Siri (1,376/ha) and the improvement over Siri was 14%.

Nicotine content in the entries ranged from 1.24 to 2.43%. Higher nicotine (2.43%) was recorded in V-4388. Reducing sugars ranged from 14.06 to 20.83%. Hema recorded maximum reducing sugars of 17.59%. Chlorides ranged from 0.72. to 1.75%.

The line V-4388 with an yield improvement of 12, 15, 17 and 14% in green leaf, cured leaf, bright leaf and grade index, respectively performed well compared to the better control Siri during second year of trial (2008-09), followed by V-4380.

Preliminary evaluation of advanced breeding lines in row trial

Thirty one advanced breeding lines viz., V-4835 to V-4855 (21 lines) and V-4948 to V-4957 (10 lines) were evaluated in a row trial along with the controls, VT-1158, Hema and Siri to identify the potential lines with higher yield. Based on the yield and morphological characters, nine selections viz., V-4848, V-4955, V-4948, V-4954, V-4835, V-4852, V-4853, V-4846 and V-4837 were identified for further evaluation in a replicated trial as Br 2(a) X during 2009-10.

Interspecific hybridization: Breeding tobacco varieties resistant to pests and diseases utilizing relevant donor species. Incorporation of aphid resistance from *N. gossei, N. repanda, N. umbratica - nesophila* and N. *benthamiana - repanda*

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

1. Maintenance of interspecific cross derivatives

During 2008-09, 78 single plant-to-row progenies in F_{11}-F_{12} and different back cross generations, 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 raised in experimental plots along with susceptible cultivars.

Details of interspecific cross derivatives maintained during 2008-09

Initial cross

N. gossei x cv. CM-12
cv. HR 62-9 x *N. gossei*
(*N. x gossei-excelsior*) x CM-12
(*N. x benthamiana-repanda*) x cv. CM-12
Delcrest x [(*N. gossei x N. glutinosa*) x CM-12]
Delcrest x [(*N. gossei x N. glutinosa*) x (cv.HR 62-9 x *N. gossei*) x Bhavya]
N. umbratica x N. tabacum

Susceptible checks: Hema, VT 1158, Kanchan, Siri and *Lanka* Special

Immune parent: *N. gossei*

Fifty six of the families were found to have attained uniformity for various morphological and yield traits.

2. Reaction to natural aphid infestation

Natural aphid infestation was reasonably low during the season. Most of the derivatives (70) were free from aphid infestation.

3. Generation advancement and selection

The derivatives exhibited variability for plant type (FCV, Burley, *Natu*, chewing, *Lanka* and very light coloured leaf mutants), biomass, plant height, canopy type, internodal length, phyllotaxy, earliness, leaf colour, number of leaves, lamina size, size and shape of auricle & petiole, curability, flower colour, fertility, etc.

Cross derivatives identified for evaluation of yield potential and leaf quality in replicated trials

Black soils	Code 9-1, 30-1, 35-1, 80-1, 85-1, 113-1, 116-2, 119-1, 125-3, 134-1, 138-3, 144-1
Light soils	51-3, 53-1, 56-1, 58-1, 59-5, 64-2, 131-1, 132-1, 139-1, 145-3, 146-1
Lanka	65-1, 135-2, 135-3, 182-1, 183-3, 185-1, 186-1, 189-2, 189-3

4. Evaluation of advanced lines for yield and quality

a) Trial TBL-2 (2006-09)

(i) Pooled analysis (2006-09)

Combined statistical analysis of the data collected on the yield trial over three seasons (2006-09) revealed that four advanced cross derivatives viz., TBST-16, TBST-11, TBST-17 and TBST 18 exhibited significantly superior performance over the best check, Siri, for different yield traits. These lines showed 13 to 25% increase in green leaf yield, 16 to 24% in cured leaf, 13 to 19% in bright leaf and 21 to 30% in grade index, respectively over the best check, Siri.

Seasonal differences were significant and yield levels during 2008-09 were lower than other two seasons. Season x entry interaction was also significant for all the four yield traits.

In general, nicotine, reducing sugars and chlorides were within the prescribed limits in the advanced cross derivatives. The characteristic features of the four best performing lines:

Line	Characteristic features
TBST-16	6' height, light cast, big leaf, close internodes , 33 leaves, elliptic, heavy body
TBST-11	6' height, light cast, big leaf, close internodes, 34 leaves elongate leaf, cured leaf colour good and bodied
TBST-17	6', big leaf size, close internodes, 32 leaves, ovate-elliptic, cured leaf colour good, medium-heavy body.
TBST-18	6', big leaf size, close internodes, 32 leaves, ovate-elliptic, cured leaf colour good, heavy body
Siri	6', close internodes, light cast, 30 leaves, good leaf colour

Based on the overall performance, all the four entries viz., TBST-16, TBST-11, TBST-17 and TBST 18 will be proposed for further studies.

b) Trial TBL-3 (2nd year)

A replicated yield trial was conducted for the second season with 10 morphologically stable advanced cross derivatives along with three checks in a RBD for evaluating their yield potential and leaf quality.

All the breeding lines were light cast. Derivatives TBST-27, TBST-21, TBST-22 and TBST-24 had desirable plant type and leaf colour besides good plant vigour. Lines TBST-20, TBST-21 and TBST-22 had bigger leaf size than others.

Differences among entries were significant for all the four yield traits. The following derivatives were found promising for various yield traits:

Green leaf:	TBST-27 (31%), TBST-21 (20%), TBST-22 (15%)
Cured leaf:	TBST-27 (30%), TBST-21 (17%), TBST-22 (16%)
Bright leaf:	TBST-27 (28%), TBST-21 (16%), TBST-22 (14%)
Grade index:	TBST-27 (30%), TBST-21 (16%), TBST-22 (14%)

(Figures in parentheses: Increase over the best check, Siri)

Colour, body and size of cured leaf were good in the entries in the following order: TBST-21, TBST-25, TBST-27, TBST-22 and TBST-20. The levels of nicotine and reducing sugars were within prescribed limits.

d) Progeny row trial

During 2008-09 season, 108 stabilized aphid resistant advanced interspecific cross derivatives were grown in progeny rows and after evaluation of plant type, leaf colour and body, leaf number, plant height, floral and fertility traits and seed bearing nature, the most promising and morphologically uniform lines were retained for further agronomic evaluation. Yield potential of the derivatives varied from 1,400 kg/ha to 2,650 kg/ha as against 1,500 to 2,000 kg/ha in different plots of the best check variety, Siri. Twenty two selections with yield potential of over 2,000 kg/ha besides leaf quality suitable for black soils were retained for further studies. Leaf samples of 24 best performing lines in replicated trials and progeny row trial were given for molecular characterization. Also, *Natu* type selections with over 25 leaves per plant were made and multiplied for further studies. About 1150 plants belonging to 77 identified advanced lines and F_3 progenies were screened in collaboration with Plant Pathologist for reaction to TMV under artificial inoculation. Thirty seven lines with uniform resistance were identified.

5. Maintenance of cross derivatives resistant to caterpillar and tolerant to leaf curl disease

Nine advanced interspecific cross (*N. gossei x N. tabacum* and *N. umbratica x N. tabacum*) derivatives previously identified as resistant to leaf eating caterpillar, were maintained. Also, 30 derivatives developed from crosses, *N. gossei x N. tabacum* and *N. umbratica x N. tabacum*, screened and identified as tolerant to leaf curl disease, were maintained.

6. Maintenance and utilization of newly developed CMS lines

A CMS line, 6-6 developed from this project has been found to be a good parent for production of tobacco hybrids with higher leaf yield and quality. This CMS source (in VT 1158, Kanchan and Rathna genetic backgrounds) is being used in the hybrid breeding programmes in NBS, NLS and KLS zones.

7. Identification of genetic male sterility

Segregation of male sterile and fertile plants was observed in the progenies of cross 72-21MS x VT 1158. Fertile plants that segregate for male sterile and fertile plants were identified in F_4 progeny of the cross and selfed. Out of the 14 selfed progenies raised from 14 fertile plants, six progenies segregated for CMS and fertile plants in different ratios.

8. 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 (50 FCV lines) and CTRI RS, Jeelugumilli (95 FCV) and CTRI RS, Guntur (40) for further evaluation.

9. Maintenance of other important genotypes

In addition to the above, the following genetic stocks/lines were also developed under

the project and maintained for future use: (i) Autotetraploids induced in lines VT-1158 and CM-12 and their selfed derivatives, (ii) Corolla-split variants, (iii) 'Asynaptic line', (iv) 'Translocation heterozygotes', (v) Variegated mutants and (vi) Cream coloured testa (the variant was digenic recessive to brown coloured seed coat).

Evaluation of advanced breeding lines for yield and quality

(K. Sarala, P.V. Venugopala Rao, T.G.K. Murthy and C.A. Raju)

Replicated trial (2nd year)

Six somaclones and five advanced breeding lines were tested in a replicated trial for the second consecutive year along with three controls, Hema, VT 1158 and Siri. Significant differences were observed among the tested lines for all the yield characters. Among the lines, the line VTCMV-1-3 and RS-10 recorded higher leaf yields than all the lines and control. The line VTCMV-1-3 showed significantly higher green (16,719 kg/ha), cured (2,781 kg/ha) and bright (1,689 kg/ha) leaf yields and grade index (2,347) than Siri with an increase of 12, 11, 12 and 11%, respectively. Green and bright leaf yields and grade index values of RS-10 are significantly superior to VT 1158 only. Rs-10 recorded an increase of 6, 4, 4 and 5% in green, cured and bright leaf and grade index values, respectively over Siri.

Observations on the morphological characteristics of breeding lines revealed that plant height, total number of leaves, number of curable leaves and leaf length were found to be significant among the lines tested, whereas, leaf width and internodal length were found to be non-significant. Maximum plant height (210 cm) was recorded in VTCMV-41-2; total leaf number (34) and number of curable leaves (30) in Siri and leaf length (63 cm) in VTCMV-1-3.

The chemical quality characteristics viz., nicotine, reducing sugars and chlorides are found to be in acceptable limits.

The variety Siri was raised in bulk, nucleus and breeder seed were collected. Seventy advanced breeding lines were raised and seed was collected for maintenance. Six F_2s were raised and plants with desirable morphological characters and few with TMV resistance were selected and selfed seed was collected.

CTRI Research Station, Jeelugumilli

Evolving FCV tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh

(T.G.K. Murthy)

(i) Preliminary evaluation of advanced breeding lines

A progeny row trial was conducted with 128 advanced lines (F_7 – F_{11}) along with the check variety Kanchan to identify selections suitable to NLS area. Ninety of the selections were found to be morphologically uniform. Cured leaf yield varied from 1,260 to 3,900 kg/ha among the advanced lines, as against 1,400-1,800 kg/ha in the check variety, Kanchan in different plots. Promising lines for leaf number (35-45), leaf colour (medium-dark), leaf nature (NLS type or flat type), internodal length, plant type (normal type and bouquet type) were identified among the lines and advanced for further evaluation.

In addition to high yielding selections, four semi-dwarf selections (RT 9 to RT 12) having compact plant type and very short internodes, suitable for close spacing were also identified and selfed for further study.

About 1,500 plants were screened against TMV disease under artificial inoculation and resistant plants were identified and promising plants were selfed for further studies.

(ii) Generation advancement and selection

F_4 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 were

advanced. Also, F_5 progeny of crosses involving Kanchan and aromatic lines, Soluky and Izmir, were grown. Five selections with suitable plant habit, small leaf size and yield were made and advanced for further studies.

(iii) Replicated yield trials

a) Trial RYT-9 (2006-09)

Nine medium green cast advanced breeding lines were evaluated along with the check Kanchan for yield and leaf quality traits in a RBD with three replications for three years in succession.

Combined statistical analysis of the data collected in the yield trial over three seasons (2006-09) was done for identifying promising lines. Three advanced cross derivatives viz., 312MC-1, JL130-3 and 325X1-D exhibited significantly superior performance over the check, Kanchan for all the three leaf yield traits with 33, 24 and 18% increase in green leaf, 37, 31 and 19% in cured leaf and 38, 39 and 20% in grade index, respectively. Seasonal differences were significant for grade index only. The season x entry interaction was significant for all the four yield traits.

The contents of nicotine, reducing sugars and chlorides were, in general, within prescribed limits in most of the entries.

Based on the overall performance, three entries viz., 312MC-1, JL 130-3 and 325 x 1-D will be proposed for multi-location testing under AINRPT.

b) Trial RYT-10 (2nd year)

Nine medium green/green cast advanced breeding lines were evaluated along with the check Kanchan for yield and leaf quality traits in a RBD with three replications for the second year in succession. Analysis of data indicated significant differences for green and cured leaf yields and grade index among the entries. The following derivatives were found promising for various yield traits:

Green leaf

M31N5N4#2 (42%), M31N5CMN4#2 (40%), H48-1 (28%), NS18#1 and M31N5VT#2 (18%)

Cured leaf

M31N5N4#2 (41%), M31N5CMN4#2 (39%), H48-1 (25%) and NS18#1 (22%)

Grade index

M31N5N4#2 (49%), M31N5CMN4#2 (39%), NS18#1 (32%) and H48-1 (27%)

(Figures parentheses: Increase over best check, Kanchan)

The test entries possessed very good physical attributes of cured leaf such as colour, size and body in the following order: M31N5CMN4#2, 323K-31-1-1, NS 16 # 1 NS 18 # 1 and M31N5N4#2. Leaf attributes in the other cultures were also desirable. Nicotine and reducing sugar levels were within the desirable limits.

Developing new varieties of irrigated *Natu* tobacco for Andhra Pradesh

(T.G.K. Murthy)

Eight advanced breeding lines, identified as superior to checks in the previous bulk assessment trials, were grown in progeny bulks, each comprising 120 to 200 plants. Among all the lines, Kommugudem Sel#1, Sel. 47 and Sel.46 appeared promising.

b. Generation advancement and selection

F_2 generation of two crosses, Singarajupalem x Kommugudem and Kommugudem x 45-90 was grown during 2008-09 season and a number of plants with desirable plant type, height, phyllotaxy, leaf shape and internodal length, were advanced.

Natu type of selections were made in F_5 generation of interspecific cross (*N. gossei x N. tabacum*) derivative, 325X-VTSel#1. Leaf number in selected progenies varied from 20 to 31 per plant in these selections.

At Rajahmundry, five *Natu* type selections (R-181, R-182, R-184, R-185, R-187) made among the advanced derivatives of interspecific cross (*N. tabacum x N. gossei*) were found to breed true for the plant type. Leaf number in these selections varied from 20 to 30 per plant. Identified single plants with higher leaf number and compact plant type were selected for further evaluation in a replicated trial.

On-farm trial

One location-specific trial was conducted with the promising advanced *Natu* breeding line, 45-90 at Palacherla village near Jeelugumilli. Line 45-90 was reported to be superior in terms of yield and leaf size to check Kommugudem.

Burley Tobacco Research Centre, Kalavacharla

Evaluation of advanced Burley breeding lines for productivity and quality

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

A replicated trial was conducted with fourteen advanced breeding lines (YB-1 to YB-14) along with three controls viz., Banket A1, Burley-21 and BSRB-2 (Swetha) with three replications. Being first year of the trial at this new location, gaps were more in the experimental plots in this season and hence, it is proposed to repeat the trial during 2009-10.

Evaluation of segregating material

Progeny row trial was conducted involving 37 F_5 progenies. Selections were made based on the morphological characters like leaf size shape, colour of leaf, stem and veins, number of leaves, internodal length, spotting, etc. Out of 37 progenies studied, 56 selections were made and further evaluation of the selections will be taken up during 2009 -10.

Incorporation of male sterility (CMS) in Burley varieties

The BC_4 crosses involving the male sterile hybrids BRK-1, BRK-2, TN-97, NCBH-127 and NC-3 were raised and back crossed with the respective male fertile recurrent parent viz., Banket A1, Burley-21, VA-510, Banket-127. The seed was collected to raise the BC_5 seedlings during 2009 -10 for further back crossing to the recurrent parents.

CTRI Research Station, Guntur

Development of FCV tobacco varieties suitable for cultivation in CBS and SBS of Andhra Pradesh

(A.V.S.R. Swamy)

Sixteen and twenty F_5 selections of the crosses, GH-9 (V-3703 x KST-26), GH-10 (V3703 x Cy-79) and GH-14 (V-3703 x Hema) were raised under CBS and SBS conditions, respectively. The experiment was raised under SBS conditions at B. Nidamanur (Prakasam district) during 2008-09 season.

Selections for CBS

Under CBS conditions, 6 selections of the 1st cross (V-3703 x KST-26) namely GH-9#1, GH-9#14, GH-9#23, GH-9#25, GH-9#34 and GH-9#39 have been raised. Out of these, GH-9#1, GH-9#23, GH-9#25 have been selected for testing under RBD during the ensuing season along with the other combinations having higher cured leaf yield and attained stability. The cured leaf yield in these selections ranged from 3,501 to 3,609 kg/ha.

In the 2nd cross (V-3703 x Cy-79), 6 selections were tested out of which only one cross GH-10#35 that yielded 3,412 kg/ha was selected and included for testing under RBD during the next season.

Out of 4 selections that emanated from the cross (V-3703 x Hema), only one selection i.e., GH-14#33 with higher cured leaf yield i.e. 3,635 kg/ha was selected for testing under RBD during the next season.

Selections for SBS

The experiment was conducted with 20 F_5 selections in three cross combinations under

SBS conditions at Medarametla, Prakasam district. In the 1st cross, (V-3703 x KST-26) , five selections namely GH-9#1, GH-9#14,GH-9#22, GH-9#23, GH-9#25, having higher cured leaf yield ranging from 3,195 to 3,628 kg/ha were selected for testing under RBD during the ensuing season.

In the 2nd cross (V-3703 X Cy-79) only one selection namely GH-10#35 was selected as it has yielded higher cured leaf of 3,462 kg/ha. The yield of this line has also stabilized under field conditions.

FCV bulk trial

New pipe line entry promoted from AVT-2 namely 147 M x 1-21 was raised along with released varieties for evaluating the yield potential. The entry has given higher cured leaf yield and grade index i.e., 3,749 kg/ha and 2,959, respectively.

***Natu* bulk trial**

Among the *Natu* entries, the advanced high yielding selection II-1873 gave maximum cured leaf yield of 2,808 kg/ha.

CTRI Research Station, Kandukur

Breeding FCV tobacco varieties for yield and quality characters under SLS conditions

(A.R. Panda, V. Venkateswarlu, K.C. Chenchaiah, P.V. Venugopala Rao, T.G.K. Murthy, K.N. Subrahmanya, A.V.S.R. Swamy and C. V. N. Rao)

Thirteen cross combinations viz., Hema x Wildfire Ornico, Hema x NC-3150, Hema x NC 12, Bell 93 x F-212, Bell93 x Cock tobacco, Cock tobacco x F-212, Cock tobacco x Cor-14, F-212 x Nc-3150, Cor-14 x Nc-3150, Siri x F-212, Siri x Bell-93, Siri x Nc-3150, Siri x Cor-14 were selected and were tested for their superiority in yield and quality parameters over the popular/standard checks Hema, VT1158 and Kanthi.

F_2 population of the crosses Yellow speck x Hema, F-212 x Hema, Bright capsule x Hema, Delcrest x Hema, Candel x Hema and Kothari Hicks x Hema were grown for single plant selection. The numbers of single plants selected from each F_2 population were 40, 10, 12, 11, 13 and 3, respectively. F_3 population of the crosses VT1158 x NLS-1, Hema x F-212, and Hema x NC-3150 was grown for single plant selection. The number of single plants selected from each F_3 population were 10, 5 and 22, respectively.

CTRI Research Station, Vedasandur

Pedigree selection in chewing tobacco (*N. tabacum* L.) population with a broad genetic base

(A.V.S.R. Swamy)

Twenty seven selections made in a broad genetic population during 2007-08, were raised in progeny rows along with Bhagyalakshmi, Abirami and Meenakshi as the checks. Based on expression of desired level of yield components and cured leaf yield (4,028-4,633 kg/ha), 12 families were selected for replicated evaluation with standard checks in the ensuing season.

CTRI Research Station, Dinhata

Diallel analysis in *Motihari* (*N. rustica*) tobacco for breeding superior varieties

(S. Amarnath and S. Roy)

Eight parent diallel crosses were made and 28 F_1s were evaluated along with parents for their yield and quality during 2005-06 & 2006-07. Based on the combined diallel analysis, four best F_1s viz., Black Queen x Manda, Black Queen x DD-437, C-25 x Snuff-2 and C-25 x Tangua, were selected to grow them in F_2 population during 2007-08 with fifteen hundred plants each and 20, 19, 23 and 12 visual selections were made, respectively, in each of the four F_2 populations for desirable plant type, leaf shape and size, thickness and maturity symptoms. Inter- and inter-se crosses were made between 4 best selections of each of the four F_2 populations to reshuffle the genetic constitution so as to exploit superior genotypes with maximum genotypic potential.

In 2008-09, all 20, 19, 23 and 12 selections of the four crosses were raised as F_3 families with 50 plants each to evaluate them under pedigree selection system. Fifty plant families of each of the 9 inter-se crosses (F_2IS) and 3 inter-crosses (F_2IC) were also raised for their evaluation under inter-mating series. Selections were affected based on the visual morphological characters e.g. desirable plant type, leaf shape and size, thickness and maturity symptoms and on yield and quality performance of the family in both pedigree and inter-mating series.

Fifteen selections in pedigree selection series and 6 selections in inter-mating series (F_2IS &F_2IC) were made to evaluate them further in F_4 and F_2IS-S-1 & F_2IC-S-1 families in the ensuing season. Perusal of mean of families in pedigree selection as well as inter-se and inter-cross i.e. inter-mating series indicated 26 and 65% superiority of total cured and first grade leaf yield, respectively, in inter-mating series over the pedigree series.

HYBRID TOBACCO

CTRI Rajahmundry

Developing hybrid tobacco suitable for Traditional black soils of Andhra Pradesh

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

One bulk evaluation trial and two replicated yield trials with CMS hybrids were conducted. Also, other works like maintenance of CMS lines and affecting fresh hybridizations were also undertaken.

1. Bulk evaluation of hybrids

Two CMS hybrids, TBSH-1 and TBSH-2, that showed significant standard heterosis for leaf yield traits in the Station replicated yield trials, were evaluated along with three other hybrids in bulk plots against two check varieties viz., Siri and VT 1158 for yield traits and leaf quality. The hybrids showed 19 to 67% heterosis for various yield traits over Siri. All the entries showed desirable colour, body and weight of cured leaf. TBSH-1 and TBSH-2 are undergoing coordinated varietal trials under AINRPT. The chemical quality characteristics viz., nicotine and reducing sugars in all the genotypes evaluated in the bulk trial were within the prescribed limits.

2. Replicated yield trials

During 2008-09, two CMS hybrid trials viz., Br 7.5 (3rd year) and Br 7.6 (2nd year) were conducted, with 9 and 10 CMS hybrids, respectively.

(i) RYT 1 with CMS hybrids (3rd year)

The trial (Br 7.5) was conducted with eight CMS hybrids for the third year in succession along with 3 check varieties in a RBD with 3 replications for evaluation of leaf yield and quality.

Based on the combined statistical analysis of the data collected on the yield trial over three seasons (2006-09), the following hybrids were found to show significantly higher standard heterosis than the variety, Siri for various yield traits.

TBSH-44: GLY: 25%, CLY: 27%, BLY: 30% and GI: 26%
TBSH-46: GLY: 22%, CLY: 21%, BLY: 24% and GI: 22%
TBSH-42: GLY: 9%, CLY: 10%, BLY: 12% and GI: 11%

Seasonal differences were significant and yield levels during 2008-09 were lower than in the other two seasons. Season x entry interaction was also significant for all the four yield traits.

The nicotine and reducing sugars levels in all the entries were within the acceptable limits.

Based on overall performance, two hybrids viz., TBSH-44 and TBSH-46 will be proposed for multi-location testing under AINRPT.

(ii) RYT-2 CMS hybrids (2nd year)

The trial (Br 7.6) was conducted for the second year in succession to test the yield potential and leaf quality of 10 CMS hybrids. The hybrids were produced by using six CMS lines (6-6RMS, CMS-11, 16-17-17-139MS, AP1-8, 72-21MSVT and MS-19VT) and six promising advanced breeding lines (Siri, Cy 142, B5-1, Cy 149, R-77B and 312-1S4) as parents. All the hybrids were evaluated along with three checks viz., Hema, VT 1158 and Siri in a RBD with 3 replications. Analysis of data revealed significant differences for all the yield characteristics among the entries. The following hybrids were promising for various leaf yield traits.

Green leaf:	TBSH-53 (34%), TBSH-59 (28%), TBSH-55 (25%), TBSH-56 (24%) and TBSH-50 (21%)
Cured leaf:	TBSH-53 (34%), TBSH-55 (27%), TBSH-56 (25%), TBSH-59 (24%) and TBSH-50 (23%)
Bright leaf:	TBSH-53 (32%), TBSH-55 (29%), TBSH-50 (26%), TBSH-56 (26%) and TBSH-59 (22%)
Grade index:	TBSH-53 (34%), TBSH-55 (27%), TBSH-50 (26%), TBSH-56 (25%) and TBSH-59 (24%)

(Figures in parentheses: Standard heterosis)

Nicotine and reducing sugars content in cured leaves of entries were within the acceptable limits.

3. Maintenance of CMS lines

A total of 15 CMS lines with varying cytoplasm sources were maintained. The stabilized CMS lines viz., AP-1-8, 6-6, MST-29, MS-19, MS-20, CR 73 were crossed with different promising recurrent parents (maintainers) for developing high yielding / resistant CMS lines for use in hybrid breeding programme. About 40 crosses were also made for conducting various RYTs with CMS hybrids and multi-location testing under AINRPT.

CMS parental lines maintained during 2008-09 season

Cytoplasm	Genetic background
N. undulata	MS DEL, MS SPG 28, MSVT1158
N. plumbaginifolia	MS 85, MSB, MS19
N. tabacum	AP1-8
N. gossei	6-6ms, MS34, CR73MS, 72-21MS, MS58, 140MS
N. suaveolens	MSH5, MSH3
N. megalosiphon	7-9MS, 7-25MS
Unknown exotic sources	NC71, T-29, RGH-04, RGH-51

Also, four crosses viz., MS58 x HDBRG, MS58 x VT-1158, MS58 x A-145 and MS58 x TI-163 were repeated to develop CMS parental lines with high biomass potential. Samples of seven CMS lines along with 5 fertile parents were submitted for biochemical and molecular characterization.

CTRI Research Station, Jeelugumilli

Developing hybrid FCV tobacco suitable for NLS area of Andhra Pradesh

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

1. Maintenance of CMS lines

Under this project several euplasmic and alloplasmic CMS lines with acceptable yield levels have been developed. During the 2008-09 season, 18 CMS lines in genetic background of Kanchan and other improved lines were maintained and crossed to maintainer parent. During 2008-09, one bulk evaluation trial with promising CMS hybrids CH-1 and CH-3 and one replicated yield trial with 11 CMS hybrids were conducted.

(i) Bulk evaluation of CMS hybrids

The CMS hybrids viz., CH-1, NLSH-1 and CH-3 that had shown significant increase in yield over Kanchan in the Station replicated yield trials and co-ordinated varietal trials under AINRPT, were evaluated for leaf yield and quality in experimental plots along with check, Kanchan. Results indicated superiority of the CMS hybrids (Table 3).

Table 3: Performance of advanced breeding lines in bulk evaluation trial (2008-09)

Entry	Green leaf (kg/ha)	Cured leaf (kg/ha)
CH-1	13,194 (9)	2,220 (10)
CH-3	14,406 (19)	2,410 (20)
NLSH-1	13,650 (13)	2,280 (13)
Kanchan (C)	12,077	2,012

(Figures in parentheses: Per cent increase over the check variety Kanchan)

Contents of nicotine, reducing sugars and chlorides in cured leaf of the CMS hybrids were comparable with Kanchan.

(ii) Replicated yield trial

Eleven CMS hybrids, produced from crosses involving identified promising CMS lines and high yielding breeding lines were evaluated for the second year in succession along with the check, Kanchan in a RBD with 3 replications. Data on yield of green leaf, cured leaf and grade index were recorded.

Analysis of yield data indicated significant variation among entries for all the three yield traits. Seven of the eleven test hybrids showed significant standard heterosis (6 to 70% for different traits) during the 2008-09 season.

Physical quality traits such as colour, body and weight of cured leaf were good in most of the CMS hybrids. The contents of nicotine, reducing sugars and chlorides were mostly within prescribed limits in the test entries.

CTRI Research Station, Kandukur

Evaluation of FCV hybrids of tobacco for yield and quality under SLS conditions

(A.R. Panda, R. Sreenivasulu, K.C. Chenchaiah, T.G.K. Murthy, P.V. Venugopala Rao, A.V.S.R. Swamy and K.N. Subrahmanya)

On the basis of green leaf yield, cured leaf yield, bright grade outrun and grade index of different hybrid combinations evaluated during 2004-05 and 2005-06 at the Station, ten hybrid combinations were selected for further evaluation. The experiment was conducted in RBD with 3 replications and 15 entries including three checks. The plot size was 6.5 x 3.25m with spacing of 65 x 65 cm (50 plants per plot). Observations were taken on green leaf yield, cured leaf yield, bright grade outrun and grade index. Nicotine, reducing sugars and chlorides were analyzed in the cured leaf samples. Observations on aphid, *S. litura* and leaf curl incidence were recorded on 0-9 scale.

The hybrid, SH-12 was superior over all the three checks followed by SH-1, SH-6 and SH-9 for green leaf, cured leaf, bright leaf yields and grade index. The improvement of SH-12 over the best check Hema in respect of green leaf, cured leaf, bright leaf and grade index was 41.96, 50.72, 69.39 and 56.79 %, respectively.

CTRI Research Station, Hunsur

Development and evaluation of F_1 hybrids suitable to Karnataka Light Soil region

(K.N. Subrahmanya, M.M. Shenoi, M. M. Swamy and S. Ramakrishnan)

Among the five male fertile hybrids assessed during the season, three recorded higher values over standard check Kanchan in cured leaf yield. All the hybrids recorded more than 2,500 kg/ha cured leaf yield. Standard heterosis ranged from 1 to 5%. CH 3 recorded significant superiority over the check in all the yield parameters. The yield differences were non-significant. The yield difference between CMS and male fertile hybrids of KLSH 10 was only 240 kg/ha and was non-significant. The

hybrids produced open grained, ripe leaves having desired levels of chemical constituents comparable to the check Kanchan. KLSH 19 recorded low incidence of *Fusarium* wilt disease. Derivatives of the fertile hybrids were advanced to higher generation through pedigree breeding.

CTRI Research Station Vedasandur

Studies on heterosis in chewing tobacco (*N. tabacum* L.)

(A.V.S.R. Swamy)

Five hybrids that have shown good performance in replicated trials during 2005-07 viz., VDH-1 (PV-7 x Abirami), VDH-2 (Vairam x Abirami), VDH-3 (Abirami x KV-1) , VDH-4 (Bhagyalakshmi x VD-1) and VDH-5 (Bhagyalakshmi x KV-1) were raised in bulk plots in the Station and also in five on-farm locations at Kosavapatty, Muthunaicken patty, Sreerangagoundenpudur in Oddanchatiram taluk, Alukuli in Gobi taluk and Akilandapuram in Aravakurichi taluk in Tamil Nadu along with the check varieties Bhagyalakshmi and Abirami for the third year for assessment of yield and quality..

The hybrid VDH-3 uniformly performed well in all the five locations as well as at the Station recording maximum mean cured leaf yield of 4,131 kg/ha,9.9% increase over the best check Abirami. The hybrid VDH-1 recorded cured leaf yield of 3,849 kg/ha, an increase of 2.4% over Abirami. It was observed that VDH-3 recorded the maximum leaf area contributing to higher cured leaf yield (Fig. 1).

On overall performance of hybrids at different centers and the Station from 2006-09, VDH-3 registered the highest mean cured leaf yield of 3,962 kg/ha against the best check Abirami, an increase of 13.3%. It is proposed to submit variety release proposals of VDH-3 after completion of agronomic evaluation.

During 2008-09, F_2 population of CDH-1, CDH-2, CDH-4 and CDH-5 were grown and selections numbering 20, 17, 18 and 17, respectively were made for further study.

Fig. 1: Chewing tobacco hybrid VDH-3

BREEDING FOR DISEASE RESISTANCE

CTRI, Rajahmundry

Incorporation of disease resistance for Tobacco Mosaic Virus (TMV)

(P.V. Venugopala Rao and C.A. Raju)

TMV resistance in F_5 progenies of Siri X VT-1158 and N-98 X VT-1158

F_5 progenies of Siri x VT-1158 (65 progenies; V-4956 to V-4920) and N-98 x VT-1158 (27 progenies; V-4921 to V-4947) were raised in a row trial. All the plants in each row were artificially inoculated with TMV and the plot-wise data were recorded.

Among the lines evaluated for TMV resistance, out of 65 progenies of Siri x VT-1158, all the plants have shown resistance. All the plants inoculated in 27 families of N-98 x VT-1158 have also shown resistance. The plot-wise yield was also recorded and the same was calculated for hectare. This yield was also taken as an indicative value. Based on these results, a total number of sixteen progenies were selected and these 16 F_5s will be evaluated in a replicated trial along with checks during 2009-10.

Incorporation of TMV resistance in Pyruvittanam of *Natu* tobacco

BC_1S_4 progenies of nineteen progenies selected during 2007-08 (PVM x VT-1158) were raised and artificially inoculated with TMV. All the plants in the lines were resistant to TMV except PVM -1, PVM-10 and PVM-11. These sixteen TMV resistant lines will be evaluated

finally for their stability for TMV resistance in a row trial during 2009-10.

Screening of *Natu* germplasm lines for black shank resistance

Three *Natu* germplasm lines viz., Rangapuram SR, Peddavittanam SR and Singarajupalem SR were screened for their reaction to black shank under artificial inoculation. The resistant plants were selfed for further screening during 2009-10.

Incorporation of black shank resistance in FCV varieties/advanced breeding lines

Incorporation of black shank resistance in the recently released variety Siri and the advanced breeding lines N-98 and Cy-142 are in progress. These lines were crossed with the resistant donors Beinhart 1000-1 and 1129SR. During 2008-09, 192 progenies were evaluated under artificial inoculation with the pathogen and data were recorded on all the plants in each progeny. The resistant lines thus obtained will be screened further during 2009-10.

CTRI Research Station, Jeelugumilli

TMV resistant *Natu* lines

(T.G.K. Murthy P.V. Venugopala Rao and C.A. Raju)

Nine *Natu* selections found to have resistance to TMV at Rajahmundry were grown in progeny rows for testing their suitability under irrigated conditions. All the lines segregated for different plant types for the second season, besides resistance to TMV. *Natu* type of selections having plant type suitable to irrigated Alfisols were made within lines viz., PVM-5, PVM-6, PVM-7, PVM-9, PVM-11, PVM-15, PVM-17, PVM-18, PVM20, PVM-21 for further studies. Among the lines, PVM 15, PVM 18 and 325X1-5N appeared most promising for plant type and leaf shape.

Confirmation of black shank resistance

The three black shank resistant irrigated *Natu* lines viz., Peddavithanam SR, Rangapuram SR and Singarajupalem SR were found to segregate for resistance at CTRI, Rajahmundry.

CTRI Research Station, Hunsur

Breeding for resistance to *Fusarium* wilt disease in flue-cured Virginia tobacco for Karnataka Light Soils

(K.N. Subrahmanya and M.M. Shenoi)

The performance of twelve advanced breeding lines derived from Dixie Bright 101 and Speight G.33 as *Fusarium* wilt disease resistant donors was assessed. Seven lines recorded higher values over the standard check Kanchan in all the yield parameters. FCH 222 recorded more than 3,000 kg/ha cured leaf yield, recording significant increase (>34%) over Kanchan. The line has also recorded highest grade outturn, ~ 39% higher than Kanchan. Except for three lines, others exhibited resistance to *Fusarium* wilt disease in sick field. FCH 221 and FCH 222 showed high level of resistance and significantly low rate of spread of wilt disease as compared to the susceptible check variety Bhavya in highly sick soil.

In the overall performance for three seasons, five among the twelve lines proved significantly superior to Kanchan in all the yield parameters. The mean cured leaf yield for three seasons among the varieties ranged from 2,150 to 2,530 kg/ha with 30 to 50% increase over Kanchan. Seasonal variations were significant for all the yield parameters. Seasons x Treatments interactions were significant for green, cured and TGE leaf yield parameters. On-farm trials were conducted to assess the performance of the two promising *Fusarium* wilt resistant lines in different disease prone areas spread over the region. They performed well in farmers' fields confirming the results obtained from the experiments. The cured leaf quality both in terms of physical and chemical was acceptable and comparable to the check.

CTRI Research Station, Vedasandur

Evaluation of black shank resistant lines

(A.V.S.R. Swamy)

Three chewing tobacco black shank resistant lines developed through backcross breeding viz., BC5S1, BC5S2 and BC5S3

involving VR-2 x Beinhart 1001 cross were evaluated along with check varieties VR-2 and Kaviri in RBD with four replications at the Station and in bulk plots at Ayakaranpulam in Vedaranyam area for the third year during 2008-09. It is observed from the combined analysis of yield and morphological data (2006-09) at the Station that all the three lines viz., BC5SI, BC5S2 and BC5S3 were statistically significant to the susceptible variety VR-2 both for whole leaf and total leaf yield recording 2,617, 2,239 and 2,498 kg/ha whole leaf and 3,687, 3,078 and 3,432 kg/ha total leaf yield, respectively. While the BC5S1 was significantly superior to Kaviri for both whole leaf yield and total leaf yield, the line BC5S3 was significantly superior to the susceptible check variety Kaviri for total leaf yield only. Seasons x Varieties interaction effects were found to be statistically significant for both kinds of yield. Variability in respect of yield component attributes such as leaf length, leaf width and stem girth were also significant. In Ayakaranpulam also, BC5S1, BC5S2 and BC5S3 recorded cured leaf yield of 3,250, 2,900 and 3,100 kg/ha, an increase of 25.0, 11.5, 19.2% over VR-2 and 15.7, 3.2, 10.3% over Kaviri, respectively. The chewing quality of BC5S1 and BC5S2 were comparable to the checks. Based on the overall performance, BC5S1 was considered to be promising with resistance to black shank.

CTRI Research Station, Dinhata

Screening for resistance against brown spot and hollow stalk in germplasm accessions of *N. rustica* and *N. tabacum* in North Bengal

(S. Amarnath and S. Roy)

Screening of *N. rustica* germplasm accessions to brown spot

A total of 179 germplasm accessions of *N.rustica* were screened for brown spot resistance under field conditions. Based on disease score at three different dates of observation, the AUDPC category were made for resistance – R (0-250), moderately resistant - MR (250.1-500), moderately susceptible - MS (500.1-750) and highly susceptible - HS (>750). During 2006-07 when disease pressure was high, none of the lines were found to be resistant, however, under MR, MS and HS category 41,118, and 18 lines were recorded, respectively.

In the year 2007-08, disease pressure in nature was moderate and hence, the AUDPC range for different categories were modified as 0-200 for R, 200.1-400 for MR, 400.1-600 for MS and > 600 for HS. None of the lines were under R category, however, 76 lines were under MR category.

In the year 2008-09, natural disease pressure was very low and hence, the AUDPC range for different categories were kept at similar level to that of the year 2007-08. Among the lines screened, 30 lines were under R category (AUDPC range of 0-200), 30 lines were under MR category (AUDPC range of 200.1-400). Thirty resistant lines will be tested under artificial conditions and the lines matching with R or MR categories in the previous years will be selected as resistant source to brown spot.

Screening of *N. rustica* germplasm lines to hollow stalk caused by *Erwinia carotovora* sub. sp. *carotovora*

A total of 90 accessions of *N. tabacum* were screened for resistance to hollow stalk during 2007-08 and based on the linear soft rot in pith tissues, 20 accessions were screened for further testing during 2008-09.

Out of 20 lines tested for the second year under artificial conditions, only four lines have shown disease reaction (Soft rot) ranging from 1.8 – 2.2 viz. T-17 (1.8cm), C-302 (2.0cm), C-26 (2.1cm) and White Pathar (2.1cm). These lines will be further tested in the ensuing crop season (2009-10) for ensuring the consistency of the results.

Out of 68 germplasm lines of *N. rustica* tested during 2008-09, 18 accessions were selected based on disease reaction ranging from 0.62 –1.90cm for screening in the ensuing crop season (2009-10).

PROGRAMME 3

BIOTECHNOLOGY FOR TOBACCO IMPROVEMENT

CTRI, Rajahmundry

Micro-propagation of elite lines and other selections

(K. Sarala)

Micro-propagation of elite lines

A total of 194 plantlets of various tobacco entries are being maintained under *in vitro* and around 451 plantlets were transferred from *in vitro* to pots for maintenance and further studies.

Development of virus tolerant tobacco lines under *in vitro*

(K. Sarala, C.A. Raju, G. Raghupathi Rao and K. Siva Raju)

Characterization of promising VT 1158 somaclones

Thirteen somaclones of VT-1158 were tested in a replicated trial at Katheru for three consecutive years along with three controls Hema, VT-1158 and Siri. It is inferred from the pooled analysis that the leaf yields were significant among the lines. The line VLCR-25-12 was found to be promising with significant increase in cured leaf (2,457 kg/ha), bright leaf (1,376 kg/ha) yields and grade index (1,920/ha) with an improvement of 15, 17 and 15% respectively over Siri. The line VTCMV-1-15-14 recorded significantly higher green (15,392 kg/ha), cured (2,308 kg/ha) leaf yields and grade index (1,789/ha) over VT1158 and bright leaf (1,297 kg/ha) over Siri.

Leaf nicotine, reducing sugars and chlorides in somaclones, in most of the cases, were found to be in the acceptable limits. Based on the overall performance, clones VLCR-25-12 and VTCMV-1-15-14 were found promising and recommended for multi-location testing under AINRPT.

Characterization of promising Kanchan somaclones

Six somaclones of Kanchan, a field selection (NM) and two low tar advanced breeding lines (JS 116-1 and JS 124) were tested along with Kanchan (control) for the third consecutive year in a replicated trial. Pooled analysis revealed that leaf yields were significant among the lines. All the somaclones and NM recorded significantly higher leaf yields than Kanchan. The increase in green leaf (NM: 17,319 kg/ha; NLCR: 18,296 kg/ha), cured leaf (NM: 2,896 kg/ha; NLCR-10: 3,043 kg/ha) and grade index (NM: 1,828; NLCR-10: 2,147 kg/ha) was 26-32, 27-33 and 32-55%, respectively compared to Kanchan.

All the somaclones and NM consistently performed superior in all the seasons with higher yields of all types. Most of the somaclones recorded higher plant height, leaf length and leaf width values than Kanchan. NLCR 7 recorded maximum number of leaves (32) after topping. Chemical quality characteristics of somaclones and advanced breeding lines at 'X' and 'L' positions are, in general, found to be in acceptable range. Based on the overall performance, all the six somaclones [NLCR, NLCR-4, NLCR-5, NLCR-7, NLCR-7(k) and NLCR-10] and NM were found to be promising and hence, recommended for multi-location testing under AINRPT.

Screening of somaclones for yield and resistance to leaf curl

Among the 39 somaclones tested in a row trial at Katheru Farm, 6 somaclones were found promising for leaf yield. Fifty four somaclones

were tested for leaf curl resistance under artificial conditions at Rajahmundry. In general 4-5% leaf curl infection was observed. Two resistant plants were selected in each clone and selfed seed was collected. The lines are proposed for testing at Guntur and Kandukur for white fly/leaf curl. Forty six somaclones were screened for CMV resistance under artificial conditions at Rajahmundry. Resistant plants were selected in 45 clones and selfed seed was collected.

Viral genome amplification

PCR primers specific to coat protein gene (cp) of tobacco leaf curl virus were used to specifically amplify a sequence of 725bp from the total DNA isolated from the tobacco plants collected from West Godavari district of Andhra Pradesh, showing leaf curl symptoms. This confirmed the presence of leaf curl virus in plants showing leaf curl symptoms.

Maintenance, evaluation and characterization of tobacco transgenics: *Bt* tobacco transgenics

(K. Sarala, G. Raghupathi Rao and K. Siva Raju)

Two transgenics, each of Hema and Jayasri were raised in transgenic screen house. These transgenics contain Cry1 A (b) and Cry 1 C genes. Cry 1 A (b) confirms resistance to *H. armigera and Cry 1 C to S. litura*. Transgenic nature of these lines was confirmed by developing and using Cry 1 A (b) specific primers. As expected these primers amplified region of 247 bps in transgenics.

These results clearly indicate the presence of Cry 1 A (b) gene in the transgenics. ENVIROLOGIX quantiplate kits were used to quantify *Bt* proteins in the plants grown *in vivo*. The Cry 1A (b) protein quantities in transgenics ranged from 8.2-13.1 ng/mg green tissue and Cry1C from 13.5 to 15.4 ng/mg green tissue. Transgenic lines were screened against *S. litura* and *H. armigera*. The transgenics were found to be tolerant to these insects than controls Hema and Jayasri.

_Bt_ tobacco transplastomics

Two transplastomic lines having Cry 9 Aa2 gene were maintained and characterized along with wild type, Petit Havana. Primers specific to Cry 9 Aa2 gene were used to amplify a region of 826 bps in transplastomics indicating the presence of Cry 9Aa2 gene. Transplastomic lines were screened against stem borer. Unlike earlier years, transplatomic lines recorded severe stem borer damage.

Molecular mapping of important tobacco traits

(K. Sarala, T.G.K. Murthy, C. V. N. Rao, K. Siva Raju and P.V. Venugopala Rao)

Studying the molecular diversities of parents used in developing mapping populations

TSNA

Molecular polymorphism studied in 11 Burley lines (Banket-A1, SOTA 6506, Harrow Velvet, Burley resistant, By 64, By Sota 51, Ky-10, T-117, BSRB-II, Burley 21 and VA 510) and three crosses (Banket A1 x BY64, BY 64 x Banket A1 and VA 510 x BA1) using 10 chromosome specific SSR primers and 4 RAPD primers. Banket A1 and Burley 21 are high TSNA yielding lines and others are low. Leaf samples from above lines crosses were collected for estimation of TSNAs.

Solanesol and nicotine

Gauthami, Siri, BY-53, A-145, GT 7, HDBRG, TI-163 and GT 8 are being analyzed for solanesol content. Nine lines (HDBRG, Gauthami, Siri, BY-53, Candel, NC-55, Nisnicotinony-121, Kumkumathri and GT-9) differing in their solanesol and nicotine and two crosses (Nisnicotinony-121 X Kumkumathri, and Candel x Nisnicotinony-121) were tested

for their molecular diversities using 4 RAPD primers and 10 chromosome specific SSRs. Flue-cured leaf samples collected from all these lines are being analyzed for solanesol and nicotine contents.

Phytochemicals

Five tobacco lines (GT-8, TI-163, HDBRG, GT-7 and A-145) and six crosses (A145 x GT7, GT-7 x A-145, TI-163 x A-145, HDBRG x GT-7, HDBRG x BY-53 and A-145 x Jayalakshmi) were assessed for their molecular diversity using 4 single arbitrary decanucleotide random primers and 10 chromosome specific SSR primers.

Development of mapping populations

For the development of mapping populations i.e. Recombinant Inbred Lines, 14 F_1s, 8 F_3s and 2 F_4s were raised and selfed seed was collected. Haploid plants developed from 12 crosses were transferred to pots. Mid-vein culture is being done to develop di-haploid.

Development of molecular markers for *Fusarium* wilt

(K. Siva Raju and K.N. Subrahmanya)

Scar marker was prepared and validated in *Fusarium* wilt susceptible parents (Kanchan and Rathna), resistant line (SG 33) and one breeding line (Rathna x Kanchan) x SG 33(F4). This marker will be used in breeding material for the selection of resistant lines.

Electrophoretic characterization of tobacco

(K. Siva Raju and K. Nageswara Rao)

Isoenzyme markers were used to study the genetic variability among the varieties, landraces and germplasm accessions of *N. rustica*. The accessions included in the present study were: NRG1, NRG2, NRG4 (germplasm accessions from USA), Bawal (landrace from Haryana), LRAI, LRA2, LRA3, LRAtura, LRAdawalgare (landrace from Assam), Dharla, DD 437 and HD 65-4O (varieties of *N. rustica* grown in West Bengal). The genetic similarity by isoenzyme analysis among the accessions, landraces and varieties varied between 20 and 86%. Among the varieties, the genetic similarity varied from 69 to 86% whereas it was between 20 and 60% among the germplasm and landraces.

The minimum genetic similarity was observed between landrace LDA2 and germplasm accession NRG4, whereas the maximum genetic similarity was observed between the varieties Dharla and HD 65-40. Unweighted pair method on arithmetic averages (UPGMA) method of clustering analysis, the 12 accessions were separated into two main clusters. Cluster 1 was formed by three varieties, three germplasm accessions and three landraces while the cluster 2 was formed by three landraces. The cluster 1 was divided in to two sub-clusters a and b. Sub-cluster 1a included two germplasm accessions (NRG1 and NRG2) and one landrace from Haryana (Bawal). The two accessions NRG1 and NRG2 showed 60%.

In the sub-cluster 1b, the three varieties Dharla, HD 65-40 and DD 437 were grouped together with 69 to 86% genetic similarity. Isoenzymes showed variations among the landraces, germplasm accessions and varieties of *N. rustica* tobacco. The common bands showed by some enzymes indicate that the evolutionary conservation in *N. rustica* species. Accession-specific isozyme patterns were observed but a few accession- specific bands were formed by some isozymes. The landraces collected from Assam and Haryana were different from cultivated varieties of *N. rustica* in West Bengal.

Randomly amplified polymorphic DNA (RAPD), Simple sequence repeats (SSRs) and Sequence tagged microsatellite (STMs) markers were used to study the genetic variability

among the *Bidi* tobacco types grown in India. The varieties included in the present study were GT-9, GT-7, GT-5, GT-4, Anand-2, Anand-119, GTH-1, NPN-190, Bhavyasree and Bhagyasree. The genetic similarity among the varieties varied between 64 and 95%. The variety GT-9 and GT-5 showed minimum genetic similarity (64%) whereas the variety NPN-190 and Bhavyasree maximum genetic similarity (95%).

The 10 varieties separated into two main clusters and the variety GT-9 independently linked to the main cluster in UPGMA method of clustering analysis. The cluster 1 was formed by 3 varieties GT-7, GTH-1 and Anand 2. The variety Anand 2 was one of the parents to the variety GT-7 and showed 79% of genetic similarity. The variety GTH-1 was a male cytoplasmic sterile hybrid and showed 89% of genetic similarity with the variety Anand 2 and 74% with GT-7. The second cluster was formed by 6 varieties with two sub-clusters. The varieties grown in Gujarat state formed the sub-cluster 1 and the varieties grown in Karnataka formed the sub-cluster 2. The sub-cluster 1 was formed by GT-4, Anand 119 and GT-5.

The variety Anand 119 was one of the parents of the variety GT-4 whereas GT-4 was one of the parents of the variety to GT-5. The sub-cluster 2 was formed by the varieties NPN190, Bhavyasree and Bhagyasree. The variety NPN 190 was one of the parents of Bhavyasree and showed 95% genetic similarity. The variety Bhagyasree showed 90% genetic similarity with the variety Bhavyasree and this close genetic similarity may be due to the fact that both these varieties had a line PL-5 as one of the parents. Thus the sub-clustering formation was based on parentage.

Tobacco specific simple sequence repeats (SSRs) were used to study the genetic diversity among the tobacco types. A total of 13 primers were used, out of which 12 primers were chosen for analysis based on reproducible amplification pattern. UPGMA method of clustering analysis separated the 9 varieties into two main clusters and the variety GT-9 independently linked to the main cluster as in the case of RAPD. The sub-clustering pattern was based on parentage as occurred in the case of RAPD i.e. GT-7 & Anand 2, GT-4, GT-5 & Anand 119 and NPN 190 & Bhavyasree were grouped together.

In both RAPD and SSR analysis, the variety GT-9 was independently linked to the main cluster. The genetic similarity among the varieties grown in Karnataka was more in RAPD analysis whereas it was very less in SSR analysis. *Bid*i tobacco cultivars were separated into two main clusters and the sub-clustering pattern was mainly based on the parentage of varieties and also based on the region *i.e.* the varieties grown in Karnataka state was separated from those grown in Gujarat state. The specific markers identified in the present study will be helpful in identifying the varieties.

PROGRAMME 4

CROP PRODUCTION TECHNOLOGY

CTRI, Rajahmundry

Long term fertilizer and manurial experiment

(P. Harishu Kumar and S. Kasturi Krishna)

At the closure of the experiment i.e., 2009-10, the soil samples before transplanting and after the crop period were collected and analyzed both in control and treated plots. Application of FYM @ 7.5 t/ha did not influence soil pH. However, continuous application of FYM @ 7.5 t/ha for 53 years, resulted in a decline in pH values. Among N (22.4 kg/ha), P(112 kg/ha) and K(56 kg/ha) application, P application alone significantly reduced soil pH from 7.83 to 7.77. Organic matter or fertiliser application did not show any effect on TSS. FYM, N, P and K application showed statistical variation with respect to organic carbon build up in soil. Continuous application of FYM improved soil organic carbon by 0.1%. Application of N and P did not show any significant variation while K application significantly reduced organic carbon content by 0.04%.

The interaction effects of N x P x K were significant. FYM application significantly improved soil available phosphorus. Among the nutrients, N and P did not show any significant variation on soil available P. However, K application reduced soil available K content FYM application did not bring statistical difference over control with respect to available soil K content. N and P application did not bring any significant changes in soil available K over no application. However, soil application of K continuously, increased soil available K by 37.4 kg/ha over no application. The interaction effects were not significant. Neither FYM nor NPK application did bring any significant impact on soil chlorides over their respective controls at the end of the experiment.

Application of FYM and fertiliser nitrogen significantly improved cured leaf, bright leaf and grade index over control. Due to FYM application, nicotine increased significantly and reducing sugars were decreased. Inorganic fertilizers did not show any significant effect on nicotine or sugar content of tobacco leaf over respective controls.

Nitrogen and spacing requirement for the FCV tobacco advance breeding line V- 4219

(P. Harishu Kumar, S. Kasturi Krishna, M. Anuradha and P.V. Venugopala Rao)

The advanced breeding line V-4219 was at par with the check variety Siri with respect to leaf yields. However, under 70 x 50 cm spacing at 70 kg N /ha, the line V-4219 recorded 2.71% more cured leaf over Siri. The midrib percentage was lower in V-4219 compared to Siri. Increasing levels of N resulted in leaf biomass production but reduced the leaf nicotine content. However, no significant effect on reducing sugars was observed. But the variety Siri showed higher values compared to the variety V-4219 at all the N levels. Leaf chlorides did not show any significant variation.

Permanent Manurial Trial

(P.R.S. Reddy)

Samples were collected from the randomly selected plants during 2007-08 crop season. Tobacco leaf lamina samples were analyzed for N, P, K, reducing sugars, nicotine, total ash and insoluble residue. Leaf burn was also determined. Tobacco composite samples (stalk, root, midrib and inflorescence) were analyzed for N, P & K and uptake of N, P and K was computed.

Lamina composition

Application of FYM alone resulted in increase in nicotine, nitrogen and leaf burn and caused a reduction in reducing sugars, chlorides, phosphorus, potassium and insoluble

residue content. Increase in nicotine and reduction in reducing sugars was observed due to application of inorganic sources of nutrients without FYM. However, no clear cut differences were noticed in the case of P and K.

Nutrient uptake

Application of FYM caused increase in N, P and K uptake, while nitrogen with or without P and K increased N, P & K uptake. Application of P and K increased P and K uptake over the absolute control.

Nitrogen and spacing requirement of the advance breeding line V-4230

(P. Harishu Kumar, P.V. Venugopala Rao, S. Kasturi Krishna and M. Anuradha)

The advanced breeding line V-4230 recorded maximum cured leaf yield of 1,598 kg/ha at 70 x 50 cm spacing under 70 kg N/ha, and was significantly superior to Siri. The performance was at par with all the N levels tested under 70 x 50 and 70 x 60 cm spacing. Under 70 x 50 cm at 70 kg N/ha fertility level, the line V-4230 recorded 17.8% more cured leaf over Siri at the same level of spacing and nitrogen. Different levels of spacing and N levels showed significant variation in nicotine but no difference in reducing sugars and chlorides. Siri in general, recorded higher nicotine and lower sugars.

Effect of micro-sprinklers and fertigation on tobacco seedlings production

(B. Krishna Rao, C.C.S. Rao, P. Harishu Kumar and V. Krishnamurthy)

Micro-sprinklers and fertigation experiment in tobacco nurseries was conducted to reduce the labour cost and improve water- and fertilizer-use- efficiency. From the results of the two seasons, it is concluded that the optimum spacing between laterals is 2.5 -3.0 m and the spacing between micro-sprinklers is 2.5 – 3.0 m under the operating pressure of 1.25 to 1.5 kg/cm^2. The root volume and weight of the seedlings increased by 30% and number of transplantable seedlings by 34% with micro-sprinklers compared to conventional application. The growth of seedlings was rapid under micro-sprinkler and seedlings were ready for transplanting in 45 days as compared to 60 days in conventional water application. Applying water to tobacco seed-beds through micro-sprinklers reduced the labour cost by Rs.1, 45,000 (90%) and saved irrigation water by 24%.

Designing and testing of tobacco bale pressing machine

(V. Krishnamurthy, B. Krishna Rao, C.C.S. Rao, S. Kasturi Krishna and N.D. Suresh)

In the design of the instrument, the weighing scale was attached at the bottom to measure the weight of bale as well as pressure applied while preparing the bale. Using different grades of cured leaf viz., LBY1, LBY2, DB, DG, PL, bales were prepared with this machine and also manually. After one month the bales lost 0.9-2.6% moisture and no molds/ fungal growth were noticed in bales prepared either manually or mechanically. Higher moisture loss was observed in bales prepared from DB grade. Lower moisture loss was observed in bales prepare from PL grade (Figs. 2 & 3).

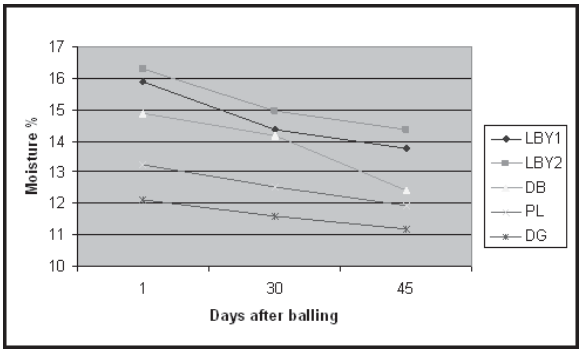


Fig. 2: Moisture loss in machine made bales during storage

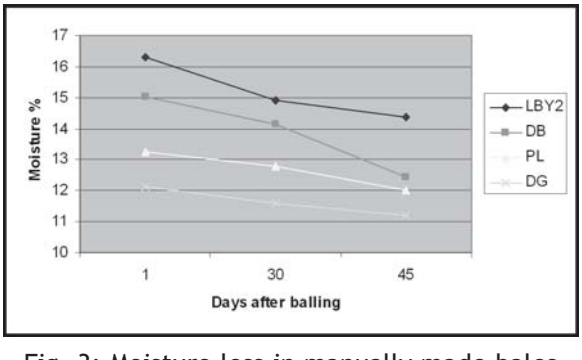


Fig. 3: Moisture loss in manually made bales during storage

Plant growth promoting rhizobacteria (PGPR) in tobacco-based cropping systems

(D.V. Subhashini and C. C. S. Rao)

In this study, the roots of *Nicotiana* sp. were chosen as a source of endophytic bacteria from TBS, SLS, NLS and KLS. It was investigated that population densities of endophytic bacteria seem to be highest in the root. As a result, twenty four isolates were isolated according to their colony morphology and subdivided into ten phenotypic groups based on the phenotypic characteristics. It was evident that the number of gram negative isolates was higher than that of gram positive. The diversity of endophytic bacteria isolated from *Nicotiana* sp. was clarified. Several factors may explain the diversity including geographical distribution, plant age and tissue type. *In vitro* experiments on antifungal activities of the isolates against phytopathogenic bacteria showed that many of the isolates, especially fluorescent pseudomonad isolates possess the ability to inhibit the growth of several plant pathogenic bacteria such as *Pythium*.

Phenotypic characterization of bacterial isolates

Thirteen isolates of Gram negative bacteria, were classified as members of *Pseudomonas*. Eleven isolates of Gram positive bacteria, were classified as members of *Bacillus* sp. on the basis of general characteristics such as fluorescense pigment production on KB, oxidase positive and catalase positive.

In vitro antagonism assay

Based on the distinct colony morphology of shape, size and color, 24 endophytic bacterial isolates were isolated from the roots of *Nicotiana* sp. It was observed that different *Nicotiana* sp. plants contained different population of endophytic bacteria. Gram negative bacteria were dominant, accounting for 54% of the total isolates.

This study revealed the diversity of culturable endophytic bacteria isolated from *Nicotiana* sp. and some of the isolates posses *in vitro* antagonistic activity against plant pathogenic fungi.

Effect of K mobilizing bacteria on the growth, yield and quality of TBS tobacco

(D.V. Subhashini)

Based on the observations of pot-culture experiment, field trial was conducted at CTRI Black Soil Farm, Katheru to study the performance of the bacterium *Frateuria aurantia* (FA) in enhancing the K uptake efficiency of FCV tobacco variety Siri with six treatments (T1: K_0, T2: K_{25}, T3: K_{50}, T4: K_0 + FA, T5: K_{25} + FA, T6: K_{50} + FA) and four replications. The bacterium dose was 10^{10} CFU/ml (around 10^3 CFU/plant) - 625 ml/ha was with FYM.

Observations were recorded on initial soil analysis, plant height, green leaf, cured leaf, bright leaf yield & grade index, uptake of N and K by the plants and FA count in the rhizosphere. Yield data revealed significant increase in the dry matter production and yield due to FA. Establishment of FA in the rhizosphere of TBS tobacco revealed that the population of FA increased with the increase in the levels of K fertilizer showing the maximum colonization of 344 CFU/g. Response of inoculation of *F. aurantia* on the growth indicated the beneficial effect on plant height, number of leaves, fresh and dry weight of the stem and root and stem girth over the control.

Response of inoculation of *F. aurantia* on the physiological observations showed a decreasing trend in photosynthetic rate with increasing levels of K fertilization. Yield data indicated the beneficial role of *F. aurantia* in increasing the yield of tobacco at three different levels of K fertilization (0, 25 and 50 kg of K along with FA). The treatment FA in combination with 50 kg of K resulted in 10, 12, 16 and 10% increase in green, cured, bright leaf yields and grade index, respectively over the control.

Prospects of biofertilizers in nursery management of FCV tobacco

(D.V. Subhashini)

The nursery experiment was conducted during 2008-09 with randomized block design

with 8 treatments and three replications (T1-control; T2-VAM; T3-. *Pseudomonas fluorescens;* T4- *Azotobacter chroococcum;* T5-*VAM*+ *P. fluorescens*; T6-VAM+*Azotobacter chroococcum;* T7- *P. fluorescens* + *A. chroococcum;* T8-*VAM*+ *P. fluorescens*+ *A. chroococcum)*. The highest microbial population was recorded in the treatment VAM + Pf + *Azotobacter* followed by the treatments with individual inoculation of *P. fluorescens* or VAM or *Azotobacter*.

Data clearly indicated that these three microorganisms could establish successfully in the rhizosphere of tobacco exhibiting synergistic effect among them. There was significant increase in total chlorophyll content and leaf area in tobacco nursery seedlings upon inoculation with all the 3 beneficial microorganisms. In the field experiment conducted during 2008-09, the microbial inoculants VAM, *P. fluorescens* and *A. chroococcum* have shown their influence on growth, yield and quality of FCV tobacco by establishing successfully in the rhizosphere. Combination of all the three bio-inoculants showed an increase of 16% photosynthetic rate, 19.5% stomatal conductance, 15% transpiration rate and 64% chlorophyll index over the control. Similar significant increase in yield parameters such as green, cured, bright leaf and grade index was recorded in the treatment.

The increase in growth and yield attributes could be because of certain growth promoting substances secreted by the microbial inoculants which in turn might have led to better yield through transport of water, uptake and deposition of nutrients. The microbial inoculants also reduced the incidence of soil borne disease, root rot caused by complex of pathogens *Phytophthora* and *Fusarium*.

Development of float-culture technology for tobacco seedling production

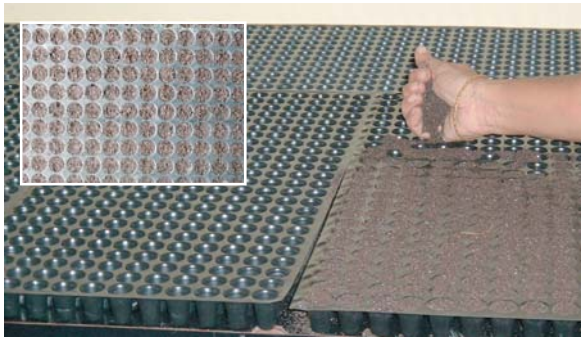
(K. Nageswara Rao, M. Anuradha and V. Krishnamurthy)

Raised bed seedling production is popular but shortage of labour and increase in wages is making tobacco seedling production uneconomical. In traditional nurseries diseases, nematodes and weeds are the major problems and their effective control decides the success of the nursery. Hence, seedling production in float-bed system is proposed as an alternative and effective method of tobacco seedling production. In this method different components are involved and there is need to standardize float-bed size, tray size, number of cells per tray, cell volume, water and nutrient requirements for successful seedling production.

Plastic trays of 56.0cm length and 29.0cm width were used in the trial. Trays with 98 and 144 and 288 cells per tray were tried in the experiment. The cell volume of three types of trays was 17.6, 11.0 and 5.5cc, respectively. The trays with larger cell volume produced less number of plants per tray and floating these trays on the water also became little difficult as compared to trays with smaller cell size. Hence, trays with 288 cells per tray and 5.5cc cell volume were considered optimum for producing maximum number of seedlings per unit area.

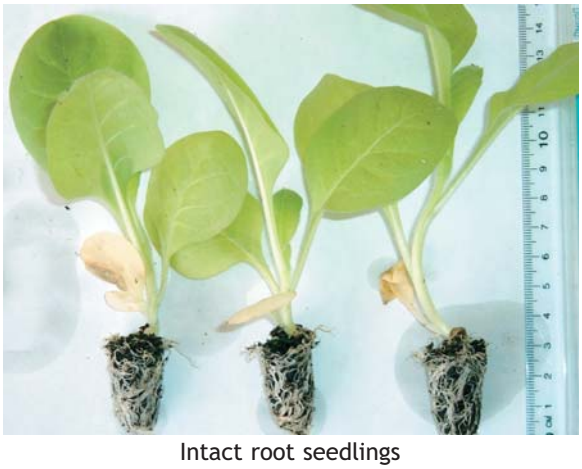
Float-beds were constructed in poly-house and also in open place. Float-beds of 3.2 m length and 0.6m width with a depth of 6.0cm were constructed in the ground using strips of card board/plywood and black alkathene sheet. The float-bed of this size accommodated 12 trays. The float-bed 6.0cm depth was filled with water to a height of 4-5.0cm and the trays were floated on the water. The depth of the cells in the tray is 2.5cm and it is to float the trays on a water depth of 4-5cm. Seed germination and growth of seedlings in the float-beds constructed in the open is good as compared to the existing poly-house conditions. However, a well ventilated poly-house is ideal for the float-beds (Fig. 4).

Different media were tried for growing the seedlings in the trays. Among the non-soil media, paddy husk ash and coconut pith are promising materials for the media. Major nutrients, NPK, were added to the float-bed water and optimum concentration of the nutrients required for good seedling growth was



Preparation of trays for sowing

Float beds in open



Intact root seedlings

Fig. 4: Float-culture technology for tobacco seedling production

established. A small mechanical device was fabricated for sowing the seed in the trays and its use is under evaluation.

QUALITY EVALUATION LABORATORY

During the period under report, 9,934 tobacco leaf lamina samples pertaining to different crop years of various projects of the main Institute and its research stations including AINRPT and traders were analysed for various Chemical Quality parameters viz., Nicotine, Reducing sugars, Chlorides and Total N. Details of the Experiments are given below.

CTRI Research Station, Jeelugumilli

Moisture and nutrient depletion/utilization pattern under NLS conditions

(S. Kasturi Krishna, S.V. Krishna Reddy, V. Krishnamurthy, C.C.S. Rao and M. Anuradha)

Field experiment was conducted with three levels of N (90, 115, 140 kg/ha) and two levels of K_2O (120, 140 kg/ha) to study the nutrient uptake and moisture depletion pattern in cv. Kanchan.

2008-09 season

Significant differences were observed in the green leaf, cured leaf and grade index of tobacco due to N and K levels. Green leaf yield and cured leaf yield increased progressively and significantly with increase in the N level from 90 to 140 kg N/ha. Higher grade index was recorded in 115 kg N/ha followed by 140 and 90 kg N/ha. Potassium could not influence yields to the level of significance. Moisture observations (Fig. 5) showed that during the crop growth period 70% of applied irrigation was depleted from 0-10 and 10-20 cm soil layer and it decreased with increasing depth of soil.

This indicates that most of root system is confined to the upper layers and not going to deeper layers. When the soil around the root system was excavated and root system was removed and observed, the tap root length ranged between 10-14 cm and the tip was

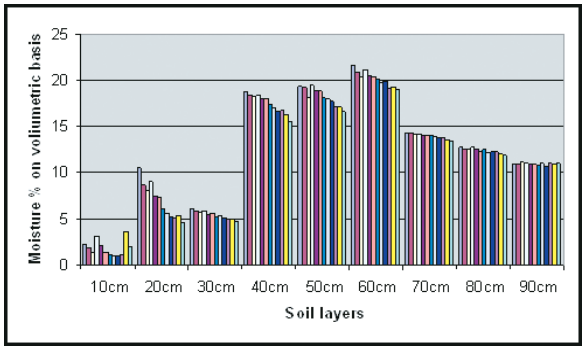


Fig. 5: Moisture depleted from different soil layers during 45-65 days after planting FCV tobacco

bending and not straight. Profuse growth of lateral roots was observed spreading within 20-25 cm below the ground level and tap root growth is restricted.

2007-08 season

The increase in growth of the crop was maximum from 60-90 days after planting (DAP). Stem and root weight continued to increase up to 130 DAP. The concentration of N in the leaf increased with increase in nitrogen dose but decreased with increase in level of potassium application at the same level of N in the cured leaf samples. Potassium content increased with increase in level of potassium application. Uptake of N increased with increased levels of N and K application. Initially, though the difference in the uptake of N and K was narrow, the ratio widened with the age of the crop and finally the ratio was 1:1.3 to 1.4. In the variety Kanchan at 90 DAP, the uptake was higher than at 30-75 DAP.

Available N and K values in soil increased with increase in depth from 0-20 to 40-60 cm. Available N in the soil increased from 0-20 to 40-60 cm depth. Available N decreased with the age of the crop from 45 DAP onwards. The available N in the soil at harvest of the crop was less than the initial value in 0-20cm soil layer but higher at 20-40 and 40-60 cm depth. It could be attributed to uptake by the crop and leaching to lower layers. Available K in soil increased from 0-20 to 40-60 cm depth. Available K concentration decreased with the age of the crop from 45 DAP onwards.

Nitrogen budgeting for FCV tobacco cv. Kanchan in irrigated Alfisols

(S. V. Krishna Reddy, S. Kasturi Krishna, C.C.S. Rao and V. Krishnamurthy)

Application of 145 kg N/ha being comparable with 130 and 115 kg N/ha produced significantly higher green leaf yield as compared to 100 kg N/ha. Application of 145 kg N/ha, being on a par with 130 kg N/ha, recorded significantly higher cured leaf yield as compared to 100 and 115 kg N/ha. Application of 130 and 145 kg N/ha both being on a par recorded significantly higher grade index as compared to 100 and 115 kg N/ha application. Application of 130 and 115 kg N/ha both being on a par recorded significantly higher grade index/cured leaf per cent as compared to 100 and 145 kg N/ha application. Application of 100 kg N/ha recorded significantly lower green leaf and cured leaf yields and grade index. Grade index/cured leaf percentage increased with increase in nitrogen level from 100 to 130 kg N/ha and decreased with further increase in N level.

Reducing sugars concentration increased from P (11.94%) to X (12.90%) and L (14.35%) positions and decreased in T position (10.25%). Nicotine content increased gradually from P (1.36%) to T (2.71%) position. Reducing sugars/nicotine ratio decreased from P (9.04) to T (3.81) position. Application of different N levels caused significant changes in lamina quality characters. Increase in nitrogen level from 100 to 145 kg N/ha increased nicotine and decreased reducing sugars, reducing sugars/nicotine. Chlorides were well with in the acceptable limits (<1.5%).

N and K uptake

Total N and K uptake increased with increase in N level. N and K uptake increased with increase in the duration of the crop from 45 DAP to harvest. The mean nutrient uptake/day was the highest between 75 and 90 DAP. The N uptake was marginal between 90 DAP and harvest.

N content and CCI in 10-12th leaf

Total N content and chlorophyll content index (CCI) increased with increase in N level from 45 -105 DAP. In general, total N content and chlorophyll content index (CCI) decreased with increase in the duration of the crop from 45 to 105 DAP.

Effect of drip-fertigation on water and fertilizer-use-efficiency in FCV tobacco cultivation in NLS

(C.C.S. Rao, V. Krishnamurthy, K. Nageswara Rao and P. Harishu Kumar)

Field experiment was executed at CTRI RS, Jeelugumilli to study the effect of different

levels of fertigation on yield, quality, and water and fertilizer-use-efficiency in FCV tobacco during the year 2008-09. Soil moisture measurements at different depths and different spacings from the emitter in different intervals of time were recorded and moisture dynamics under drip irrigation and furrow irrigation were studied.

The moisture dynamics under furrow irrigation between two irrigations are presented in Fig. 6. Two days after irrigation, the moisture content at 10cm depth reached 14%. At the end of the irrigation cycle (10th day) it reached to 4%. The moisture dynamics were recorded up to 80cm depth. The maximum moisture content was recorded beyond 50cm depth. In the case of drip irrigation, maximum moisture was recorded up to 40cm depth beyond that the moisture content was almost constant (Fig. 7).

Soil samples at different spacings and depths at different intervals were collected and analyzed. Nitrogen and potassium dynamics under fertigation, drip irrigation and furrow irrigation were studied. In fertigation and drip irrigation, the maximum available nitrogen and potassium were found near the active root-zone of the plant. In furrow irrigation, the maximum available nitrogen and potassium were found beyond the active root-zone of the plant (Figs. 8 & 9). More nutrient loses were observed in furrow irrigation.

Digital water meter was installed in the pipe line and for each irrigation, water meter readings were recorded and water saving was calculated. The drip irrigation and alternate furrow irrigation saved ~ 50 & 17 % of irrigation water, respectively.

The physiological parameters like photosynthetic value, transpiration rate, intercellular CO_2 conductance and leaf area index (LAI) were recorded. Intrinsic and instantaneous water-use-efficiency was calculated. The LAI, photosynthetic value and instantaneous water-use-efficiency were significantly higher for the treatments viz., fertigation with 100% RD (T1), fertigation with 80% RD (T2) and drip irrigation with RD (T5) over T6 (furrow irrigation).

Yield under different levels of drip-fertigation were recorded and analysed. Significantly higher green leaf, cured leaf and grade index were recorded for the treatments

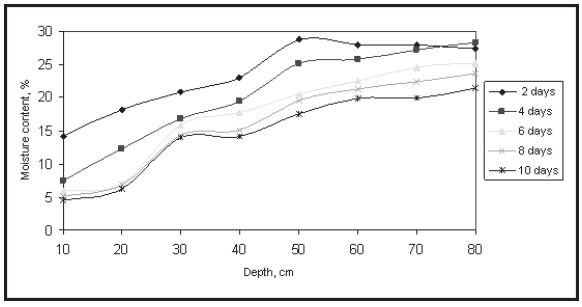


Fig. 6. Moisture dynamics under furrow irrigation

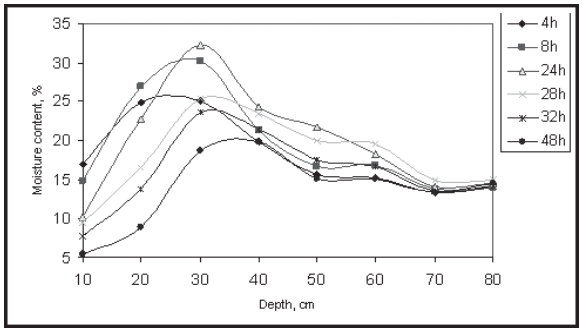


Fig. 7. Moisture dynamics under drip irrigation

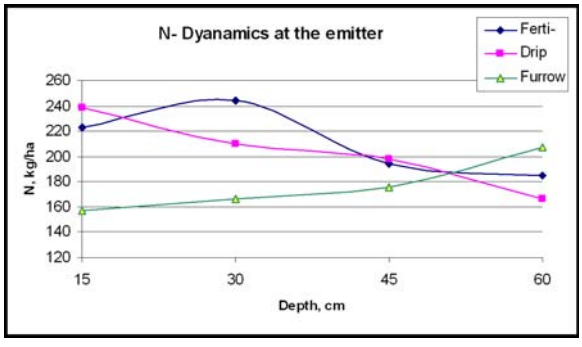


Fig. 8: Nitrogen dynamics

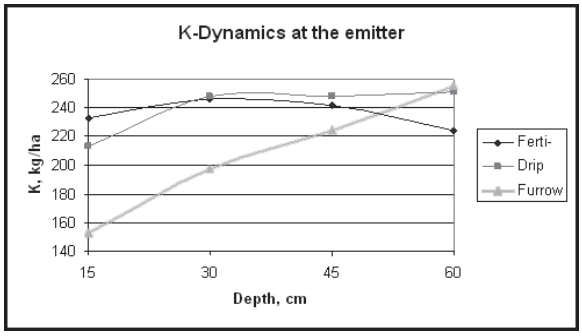


Fig. 9: Potassium dynamics

T1, T2 and T5. Fertigation with recommended dose increased the yield up to 44%. Drip irrigation with the dollop method with recommended dose increased the yield up to 25 %.

Crop growth modelling for FCV tobacco in Northern Light soils

(C.C.S. Rao, M. Anuradha, K. Siva Raju, S. Kasturi Krishna and H. Ravisankar)

Micronutrient uptake at different growth stages

Increase in days after transplanting increased the concentration and uptake of Zn and Cu up to 102 days and decreased thereafter (Fig.10). Fe and Mn concentration have not shown much variation during the growth stages. Uptake of Fe was maximum at 102 days whereas that of Mn was maximum at 112 days (Fig. 11). Among the micronutrient cations, Fe uptake was maximum and Cu uptake was minimum.

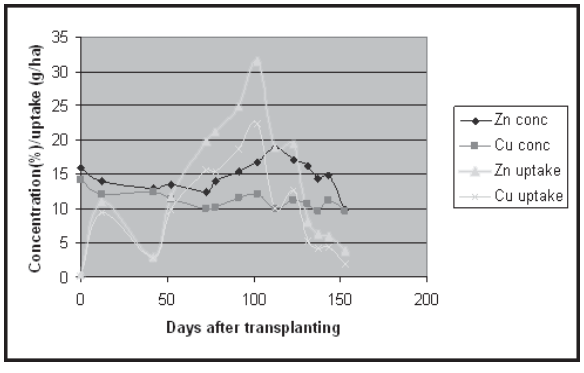


Fig. 10: Uptake of Zn and Cu at different growth stages

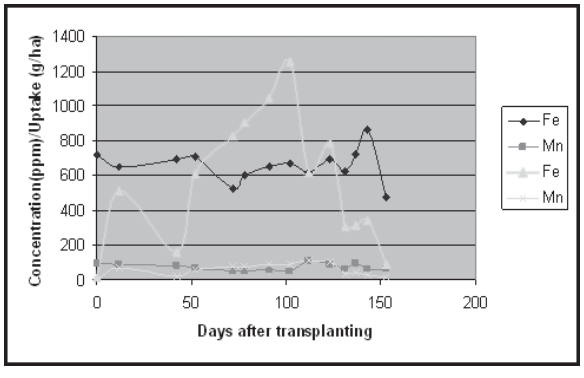


Fig. 11: Uptake of Fe and Mn at different growth stages

Effect of different nitrogen levels on nitrogen concentration at different growth stages

Increase in nitrogen levels increased the nitrogen concentration (Fig. 12). Nitrogen concentration in the lamina decreased as the days after sowing increased. Increase in the nitrogen concentration with nitrogen dose at 75 and 105 days followed linear function with R^2 values 0.955* and 0.988*, respectively (Fig. 13).

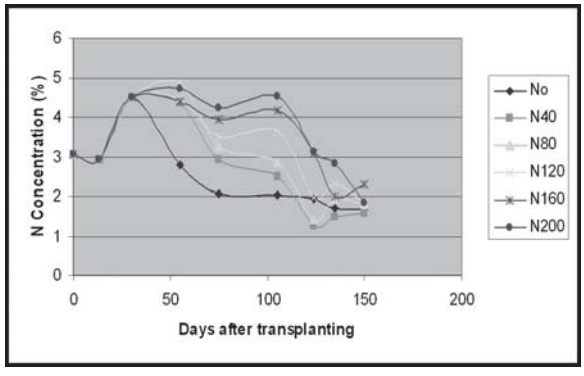


Fig. 12: Nitrogen concentration at different growth stages under different N levels

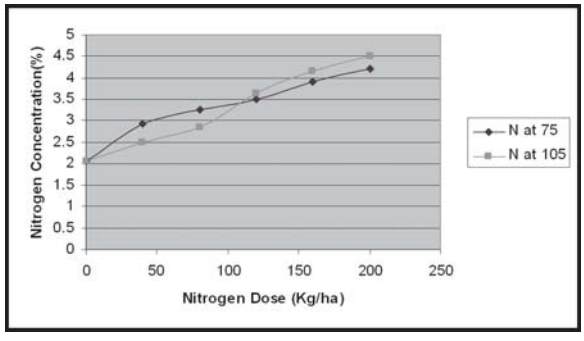


Fig. 13: Effect of Nitrogen dose on nitrogen concentration (%) in lamina

Effect of different nitrogen levels on biochemical parameters of leaf

Cured leaf samples were collected from different leaf positions (P, X, L and T) during 2007-08 season for analysis of of different biochemical parameters.

Chlorophyll a content increased in each position (P to T) with increase in the level of nitrogen from N_{40} to N_{200} In all the levels of nitrogen. Chlorophyll b content increased with

increase in the nitrogen level from N_{40} to N_{160} in each position (P to T), but further increase in the nitrogen level to N_{200}, there was a decrease in the chlorophyll b content. Increase in the nitrogen level from N_{40} to N_{160} level, caused increase in carotenoid content in all the leaf positions with exception in the T position where there was a decrease from N_{120} to N_{160}. However, with the increase in the nitrogen level from N_{160} to N_{200} level, there was a decrease in the carotenoid content in all the leaf positions. Increase in nitrogen from 40 kg/ha to 80 kg/ha, the starch content increased in X and L positions, whereas it decreased in P position and there was no specific trend in the T position.

With increase in nitrogen level from N_{40} to N_{120}, the chlorogenic acid content also increased in all the leaf positions and with further increase from N_{160} to N_{200}, there was decrease. The rutin content increased with increase in from N_{40} to N_{120} in all the leaf positions. The free FFA content increased from P position to L position in all the levels of nitrogen and there was a decrease in FFA content in T Position over L position. In each nitrogen treatment, the PEE content increased from P position to L position and there was a marginal reduction in the T position over L position. The proline content increased with increase in N levels from N_{40} to N_{120} in all the leaf positions, but on further increase in N levels, there was a decrease in proline content except in L position where there was an increase in proline content from N_{120} level to N_{160}.

CTRI Research Station, Kandukur

Studies on the influence of quality of irrigation water and fertilizer levels on growth and production of healthy seedlings from tobacco nurseries under SLS conditions

(R. Sreenivasulu and C.C.S.Rao)

An experiment was conducted in nursery using water containing 28, 50, 100, 200, 300, 400,500 and 600ppm chlorides in main plots and two fertilizer levels viz., recommended dose of fertilizer (RDF) and 1.5 times to RDF in sub-plots.

Salient findings

- The germination count tended to decline significantly in response to increased chloride content beyond 200ppm
- Thickening and brittleness of leaves and yellowing and slow death of seedlings in early stages symptoms were observed
- A slight decline in damping-off and blight diseases was noticed with increasing chlorides and the incidence was relatively more at increased fertilizer dose.
- Dry weight of seedlings decreased significantly with increase in chlorides in irrigation water beyond 200ppm.
- The weight of seedlings was significantly more under increased fertilizer level especially when high chloride water is used.
- Yield of transplantable seedlings decreased significantly with increase in chlorides in water beyond 100ppm.
- Higher number of transplantable seedlings was recorded under increased fertility level especially with water containing high chlorides.
- Irrigation with water containing higher chlorides increased EC of soil and caused accumulation of chlorides in soil and to some extent in seedlings. This was clearer in pot culture study.
- The seedlings raised with water varying in chloride content could not influence either yield parameters or quality characteristics.

Effect of different chemicals on sucker control in FCV tobacco under SLS conditions

(R. Sreenivasulu and K. Nageswara Rao)

Topping and sucker control is an important practice adopted in all tobacco growing countries to improve yields and quality of FCV tobacco. However, under SLS conditions topping is not practiced due to increasing labour cost and low returns. To find out an effective sucker control agent, new chemicals at varying concentrations were tried along with recommended chemicals. Prime+ (Flumetralin)

and Stomp (Pendemethalin) were tried @ 0.75, 1.00, 1.25 and 1.5% along with Suckerout @ 4%, Decanol @ 4% and hand-suckering and no topping (control). When averaged over different superior treatments, topping improved the yields of cured leaf and bright leaf by 9.9 and 4.6%, respectively over control When cured leaf yields were considered, the yields were almost similar between hand-suckering, Prime+ @1.50%, 1.25%, Stomp @ 1.5%, 1.25% and Decanol @ 4%, Suckerout @ 4%. From these results it may be seen that Prime+ @ 1.25%, and Stomp @ 1.50% are promising for sucker control under SLS conditions.

Agro-techniques for productivity enhancement of FCV tobacco under SLS conditions: Augmenting planting time for high fertilizer utilization

(R. Sreenivasulu, A.R. Panda and K.C. Chenchaiah)

Due to increasing cost of production, the tobacco crop at present yield levels of 850 to 1,000 kg/ha is becoming less remunerative under SLS conditions. Further, there is a shift in trade preference for medium and low grades instead of high grades. Under these circumstances, instead of aiming for higher bright grade outturn, improved productivity by enhanced fertilizer utilization by augmenting planting time with a suitable variety is desirable. An experiment was laid out with three dates of planting (September III week, October II week and October IV week) and three varieties (Siri, N-98 and Hema) in main plots and three fertilizer levels (60-60-60, 80-60-70, 100-60-80 kg NPK/ha, in sub-plots in split-plot design with three replications.

Salient findings

- Siri and N-98 out yielded Hema by 15.4 and 9.8% in 1st date of planting (DOP), by 18.7 and 15.2% in 2nd DOP and by 14.8 and 11.7% in 3rd DOP (late planting), respectively.
- Average yield improvement due to early planting was 7.6% and middle date of planting was 12.2% compared to delayed planting.
- Yield increased with the increase in fertilizer up to 100-60-80 NPK kg/ha. However, differences between 80-60-70 and 100-60-80 NPK kg/ha were non- significant.
- Incidence of leaf curl, caterpillar and aphids was relatively high in Hema compared to Siri and N-98.
- Mean values of nicotine, reducing sugars and chlorides in leaf samples were 2.45, 12.46 and 0.41%, respectively.
- Higher nicotine and slightly lower sugars were recorded with increased fertilizer levels.
- Early planted crop showed relatively more nicotine and less sugars due to continuous drought.
- Early/mid planting of the high yielding variety Siri or N-98 with enhanced fertilizer dose (80-60-70 kg NPK/ha) improved the yield under SLS conditions.

It is concluded that the variety Siri is suitable for SLS area and N-98 proved promising. Significant improvement in cured leaf yield could be achieved by adopting high yielding variety Siri or line N-98, early planting and increase in fertilizer dose from the 60-60-60 kg NPK/ha to 80-60-70 kg NPK/ha under SLS conditions.

CTRI Research Station, Hunsur

Integrated nutrient management for FCV tobacco in KLS

(M. M. Swamy)

Integrated Nutrient Management practices involving different organic: inorganic ratios and various sources of organics were evaluated during 2005-08 seasons to identify optimum ratios (organic: inorganic) and best source of organics. The three-year study revealed that 25:75 (organic: inorganic) ratio as optimum INM package for realizing maximum productivity of both cured leaf yield (CLY) as well as top grade equivalent (TGE) compared to 50:50 or 75:25 ratios. Among the different organic sources tried, vermicompost was found to be more

effective compared to pressmud or FYM. Relatively higher leaf nicotine and lower reducing sugars were observed in 25:75 ratio as compared to 50:50 or 75:25 ratios. The bulk trial conducted with 25:75 (organic:inorganic) ratio revealed 7.6% increase in CLY and 6.7% increase in TGE compared to 100% inorganic alone. Hence, 1.50 t/ha of vermicompost + 45 kg N/ha, 4O P_2O_5 kg/ha and 120 kg K_2O/ha may be advocated as INM practice for FCV tobacco in KLS.

Agronomic evaluation of promising FCV tobacco varieties (FCH 196 & FCH 201)

(M. M. Swamy)

Field experiments were conducted to evolve suitable agronomic packages for promising new tobacco line FCH 201. The second year trial conducted during 2008-09 as well as the pooled data of two seasons revealed that 100 x 55cm spacing and 22 leaves topping level was ideal for maximizing the cured leaf productivity and TGE. The productivity level tends to reduce by 4% at higher spacing level of 100 x 60cm. The levels of topping (20 or 22 leaves) did not significantly influence the yield levels. With regard to levels of N, there was gradual increase in the cured leaf productivity from 50 to 70 kg N/ha. The productivity increased by 6.7 and 8.5%, respectively by the application of N @ 60 and 70 kg/ha, respectively over 50 kg N/ha. The cured leaf quality parameters were not altered by the different spacing and topping levels adopted as well as graded application of N levels. Hence, it can be concluded that 100 x 55cm spacing, 22 leaves topping and N application @ 60kg/ha can be adopted for realizing the potentiality of the new promising line FCH 201 under KLS conditions.

Feasibility of producing organic tobacco in KLS

(M. M. Swamy)

Feasibility of producing organic tobacco using various organics (vermicompost @ 6 t/ha, use of biofertilizers @ 10 kg/ha, Green manuring in *rabi* season with sunnhemp, use of neem based organics and biopesticides etc.) is being attempted on a permanent site at Sollepura farm since 2006-07 season. The results of the third year trial indicated that fully organic treatment resulted in loss in productivity to an extent of 23.8% in cured leaf yield and 18.2% in TGE compared to the conventional practice. It can be noted that during the initial two years of the project, the reduction in the productivity of cured leaf yield was as high as 35-36% which indicates improvement in productivity over the years in the fully organic treatment. With respect to 75:25 and 50:50 (organic: inorganic ratios) the loss in productivity was 10.3 and 7.5%, respectively compared to the conventional practice. The leaf nicotine values were fairly lower in the 100% inorganic treatments as observed during the previous two years.

Development and evaluation of Integrated Farming System model for rain fed system of KLS

An integrated farming system model involving agri-horti, silvipasture, cropping systems and subsidiary enterprises is being developed and evaluated in one acre operational area at Hunsur farm since 2005-06. During the period under report, castor crop in agri-Horti system, fodder crops in silvipasture and cotton, pigeonpea + groundnut (2:8), finger millet, maize+cowpea (1:1) in *kharif* and field bean, horse gram etc. (*rabi*) in the cropping system blocks were raised. In addition, vegetable production (nutrition garden), FYM and vermicompost production, animal husbandry etc. were taken up to earn additional farm income and to generate organic resources for the system. Live fence with Jatropha was further developed in the model. The fourth year economic evaluation of the model indicated a total revenue of Rs. 25,077/- from the 1.0 acre model from all the systems during 2008-09 season. There was good growth and higher productivity of *kharif* crops like cotton, pigeonpea, groundnut, finger millet etc. as the rainfall and weather were very much favourable for the crop production. Maximum returns (Rs. 20,747/-) were obtained from the subsidiary components/enterprises as observed in the previous seasons indicating the

importance of allied enterprises in agriculture, especially in the rainfed farming situations such as KLS. The net profit generated from the model was Rs. 17,872/- with C: B ratio of 3.48.

Burley Tobacco Research Centre, Kalavacharla

Response of Burley tobacco (var. Banket - A1) to varying levels of vermicompost and nitrogen

(P. Harishu Kumar)

The cured leaf of Banket A1 variety of Burley tobacco did not differ significantly due to various N levels under different vermicompost doses. However, vermicompost at 2 t + 140 kg N recorded more than 2000 kg cured leaf followed by 6 t vermicompost + 100 kg N/ha. It is also evident that total N applied (organic + inorganic) @ 160 kg/ha gave better cured leaf than others. In the leaf samples, nicotine and reducing sugars ranged from 0.81 to 1.75 % and 0.67 to 1.90%, respectively.

CTRI Research Station, Vedasandur

Phosphorus management in chewing tobacco under Vedasandur conditions

(M. Kumaresan, P. Harishu Kumar and C.C.S. Rao)

Pooled data of first cycle (2005-06 & 2007-08)

Pooled data revealed that leaf length, first grade leaf yield (FGLY) and total cured leaf yield (TCLY) with 100% P + PSB was comparable with 50% P + PSB. The FGLY increase with 50% P + PSB, 75% P + PSB, 100% P + PSB was 25, 20 and 20%, respectively over no P. Different P levels significantly influenced the TCLY also. The TCLY increase with 50 % P + PSB, 75% P + PSB, 100 % P + PSB was 19, 17 and 18%, respectively over no P. No P recorded lower FGLY and TCLY. Significantly higher N, P, K uptake and soil available P were observed with 50% P + PSB, 75% P + PSB and 100% P + PSB over no P. No P recorded less N, P, K uptake and soil available P. Different levels of P significantly influenced the economic returns. The gross returns, net returns and B:C ratio with 100% P + PSB was comparable with 75% P + PSB and 50% P + PSB. No P recorded lower returns.

Pooled results of second cycle (2006-07 & 2008-09)

Pooled data of second cycle revealed that leaf length/width at harvest were not influenced by levels of P. However, increased growth attributes were noticed with all levels of P as compared to no P. P levels significantly influenced FGLY. The FGLY increase with 50, 75 and 100% P were 10, 8 and 7%, respectively over no P. FGLY with 100% P was comparable with 75 and 50% P. No P recorded lower FGLY. Significant influence of P levels was observed with TCLY also. TCLY significantly increased by 16, 17 and 20% with 50, 75 and 100% P, respectively over no P. TCLY at 50% P was comparable with 75 and 100% P. Preferable chewability was observed in all the P applied treatments. Pooled data of the economics of the second cycle revealed that gross returns, net returns and B:C ratio with 100% P was comparable with 50% P. No P resulted in significantly lower economic returns.

Application of 50% P + PSB in the first year and 50% P in the second year would be optimum for higher FGLY, TCLY and net returns. Non-application of phosphorus decreased the yield and returns of chewing tobacco.

Effect of spacing, nitrogen and phosphorus on yield and quality of chewing tobacco in Tamil Nadu

(M. Kumaresan, V. Krishnamurthy, P. Harishu Kumar and A.V.S.R. Swamy)

Three levels of spacing were tested under three levels of nitrogen in FRBD with three replications. The results of the first year showed that the levels of spacing significantly influenced the growth attributes. Leaf length/width at topping as well as harvest significantly increased with 90 x 75 cm spacing over the other two spacings. The spacing 90 x 75 cm significantly increased the FGLY over the spacing 75 x 75 cm by 8%. Nitrogen significantly influenced the growth, yield and economics of

chewing tobacco. Nitrogen @ 150 kg/ha was comparable with 125 kg N/ha with respect to biometric observations and TCLY. Nitrogen @ 150 kg/ha significantly increased FGLY by 14% over 75 kg N/ha. TCLY significantly increased by 8% with 150 kg N/ha over 75 kg N/ha. Gross returns, net returns and B:C ratio with 75 x 75 cm and 90 x 75 cm were comparable. The spacing 90 x 90 cm recorded lower gross returns, net returns and B:C ratio. Nitrogen at 150 kg/ha and 125 kg/ha are comparable with respect to gross returns, net returns and B: C ratio.

Scheduling irrigation through drip system based on daily evapo-transpiration for chewing tobacco in Tamil Nadu

(M. Kumaresan, A.V.S.R. Swamy, V. Krishnamurthy and P. Harishu Kumar)

Scheduling irrigation through drip irrigation system based on different crop evapo-transpiration (Et) was tested and compared with irrigation based on IW/CPE=1 ratio and conventional method of furrow irrigation in RBD with three replications (Fig. 14).

Drip irrigation daily and on alternate days at 100% ETc was comparable with conventional method of irrigation with respect to leaf length and width. FGLY significantly increased with daily and alternate drip at 100% ETc over 75 and 50% ETc. FGLY with drip daily and alternate days at 100% ETc was comparable with IW/CPE ratio and conventional method of irrigation. Drip daily and alternate days at 100% ETc significantly increased the TCLY by 13 and 10%, respectively over the conventional method of irrigation. The yield recorded was 3,673 and 3,605 kg/ha with drip daily and alternate days, respectively at 100 % ETc. Total quanta of irrigation given were 376.84, 480 and 660 mm for drip system, IW/CPE=1.0 (IW=30 mm) and conventional method of irrigation, respectively. The saving in irrigation water in drip system was 43% over the conventional method of irrigation. Water-use-efficiency was higher with daily drip at 100 % ETc by about twice over the conventional method.

Fig. 14: Drip irrigation for chewing tobacco in Tamil Nadu

Drip daily at 100% ETc significantly increased the gross returns (Rs. 1, 50,900/-) by 13% over the conventional method. Drip on alternate days at 100% ETc significantly increased gross returns (Rs.1, 48,100/-) by 11% over the conventional method of irrigation. Higher net returns were recorded with the conventional method and were comparable with irrigation at IW/CPE = 1, daily and alternate days drip at 100% ETc. The net returns recorded with daily and alternate days drip at 100% ETc was Rs.82,700/ha and 80,000/ha, respectively. B:C ratio was higher with conventional method and irrigation at irrigation at 1 IW/CPE ratio, followed by daily/alternate days drip at 100% ETc.

Spacing and nitrogen requirement for the advanced breeding lines of chewing tobacco under Vedasandur conditions

(M. Kumaresan and A.V.S.R. Swamy)

Three genotypes (VDH-1, VDH-3 and Abirami) were tested under three spacing viz., 75x75cm and 90x75cm at two N levels (75 and 125 kg N/ha) in FRBD design with three replications. FGLY significantly increased (2,474 kg/ha) with VDH -3 by 12% over the check variety. TCLY significantly increased (3,422 kg/ha) with VDH-3 by 16% over Abirami. Significant increase in FGLY (2,423 kg/ha) was recorded with the spacing 90 x 75cm over 75 x 75cm. FGLY increase with 90 x 75 cm spacing was 7% over 75 x 75cm spacing. Higher TCLY was recorded with 90 x 75 cm spacing and was comparable with 75 x 75 cm spacing. Nitrogen at 125 kg/ha significantly increased the leaf

length/width, FGLY and TCLY. Increase in TCLY was 5% over 75 kg N/ha. Higher gross returns, net returns and B:C ratio were recorded with the advanced hybrid line VDH-3 under 90 x 75cm spacing and 125 kg N/ha.

CTRI Research Station, Dinhata

Permanent manurial trial on *Motihari* tobacco

(S. Amarnath and S. Roy)

Application of 112 kg N PK/ha significantly increased the green, cured and first grade leaf yields as compared to control. 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 the treatments PK, P & K alone, 25 and 50 t FYM /ha. FYM at 50 t/ha was significantly superior to 25 t FYM/ ha for green leaf yield only. The recovery (68.6 %) of first grade leaf was highest in NPK and closely followed by NK (59.8%) and NP(54.5%) applied plots. It is 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 gave minimum first grade leaf yield as compared to application of nitrogen alone or in combination of phosphorus and potassium. Application of 112 kg N + 112 kg P_2O_5 + 112 kg K_2O/ha recorded highest gross (Rs.1,02,829/ha) and net (Rs.60,613/ha) returns followed by 112 kg N + 112 kg K_2O/ha, 112 kg N/ha +112 P_2O_5 and 112 kg N /ha. The highest benefit : cost ratio (3.44) was recorded in 112 kg N + 112 kg P_2O_5 + 112 kg K_2O/ha followed by 112 kg N + 112 kg k_2O , 112 kg N +112 kg P_2O_5 .

Spacing cum nitrogen requirement for the early maturing *Motihari* tobacco genotype

(S. Amarnath and S. Roy)

The new tobacco genotype Torsa as compared to check Bitri revealed significantly higher green (12.9%), cured (15.4%) and first grade (51.0%) leaf yields and 31.2% higher recovery of quality leaf over the check Bitri. Significantly higher green and cured leaf yields were recorded at 45 x 45cm spacing but first grade leaf yield (26.2%) was significantly inferior and recovery of quality leaf (33.0%) was lower than with the higher spacing of 60 x 45 cm. The cured leaf yield increased significantly with addition of nitrogen from 100 to 125 kg/ha and 125 to 150 kg/ha but non-significant increase was observed for first grade leaf yield with increase in N level from 125 to 150 kg/ha. Thus, the variety Torsa proved its superiority over Bitri at 125 kg/ha N fertilization and 60 x 45 cm spacing for higher first grade leaf yield, higher recovery of quality leaf and net profit.

Farm pond technology for SLS in Andhra Pradesh

PROGRAMME 5

CROPPING SYSTEMS FOR SUSTAINABLE PRODUCTION

CTRI, Rajahmundry

Productivity enhancement of soybean - chickpea through integrated nutrient management in rainfed Vertisols of Andhra Pradesh

(S.Kasturi Krishna, S.V.Krishna Reddy, P. Harishu Kumar and V. Krishnamurthy)

Soybean- chickpea system was one of the viable alternative systems to sole FCV tobacco. The present experiment was formulated to enhance the productivity of this cropping system in rainfed Vertisols. Soybean was sown during *kharif* season with following treatments (1) 5 t/ha FYM + 100% RD of NP, (2) 5 t/ha FYM + 75% RD of NP + *Rhizobium* and PSB, (3) 3.25 t/ha Vermicompost + 100% RD of NP, (4) 3.25 t/ha Vermicompost + 75% RD of NP + *Rhizobium* and PSB and (5) Recommended dose (RD) of fertilizers only. Chickpea was sown during *rabi* season with (1)15 kg N + 50 kg P_2O_5, (2) 20 kg N + 37.5 kg P_2O_5 and (3) 20 kg N + 50 kg P_2O_5. It is inferred from the data that higher yields of soybean were recorded in FYM applied plots and was on par with vermicompost applied plots. The yield was higher in FYM applied plots with *Rhizobium* and PSB than with vermicompost applied plots when compared with the control. Significant differences were observed in the yields of chickpea due to the residual effect of *kharif* crop nutrition. The yield of chickpea in FYM applied plots was on par with vermicompost applied plots. Vermicompost and FYM applied plots recorded significantly higher yields than RDF alone. Application of RDF gave higher yields than 75% of recommended dose of N & P. Reducing 25% N decreased the yields by 4.72 % than RDF whereas 25% reduction in P decreased yields by 2.68% only.

Effect of *Rabi* crops on the emergence of *Orobanche*

(S. Kasturi Krishna, S.V. Krishna Reddy and C.A. Raju)

Orobanche is a serious total root parasite in tobacco. In order, to check the germination of the parasite seed in field tobacco crop, pseudo-hosts like green gram, gingelly and sorghum were grown in sequence with tobacco to make the seeds to germinate and die in course of time. The permutations of the crops gingelly, sorghum and green gram are worked out along with tobacco and the *Orobanche* germination is to be studied in a three-year cycle. *Orobanche* biomass was estimated in tobacco plot as 80 g/plant.

Alternative crops for *Hookah* and Chewing tobacco in West Bengal

PROGRAMME 6

BIO-ECOLOGICAL AND PATHOLOGICAL STUDIES ON PESTS AND DISEASES

CTRI, Rajahmundry

ENTOMOLOGY

Monitoring of insect pests of tobacco with pheromone traps

(U. Sreedhar)

Monitoring of tobacco caterpillar, *Spodoptera litura* in tobacco nurseries

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

The results indicated that with the increase in the trap catch (lagged variable), there is an increase in the seedlings damaged in the following week. The trap catch was highest in the 44th standard week (521/trap) and another two peaks were recorded during 45th (486) and 47th (504) standard weeks. The correlation between trap catch and per cent seedlings damaged was highly significant in all the four blocks. Among the weather parameters, rainfall of the previous week (lagged variable) had a significant and positive correlation with the trap catch as evidenced by increase in the moth catch one week after the rainfall. Perusal of correlation matrix shows that there is a highly significant and positive correlation between trap catch and per cent seedlings damaged, where as, rainfall had a significant and positive correlation with the moth catch in pheromone traps.

The fitted multiple linear regression equation for the moth catch in pheromone traps vs. weather parameters explains 86.5% of variation in the moth catches in pheromone traps and only 13.5% variation in the dependent variable could not be explained. The linear regression equation fitted for per cent seedlings damaged vs. moth catch in the pheromone traps explains 51.1% variability of the dependent variable by pheromone trap catch and 48.9% variation in the seedlings damaged by *S. litura* went unexplained.

The fitted multiple linear regression equation for per cent seedlings damaged vs. moth catch and weather parameters explains 70% variability of the dependent variable by pheromone trap catch together with weather parameters and 30% variation in the seedlings damaged by *S. litura* went unexplained.

Studies on seasonal incidence of insect pests of Burley tobacco in East Godavari plains

(G. Raghupathi Rao)

Seasonal incidence of insect pests of tobacco was recorded at BTRC, Kalavacharla. The pest incidence was monitored in both protected and unprotected plots. In protected plot, need based selective insecticides were used for the management of insect pests.

In nurseries, the first spraying was given with NSKS and subsequent two need based sprayings were given with chlorpyriphos (0.5%), Sl. NPV and acephate (0.1%) for the management of *S. litura*.

In planted crop, the protected plots were managed with need based sprayings viz., imidachloprid @ 0.005 % was sprayed to manage whitefly/leaf curl and second spray was given to manage the aphid infestation. Chlorpyriphos (0.5%) was sprayed to manage stem borer. For the management of *S. litura* and *H. armigera*, the first spray was given with Sl. NPV and subsequent two need based sprayings with acephate and chlorpyriphos.

Nursery

In protected beds, the infestation of *S. litura* commenced from 30 DAS (2.5%) and

gradually increased till 50 DAS (8.6%). Whereas, in unprotected beds, it was 8.5 and 22% at 30 and 50DAS, respectively. The larval intensity in protected beds ranged from 0.6 to 0.8 larvae/plant as against 2 to 2.5 larvae/plant. In the protected plot, incidence of *S. litura* was minimized to the tune of 2.6 folds over unprotected beds.

Planted crop

Incidence of white fly (*B. tabaci)*, aphids *(M. nicotianae)*, stem borer (*S. heliopa)*, leaf eating caterpillar (*S. litura)* and tobacco bud worm, (*H. armigera)* was recorded in protected and unprotected plots and the findings are as follows.

White fly : Incidence of white fly was monitored by using yellow sticky traps. The incidence commenced from 2nd week of July and continued till the last week of November. The catches gradually increased from 4th week of August, reached peak during 1st week of October and subsequently declined gradually. The intensity of whitefly in unprotected plot commenced from 30 DAP (3.5 whiteflies / plant) and continued till 60 DAP (7.6 whiteflies/plant). In contrast, in protected plot, it reduced by 50% over unprotected plot. A 2-fold reduction in the incidence of leaf curl was noticed in protected plot compared to the unprotected plot.

Stem borer: Stem borer infestation in unprotected plot commenced from 15 DAP (4.5%) and reached peak by 60 DAP (12%). In contrast, it varied from 1 to 7% in protected plot and more than 50% reduction was observed in the unprotected plot.

Aphids: In the unprotected plot, incidence of aphid commenced from 30 DAP (8 aphids/plant), reached peak after 60 DAP (398 aphids/plant) and thereafter, the incidence declined. In insecticide treated plot, the intensity of aphids ranged from 4 at 30 DAP to 210 aphids/plant at 60 DAP. At 75 DAP, 8.2% plants showed aphid infestation in the unprotected plots as against 4.6% in the protected plot.

Leaf eating caterpillar (*S. litura):* The infestation in protected plot ranged from 0.5 to 8.5%, whereas it was 2.5 to 16.5% in the unprotected plot. Larval population was low in the protected plot and ranged from 0.2 to 1 larvae/plant as against 1.2 to 2.4 larvae/plant in the unprotected plot.

Bud worm (*H. armigera)*: The bud worm infestation fluctuated between 2 and 7.8% in the protected plot, whereas it ranged from 5.6 to 14% in the unprotected plot. The larval population was suppressed by 60% in the protected plot.

Natural enemies: In the unprotected plot, the activity of *Verania* sp. was found to be high between 40-50 days of crop growth, whereas the activity of *Cheilomenes* sp. was high when the crop was 60 days old. The activity of *C. transversalis* was high when the crop was 60 days old. In general, activity of *Verania* sp. *and Cheilomenes* sp. was high on Burley tobacco.

Yield: The cured leaf yield was relatively high (890 kg/ha) in the protected plot as against 650 kg/ha in the unprotected plot.

CTRI RS, Guntur

Studies on relationship of pheromone trap catch of *H.armigera* with field incidence and weather parameters in tobacco, cotton (*Bt* and Non-*Bt*)

(J.V. Prasad)

Pheromone traps were installed in tobacco nursery to trap adult moths of *Spodoptera litura* at the rate of 4 traps per acre. Data on moths trapped were collected daily and the lures were changed every three weeks. The data on the incidence of the pest were recorded at weekly interval from three random square meter areas (Fig. 15-17).

There was a steady increase in the number of moths trapped from September 1st week, reached a peak at September 4th week and declined. Similar trend was observed in the case of incidence of the pest in the nursery with a lag of two weeks in comparison with pheromone trap catch. The peak infestation of the pest was observed two weeks after peak catch of the moths in pheromone traps. In the field crop of FCV tobacco, there was a

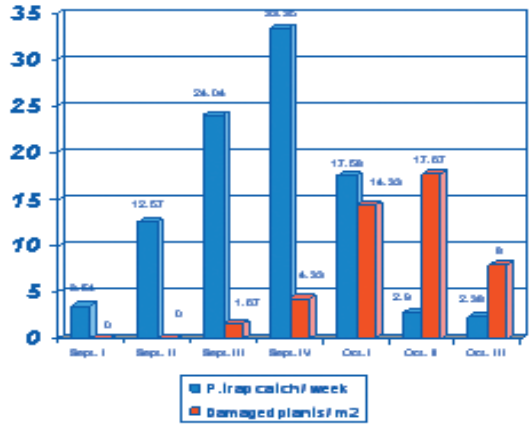


Fig. 15: Incidence of *S. litura* in tobacco nursery

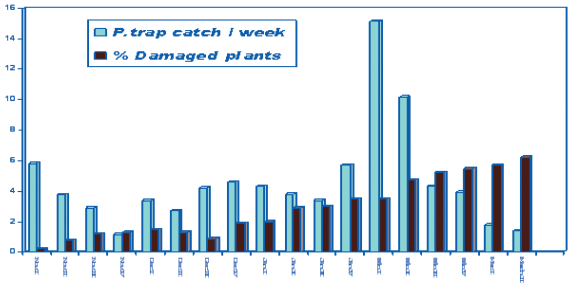


Fig. 16: Incidence of *S. litura* in field crop of FCV tobacco

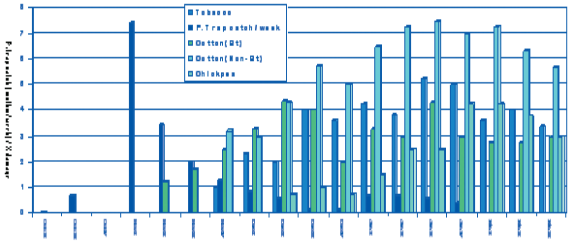


Fig. 17: Incidence of *H.armigera* in tobacco, cotton and chickpea

moderate catch of moths in the traps which reached a peak in the February 1st week followed and declined. The infestation of *S. litura* reached a peak three weeks after peak catch of moths was recorded in pheromone traps.

The incidence of *H.armigera* was low during the crop season in all the crops under study and no clear association of the pheromone trap catch was observed with field incidence. The peak catch of moths of *H.armigera* in pheromone traps was noticed in November 1st week during which period the crops were not in a stage suitable for feeding of the pest. The highest incidence of the pest was recorded during January 3rd week in tobacco. Peak infestation of the pest was observed in non-*Bt* cotton and chickpea during January 4th week.

There was a significant positive association of rainfall and trap catch of *S. litura*. Trap catch of *S. litura* could be explained by weather parameters to a tune of 78% as shown by the R^2 value. Only 30% of the variation in the trap catch of *H. armigera* could be explained by weather parameters and no significant association of any of the weather parameters was noticed with the trap catch in the case of this pest.

The incidence of *S. litura* in tobacco nurseries could be explained by weather parameters to an extent of 74%. Forenoon RH and rainfall had a significant positive effect on the incidence of the pest. Sixty five percent of the variability in the incidence of *S. litura* in the field crop could be explained by weather parameters. The variability in the field incidence of *H.armigera* in the case of cotton (*Bt* and non-*Bt*) and chickpea could be influenced by weather parameters to an extent of 27-44 % only and no significant association of field incidence was noticed with weather parameters.

CTRI RS, Kandukur

Population development studies of aphid, *M. nicotianae* under SLS conditions

(K.C. Chenchaiah)

An experiment was initiated with three dates of planting to generate basic data on the incidence and population development of aphid in the prevailing weather conditions and biotic controlling factors. Weekly observations on aphid count were recorded on 5 tagged and 5 un-marked plants in each plot. The prevailing weather conditions were also recorded during the cropping season starting from 16th October to the end of leaf harvesting. The results indicated that, aphids were recorded in the 3rd week of December and continued till the harvest. The early planted crop almost escaped the attack of the aphid. The normal planted

crop got aphid infestation from 3rd week of December and the late planted crop got the aphid infestation from 1st week of January with the start of severe winter and continued till harvest. The intensity ranged from 1-500 per plant. The important biotic factors noticed are *Nesidiocoris* sp., mummified aphid, syrphid predators and very few lady bird beetles.

Relationship between weather parameters and pest/predator incidence under three dates of planting

Early planting

- Variability in the occurrence of aphid could be influenced by weather parameters to an extent of 57.0%
- None of the weather parameters had a significant influence on the incidence of aphid
- Weather factors influenced (87.2%) population of mummified aphid
- Maximum temperature had a negative impact on mummified aphid population
- Syrphid population was collectively influenced by weather parameters and aphid population to an extent of 76.8%

Normal planting

- Weather parameters (Maximum temperature: negative; Sunshine hours: positive) significantly influenced (82.1%) aphid population
- Weather and aphid population (positive) significantly influenced populations of *Nesidiocoris* sp. (85.6%), mummified aphids (63.9%), syrphids (86.3%) and lady bird beetles (75.7%)
- Minimum temperature and sunshine hours had negative impact on the syrphid and lady bird beetle populations, respectively.

Late planting

- Weather parameters (Minimum temperature: negative) significantly influenced aphid population (83.3%)
- Influence of weather parameters on *Nesidiocoris* sp. population was non-significant.
- Weather and aphid population significantly influenced populations of mummified aphids (100%), syrphids (68.2 %) and lady bird beetles (79.7%)
- Mummified aphid population was influenced by aphid population (negative), maximum temperature (negative), RH (positive) and sunshine hours (positive)
- Individual factors had no impact on populations of syrphids and lady bird beetles

Studies on biology and management of mealy bug on FCV tobacco

(K.C. Chenchaiah)

Studies were initiated on the biology and control of mealy bug under SLS conditions on FCV tobacco (Fig. 18). Biology and control was studied under laboratory conditions. Under biology, egg sacks were collected and kept for observation under laboratory conditions. An average of 133.75 crawlers emerged from each egg sack. All the treatments differed significantly in controlling the mealy bug. The mortality of mealy bugs ranged from 10% (water spray) to 95% (chlorpyriphos). All the chemicals also caused mortality of mealy bug as the dose of the spray increased. Chlorpyriphos even @ 0.125% (1.25 ml/L water) caused 85% mortality.

Fig. 18: Mealy bug in tobacco nursery in SLS

CTRI RS, Hunsur

Survey for assessment of insect pest incidence in KLS tobacco

(P. Venkateswarlu, M. M. Shenoi and S. Ramakrishnan)

Nursery

A survey was conducted for assessment of insect pest incidence in KLS tobacco. Five major tobacco growing areas/Taluks of Karnataka viz., Hunsur, H.D. Kote, Periyapatna, K.R. Nagar and Ramanathapura were selected for this study. A total of 50 villages and 200 nurseries were covered under this survey. Out of them, 134 nurseries (67%) were infested by tobacco caterpillar, *Spodoptera litura*. The infestation ranged from 0-45%. Among the infested nurseries, 43.4% had infestation above ET level (> 5%). The average infestation within the infested nurseries was 5.8%. The overall infestation of the pest in the entire area was 3.9%. Among the five Taluks surveyed, the overall infestation of the caterpillar was more in Periyapatna (5.1%) followed by Hunsur (4.7%), H.D.Kote (3.4%), K.R.Nagar (2.5%) and Ramanathapura (2.3%).

Main Field

For main field survey, 100 villages and 300 fields were covered. Aphid incidence (*Myzus nicotianae*) was recorded in all the five taluks. Budworm, *Helicoverpa armigera* was noticed in four taluks viz., Hunsur, Periyapatna, K.R.Nagar and Ramanathapura. Stem borer, *Scrobipalpa heliopa* incidence was recorded in Hunsur, H.D.Kote and Periyapatna. Tobacco caterpillar, *S. litura* incidence was nil in the entire area and its incidence was mainly restricted to nurseries. The per cent fields infested by aphid, stem borer and budworm were 47.0, 9.6 and 11.7, respectively. The average infestations of these pests in the infested fields were 17.3, 8.0 and 7.0%, respectively. The overall infestation by these three pests in the area were 8.1, 0.8 and 0.8%, respectively.

Among these three pests, aphid is major (141 infested fields) followed by budworm (35) and stem borer (29). Among the five Taluks surveyed, the overall infestation of aphid was more in Hunsur (13.0%) followed by H.D.Kote (9.0%), Periyapatna (8.9%), Ramanathapura (3.9%) and K.R.Nagar (2.8%). Except aphids, the populations of remaining two pests were below ET levels. Although aphid infested plants were more, the population was low to medium (1-3 score). Stem borer incidence was recorded more in late plantings and budworm incidence was more in un-topped plots. The survey of KLS region revealed that tobacco caterpillar, *S. litura* is the major insect pest in the nurseries, whereas aphid, *M. nicotianae* is the major pest in the field crop.

PLANT PATHOLOGY

CTRI RS, Dinhata

Management of bacterial wilt in *Motihari* tobacco and biochemical and molecular characterization of pathogenic isolates

(S. Roy, S. Amarnath and K. Siva Raju)

Survey and epidemiology

Incidence of bacterial wilt caused by *Ralstonia solanacearum* at different villages in and around Dinhata sub-division of Cooch Behar district has been documented. Bacterial wilt was recorded in different varieties of *Motihari* tobacco at 17 locations ranging from 0.62-12.5%. The disease was recorded from second fortnight of December, 2008 to first fortnight of January, 2009.

Low bright sunshine hours/day and RH (am) in the month of December, 2008 and January, 2009 were 4.6 h and 93% and 4.1 h and 97%, respectively which might have contributed for expression of the disease coupled with minimum and max temperature ranging from 10.6 to 24.5^0 C.

Cultural management of Bacterial wilt

The results indicated that fallowing of land, soil liming and green manuring had a pronounced individual as well as bipartite and tripartite consortium impact in bringing down bacterial population in the soil, thereby reducing the incidence of disease to a substantial level.

Bacterial wilt in *Motihari* and *Jati* tobacco can successfully be managed by liming @ 560 kg/ha after field preparation, green manuring with *Dhaincha* and keeping the field fallow for 30 days is recommended for the farmers of Terai region in North Bengal.

PROGRAMME 7

INTEGRATED PEST AND DISEASE MANAGEMENT

Entomology

CTRI, Rajahmundry

Management of stem borer, *Scrobipalapa heliopa* in tobacco

(U. Sreedhar)

Evaluation of insecticides against stem borer, *S.heliopa* on tobacco

An experiment was conducted in pot culture to evaluate selective insecticides against stem borer, *S.heliopa* on FCV tobacco. The seedlings grown in pot culture were confined along with *S.heliopa* moths in an insect proof net. The seedlings were sprayed with the test insecticides viz., spinosad 45 SC @ 0.018% , flubendiamide 480 SC @ 0.012%, rynaxypyr 25 SC @ 0.0075%, emamectin benzoate 5 SG @ 0.001%, carbosulfan 25 EC @ 0.05%, profenophos 50 EC @ 0.15% and compared with chlorpyriphos 20 EC @ 0.05% and untreated control. The tobacco plants were observed for stem borer infestation symptoms and at 60 days the plants were cut open to find the *S.heliopa* pupae.

The results showed that the infestation in untreated control was 82.82% whereas in all the treatments it was significantly less. Rynaxypyr and flubendiamide were the most effective treatments as shown by no infestation followed by spinosad and emamectin benzoate (6.14). Among the treatments, chlorpyriphos 0.05% was least effective (28.77%) and was on par with profenophos (14.99). Carbosulfan with 12.28 % infestation remained on par with spinosad, emamectin benzoate and profenophos. observations on mean number of pupae per plant showed that, in control maximum number of pupae were recorded (3.50), whereas least number of pupae were recorded in rynaxypyr (1.00) followed by flubendiamide and spinosad (1.14). The number of pupae recorded in all the treatments was on par with each other except that in chlorpyriphos treatment (2.15). The pot culture experiment indicated that rynaxypyr, flubendiamide, spinosad, emamectin benzoate and carbosulfan were effective against *S.heliopa*.

Management of stem borer, *S. heliopa* with sequential spray of insecticides in the seed beds as well as planted crop

A field experiment was conducted to evaluate promising insecticides against stem borer through sequential spray in seed beds as well as planted crop. The seedlings were treated with the insecticides ten days before pulling and the same were sprayed with the respective insecticides 10 days after transplanting (DAT). An untreated control plot was kept for comparison. Observations were recorded periodically at 30, 40 and 50 DAT. Data on yield parameters were recorded.

Results showed that at 30 DAT the infestation in control (untreated) plot was significantly high (30.22) as compared to treatments. The infestation was least in rynaxypyr and flubendiamide (8.49) which was on par with spinosad (10.51), emamectin benzoate (13.15) and carbosulfan (14.63). Chlorpyripos recorded highest (18.26) infestation among the treatments followed by profenophos (17.27) and they were on par with carbosulfan, emamectin benzoate and spinosad. Similar trend was observed at 40 DAT. At 50 DAT a maximum infestation of 36.5% was recorded in control (untreated) plots. The infestation remained least in rynaxypyr and flubendiamide (8.49). However, it was on par with spinosad (11.99) and emamectin benzoate (16.12). Among the treatments, chlorpyriphos recorded highest infestation (23.02%) followed by profenophos (21.40) and both were on par with carbosulfan (17.27) and emamectin benzoate ((16.12).

All the treatments recorded significantly higher green leaf yield than control (9,316 kg/

ha). The plots treated with rynaxypyr recorded highest green leaf yield and was on par with the yield in the plots treated with flubendiamide, spinosad and emamectin benzoate. Among the treatments chlorpyriphos recorded the lowest yield (11,400 kg/ha) which was on par with carbosulfan (11,650 kg/ha) and profenophos (11,585 kg/ha). As regards cured leaf yield, rynaxypyr recorded highest yield (1,975 kg/ha) which was on par with flubendiamide (1,920 kg/ha). Cured leaf yield in spinosad (1,890 kg/ha) was on par with emamectin benzoate (1,690 kg/ha). Chlorpyrifos recorded lowest cured leaf yield (1,576 kg/ha) which was on par with control, as well as carbosulfan and profenophos (1,600 kg/ha).

All the treatments recorded significantly higher bright leaf yield than control. The bright leaf yield in rynaxypyr, flubendiamide, and spinosad and emamectin benzoate was on par with each other. It was lowest in chlorpyriphos which was on par with profenophos and carbosulfan. The grade index was highest in rynaxypyr (1,440) and it was on par with that of flubendiamide (1,429), spinosad (1,398) and emamectin benzoate (1,285). The grade index was lowest in control plots (990). Among the treatments chlorpyriphos recorded lowest grade index (1,160) which was on par with that of profenophos (1,200) and carbosulfan (1,205).

Management of stem borer, *S. heliopa* with scheduled application of insecticides in the planted crop

A field experiment was conducted in which two sprays were given 10 days and 20 days after transplanting (DAT) with the insecticides. An untreated control plot was kept for comparison. Observations were recorded periodically at 30, 40 and 50 DAT. Data on yield parameters were recorded.

Results showed that all the treatments gave significantly superior protection to tobacco plants from *S.heliopa* infestation than control (29.57, 34.52 & 37.89) at 30, 40 and 50 DAT respectively. At 30 DAT rynaxypyr recorded the least infestation (7.01) followed by flubendiamide (8.49) which was on par with spinosad (11.99) and emamectin benzoate (13.48). Among the treatments, chlorpyriphos recorded the highest infestation 920.31) and was on par with profenophos (19.42) and carbosulfan (16.12) and emamectin benzoate (13.48). Similar trend was observed at 40 DAT except that chlorpyriphos (22.30) was on par with profenophos (20.40) and carbosulfan (17.27), whereas these two were on par with emamectin benzoate (15.79). At 50 DAT, the infestation in rynaxypyr (11.99), flubendiamide (13.15) and spinosad (14.63) was less than other treatments and on par with each other. Chlorpyriphos recorded highest infestation (24.01) and was on par with profenophos (2131) and carbosulfan (20.41).

Perusal of yield data showed that all the treatments recorded significantly higher green leaf, cured leaf, bright leaf and grade index as compared to control (untreated). Rynaxypyr recorded highest green leaf, cured leaf, bright leaf and showed better grade index than others followed by flubendiamide. However, they were on par with spinosad and emamectin benzoate. Among the treatments, chlorpyriphos recorded the lowest green leaf, cured leaf, bright leaf and grade index and was on par with profenophos and carbosulfan

AICRP on Biological Control

Studies on the influence of water quality on the efficacy of entomopathogens against tobacco pests (Nuclear Polyhedrosis Virus)

(S. Gunneswara Rao)

The efficacy of *Sl* NPV was not affected at pH 6 to 8 and there was an increase in damage up to 3% at pH 5 and 9% at pH 9 over pH 7. It was concluded that water suspensions beyond pH 8 are not suitable for using *Sl* NPV and may be avoided at pH 5. Highest number of diseased larvae was recovered from plots that received *Sl* NPV at pH 7 and 8, followed by *Sl* NPV at pH 6. Least numbers were obtained from plots with *Sl* NPV at pH 9 and control followed by *Sl* NPV at pH 5. It was concluded that as the pH of different EC solutions of Sl NPV was nearer to pH 7, the salt concentration has not affected the performance of *Sl* NPV. Hence, any water solutions at EC 0.5 to 6 % are suitable for spraying Sl NPV, if the pH is ranging from 6 - 8.

At different ranges of pH of the Sl NPV solution, the leaf biochemical constituents were not affected except at pH 9 where chlorophyll a was slightly reduced. As regards different EC levels, there was no influence on leaf biochemical constituents.

Comparative study of virulence of different isolates of *S. litura* NPV in tobacco ecosystem

(S. Gunneswara Rao)

Results of the two year experimentation revealed that in the case of number of larvae per plant at 3 days after spraying (DAS) different Sl NPV strains, the treatments showed significant differences between two seasons and the pooled data indicated that significantly least number of larvae was found on plants with Rajahmundry strain (3.70) followed by strains from Jeddangi (4.22) and Jeelugumilli (4.42), which were at a par. Highest number of larvae per plant was observed on plants sprayed with Nandyal strain (6.17), followed by Guntur strain (5.60). However, all the strains were superior to control (no spray).

Similar trend was observed at 7 DAS in the case of strains from Rajahmundry (1.77) followed by Jeelugumilli (2.82) and Jeddangi (2.85) strains. Highest number of larvae was noticed in plants sprayed with Nandyal (4.92) and Guntur strains (4.22) which were significantly different. All the treatments were superior to control i.e., no spray (5.47).

Combined analysis of the data indicated that the differences were not influenced by seasons in the case of leaves damaged per plant and the trends of different strains are as follows: Rajahmundry (3.99%), Jeelugumilli (4.25%), Jeddangi (6.32%) and control (17.77%). Guntur and Nandyal strains were at a par and inferior to rest of the strains.

Significant differences with respect to seasons were not observed in case of green and cured leaf yields. There were no significant differences among the strains with respect to cured leaf yield. All the treatments were superior to control (no spray). Among the NPV strains, Rajahmundry, Jeddangi and Jeelugumilli strains were found superior to Nandyal and Guntur strains in reducing the damage of tobacco leaves by *S. litura*.

Studies on biological control options for suppression of tobacco stemborer *Scrobipalpa heliopa*

(S. Gunneswara Rao)

In pot culture studies in the net house, PDBC *B.t.* strain at 1:10 and 1:100 dilutions could bring about mortality of larvae in stem from 37.81 to 53.6%. In veins, the mortality ranged from 38.16 to 49.57% (Fig. 19). Stem gall was noticed though mortality of larvae occurred in stem. Efficacy of *B.t.* can be further evaluated in nursery plots.

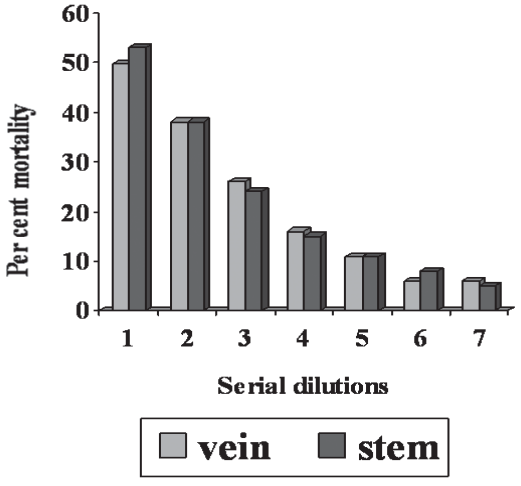


Fig.19: Performance of B.t.(PDBC) on tobacco stemborer

Production of NPV of *Spodoptera litura*

From 1.04.08 to 10.06.09 1,22,000 LE of *Sl* NPV was produced and supplied to tobacco farmers through Tobacco Board and Bio-Control Laboratory, Govt. of Andhra Pradesh, Visakhapatnam.

Entomophage Park

In view of the depletion of safe habitat for insect natural enemies in highly managed ecosystems like agricultural farms, the Entomophage Park was established at CTRI Farm, Katheru and it is being maintained. During this year, the park was divided into three components. The first and second components contained, twelve blocks each

with a mono-crop. The first component was maintained with weeding and the second one without weeding. In the third, random mixtures of crops were sown in each block to obtain crop diversity. Pesticides were not applied in the entire park area.

The insect herbivore densities were lowest in mixed crop blocks than in weeded and unweeded blocks of cereals. Weeded blocks contained higher number of herbivores. Higher herbivore densities were recorded in unweeded blocks than in weeded blocks of pulses. However, as in the case of cereals, lowest insect herbivore densities were recorded in mixed crop blocks among the three situations. In the case of oilseeds also, unweeded blocks had higher number of insect herbivores except in the case of groundnut than in weeded plots and the mixed blocks showed lowest number of herbivorous insects among the three situations.

Insect herbivores to carnivore ratios were altering with each crop. In *ragi*, carnivores were observed more in mixed crop situation followed by unweeded and weeded blocks. In *bajra*, carnivores were higher in weeded blocks followed by mixed and unweeded blocks. Maize had more insect carnivores as a sole crop under weeded than in unweeded and mixed blocks. Finally, *jowar* with highest number of entomophages among all the crops had more of them under weeded situation and with nearly fifty per cent reduction under other situations.

The species diversity of entomophages was high in castor followed by *Cassia occidentalis*, a weed in the ecosystem. Lowest diversity was seen in groundnut.

In conclusion, it was observed that crop combinations harbour higher number of entomophage fauna than in monocrop situations whether in weeded or unweeded situations.

CTRI RS, Guntur

Studies on compounds with insecticidal value from wild *Nicotiana* species

(J.V. Prasad, S. Gunneswara Rao and K. Siva Raju)

Mature and fully expanded leaves of *N. benthamiana* and *N. repanda* were harvested at blooming stage for extracting sugar ester fractions. The leaves were dipped in dicholoromethane to get the sugar ester fraction into solution. After evaporating the solvent, the extract was dissolved in hexane and partitioned with acetonitrile. The acetonitrile fraction was again partitioned with 1 N tartaric acid to remove the alkaloids and finally the acetonitrile fraction thus obtained was used as crude sugar ester fraction in bio-assays against tobacco aphid, *Myzus nicotianae*.

The sugar ester fraction from *N. repanda* was found to be more toxic to the aphids than the same obtained from *M. benthamiana*. The highest mortality of 61.49% was recorded in case of 2 % crude sugar ester fraction obtained from *N. repanda* (Fig. 20). The aphids died of desiccation after being sprayed with the crude sugar ester fraction.

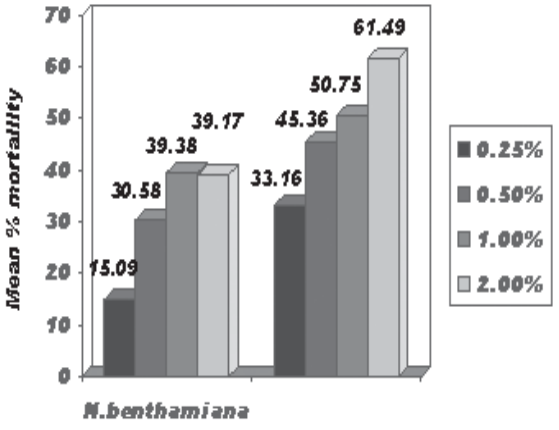


Fig. 20: Effect of crude sugar ester fractions from *N.benthamiana* and *N.repanda* on tobacco aphid *M.nicotianae*.

The dry leaf powders of *N. gossei*, *N. trygonophylla* and *N. glutinosa* were extracted with hexane and dichloromethane using Soxhlet method and were tested for their oviposition deterrence activity against the adults of *H.armigera*. The highest oviposition deterrence was recorded with dichloromethane fraction of *N. trigonophylla* @ 0.5% followed by the same fraction @ 0.25%, dichloromethane fraction of *N.gossei* @ 0.5%

and the same fraction @ 0.25%. The hexane and dichloromethane fractions of *N. glutinosa* exhibited very low oviposition deterrence even @ 0.5%.

CTRI RS, Kandukur

Evaluation of FCV germplasm for tolerance to *S. litura*

(K.C. Chenchaiah)

An experiment was laid out with 17+2 accessions in replicated design to evaluate FCV tobacco germplasm for tolerance to *S. litura*. Each accession has 2 x 10 plant population. The accessions were screened with the natural infestation of *S. litura* and with the inoculated egg mass on four selected test plants under each treatment. All the entries were screened as per the damage rating of *S. litura* (O, L, M and H). Seven entries having low infestation (0-20% leaf damaged) were classified as tolerant, seven entries having 20-30% leaf damage were categorized as medium and five including the two check varieties having high leaf damage (>30%) were identified as susceptible.

Three entries, 117-1CR, RT115-1CR and 157-1CR have shown low response to all the characters under study were termed as tolerant, followed by 150-1CR, 155-2CR, 119-1CR, 118-1CR and 83-3CR. It was found that young larvae hatched out of the egg shell and died later on subsequent day on most of the entries. The mortality ranged from 0-100 larvae. Three entries, 117-1CR, RT115-1CR and 157-1CR had 100% mortality of larvae indicating that these treatments did not support the young caterpillars.

Evaluation of FCV germplasm for tolerance to aphid, *M. nicotianae* under SLS condition

(K.C. Chenchaiah)

An experiment was laid out with 39+2 accessions in replicated design to evaluate for aphid resistance. Each accession has 2 x 15 plant population. The accessions were screened with the natural infestation and with artificial inoculation of aphids. Under natural conditions, 30 entries had no aphid damage and only 9 entries had 1-5 infestation rating. The results from the aphid inoculation with one infested top leaf on 5 plants revealed that aphid development on these lines was moderate and the aphid rating based on the top three leaves and spread of aphid was recorded on 4th day of inoculation. Two entries RT101-1 AR/CR and 14-1 AR did not support the aphid and had 0 rating and can be rated as resistant. Twenty eight entries have infestation rating of 1. Out of the three entries, 15-2 AR, 35-1 AR and 16-1 AR have good crop with uniform maturity. Five entries have 2.0 aphid rating were termed as moderate and three entries have an infestation rating of 5 and were classified as susceptible.

CTRI RS, Hunsur

Integrated management of tobacco aphid, *Myzus nicotianae* under KLS conditions

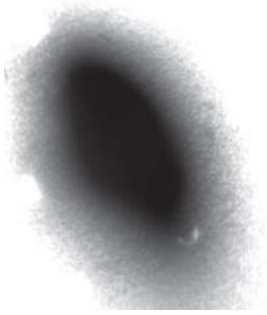
(P. Venkateswarlu and M.M. Shenoi)

A field trial was conducted for integrated management of tobacco aphid, *Myzus nicotianae* in FCV tobacco (var. Kanchan). The treatments consisted of border crop (bajra), an entomopathogenic fungus (*Verticillium lecanii* @ 0.3%), recommended chemical pesticide (imidacloprid @ 50g a.i./ha) and their combinations (Fig. 21). The plot with only chemical spray viz., one spray of imidacloprid and one spray of acephate (@ 750g a.i./ha) served as recommended chemical control plot. An unsprayed plot without any border crop was maintained for comparison (control).

Two rows of border crop with 30 cm spacing were sown simultaneously with the plantings of tobacco. Sprayings were given at 45 and 55 days after planting. Observations on aphid infested plants, aphid population on leaves, natural enemy population, sooty mold incidence and tobacco yield were recorded in each treatment.

All the treatments were significantly superior to control in reducing aphid infestation after 10 days of second spray. The infestation was nil in chemical control plot and

Live aphid



Fungus affected aphid

Fig. 21: Effect of *V. lecanii* on aphid

also in plots which received one spray of imidacloprid in combination with bajra border or with one spray of *V. lecanii*. In control plot, the per cent aphid infested plants were 95. Among the other treatments, more infestation (27%) was recorded in border crop with *V. lecanii* at 55 days followed by border with *V. lecanii* at 45 days (22.33%) and *V. lecanii* applied at 45 and 55 days (15.33%). The reduction of infestation over control ranged from 71.54 to 100%. The aphid population counted on infested plants in each treatment showed similar trend.

Although aphid infested plants were more, aphid population on individual plant was less (1-3 score) and confined to top and middle leaves only. After ten days of second spray, aphid population was nil both on top and middle leaves of chemical control plot and also in plots which received one spray of imidacloprid in combination with bajra border or with one spray of *V. lecanii*.

The treatments with chemical spray schedules showed drastic reduction in the population of natural enemies in tobacco. Predator population was more (29.86 to 32.40/plant) in plots sprayed with *V. lecanii* alone or with border and was on par with untreated control (31.50/plant). In pesticide applied plots, predator population ranged from 3.56 to 11.26/plant. It indicated that entomopathogenic fungus has not shown any effect on predator population.

The natural enemy population on bajra border was also recorded. Among them, coccinellid predators were dominant followed by spiders, wasps and syrphid flies. Imidacloprid sprayed in tobacco at 45 or 55 days had no effect on predator population on bajra border. The total predator population on bajra varied from 7.50 to 8.10/plant.

As aphid population was moderate, the level of sooty mold formation was low to medium. All the treatments were significantly superior to control in reducing sooty mold incidence. The incidence of other viral diseases was negligible. Treatments having chemical spray and also two sprays of *V. lecanii* at 45 and 55 days were highly significant with 100% reduction of sooty mold incidence. In control plot, sooty mold incidences were 18.66 and 35.33% of low and medium levels, respectively.

Green leaf, total cured leaf and bright leaf yields were more in treated plots, whereas, low and medium grade yields were more in control plot. However, there was no significant difference among the treatments. It is concluded that *bajra* border as barrier crop with one spray of *Verticillium lecanii* @ 0.3% at 45 DAT reduced tobacco aphid (*Myzus nicotianae)* infestation by 76.39% over control under low to medium levels of infestation (1-3 score). Treatments having chemical spray reduced aphid infestation and sooty mold by 100% over control and increased bright grade yield.

Management of tobacco caterpillar, *Spodoptera litura* in nurseries

(P. Venkateswarlu, M.M. Shenoi and S. Ramakrishnan)

Four bio-agents viz., *Nomuraea rileyi, Bacillus thuringiensis Var. Kurstaki, EPN (Steinernema carpocapsae)* and *Sl* NPV; two botanicals viz., *Calotropis* spp. leaf extract and neem seed kernel suspension and two chemical

pesticides, novaluron 10EC and chlorpyriphos 20EC were evaluated against tobacco caterpillar, *Spodoptera litura* in FCV tobacco nursery (var. Kanchan). An untreated control was also kept for comparison. A total of two sprays were given at 45 and 55 days of sowing. Observations on infested seedlings in each treatment were recorded before spraying, five and ten days of each spray. Per cent reduction of damaged seedlings over control after ten days of second spray was calculated for each treatment.

The data revealed that except EPN, all other treatments were significantly superior over control in reducing the damage at ten days of second spray. Lowest seedling infestation (2.85%) was recorded in chlorpyriphos 20 EC applied plot followed by novaluron 10 EC (4.85%). Among the bio-agents, *B. thuringiensis Var. Kurstaki*, and *Sl* NPV proved better with 7.68 and 8.68% infestations, respectively. Both the botanicals also proved better with 10.77% (NSKS) and 12.22% (*Calotropis*) seedling infestations. The remaining two bio-agents, *N. rileyi* and EPN were least effective with 22.49 and 29.35% infestations, respectively. In control plot, the infestation was 31.58.

Similarly, per cent reduction of damaged seedlings over control was more (90.92) in chlorpyriphos 20 EC and less (12.55) in EPN applied plot. Corresponding to the seedling infestation, per cent transplantable seedlings were more (56.42) in novaluron 10EC treated plot followed by chlorpyriphos 20EC (55.91), NSKS (54.19), *B. thuringiensis Var. Kurstaki* (52.64), *Calotropis* (52.21), *Sl* NPV (51.41), *N. rileyi* (48.32) and EPN (47.86). In control plot, the per cent transplantable seedlings were 46.96. Similarly, the per cent increase of transplantable seedlings over control was more (20.25) in novaluron 10 EC and less (3.61) in EPN applied plot.

It is concluded that among the bio-agents tested against tobacco caterpillar, *S. litura*, only two agents viz., *B. thuringiensis Var. Kurstaki* and *Sl* NPV proved better in reducing the damage and increasing the transplantable seedlings over control.

Screening of tobacco germplasm against caterpillar, *Spodoptera litura*

A total of 250 tobacco germplasm accessions were screened in nursery against caterpillar, *Spodoptera litura* under natural infestation. Among them, five accessions namely, FCH-221, FCH-222, FCH-201, FCH-197 and FCH-196 registered relatively more infestation with 13.0, 11.0, 9.0, 8.0 and 7.0%, respectively. In all the remaining accessions, infestation was below 5%.

PLANT PATHOLOGY

CTRI, Rajahmundry

Studies on broomrape of tobacco
(C.A. Raju)

Reaction of *Nicotiana species* to *Orobanche*

Thirty seven *Nicotiana* species were raised at Katheru farm, 28 *Nicotiana* species were raised in a sick field (micro-plot) and 25 species were raised in light soil for assessing the reaction of all available wild *Nicotiana* species towards *Orobanche*. Observations on per cent plants infested and number of *Orobanche* spikes per plant in each species/plant were recorded at 70 and 100 days after planting.

Among the 37 entries at Katheru farm, *N. stocktonii*, NB-R, *N. nesophila*, TW-101, TR-10 and NU-N showed resistance to *Orobanche*. Out of 28 entries in sick field (micro-plot), 24 entries showed resistance to *Orobanche* except TW-7, *N. glutinosa*, *N. gossei*, *N. longiflora* and among the 25 entries in light soil, which is not a sick plot, all showed resistance reaction, except *N. glauca*. The species showing lowest rating of these parameters will be further screened in the subsequent years for confirmation.

Studies on wilt disease of tobacco
(C.A. Raju)

Very low disease incidence was observed during the crop growth and the problem was never reported by the farmers in their fields, probably the weather was not congenial for the disease and hence, chemical control or varietal screening trials could not be taken up.

Two more new isolates of the pathogen were obtained during the season which were culturally different from the existing ones but the chemical control trials *in vitro* with the fungicides revealed that carbendazim @ 0.05 % was effective in controlling the pathogen like in earlier isolates. The existing *Trichoderma* isolates could not show any inhibition of the pathogen in *in vitro* studies.

CTRI RS, Hunsur

Further studies on *Fusarium* wilt and wilt complex in FCV tobacco crop

(M.M. Shenoi and S. Ramakrishnan)

A replicated trial was conducted during the period with four bio-agents viz., *Pseudomonas fluorescens, Paecilomyces lilacinus, Trichoderma viride* and *Aspergillus niger* in commercial formulations in a rational combination through fortified vermicompost. Results indicated that the bio-agents offered only a partial control for wilt disease. The treatments affected 49.8 to 55.6% control up to 55 days after transplanting (DAT) which was further reduced to 33.3 to 37.3% by 70 DAT due to high disease pressure. However, the two advanced breeding lines FCH 221 and FCH 222 gave 88.9 & 94.2 and 87.3 & 83.3% control at 50 and 70 DAT, respectively suggesting high degree of resistance even under high disease pressure.

The effectiveness of chemical control (carbendazim schedule) also got reduced to 25% at 70 DAT from the initial 60.9%. The wilt incidence in control treatment was in the range of 22.5 to 30.0% at 50 and 70 DAT, respectively as against 2.5 to 3.8% in line FCH 221 and 1.3 to 5.0% in line FCH 222 at 50 and 70 DAT, respectively. Growing resistant varieties with bio-agent treatments through fortified vemicompost seems to be the answer for eco-friendly, non-chemical management of wilt disease in FCV tobacco crop of KLS.

Studies on soreshin disease in FCV tobacco nursery

(M.M. Shenoi)

The study on the chemical control of soreshin in FCV tobacco nursery was carried out in a replicated trial. The results of second year study indicated that all the chemicals viz., propiconazole, thiophanate methyl, carbendazim, chlorothalonil and copper hydroxide were significantly superior over untreated check for the control of soreshin disease in the nursery even up to 50 days after spray (DAS). The disease control in various treatments was in the range of 88.5 to 96.5% and 64.0 to 93.7% at 40 & 50 DAS, respectively.

The results suggest high efficacy of propiconazole for control of the disease even at 50 DAS causing 95.6-96.5% and 89.7-93.7% control at 40 and 50 DAS, respectively with different doses. The next best chemical identified was carbendazim. The yield of total healthy transplants was in the range of 813 to 850 per m^2 in various treatment schedules as against 576 in untreated control.

CTRI RS, Dinhata

Role of biocides against damping-off of seedlings and growth promoting activity in *Jati* and *Motihari* tobacco nurseries

(S. Roy and S. Amarnath)

Freshly prepared broth inoculum of *Trichoderma viride* (Tv) and *Pseudomonas fluorescens* (Pf) cultured in talc was enriched in vermicompost. Inoculum (4 g) was mixed @ 1 kg of vermicompost. For a nursery bed of $3m^2$, 12 g of inoculum @ 3 kg vermicompost was mixed and kept in open air for a week to facilitate multiplication of the organisms. The mixture was covered with paddy/wheat straw to conserve moisture.

After preparation of the nursery beds, the biocide-vermicompost complex was evenly distributed in nursery beds and seeds were sown after an interval of two days. No plant protection measures were adopted to contain the natural occurrence of disease. Observations were taken on natural occurrence of damping-off of seedlings in nursery and brown spot in field crop. Growth attributes on stem and root length; fresh and dry weight of stem and root in nursery seedling for all the treatments were recorded.

Salient findings

- The efficacy of the biocides was enhanced when half of the dose of FYM was applied in nursery beds and the rest half is substituted with vermicompost inoculated with biocides (Tv & Pf).
- The management of damping-off of seedlings was more effective in combined treatment of Tv & Pf than their application alone.
- Significantly higher healthy nursery transplants were obtained under all the treatments having Tv, Pf, Pv+ Pf and their combination with SSP than SSP alone.
- In biocide treatment, alone and in their combination, there was pronounced improvement in the growth activity of nursery seedlings in terms of length of roots/shoots; fresh and dry weight of roots/ shoots.
- Foliar application of Tv, and Pf in combination was significantly more effective in checking the infection of brown spot of *Jati* tobacco var. Manasi than their application alone.
- There was marked increase in cured leaf yield in the biocide treatments under all combinations ranging from 16.8 to 41.3% (mean of two seasons) in comparison to the check (without SSP).
- In the consortium of Tv + Pf and Tv+Pf+SSP, the average increase in cured leaf yield was 31.2 and 41.26%, respectively.
- In case of first grade leaf yield, the increase (mean of two seasons) ranged from 68.34 to 104%, respectively in comparison to check (without SSP).

NEMATOLOGY

CTRI RS, Hunsur

Survey for plant parasitic nematodes associated with tobacco

(S. Ramakrishnan)

Under this long term project, fields in Hunsur and Sollepura farms were surveyed for root-knot nematodes and other plant parasitic nematodes associated with FCV tobacco crop. Soil and root samples were drawn randomly from fields and processed for enumeration of nematode population. In addition to root-knot nematodes, presence of reniform nematode, *Rotylenchulus reniformis* was also noted. However, population in FCV tobacco rhizosphere was below pathogenic level. The root-knot index in various fields on 0-5 scale ranged from 1.0 to 3.0 and 2.0 to 4.3 in Hunsur and Sollepura farms, respectively. The root-knot nematode incidence was more in Sollepura Farm as compared to Hunsur farm.

Screening of tobacco germplasm against root-knot nematodes

(S. Ramakrishnan and K.N. Subrahmanya)

A total of seventeen advanced breeding lines maintained at CTRI Research Station, Hunsur were subjected to intensive screening against root-knot nematodes under sick field conditions. The variety Bhavya was included as resistant check and the varieties Rathna and Kanchan as susceptible checks. At maturity, the plants were uprooted and scored for Root-Knot Index (RKI) on 0-5 scale. Experimental results revealed that the following materials viz., FCH 197 217, 219, 222, 224, 226, 227 and 228 recorded RKI of <2.0 and were most promising against root-knot nematodes.

These lines will be further subjected to intensive screening under both field and artificially inoculated conditions for further confirmation. Among the 15 hybrid tobacco lines screened against root-knot nematodes under sick field conditions with appropriate check varieties, CH-1, KLSH-20, KLSH-25, KLSH-10, KLSH-10(ms), SH-1 and SH-6 recorded RKI of <2.0 under 0-5 scale and were found promising.

Bio-intensive management of root-knot nematode and soil borne fungal diseases in FCV tobacco nursery

(S. Ramakrishnan and M.M. Shenoi)

Farm yard manure enriched with nematode and fungal antagonists, *Pseudomonas fluorescens*, *Trichoderma viride* and *Aspergillus niger* either singly or in rational combinations were evaluated @ 4 kg/m^2

against root-knot nematodes and other soil-borne fungal pathogens in FCV tobacco nursery under replicated trials. The following conclusions are drawn from the pooled analysis of three years results:

- At 60 DAS, significantly increased number of healthy transplants of 640.9 per m^2 was recorded with the application of FYM enriched with *P. fluorescens* + *A. niger* @ 4 kg/ m^2, which is a 40.2% increase over the check (457/m^2).
- Significantly reduced RKI of 1.97 was recorded due to FYM enriched with *P. fluorescens* + *A. niger* @ 4 kg/m^2 compared to 1.91 in chemical check (Carbofuran + Metalaxyl MZ schedule) and 3.80 in the check. Further, it also caused 49.5% reduction in final soil nematode population compared to the check.
- FYM enriched with bio-agents recorded significant decrease in damping- off at 35 DAS (41.1 to 52.4%), damping-off + blight at 45 DAS (44.1 to 52.9%) and black shank (45.7 to 58.3%) compared to untreated check. But the treatments differed significantly from chemical schedule, which was superior in decreasing the damping-off by 90%, damping-off + blight by 93.9% and black shank by 93.4% compared to untreated check.

Evaluation of organics enriched with bio-agent in integration with soil solarization against root knot nematodes in FCV tobacco nursery

(S. Ramakrishnan and M.M. Shenoi)

Various bio-agents enriched FYM and vermicompost were evaluated against root-knot nematodes in FCV tobacco nursery. Results revealed that at 60 DAS, *Paecilomyces lilacinus* enriched vermicompost and *Pseudomonas fluorescens* enriched vermicompost were on par with each other in recording reduced RKI of 1.90 and 2.20 compared to 2.20 in carbofuran treated beds and 3.65 in check. Reduction in RKI in treated beds ranged from 30.1 to 47.9% compared to the check. Reduction in final soil nematode population after experimentation in bio-agents treated plots ranged from 27.0 to 46.9% compared to the check. The subsequent increase in root-knot free transplantable seedlings in bio-agents treated beds ranged from 41.9 to 51.1% compared to the check.

AICRP on Biological Control

Biological control of root-knot nematode, *Meloidogyne* spp. in FCV tobacco nurseries

(S. Ramakrishnan)

The egg parasitic fungus, *Paecilomyces lilacinus* (PDBC strain in talc formulation) was evaluated for the second season as single application and also in combination with neem cake and vermicompost against root-knot nematodes in FCV tobacco nurseries. Pooled results of two year trial revealed that :

- Application of *P. lilacinus* in talc based formulation does not cause any phytotoxicity and does not affect tobacco seed germination
- At 60 DAS, application of *P. lilacinus* @ 100 g/m^2 recorded 31.3% increase in healthy transplants compared to the check
- Combined application of *P. lilacinus* with neem cake @ 1kg/m^2 recorded 34.4% increase in healthy transplants count and was on par with *P. lilacinus* with vermicompost @ 1 kg/ m^2
- The two treatments recorded significantly reduced RKI of 1.89 compared to 2.05 in Carbofuran @ 50g/m^2 treated beds (standard chemical check) and 3.86 in untreated check
- The two treatments were on par with each other in significantly reducing number of egg masses/g root and final soil nematode population
- The positive effect of VAM, *Glomus fasciculatum* against root-knot nematode in FCV tobacco was not noticed
- Evaluation of nursery treated seedlings under field conditions for yield parameters revealed that there was no significant difference in yield parameters compared to the check.

PROGRAMME 8

SOIL FERTILITY, WATER QUALITY AND NUTRIENT MANAGEMENT

CTRI, Rajahmundry

Soil fertility investigations: Preparation of soil test summaries, nutrient indices and soil fertility maps of tobacco growing soils of India

(V. Krishnamurthy, C.C.S. Rao, M.M. Swamy and A.V.S.R Swamy)

Soil fertility status and water quality of chewing tobacco growing areas of Dindigul district in Tamil Nadu

To study the soil fertility status of chewing tobacco growing areas of Dindigul district in Tamil Nadu, fifty surface soils (0-22.5cm) and corresponding sub-soils (22.5-45.0 cm) were collected from 25 villages of the district during 2009. These soil samples were processed and analyzed for pH, EC, chlorides organic carbon, available nitrogen, available phosphorus and available potassium using standard methods (Table 4). Soil test summaries were prepared from individual village data and nutrient index values for the district were calculated (Table 5). The soils are alkaline in reaction, low in soluble salts and but high in chlorides. The organic carbon status is medium and available P and K status are high. A balanced dose of 100:50:50 NPK/ha with 10 t FYM /ha is essential to sustain higher yields of 3,000 to 4,000 kg/ha.

Table 5: Nutrient Indices* for tobacco soils of Dindigul district, Tamil Nadu

No. of villages surve-yed	No. of soil samples collected	Depth (cm)	Organic carbon	Avail. N	Avail. P	Avail. K
25	50	0-22.5	1.78 M	1.50 L	2.34 H	2.96 H
25	50	22.5-45.0	1.32 L	1.32 L	1.96 M	2.94 H

* A nutrient index value represents the nutrient status of the whole area as a single value for comparing the fertility status

* A nutrient index below 1.67 is low, 1.67 – 2.33 is medium and above 2.33 is high

Water quality of chewing tobacco areas of Dindigul district in Tamil Nadu

Fifty irrigation water samples were collected from chewing tobacco growing villages of Dindigul district during 2009 and were analyzed for pH, EC, chlorides, calcium, magnesium and sodium. From the data, SAR was calculated and water quality classes were determined. Results revealed that main source of irrigation is bore/tube wells. All these water

Table 4: Fertility status of chewing tobacco soils of Dindigul district, Tamil Nadu (Ranges and Average Values)

Depth (cm)	No. of villages surveyed	No. of soil samples collected	Soil texture	pH (1:2)	EC (dS/m) (1:2)	Chlorides (ppm)	Organic carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)
0 - 22.5	50	25	Sandy loams	7.3- 8.4 (7.8)	0.1-1.90 (0.40)	12-1648 (671)	0.21-0.89 (0.57)	184-379 (284)	5-77 (27)	235-2061 (671)
22.5 - 45	50	25	Loams	7.0-8.5 (7.9)	0.11-1.30 (0.37)	12-1004 (208)	0.15-0.84 (0.45)	182–269 (269)	2-73 (19)	179-1523 (610)

Figures in parentheses represent average values

samples are alkaline, high in electrical conductivity and chlorides. They are unsuitable for FCV tobacco cultivation. However, chewing tobacco can be grown by reducing the number of irrigations. SAR is low in 88% of waters and medium in 12% waters. Water quality classes ranged from C_3S_1 to C_4S_4. Since the waters are highly saline, there is an urgent need to reduce the number and quantum of irrigations to contain the salinity and chlorides in soil and tobacco plant.

Nutrient Composition and chemical quality parameters of Periyapatna taluk of Mysore district in Karnataka

Thirty leaf samples (X and L-positions) collected from different locations in 4, 5 and 6 platforms of Mysore district in Karnataka were processed and analyzed for nutrient composition and also chemical quality parameters. Data showed that N, P, K content of lamina in X and L positions are in the desirable range (N=2.0%, P=0.2% and K=1.8%). Reducing sugar content of lamina and mid-rib are high, which is a typical character of KLS tobacco. The chloride content of lamina is < 1%, but the midrib contained higher chlorides (> 1.5%). In general, midrib contained higher reducing sugars, higher K content with low nicotine and thus the midrib can be used as blending material in cigarette manufacturing for improving the leaf burn and to get soothing flavour. Nicotine content, in general, is low (1.0-1.2%) which might be due to low N application coupled with no topping practice.

Because of the ideal N, P, K concentrations and balanced nicotine and reducing sugars contents and very low chlorides, Karnataka tobacco is rated as quality leaf besides its ideal physical properties.

Investigations on phosphorus and potassium dynamics of FCV tobacco growing soils of Prakasam and Nellore districts

(C. C. S. Rao, V. Krishnamurthy and P.R.S. Reddy)

Phosphorus adsorption isotherms

Phosphorus adsorption isotherms were prepared for five selected surface soil samples (texturally different) collected from SLS and SBS areas of Prakasam and Nellore districts. Five grams of each soil was equilibrated with 50 ml of solution each of different P concentrations (0,2,4,6,8,10,12,14,16,18 ug/ml) for six days. These samples were centrifuged and supernant liquid was filtered. These equilibrium solutions were analysed for P concentration. The amount of P adsorbed by the soil was determined. Adsorption data was fitted in Langmuir equation as given below.

Langmuir equation: $C/x/m = 1/kb + c/b$

Where, C is the phosphorus concentration of equilibrium solution. X/m is the amount of phosphorus adsorbed; B is the adsorption maximum and K is the bonding energy.

The data on amount of P adsorbed (X) and equilibrium concentration (C) indicated that increasing amount of P was adsorbed with increase in P concentration in equilibrium solution (Figs. 22&23). Langmuir equation was best fit for these soils to explain the P

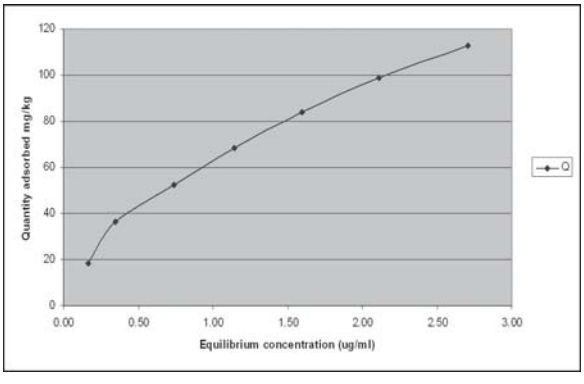


Fig. 22: Sorption behaviour of P in Buddavaram soils (SBS)

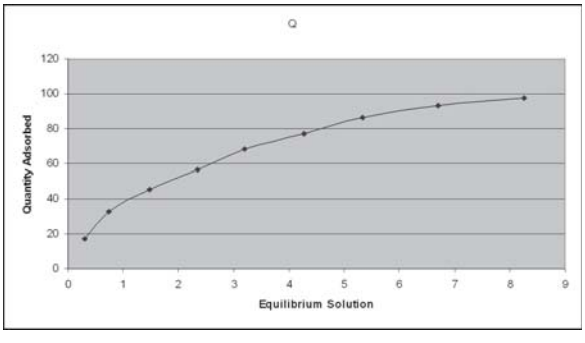


Fig. 23: Sorption behaviour of P in Oletivaripalem soil (SLS)

adsorption behaviour as shown by their higher R^2 values. Adsorption maxima values ranged from 107.6 -184.8. Bonding energy values ranged from 0.260 – 0.750. Standard P requirement to maintain 0.2 ug P /ml of soil solution varied from 9.10-20.0 ppm.

Characterization of soil phosphorus and potassium in FCV tobacco growing areas of Karnataka

(P.R.S. Reddy and C. C. S. Rao)

Soil fertility

Surface (0-22.5 cm) and corresponding sub-soil (22.5-45.0 cm) samples were collected from 28 locations covering all the auction platform areas of KLS during February, 2008. After removal of gravel, the fine earth fraction of all soil samples was subjected to particle-size analysis. All the soil samples were analyzed for pH, EC, chlorides, organic carbon, available P and available K.

Soil organic carbon status ranged from 1.28 g/kg (low) to 9.98 g/kg (high). Mean organic carbon content in KLS was low in both surface and sub-surface layers at 4.29 and 4.19 g/kg, respectively. Available P ranged from 4.90 to 103 mg/kg in surface layer and from 1.85 to 42.4 mg/kg in sub-surface layer. Mean value of available P status was 30.9 mg/kg (high) in surface layer and 9.09 mg/kg (medium) in sub-surface layer. Only 14% soils had medium fertility in respect of P while the rest of samples had high fertility in surface layer. Sub-surface soils had high P fertility in 32% of samples while the rest were low to medium. Available K ranged from 53.4 mg/kg (medium) to 252 mg/kg (high) in surface layer and from 43.6 mg/kg (low) to 342 mg/kg (high) in sub-surface layer.

Around 36% of samples in surface layer and 21% of samples in subsurface layer had high level of K fertility. Only 7% of samples in sub-surface layer had low level of K fertility.

Good yield response to application of N fertilizers, poor response to application of P fertilizers and medium response to application of K fertilizers is expected in these soils.

Soil texture

Majority of soils (75%) in surface layer were loams belonging to sandy clay loam and sandy loam textural classes. Around 57% of soils were loams (clay loam, sandy clay loam and sandy loam) in sub-surface layer. Broad textural class of sandy soils was observed in 21.4% of surface layers and 7.2% of sub-surface layers. Broad textural class of clayey soils was observed in 3.6% of surface layers and 35.7% of sub-surface layers. From the data on particle size fractions of fine earth fraction and gravel content of soils, it can be deduced that majority of soils have good infiltration, good permeability, poor to good water holding capacity, poor to fair fertility and fair to good tilth and workability.

Soil water retention properties

Soil water retained at -1/3 bar and -15 bar matric potential are being determined. Analysis of 28 surface soil samples indicated that water (g/g) retained at -1/3 bar matric potential ranged from 4.64 to 18.72% with a mean of 11.34%.

Micronutrient distribution in different types of Indian tobaccos

(P.R.S. Reddy)

One hundred and seventy five FCV tobacco leaf lamina samples of 2006-07 season from different locations pertaining to different platforms viz., Kondepi, Tangutur, Ongole – I, Ongole - II, Vellampalli - I and Vellampalli - II spread over Southern Black Soil (SBS) area were analyzed for the micronutrient cations viz., iron, manganese, zinc and copper (Table 7).

Twenty seven FCV tobacco leaf lamina samples of 2007-08 season from different auction platforms of SBS were also analyzed for iron, manganese, copper and zinc. Sixty FCV tobacco leaf lamina samples from 2007-08 season from different locations of ten auction platforms of the Karnataka Light Soil (KLS) area were also analyzed for iron, manganese, zinc and copper.

Table 7: Levels of micronutrients in FCV tobacco from SBS and KLS

Micro-nutrient (mg/kg)	Range	Mean	SD±	CV (%)
SBS samples (27)				
Iron	451 -1934	987	474	48.0
Manganese	83 - 217	154	39.1	25.5
Zinc	7.2 - 33.5	19.6	7.3	37.4
Copper	5.2 - 28.3	13.7	5.7	41.4
KLS samples (60)				
Iron	289 - 2204	758	325	42.8
Manganese	43 - 216	106	38.5	36.5
Zinc	8.9 - 38.4	19.5	6.95	35.7
Copper	5.8 - 37.8	10.7	4.65	43.5

Salient findings

- Iron and manganese were present in the range of sufficiency at all the locations in the FCV tobacco grown in the SBS and KLS areas.
- Zinc content was in the border-line (<10 mg/kg) in a very few locations in SBS area. Only one out of 60 samples tested in KLS had less than 10 mg/kg zinc.
- Copper content was in the range of sufficiency in SBS area except in a very few locations. Copper content in lamina was less than the critical limit in 53% of samples of KLS. Mean values are also less than the critical limits in three auction platform areas of KLS.

These observations warrant further studies/observations on zinc and more so on copper in SBS and more particularly in KLS for establishing the deficiencies/hidden hungers, if any.

Chloride nutrition of flue-cured tobacco

(M. Anuradha, K. Nageswara Rao, C. C. S. Rao and V. Krishnamurthy)

A pot trial was conducted with different levels of chloride in irrigation water [18 (control - Godavari water), 50, 100, 150, 200 and 250 ppm]. Observations on photosynthetic rate, transpiration rate, stomatal conductance and chlorophyll content index were recorded Results revealed that increase in the level of chloride did not influence yield and quality characters significantly though there is a decreasing trend with higher levels of chloride (beyond 50 ppm) in irrigation water. Increased level of chlorides in irrigation water increased lamina chloride concentration and reduced leaf burn significantly. The lamina chloride concentration was > 3% beyond 100 ppm chloride in irrigation water and the leaf burn was zero. Leaf thickness increased with increased level of chloride in irrigation water up to 100 ppm.

Nitrogen nutrition of flue-cured tobacco

(M. Anuradha, K. Nageswara Rao, C. C. S. Rao and V. Krishnamurthy)

A field experiment was conducted with six levels of nitrogen (0, 40, 80, 120, 160, 200 kg N/ha) with six replications in light soil using recommended package of practices. Increased nitrogen fertilization increased the chlorophyll content index (CCI) at all the growth stages (Fig. 24). In fully formed leaf, the chlorophyll content index decreased with the age of the plant except at one or two stages.

The nitrogen content reduced with the plant's age up to 95 DAP later it remained almost at the same level up to 125 DAP. In the case of 10th and 11th leaf also nitrogen content decreased and chlorophyll content index reduced up to 75 DAP. Later CCI decreased and nitrogen content remained almost the same. Increased nitrogen fertilization increased photosynthetic rate up to 80 kg/ha level where as leaf area index increased up to 160 kg/ha N level. Increased nitrogen fertilisation increased yield up to 120 kg/ha. Later they remained on par. Nicotine content increased with increased application of nitrogen at all positions of the plant. Reducing sugars were reduced due to

Fig. 24: Green leaf colour vs nitrogen fertilization

increased application of nitrogen at X, L and T positions.

In the pot trial conducted with six levels of nitrogen (0, 2.4, 4.8, 7.2, 9.6, 12.0 g N/ plant) in light soil using recommended package of practices, increased application of nitrogen increased net photosynthetic rate, stomatal conductance, transpiration rate, chlorophyll content index (CCI) and lamina nitrogen content. Leaf area, cured leaf yield and grade index increased with increased level of applied nitrogen. Nicotine content increased with increased application of nitrogen at all positions of the plant. Reducing sugars were reduced due to increased application of nitrogen at X, L and T positions.

Dynamics of potassium absorption, utilization and re-translocation in flue-cured tobacco

(K. Nageswara Rao, M. Anuradha and V. Krishnamurthy)

Sand culture experiment was conducted using Mc Murtrey's nutrient medium to find out the effect of magnesium on potassium uptake and utilization. In this experiment two levels of potassium (8.0 and 12.0g/plant) were applied along with four levels of magnesium (1.2, 2.4, 3.6 and 4.8g/plant). The levels of potassium did not influence the green leaf, cured leaf yield or grade index but there was increasing trend with higher levels potassium dose. Nicotine content was lower with higher dose of potassium in T position leaf but it is not consistent.

Increasing magnesium levels resulted in decrease of leaf nicotine in L and T position. Effect of potassium and magnesium levels did not show consistent trend on reducing sugars and chlorides were not affected by the treatments. Potassium content of leaf from L position did not change significantly due to both potassium and magnesium levels whereas nitrogen content was affected by magnesium levels.

PROGRAMME 9

ALTERNATIVE USES OF TOBACCO AND REDUCTION OF HARMFUL SUBSTANCES

CTRI RS, Vedasandur

Breeding for high seed and oil yield in tobacco

(A.V.S.R. Swamy and C. V. N. Rao)

On the recommendations of RAC to study the feasibility of diversifying the use pattern of tobacco, this project was initiated. Ten germplasm accessions that have shown good promise in seed yield in the previous years (2006-08) in replicated evaluation viz., A-119, A-145,Beinhart, GT-6, HP6-11, Madranski, Manila gold, Penswar, Regional Connecticut and TN Palayam were crossed with Bhagyalakshmi and Abirami and the resultant 22 hybrids were evaluated in a replicated trial along with Bhagyalakshmi and Abirami as check varieties under 60 x 50 cm spacing for assessment seed and oil yield or both unprimed and primed conditions.

All the hybrids exhibited significant differences among themselves as well as to check varieties for seed yield. The hybrid A-119 x Abirami recorded significantly the highest seed yield of 2,213 kg/ha against the check varieties Bhagyalakshmi and Abirami under unprimed condition. This was followed by hybrids A-119 x Bhagyalakshmi, A-145 x Bhagyalakshmi which recorded significant seed yield of 2,153 and 2,042 kg/ha, respectively.

Under primed condition, hybrid A-145 x Bhagyalakshmi registered significantly highest seed yield of 1,916 kg/ha over the check varieties Bhagyalakshmi and Abirami. Other promising hybrids that yielded significant seed yield under primed condition over the check varieties were Madranski x Bhagyalakshmi, A-119 x Abirami, Manila Gold x Bhagyalakshmi, Manila Gold x Abirami, Regional Connecticut x Bhagyalakshmi, TN Palayam x Abirami, GT-6 x Bhagyalakshmi, and GT-6 x Abirami recording 1,685, 1,676, 1,658,1,653,1,537,1,487,1,472, and 1,435 kg/ha seed yield, respectively.

While the hybrids A-119 x Abirami, GT-6 x Abirami and A-119 x Bhagyalakshmi recorded significant seed yield of 1,412, 1,139 and 1,093 kg/ha, respectively in panicle, hybrids A-119 x Bhagyalakshmi, A-145 x Bhagyalakshmi, Beinhart x Bhagyalakshmi and TN Palayam x Bhagyalakshmi recorded significant seed yield of 1,060, 1,051, 930 and 824 kg/ha, respectively in suckers under unprimed condition. In primed condition, Penswar x Bhagyalakshmi, A-119 x Abirami, Manila Goldx Bhagyalakshmi, GT-6 x Abirami and A-145 x Bhagyalakshmi recorded seed yield of 1,148,1,065,963 and 958 kg/ha, respectively in panicle whereas in suckers the hybrids A-145 x Bhagyalakshmi , Regional Connecticut x Bhagyalakshmi Maila Gold x Abirami and TN Palayam x Abirami recorded significant seed yield of 958, 843,778,and 644 kg/ha, respectively over the check varieties.

It was observed that most of the hybrids recorded higher seed yield in unprimed condition. Hybrids having narrow, dark-green leaves recorded the highest seed yield compared to broad medium green to light green leaf. In addition to seed yield, cured leaf yield of lower quality was obtained from the promising crosses ranging from 1,868 to 2,176 kg/ha which can be profitably used for the extraction of phytochemicals. The hybrid Madranski x Abirami produced the maximum cured leaf yield of 2,225 kg/ha in addition to seed yield.

CTRI RS, Dinhata

Screening for higher seed yield and oil recovery in *Jati* (*N.tabacum*) tobacco accessions

(S. Amarnath and S. Roy)

Six *Jati* tobacco (*N. tabacum*) germplasm lines were evaluated for their seed yield in a replicated trial. Data was collected for plant

height (up to crow foot), number of main branches, number of sub-branches, number of capsule/plant and seed yield (kg/plot). Lines Sel.II-Ia-7-79 and Sel.III-148 being at par were significantly superior over others for plant height. Number of main branches in line Sel.II-Ia-7-79 was significantly superior over others. Line PT-76 being at par to line J -7 was significantly superior over others for number of sub- branches. Bhagyalakshmi and J-7 recorded significantly higher seed yield of 1,334 and 1,192 kg/ha registering an increase of 99.7 and 78.4%, respectively over line sel.II-1a-7-79 (668 kg/ha) and capsule number of these lines were 700 and 652 per plant.

CTRI Rajahmundry

Biochemical characterization of tobacco seed oil

(K. Siva Raju, C.V.N. Rao and V. Krishnamurthy)

Tobacco seed oil content was estimated in 120 FCV tobacco germplasm accessions and wild species. The oil content in Speight G germplasm series varied from 15.57% to 33.17%, McNair series from 16.27% to 30.48% whereas in Coker series it was from 16.80% to 32.72%. Among the Bell accessions the oil content varied from 17.15% to 26.17%. The peroxide value and free fatty acid content in various edible oils was estimated.

Evaluation of smoke constituents in tobacco and tobacco products

(C. V. N. Rao)

During the period under report a total number of 77 samples from different regions (CBS/SBS/NBS:13; SLS:4; KLS:40 & NLS:20) were analyzed for smoke constituents (tar, nicotine carbon monoxide and solanesol) and leaf constituents (nicotine, reducing sugars, chlorides, potassium petroleum ether extractives and solanesol). The ratios of reducing sugars/nicotine and potassium/ chlorides were worked out.

The trends in leaf and smoke constituents in different samples are as follows: leaf constituents (nicotine: NLS>BS>SLS>KLS; reducing sugars: KLS >SLS >BS>NLS; potassium: KLS> SLS = BS>NLS; PEE: NLS>BS>SLS>KLS; solanesol: NLS>BS>SLS>KLS; RS/Nicotine: KLS >SLS >BS>NLS and potassium/chlorides SLS >KLS >BS>NLS) and smoke constituents (tar: NLS>BS>SLS>KLS; nicotine: NLS>BS>SLS>KLS; CO: SLS>BS>NLS>NLS and solanesol: NLS>BS>SLS>KLS).

It is evident from the data that leaf nicotine, PEE and solanesol have a positive influence on smoke tar, nicotine, CO and solanesol. However, leaf potassium and reducing sugars have a negative influence on smoke constituents. The ratios of reducing sugars/nicotine and potassium/ chlorides have a negative influence on smoke constituents.

Monitoring of pesticide residues in tobacco samples from different areas

(C. V. N. Rao)

The mean values and ranges of organochlorine pesticide residues in samples received from different auction platforms in NLS, SLS, SBS, CBS (2008-09 season) are presented in Table 8. It is inferred that generally, the residues are below the GRL values prescribed for different pesticides, except in a few cases.

Evaluation of tobacco hybrids for leaf biomass and seed yields

(P. Harishu Kumar, C. V. N. Rao, K. Siva Raju, M. Anuradha and T.G.K. Murthy)

Maximum fresh weight of biomass (48.546 t/ha) was recorded in hybrid HDBRG x GT-7, at par with TI -163 x GT-7 (46.246 t/ha) followed by GT-7 x GT-8 (45.62 t/ha). The pooled data indicated that the hybrids HDBRG x GT-7 (45.20 t/ha) and TI -163 x GT-7 (40.57 t/ha), GT- 7 x GT-8 (40.22 t/ha) and pure line HDBRG (42.88 t/ha) consistently gave significantly higher leaf biomass and are

Table 8: Organochlorine pesticide residues in FCV Tobacco (2008-09 season)

Values in ppm

Area	Total BHC	Gama BHC	Chlorpyri-phos	Dieldrin	Endrin	Total Endosulfan	Total DDT
NLS (35)	0.28 (ND-0.53)	0.01 (ND-0.05)	0.50 (ND-4.09)	0.01 (ND-0.05)	ND	1.17 (0.05-13.44)	0.41 (ND-2.88)
SLS (43)	0.19 (ND-0.35)	0.03 (ND-0.22)	0.07 (ND-0.36)	0.01 (ND-0.05)	ND	0.35 (0.04-2.21)	0.11 (0.01-0.62)
SBS (23)	0.19 (0.04-0.46)	0.05 (ND-0.13)	0.12 (ND-0.40)	0.01 (ND-0.05)	ND	0.26 (0.04-1.04)	0.25 (0.02-0.49)
CBS (3)	0.25 (0.23-0.26)	0.05 (0.04-0.06)	ND	ND	ND	0.28 (0.24-0.31)	0.07 (0.06-0.10)
GRL	0.50	0.50	0.50	0.05	0.05	1.00	0.40

potential biomass yielders in Vertisols when planted at 80 x 40 cm spacing with 120 kg N kg/ha as ammonium sulphate with one irrigation at 45 days after transplanting.

The varieties and the hybrids that recorded more than 30 kg solanesol per ha are: HDBRG, HDBRG x A - 145, HDBRG x GT-7, HDBRG x GT-8, GT-8 x HDBRG and GT-7 x GT- 8. From the mean of three years, HDBRG, HDBRG x GT-8 and GT-8 x HDBRG recorded more than 30 kg solanesol per hectare. On single plant selection basis, HDBRG recorded 87.35 kg/ha, HDBRG x A -145 with 48.68 kg/ha and TI-163 x HDBRG with 59.2 kg/ha in F_3 generation.

All the varieties and hybrids recorded more than 70 kg nicotine per hectare during the year. Hybrids GT-7 x GT-8, TI -163 x A-145 and the variety A-145 recorded more than 90 kg/ha. From the pooled data, it is observed that more than 80 kg/ha was recorded in A -145, TI-163, TI -163 x GT-7 and HDBRG x GT-7. In F_3 generation, HDBRG P-1 and P-2 recorded 106.9 and 153.4 kg/ha, respectively followed by HDBRG x A -145 with 147.2 kg and TI-163 x HDBRG with 163.3 kg/ha

During 2008-09, among the hybrids tested for seed yields, HDBRG x A - 145 with 1,666 kg/ha and TI -163 x A - 145 with 1,483 kg/ha seed were significantly superior to others. From the mean values, it is seen that HDBRG x A -145 with 1,832 kg/ha and A-145 x HDBRG with 1,641 kg/ha seed potential ranked higher. However, the hybrid A-145 x GT-7 showed stability in seed yield over three years with 1,452 kg seed/ha. The other good yielders are GT-8 x HDBRG, with 1,436 kg/ha and GT-7 x GT-8 with 1,429 kg/ha and A-145 with 1,490 kg/ha also showed better performance. From the pooled data over three years, all most all the parents and hybrids recorded more than 30% oil in seed. The cross TI-163 x A-145 recorded a maximum mean oil yield of 602 kg/ha followed by HDBRG x A-145 with 598 kg/ha.

Efforts were made to isolate certain HDBRG lines for their potential seed yields so that single line would be sufficient for solanesol, nicotine, protein and seed oil. The seed yield per plant basis ranged from 1,563 to 1,875 kg/ha showing its potential.

PROGRAMME 10

AGRICULTURAL EXTENSION AND INFORMATION TECHNOLOGY

Agricultural Extension

Stress analysis of tobacco farmers and changing scenario of the cropping pattern of Andhra Pradesh

(K. Sumankalyani and S. K. Naidu)

In Andhra, the production was increased from 170 million kg to 220 million kg during 2009-10. In NLS, 25,000 ha is under tobacco cultivation and is distributed in the mandals Jangareddygudem, Buttaigudem, C.Narasapuram, Koyyalagudem, Gopalapuram, Devarapalli from West Godavari Aswaraopet and Dammapeta from Khammam district. During this year, the maximum price has gone up to Rs. 164/- per kg tobacco, the average price being Rs.144.92 and the minimum price is Rs.65/- per kg in the NLS zone, which in turn has improved the socio-economic status of tobacco farmers.

In 2007-08, the market price of tobacco was Rs. 50/- per kg and it increased to Rs. 100/- during 2008-09 which further increased to Rs 150/kg during 2009-10. The cost of production is one-third, whereas the profit is around two-thirds per kg tobacco this year. With the increase in tobacco prices, farmers are reluctant to move away from tobacco to other crops in different zones of Andhra Pradesh and Karnataka.

Trend analysis of cost of production and price behaviour of FCV tobacco in SLS area of Andhra Pradesh

(Y. Subbaiah and S. K. Naidu)

Secondary data pertaining to production, productivity and price behaviour was collected. Further, primary data from real farm situation was collected for comparative analysis.

On-farm trial with new pipeline selections V-4219 and V-4230 in comparison with Siri as control in NBS and CBS zones of AP

(S. K. Naidu, P. V. Venugopala Rao and Y. Subbaiah)

The new pipeline selections viz., V-4219 and V-4230 were raised along with Siri as check in one acre plot each at Velerupadu of Khammam district (NBS zone) and at CTRI Research Farm, Guntur (CBS zone). All the recommended package of practices was scrupulously followed on common basis in both the experimental and control plots. The line V-4219 performed better compared to the check Siri in respect of yield parameters. Due to heavy rains at Guntur in the second fortnight of November, 2008, lower grades were obtained (Table 9).

Table 9: On-farm trial with new FCV selections V-4219 and V-4230

Yield in kg/ha

Location	V-4219			V-4230			Siri		
	Cured leaf (kg/ha)	Bright leaf (kg/ha)	Bright grade (%)	Cured leaf (kg/ha)	Bright leaf (kg/ha)	Bright grade (%)	Cured leaf (kg/ha)	Bright leaf (kg/ha)	Bright grade (%)
Velerupadu	2690	2008	74.7	2520	1806	71.7	2240	1563	69.8
Guntur	2575	1285	49.9	2400	1170	48.8	2360	1120	47.5

On-farm trial on testing of new FCV tobacco hybrids CH-1 and CH-3 in NLS area

(K. Sumankalyani, T.G.K. Murthy and S. K. Naidu)

On-farm trials were conducted for testing the new pipe line hybrids viz., CH-1& CH-3 along with Kanchan in NLS zone viz., Upper NLS (Achiyyapalem), Middle NLS (Ankalagudem) and Lower NLS (Gopalapuram). All the recommended package of practices were scrupulously followed.

The farmers exposed to on-farm trials (OFTs) were convinced with the performance of new pipe line hybrids CH1 & CH3 under farm situation. Farmers have shown interest to grow CH-1 & CH3 hybrids because of vigorous growth, short inter-nodes, more number of leaves and high yielding capacity. Farmers opined that they can produce hybrid seed on their own and can supply to the neighbouring farmers as they are already producing hybrid seed (Table 10).

On-farm trial on testing of new tobacco variety irrigated *Natu* (L45-90) and Kommugudem in NLS area

(K. Sumankalyani, V. Krishnamurthy and T. G.K. Murthy)

On-farm trial was conducted for testing the irrigated *Natu* variety, L45-90 in one acre plot in Palacherla village in NLS zone. The variety L45-90 performed better in comparison to Kommugudem variety and yielded 1,000 kg/ha extra cured leaf with 56% bright-grades as against the check variety Kommugudem with 50% bright-grades. Nicotine, reducing sugars and chlorides in cured leaf were well within the desirable limits in both line 45-90 and check Kommugudem. The farmers were convinced with the performance of the variety L45-90 under farm situation. Other agency farmers have shown interest to grow L45-90 because of its high yielding capacity.

DBT Project (Funded by Ministry of Science and Technology):

An externally funded DBT project entitled 'Empowerment of tribal through agro-ecological conservation and bio-technological approaches in East Godavari District of Andhra Pradesh' was approved by the Department of Biotechnology; New Delhi with an out lay of Rs.12.58 lakhs. Identification of problems in agency area was conducted on socio-economic conditions by using PRA techniques to analyze the tribal scenario of East Godavari district. The major problems were identified and the interventions were proposed. The proposed interventions will be carried out in the selected villages for the employment generation and sustenance of tribal families for a period of three years.

Problems identified

- Low productivity and low net returns in cereals (Rice, Jowar, Maize), pulses (Black gram, Green gram, Cow pea) and Tapioca
- Lack of awareness and knowledge about high yielding varieties and the latest technical know-how in crop production
- Lack of employment during lean period (March to July)

Table 10: On-farm trial with FCV tobacco hybrids CH-1 and CH-3 - Yield data

Location	CH-1		CH-3		Kanchan	
	Cured leaf (kg/ha)	Bright grades (%)	Cured leaf (kg/ha)	Bright grades (%)	Cured leaf (kg/ha)	Bright grades (%)
Upper NLS (Atchayyapalem)	3,000	80	2,813	75	2,375	70
Middle NLS (Ankalagudem)	2,050	68	2,063	65	2,000	60
Lower NLS (Gopalapuram)	2,765	75	2,555	72	2,230	70

- Under/non-utilization of natural resources like Minor Forest Produce (MFP).
- Low income from alternative sources of livelihood
- Low egg productivity in local chicks
- Poor health and nutritional status in women and children
- Occupational health hazards and drudgery in agro-based activities

Agro-based interventions selected

- Package of practices in cereals, pulses, millets and tobacco
- Soil test based fertilizer application
- Introduction of indigenous, high yielding backyard poultry, sheep and goattery
- Introduction of green manuring and vermicompost technologies
- Drudgery reduction by introduction of agricultural implements
- Nutritional security through back yard kitchen gardening

Interventions through micro-enterprises and homestead units

- Training and skill development in the proposed micro enterprises viz. *adda* leaf plate making, tamarind processing, bamboo products making and Burley seedling production.
- Homestead units viz., natural dyes, tannins & gums unit, herbal products unit, garment making and value addition.
- Value-addition in minor forest produces.
- Introduction of floriculture - *Crossandra infundibuliformis* (Kanakambaram) in tribal backyards.
- Development of marketing avenues to the finished products.

The work has been initiated in the two villages viz. Pedagaddada and Thallapalem villages of Rampachodavaram mandal. A total of 150 kg of paddy seed of improved varieties viz. MTU-1001, MTU-1010 and MTU-3626 was distributed for ten farmers for implementation of Front Line Demonstrations (FLDs).

Agricultural Research Information System (ARIS)

Creation of Web pages for CTRI

(H. Ravi Sankar, C. V. N. Rao and V. Krishnamurthy)

Content in the web pages (www.ctri.org.in) is being updated at regular intervals. Information in web pages viz., research projects on-hand, staff strength, list of staff members, documents (Annual Report & CTRI News) were updated. Information regarding tenders, press releases, circulars, trainings, meetings and other information related to the Institute was uploaded in the website. The CTRI website has been visited by 33,274 persons so far.

Expert system on diseases of major crops

(H. Ravi Sankar and C.A. Raju)

Expert system for different diseases of major crops in Andhra Pradesh was developed which helps in retrieving information on diseases of major crops in the State. Data entry for the diseases of tobacco crop has been completed. Other module entitled "Expert system for identification and management of abiotic stresses in tobacco" has been developed. Testing and debugging of this module, creation of setup program also has been completed.

Decision support system for quality evaluation of flue-cured tobacco

(H. Ravi Sankar and V. Krishnamurthy)

Decision support system for quality evaluation of flue-cured tobacco was

developed which will be utilized as a prediction model to identify the quality of the FCV tobacco leaf based on the physical, chemical, quality and manufacturing parameters. Data entry for chemical parameters has been completed. Reports are generated and tested with chemical parameters. Data entry for physical, quality and manufacturing parameters is in progress.

Designing algorithms for data classification

(H. Ravi Sankar)

Based on a new algorithm developed on Data Mining, a decision support system for soil and water quality evaluation has been developed which will help in preparation of soil and water testing reports along with fertilizer recommendations based on soil testing reports, which saves lot of time and energy, precision, thereby more number of soil and water samples can be analysed in a day. This decision support system can be applicable to any soil testing laboratory, where fertilizer recommendations are given to different crops.

In this particular system, by simply giving instrument reading, it will be transformed into soil testing value of the concerned parameter which will be compared with recommended values for classification, finally suitability of soil and water for tobacco cultivation will be judged and fertilizer recommendations for different tobacco zones will be prepared and printed in the prescribed format. The software was developed with visual basic as front end and MS-access as back end for the benefit of soil testing laboratories. The software helps in reduction of time for preparation of soil test reports instantaneously and avoids the errors in calculation of each parameter and preparation of reports. It will reduce the time taken for computation of results and this decision support system could be applicable for other crops.

Other Softwares developed

Pay roll System

A payroll package using FoxPro has been developed as per the format given by the 6th Pay commission. Developed various modules for Appending, Deleting, Updating the employee information for computing the salaries. Reports were generated for taking the hard-copies of the monthly statements. Graphical User Interface was provided for easy execution of the software.

Expert system for identification of natural enemies of tobacco pests (AINRPT)

A knowledge based system for identification of natural enemies of tobacco pests, which acts as a decision tool for the farmers and scientists has been developed. Software development has been completed. Data entry and Query menus has been created. Testing of the Software with sample data has been completed. Data entry is in progress.

TECHNOLOGY ASSESSED AND TRANSFERRED

At CTRI, Rajahmundry new FCV tobacco lines viz., V-4219 and V-4230 were tested along with the check variety Siri to assess the performance of new lines on yield and quality parameters. The assessment was conducted in NBS and CBS areas of FCV tobacco. V-4219 gave cured leaf yield of 2,690 kg/ha with 75% bright grade out-turn while that of V-4230 is 2,520 kg/ha with 72% bright grade out-turn. The check variety Siri yielded 2,340 kg/ha with 70% bright grade out-turn. V-4219 and V-4230 outscored the yield of check variety by 20% and 12.5%, respectively.

New hybrids viz., CH-1 & CH-3 were tested against Kanchan to analyze the suitability of hybrids and to assess their performance in different soil & natural environment. The hybrids CH-3 and CH-1 recorded 11.7 to 17.01 % higher cured leaf yield and 4 to 7.7 % higher bright grades over Kanchan.

On-farm trial was conducted with the Natu tobacco advanced breeding line L 45-90 for two crop seasons, 2008-2009 and 2009-2010 at two locations viz., Sirivarigudem and Palacherla villages in NLS zone. The Line 45-90 was compared with control, Kommugudem. The variety L 45-90 yielded 1,920 kg/ha cured leaf with 65% top (Melimi) grades at Sirivarigudem. The check variety, Kommugudem yielded 1,640 kg/ha with 50 % top grade out turn. The variety, L 45-90 showed 17.07 % increase in cured leaf over control, Kommugudem. At Palacherla, the variety L 45-90 yielded 2,200 kg/ha cured leaf with 70% bright grades. The check variety, Kommugudem yielded 1,800 kg/ha with 60% bright grade out turn. The variety L 45-90 showed 22.2 % increase in cured leaf over control, Kommugudem.

At CTRI RS, Hunsur, Integrated Farming System model generating a net profit of about Rs.17,872/- from one acre with resultant C:B ratio of 3.48 was successfully demonstrated to farmers. Organic: inorganic ratio of 25:75 was found to be optimum and ideal Integrated Nutrient Management package in realizing maximum productivity of both cured leaf yield and top grade equivalent in FCV tobacco in Karnataka.

Propiconazole, a triazole compound is found effective against soreshin disease caused by *Rhizoctonia* sp. in tobacco nursery.

On-farm trials were conducted with advanced breeding lines FCH 201 having characters intermediary to cultivars Kanchan as well as Rathna and having superior yield, grade out-turn; FCH 221 & FCH 222 having resistance to *Fusarium* wilt in different platform areas. Performance of these lines in farmers' fields was encouraging.

At CTRI RS, Vedasandur, one promising caterpillar resistant chewing tobacco selection HV.2000-6 under the name Abirami CR was identified as a resistant version of the popular cultivar Abirami with yield potential of 3,738 kg/ha an increase of 9.1% over the susceptible cultivar Abirami. This promising caterpillar resistant selection is proposed to be released in the Tamil Nadu Varietal Release Committee meetings for its final release.

EDUCATION AND TRAINING

Central Tobacco Research Institute has organized different extension activities viz., training, scientist-farmer interface, field days, *kisan melas*, exhibitions, workshops and meetings. Added emphasis has been accorded for collaborative activities with Tobacco Board, tobacco industry, State Agricultural Universities & State Department of Agriculture to achieve increased productivity, enhanced quality and to get more net returns at real farm situation.

- Farmers' Workshop was organized at CTRI Research Station, Hunsur on 07.08.2009.
- Farmers' Day was organized at the CTRI Research Station, Hunsur on 15.09.2009.
- A training programme on "FCV tobacco nursery and field crop management in NLS area" was conducted at CTRI Research Station, Jeelugumilli Farm on 07.10.2009 in collaboration with Tobacco Board. A team of Scientists from CTRI, Rajahmundry, Regional Manager, Tobacco Board, Manager, ITC, Tobacco Board Auction Superintendents, field officers and progressive farmers participated in the training programme.

Sl. No.	Programme & Participant (s)	Date & Place
Training programme on 'Nursery Management'		
1.	Dr. M. M. Shenoi & K. N. Subrahmanya	13.04.2009 at Haralipura & Kampalapura
2.	Dr. M. M. Shenoi & K. N. Subrahmanya	15.04.2009 at Harinahally & Kampalapura
3.	Dr. M. M. Shenoi & K. N. Subrahmanya	17.04.2009 at Kebbe Koppalu
4.	K. N. Subrahmanya & Dr. M.M. Swamy	18.04.2009 at Nilalvagilu
5.	K. N. Subrahmanya & Dr. M.M. Swamy	18.04.2009 at Banugundi
6.	Dr. M. M. Shenoi & K. N. Subrahmanya	22.04.2009 at Manchabayanahally
7.	Dr. M. M. Shenoi & K. N. Subrahmanya	22.04.2009 at Maragowdanahally
8.	Dr. M. M. Shenoi & K. N. Subrahmanya	22.04.2009 at Kereyooru
9.	Dr. M. M. Shenoi	24.04.2009 at Hosa Penjahally
10.	Dr. M. M. Shenoi	24.04.2009 at Hale Penjahally
Training programme on 'Field crop management'		
11.	Dr. M. M. Shenoi	20.05.2009 at Gavadagee
12.	Dr. M. M. Shenoi & K. N. Subrahmanya	21.05.2009 at Thathanahally
13.	Dr. M. M. Shenoi & K. N. Subrahmanya	21.05.2009 at Dadadahally
14.	Dr. M. M. Shenoi & Dr. M. M. Swamy	22.05.2009 at M.R.Hosahally
15.	Dr. M. M. Shenoi & Dr. M. M. Swamy	22.05.2009 at Sathyagala
16.	Dr. M. M. Shenoi &Dr. M. M. Swamy	22.05.2009 at Uthenahally
17.	Dr. M. M. Shenoi & K. N. Subrahmanya	26.05.2009 at Chikkahejjur
18.	Dr. M. M. Shenoi & Dr. M. M. Swamy	27.05.2009 at Muddenahally
19.	Dr. M. M. Shenoi and K. N. Subrahmanya	28.05.2009 at Chapparadahally
20.	Dr. M. M. Shenoi & K. N. Subrahmanya	29.05.2009 at Gavadagere

Sl. No.	Programme & Participant (s)	Date & Place
21.	Dr. M. M. Shenoi	01.06.2009 at N.Settyhally
22.	Dr. M. M. Shenoi	02.06.2009 at Mookanahally
23.	Dr. M. M. Shenoi & K. N. Subrahmanya	04.06.2009 at Gohally
24.	Dr. M. M. Shenoi & K. N. Subrahmanya	04.06.2009 at Ibbadi
Training program to technical officers and field staff of Tobacco Board and ITC (MPA)		
25.	All Scientists of CTRI Research Station, Hunsur	17.06.2010 at CTRI Research Station, Hunsur
Kisan Mela		
26.	Dr. T. G. K. Murthy, Dr. K. Sumankalyani & N. Aruna Kumari	19.06.2009 at Pedageddada
Sericulture Meet		
27.	Dr. M. M. Shenoi, K. N. Subrahmanya & Dr. M. M. Swamy	03.07.2009 at Girgur
Training programme on 'PHPM'		
28.	K. N. Subrahmanya	06.07.2009 at Haralipura
29.	Dr. M. M. Shenoi	08.07.2009 at Annur Hosahally
30.	Dr. M. M. Shenoi & K. N. Subrahmanya	09.07.2009 at Basavanahally
31.	Dr. M. M. Shenoi & K. N. Subrahmanya	09.07.2009 at Bidarur
32.	Dr. M. M. Shenoi & K. N. Subrahmanya	15.07.2009 at Aswalu
33.	Dr. M. M. Shenoi & K. N. Subrahmanya	15.07.2009 at Hemmige
34.	K. N. Subrahmanya	16.07.2009 at Gavadagere
35.	Dr. M. M. Shenoi	16.07.2009 at Melur
36.	Dr. M. M. Shenoi & K. N. Subrahmanya	17.07.2009 at M. Settally
37.	Dr. M. M. Shenoi & K. N. Subrahmanya	17.07.2009 at Nadappanahally
38.	Dr. M. M. Shenoi & K. N. Subrahmanya	18.07.2009 at Hardur
39.	Dr. M. M. Shenoi & K. N. Subrahmanya	20.07.2009 at Thathanahally
OFT/PHPM		
40.	K. N. Subrahmanya	29.07.2009 at Kirsodlu
41.	Dr. M. M. Swamy	29.07.2009 at N.D.G. Koppalu
42.	Dr. M. M. Shenoi & K. N. Subrahmanya	04.08.2009 at Keragodu
43.	Dr. M. M. Shenoi & K. N. Subrahmanya	04.08.2009 at V.G.Koppal
44.	Dr. M. M. Shenoi & K. N. Subrahmanya	05.08.2009 at B. Matkere
45.	Scientists and Technical Officers of CTRI RS, Hunsur	07.08.2009 at Hunsur
46.	Dr. M. M. Shenoi & Dr. M. M. Swamy	11.08.2009 at Kallahally
47.	Dr. M. M. Shenoi & Dr. M. M. Swamy	11.08.2009 at Borehosahally
48.	Dr. M. M. Shenoi & K. N. Subrahmanya	12.08.2009 at K.G.Koppal
49.	K. N. Subrahmanya	20.08.2009 at Hosakote

Sl. No.	Programme & Participant (s)	Date & Place
50.	K. N. Subrahmanya & Dr. M. M. Swamy	26.08.2009 at Kellur
51.	K. N. Subrahmanya & Dr. M. M. Swamy	26.08.2009 at Haranahally
52.	Dr. M. M. Shenoi	27.08.2009 at Muddenahally
53.	Dr. M. M. Shenoi & K. N. Subrahmanya	07.09.2009 at Kallabetta
54.	Dr. M. M. Shenoi & K. N. Subrahmanya	16.09.2009 at Somanahally
55.	Dr. M. M. Shenoi & K. N. Subrahmanya	17.09.2009 at R.G.Hundi
Field Day		
56.	Dr. C.C.S. Rao, Dr. K. Sumankalyani & N. Aruna Kumari	10.09.2009 at Pedageddada
Crop seminar on 'FCV tobacco'		
57.	Dr. V. Krishnamurthy, Dr. C.C.S. Rao, Dr. U. Sreedhar, Dr. C.A. Raju & Dr. S. Kasturi Krishna	16.09.2009 at Dippakayalapadu
Training programme on 'Seed bed preparation, Nursery management, Pest & disease control in seed-beds'		
58.	Dr. K. Nageswara Rao, Dr. S.V. Krishna Reddy, S. Gunneswara Rao & Dr. S.K. Dam	30.09.2009 at Jangareddygudem I & II Auction Platforms
Nursery Management		
59.	Dr. G. Raghupathi Rao & Dr. S.V. Krishna Reddy	02.10.2009 at Koyyalagudem & Bandapuram
Exposure visit on 'Rice production technologies'		
60.	Dr. K. Sumankalyani, S. Nageswara Rao & N. Aruna Kumari	06.10.2009 at RARS, Maruteru
Training programme in 'Model Project Area in NLS'		
61.	Heads of Divs. & Head, CTRI RS, Jeelugumilli	07.10.2009 at Jeelugumilli
Training programme on 'Watershed Development'		
62.	Dr. M. M. Swamy	15.10.2009 & 16.10.2009 at BAIF Institute, Tiptur
Training programme on 'Seed bed preparation, Nursery management, Pest & disease control in seed-beds'		
63.	Dr. S.V. Krishna Reddy & Dr. S.K. Dam	27.10.2009 at Katavaram & Mirthipadu

Sl. No.	Programme & Participant (s)	Date & Place
Training programme on 'Plantings, fertiliser application, intercultivations, ridge formation, IPM and irrigations'		
64.	Dr. K. Siva Raju, Dr. S.V. Krishna Reddy & S. Gunneswara Rao	11.11.2009 at Pothavaram, Kavuluru & P.N. Palem
Training programme on 'Main field preparation, fertiliser application, plantings, intercultivations & IPM'		
65.	Dr. K. Siva Raju Dr. S. Kasturi Krishna & Dr. S.K. Dam	12.11.2009 at Katavaram & Muggulla
66.	Dr. K. Nageswara Rao & S. Gunneswara Rao	17.11.2009 at J.R. Gudem – I & II
Training programme on 'Main field operations on VFC tobacco'		
67.	Dr. G. Raghupathi Rao & Dr. S.V. Krishna Reddy	16.11.2009 at V. Ch. Gudem, Gopalapuram, Rajampalem & Dondapudi
Krishi Mahiti Sapthaha Tobacco Package Practices		
68.	C. Mahadeva	27.11.2009 at Holenarasipura
Training programme on 'Fertilisation, ridge formation, intercultivations, IPM & Irrigation'		
69.	Dr. S.V. Krishna Reddy, Dr. G. Raghupathi Rao & Dr. S.K. Dam	17.12.2009 at Krishnampalem & Sangaigudem
Training programme on 'Package of practices for pulses cultivation'		
70.	Dr. M. Kumaresan	24.12.2009 at Vedasandur
Training programme on 'Topping, de-suckering, harvesting, curing, grading and PHPH'		
71.	Dr. S.V. Krishna Reddy, Dr. Y. Subbaiah & Dr. M. Anuradha	06.01.2010 at Murari
Training organized by BAIF on 'Water and soil conservation'		
72.	Dr. M. M. Shenoi and Dr. M. M. Swamy	06.01.2010 at CTRI RS, Hunsur
Training programme on 'Topping and de-suckering'		
73.	Dr. S.V. Krishna Reddy & Dr. G. Raghupathi Rao	12.01.2010 at Chinnagudem, Vadalakunta & Gopalapuram

Sl. No.	Programme & Participant (s)	Date & Place
Inter Agency Team visit		
74.	Dr. P. Harishu Kumar	19.01.2010 at Thorredu
75.	Dr. S.V. Krishna Reddy	20.01.2010 at Devarapalli & Gopalapuram
76.	Dr. S. Kasturi Krishna	21.01.2010 at Koyyalagudem & J.R. Gudem-1
77.	Dr. C. C. S. Rao	22.01.2010 at J.R. Gudem - II
Training programme on 'Topping, de-suckering, harvesting & curing, grading and PHPM'		
78.	M. Nageswara Rao, S. Nageswara Rao & Dr. S.K. Dam	09.02.2010 at Shobhanadripuram
79.	Dr.K. Siva Raju & Dr. M. Anuradha	11.02.2010 at Vadisileru
80.	Dr. P. Harishu Kumar, Dr. G. Raghupathi Rao & Dr. M. Anuradha	18.02.2010 at Makkinavarigudem
81.	Dr. Dr. P.V. Venugopala Rao & Dr. D.V. Subhashini	18.02.2010 at Sitampeta
Field day at On-farm trial plot/Varietal trial plot		
82.	Dr. P. Harishu Kumar, S. Gunneswara Rao & Dr. S.K. Dam	10.02.2010 at Chinnaigudem
83.	S. Gunneswara Rao & Dr. Y. Subbaiah	17.02.2010 Atchaipalem
84.	Dr. S.V. Krishna Reddy & Dr. M. Anuradha	19.02.2010 at Gopalapuram

Field Visits

Sl. No.	Participant (s)	Date & Place
1.	Dr. S. Kasturi Krishna, S. Jitendranath & Dr. S.K. Dam	03.10.2009 Tobacco nurseries surrounding to Kalavacharla village
2.	Dr. C.C.S. Rao, Dr. P.V. Venugopala Rao, S. Nageswara Rao, S. Jitendranath & Dr. S.K. Dam	08.10.2009 Tobacco nursery growing areas in and around Kalavacharla, Rajanagaram
3.	Dr. S. Kasturi Krishna, S. Gunneswara Rao & Dr. S.K. Dam	08.12.2009 Tobacco nursery growing areas in and around Vadisileru, Jaggampeta

Diagnostic Visits

Diagnostic visits were organised to identify the problems pertaining to tobacco field crop, post-harvest technologies viz. curing, grading and bulking and advocated viable technologies for yield and quality improvement.

Sl. No.	Participant (s)	Date & Place
1.	Dr. G. Raghupathi Rao, Dr. S. V. Krishna Reddy, Dr. Y. Subbaiah, S. Nageswara Rao & Dr. S. K. Dam	06.01.2010 Areas under Koyyalagudem Auction Floor
2.	Dr. G. Raghupathi Rao, Dr. Y. Subbaiah, S. Nageswara Rao & Dr. S. K. Dam	08.01.2010 *Lanka* tobacco growing areas in Alamuru and Athreyapuram mandals of East Godavari district
3.	S.K. Naidu & S. Nageswara Rao	13.01.2010 Areas under Jangareddygudem -II
4.	Dr. C.A. Raju, Dr. Y. Subbaiah, Dr. S. Kasturi Krishna, S.Gunneswara Rao & S. Nageswara Rao	28.01.2010 Areas under Jangareddygudem -I
5.	Dr. P. Harishu Kumar, Dr. C.A. Raju, Dr. G. Raghupathi Rao, Dr. Y. Subbaiah & S. Nageswara Rao	04.02.2010 Aswaraopet cluster under Jangareddygudem -II
6.	Dr. G. Raghupathi Rao, Dr. Y. Subbaiah, Dr. S. Kasturi Krishna & S. Nageswara Rao	10.02.2010 Areas under Thorredu Auction Floor

Guest Lectures

S.No.	Participant (s)	Lecture	Date & Place
1.	Dr. B. Krishna Rao	Watershed management	18.07.2009 at ANGRAU, Rajahmundry
2.	Dr. C.V.N. Rao	Effect of Ozone on the climate	16.09.2009 at Govt. Colege, Rajahmundry.
3.	Dr. H. Ravi Sankar	Data mining concepts and techniques	16.10.2009 at Sri Satya Sai P.G. College, Palivela
4.	Dr. J.V. Prasad	Trends in management of tobacco pests'	07.11.2009 at RARS, Lam, Guntur
5.	Dr. U. Sreedhar & Dr. S. Kasturi Krishna	Crop production and protection technologies	25.10.2009 at CTRI, Rajahmundry
6.	Dr. S. Ramakrishnan	Bio-intensive management of plant parasite nematodes in tobacco based cropping system	December, 2009 at National Bureau of Agriculturally Important Insects, Bangalore

Radio Talks

Sl. No.	Name	Topic, Station & Date of broadcast
1.	Dr. C. V. N. Rao	Harmful substances in tobacco and approaches for their reduction (in Telugu) (AIR, Visakhapatnam; 17.06.2009)
2.	Dr. B. Krishna Rao	Micro-irrigation in tobacco cultivation (in Telugu) (AIR, Visakhapatnam; 19.06.2009)
3.	J.V.R. Satyavani	Post-harvest management practices in mango and cashew (in Telugu) (AIR, Vijayawada; 01.08.2009)
4.	S. Jitendranath	Fodder cultivation in *Lanka* soils (in Telugu) (AIR, Vijayawada; 06.09.2009)
5.	Dr. P.V.V.S. Siva Rao	Milch animal management for higher yields (in Telugu) (AIR, Vijayawada; 16.09.2009)

Farmers' Study Tours

Date	Programme	Participants
23.12.2009	Good Agricultural Practices in FCV tobacco production	38 Farmers from SBS region visited CTRI and Research Farm, Katheru
08.01.2010	Improved production / protection technologies of FCV tobacco crop	40 tobacco farmers from Kandukur Auction Floor-I visited CTRI & Research Farm, Katheru
22.01.2010	Explained about improved FCV tobacco production/ protection technologies	40 tobacco farmers from Podili Auction Floor- I & II visited CTRI & Research Farm, Katheru.
	Low-cost technologies in rice, groundnut, green fodder etc.	CTRI-KVK, Kalavacharla
04.02.2010	Improved production / protection technologies of FCV tobacco	20 farmers from Vellampalli Auction Floor No. II visited CTRI & Research Farm, Katheru
19.02.2010	Improved technologies in FCV tobacco production	Vellampalli Auction Floor-I visited CTRI & its Research Farm, Katheru

TV PROGRAMMES

1.	Dr. A.V.S.R Swamy Dr. M. Kumaraesan	Alternative uses of tobacco : Production of tobacco seed and oil	8.3.2010 Sun TV News

Exhibitions

- An exhibition stall of CTRI Research Station, Hunsur was put up during the "Grameena Dasara" celebrations held at Hunsur on 23.09.2009.
- An exhibition stall was arranged by the Head, CTRI Research Station, Vedasandur in the State level Agricultural Fair organized by Department of Agriculture from 23.01.2010 to 26.01.2010 at Dudley Higher Secondary School, Dindigul depicting the tobacco production technology for the benefit of visitors.

Books/Pamphlets

- Booklet entitled 'Socio-economic Analysis of Tribal of East Godavari District, Andhra Pradesh' by Dr. K. Sumankalyani, Dr. C.C.S. Rao. Dr. V. Krishnamurthy, N. Aruna Kumari and V.K. Jyothirmai
- Pamphlets on "Package of practices in Paddy and Jowar"
- Bulletin entitled "Scientific Management Practices for Higher Yields in Cocoa" by Y. Subbaiah, J.V.R. Satyavani, V. Krishnamurthy and E. Vijaya Prasad
- Crop Calendar for Rice, Cashew and Blackgram.

Tobacco Information Centre (TIC)

The Tobacco Information Centre acts as ready reckoner in transfer of technologies and dissemination of tobacco information to the stake-holders. The centre is making efforts to collect information on the latest developments in research, development, marketing, manufacturing, exports and imports, production policies and other tobacco related issues. Latest literature on tobacco farming from time to time is being displayed for the benefit of tobacco farmers. During the year, the TIC has sold 99 books and one CD and an amount of Rs 32, 654/-.

Monitoring Visits

- Project Monitoring and Evaluation Team consisting of the Director and a team of scientists visited Karnataka on 27.07.2009 for monitoring the experiments at CTRI RS, Hunsur and farmers' fields in KLS area.
- Institute Project Monitoring and Evaluation Team visited CTRI Research Stations in Guntur and Kandukur on 6th and 7th January, 2010 to monitor the progress of research work being conducted under Institute and AINRPT projects during 2009-10 crop season. The team consisting of the Director, Heads of Divisions and PSO also surveyed the FCV tobacco growing areas in Prakasam and Nellore districts and advised farmers on corrective/ remedial measures in problem areas.

KRISHI VIGYAN KENDRA, KALAVACHARLA

Significant achievements

1. Organised 9 OFT'S and 14 FLD'S in agriculture and allied activities during the period under report.
2. A total no of 130 training programmes were conducted covering 5,675 participating farmers.
3. Refined and popularized paddy drum seeder for direct seeding in paddy in uplands and also in Delta areas of East Godavari district.
4. A patent was obtained for Palmyrah fibre separator (Patent No 227533).

Palmyrah fibre separator

5. Designed and developed 'Low-cost bamboo slicer-cum-incense stick making machine' and 'Low-cost chaff cutter' suitable to homesteads.

Bamboo slicer-cum-incense stick maker

6. Planting material viz., mango grafts, cashew grafts etc. (20,000) were supplied to the needy farmers.
7. Paddy seed of popular varieties viz., MTU 7029 and BPT 5201 were produced and supplied to farmers
8. Assessed the performance of CoFS-1 (Sorghum), CO-4 (Napier bajra) fodders and found that CO-4 was better than CO-3.

CO-4 (Napier bajra)

9. Introduced commercial units of backyard poultry in the agency area.
10. Fifty Banana fibre extractor machines were supplied to Universities, Govt. agencies, NGOs and Entrepreneurs.

Important programmes

- Organized a Cashew Seminar on 20.10.2010 at KVK, Kalavacharla in collaboration with DCCD, Cochin.

State level seminar on Cashew

- Organised seminar on "Scientific Management Practices for Higher Yields in Cocoa" on 9-7-09 in collaboration with DCCD, Cochin.

- Two demonstrations were conducted on 'Cashew Apple Utilization' in collaboration with DCCD, Cochin during 6-5-2010 and 7.5.2010.
- Conducted SAC meetings for *Rabi*-2009 and *Kharif*-2010 on 19-8-2009 and 20-1-2010, respectively.
- Technology Week celebrations were organized during October 23-27, 2009.
- International Women's Day was organized on 8-3-2010 at KVK, Kalavacharla.

Innovative methodologies adopted

- Technology transfer through Farm Advisory Circles involving a group of progressive & knowledgeable farmers in field visits
- Formulated inter-agency teams in co-ordination with DAATT Centers and state line departments
- Adopted satellite farmers approach
- Adopted family approach to prepare key communicators
- Convergence linkages
- Organized ex-trainee meets

Success stories of KVK

- Refined and popularized Drum Seeder for direct seeding in paddy
- Expanded backyard poultry units and supplied eggs & chicks throughout the state
- Produced 20,000 Mango and Cashew grafts for supply to the needy farmers
- Clonal multiplication of Casuarina
- Value-addition to cashew apple
- Designed and developed "Low cost bamboo slicer" and "Low cost chaff cutter" suitable to homesteads.

Technology assessed and refined

- Assessment of soil test based fertilizer recommendation, method and time of application on yield and cost of *Lanka* tobacco
- Assessment of performance of tapioca as an inter-crop in the rainfed upland cashew orchards of East Godavari district
- Influence of plant growth hormones and micro nutrients on early bearing, fruit retention and yield enhancement in mango
- Assessment of canker resistant planting material viz., Balaji Acid Lime along with organic amendments
- Assessment/management of *Rhinoceros* beetle and Red palm weevil in coconut orchards
- Assessment of Amylase Malt Mix 80 g for management of malnutrition in children below 5 years

Front line demonstrations

- Balanced fertilizers in pigeonpea + soybean inter cropping system
- Management of suckers in *Natu* tobacco
- Reduction of cost of cultivation and crop duration through TNAU Paddy row seeder
- Varietal introduction in pulses (chickpea JG-11)
- Varietal introduction in oilseeds (Groundnut : K-6; Sesame: YLM-66, Swetha, Chandan)
- Management of magnesium and boron deficiencies in oil palm
- Efficacy of *Trichoderma viride* against stem bleeding in coconut
- Management of cassava mosaic in tapioca
- Management of shoot and fruit borer and bacterial wilt in Brinjal
- Management of tea mosquito in cashew
- Management of hopper in mango
- Management of leaf curl, ring spot, mosaic virus in papaya
- Detection of silent heat and induction of heat in buffaloes
- Prevention of mastitis in cattle
- CoFS (sorghum) perennial fodder
- Male buffalo-calf rearing
- Mortality control in buffalo calves
- *Azolla* as feed to cattle
- Kitchen garden in rural backyards
- Introduction of drudgery reducing weeders and bhendi pluckers for women in agriculture

AWARDS AND RECOGNITIONS

- Dr. D. Damodar Reddy received the prestigious IMPHOS-FAI Award on the "Role of Phosphorus on yield and quality of crops" for the year 2009 from Sri M.K. Alagiri, Hon'ble Union Minister for Chemicals & Fertilisers at Hyderabad Marriott Hotel, Hyderabad on 13.12.2009.

- The poster entitled "Rainwater harvesting for drought proofing and productivity enhancement of FCV tobacco in South Coastal Andhra Pradesh" By R. Sreenivasulu, M. Osman, V. Krishnamurthy, K.V. Rao, K.L. Prasad and B. Narsimulu was awarded Best Poster in the thematic area "Climate Change and natural resources: Soil, water and biodiversity" in the National Symposium on "Climate Change and Rainfed Agriculture" held at CRIDA, Hyderabad during 18-20th February, 2010.

- Tobacco Board Award for outstanding contribution in Tobacco Research & Development conferred by ISTS for the research paper "Soil fertility management of flue cured tobacco growing light soils of Karnataka" was presented to Dr. V. Krishnamurthy, Dr. C.C.S. Rao and Dr. M.M. Swamy during the National Symposium on Tobacco – 2009 – Challenges and Opportunities, Nov. 24-26th 2009, CTRI, Rajahmundry.

- ISTS Award for outstanding contribution in Tobacco Research & Development for the research paper "Integrated approach for high value phytochemicals and seed oil from tobacco crop" was presented to Dr. P. Harishu Kumar, Dr. K. Siva Raju, Dr. C.V.N. Rao and Dr. M. Anuradha during the National Symposium on Tobacco – 2009 – Challenges and Opportunities, Nov. 24-26th 2009, CTRI, Rajahmundry.

- Dr. T. G. K. Murthy, Head, Division of Crop Improvement, Dr. C. C. S. Rao, Head, Division of Crop Production; Sri M. M. Yusuff, Sr. Vice-President, Godfrey Phillips India Ltd., Guntur and Dr. T. Lakshmi Narasaiah, Leaf Executive, VST Industries, Guntur were conferred ISTS - FISTS Award

during the National symposium organized by Indian Society of Tobacco Science (ISTS) on **Tobacco - Challenges and Opportunities** held during **November 24 - 26, 2009.**

- A paper entitled "Role performance of tribal women in agriculture - A study in agency area of East Godavari district, Andhra Pradesh" presented by Dr. K. Sumankalyani, Dr. V. Krishnamurthy, Dr. C. C. S. Rao and N. Aruna Kumari was adjudged as the best paper which was presented in the National Seminar on "Sustainable Development of Tribal Areas through Integrated and Eco-Friendly Approaches" at KVK, Waghai, Dangs Dist held during December 11-13, 2009 organized by Navsari Agricultural University, Gujarat.

- P. Neelakanteswara Rao, Assistant, CTRI, Rajahmundry was given the "Best Administrative Worker Award" for the year 2009.

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, Department of Biotechnology and lead banks are associated with different tobacco development programmes.

Research projects have been taken up with the collaboration of various research organizations such as NBPGR, New Delhi, CIAE, Bhopal, PDBC, Bangalore and NBSS&LUP, Nagpur.

Sl. No.	Name of the Collaborating Agency	Project title/Activity
a) National Institutes/Agricultural Universities		
1.	Ministry of Health & Family Welfare, Govt. of India, New Delhi	Pilot project on "Alternative crops to *Bidi* and Chewing tobacco in different AESRs in the country"
2.	Bureau of Indian Standards, New Delhi	Development of Indian standards for tobacco and tobacco products
3.	Department of Biotechnology, New Delhi	Empowerment of tribals through agro-ecological conservation and bio-technological approaches in East Godavari district of Andhra Pradesh
4.	Tobacco Board, Guntur	Model Project Area scheme and on-farm trials for improving yield and quality of FCV tobacco in different zones
5.	National Bureau of Soil Survey & Land Use Planning, Nagpur	Soil resource mapping of tobacco growing soils in India
6.	National Bureau of Plant Genetic Resources, New Delhi	National Active Germplasm Site (NAGS)
7.	Directorate of Oil Palm Research, Pedavegi	Production technology for oil palm and intercropping of FCV tobacco in oil palm
8.	Department of Agriculture in different states	Transfer of technology in non-FCV types and supply of inputs
9.	Indian Meteorology Dept., Pune	Maintenance of meteorological observatories at different Stations
10.	M/s ITC Ltd.-ILTD Divn., 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
11.	PDBC, Bangalore	Coordinated trials in Biological control
12.	Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal	Ph.D. programme on Management of brown spot disease in *Motihari* tobacco in West Bengal
13.	The Andhra Pradesh Paper Mills, Rajahmundry	Micropropagation of Superior Genotypes of *Casuarina*
(b) International Institutions		
1.	CORESTA, France	Evaluation of pest and disease resistant varieties
2.	ISO-TC126, Berlin, Germany	Development of international standards for tobacco and tobacco products

ALL INDIA NETWORK RESEARCH PROJECT ON TOBACCO

Crop Improvement

In the different trials viz., Initial Varietal Trial (IVT) and Advanced Varietal Trial (AVT) conducted at the AINRPT Centres, promising lines were identified in different types of tobacco considering their superiority over the respective checks.

Initial Varietal Trials

Centre	Promising line(s)
***Bidi* tobacco**	
Anand	ABD 113, ABD 114, 22-9-4-26 and 36-37-2-33-6
Araul	ABD 112
Nandyal	Hybrid NBTH 130
Nipani	NBTH 130
Chewing tobacco (*Jati*)	
Dinhata	DJ 1 and DJ 2
Berhampur	Sel-36-14 and Chootamani
FCV tobacco	
Guntur	TBST 2, FCH 210, A 13, TBST 1 and Hybrid SH 1
Hunsur	NLST 2, FCH 221 and FCH 222
Jeelugumilli	A 13, NLST 2, FCH 221 and FCH 222
Kandukur	TBST 2 and FCH 209; Hybrids SH 1, SH 6 and KLSH 10
Rajahmundry	TBST 2 and FCH 210; Hybrids SH1 and KLSH1
Shimoga	NLST 1, TBST 1 and TBST 2
***Rustica* tobacco**	
Anand	AR 100

In the AVT conducted at Hunsur Centre, the CMS hybrid CH3 recorded significant superiority over Kanchan with 14% standard heterosis. Topping at 22 leaves stage and application of 70 kg N/ha were optimum for maximizing both productivity and grade outturn.

Advanced Varietal Trials	
Centre	**Line(s)**
***Bidi* tobacco**	
Anand	ABD 111 and ABD 108
Araul	ABD 111
Chewing tobacco (*Jati*)	
Dinhata	VDH 3 and VDH 1
Chewing tobacco	
Vedasandur	VDH 3
FCV tobacco	
Guntur	Cy 159, Entry 56-3, Hybrid TBSH 1
Hunsur	FCH 197, A 3, Hybrids CH 39 and NLSH 1
Jeelugumilli	RT 13; Hybrids NLSH 1 and CH 39
Rajahmundry	Line 56-3 and FCH 197; Hybrid TBSH 1
Shimoga	LV 2; Hybrids CH 96, KLSH 10, CH 39, CH 1, CH 3 and NLSH 1
***Rustica* tobacco**	
Araul	AR 95 and AR 93
Ladol	AR 95

FCV tobacco hybrids CH 1 and CH 3 were found to show significantly higher standard heterosis over the check variety, Kanchan for the yield traits, 16 and 18% for cured leaf and 28 and 27% for grade index, respectively in the AVT conducted at the Jeelugumilli Centre. Among the two hybrids, CH 1 possesses greener leaves and is slow maturing than CH 3, besides possessing higher level of flavour compounds and more ripe leaf. Therefore, the hybrid CH 1 was identified in the IRC of CTRI and AINRPT Workshop at Bangalore for commercial cultivation in the Northern light soils of Andhra Pradesh.

In the Station Hybrid trial on *Bidi* tobacco at Nadyal, five hybrids, NyBTH 1, 2, 3, 4 and 5 recorded significantly superior cured leaf yield

(2,200 to 2,250 kg/ha) over the check hybrid GTH 1 (1,780 kg/ha) and were promoted to IVT. At Nipani Centre, among the twelve new hybrids tried, three hybrids viz., NBTH 136 (1,253 kg/ha), NBTH 657 (1,235 kg/ha) and NBTH 658 (1,218 kg/ha) were significantly superior to the check Vedaganga 1.

Crop Production

In Gujarat, application of irrigation through surface method (check basin) produced significantly higher cured leaf yield than furrow method or alternate furrow method. Scheduling irrigation at 0.5 IW/CPE produced higher cured leaf than at 0.7 IW/CPE and 0.3 IW/CPE for MRGTH 1. Green manuring with sunnhemp or sesamum decreased the *Orobanche* incidence and increased the cured leaf yield. Application of 220 kg N/ha significantly improved the nicotine content of tobacco.

In Uttar Pradesh (Araul), application of 50 kg P_2O_5/ha resulted in significantly higher yields over application of 30 or 40 kg P_2O_5/ha in *rustica* tobacco. Application of 40 kg K_2O/ha resulted in significantly higher yields over application of 30 kg.

Among the cropping systems, *Pikka* tobacco + tomato intercropping at 2:4 ratio recorded the highest tobacco cured leaf equivalent yield (1,502 kg/ha) and net returns (Rs.13, 536/ha) compared to sole tobacco with a leaf yield of 955 kg/ha and net returns of Rs 6,690/ha.

In the trials conducted on FCV tobacco hybrids at Jeelugumilli in Andhra Pradesh, application of 115 kg N/ha and 135 kg K_2O/ha, spacing of 100x60cm and topping at 26 leaves for CH 1 and CH 3 hybrids resulted in significantly higher cured leaf yield and grade index.

The lines ABD 77 (2,062 kg/ha) and NBD 119 (1,994 kg/ha) have recorded 27 and 23% increase in cured leaf yield, respectively, over the check, A 119 (1,615 kg/ha) at Nandyal. Application of 130 kg N/ha and a spacing of 90 X 60 cm recorded significantly higher cured leaf yield over 90 and 110 kg N/ha. Application of 130 kg N/ha in organic-inorganic proportion of 25:75 with organic component of vermicompost recorded significantly higher plant height, leaf length, leaf width and cured leaf yield (1,848 kg/ha).

Sunnhemp green manuring and 100% recommended dose of fertilizers (75 kg N+50 kg P_2O_5+50 kg K_2O/ha) to chewing tobacco significantly increased the yield and net returns of chewing tobacco at Vedasandur in Tamil Nadu .

Crop Protection

At Anand Centre, among the barrier crop treatments, lowest whitefly population and leaf curl incidence was recorded on tobacco surrounded by bajra as border crop, while maize crop has recorded higher natural enemy population.

Looking at the effectiveness and ICBR, the bidi tobacco farmers are advised to drench neem or naffatia 10% leaf extract @ 2 l/m^2 for the control of rove beetle in tobacco nursery. Application of carbosulfan @ 2.5 l/ha to bidi tobacco nursery increased number of transplants at first pulling (38 DAS) avoiding 11.6% loss due to stunt nematodes with overall loss to the tune of 9.6% in the production of transplants. Lowest infestation of 0.2% root-knot disease was recorded in ABT 10 as against the local check, A 119 (62%) at Nandyal Centre.

In the studies conducted at Nipani Centre, *Bidi* tobacco line ABD 111 has shown promising tolerance reaction against brown spot, root-knot diseases and aphid infestation. New formulations Abamectin 300 FS (Avicta) and Abamectin 1.9 EC (Vertimac) were effective in reducing the incidence and severity of tobacco root-knot disease but not to the extent of recommended checks, poultry manure (1 t/ha)+Carbofuran (5 kg/ha) spot application and Carbofuran 33 kg/ha broadcasting.

Out of 25 FCV tobacco entries screened against black shank disease in sick plot at Shimoga, four entries were found resistant viz., KST 27, CH 3, NLSH 1 and KST 28. Among the 51 FCV entries screened for frog eye leaf spot disease under field conditions, FCH 209, FCH 210, KLSH 10 and Cy 156 were found tolerant. Among the 25 germplasm lines screened against root-knot nematode, Kanchan, A 3 and KST 27 were found to be resistant.

XIX TOBACCO WORKSHOP

The XIX Tobacco Workshop of All India Network Research Project on Tobacco was held at the University of Agricultural Sciences, Bangalore from 25th to 26th July, 2009. Scientists of all AINRPT centers attended and presented research results of the crop season year 2008-09 and finalized the technical programme for the year 2009-10.

Dr. P.G. Chengappa, Vice-Chancellor, UAS, Bangalore addressing the delegates

EMPOWERMENT OF WOMEN IN AGRICULTURE

So as to promote empowerment of women, the following strategies are adopted : Group approach, Master trainer concept, Multiple skill concept, Direct linkage with market, Linkage with financial institutions and Regular follow-up visits.

- Three collaborative training programmes on women Empowerment activities were conducted in collaboration with world vision India (NGO) Rajahmundry from 18.12.09 to 12.01.10.
- A training programme on "Integrated health and Nutrition Management" was organised in collaboration with World Vision India (NGO) - Vizianagaram for 38 Community Volunteers from 22.03.2010 to 26.03.2010.
- A training programme on "Value-addition to fabrics with *maggam* embroidery" was organized for 20 women from 26.8.2009 to 31.8.2009 and 8.3.2010 to 30.3.2020.
- A training programme on "Skill upgradation in garment making" was organized for 25 women from 24.12.2009 to 23.1.2010 and 24.1.2010 to 30.2.2010.
- A training programme on "Value-addition to fruits & vegetables/bakery products" was organized for 25 women from 29.12.2009 to 30.1.2010.
- A training programme on "Value-addition of locally grown food grains" was organized for 22 women on 28.1.2010.

Impact of the programmes

Two automatic coir 2-ply yarn making units were promoted through KVK at Peddapuram and Kalavacharla areas with an investment of Rs.7.00 lakhs and 10.00 lakhs, respectively. Currently a total of 24 coir automatic units promoted by KVK are running successfully earning net profit of Rs.10,000 to 20,000 per month per unit. The women group (8 members) of S.T.Rajapuram trained by KVK has started a homestead yarn and door mat making unit producing1,000 doormats per month earning a net income of Rs.1,500/month/head. Two Plate making units with aluminium foil papers were promoted by KVK at Kalavacharla and S.T.Rajapuram villages with Rs. 2.00 lakhs and Rs. 0.50 lakhs respectively with subsidy from Khadi Village Industries Board.

Coir doormat homestead unit promoted by KVK

Paper plate homestead unit promoted by KVK

Embroidery training programme

LIST OF PUBLICATIONS

Amarnath, S. and S. Roy (2009) Cultivation practices for *Jati* tobacco (In Bengali). Sasya Utpadaner Prathamik Tattya, Mahakuma Krishi Karan. pp 58-59.

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Krishna Reddy, S.V., S. Kasturi Krishna, K. Deo Singh, P. Harishu Kumar, C.C.S. Rao and V. Krishnamurthy (2008) Effect of conjunctive use of FYM and nitrogen on yield, quality and economics of FCV tobacco (*Nicotiana tabacum*). **Indian Journal of Agronomy** 53(4):318-22.

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Kumaresan, M., P. Harishukumar, C.C.S. Rao, A.V.S.R. Swamy and R. Athinarayanan (2008).

Preliminary investigations on the performance of *Bidi* tobacco hybrid (*Nicotiana tabacum*) GJH-108 for chewability in Tamil Nadu. **Tobacco Research** 34(1&2):93-5.

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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 Dr. T.G.K. Murthy
2	Br.6.1.4(a)	Incorporation of disease resistance for tobacco mosaic virus (TMV) Dr. P.V. Venugopala Rao and Dr. C.A. Raju
3	Br.2	Evolving superior varieties of FCV tobacco through hybridization Dr. P.V. Venugopala Rao
4	Cy.7(iii)	Tissue culture studies in tobacco (III) Micropropagation of elite lines and other selections Dr. K. Sarala and Dr. T.G.K. Murthy
5	Cy.2.1 (f)	Incorporation of aphid resistance from *N. gossei. N. repanda, N x. umbratica-nesophila and N x benthamiana -repanda* Dr. T.G.K. Murthy, Dr. U. Sreedhar and Dr. K. Siva Raju
6	Bio-tech-4	Development of virus tolerant tobacco lines under *in vitro* Dr. K. Sarala, Dr. C.A. Raju and Dr. K. Siva Raju
7	Br.7	Developing hybrid FCV tobacco suitable for traditional black soil area of Andhra Pradesh Dr. T.G.K. Murthy, Dr. P.V. Venugopala Rao and Dr. K. Sarala
8	MB-9	Evaluation of advanced breeding lines for yield and quality Dr. K. Sarala, Dr. P.V. Venugopala Rao and Dr. T.G.K. Murthy
9	Biotech-5	Maintenance, evaluation and characterization of tobacco transgenics Dr. K. Sarala and Dr. K. Siva Raju
10	Biotech-6	Molecular mapping of tobacco traits: Tobacco specific nitrosamines in Burley Dr. K. Sarala, Dr. T.G.K. Murthy, Dr. C.V.N Rao, Dr. K. Siva Raju and Dr. P.V. Venugopala Rao
CROP PRODUCTION		
1	A- 74	Productivity enhancement of soybean-chickpea through integrated nutrient management in rainfed Vertisols of Andhra Pradesh Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy, Dr. P. Harishu Kumar and Dr. V. Krishnamurthy
2	A-78	Effect of *rabi* crops on the emergence of *Orobanche* Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy and Dr. CA Raju
3	A-76	Nitrogen and spacing requirement for the FCV tobacco advance breeding line V-4219 Dr. P. Harishu Kumar, Dr. S. Kasturi Krishna and Dr. M. Anuradha

Sl. No	Institute Code	Title of the project and Investigator(s)
4	A-77	Nitrogen and spacing requirement for the FCV tobacco advance breeding line V-4230 Dr. P. Harishu Kumar, Dr. S. Kasturi Krishna and Dr. M. Anuradha
5	A-79	Investigations on coirpith utilization in tobacco production Dr. C.C.S. Rao, Dr. V. Krishnamurthy and R. Sudhakar
CROP PROTECTION		
1	P.Orb-1	Studies on broomrape of tobacco Dr. C.A. Raju
2	P.78	Studies on wilt disease of tobacco Dr. C.A. Raju
3	E 74	Monitoring of insect pests of tobacco with pheromone traps Dr. U. Sreedhar
4	E 75	Management of stemborer, *Scrobipalapa heliopa* in tobacco Dr. U. Sreedhar
5	E-78	Management of tobacco caterpillar, *S. litura* in tobacco with eco- friendly insecticide baits Dr. U. Sreedhar and Dr. K. Nageswara Rao
CROP CHEMISTRY AND SOIL SCIENCE		
1	AC-1	Permanent manurial experiment Dr. P.R.S. Reddy
2	Ag.SS-2	Soil fertility Investigations: Soil fertility survey of tobacco growing soils of India : a) Soil fertility evaluation of chewing tobacco growing areas of Tamil Nadu Dr. V. Krishnamurthy, Dr. C.C.S. Rao and Dr. A.V.S.R. Swamy
3	OC-10	Evaluation of smoke constituents in tobacco and tobacco products Dr. C.V. N. Rao
4	PR-1	Monitoring of pesticide residues in tobacco samples collected from different areas Dr. C.V.N. Rao
5	BC-8	Electrophoretic characterization of tobacco cultivars Dr. K. Siva Raju and Dr. K. Nageswara Rao
6	SSMB-7	Plant growth-promoting *Rhizobacteria* (PGPR) in tobacco based cropping systems Dr. D.V. Subhashini and Dr. C.C.S. Rao
7	SS-23	Investigations on lead and cadmium contents in Indian tobaccos Dr. C.C.S. Rao and Dr. P.R.S. Reddy
8	SS -26	Determination of critical level of zinc for FCV tobacco in soils of NLS area Dr. P.R.S. Reddy and Dr. C.C.S. Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
9	BC-11	Biochemical characterization of tobacco seed oil Dr. K. Siva Raju, Dr. C.V.N. Rao and Dr. V. Krishnamurthy
10	PHY-71	Chloride nutrition in flue-cured tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao, Dr. C.C.S. Rao and Dr. V. Krishnamurthy
11	PHY-72	Dynamics of potassium absorption, utilisation and re-translocation in FCV tobacco Dr. K. Nageswara Rao, Dr. M. Anuradha and Dr. V. Krishnamurthy
12	C 83	Influence of curings on chemical composition of chewing tobacco Dr. K. Siva Raju
13	SS 28	Characterization of soil phosphorus and potassium in FCV tobacco growing soils of Karnataka Dr. P.R.S. Reddy and Dr. C.C.S. Rao
14	SSMB-9	Effect of K mobilizing bacteria and VAM on the growth, yield and quality of NLS tobacco Dr .D.V. Subhashini
15	Phy-75	Development of float-culture technology for tobacco seedling production Dr. K. Nageswara Rao, Dr. M. Anuradha and Dr. V. Krishnamurthy
AGRL. EXTN., AGRL. ENGG.		
1	Ag. Extn. 36	Stress analysis of tobacco farmers and changing scenario of the cropping pattern Dr. K. Sumankalyani and S.K. Naidu
2	Ag. Engg.7	Fertigation system for tobacco nurseries to reduce labour and improve Water & Nutrient use efficiency Dr. C.C.S. Rao, Dr. V. Krishnamurthy and Dr. P. Harishu Kumar
3	Ag. Engg.8	Designing and testing of tobacco bale pressing and packing machine Dr. V. Krishnamurthy, Dr. C.C.S. Rao, Dr. Kasturi Krishna and N.D. Suresh
4	Ag. Extn.41	On-farm testing of new pipelines viz., V-4219 and V-4230 S.K. Naidu, Dr. P.Venugopala Rao and Dr. Y. Subbaiah
5	Ag. Extn.44	On- farm trial on testing of irrigated *Natu* variety L-45-90 vs. Kommugudem variety Dr. K. Sumankalyani, Dr.V. Krishnamurthy and Dr. T.G.K. Murthy
6	Ag. Extn.46	'On-farm testing of new lines/ selections (YB-4, YB-10) in Burley tobacco' Dr. Y Subbaiah, S.K Naidu and Dr. P.V.Venugopala Rao
7	Ag. Extn. 45	On-farm demonstration of production technology for Sabari *Lanka* tobacco in Khammam District'

Sl. No	Institute Code	Title of the project and Investigator(s)
AGRICULTURAL RESEARCH INFORMATION SYSTEM (ARIS)		
1	ARIS-2	Creation and maintenance of WEB pages of CTRI Dr. H. Ravi Sankar, Dr. C. V. N. Rao and Dr. V. Krishnamurthy
2	ARIS-11	Designing algorithms for data classification Dr. H. Ravi Sankar
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 Dr. T.G.K. Murthy
2	JLN-1	Maintenance of germplasm of *Natu* tobacco Dr. T.G.K. Murthy
3	JLN-2	Developing new varieties of irrigated *Natu* tobacco for Andhra Pradesh Dr. T.G.K. Murthy
4	JL Br.3	Developing hybrid FCV tobacco suitable for Northern light soils (NLS) of Andhra Pradesh Dr. T.G.K. Murthy and Dr. K. Sarala
5	SS-27	Crop growth modelling in FCV tobacco in NLS Dr. C.C.S. Rao, Dr. M. Anuradha, Dr. K. Siva Raju, Dr. S. Kasturi Krishna and Dr. H. Ravisankar
6	JLA-33JML	Moisture and nutrient depletion pattern under NLS conditions Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy, Dr. V. Krishnamurthy, Dr. C.C.S. Rao and Dr. M. Anuradha
7	JLA-34JML	Nutrient budgeting for FCV tobacco variety Kanchan in irrigated Alfisols Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. C.C.S. Rao and Dr. V. Krishnamurthy
8	Ag. Engg-9	Fertigation system for tobacco to reduce labour and improve water and nutrient-use-efficiency Dr. C.C.S. Rao, Dr. V. Krishnamurthy, Dr.K. Nageswara Rao and Dr. P. Harishu Kumar
9	Phy.74JML	Nitrogen nutrition of FCV tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao, Dr. C.C.S. Rao and Dr. V. Krishnamurthy
10	JLA-35	Integrated weed management in FCV tobacco grown under irrigated Alfisols Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy and Dr. K. Nageswara Rao
11	JLA-36	Indices for N and K nutrient-use-efficiency in FCV tobacco grown in irrigated Alfisols Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. D. Damodar Reddy, Dr. C.C.S. Rao, Dr. K. Nageswara Rao and Dr. V. Krishnamurthy
12	SS-29	Potassium supply strategies for improved productivity, quality and potassium use efficiency of FCV tobacco grown on irrigated Alfisols Dr. D.Damodar Reddy, Dr. M. Anuradha and Dr. V. Krishnamurthy

Sl. No	Institute Code	Title of the project and Investigator(s)
BURLEY TOBACCO RESEARCH CENTRE, KALAVACHARLA		
1	By.Br.1	Evaluation of advanced Burley breeding lines for productivity and quality Dr. P.V. Venugopala Rao and Dr. T.G.K. Murthy
2	By.Br.2	Evaluation of Burley tobacco hybrids suitable for Burley growing areas of Andhra Pradesh Dr. P.V. Venugopala Rao and Dr. T.G.K. Murthy
3	AO-1	Studies on the influence of plant population and nitrogen level on yield and quality of Oriental tobacco Dr. P. Harishu Kumar
4	AB-28	Response of Burley tobacco (var. Banket A1) to varying levels of vermicompost and nitrogen Dr. P. Harishu Kumar and Dr. C.C.S. Rao
5	E-77	Studies on seasonal incidence of insect pests of Burley tobacco in East Godavari plains Dr. G. Raghupathi Rao
6	EB-79	Spatial distribution and pest succession of insect pests as influenced by cultural practices in Burley tobacco in the plains of East Godavari Dr. G. Raghupathi Rao and Dr. P. Harishu Kumar
7	AB-29	Development and testing of bio-dynamic manure suitable for Burley tobacco production Dr. P. Harishu Kumar, Dr. C.C.S. Rao, Dr. D.V. Subhashini and Dr.K. Siva Raju
CTRI RESEARCH STATION, GUNTUR		
1	A-42	Effect of FYM, N, P and K on tobacco leaf yields in permanent manurial trial on FCV tobacco Dr. P. Harishu Kumar and Dr. G. Raghupathi Rao
2	A-50	Effect of FYM, N, P and K on tobacco leaf yields in permanent manurial trial on *Natu* tobacco Dr. P. Harishu Kumar and Dr. G. Raghupathi Rao
3	Br.14	Development of FCV tobacco varieties suitable for cultivation in SBS of AP Dr. A.V.S.R. Swamy
4	EG-6	Performance of different spray schedules on the incidence of major insect pests on tobacco Dr. G. Raghupathi Rao
5	EG-7	Influence of diversified cropping system on host preference and cross over by major insect pests during *kharif* and *rabi* seasons Dr. G. Raghupathi Rao and S. Gunneswara Rao
6	A-83	Influence of plant population on nitrogen on advanced breeding line V-4064 Dr. P. Harishu Kumar and Dr. G. Raghupathi Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
7	AO-2b	Response of Oriental tobacco types to N and K fertilization under different agro-climatic conditions Dr. P. Harishu Kumar and Dr. G. Raghupathi Rao
8	EG-12	Studies on relationship of pheromone trap catch of *H. armigera* with field infestation and weather parameters in tobacco, cotton (*Bt* and non-*Bt*) and chickpea Dr. J.V. Prasad
9	EG-13	Studies on monitoring resistance in *Helicoverpa armigera* to *Bt* toxins and other insecticides on cotton, tobacco and chickpea Dr. J.V. Prasad
CTRI RESEARCH STATION, KANDUKUR		
1	K.Br.6	Breeding FCV tobacco variety for yield and quality under SLS conditions Dr. A.R. Panda, Dr. K.C. Chenchaiah, Dr. P.V. Venugopala Rao, Dr. T.G.K. Murthy, K.N. Subrahmanya, Dr. A.V.S.R. Swamy and Dr. C.V.N. Rao
2	EK-14	Bio-ecology and management of tobacco aphid under SLS conditions Dr. K.C. Chnachaiah
3	EK-15	Evaluation of FCV tobacco germplasm for the tobacco caterpillar tolerance under SLS conditions Dr. K.C. Chnachaiah
4	EK-16	Evaluation of FCV tobacco germplasm for the aphid tolerance under SLS conditions Dr. K.C. Chenchaiah
5	AK-19	Effect of different chemicals on sucker control in FCV tobacco under SLS R. Srinivasulu and Dr. K. Nageswara Rao
6	AK-20	Agro-techniques for productivity enhancement in FCV tobacco under SLS condition R. Srinivasulu, Dr. A.R. Panda and Dr. K.C. Chenchaiah
7	K Br 8	Evaluation of FCV tobacco hybrids for yield and quality under SLS conditions Dr. A.R. Panda
8	EK-17	Studies on biology and management of melaybug, *Phenacoccus solenopsis* on FCV tobacco Dr. K.C. Chenchaiah
CTRI RESEARCH STATION, HUNSUR		
1	BR.12	Germplasm maintenance of *Nicotiana tabacum* varieties/lines K.N. Subrahmanya and Dr. M.M. Shenoi
2	P.3.2	Screening of tobacco germplasm against root-knot nematode Dr. S. Ramakrishnan and K.N. Subrahmanya

Sl. No	Institute Code	Title of the project and Investigator(s)
3	N 1.1	Survey for plant parasitic nematodes infecting tobacco Dr. S. Ramakrishnan
4	BR-19	Development and evaluation of F1 hybrids of FCV tobacco suitable to Karnataka light soil region K.N. Subrahmanya, Dr. M.M. Shenoi, Dr. M.M. Swamy and Dr. S. Ramakrishnan
5	P.19	Further studies on *Fusarium* wilt and wilt complex in FCV tobacco crop Dr. M.M. Shenoi and Dr. S. Ramakrishnan
6	P.20	Studies on Soreshin disease *(Rhizoctonia)* in FCV tobacco nursery in KLS Dr. M.M. Shenoi
7	A.37	Agronomic evaluation of promising pipeline varieties (FCH 196 and FCH 201) of FCV tobacco in KLS Dr. M. M. Swamy
8	A.38	Feasibility of producing organic tobacco under KLS situation Dr. M. M. Swamy, Dr. MM Shenoi, Dr. P.Venkateswarlu and Dr. S. Ramakrishnan
9	N.18	Evaluation of organics enriched with bio-agents in integration with soil solarisation against root-knot nematodes in FCV tobacco nursery Dr. S. Ramakrishnan, Dr. M.M. Shenoi and Dr. P.Venkateswarlu
10	EH-1	Survey for assessment of insect pest incidence in KLS tobacco Dr. P.Venkateswarlu, Dr. M.M. Shenoi and Dr. S. Ramakrishnan
11	EH-2	Integrated management of tobacco aphid, *Myzus nicotianae* under KLS conditions Dr. P. Venkateswarlu and Dr. M.M. Shenoi
12	EH-3	Management of tobacco caterpillar, Spodoptera litura under KLS condition Dr. P.Venkateswarlu and Dr. M.M. Shenoi
13	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 Dr. M.M. Swamy, Dr. S. Ramakrishna and Dr. V. Krishnamurthy
14	P-21	Monitoring the incidence of pests and diseases in KLS tobacco Dr. M.M. Shenoi, Dr. P.Venkateswarlu and Dr. S. Ramakrishnan
15	N-19	Bio-intensive management of nematodes in FCV tobacco of KLS using tray nurseries Dr. S. Ramakrishnan, Dr. M.M. Shenoi and Dr. M.M. Swamy
CTRI RESEARCH STATION, VEDASANDUR		
1	G.S.1	Evaluation and maintenance of germplasm Dr. A.V.S.R. Swamy
2	B.48	Studies on heterosis breeding in chewing tobacco (*N. tabacum*) Dr. A.V.S.R. Swamy

Sl. No	Institute Code	Title of the project and Investigator(s)
3	B.49	Synthesis of broad-based gene pool in chewing tobacco (*N. tabacum*) enhancing selection gain Dr. A.V.S.R. Swamy
4	B.50	Breeding for high seed and oil yield in tobacco Dr. A.V.S.R. Swamy and Dr. C.V.N. Rao
5	A 99	Effect of spacing, nitrogen and phosphorus on yield and quality of chewing tobacco in Tamil Nadu Dr. M. Kumaresan, Dr. V. Krishnamurthy, Dr. P. Harishu Kumar and Dr. A.V.S.R. Swamy
6	A 100	Scheduling irrigation through drip system based on daily evapo-transpiration for chewing tobacco in Tamil Nadu Dr. M. Kumaresan, Dr. A.V.S.R. Swamy, Dr. P. Harishu Kumar and Dr. C.C.S. Rao
CTRI RESEARCH STATION, DINHATA		
1	A-10	Permanent manurial experiment with *Motihari* tobacco Dr. S Amarnath and Dr. S. Roy
2	B-17	Diallel analysis in *Motihari* tobacco (*N.rustica*) Dr. S. Amarnath and Dr.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 Dr. S. Amarnath and Dr. S. Roy
4	PP-7	Management of bacterial wilt in *Motihari* tobacco and biochemical and molecular characterization of pathogenic isolates Dr. S. Roy, Dr. S. Amarnath and Dr. K. Siva Raju
5	PP-8	Role of biocides against damping-off of seedlings and growth promotion activity in *Jati* and *Motihari* tobacco nurseries Dr. S. Roy and Dr. S. Amarnath
6	B-18	Screening for higher seed yield and oil recovery in *Jati* (*N. tabacum* L.) tobacco accessions in North Bengal Dr. S. Amarnath
7	PP-10	Weather based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions Dr. S. Roy and Dr. S. Amarnath
9	PP-11	Nursery and field evaluation of *Trichoderma viride* and *Pseudomonas fluorescens* to brown spot disease and yield and quality of *Motihari* tobacco Dr. S. Roy and Dr. S. Amarnath

RAC, QRT, IRC AND IMC MEETINGS

RESEARCH ADVISORY COMMITTEE

Dr. P. Raghava Reddy — CHAIRMAN
Vice-Chancellor,
ANGRAU, Rajendranagar,
Hyderabad - 500 030

Dr. M. Mani — MEMBER
Chief Scientist,
ITC Ltd. – Agri. Business Division,
ILTD, Research department,
Hukkumpeta, Rajahmundry 533103
Andhra Pradesh

Dr. B. C. Biswas — MEMBER
Former Chief Agronomist, FAI,
19, Rohit Apartments,
Plot 30, Sector 10, Dwaraka,
New Delhi 110075

Dr. R. Samiyappan — MEMBER
Director,
Centre for Plant Protection Studies,
Tamil Nadu Agricultural University,
Coimbatore - 641003, Tamil Nadu

Dr. A. Nazir Ahmed Khan — MEMBER
Former Professor and Head,
Department of Plant Pathology, UAS,
Dr. No.239, 8th Main Road,
Jayanagar, 1st Block East, Byrasandra,
Bangalore – 560 011, Karnataka

Dr. Kanwal Raj — MEMBER
Former Scientist G,
Central Drug Research Institute,
B 104/11, Nirala Nagar,
Lucknow – 226 020, Uttar Pradesh

Dr. K.C. Jain — MEMBER
Asst. Director-General (CC),
Indian Council of Agril. Research,
Krishi Bhawan,
New Delhi - 110 114

Dr. V. Krishnamurthy — MEMBER
Director,
CTRI, Rajahmundry - 533 105

Sri Kanneboina Nageswara Rao — MEMBER
Member, IMC-CTRI,
H.No.16-15-207,
Yadav Street, Old Guntur,
Guntur, Andhra Pradesh

Sri Dama Ankaiah — MEMBER
Member, IMC-CTRI,
Naladalapur Village,
V.V. Palem Mandal,
Prakasam Dist., Andhra Pradesh

Dr. C. V. N. Rao — MEMBER-SECRETARY
Principal Scientist,
CTRI, Rajahmundry - 533 105

▲ The Second meeting of Research Advisory Committee was held on 22.03.2010 at CTRI, Rajahmundry.

RAC Meeting held on 22.03.2010

QUINQUENNIAL REVIEW TEAM

The ICAR, New Delhi has constituted the Quinquennial Review Team (QRT) vide Office Order No.1(5)/08-IA.III dated 21st May, 2008 for reviewing the research achievements of CTRI, Rajahmundry, its Regional Research Stations, AINRPT and KVK for the period from 2003 to 2008. The QRT reviewed the work and submitted its report. The Governing Body of ICAR has accepted the recommendations made by the QRT with the comments of the Council.

Prof. S. Kannaiyan — CHAIRMAN
Former Chairman,
National Biodiversity Authority,
17 C-A1, Sapthaswara Apartment,
3rd Seaward Road – Lane,
Valmiki Nagar,
Thiruvanmiyur,
Chennai – 600 041
Tamil Nadu

Dr. D. N. Yadav — MEMBER
Professor of Bio-control (Retd.),
'The Nest'
34-35, Mangal Nagar,
1st Street, Vidya Dairy Road,
Anand – 388 001
Gujarat

Dr. R. B. Sharma — MEMBER
Director of Research (Retd.),
IGKVVF2 Krishak Nagar,
IGKVV Campus,
Raipur – 492 006
Chattisgarh

Dr. R. Lakshminarayana, — MEMBER
Principal Scientist & Head (Retd.),
D.No.23-11-12/1,
Ramakrishnarao Peta,
Rajahmundry – 533 105

Dr. K. Muralidharan — MEMBER
Principal Scientist &
Head, Crop Protection (Retd.),
Directorate of Rice Research,
Block 11, Flat 2, HIG II,
Baglingampalli,
Hyderabad – 500 044

Dr. K.P. Singh — MEMBER
Former Professor & Director of Extension,
G.B. Pant University of Agriculture
and Technology, Pantnagar,
Udhamsingh Nagar - 263145
Uttarakhand

Dr. C. V. N. Rao — MEMBER-SECRETARY
Principal Scientist,
Div. of Crop Chem. & Soil Science,
CTRI, Rajahmundry- 533 105

INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

The Institute Research Committee Meetings of CTRI were held from 27th to 30th June, 2009 at this Institute. Scientists of CTRI, its Research Stations, Tobacco Board officials and representatives of trade and industry participated in the meetings. The progress of research work carried out during the year 2008-09 was reviewed and the technical programme for the crop season 2009-10 was discussed and finalized.

IRC Meetings held during June 27-30, 2009

INSTITUTE MANAGEMENT COMMITTEE

Dr. V. Krishnamurthy
Director & Chairman

Dr. K.C. Jain — MEMBER
Asst. Director General (CC),
Indian Council of Agricultural Research,
Krishi Bhawan, New Delhi – 110 114

Director of Agriculture — MEMBER
Govt. of Andhra Pradesh,
Opp. L.B. Stadium, Basheerbagh,
Hyderabad, Andhra Pradesh

Director of Agriculture — MEMBER
Govt. of Karnataka
No.1, Seshadri Road,
Bangalore – 560 001, Karnataka

Director of Research (Agriculture) — MEMBER
ANGRAU,
Rajendranagar,
Hyderabad – 500 407, Andhra Pradesh

Finance & Accounts Officer, — MEMBER
NAARM, Rajendranagar,
Hyderabad – 500 407, Andhra Pradesh

Dr. Harveer Singh — MEMBER
Principal Scientist
Directorate of Oilseeds Research,
Rajendranagar, Hyderabad – 500 507
Andhra Pradesh

Dr. S. Amarnath — MEMBER
Principal Scientist &
Head-in-Charge, CTRI Research Station,
Dinhata – 736 135, West Bengal

Dr. M. M. Swamy — MEMBER
Sr. Scientist
CTRI Research Station,
Hunsur- 736 135, Karnataka

Sri Dama Ankaiah — MEMBER
Naladalapur Village
V.V. Palem Mandal,
Prakasham dist., Andhra Pradesh

Sri Kanneboina Nageswara Rao — MEMBER
H.No.16-15-207,
Yadav Street, Old Guntur,
Guntur, Andhra Pradesh

Dr. K. Nageswara Rao — MEMBER
Sr. Scientist & Head,
CTRI Research Station,
Jeelugumilli – 534 456,
Andhra Pradesh

Sr. Administrative Officer, — MEMBER-SECRETARY
CTRI,
Rajahmundry - 533 105.
Andhra Pradesh

- The 45th Meeting of the Institute Management Committee was held on 17.09.2009.

IMC Meeting held on 17.09.2009

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS AND SYMPOSIA

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. U. Sreedhar	Inputs Committee Meeting for Karnataka	15.04.2009 at Directorate of Auctions of Tobacco Board, Bangalore
2.	Dr. B. Krishna Rao	National Workshop cum Brain-storming Session on "Rainwater Harvesting and reuse through farm ponds"	April 21-22, 2009 at ICAR Res. Complex for NEH Region, Ri-Bhoi
3.	Dr. V. Krishnamurthy	Briefing Meeting of Madrid Meeting of ISO/TC 126 and its Sub Committees	28.04.2009 at BIS, New Delhi
4.	Dr. U. Sreedhar	Inputs Committee Meeting for Karnataka	01.05.2009 at Tobacco Board, Mysore
5.	Dr. U. Sreedhar	Summer school 'Changing Pest Scenario and Management Strategies in Different Crops'	15.06.2009 at ANGRAU, Hyderabad
6.	Dr. K. Siva Raju & Dr. D.V. Subhashini	First Asian PGPR Congress for Sustainable Agriculture	June 21-24, 2009 at ANGRAU, Hyderabad
7.	Dr. K. Sarala	Board of Studies Meeting Biotechnology and Zoology	08.07.2009 at Govt. College, Rajahmundry
8.	Dr. C. C.S. Rao	Inputs Committee meeting for Andhra Pradesh	10.07.2009 at Tobacco Board, Guntur
9.	Dr. V. Krishnamurthy	ICAR Foundation Day Celebrations and Directors Meeting	16.07.2009 at New Delhi
10.	Dr. V. Krishnamurthy	National Meet on Conservation Agriculture	17.07.2009 at New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
11.	Dr. C. V. N. Rao	Second Meeting of the Technical Advisory Committee	19.07.2009 at Min. of Health & Family Welfare, New Delhi
12.	Dr. V. Krishnamurthy	Meeting on the "Pilot Project on Alternative crops to *bidi* and chewing tobacco in different agro – ecological sub – regions"	23.07.2009 at Min. of Health & Family Welfare, New Delhi
13.	Dr. V. Krishnamurthy	126th Meeting of Tobacco Board	03.08.2009 at New Delhi
14.	Dr. S.V. Krishna Reddy	ZREAC Meetings of Godavari zone for *Rabi* - 2009	August 17-18, 2009 at Kakinada
15.	Dr. J.V. Prasad	Zonal Research and Extension Advisory Council Meeting of Krishna zone for *Rabi* - 2009	August 19-20, 2009 at Guntur
16.	Dr. M. Kumaresan	Chewing Tobacco Farmers, Traders and Manufacturers Meet	27.08.2009 at Bhavani
17.	Dr. M.M. Swamy	Scientific Advisory Committee Meeting	02.09.2009 at KVK, Suttur, Mysore District
18.	Dr. M. Kumaresan	ATMA meeting	05.10.2009 at Department of Agriculture, Dindigul
19.	Dr. V. Krishnamurthy	Special Interactive Workshop on Administrative and Financial matters for the Institutes located in South India	Sep. 10-11, 2009 at NAARM, Hyderabad
20.	Dr. V. Krishnamurthy	24th Annual General Meeting of the International Tobacco Growers Association (ITGA) as an Observer on Issues Day	26.10.2009 at Hyderabad
21.	Dr. M.M. Swamy	Training programme organized by BAIF Institute of Rural Development, Karnataka	16.10.2009 at Tiptur

Sl. No.	Participant (s)	Programme attended	Date and place
22.	Dr. H. Ravisankar	Training programme on "Web based e-learning and content management"	November 3-13, 2009 at NAARM, Hyderabad
23.	Dr. V. Krishnamurthy	Sixth Solanaceae Genome Workshop-2009	November 12-13, 2009 at New Delhi
24.	Dr. K. Siva Raju	National Symposium on 'Recent Global Developments in the Management of Plant Genetic Resources'	November 17-18, 2009 at NBPGR, New Delhi
25.	All Scientists of CTRI	National Symposium on Tobacco – 2009	November 24-26, 2009 at CTRI, Rajahmundry
26.	Dr. H. Ravi Sankar	ICAR Winter School training on "Bioinformatics and its applications in agriculture"	December 1-21, 2009 at Kerala Agril. University, Thrissur
27.	Dr. D. Damodar Reddy	FAI Seminar – 2009 on "Fertiliser policy for sustainable agriculture"	December 2-5, 2009 at Hyderabad
28.	Dr. V. Krishnamurthy Dr. C. V. N. Rao	7th Meeting of Tobacco and Tobacco Products Sectional Committee, FAD -4	December 4-5, 2009 at BIS, Jaipur
29.	Dr. K. Varalakshmi	Training Programme on 'Agricultural Policy Analysis'	December 7-11, 2009 at NCAP, New Delhi
30.	Dr. K. Sumankalyani	National Seminar on "Sustainable Development of Tribal Areas through Integrated and Eco-Friendly Approaches"	December 11-13, 2009 at KVK, Navsari Agril. University, Waghai (Dangs)
31.	Dr. S. Ramakrishnan	Winter School on 'Advances in Bio-control of Plant Diseases' - Bio-management of tobacco nematodes	14.12.2009 in NBAII, Bangalore
32.	Dr. D.V. Subhashini	Golden Jubilee Annual Conference of Microbiologists	Dec. 16-18, 2009 at National Chemical Laboratory, Pune

Sl. No.	Participant (s)	Programme attended	Date and place
33.	Dr. H. Ravisankar	International Conference on "Statistics, Probability, Operations Research, Computer Science and Allied areas"	January 4-7, 2010 at Andhra University, Visakhapatnam
34.	Dr. C.C.S. Rao	International Conference on 'Climate change and bioresource'	February 9-12, 2010 at Bharathidasan University, Tiruchirapalli
35.	Dr. U. Sreedhar	National Conference on "Plant Protection in Agriculture through Eco-friendly Techniques and Traditional Farming Practices"	February 18-20, 2010 at Agricultural Research Station, Durgapura, Jaipur
36.	R. Sreenivasulu, Dr. L.K. Prasad	National Symposium on 'Climate Change and Rainfed Agriculture"	February 18-20, 2010 at CRIDA, Hyderabad
37.	Dr. S. Ramakrishnan	National Conference on 'Innovations in Nematological Research for Agricultural Sustainability – Challenges and A Roadmap Ahead"	February 23-25, 2010 at TNAU, Coimbatore
38.	Dr. M. M. Swamy, Dr. P. Venkateswarlu & Dr. S. Ramakrishnan	International Conference on 'Plant Biodiversity and Climate Change for Sustainable Environment'	March 12, 2010 at JCE College Campus, University of Mysore, Mysore
39.	Dr. K. Sarala	XIX National Conference on "Recent Trends in Viral Disease Problems and Management"	March 18-20 , 2010 at Tirupathi

FOREIGN VISITS

The Bureau of Indian Standards (BIS), Ministry of Consumer Affairs, Food and Public Distribution, Govt. of India, New Delhi nominated Dr. V. Krishnamurthy, Director, CTRI, Rajahmundry and Chairman, BIS Sectional Committee FAD 4 as a leader of Indian delegation and Dr. C. V. N. Rao, Principal Scientist, CTRI as member to participate in the 28th meeting of International Organisation for Standardisation (ISO) – Technical Committee (TC) 126 on 'Tobacco and Tobacco Products' held during May 12-13, 2009 at Madrid in Spain. Dr. V. Krishnamurthy made a presentation on "Indian *Bidi* – Need for International Standards" in the meeting.

Dr. V. Krishnamurthy making a presentation in the ISO/TC 126 meeting

Delegates in the ISO/TC 126 meeting

Indian delegation in the ISO/TC 126 meeting

Dr. V. Krishnamurthy participated in the Tobacco Growers' Delegation to China from 17-22 August, 2009 to study the tobacco cultivation practices, interaction with Growers, Scientists and Government officials of China on the aspects of production, extension and marketing systems in China.

Tobacco Board delegation in Peoples Republic of China

Dr. V. Krishnamurthy with Scientists of Yunnan Tobacco Agricultural Research Experimental Station

FCV tobacco field crop in Yunnan Provinance of China

WORKSHOPS, SEMINARS AND FARMERS' DAYS ORGANISED

- Hindi Workshops were organized at CTRI, Rajahmundry on 18.04.2009 and 15.12.2009 to create interest and promote the use of Hindi among the staff.

Hindi Workshop held on 15.12.2009

- Institution Bio-Safety Committee Meeting (IBSC) was held on 11.09.2009 at the Institute.

- The 13th National Symposium on Tobacco with the theme "Challenges and Opportunities" was held at CTRI, Rajahmundry during 24-26th November, 2009. Scientists of CTRI, its Research Stations, AINRPT Centres, officials from Tobacco Board, trade and industry participated in the Symposium. During the Symposium, issues on tobacco production, productivity, marketing and exports of different tobaccos were discussed. Guest lectures were delivered on different aspects of general agriculture and tobacco research by eminent personalities.

Dignitaries on the dais

Delegates in the Symposium

Release of Symposium Souvenir

- Model Training Course on "Recent Advances in FCV tobacco Production Technology" sponsored by the Directorate of Extension, Ministry of Agriculture, New Delhi was held at CTRI, Rajahmundry during December 4 -11, 2009. Eleven Field Officers from Tobacco Board, Guntur and four Agricultural Officers of Department of Agriculture, Govt. of Andhra Pradesh have participated in the programme.

Participants with the Course Director and the Resource Persons

- Field IRC was conducted at CTRI Research Station, Jeelugumilli to monitor the experiments conducted at Jeelugumilli on 10.12.2009 to examine the layout of the experiments as per the approved technical programme, the crop growth and the impact of treatments, varietal performance etc. during 2009-10 crop season.

- The Scientific Advisory Committee (SAC) Meeting of Krishi Vigyan Kendra (KVK) was held at KVK, Kalavacharla on 19.02.2010.

SAC meeting of KVK held on 19.02.2010

- A Workshop on "Quality FCV Tobacco Production in NLS" was organized in collaboration with Tobacco Board on 2nd March, 2010 at Atchayyapalem under Koyyalagudem Auction Platform in West Godavari District

- Hindi-fortnight celebrations were organized at the institute from 14th - 29th September, 2009. Dr. V. Krishnamurthy, Director, CTRI inaugurated the celebrations by lighting the lamp on 14.09.2009. Officers/Staff of CTRI have participated in various events/ competitions in Hindi during the fortnight. The valedictory function was organized on 29.09.2009 Sri G. Raghavendra Rao, General Manager, BSNL, Rajahmundry was the Chief Guest. Dr. V. Krishnamurthy presided over the function.

Valedictory function of Hindi fortnight celebrations

DISTINGUISHED VISITORS

Date	Name	Address
CTRI, Rajahmundry - 533 105		
25.08.2009	Dr. K. Muralidharan	Principal Scientist & Head (Rtd.) Directorate of Rice Research, Hyderabad
28.10.2009	G.L. Kapalamula R. Gomanda	Malawi
29.10.2009	Hari Senthin Dasan	COO, Biotech Elite, Malaysia
20.11.2009	Yatin Jagannath Mokal	Cheminova, Mumbai
14.12.2009	Dr. Ch. Mohan Rao	Director, CCMB, Hyderabad
21.03.2010	Dr. G.M. Linga Raju	Senior Scientific Officer (Grade-I) , Department of Biotechnology, Government of India, New Delhi
05.02.2010	Dr. Brain Lawrence	Scientist (Rtd.), USA
CTRI Research Station, Hunsur		
15.05.2009	Dr. S.M.H. Qadri	Director, Central Silk Board, Ministry of Textiles, Government of India.

Scientists from USA in CTRI Farm, Katheru

Dr. Ch. Mohan Rao in CTRI museum

PERSONNEL

(As on 31-3-2010)

Director	:	**Dr. V. Krishnamurthy**
Heads of Divisions/ Stations/Sections		
Crop Improvement	:	Dr. T.G.K. Murthy
Crop Production	:	Dr. C. C. S. Rao
Crop Protection	:	Dr. U. Sreedhar
Crop Chemistry & Soil Science	:	Dr. P.R.S. Reddy (up to 17.05.2009) Dr. D. Damodar Reddy (18.05.2009 onwards)
CTRI Res. Stn., Guntur	:	Dr. J.V. Prasad
CTRI Res. Stn., Kandukur	:	Dr A.R. Panda
CTRI Res. Stn., Hunsur	:	Dr. M.M. Shenoi
CTRI Res. Stn., Vedasandur	:	Dr. A.V.S.R. Swamy
CTRI Res. Stn., Dinhata	:	Dr. S. Amarnath
CTRI Res. Stn., Jeelugumilli	:	Dr. K. Nageswara Rao
BTRC, Kalavacharla	:	Dr. P. Harishu Kumar
RMC Unit	:	Dr. C. V. N. Rao
AINRP(T)	:	Dr. P.R.S. Reddy
ARIS Cell	:	Dr. U. Sreedhar
Seed Production	:	Dr. T.G.K. Murthy
Krishi Vigyan Kendra	:	Dr. Y. Subbaiah (up to 17.12.2009) Dr. C. C. S. Rao (18.12.2009 onwards)
Lib. & Documentation Service	:	N. Syam Prasad (up to 30.09.2009) Ch. Srirama Rao (01.10.2009 onwards)
Agricultural Extension	:	S.K. Naidu
CTRI Farm, Katheru	:	T. Krishna Reddy
Senior Administrative Officer	:	B.K. Sinha
Asst. Finance & Accounts Officer	:	P.V.S. Bharathi

Exploiting tobacco as an oilseed crop

High seed yielding line HDBRG x A 145 in A.P.

High seed yielding line A-119 x Abirami in T.N.

INPUT-USE-EFFICIENCY IN TOBACCO CULTIVATION

Sprinkler irrigation in FCV tobacco nursery

Fertigation in FCV tobacco field crop in NLS