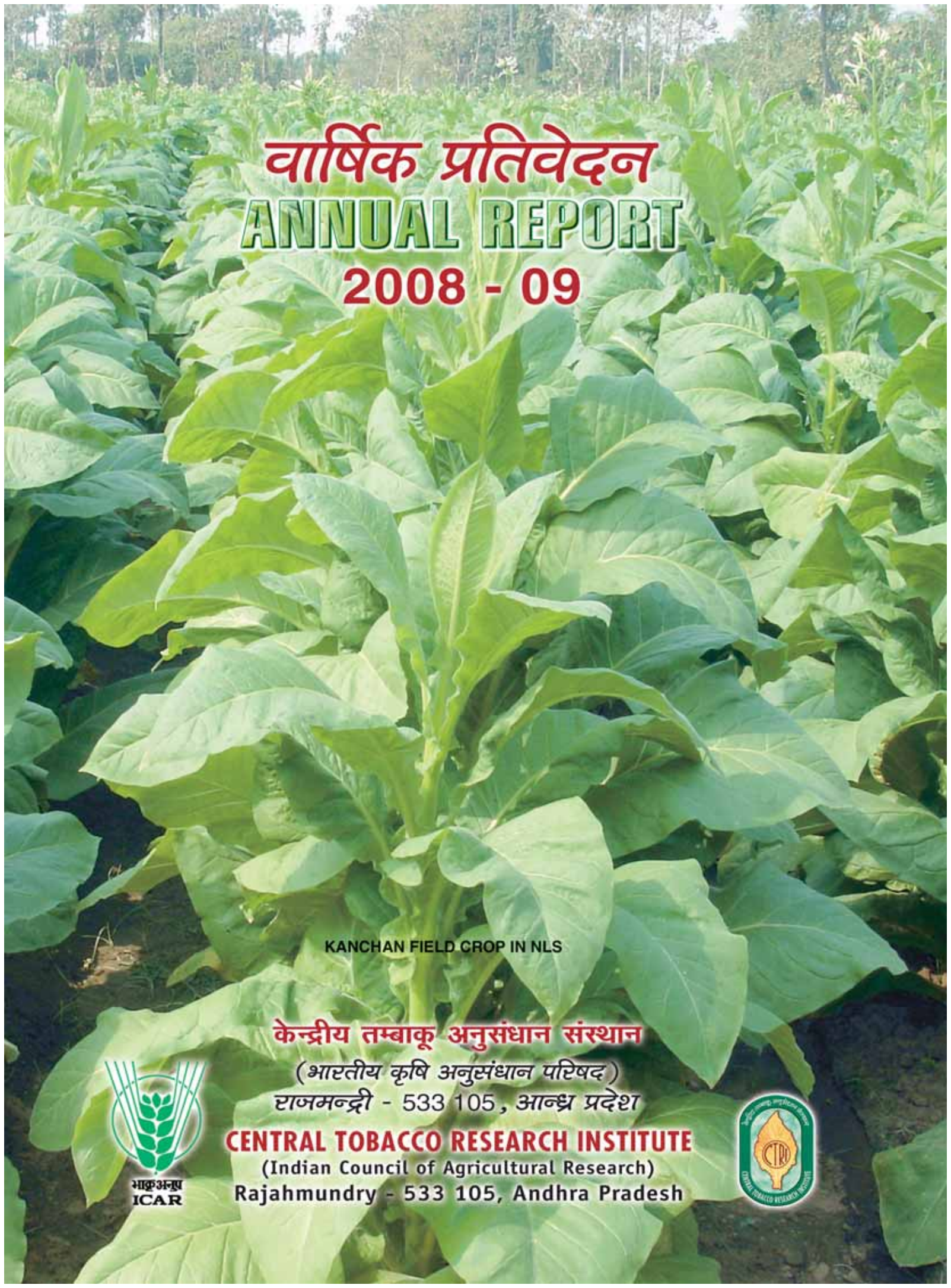
वार्षिक प्रतिवेदन
ANNUAL REPORT
2008 - 09

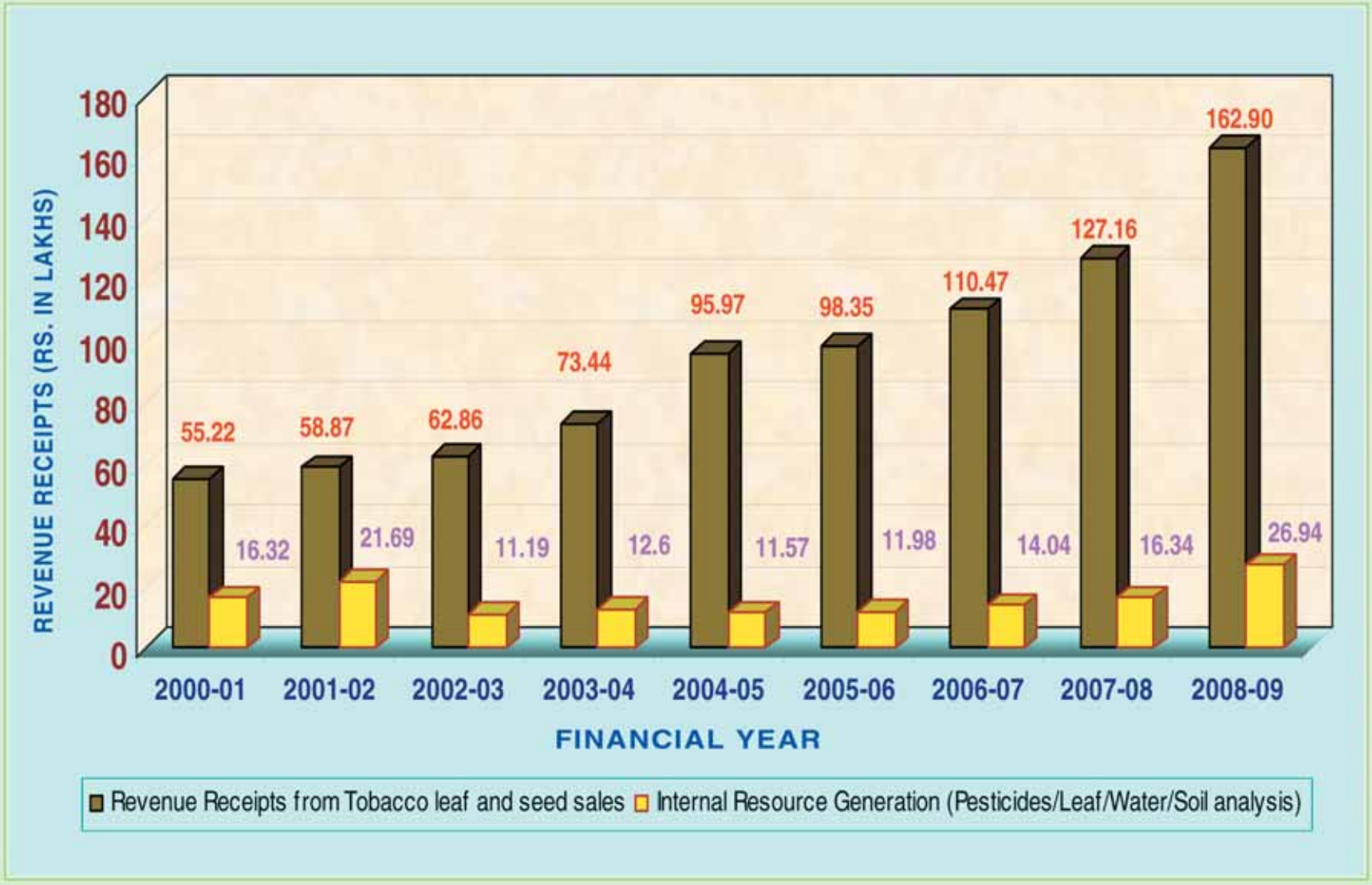


KANCHAN FIELD CROP IN NLS

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

RESOURCE GENERATION SINCE 2000-01
(FINANCIAL YEAR-WISE)



वार्षिक प्रतिवेदन

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2008 - 09

Rustica Seed Crop

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(भारतीय कृषि अनुसंधान परिषद)

राजमन्द्री - ५३३ १०५, आन्ध्र प्रदेश

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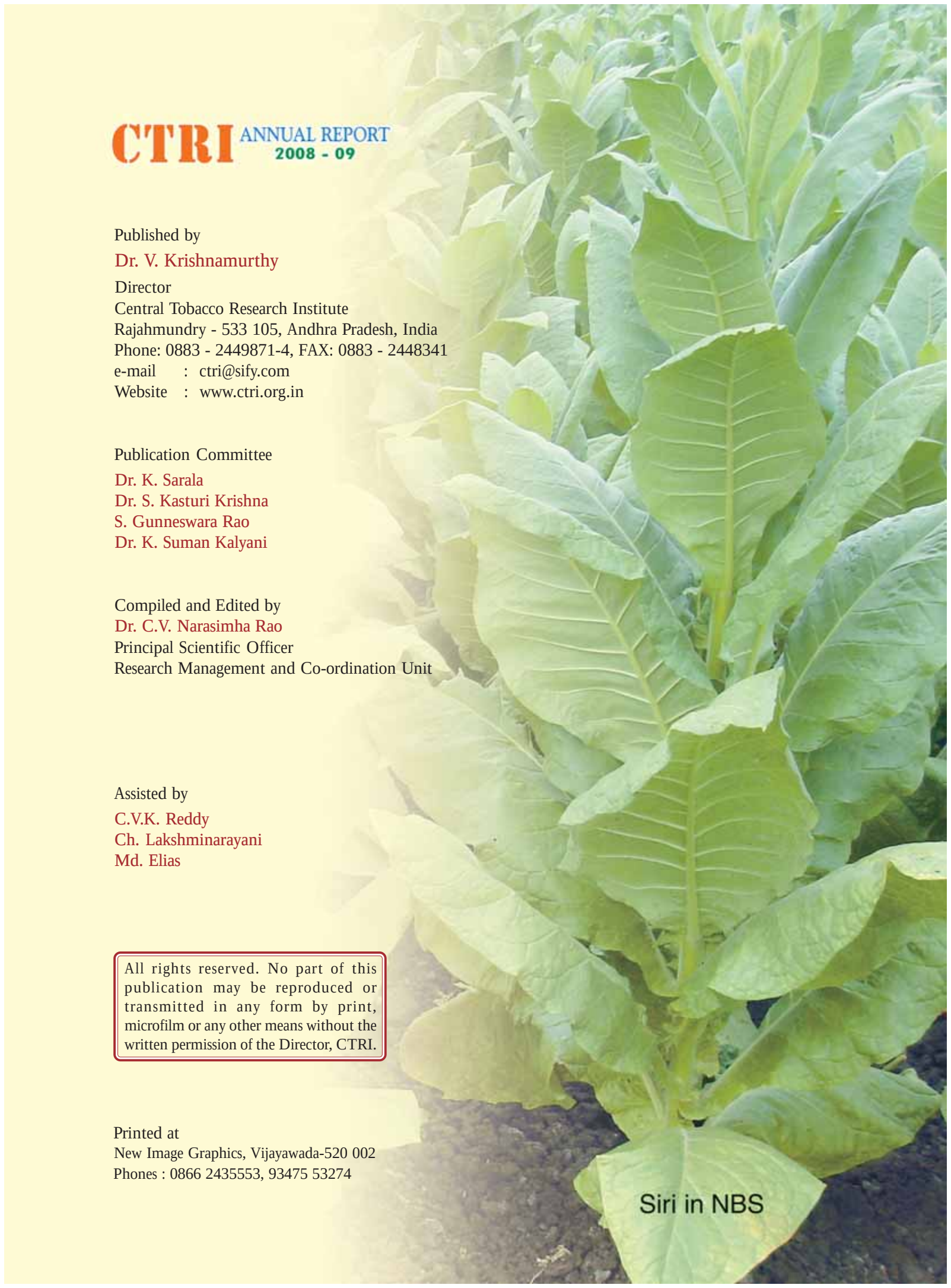


Contents

Preface

The crop season 2008-09 is considered as the **'Golden Year'** for the FCV tobacco farmers in the country because of the very good prices they have realized due to the vibrant market. Farmers cultivating air-cured tobaccos like *Bidi* and Chewing in different parts of the country also realized good prices because of the buoyancy in market prices. During the 2007-08 crop season, 165.32 million kg of FCV tobacco was produced in Andhra Pradesh from an area of 1,26,700 ha and marketed through the Tobacco Board as against the authorized quantity of 149.91 million kg. The average price realized by the farmers was Rs. 84.75 per kg as compared to Rs.47.47 per kg in 2007, accounting for a record increase of 78.5% in prices. Keeping in view the global situation and internal demand, a crop size of 170 million kg was fixed by the Tobacco Board for the crop season 2008-09. On the other hand, in Karnataka, as against the fixed crop size of 100 million kg for the 2008 crop season, 113.99 million kg was marketed at an average record price of Rs. 109.71, an increase of 84.6% compared to the price realized in 2007 season. Moreover, in 2008-09, the exports of un-manufactured tobacco have reached a new peak of 196.63 million kg valued at Rs. 2,708 crores and the total exports touched an all time high of 224.40 million kg valued at Rs.3,383.31 crores as against Rs.2,022.78 crores during 2007-08, thus, recording a spectacular growth of 67% in value terms.

At this juncture, I wish to inform that India being the signatory to the World Health Organisation (WHO) - Framework Convention of Tobacco Control (FCTC), it is mandatory for us to phase-out the tobacco with viable alternative crops/cropping systems. In this background, the Ministry of Health and Family Welfare (MoH & FW), Government of India has sanctioned a pilot-project entitled "Alternative Crops to *Bidi* and Chewing Tobacco in Different Agro-ecological Sub-regions" in the country with Central Tobacco Research Institute, Rajahmundry as the nodal centre sanctioning an amount of Rs. 2.17 crores as the first installment. Initially, the project is implemented at the Central Tobacco Research Institute (CTRI) Research Stations located at Vedasandur (Tamil Nadu) and Dinhata (West Bengal) and All India Network Research Project on Tobacco (AINRPT) Centres located at Anand (Gujarat), Nandyal (Andhra Pradesh) and Nipani (Karnataka). The MoH & FW nominated Dr. V. Krishnamurthy, Director, CTRI, Rajahmundry to participate in the WHO-FCTC 2nd Study Group Meeting on "Economically Sustainable Alternatives to Tobacco Growing" held in Mexico City, Mexico during June 17 – 19, 2008. The presentation on "Alternative Crops/ Cropping Systems to *Bidi* and Chewing Tobacco in India" focused the Indian view point at the Meeting.

I am happy to inform that ICAR has constituted the Quinquennial Review Team with Prof. S. Kannaiyan, Former Vice-Chancellor, TNAU and Former Chairman, National Biodiversity Authority, Chennai as the Chairman. Currently, the QRT is auditing the achievements of the research projects of the CTRI, its Regional Research Stations, the AINRPT and CTRI- KVK for the period 2003-2007.

A collaborative project has been taken up with M/s The Andhra Pradesh Paper Mills (APPM) Ltd., Rajahmundry on "Micro-propagation of Superior Genotypes of *Casuarina*" with the primary objective of micro-propagation of superior *Casuarina* genotypes. The APPM will provide the necessary financial assistance to the tune of Rs. 23. 00 lakhs and CTRI will extend the scientific support. The project entitled "Empowerment of tribals through agro-ecological conservation and biotechnological approaches in East Godavari district of Andhra Pradesh" with a financial outlay of Rs.12.58 lakhs was sanctioned by the Department of Biotechnology, New Delhi.

The Banana Fibre Extractor developed by the CTRI - KVK has become popular throughout the country and recently two units were exported to West Indies. I am happy to mention that the Silver Jubilee Celebrations of CTRI - KVK were held on 20.10.2008 at Kalavacharla, East Godavari district.

It is gratifying to note that as against the target of Rs.134.00 lakhs fixed by the Council for 2008-09, an amount of Rs.162.90 lakhs was realized through the sale of tobacco leaf & tobacco seeds and Rs.26.94 lakhs was generated through analysis of soil, water, pesticide residues and leaf analysis.

I take this opportunity to express my deep sense of gratitude to Dr. Mangala Rai, Secretary, DARE and Director-General, ICAR, New Delhi for his dynamic leadership and strong support for the overall development of the Institute. I am also grateful to Dr. P. L. Gautam, Deputy Director-General (CS), Dr. S. P. Tiwari, Deputy Director-General (Education & CS) and Dr. K. C. Jain, Assistant Director-General (CC), ICAR, New Delhi for their valuable suggestions and guidance in our pursuits to sustain the productivity and profitability of the crop.

V. Krishnamurthy

Date : 20.06.2009

(V. KRISHNAMURTHY)
Director

प्रमुख अनुसंधान गतिविधियाँ

- संस्थान में उपलब्ध कुल 2,383 जननिक भंडारण में से, वर्ष के दौरान 150 आगमनों के 53 वन्य निकोषियाना प्रजातियों के अलावा करीब 630 एफ.सी.वी. एवं 640 एफ.सी.वी. इतर वंशावलियों को सुरक्षित किया गया।

- तीन वर्षों के निष्पादन आधार पर, 3 चयन जैसेकि वी-4270, वी-4263 एवं वी.-4280 ने विभिन्न उत्पादन जांचों में मानक जाचों के विरुद्ध 17-23 प्रतिशत वृद्धि दर्ज की एवं बहु-स्थानीय जांचों के लिए इनका चयन किया गया।

- दो आशाजनक सी.एम.एस. संकर, एन.एल.एस. में केन्द्र की थोक जांच में कंचन की तुलना में सी एच-1 एवं सी.एच.-3 ने उत्पादन में बेहतर प्रदर्शन किया।

- एफ.सी.वी. के थोक जांच में, सी.बी.एस. में ए.वी.टी.-2 (2006-07) की किस्म-139 बेहतर संसाधन, उजलापन एवं ग्रेड सूची उत्पादनों में क्रमशः 2851, 1473 तथा 2458 किलोग्राम प्रति हेक्टेयर उत्पादन सहित बेहतर पाया गया।

- नौ अग्रिम प्रजनन वंशावलियों में से, के.एल.एस. में मानक जांच वाले कंचन की तुलना में सात >2,400 किलोग्राम प्रति हेक्टेयर उत्पादन क्षमता एवं >15 प्रतिशत बेहतर उत्पादन दिया।

- के.एल.एस. में, भूरा चित्ती रोग प्रतिरोधी अग्रिम प्रजनन वंशावली एफ.सी.एच.209 एवं एफ.सी.एच.210 नामक जांचयुक्त कंचन से बेहतर सिद्ध हुआ। ए.आई.एन.आर.पी.टी. के अंतर्गत प्रारंभिक किस्म ने जांच में योगदान दिया।

- ईरोड जिले के भवानी, अंतीजुर एवं कुरीची क्षेत्रों एवं सेलम जिले के एडापाडी क्षेत्र में कृषि के लिए औसत संसाधित पत्ता उत्पादन क्षमता 3,265 कि.ग्रा. प्रति हेक्टेयर वाले सिंकुडे पत्ता वाला देसी चुरट तम्बाकू किस्म संगमी को किसानों के लिए विमोचित किया गया।

- दो ट्रांसजनिक वंशावली एवं एक ट्रांसप्लास्टोमिक वंशावली में कृत्रिम टीका के अंतर्गत स्पोडेप्टेरो लिटुरा के कारण होने वाले नुकसान में कमी देखी गई।

- सूक्ष्म छिडकाव के अंतर्गत पौधों की वृद्धि तेजी से हुई, पौधे अधिक थे और पारंपरिक जल उपयोग से 60 दिनों में रोपण के लिए तैयार होते थे जबकि इस विधि से 45 दिनों के अंदर तैयार हो गए जबकि श्रम लागत में भी 1,45,000 रुपए प्रति हेक्टेयर की कमी आई।

- एन.एल.एस. में, केवल राईजोबियम या पी.एस.बी या बिना टिका की तुलना में उडद के बीजों को राईजोबियम एवं पी.एस.बी. के टीकाकरण से उडद के उत्पादन में महत्वपूर्ण वृद्धि हुई।

- एन.एल.एस. में सनई के स्वस्थाने हरे खाद - तम्बाकू की खेत में कार्बनिक एन नाइट्रोजन को 25:75 के अनुपात में 120 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर तथा नाइट्रोजन उर्वरक के प्रयोग से महत्वपूर्ण रुप से बेहतर हरा पत्ता उत्पादन, संसाधित पत्ता उत्पादन एवं श्रेणी सूचक प्राप्त हुआ।

- एन.एल.एस. में अर्ध-सिस्टेमिक एवं संपर्क सकरीसाइडों से जांच क्षेत्र में 3 प्रतिशत डेकनाल + 2 प्रतिशत फलुमेट्रालिन उपचार से सकर काउंट, सकर के ताजा भार एवं सकर के शुष्क भार में कमी आई।

- बिना फुनगियाना की अपेक्षा फुनगियाने से संसाधित पत्ता एवं चमकीले पत्तों के उत्पादन में क्रमशः 9.1 एवं 7.0 प्रतिशत का बेहतर उत्पादन प्राप्त हुआ। एस.एल.एस. परिस्थितियों के अंतर्गत सकर नियंत्रण के लिए प्राइम + @ 1.00% एवं स्टोमप @ 1.25% आशाजनक पाया गया।

- एस.एल.एस. में, 30 मि.मी. की गहराई में प्राण रक्षा सिंचाई के परिणामस्वरुप करीब 3,785 रुपए प्रति एकड अतिरिक्त कुल प्रतिफल प्राप्त हुआ। जहाँ भू-जल स्रोत की कमी एवं इसकी गुणवत्ता में कमी हो, वहाँ एस.एल.एस. परिस्थितियों के अंतर्गत फार्म तालाब प्रौद्योगिकी आशाजनक सिद्ध हुई।

- के.एल.एस. में, संसाधित पत्ता उत्पादन एवं उच्च श्रेणी समतुल्यता दोनों के अधिकतम उत्पादन प्राप्त करने के लिए समेकित पोषक प्रबंधन पैकेज का 25:75 का कार्बनिक और अकार्बनिक अनुपात अधिकतम था।

- 4 टन प्रति हेक्टेयर वर्मीकंपोस्ट सहित 120 किं.ग्रा. नाइट्रोजन स्तर पर बर्ली तम्बाकू किस्म बैकेट ए1 ने 2,683 कि.ग्रा. प्रति हेक्टेयर संसाधित पत्ता उत्पादन दर्ज किया।

- पश्चिम बंगाल में, बिना बोरान की अपेक्षा 5 कि.ग्रा. बोरान प्रति हेक्टेयर के प्रयोग से 16.7% बेहतर गुणवत्ता वाले पत्ता सहित बेहतर हरितमा (13%), संसाधन (6.3%), प्रथम श्रेणी का पत्ता उत्पादन (24.2%) दर्ज किया।

- वर्टीसोल्स में, एफ.सी.वी. तम्बाकू के बदले उत्पादन वृद्धि एवं आर्थिक लाभ के लिए सोयाबीन-चना एक वैकल्पिक अंतरा सस्ययन प्रणाली है।

- एफ.सी.वी. तम्बाकू पर एन.एस.के.एस. @ 0.5 प्रतिशत के पर्णीय छिडकाव सहित गेंदा (एक चक्रिल) एवं. रस्टिका तम्बाकू को मेंढ के रुप में रोपण करने से एफ.सी.वी. तम्बाकू में एच. आरनिजेरा के संदूषण में प्रभावी रुप से कमी आई और कलिका कृमि संख्या को रोक सकी।

SIRI

- *बर्ली तम्बाकू में जैविक नियंत्रण की तुलना में समेकित नाशीजीव प्रबंधन एवं रसायन नियंत्रण प्लांटों में कलिका कृमि, तम्बाकू इल्ली, तना बेधक, पर्ण कुंचन एवं तम्बाकू एफिड का संदूषण कम था। समेकित नाशीजीव प्रबंधन प्लाट में मेंढ पर उगाया गया ज्वार प्रकृतिक शत्रुओं के लिए रिज़रवायर का काम किया।*

- *तम्बाकू बीज बेडों में एस. लिटुरा एवं फसल के खेतों में एच. आरमिजेरा के खिलाफ प्रोक्लेम (इमामेक्टिन बेनजोएट)* @ 11 g a.i *प्रति हेक्टेयर अत्यधिक प्रभावी था।*

- *अक्तूबर के प्रथम सप्ताह के दौरान बोए गए तम्बाकू फसल में प्रमुख नाशीजीवों का आपतन न्यूनतम दर्ज हुआ। अक्तूबर के तीसरे सप्ताह के दौरान बोई गई फसल को एफिड, एम. निकोषियाने द्वारा भारी नुकसान हुआ।*

- *एस.एल.एस. में, शीर्ष एवं. मध्य पत्तों पर एफिड संख्या की कटौती में जैव-एजेंट, वर्टिसिल्लम लेकानी* @ 0.4 *प्रतिशत ने क्रमशः* 42.3 *एवं* 41.6 *प्रतिशत प्रदर्शित किया।*

- *तम्बाकू नर्सरी में, रिजोक्टोनिया एसपी., मेटालाक्सिल एम + क्लोरोथालोनिल एवं मेटालाक्सिल एम + मृदा जनित फंगल रोग नियंत्रण मनकोजेब सूत्रीकरणों द्वारा होने वाला सोरोशिन रोग के विरुद्ध प्रोपीकोनाज़ोल, एक ट्रियाज़ोल यौगिक प्रभावी पाया गया।*

- *के.एल.एस. परिस्थितियों के अंतर्गत अनौपचारित जांच* (3.75) *की तुलना में स्यूडोमोनास फ्लूरेसिनस एवं एसपरिजिल्लस नाइगर समृद्ध गोबर* @ 4 kg/m^2 *के प्रयोग से आर.के.आई.* (1.92) *में* 48.8 *प्रतिशत की कमी दर्ज हुई।*

- *जांच की तुलना में एफ.सी.वी. तम्बाकू नर्सरी में पैसिलोमिसेस लिलासिनस* @ 10 g/m^2 *के प्रयोग से मूलगांठ मुक्त पौधों की संख्या में* 32.1 *प्रतिशत की वृद्धि हुई। जांच के* 3.75 *की तुलना में मूलगांठ सूचकांक* 2.05 *तक की कमी भी आई तथा पैसिलोमिसेस लिलासिनस + नीम की खली* (1.87) *और पैसिलोमिसेस लिलासिनस + वर्मीकंपोस्ट* (1.82) *के समान था।*

- *पश्चिम बंगाल में, वर्मीकंपोस्ट में समृद्ध बायोसाइडों (टी. विरीडे एवं पी. फ्लूरेसीनस) को मिलाकर प्रयोग करने के परिणामस्वरुप जाती तम्बाकू में नर्सरी पौधों के क्लेदगलन रोग से मुक्ति मिलने के अलावा वृद्धि में तेजी के कारण जड़ एवं तना तथा जड़ तना के शुष्क पदार्थ में वृद्धि हुई।*

- *शिमोगा, दावणगिरी एवं चिकमगलूर जिलों के एफ.सी.वी. तम्बाकू उगाए जाने वाली मृदा अम्लीय, घुलनशील लवणों, क्लोराइडों तथा अजैविक कार्बनों की कमी थी। शिमोगा एवं चिकमगलूर जिलों में उपलब्ध फासफोरस मात्रा अधिक थी जबकि दावणगिरी जिले में उपलब्ध फासफोरस की मात्रा मध्यम थी। शिमोगा एवं दावणगिरी जिलों की मृदाओं में उपलब्ध पोटाशियम की मात्रा अधिक थी जबकि चिकमगलूर*

जिले की मृदा में उपलब्ध पोटाशियम की मात्रा मध्यम थी। चित्रदुर्ग के चबाऊ तम्बाकू उगाए जाने वाली मृदा क्षारीय, अजैविक कार्बन मे कमी, उपलब्ध फासफोरस की अधिकता और उपलब्ध पोटाशियम मध्यम था।

- बायोमास, सोलनेसोल, निकोटिन एवं प्रोटीन की उत्पादन क्षमताएं क्रमशः 39.73 टन प्रति हेक्टेयर (एच.डी.बी.आर.जी. x जी.टी.-7) , 39.66 कि.ग्रा. प्रति हेक्टेयर (टी.आई.163 x जी.टी.-7), 155.51 कि.ग्रा. प्रति हेक्टेयर (टी.आई.163 x ए 145) तथा 616 कि.ग्रा. प्रति हेक्टेयर एच.डी.बी.आर.जी. x जी.टी.-7 दर्ज हुए।

- जी.टी.8 x एच.डी.बी.आर.जी. के संकर ने 1,625 कि.ग्रा. प्रति हेक्टेयर का महत्वपूर्ण रुप से बेहतर बीज उत्पादन दर्ज किया उसके बाद टी.आई.163 x जी.टी.-8 (1,500 कि.ग्रा. प्रति हेक्टेयर) था। बडे पैमाने पर जांच के अंतर्गत ए 145, ए 145 x एच.डी.बी.आर.जी. तथा एच.डी.बी.आर.जी. x ए 145 ने क्रमशः 1,562, 1,640 तथा 1,781 कि.ग्रा. बीज दर्ज किया।

- विदेशी हवा संसाधित प्रकार के 43 जननद्रव्य संग्रह में, तेल की मात्रा की विविधता 33.06 (ई.ए.सी. 145) से 44.94 प्रतिशत (ई.ए.सी. 101) के बीच थी। बर्ली संग्रहणों में, तेल की मात्रा की विविधता 23.09 (बी.जी.पी. 33) से 45.61 प्रतिशत (बी.जी.पी. 35) के बीच थी। निकास के 90 दिनों के अंदर पेराक्साइड मूल्य 8.24 से 84.24 एम ई पेराक्साइड प्रति कि.ग्रा. हो गया जबकि सूरजमुखी के तेल में 90 दिनों के अंदर पेराक्साइड मूल्य 6.24 से 50.12 एम ई पेराक्साइड प्रति कि.ग्रा. था।

- विभिन्न प्रसार गतिविधियों (फार्म पर जांच, क्षेत्रीय दौरे एवं किसानों-वैज्ञानिकों-व्यापारियों का इंटरफेस) द्वारा अनुसंधान उपलब्धियों का प्रसार किया गया। किस्म सिरी पर क्षेत्रीय स्तर के प्रदर्शनों ने स्पष्ट किया कि जांच की गई किस्म वी.टी. 1158 की तुलना में नई किस्म ने उत्पादन एवं उजलेपन में क्रमशः 17.4 प्रतिशत एवं 30.8 प्रतिशत अंक प्राप्त किया।

- अवधि के दौरान निम्न लिखित कार्यक्रम आयोजित किए गएः प्रशिक्षण कार्यक्रमः 32, किसान सम्मेलन/ क्षेत्रीय दिवसः 3, रेडियो वार्ताः 19, दूरदर्शन कार्यक्रमः 1.

SIRI

EXECUTIVE SUMMARY

Major thrust areas identified for Tobacco Research during the XI Plan period are 1) Improving the productivity, quality and profitability of tobacco, 2) Nutrient, water and IPM strategies for resource-use-efficiency, 3) Remunerative cropping systems for different agro-climatic zones, 4) Reduction of harmful substances in tobacco and tobacco products and 5) Alternative uses of tobacco and their commercialisation. Keeping in view the mandate of the Institute and research priorities, research work has been taken up under the ten broad research programmes and the important findings emanated are summarised as under.

1. Germplasm Resource Management

Out of 2,383 total genetic stocks available with CTRI, about 630 FCV and 640 non-FCV lines besides 150 accessions of 53 wild *Nicotiana* species were maintained during the year 2008-09. Seven indigenous lines from Kerala and two from Meghalaya were collected. A total of 83 new accessions of 50 wild species and 8 species hybrids were imported from USA. With this acquisition, the total wild species maintained at CTRI has gone up to 67 with 180 accessions. The species, *N. repanda, N. stocktonii, N. longiflora, N. trigonophylla, N. rotundifolia, N. palmeri, N. undulata, N.* sp. *EC554935, N.* sp. *EC554936; species hybrids B.* x *benthamiana-repanda and N.* x *umbratica-nesophila, and N. tabacum* TI-832 were promising against *Orobanche*.

2. Tobacco Cultivar Development

In Vertisols, 3 selections viz., V-4270, V-4263 and V-4280 that showed 17-23% increase over standard checks for different yield traits over three years, were identified for multi-location trials. Two CMS hybrids, TBSH-1 and TBSH-2 showed 20 to 38% heterosis for various yield traits over Siri. Among the hybrids, TBSH-2 recorded higher cured leaf yield (2,834 kg/ha) than TBSH-1 (2,470 kg/ha) and all the entries showed desirable colour, body and weight of cured leaf. TBSH-1 and TBSH-2 are undergoing initial varietal trial under AINRPT. In CBS FCV bulk trial, Cy-139 has recorded higher cured leaf yield (2,851 kg/ha), bright leaf yield (2,458 kg/ha) and grade index (1,473 kg/ha).

Two promising CMS hybrids, CH-1 and CH-3 gave superior performance for yield compared to the check Kanchan in station bulk trials in NLS. In KLS, among the nine advanced breeding lines, seven lines exhibited more than 2,400 kg/ha yield potential and more than 15% higher yields over standard check Kanchan. Advanced breeding lines FCH 209 & FCH 210 having brown spot disease resistance and proved superior to the standard check Kanchan were contributed to the Initial Varietal Trial (IVT) under AINRPT. The flue-cured tobacco variety Sahyadri has been approved for release by the Karnataka State Variety Release Committee (KSVRC) for cultivation in Shimoga region.

The root-knot resistant *Bidi* tobacco line, ABD 105 has been released by the Gujarat State Variety Release Committee (GSVRC) in 2008-09 as ABT 10. In Tamil Nadu, the narrow leaf country cheroot tobacco variety 'Sangami' with an average cured leaf yield potential of 3,265 kg/ha was released for cultivation in Bhavani, Anthijur and Kurichi areas of Erode district and Edapady area of Salem district in Tamil Nadu.

3. Biotechnology in Tobacco Improvement

Two transgenic lines and one transplastomic line were found to have less damage due to *Spodoptera litura* under artificial inoculation.

4. Crop Production Technology

Seedling growth under micro-sprinkler was rapid, transplantable seedlings were more and the seedlings were ready for transplanting in

45 days as compared to 60 days in traditional water application through rose cans, reducing the labour cost by Rs.1,45,000/ha. In NLS, combined inoculation of *Rhizobium* and PSB to blackgram seed increased the grain yield significantly as compared to single inoculation of either *Rhizobium* or PSB or no inoculation. Sunnhemp *in situ* green manuring - tobacco with application of 120 kg N/ha in 25:75 proportions of organic N: fertilizer N gave significantly higher green leaf yield, cured leaf yield and grade index. Sucker count, sucker fresh weight and sucker dry weight were lower in 3% Decanol + 2% Flumetralin treatment in the field trial with semi- systemic and contact suckericides.

Topping improved the cured leaf and bright leaf yields by 9.1 and 7.0%, respectively over no topping. Prime + @1.00% and Stomp @ 1.25% were promising for sucker control under SLS conditions. One life-saving irrigation at 30 mm depth resulted in additional net returns of approximately Rs. 3,785/- per hectare. Thus, the farm pond technology holds promise under SLS conditions, wherever ground water source is scarce and its quality is poor.

In KLS, organic:inorganic ratio of 25:75 was optimum for Integrated Nutrient Management package in realizing maximum productivity of both cured leaf yield and Top Grade Equivalent. The recommended spacing of 100 x 55 cm (18,181/ha) was found superior to 100 x 60 cm (16,666/ha) spacing in both the varieties. Topping at 18 leaves was found to increase the yield by 4.9% in FCH 201. In FCH 196, positive response up to 70 kg N/ha was observed while 60 kg N/ha was found to be sufficient for FCH 201. Nitrogen level @ 70 kg N/ha increased the productivity by 4.5% in FCH 196 compared to the recommended dose of 60 kg N/ha. The integrated barn comprising of Ventury furnace and modified flue-pipe system was found to utilise 4.11 kg of wood fuel to get one kg cured leaf under Shimoga conditions. Coffee husk was used as alternative fuel for curing FCV tobacco and 5.11 kg of coffee husk was consumed to obtain one kg cured leaf.


SIRI

The Burley tobacco variety Banket A1 recorded significantly higher cured leaf yield of 2,683 kg/ha at 120 kg N level with 4 t/ha vermicompost. The Burley tobacco hybrid JBH-1 on pooled yield basis recorded 2,316 kg/ha of cured leaf with 140 kg N/ha.

The farmers of middle Gujarat Agro-climatic zone - III growing *Bidi* tobacco (Variety GTH 1) are advised to apply 187 kg N (AS + Urea in 1:3) + *Azotobacter chroococcum*, ABA 1 or 187 kg N (AS + Urea in 1:3) + *Azospirillum lipoferum* ASA 1 + FYM @ 12.5 t/ha for saving 15% N and getting higher yield of tobacco. These farmers are also advised to use 8 kg seed/ha for raising *Rustica* tobacco nursery to obtain more transplants and higher net returns.

In Tamil Nadu, sunnhemp raised as a green manure crop and ploughed *in situ* at 45 days + *Azospirillum* @ 10 kg/ha + Phosphorus Solubilizing Bacteria @ 10 kg/ha along with 100% recommended dose of fertilizer (75 kg N+100 kg P_2O_5+50 kg K_2O/ha) to chewing tobacco significantly increased the growth attributes, yield and net returns.

In West Bengal, higher green leaf (13%), cured leaf (6.3%), first grade leaf yields (24.2%) with 16.7% higher recovery of quality leaf was recorded with application of 5 kg B/ha over no boron.

Bulk trial at Berhampur (Orissa) confirmed that application of 80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha along with Azotoplus @ 1.5 kg/ha recorded the highest cured leaf yield of 1,530 kg/ha of *Pikka* tobacco, compared to application of 80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha without Azotoplus (1,220 kg/ha).

5. Cropping Systems for Sustainable Production

Soybean - Chickpea is an alternative cropping system to FCV tobacco in Northern Black Soils of Andhra Pradesh for improving the system productivity and higher net returns.

6. Bio-ecological and Pathological Studies on Pests and Diseases

The predatory potential of *Nesidiocoris tenuis* against different stages of tobacco pests revealed that the predation of eggs of lepidopteran pests by *N. tenuis* increased with the advancement of age of the eggs. It is evident from the results that maximum and minimum temperatures, maximum RH and rainfall had negative influence on the aphid incidence at CTRI RS, Guntur.

Out of 30 *Nicotiana* species raised in sick plots, only in one entry (TW 110) less than 25% incidence of *Orobanche* was recorded. In KLS, lines FCH 205, 206, 211, 212, 215 and 216 recorded RKI of $\leq$ 2.0 and were most promising against root-knot nematodes.

7. Integrated Pest and Disease Management

In Vertisols, Proclaim (Emamectin benzoate) @ 11 g a.i./ha was highly effective against *S. litura* in tobacco seed beds and *H. armigera* in the field crop. Planting of marigold (single whorl) and *Rustica* tobacco as border along with foliar spray of NSKS @ 0.5% on FCV tobacco proved effective in reducing the infestation of *H. armigera* in FCV tobacco and increased the trapping of budworm population. Tobacco crop planted during the first week of October recorded the lowest incidence of major insect pests. The crop planted during the third week of October suffered from heavy damage by the aphid, *M. nicotianae*. In KLS, the bio-agent, *Verticillium lecanii* @ 0.4% exhibited 42.3 and 41.6% reduction of aphid population on top and middle leaves, respectively.

Infestation of budworm, tobacco caterpillar, stem borer, leaf curl and tobacco aphid was less in IPM and chemical control plots as compared to biological control plot in Burley tobacco in Andhra Pradesh. Border crop of sorghum served as the reservoir for natural enemies in IPM plot.

In *Bidi* tobacco at Anand, IPM module having castor and marigold as trap crops and one spray of 2% NSKS reduced *S. litura* incidence up to 50% over unsprayed plot. The module having marigold and castor played important role in increasing activity of natural enemies like coccinellids, syrphids, chrysophids, spiders and *N. tenuis*. In *Bidi* tobacco at Nandyal, sorghum as barrier crop against aphids played a major role in obstructing the movement of aphids in main field, while the trap crop, castor played an important role in trapping the larvae and egg-masses of *Spodoptera*. Occurrence of mealy bug on *Bidi* tobacco was recorded for the first time in Kurnool district of Andhra Pradesh.

In tobacco nurseries, Propiconazole, a triazole compound was found effective against soreshin disease caused by *Rhizoctonia* sp., Metalaxyl M + Chlorothalonil and Metalaxyl M + mancozeb formulations controlled soil-borne fungal diseases in KLS. Application of *Pseudomonas fluorescens* and *Aspergillus niger* enriched FYM @ 4 kg/m^2 recorded 48.8% reduction in RKI (1.92) compared to untreated check (3.75) under KLS conditions. Application of *Paecilomyces lilacinus* @ 10g/m^2 in FCV tobacco nursery caused 32.1% increase in number of root-knot free healthy transplants compared to check. It also reduced the root-knot index to 2.05 compared to 3.75 in check and was on par with *P. lilacinus* + Neem cake (1.87) and *P. lilacinus* + vermicompost (1.82).

Results of Integrated Disease Management in *Bidi* tobacco nursery in Gujarat using physical, cultural and chemical means revealed that nematode population reduced at seeding. Significantly higher number of seedlings was recorded in treatment soil solarization + carbosulfan + metalaxyl MZ + carbendazim. For integrated management of root-knot nematodes, frog-eye-spot and leaf curl disease in *Bidi* tobacco fields, farmers of middle Gujarat are advised to plant their crop during 1st to 3rd week of September.

In West Bengal, application of biocides (*T. viride* and *P. fluorescens*) enriched in vermicompost resulted in disease suppression of damping-off in nursery seedlings in *Jati*

tobacco. In addition, growth promoting activities have enhanced the root and shoot growth and dry matter of roots and shoots. Hollow stalk infection was recorded for the first time in *Jati* tobacco during 2007-08 from Natabari and CTRI RS, Dinhata in West Bengal.

8. Soil Fertility, Water Quality and Nutrient Management

FCV tobacco growing soils of Shimoga, Davanagere and Chikkamagalur districts were acidic in soil reaction, low in soluble salts and chlorides and low in organic carbon status. Available P content of soils of Shimoga and Chikkamagalur districts was high whereas it was medium in Davanagere district. Soils of Shimoga and Davanagere districts were high in available K where as the soils of Chikkamagalur district were medium in available K. Chewing tobacco soils of Chitradurga district were alkaline reaction, low in organic carbon, high in available P and medium in available K status.

9. Alternative Uses of Tobacco and Reduction of Harmful Substances

In Vertisols, the potential yields of biomass, solanesol, nicotine and protein recorded were 39.73 t/ha (HDBRG x GT-7), 39.66 kg/ha (TI-163 x GT-7), 153.51 kg/ha (TI-163 x A145) and 616 kg/ha HDBRG x GT-7, respectively. The cross GT-8 x HDBRG recorded significantly higher seed yield of 1,625 kg/ha followed by TI-163 x GT-8 (1,500 kg/ha). Under bulk testing, A145, A145 x HDBRG and HDBRG x A145 recorded 1,562, 1,640 and 1,781 kg seed, respectively.

Analysis of seed oil content at CTRI, Rajahmundry revealed that among the 43 germplasm accessions of exotic air-cured type, the oil content varied from 33.06 (EAC 145) to 44.94% (EAC 101). Among the Burley accessions, the oil content varied from 23.09 (BGP 33) to 45.61% (BGP 35). The peroxide value increased from 8.24 to 84.24 me peroxide/kg within 90 days from the date of extraction whereas it varied from 6.24 to 50.12 me peroxide/kg within 90 days in sunflower oil. At Anand, the highest oil content of 39.39% was recorded in genotype, 693-4-29-23. Line 169-23-16 produced highest seed yield (1,163 kg/ha). While comparing the oil yield potential, GT 4 recorded the highest oil content of 389 kg/ha. Line ABD 28 was significantly superior in seed yield, seed oil content, *khakhri* yield and nicotine content of *khakhri* and thereby oil and nicotine yield potential were also higher than A 145.

10. Agricultural Extension and Information Technology

Decision support system for quality evaluation of flue-cured tobacco was developed which will be utilized as a prediction model to assess the quality of the FCV tobacco leaf based on physical and chemical quality parameters and manufacturing properties. Using a new technique for classification of data, software entitled 'Expert system for the diagnosis of nutrient deficiencies' was developed.

Research findings were disseminated through various extension activities like, On-farm trials, Field visits and Farmers-Scientists-Traders Interface. The FLDs on cv. Siri revealed that the new cultivar recorded higher cured leaf yield and higher bright grade outturn over the check variety VT-1158 by 17.4% and 30.8%, respectively. Thirty two training programmes, 3 *Rytu sadassus*/Field days, 19 Radio talks and 1 Television Show were organised.

SIRI

INTRODUCTION

In 2008, the total economic value of FCV tobacco produced in Andhra Pradesh (Rs.1,397 crores) and Karnataka (Rs. 1,251 crores) is Rs. 2,648 crores which by any means is a significant contribution to the economy. In Andhra Pradesh, 165.32 million kg of FCV tobacco was produced from an area of 1,26,700 ha in the 2007-08 crop season. Farmers realized an average price of Rs. 84.75 per kg as compared to Rs.47.47 per kg in 2007 (78.5% increase). In Karnataka, 113.99 million kg was produced from an area of 90,000 ha in the 2008 crop season and marketed at a record average price of Rs. 109.71 (84.6% increase) compared to the price realized in 2007 season (Table 1 and Fig.1).

In 2008-09, the exports of un-manufactured tobacco reached a new peak of 196.63 million kg valued at Rs. 2,708 crores; 27.78 million kg of tobacco products valued at Rs. 675.26 crores were exported during the period. Thus, the total exports touched 224.40 million kg valued at Rs. 3,383.31 crores as against Rs. 2,022.78 crores during 2007-08, accounting for a growth of 9% in quantity and 67% in value (Fig. 2).

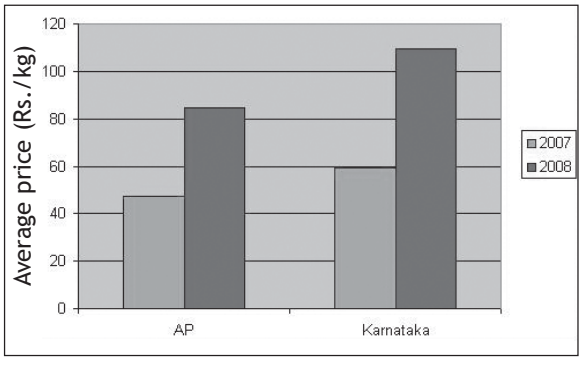


Fig. 1: Average price of FCV tobacco

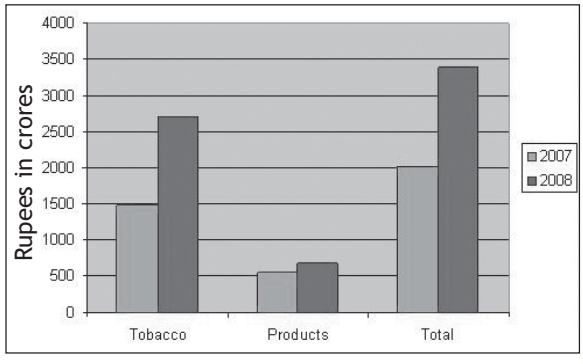


Fig. 2: Tobacco and tobacco products exports from India

Table 1: Production and economic value of Indian FCV tobacco (2008-09)

FCV tobacco zone	Area (ha)	Authorised production (million kg)	Production (million kg)	Productivity (kg/ha)	Average Price (Rs/kg)	Economic value (Rs. in crores)
Andhra Pradesh						
NLS	25,778	43.90	45.73	1,774	99.09	453.14
SLS	64,555	49.83	56.26	872	76.19	428.64
SBS	30,945	46.37	53.55	1,730	80.27	429.85
NBS	2,553	5.68	5.70	2,233	83.14	30.52
CBS	2,869	4.13	4.09	1,425	83.75	34.25
Total for AP	1,26,700	150.00	165.33	1,305	84.49	1,396.87
Karnataka						
KLS	90,000	97.32	113.99	1,266	109.71	1,250.58
Grand Total	2,16,700	247.32	279.32	1,290	96.73	2,647.46

Future

It is forecast that global tobacco market is set for "robust growth" with signs of increasing demand in different markets. Thus, it is right time for India to take advantage of the situation and consolidate its position in the global tobacco market which would ultimately improve the economic conditions of tobacco farmers in the country.

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.

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

Keeping in view the research priorities, the following new projects have been approved by the Institute Research Committee (IRC) in 2008.

1. Effect of *Rabi* crops on the emergence of *Orobanche*
2. Effect of micro-sprinklers and fertigation on tobacco seedling production


SIRI

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

4. On-farm testing of new pipelines of FCV tobacco viz., V-4219 and V-4230

5. Effect of tray seedlings on yield and quality of FCV tobacco in NLS region

6. On-farm trial on testing of irrigated *Natu* variety 45-90 vs. Kommugudem variety

7. Monitoring of insect pests of tobacco using pheromone traps

8. Management of stemborer, *Scrobipalapa heliopa* in tobacco

9. Management of tobacco bud worm/ capsule borer, *Helicoverpa armigera* on HDBRG seed crop and their impact on harmful residues in seed oil

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

11. 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

12. Weather based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions

13. Development of microbial consortium for tobacco based cropping systems in irrigated Alfisols of Andhra Pradesh

Externally Funded Projects

1. Pilot-project on "Alternative Crops to *Bidi* and Chewing Tobacco in Different Agro-ecological Sub-regions" was sanctioned by the Ministry of Health and Family Welfare, Govt. of India, New Delhi

2. Collaborative project on "Micropropagation of Superior Genotypes of *Casuarina*" was sponsored by M/s The Andhra Pradesh Paper Mills (APPM) Ltd., Rajahmundry

DBT project on "Empowerment of tribals through agro-ecological conservation and biotechnological approaches in East Godavari district of Andhra Pradesh" was sanctioned by the Department of Biotechnology, New Delhi.

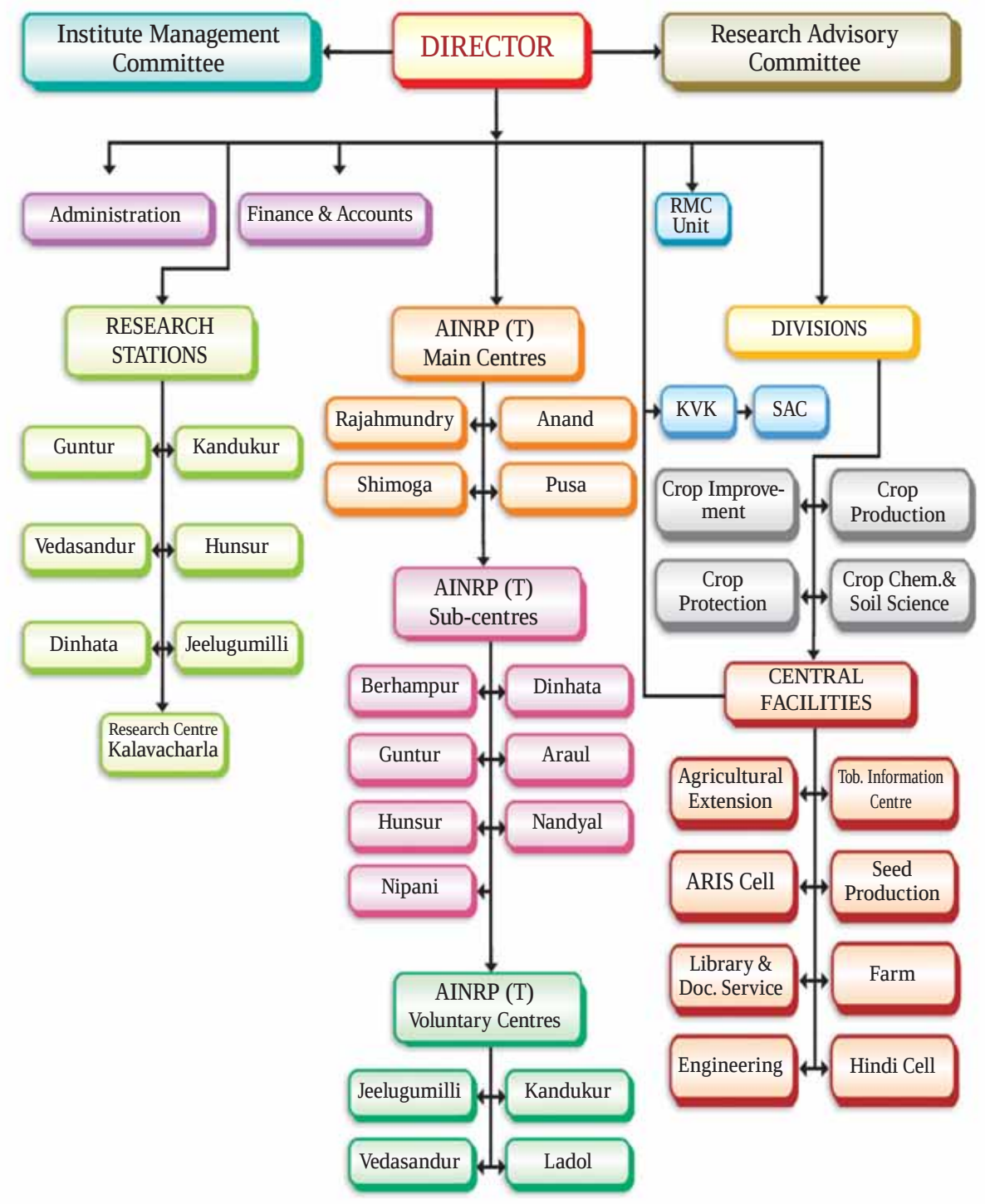
STAFF POSITION AS ON 31.03.2009

Sl. No	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	78+1	36+1	42
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)	 05 54 93	 03 46 88	 2 8 5
3.	Ministerial	77	68	9
4.	Supporting SS.Gr.IV SS.Gr.III SS.Gr.II SS.Gr.I	 19 40 65 57	 19 33 50 43	 - 7 15 14
5.	Casual Workers on Temporary Status		124	

FINANCIAL STATEMENT FOR THE YEAR 2008-09

Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	1721.00	1720.90
Plan	200.00	200.00
KVK	86.45	86.44
NATP	186.00	186.00
AP Cess Fund Schemes	—	—
Pension & Retirement benefits	500.00	499.92
Personal Loans & Advances	15.00	15.00
Recurring Deposit Schemes	241.67	236.29
Revolving Fund Scheme	68.61	61.27
Internal Resource Generation	26.94	22.0
Total	3045.67	3027.82
Revenue Receipts	Target 134.00	Achievement 162.90

ORGANISATIONAL STRUCTURE



Research Achievements

PROGRAMME 1

GERMPLASM RESOURCE MANAGEMENT

CTRI, Rajahmundry

Germplasm Acquisition, Maintenance, Evaluation and Utilization

(R.V.S. Rao and T.G.K. Murthy)

Acquisition

Seven indigenous lines from Kerala and two from Meghalaya were collected. A total of 83 new accessions of 50 wild species and eight species hybrids were imported from USA. Now the total wild species maintained at CTRI have gone up to 67 with 180 accessions.

Maintenance

Out of the 2,383 total genetic stocks, 1,301 genetic stocks (637 FCV varieties and 644 non-FCV varieties) were regenerated and selfed seed was collected. Fifty two CMS lines of different sources were crossed with respective recurrent parents for maintenance.

During the season, 153 accessions (53 wild *Nicotiana* species and two subspecies) were maintained in pots/experimental micro-plots. Two non-flowering species were rescued through *in vitro* micro-propagation. Fifty eight accessions were rejuvenated at Katheru farm. One autotetraploid of *N. longiflora* and five species hybrids viz., *N.* x *umbratica-nesophila*, *N. benthamiana-repanda*, *N.* x *repanda-sylvestris*, *N.* x *excelsior-plumbaginifolia* and *N.* x *gossei-glauca*, are maintained for further use.

Conservation

All the new germplasm accessions acquired during past five years were sent to NBPGR, New Delhi for long term conservation.

Seed supply

About 421 germplasm accessions of both wild and cultivated species were supplied to 28 indenters in the country for research purpose.

Evaluation

1) Reaction of *Nicotiana* species to *Orobanche* infestation

Fifty three *Nicotiana* species accessions were screened, in collaboration with Plant Pathologist, under high natural infestation pressure of *Orobanche* at Katheru farm. Among them, accessions *N. stocktonii* (100% uninfested plants), *N.* sp. EC554935 (94%), *N.* sp. EC554936 (75%), *N. repanda* TW 110 (36-100%), *N. tabacum* TI 832 (100%), *N.* x *benthamiana-repanda (100%)* and *N.* x *umbratica-nesophila* (100% free) are promising. Number of *Orobanche* spikes per infested plant among the species varied from 1.0 to 30.4. In general, accessions of *N. tabacum* supported high number of *Orobanche* spikes as compared to wild species. Infested plants among the species like *N. longiflora* (1.0), *N. repanda* (1.0), *N.* sp EC554935 (1.0) and *N. palmeri* (1.7) supported very less number of spikes.

Out of 35 species screened under artificial field inoculation by the Plant Pathologist, *N. repanda* (5, 19, 22 & 60% infestation in different accessions), *N. stocktonii* (30 & 60%), *N. nesophila* (40%) and *N. trigonophylla* (35% infestation) were found promising. Number of spikes in infested plants was much lower in wild species than *N. tabacum* lines.

Results of the studies made under natural and artificial inoculation conditions during the last three seasons revealed that species viz., *N. repanda, N. stocktonii, N. longiflora, N. trigonophylla, N. rotundifolia, N. palmeri, N. undulata, N.* sp. EC554935, *N.* sp. EC554936; species hybrids *B.* x *benthamiana-repanda and N.* x *umbratica-nesophila, and N. tabacum* TI-832 among others were promising against *Orobanche* infestation (Fig. 1).

2) Seed oil content : Estimation of seed oil content and analysing variability of seed oil in 329 *N. rustica* lines is in progress.


Fig.1 : *N. repanda* showing resistance to *Orobanche*

3) Yield and quality of FCV tobacco (Black soil farm, Katheru)

(a) Trial VT-13

Nine advanced cross derivatives were evaluated along with three standard checks, Siri, VT-1158 and Hema in RBD with 3 replications for the second year in succession for leaf yields. Significant differences were observed among the entries for all the four leaf yield traits. Line R 2-3 was significantly superior to best check, Siri with an increase of 35% green leaf yield (12,996 kg/ha), 31% for cured leaf (2,267 kg/ha), 21% for bright leaf (1,339 kg/ha) and 35% for grade index (1,817 kg/ha). Also, line R 55-1 recorded significant superiority over check, Siri for green (12,326 kg/ha) and cured leaf (1,974 kg/ha) yields. Chemical quality parameters like nicotine, reducing sugars and chlorides were in acceptable limits.

(b) Trial HRET -2 (Hybrid Replicated Evaluation Trial)

Eight CMS hybrids (TBSH-60 to 67) were evaluated for yield characteristics and chemical quality of cured leaf along with three checks in RBD with 3 replications. Significant differences were found among the entries for all the four leaf yield traits.

The hybrid TBSH-66 was significantly superior with 19% increase in green leaf yield (12,054 kg/ha), 26% in cured leaf yield (2,170 kg/ha), 37% in bright leaf (1,143 kg/ha) and 30% in grade index (1,699 kg/ha), over the best check Siri. Other hybrid, TBSH-63 showed significant increase in green leaf (13,120 kg/ha) and cured leaf (2,039 kg/ha) yields over Siri. However, the hybrids TBSH-60 and 67 that showed significant standard heterosis over Siri during 2006-07 season, showed only numerical increase in yield levels during this season. All the hybrids had acceptable levels of nicotine, reducing sugars and chlorides in the cured leaf.


SIRI

F. Documentation: Catalogues on FCV and Non-FCV tobacco germplasm were prepared.

CTRI Research Station, Guntur

Rejuvenation of *Natu* germplasm

(A.V.S.R. Swamy)

About 151 *Natu*, Oriental, HDBRG, Burley and *Motihari* tobacco germplasm lines were maintained and nucleus seed was collected for the next year. Yield data of cured, bottom, middle and top leaf was recorded. The cured leaf in these germplasm lines ranged from 734 kg/ha in Gadikuruchvithanam (Purushothapattanam) to 2,359 kg/ha in NG-73.

CTRI Research Station, Hunsur

Germplasm maintenance of *Nicotiana tabacum* varieties/lines

(N. Subrahmanya and M.M. Shenoi)

Seven new genotypes were added to the gene bank during the year. Active stock of 622 germplasm accessions was maintained. Under the periodical seed multiplication programme, 230 germplasm accessions were regenerated.

CTRI Research Station, Vedasandur

Evaluation and maintenance of germplasm

(A.V.S.R. Swamy)

Maintenance of germplasm

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

Evaluation of black shank resistant lines

Three black shank resistant chewing tobacco lines developed through backcross

breeding viz., BC5S1, BC5S2 and BC5S3 involving VR-2 x Beinhart 1001 cross were evaluated along with the check varieties VR-2 and Kaviri in RBD with four replications at the Station and in bulk plots at Ayakaranpulam in Vedaranyam area.

At CTRI Research Station, Vedasandur, the yield and growth characters were found to be significant. All the three lines were significantly superior to VR-2 for both kinds of yields recording 1,731, 1,827 and 1,521 kg/ha whole leaf and 2,677, 2,523 and 2,217 kg/ha total leaf yield, respectively. The lines BC5S1 and BC5S2 were on par with the variety Kaviri in total leaf yield. In whole leaf yield, BC5S2 was significantly superior to the check variety Kaviri recording 1,827 kg/ha whole leaf. Whereas, the other two lines BC5S1 and BC5S3 were on par with Kaviri in whole leaf yield.

With respect to growth characters it was observed that BC5S1 and BC5S2 showed significant superiority in leaf length over VR-2. In leaf width and stem girth, all the three lines showed significant superiority over VR-2. In Ayakaranpulam, the chewing quality of BC5S1 and BC5S2 were comparable with the checks. In Ayakaranpulam also BC5S1 and BC5S2 recorded cured leaf yield of 3,600 and 3,200 kg/ha.

CTRI Research Station, Dinhata

Maintenance of *Jati*, *Motihari*, Cigar Wrapper and Cigar Filler tobacco germplasm

(S. Amarnath)

Ten plants of each of the 239 lines of *N. tabacum* (63 *Jati* : 63, 94 Cigar Wrapper: 94 and Cigar Filler 82) and 185 lines of *N. rustica* (*Motihari*) tobacco were grown and three healthy plants in each line were selfed. Selfed seeds of each line were collected separately for use in the ensuing season.

EXP. No. B 1-1: Tobacco cultivar evaluation at CTRI Research Station, Dinhata

Tobacco cultivar Bawal collected from Haryana was evaluated in bulk plots along with *Jati* tobacco varieties viz., Podali and Chama with 500 plants each under topped conditions. Data on growth, morphological characters and cured leaf and first grade leaf yield were collected. Morphologically, the plant appeared to be of *N. tabacum* type and leaf shape like that of variety Chama. Plant height (46.9 cm) was comparable to Podali (46.5 cm) but lower than Chama (55.5 cm). Leaf length and maturity score were inferior in cv. Bawal than Podali and Chama. Leaf breadth (27.1 cm) and no of leaves (9.3) in cv. Bawal were intermediate to Podali and Chama. The cured leaf (957 kg/ha) and first grade leaf (197 kg/ha) yields were lower in Bawal compared to Podali and Chama.

EXP. No.B 1-2: Tobacco exploration in Meghalaya

Exploration of tobacco and its cultivation was taken up during 2008-09 in Tura area of Meghalaya state. Seeds of the two local cultivars have been collected for their evaluation in the ensuing season.

EXP. No. B 1-3: Tobacco demonstration trials in Assam

Tobacco demonstration trials with improved varieties of *Jati* (*N. tabacum*) var. Manasi and *Motihari (N. rustica*) var. Dharla were conducted in five farmers' fields in each of the five districts of Assam viz., Kamrup, Kokrajhar, Bongaigaon, Barpeta and Goalpara with the cooperation of Assam State Agriculture Department. Yield data collection is in progress.

PROGRAMME 2

TOBACCO CULTIVAR DEVELOPMENT

BREEDING FOR YIELD IMPROVEMENT

CTRI, Rajahmundry

Evolving superior varieties of FCV tobacco through hybridization

(P.V. Venugopala Rao)

Yield parameters

A replicated trial was conducted with seven advanced breeding lines viz., V-4262, V-4263, V-4269, V-4270, V-4272, V-4278 and V-4280 along with the check varieties VT-1158 and Hema for three consecutive years. Results of combined analysis revealed that the treatments differed significantly for all the yield characters studied. Except V-4262, all the selections recorded higher green, cured and bright leaf yield and grade index values compared to the controls. The cured yield was highest in V-4263 (1,990 kg/ha) with an improvement of 23% over the better control VT-1158 (1,620 kg/ha). This was followed by V-4270 and V-4280 with an improvement of 20 and 18%, respectively over VT-1158.

Based on the performance of the selections over three years, it is concluded that among the selections V-4270, V-4263 V-4280 and V-4278 with 10-23% cured leaf, 22-23% bright leaf and 13-23% grade index higher than VT-1158 were found to be superior. These four lines will be proposed for testing in the Initial Varietal Trial (IVT) under All India Network Research Project on Tobacco (AINRPT).

Sub-Project Br2 (a) VIII: Evaluation of advanced breeding lines for yield and quality

Yield parameters

Nine advanced breeding lines viz., V-4339, V-4340, V-4343, V-4344, V-4350, V-4351, V-4361, V-4362 and V-4367 were evaluated against three controls viz., VT-1158, Hema and Siri in a replicated trial. Significant differences between the treatments was recorded in all the four yield characters. Among the lines tested, line V-4344 recorded highly significant green leaf yield (15,197 kg/ha), cured leaf yield (2,132 kg/ha) and grade index (1,697 kg/ha) and higher bright leaf yield (1,325 kg/ha) compared to the better control Siri. Nicotine in the entries ranged from 1.56 to 2.76%. Higher nicotine of 2.76 was recorded in Siri. Reducing sugars varied from 10.45 to 15.05%. Chloride content ranged from 1.29 to 1.75%.

Sub-Project - Br2 (a) IX: Evaluation of advanced breeding lines for yield and quality

Yield parameters

Advanced breeding line 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 viz., VT-1158, Hema and Siri in a replicated trial. Significant differences between the treatments were recorded in all the four yield characters. Cured leaf yield was highly significant in V-4391 (2,217 kg/ha) followed by V-4380 (2,204 kg/ha) compared to the better control Siri (1,777 kg/ha) and the yield improvement over Siri was 25% and 24%, respectively. Nicotine in the entries ranged from 1.33 to 2.47%, Reducing sugars from 10.89 to 17.59% and chloride content varied from 1.07 to 1.75%.

Preliminary evaluation of advanced breeding lines in row trial

Advanced breeding lines (43), V-4496 to V-4538, were evaluated in a row trial along with three controls viz., VT-1158 Hema and Siri to identify the potential lines with higher yield. Based on the morphological characters, 21 selections were made for further evaluation during 2008-09.

SIRI

Evaluation of advanced breeding lines for yield and quality

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

Replicated trial (1st year)

Six somaclones and five advanced breeding lines were tested in a replicated trial along with three controls viz., Hema, VT 1158 and Siri. Among the lines tested, maximum plant height (213 cm) was recorded in RS 6, total leaf number (33) and number of curable leaves in Siri (29), leaf length (62) and width (36) in VTCMV-1-P7. Significant differences were observed among the tested lines for all the yield characters. Among the lines, the line RS-10 recorded higher leaf yield than all the lines and control. Leaf yield of RS-10 was significantly higher than the better control Siri. This line has recorded 16,345 kg/ha green leaf yield, 2,455 kg/ha cured leaf, 1,328 kg/ha bright leaf and 1,991 grade index, an increase of 16, 17, 23 and 22%, respectively over Siri. Another line RS-3 recorded significantly higher leaf yields of all types than control VT 1158 with an increase of 18% in cured leaf yield (2,168 kg/ha), 18 % in bright leaf yield (1,122 kg/ha) and 21% in grade index (1,734 kg/ha) than VT 1158. The chemical quality characteristics viz. nicotine and reducing sugars were in acceptable limits in the cured leaf.

The variety Siri was raised in bulk, nucleus and breeder seed were collected. Sixty eight advanced breeding lines were raised and seed was collected for maintenance. Among the 20 breeding lines tested for TMV resistance Cy 159, Cy 161, Cy 163, Cy 164 and Cy 165 found to be TMV resistance.

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 158 selections (F_6-F_{10}) along with the check variety Kanchan to identify selections suitable to NLS area. The lines varied for important morphological and agronomical traits. Thirty of the selections were morphologically uniform. Cured leaf yield varied from 1,560 to 3,160 kg/ha among the advanced lines. Promising lines in terms of leaf number (35-45), leaf colour (medium-dark), leaf nature (NLS type or flat type) and plant type (normal type and bouquet type) were identified among the advanced lines. Fifty eight single plant selections showing good plant type and leaf characteristics suitable for NLS besides high yield potential, were advanced for further evaluation. In addition to high yield, four semi-dwarf selections (RT 9 to RT 12) with compact plant type and very short internodal length suitable for closer spacing were also identified and selfed for further study.

(ii) Generation advancement and selection

Six F_4 progenies of crosses involving Kanchan as one of the parents were raised and 14 single plant selections showing plant type suitable to NLS besides having high leaf number were advanced.

Also, one F_5 progeny of cross 312-1 x Kanchan was grown and 2 single plant selections having resistance to TMV were made for further study. At Rajahmundry also, crosses involving Kanchan and TMV resistance donors were advanced to F_3 and under artificial screening, mosaic resistant progenies having Kanchan plant type were identified for further testing. 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 (2nd year): Nine medium green cast advanced breeding lines were evaluated along with the check Kanchan for yield and leaf quality in RBD with three replications for the second successive year. Analysis of data indicated significant differences for green and

cured leaf yields and grade index among entries. Two lines viz., 312MC-1 and JL130-3 showed vigour for plant growth, leaf size, body and suitability to NLS area. The two lines also showed significant increase in green and cured leaf yields and grade index over check, Kanchan with 16 and 14% for green leaf, 27% for cured leaf and 27 and 35% for grade index. The test entries viz., 312 MC-1, JL130-1, JL130-3 and JL130-6 along with check, Kanchan showed desirable physical attributes such as size, body and colour of the cured leaf. The levels of nicotine, reducing sugars and chlorides were within prescribed limits in all the test entries.

b) Trial RYT-10 (1st year): Nine medium green/green cast advanced breeding lines were evaluated along with the check Kanchan for yield and leaf quality traits in RBD with three replications for the second successive year. Analysis of yield data indicated significant differences for green and cured leaf yields and grade index among the entries. Four lines viz., M31N5N4#2, M31N5CMN4#2, NS 16 #1 and NS18#1 showed big leaf size and body. The four lines also showed significant increase for green and cured leaf yields and grade index over check, Kanchan. The increase was 15-28% for green and cured leaf yields and 20-33% for grade index. The test entries viz., M31N5CMN4#2, 323K-31-1-1, NS 16 # and M31N5N4#2 in that order possessed very good physical attributes of cured leaf such as colour, size and body. Nicotine and reducing sugar levels in all the entries were within desirable limits.


SIRI

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

(T.G.K. Murthy)

Bulk evaluation

Seven advanced breeding lines, identified as superior to checks in previous bulk assessment trials, were grown in progeny bulks, each comprising 120-200 plants. Among all, Sel. 47, Sel. 45 and Singarajupalem SR appeared promising with 1,720, 1,404 and 1,596 kg cured leaf yield/ha.

Generation advancement and selection

F_1 hybrids of crosses viz., Singarajupalem x 45-90, 45-90 x Kommugudem and Kommugudem x 45-90 showed heterosis for plant growth and leaf number. Two plants in each of the crosses were selfed for growing segregating generation during 2008-09 season.

Natu type of selections were made in F_5 generation of interspecific cross (*N. gossei x N. tabacum*) derivative, 325X-VTSel#1. Leaf number varied from 18 to 25 per plant in these selections.

At Rajahmundry, *Natu* type of selections (R-181, R-182, R-184, R-185, R-187) were made among advanced derivatives of interspecific cross (*N. tabacum x N. gossei*). In these selections, leaf number varied from 20-27 leaves per plant.

TMV resistant *Natu* lines

Ten *Natu* selections that were 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 FCV and other plant types, besides resistance to TMV. *Natu* type of selections having plant type suitable to irrigated Alfisols were made within lines viz., PVM-2, PVM-5, PVM-6, PVM-11, PVM-17, PVM-18 and PVM-19 for further studies.

Confirmation of black shank resistance

The three black shank resistant irrigated *Natu* lines viz., Peddavithanam SR, Rangapuram SR and Singarajupalem SR were screened at CTRI, Rajahmundry for confirmation of black shank resistance in collaboration with Plant Pathologist.

CTRI Research Station, Guntur

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

(A.V.S.R. Swamy)

Forty Five F4 selections of the crosses, i-GH-9 (V-3703 X KST-26), ii-GH-10(V3703X Cy-79), and iii GH-14 (V-3703 X Hema), each

of 15 selections, were raised under CBS (CTRI-RS) and SBS conditions (Medarametla). Data was recorded on yield and pest incidence under natural conditions on above crosses.

Selections for CBS

In CBS condition, 6 selections in the 1st cross (V-3703 X KST-26) i.e., GH-9#1, GH-9#14, GH-9#23, GH-9#25, GH-9#34 and GH-9#39 having high cured leaf yield potentiality ranging from 3,271 to 3,557 were selected for testing under F5 during ensuing season.

In the 2nd cross (V-3703 X Cy-79), 6 selections were made i.e. GH-10#1, GH-10#3, GH-10#17, GH-10#20, GH-10#29, GH-10#35, which fared well for higher yield potential and promoted to next progeny. The yield in such selections was ranged from 2,957 to 3,471 kg/ha.

Four selections in the 3rd cross (V-3703 X Hema) i.e., GH-14#14, GH-14#29,GH-14#33, and GH-14#35, having high cured leaf yield potentiality ranged from 3,342 to 3,471 were selected to test under F5 during next season.

Selections for SBS

The experiment with 45 F4 selections in 3 cross combinations, 15 each with their parents were raised under SBS condition at Medarametla, Prakasam district. In 1st cross (V-3703 X KST-26), 7 selections i.e., GH-9#1, Gh-9#14, GH-9#22, GH-9#23, GH-9#25 and GH-9#26, GH-9#34 having high cured leaf yield potentiality ranging from 3,071 to 3,3742 were selected to test under F5 during ensuing season.

In the 2nd cross (V-3703 X Cy-79), 7 selections were made i.e. GH-10#1, GH-10#2, GH-10#11, GH-10#17, GH-10#29, GH-10#30, GH-10#35 which fared well for higher yield potential and promoted to next progeny. The yield in such selections ranged from 2,914 to 3,542 kg/ha.

Six selections in the 3rd cross (V-3703 X Hema) i.e. GH-14#14, GH14#21, GH-14#29, GH-14#33, GH-14#35, and GH-14#36 having high cured leaf yield potentiality ranging from 2,928 to 3,657 kg/ha were selected to test under F5 during next season.

None of the cross combinations showed significant differences to pests and disease incidence.

FCV bulk trial

New pipe line entries promoted from AVT-2 i.e., KST-28, V-4064, Cy-118 Sel, and Cy-139 were raised along with released varieties for evaluating the yield potential. The line Cy-139 was found to be superior in terms of higher cured and bright leaf yields and grade index of 2,851, 1,473 and 2,458 kg/ha, respectively.

***NATU* bulk trial**

Among the *Natu* entries (Prabhat, *Natu*-Spl, Viswanath, Bhairavi, II-1873, HDBRG-1 and HDBRG-2 WAF) tested in a bulk trial, the advanced high yielding selection II-1873 gave maximum cured leaf yield of 2,708 kg/ha, which is 125% higher cured leaf over WAF (control), respectively.

Burley Tobacco Research Centre, Jeddangi

Evaluation of advanced Burley breeding lines for productivity and quality

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

Fourteen advanced breeding lines (YB-1 to YB-14) were selected for testing under replicated trial with three replications during 2007-08 (II year) along with three controls viz., Banket A1, Burley-21 and Swetha. The treatments differed significantly for both the yield characters viz., green leaf and cured leaf yields. YB-10 recorded significantly higher green yield of 13,996 kg/ha followed by YB-4 (13,181 kg/ha). Cured leaf yields also significantly higher in YB-10, YB-4, YB-6 YB-14 and YB-12. The maximum cured leaf yield was recorded in YB-10 with 2,217 kg/ha followed by YB-4 (2,032 kg/ha). Chemical quality characteristics viz., nicotine, reducing sugars and chlorides in all the test entries were under acceptable limits. During the 2007-08 crop season also the lines YB-10 and YB-4 were significantly superior to the better control

Banket A1 in both the yield characters studied.

Evaluation of segregating material

Progeny row trial was conducted involving 54 F4 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 53 F4 progenies studied, 61 selections were made and these selections will be evaluated further during 2008-09.

F2 progenies of the two new crosses made during 2005-06 viz., Banket A1 x Ky-42 and SM13 x Ky-42 were raised. Selections were made and selfed seed collected to raise F3 during 2008-09. This was taken up to incorporate the typical creamy white Burley nature of the Ky-42 and higher yields into the advanced breeding lines and the cultivars.

Incorporation of Male sterility (CMS) in Burley Varieties

The BC3 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 parents viz., Banket A1, Burley-21, VA-510, Banket-127. The seed was collected to raise the BC4 seedlings during 2008-09 for further back crossing to the recurrent parents.

Hybrid seed production

Hybrid seed of BA1 X 324C was produced and the seedlings were supplied to the Agronomist for further studies.


SIRI

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. Narasimha Rao)

Seed from single plant progeny were collected from 360 accessions of FCV germplasm for rejuvenation. Two hundred and seven single plant selections were made from the F-2 population of SH-1 (48), SH-6 (42), SH-9 (55) and SH-12 (62) crosses. Selfed seed from the crosses of H-3, H-4, H-10, H-11, H-13 and H-14 were collected to raise F-2 population for further selection.

CTRI Research Station, Vedasandur

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

(A.V.S.R. Swamy)

From the 35 selections made in a broad genetic population during 2006-07, 35 families were raised in progeny rows along with Bhagyalakshmi, Abirami and Meenakshi as checks at regular intervals. Based on expression of desired level of yield component attributes, 27 selections were made from 16 families and self-pollinated for generation advancement and further selection. Observations on plant height, number of leaves, leaf length, leaf width, internodal length and stem girth were recorded in the selections as well as checks. It was observed that the selections showed higher values in one or more yield component attributes than checks. With respect to cured leaf yield, 10 families recorded higher cured leaf yield ranging from 3,210 (BGB-13) to 3,611 (BGB-25) kg/ha thus showing that there has been appreciable increase of frequency of desirable genes for productivity in the selected families arising from diallel selective mating series.

CTRI Research Station, Dinhata

Screening of early maturing locally grown superior *Motihari* tobacco varieties for their yield and quality

(S. Amarnath)

Four cultivars viz. Manda, Tangua Manda, Bombai and Bitri were evaluated in replicated trial during 2007-08. Data were collected for eight morphological, yield and quality characters. Analysis of data revealed that varieties differed significantly for all the characters studied. Cultivar, Tangua manda was found to be significantly superior over Bitri for cured leaf yield and first grade leaf yield recording 15.8 and 23.5% higher yields,

respectively, over Bitri. Plant height, leaf breadth, leaf length, number of leaves and maturity score being at par were superior to Bitri. The intensity of brown spot in cv. Tangua Manda was observed to be low (12.9%) as compared to others.

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

(S. Amarnath)

Eight parent diallel crosses were made and 28 F_1's were evaluated along with parents for their yield and quality for two years i.e. 2005-06 & 2006-07. Based on the combined diallel analysis, four best F_1's viz., Black Queen x Manda, Black Queen x DD-437 , C-25 x Snuff-2 and C-25 x Tangua were selected to grow as F_2 population during 2007-08. Among these F_2's, 20,19, 23 and 12 selections having desirable plant type, leaf shape and size, thickness and maturity symptoms were, respectively, made. Inter and *inter se* crosses were made between selections in each of the four F_2 populations to reshuffle the genic constitution so as to develop superior genotypes with maximum genetic potential.

Hybrid Tobacco

CTRI, Rajahmundry

Developing hybrid tobacco suitable for Traditional black soils of Andhra Pradesh

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

During the year, one bulk evaluation trial and three replicated yield trials with CMS hybrids and one with fertile hybrids were conducted. Also, maintenance of CMS lines and fresh hybridization was also undertaken.

1. Bulk evaluation of hybrids

Two CMS hybrids, TBSH-1 and TBSH-2 that showed significant standard heterosis in the Station replicated yield trials were grown in bulk plots along with two check varieties, Siri and VT 1158 for evaluation of yield traits (Fig. 2). The hybrids showed 20 to 38% heterosis for various yield traits over Siri. Among the hybrids, TBSH-2 recorded higher cured leaf yield (2,834 kg/ha) than TBSH-1 (2,470 kg/ha) and all the entries showed desirable colour, body and weight of cured leaf. TBSH-1 and TBSH-2 are undergoing initial varietal trial under AINRPT. The content of nicotine and reducing sugars in cured leaf of all the genotypes evaluated in the bulk trial were within the desirable limits.

Fig.2 : Promising CMS hybrids - TBSH-1 & 2

2. Replicated yield trials

(i) RYT 1-CMS hybrids (Second year)

The trial was conducted with eight CMS hybrids produced by using four CMS lines (6-6RMS, AP1-8, 72-21MSVT and MST29) and six promising advanced breeding lines (Cy 79, Cy 139, Cy 142, Cy 149, R-77 and 312-1S4) as parents. All the hybrids were evaluated for yield potential and leaf quality along with three checks viz., Hema, VT 1158 and Siri in RBD with 3 replications. Significant differences were observed for all the yield characteristics among the entries. Two hybrids viz., TBSH-44 and TBSH-46 showed significantly higher standard heterosis than the high yielding check, Siri for all the four yield traits, besides having good leaf physical quality. The heterosis varied from 18 to 33% for different yield traits. The nicotine and reducing sugars content in cured leaves of all the entries in the experiment were within acceptable limits.

(ii) CMS hybrids (1st year)

The trial was conducted for the first year with ten new CMS hybrids that showed promise in progeny row trials during previous years. The CMS 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 for yield potential and leaf quality 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 entries.

One hybrid, TBSH-50 showed significantly higher standard heterosis than high yielding check, Siri for all the four yield traits besides having good size, body and colour of cured leaf. The heterosis varied from 23 to 26% for different traits. Another hybrid, TBSH-56 showed significant improvement (17%) over check, Siri for bright leaf yield only.

3. Maintenance of CMS lines

A total of 21 CMS lines with varying cytoplasm sources (*N. undulata, N. plumbaginifolia, N. tabacum, N. gossei, N. suaveolens, N. megalosiphon* etc.) were maintained. The stabilized CMS lines viz., AP-1-8, 6-6, MST-29, MS-19, MS-20, CR 73 were involved in crosses with different promising recurrent parents (maintainers) for developing high yielding/resistant CMS lines for use in hybrid breeding programme. Crosses were also made for conducting various RYT's with CMS hybrids and multi-location testing under AINRPT. Four crosses viz., MS58 x HDBRG, MS58 x VT-1158, MS58 x A-145 and MS58 x TI-163 were also made to develop CMS parental lines with high biomass potential.

CTRI Research Station, Jeelugumilli

Developing hybrid FCV tobacco suitable for NLS area of Andhra Pradesh

(T.G.K. Murthy, R.V.S. Rao, 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 2007-08 season, 18 CMS lines in the genetic background of Kanchan and other improved lines were maintained and crossed to maintainer parent. High yielding CMS hybrid NC 71 was crossed with Kanchan and other improved lines (BC_4) for developing high yielding CMS parental lines.

(i) Bulk evaluation of CMS hybrids

The CMS hybrids viz., CH-1 and CH-3 that had shown significant increase in yield over Kanchan in station replicated yield trials and IVT were grown in experimental plots along with the check, Kanchan. Results indicated superiority of the CMS hybrids, although the increase in the hybrid, CH-1 was marginal. Between the hybrids, CH-3 was promising with 2,559 kg/ha cured leaf compared to CH-1 (2,153 kg/ha). Nicotine, reducing sugars and chloride content in cured leaf of the CMS hybrids were comparable with Kanchan (Fig. 3).

Fig.3 : CMS hybrids in NLS

(ii) Evaluation of CMS hybrids in replicated yield trial

Eleven CMS hybrids, produced from crosses involving identified promising CMS lines and high yielding breeding lines were evaluated along with the check, Kanchan in 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. Two hybrids viz., 6-6R x RT 29 and 6-6R x FCH 201 were found to be significantly superior to Kanchan for yield traits. The increase over Kanchan was 18 & 20% in green leaf yield, 21 & 25% in cured leaf and 27& 35% in grade index. The contents of nicotine,

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

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)

A trial constituting 10 hybrids developed by the Research Station and 2 hybrids (CH-1 & CH-3) and 3 check varieties viz., Hema, Siri and Kanthi was conducted in RBD with 3 replications to evaluate the yield potential of hybrids. The chemical quality parameters of cured leaf of all the entries were in acceptable limits. The hybrids SH-1, SH-6, SH-9, and SH-12 were significantly superior to all the three check varieties, Hema, Kanthi and Siri with respect to green leaf yield (12,828 to 13,336 kg/ha). The hybrids SH-1, SH-9, and SH-12 were significantly superior to check varieties, Hema, Kanthi and Siri with respect to cured leaf yield (1,028 to 1,135 kg/ha). Hence, SH-1 and SH-6 were contributed for IVT Hybrid trial during 2008-09 (Fig. 4).

Fig.4 : Fertile hybrids SH-1 & SH-6 in SLS

CTRI Research Station, Hunsur

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

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

Among the 14 male fertile hybrids and 3 CMS hybrids assessed for the third successive season, nine recorded higher values over standard check Kanchan in all yield parameters. Standard heterosis ranged from 1 to 19%. KLSH-2, 6, 8, 13 have recorded 1,800 kg/ha cured leaf yield as against 1,570 kg/ha yield in Kanchan during the season. Even though, bright grade out turn was better in KLSH-6 and KLSH-8 the yield increase over Kanchan was not significant.

In the mean values for three seasons, ten out of seventeen hybrids exhibited standard heterosis ranging from 1 to 22% for all the yield parameters. In cured leaf yield, four hybrids recorded above 1,800 kg/ha productivity with >15% standard heterosis. However, the increase in yield over standard check was not significant. In bright grade out turn, KLSH-10 recorded significant superiority (22%) over standard check Kanchan. Seasonal variations were significant for green and bright grade leaf yields and top grade equivalent. Seasons x Treatment interactions were not significant for all yield parameters. KLSH-10 has been contributed to IVT under AINRPT for multi-location testing. A new set of hybrids have been developed for assessment during the ensuing season.

CTRI Research Station, Vedasandur

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

(A.V.S.R. Swamy)

Five hybrids showing better performance in replicated trials during 2005-07 viz., VDH-1

Fig.5 : Chewing tobacco hybrid VDH-3

(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 as well as in three on farm trials at Oddanchattram, Gobi and Aravakurichi taluks in Tamil Nadu along with the check varieties Bhagyalakshmi and Abirami for yield assessment (Fig. 5).

The hybrid VDH-3 uniformly performed well in all the four locations and recorded maximum mean cured leaf yield of 3,867 kg/ha with an increase of 18.7% over the best check Abirami followed by VDH-1 of 3,330 kg/ha. In respect of morphological characters, it was observed that VDH-3 showed the highest leaf area along with stem girth which are the positive characters for higher cured leaf yield.

BREEDING FOR DISEASE RESISTANCE

CTRI, Rajahmundry

Incorporation of disease resistance for Tobacco Mosaic Virus (TMV)

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

The BC_3 generation plants of the crosses V-4294, V-4297, V-4298 (involving Cy-135 as recurrent parent), V-4304 and V-4307 (involving N-98 as recurrent parent) were raised and artificial inoculation was made with TMV. The resistant plants were back crossed with the respective recurrent parent and seed collected to raise the BC4/BC3 during 2007-08.

TMV resistance in F_4 progenies of Siri and N-98

F_4 progenies of Siri X VT-1158 (211 progenies) and N-98 X VT-1158 (48 progenies) 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 52 progenies of line V-4419 evaluated for TMV resistance, all the plants in 45 progenies have shown resistance. Out of 51 families of V-4427, 34 families; out of 52 families of V-4437, 44 families; out of 53 families of V-4440, 33 families and out of 48 families of V-4456, 41 families shown total resistance. Based on these results and the visual observations of the resistant families, a total number of forty nine progenies were selected for further screening during 2008-09.

Incorporation of TMV resistance in Pyruvittanam of *Natu* tobacco

BC_1S_3 progenies of ten progenies selected during 2006-07 (of PVM X JMR / VT-1158) were raised and artificially inoculated with TMV. The results showed that all the plants in the lines PVM-2, 3, 4, 5, 7, 8, 9 and 10 were resistant to TMV. These eight lines will be evaluated for the stability in a row trial during 2008-09.

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.

Incorporation of Black Shank resistance in FCV varieties/Advanced breeding lines

Black shank resistance incorporation in the recently released variety Siri and the advanced breeding lines N-98 and Cy-142 using Beinhart 1000-1 and 1129SR are in progress. The breeding material is in F_3 generation.

CTRI Research Station, Hunsur

Imparting resistance to brown spot in the high yielding FCV tobacco varieties/advanced breeding lines suitable for Karnataka light soils

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

Breeding for quality improvement

Nine advanced breeding lines from crosses involving Kanchan and Rathna were assessed for three years. In the mean yield for three seasons, seven advanced breeding lines recorded higher values (5 to 52%) in cured leaf yield (2,632-2,970 kg/ha), bright grade leaf yield (1,357-1,796 kg/ha), and top grade equivalent (1,689-2,057 kg/ha), yields over standard check Kanchan. In cured leaf yield, FCH 196, FCH 197, FCH 198 and FCH 201

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recorded significant superiority over Kanchan. In bright grade leaf yield, the same four lines recorded >20% higher yields over Kanchan and yield increase in FCH 196, 197 and 198 were statistically significant. The same trend is noticed in top grade equivalent yield too. Seasonal variations were significant. 2006-07 crop season was favourable for higher productivity. Seasons x treatment interactions were not significant (Fig. 6).

Fig.6 : Advanced breeding line FCH 197 in KLS

Breeding for resistance to brown spot

Twelve advanced breeding lines derived from the crosses involving the brown spot disease resistant donors Beinhart 1000-1 and L.1128 (SR) were assessed in a replicated trial for three seasons (2005-08). In mean yields over three years, FCH 209 and FCH 210 derived from crosses involving Rathna and L.1128 (SR) recorded higher values in all the yield parameters (Fig. 7). Both the lines have >2,000 kg/ha yield potential with mean yield of >1,900 kg/ha. They also have higher bright grade out turn potential among the sister lines. Seasonal variations were non-significant, Seasons x Treatments interaction was significant. FCH 209 performed well in the year 2006, while FCH 210 performed well in both the years . The two lines have been contributed to Initial Varietal Trial under AINRPT for multi-location testing.

Fig.7 : Brownspot resistant line FCH 210

Breeding for resistance to *Fusarium* wilt disease in FCV tobacco for Karnataka Light Soils

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

Among the twelve advanced breeding lines derived using Dixie Bright 101 and Speight G.33 as *Fusarium* wilt disease resistant donors, FCH 219, FCH 220, FCH 221 and FCH 222 recorded higher values over standard check Kanchan in all the yield parameters. FCH 221 recorded >2000 kg/ha cured leaf yield, recording an increase of >20% over the standard check Kanchan. The line has also given highest grade out turn, exhibiting about 16% higher values over variety Kanchan. Based on two years performance, FCH 221 and FCH 222 have been contributed to Initial Varietal Trial under AINRPT for multi-location testing (Fig. 8).

Fig.8 : *Fusarium* wilt resistant lines FCH 221 & 222

INTERSPECIFIC HYBRIDIZATION

CTRI, Rajahmundry

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, R.V.S. Rao, U. Sreedhar and K. Siva Raju)

1. Maintenance of interspecific cross derivatives

About 180 single plant-to-row progenies in F_{10} - F_{11} and different back cross generations,

derived from crosses involving *N. tabacum* as one parent and aphid resistant donors viz., *N. gossei*, *N. excelsior*, *N. x benthamiana-repanda*, and *N. umbratica* as the other parents, were grown in experimental plots along with the susceptible cultivars.

2. Reaction to natural aphid infestation

In general, natural aphid infestation was reasonably high during the 2007-08 season. About 70% of the plants of susceptible check, Lanka Special were infested by aphids and about 30% of the total plants were totally damaged with sooty mold. In contrast, over 95% of the resistant advanced interspecific derivatives were free from aphid infestation.

Also, 40 derivatives (in addition to the already identified six resistant derivatives) were sent for screening by Entomologist during 2007-08 under artificial inoculation at CTRI RS, Guntur and CTRI RS, Kandukur.

3. Characterization for morphology and other traits

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, size and shape of auricle & petiole, curability, flower colour, fertility, etc.

4. Promising derivatives identified

Under the project, a number of interspecific advanced cross derivatives having desirable traits were developed and maintained. They include high yield potential (flat leaf type 29 lines and NLS type 23), more leaf weight (4), short internodal length (10), light cast (70), medium cast (3), green cast (120), bigger leaf size (31), high biomass (4), earliness (1), Burley type (3), *Natu* type (5) and *Lanka* (4 derivatives).

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5. Evaluation of advanced lines for yield and quality

a) Trial TBL-2 (2nd year): A replicated yield trial was conducted for the second season in succession with ten morphologically stable advanced cross derivatives along with three checks in RBD with three replications for evaluating their yield potential and leaf quality. Cross derivatives viz., TBST-11, TBST-16 and TBST-9 had desirable plant type and leaf colour besides good plant vigour. Differences among entries were significant for all the four yield traits. The following lines were found promising for various yield traits:

Green leaf:	TBST-11 (27%)* TBST-16 (15%), TBST-17 (13%).
Cured leaf:	TBST-11 (22%), TBST-16 (16), TBST-9 (14%)
Bright leaf:	TBST-11 (33%), TBST-18 (31%), TBST-16 (24%), TBST-17 (20%).
Grade index:	TBST-11 (33%), TBST-16 (19%), TBST-18 (17%)

* increase over best check, Siri

Colour, body and size of cured leaf were better in the entries, TBST-18, TBST-16, TBST-11, TBST-17 and TBST-9, besides the checks. In general, the nicotine, reducing sugars and chloride contents were within the desirable limits in the advanced cross derivatives.

b) Trial TBL-3 (1st year): A replicated yield trial was conducted for the first season with 10 morphologically stable advanced cross derivatives along with three checks in RBD for evaluating their yield potential and leaf quality. Derivatives, TB-27, TB-21, TB-22 and TB-24 had desirable plant type and leaf colour besides good plant vigour. Differences among entries were significant for all the four yield traits. The following derivatives were found promising for various yield traits:

Green leaf:	TBST-21 (39%)* TBST-27 (38%), TBST-24 (33%), TBST-25 (30%), TBST-22 (28%).
Cured leaf:	TBST-21 (37%), TBST-27 (35%), TBST-24 (30%), TBST-25 (29%), TBST-22 (27%).
Bright leaf:	TBST-27 (43%), TBST-21 (36%), TBST-22 (32%), TBST-24 (30%), TBST-25 (25%).
Grade index:	TBST-27 (41%), TBST-21 (37%), TBST-24 (31%), TBST-22 (30%), TBST-25 (27%).

* increase over best check, Siri

Colour, body and size of cured leaf were good in the entries, TBST-27, TBST-24, TBST-21, TBST-25 and TBST-22 in that order. The level of nicotine and reducing sugars were within the desirable limits in all the entries.

c) Trial VT 13: Nine advanced interspecific cross derivatives (*N. tabacum* x *N. gossei*, *N. umbratica x N. tabacum*) were evaluated for second successive year along with the check cultivars in RBD. Line R 2-3 was found significantly superior to best check Siri with an increase of 35% green leaf yield, 31% for cured leaf, 21% for bright leaf and 35% for grade index. The line R 55-1 recorded significant superiority over Siri for green and cured leaf yields also.

d) Progeny row trial: A number of aphid resistant advanced interspecific cross derivatives having desirable plant type and leaf colour (light, medium or dark cast) have been developed under the project. All the lines 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 morphologically uniform lines were retained for further agronomic evaluation. During 2007-08, the cured leaf yield potential of 93 such progenies varied from 1,420 to 3,220 kg/ha. Twelve selections with yield potential of over 3,000 kg/ha besides leaf quality suitable for black soils were identified for further studies.

Besides FCV type, promising *Lanka* type selections were also made among interspecific cross derivatives, the promising lines for yield potential include R-182, R-183, R-185, R-186 and R-189. Also, *Natu* type plants with over 25 leaves per plant (R-184, R-187) were selected and multiplied for further studies.

Forty identified advanced lines and six F_2 progenies were screened in collaboration with Plant Pathologist for reaction to TMV under artificial inoculation. Twenty one lines were found to be TMV resistant while 11 segregated for resistance; eight lines were susceptible. The six F_2 progenies derived from crosses involving Kanchan and TMV resistant lines as parents, segregated for TMV resistance. The resistant plants identified were selfed for further studies.

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

Ten 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, under natural infestation, pressure in unsprayed nursery condition, following derivatives were observed to be free from caterpillar damage: X-5, 137MX-1-1CR#2, 137MX-1-1CR#3, 144MX1-9CR, 99-13-18-5-20-11-12, 99-13-19-23-19-20, 99-13-19-23-1-4-20, 99-13-19-1-9-10, 99-13-19-23-1-19-14, G 566-15-11, 13-2 Lanka.

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 in collaboration with Entomologist, were supplied to CTRI RS, Kandukur for screening under high infestation pressure for confirmation of tolerance.

6. Maintenance & utilization of newly developed CMS lines

A CMS line (6-6) developed from this project has been found to be a good parent for synthesis of tobacco hybrids with high leaf yield and quality. The CMS line, with VT 1158 and Rathna genetic back grounds, is 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 segregated for male sterile and fertile plants have been identified in F_4 progeny of the cross and selfed for further studies. The segregation of fertile, partially male sterile and totally male sterile plants in this progeny was in the ratio of 19:2:3. Segregation of male sterile and fertile plants has also been observed in progeny of one advanced derivative of cross *N. tabacum x N. gossei* (R-117). The observed ratio of fertile, partial sterile and totally male sterile plants in this progeny was 16:1:6.

8. Location specific evaluation of cross derivatives

Promising derivatives of different growth habits identified in the project were contributed to CTRI RS Kandukur (50 FCV lines) and CTRI RS Jeelugumilli (55 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

(vi) Cream coloured testa (The variant was digenic recessive to brown coloured seed coat, as revealed from analysis of F_2 data of 3 reciprocal crosses; the gene which was allelic to that in line, Jayalakshmi)

PROGRAMME 3

BIOTECHNOLOGY FOR TOBACCO IMPROVEMENT

CTRI, Rajahmundry

Micropropagation of elite lines and other Selections

(K. Sarala)

Micropropagation of elite lines

Three *Nicotiana* species, one Bt transgenic line, three haploids of tobacco lines, nine haploids from crosses and one variety were micropropagated under *in vitro*.

Development of virus tolerant tobacco lines under *in vitro*

(K. Sarala, C.A. Raju, J.V. Prasad and K. Siva Raju)

Characterization of promising VT 1158 somaclones

Thirteen somaclones of VT-1158 were tested in a replicated trial at Katheru farm for the second consecutive year along with three controls viz., Hema, VT-1158 and Siri. Significant yield differences were observed among the entries for all the leaf yields. Somaclones, VLCR-25-12 recorded significantly higher leaf yields over Siri. Clones, VLCR-25-12 and VTCMV-1-15-14 recorded higher cured leaf, bright leaf and grade index values than the better control Siri and are significantly superior to VT 1158. Among these lines, VLCR 25-12 was found to be promising, with 18, 14 and 16% increase in cured leaf (2,382 kg/ha), bright leaf (1,396 kg/ha) and grade index values (1,975 kg/ha), respectively, over Siri. Clone, VTCMV-1-15-14 recorded 11, 8 and 10% increase in cured leaf, bright leaf and grade index values, respectively, over Siri. Various morphological characteristics viz., plant height, number of leaves, internodal length, leaf length and width were recorded in all the 13 VT 1158 somaclones. Somaclone VLCR-25-12 recorded maximum leaf length (60 cm), VTCMV-1-6 maximum leaf width (36 cm) and VTCMV-1-15-14 maximum curable leaves (26) compared to controls and other clones. In general, leaf nicotine and reducing sugars in somaclones were in acceptable limits.

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 for the second consecutive year in a replicated trial along with Kanchan (control) at CTRI RS, Jeelugumilli. Significant yield differences were recorded among the somaclones, breeding lines and control. All the somaclones and NM recorded significantly superior yields of all types to Kanchan. The cured leaf yield in somaclones ranged from 2,978 kg/ha in NLCR-4 to 3,344 kg/ha in NLCR-7 (k) as against 2,280 kg/ha in Kanchan. The cured leaf yield increase in somaclones over Kanchan ranged from 31 to 47% and grade index from 36 to 58%. Most of the somaclones recorded higher leaf length and leaf width values than Kanchan. NLCR 5 recorded maximum leaf length (72 cm) and JS 124 maximum leaf width (36 cm). NLCR 7(k) recorded maximum number of leaves (34) after topping. Chemical quality characteristics of somaclones and advanced breeding lines at 'X' and 'L' positions were in the acceptable range.

Screening of Somaclones for yield and resistance in row trial

Nineteen S_7 generation somaclones and 34 S_6 generation somaclones were tested in a row trial at Katheru Farm. Two S_7 and 3 S_6 somaclones were found to be promising.

Fifty four somaclones were tested for leaf curl resistance under artificial conditions at Rajahmundry. Eighteen clones were found to be free from leaf curl incidence (100% resistance). Fifty two somaclones were

screened for CMV resistance under artificial conditions at Rajahmundry. CMV infection was higher in 2007-08 season. All the plants in 7 clones recorded higher percentage (88%) of CMV resistant plants.

Viral genome amplification

PCR primers specific to coat protein gene (cp) of tobacco leaf curl virus were designed based on the sequences of tobacco leaf curl virus-Karnataka1 (TbLCV-Kar1) and tobacco leaf curl virus-Karnataka2 (TbLCV-Kar2) genes available in the NCBI data base. The designed primers 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 the symptoms. This confirmed the presence of leaf curl virus in plants showing the symptoms. The amplified DNA was eluted and purified.

Partial Coat Protein gene sequence information of seven isolates of tobacco leaf curl virus isolates was submitted to The National Centre for Biotechnology Information (NCBI) data base.

Maintenance, evaluation and characterization of tobacco transgenics

(K. Sarala and K. Siva Raju)

Bt tobacco transgenics

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)* confirming resistance to *Heliothis armigera and Cry 1 C to Spodoptera* 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 indicated the presence of Cry 1 A (b) gene in the transgenics.

ENVIROLOGIX quantiplate kits were used to quantify Bt proteins in the *in vivo* grown plants. The Cry 1A (b) protein quantities in transgenics ranged from 8.9 to 13.3 ng/mg green tissue and Cry1C from 15.3 to 19.1 ng/mg green tissue.

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Transgenic lines were screened against *Spodoptera*. The leaf area consumed by five larvae in two days was found to be less in transgenics (0-5cm^2) than control (13-20 cm^2).

Bt tobacco Transplastomics

Two transplastomic lines having Cry 9 Aa2 gene were maintained and characterised along with wild type, Petit Havana. Primers specific to Cry 9 Aa2 gene were used to amplify a region of 826 bps in transplastomics. This indicates the presence of Cry 9Aa2 gene. Transplastomic line pSKC 84-19C was initially maintained in the tissue culture and transferred to pots. Transplastomic lines were screened against *Spodoptera*. The leaf area consumed by five larvae in two days was found to be less in transgenics (0.2-1 cm^2) than control (12 cm^2). In order to transfer the Cry 9 Aa2 gene into FCV type, transplatomic lines were crossed with Siri.

Molecular mapping of important tobacco traits

(K. Sarala, T.G.K. Murthy, C.V. Narasimha 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 12 Burley lines viz., Banket-A1, SOTA 6506, Harrow Velvet, Burley resistant, By 64, By Sota 51, Ky-10, T-117, BSRB-II, Burley 21, HDBRG and VA 510 using 12 chromosome specific SSR primers and 9 RAPD primers. Banket A1 and Burley 21 are high TSNA yielding lines and others are low. Out of 77 SSR bands amplified, 47 were found to be polymorphic. Out of nine RAPD primers, amplification was found with 4 primers only.

Solanesol and Nicotine: Air-cured leaf samples collected from Gauthami, Siri, BY-53, A 145, GT 7, HDBRG, TI-163 and GT 8 are being analyzed for solanesol content.

Leaf nicotine content was estimated in 13 tobacco lines and 16 crosses in air-cured middle picks during the season. Siri, NC 55, Candel and GT-9 recorded higher nicotine values (2.11-2.89%) and Nisnicotinony-121

lower (1.12%) than the other lines. All the crosses involving Nisnicotinony-121 recorded lower nicotine values. Most of the crosses involving TI-163, except A-145 X TI-163, recorded higher nicotine values (2.05-2.74%).

Eight lines (Gauthami, Siri, BY-53, Candel, NC-55, Nisnicotinony-121, Kumkumathri and GT-9) differing in their solanesol and nicotine were tested for their molecular diversities using 9 RAPD primers, 11 chromosome specific SSRs, 2 mt SSRs and 4 tobacco specific SSRs. Out of the 17 specific primers, 13 primers produced polymorphic bands between the tobacco lines. Seventy six different bands were detected of which 46 were polymorphic (60.52%). Out of the 9 RAPD primers used, only two showed response.

Phytochemicals: Five tobacco lines (GT-8, T1-163, HDBRG, GT-7 and A-145) and two crosses (A-145 x GT-7 and GT-7 x A-145) were assessed for their molecular diversity using 9 single arbitrary decanucleotide random primers and 11 chromosome specific SSR primers. Ten SSR primers produced polymorphic bands between the tobacco lines. Sixty five different SSR bands were detected; of which 35 were polymorphic (54%). Out of the 9 RAPD primers used, only two showed response (Fig. 9).

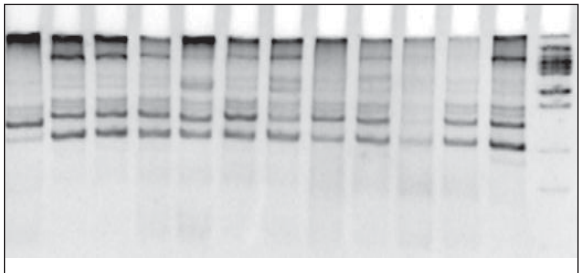

Fig. 9: SSR profile of Burley lines with chromosome 20 specific primer

Development of Recombinant inbred lines (RILs)

Mapping populations viz., RILs are being developed for nicotine, solanesol, TSNA and phytochemicals. In most of the cases, the materials are in F_2 generation stage.

Development of Doubled Haploid (DH) lines

Flower buds from three tobacco hybrids viz., Candel x Nisnicotinony-121, GT 9 x Nisnicotinony-121 and HDBRG x By 53 were collected, and anthers were excised and inoculated in tissue culture for the production of haploid lines necessary for molecular mapping of nicotine and solanesol. Anthers from all the crosses responded by production of either callus or shoots in 12 to 20 days. The shoots were transferred to MS basal medium for rooting. Roots were observed after one week.

Tissue culture raised haploid plants from five crosses viz. GT-7 x HDBRG, HDBRG x TI-163, GT 7 x TI-163, A 145 x HDBRG and A 145 x TI 163 were transferred to pots. Mid-veins from full grown plants of these haploids were inoculated on to the direct organogenesis medium for the development of di-haploid lines. Explants from all the crosses responded and shoots could be developed from all the crosses (Fig. 10).

HDBRGxTI163 GT7x HDBRG GT7xTI163

Fig.10: Mid-vein culture of haploids for DH line development

Electrophoretic characterization of tobacco

(K. Siva Raju and K. Nageswararao)

Randomly amplified polymorphic DNA (RAPD) and Simple Sequence Repeat (SSR) markers were used for the development of molecular markers and to study the genetic diversity among the cultivars grown in Tamil Nadu and Bihar states. The varieties included in the present study are: 1)Thangam, 2) Bhagyalakshmi, 3) Maragadam, 4) Vairam, 5) Meenakshi, 6) Abirami (cultivated in Tamil Nadu), 7) DP-401, 8) Gandakbahar, 9) Sona

10) Prabha, 11) PT-76, 12) Vaishali spl and 13) Lichchavi (cultivated in Bihar).

The genetic similarity among the chewing tobacco cultivars varied between 45 and 94% with an average genetic similarity of 69.5%. Among the varieties grown in Tamil Nadu, the genetic similarity varied between 62 and 94%, with an average genetic similarity of 78% whereas the genetic similarity among the cultivars of Bihar varied from 69 to 91% with an average genetic similarity of 80.0%.

The Unweighted Pair Group Method on Arithmetic Averages (UPGMA) method of clustering analysis the varieties separated into two main clusters based on region of cultivation. The cluster A was formed by the 6 varieties grown in Tamil Nadu. The cluster A was formed by a main sub-cluster with 5 cultivars and the 6th cultivar Maragadam was separately linked to this cluster. The cluster forming pattern showed the genetic relationship based on pedigree. The varieties Baghyalaksmi, Vairam and Thangam had the line I-64 as one of the parents and Abirami was a chemical mutant of I-64. The variety Meenakshi and Thangam had PV-7 as one of the parents and were clustered together.

The second cluster was formed by the cultivars grown in Bihar state. This cluster included two sub-clusters and the varieties Gandakbahar was linked independently to the main cluster. The sub-cluster was formed by the varieties Prabhat and PT-76 which have different parentage. The second subcluster was formed by the varieties Sona, DP-401, Vaishali Spl. and Lichchavi.

In SSR marker studies, the clustering pattern was based on the region and also parentage. All the 12 varieties were mainly grouped into two main clusters based on the region. The cluster A included all the 5 varieties cultivated in Tamil Nadu. The cluster A was formed by sub-cluster including the varieties Bhagyalakshmi, Abirami, Vairam and Maragadam whereas the variety Meenakshi independently linked to this sub-cluster. The second cluster was formed by the cultivars grown in Bihar. The variety Prabhat having different parentage was linked independently to the sub-cluster formed by other 6 cultivars. The varieties Sona, DP-401, Vaishali Spl. and Lichchavi were all grouped based on their parentage with the exception of PT-76, which had different parentage from these varieties. Sequence tagged markers developed from the chloroplast genome were used in the present study, but all the primers gave monomorphic pattern.

Development of molecular markers for *Fusarium* wilt

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

Two *Fusarium* wilt susceptible parents (Kanchan and Rathna), resistant line (SG 33) and one breeding line (Rathna x Kanchan) x SG 33(F4) were screened with RAPD and SSR primers for selection of primers that detect polymorphism between the parental lines. Scar marker work is in progress.

SIRI

PROGRAMME 4

CROP PRODUCTION TECHNOLOGY

CTRI, Rajahmundry

Permanent Manurial trial: Long term manurial and fertilizer experiments on FCV tobacco in Vertisols (Variety: VT-1158)

(R. Subba Rao and P. Harishu Kumar)

The results indicated that continuous application of FYM and nitrogen alone gave significantly higher green leaf, cured leaf, bright grade leaf yields and grade index. Nitrogen application alone or in combination with FYM significantly recorded higher leaf yields. Nitrogen in combination with P or K either in the presence or absence of FYM did not show its positive effect.

Performance of *Rustica* tobacco in black soils

(P. Harishu Kumar)

In order to test the quality of *Rustica* tobacco grown in Vertisols, 35-day old 100 seedlings of line SH-30 were planted at 80 x 40 cm at a fertility level of 100:50:50 NPK kg/ha. Two irrigations were given and the crop was topped at 7 leaves. At maturity, leaves were harvested, shade dried and powdered for chemical analysis after grading the leaves into four categories (Table 1).

Table 1: Chemical analysis of *Rustica* tobacco

Grades	Nicotine (%)	Sugars (%)	Chlorides (%)
I	8.22	3.86	2.59
II	7.90	3.92	2.77
III	5.59	4.26	2.54
IV	3.55	1.99	3.04

Crop Growth Modelling for FCV tobacco in Northern Light Soils

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

Regression equations

Regression equations were computed from the two years (2005-06 and 2006-07) data to study the impact of growth parameters (LAI, CGR, SLW and NAR) alone and also in combination with weather parameters on Total Drymatter (TDM) and Leaf Weight (LW). Results revealed that Leaf Area Index (LAI) alone can predict TDM (0.957**) and LW (0.934**) of FCV tobacco significantly. By including the specific leaf weight, the accuracy of prediction was improved for TDM (0.964**) and LW (0.954**). The accuracy was further improved by including the weather parameters like minimum and maximum temperatures, rainfall, sunshine hours and evaporation. Net Assimilation Rate (NAR) and Crop Growth Rate (CGM) alone can not predict the TDM or LW as the R^2 values were very low.

Nutrient uptake at different growth stages

Plant samples (lamina, midrib, stem and root) at different growth stages under early, normal and late planting of 2006-07 season were analysed for N, P and K and uptake by individual plant parts were computed from which total uptake was calculated. Results revealed that the total uptake of N, P & K were maximum between 91 - 102 DAT, in early planting, 98 - 109 days in normal planting and 84 - 95 days in late planting. Uptake of nutrients was less in late planting.

Effect of different nitrogen doses on biochemical parameters

Pot culture experiment was conducted at CTRI, Rajahmundry to study the effect of different nitrogen levels viz., 0, 40, 80,120 160 and 200 kg N/ha on physiological and biochemical parameters. Leaf samples were collected from bottom, middle, top positions at 50, 60 and 70 days after transplanting (DAT) and were analysed for biochemical and physiological parameters. At 50 DAT, chlorophyll content index, specific leaf weight and N content were determined and correlation coefficients were worked out (Table 2). Results revealed that chlorophyll content, specific leaf weight and N content increased with increase in position of leaf from bottom to top on the plant and also nitrogen levels. Starch content increased with increase in DAT. Each successive increase in nitrogen levels decreased the starch content significantly in all positions. Nitrate reductase (NR) activity decreased with increase in DAT. Increase in nitrogen levels increased the NR activity. In general, higher levels of nitrogen (160 & 200 kg N/ha) showed significantly higher NR-ase activity over lower levels of N (40 and 80 kg N/ha). NR-ase activity increased from bottom to top level. Increase in DAT decreased the Nitrate-N content when nitrogen is applied at higher levels. In general, increase in nitrogen dose increased the nitrate-N significantly. Nitrate nitrogen increased from bottom to top position of the plant. Higher levels of nitrogen (160 and 200 kg N/ha) showed significantly higher Nitrate-N compared to lower levels (40 and 80 kg N/ha).

Permanent manurial trial

(P.R.S. Reddy)

Application of FYM @ 7.5 t/ha increased lamina nicotine content from a mean value of 2.21 to 2.51%, lamina N from a mean value of 2.20 to 2.39% and lamina K from a mean value of 1.37 to 1.66% over no FYM. Wide variations in lamina reducing sugars, lamina chlorides, and total ash content and lamina P were not observed between FYM applied and not applied treatments. However, application of FYM @ 7.5 t/ha decreased the insoluble residue and leaf burn. Chloride content of lamina was above the acceptable range in all the treatments.

As regards the application of inorganic sources of nutrients, application of N with or without FYM resulted in a slight increase in the leaf nicotine and nitrogen contents when compared to non-application of N fertilizer. No clear-cut differences were noticed in the leaf chemical composition or leaf burn with the application of P and K either individually or in combination with N.

Uptake of major nutrients by the whole plant

Application of FYM @ 7.5 t/ha increased the uptake of all the three major nutrients by the whole plant over non-application of FYM. Uptake (mean) of N increased from 45.6 to 61.6 kg/ha, P from 4.12 to 5.22 kg/ha and K from 58.3 to 77.0 kg/ha by the crop due to application of FYM @ 7.5 t/ha over non-application of FYM.

Table 2: Correlation matrix of biochemical parameters in FCV tobacco in NLS

	SLW	N (%)	Starch	NR Activity	Nitrate - N
CCI	0.409	0.943**	0.938**	0.862**	0.793**
SLW		-0.382	0.479*	-0.214	-0.302
% N			-0.947**	0.881**	0.846**
Starch				-0.818**	-0.788**
NR Activity					0.797**

As regards the application of inorganic sources of nutrients, application of N either alone or in combination with P or K or both increased the uptake of all the three major nutrients when compared to the absolute control and the fertilizer combinations without N. Phosphorus application either alone or in combination with the other two nutrients increased the uptake of P over absolute control. Application of potassium either alone or in combination with the other nutrients increased the uptake of K over absolute control. However, influence of N was more on N, P and K uptake than the influence of P or K which can be attributed to the higher yields obtained by N application.

Micronutrient distribution in different types of Indian tobaccos

(P.R.S. Reddy)

FCV tobacco leaf lamina samples of 2006-07 season pertaining to different platforms viz., Podili I, Podili II, Kandukur I, Kandukur II, Kaligiri and D.C. Palli spread over the entire Southern Light Soil (SLS) area were analyzed for the micronutrient cations viz., iron, manganese, zinc and copper. FCV tobacco leaf lamina samples from different locations of different platforms of the Karnataka Light Soil (KLS) area (2005 crop) were analysed for iron, manganese, zinc and copper. The observations warrant further studies on zinc and copper in the SLS area for establishing the deficiency/ hidden hunger, if any. Nevertheless, the occurrence of zinc and copper contents below the critical levels in a very few locations in SLS area can not be over emphasized, keeping in view of the toxicity of these micronutrients at higher concentrations. Hence, supplementation of these micronutrients need not be carried out at this juncture.

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

(D.V. Subhashini and C. Chandrasekhararao)

Dynamics of plant growth promoting rhizobacteria in Vedasandur soils

Soil samples were collected from Vedasandur to assess the PGPR status of the soil. Beneficial microorganisms inhabiting the rhizosphere of chewing tobacco variety Abirami were isolated, purified and identified as *Pseudomonas, Bacillus, Azotobacter, Azospirillum, Streptomyces, Trichoderma* and *Aspergillus*.

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

(D.V. Subhashini)

Pot culture experiment was conducted for 2 consecutive seasons to study the interaction of arbuscular mycorrhizae (AM) and *Frateuria aurantia* (FA) and their utility as biofertilizers in NLS. Combined application of VAM and FA with recommended dose of fertilizer (RDF) resulted in the maximum infestation of VAM and FA in the tobacco rhizosphere. There was no significant difference among treatments regarding plant height, number of leaves and seed weight. Fresh and dry weights of root, stem and inflorescence were superior to control in the treatments, VAM + RDF and VAM, in combination with FA + RDF. The available K in the soil is significantly more in the treatments FA + VAM + RDF followed by FA + VAM, showing a synergistic interaction between the two inoculated microorganisms in enhancing the uptake of important nutrients in tobacco.

Prospects of biofertilizers in nursery management of FCV tobacco

(D.V. Subhashini)

A nursery experiment was carried out to study the prospects of biofertilizers in FCV tobacco cultivation with 8 different treatments (T1 = Control, T2 = VAM (16 spores/g), T3 = *Pseudomonas fluorescens* (1 x 10^9 CFU/ml), T4 = *Azotobacter* (1 x 10^9 CFU/ml), T5 = T2+T3 (VAM + *P. fluorescens*), T6 = T2 + T4 (VAM + *Azotobacter*), T7 = T3 + T4 (*P. fluorescens*+ *Azotobacter*) T8 = T2+T3+T4 (VAM + *P. fluorescens* + *Azotobacter*) in 3 replications.

Seed inoculation was carried out using specific strains of microbes that can grow in association with plant roots viz., VAM,

Azotobacter and *Pseudomonas*. Seed treatment included with one or two or more bacteria without having antagonistic effect.

Tobacco seedlings were raised in nursery to study the effect of nitrogen fixing bacteria *A. chroococcum*, phosphorus solubilising bacteria, *P. fluorescens*, AM fungi, *Glomus intraradicus* on growth, metabolites and nutrient uptake. Bioinoculants improved fresh and dry weight of the seedlings with maximum enhancement in dual inoculation. Number of transplantable seedlings obtained are more in the treatments with dual inoculation. The establishment and multiplication of inoculated microorganisms were studied before transplanting the seedlings. The data showed that the population of *A. chroococcum*, phosphorus solubilising bacteria (PSB), *P. fluorescens*, AM fungi, *G. intraradicus* increased by manifold and established successfully in the rhizosphere of tobacco seedlings.

Carbohydrate metabolism as influenced by Nitrogen and Potassium nutrition in flue-cured tobacco grown in NLS

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

Chemical analysis of 20006-2007 leaf samples

Green leaf samples and cured leaf samples collected from different treatments were analysed for chemical quality constituents. Harvestable leaves contained lower per cent nitrogen and potassium as compared to developing green leaf indicating that there is remobilization of these two mineral elements once developmental activity is over in the growing and expanding leaf. Cured leaf samples from P, X, L, T leaf positions were analysed for nicotine, sugars and chlorides. Nicotine content increased with higher nitrogen levels. Nicotine content was higher in L and T-position leaves with 120 and 140 Kg N/ha as compared to 80 and 100 kg N/ha. Nicotine content was not affected by potassium levels and the interaction also became non-significant. Reducing sugars and chlorides were not affected by nitrogen and potassium levels. Nitrogen and potassium contents in cured leaves from L position has shown increasing trend with increasing levels of nitrogen dose from 80 to 140 kg N/ha and 120 to 210 kg K_2O, respectively. Starch in the cured leaf was not affected significantly by nitrogen or potash levels, though there was a decreasing trend in starch content with increasing levels of nitrogen application.

Crop season 2007-08

In the field trial conducted during the crop season 2007-2008, four levels of nitrogen (80, 100,120 and 140 kg N/ha) and four levels of potash (120,150,180 and 210 kg K_2O/ha) were tried at CTRI, RS, Jeelugumilli to study the effect of levels of nitrogen and potash on the yield and chemical composition of flue-cured tobacco variety Kanchan. Nitrogen levels significantly affected green leaf and cured leaf yields. Higher levels of nitrogen (120 and 140 kg N/ha) gave significantly higher green leaf and cured leaf yield as compared to 80 and 100 kg N/ha. Potash levels did not affect the yield characters and the interaction between nitrogen and potash became non-significant. Leaf area of three leaves from L position was measured and it was found that there was increase in leaf area of leaves from L position with higher levels of nitrogen as well as potassium. Cured leaf samples collected from different positions were processed and chemical analysis for quality constituents was carried out. Nicotine content in the cured leaf from X, L and T-positions did not change significantly due to levels of nitrogen or levels of potash, although there was increasing trend with higher dose of nitrogen application. Reducing sugars and chlorides also were not significantly affected by the levels of nitrogen and potash, though there was decrease in reducing sugars with higher dose of nitrogen.

Sucker control in flue-cured tobacco grown in NLS

(K. Nageswara Rao and M. Anuradha)

Sucker control in flue-cured tobacco grown in NLS is an important operation which results


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in substantial increase of yield and improvement in quality of tobacco. Various chemical suckericides were tried for sucker control earlier but semi-systemic suckericide formulations based on dinitro-aniline compounds were tested in the present trial along with contact type of suckericides. A field experiment with four suckericide treatments along with control, 4% Decanol was conducted at CTRI RS, Jeelugumilli during the crop season 2007-2008. The semi-systemic suckericides, Flumetralin and Pendimethalin were tried at 2% concentration alone and along with 3% Decanol application (Decanol application followed by Fluemetralin application). The results showed that the yield characters viz., green leaf, cured leaf and grade index were not significantly affected due to sucker control with new suckericides as compared to control i.e., 4% Decanol. Visual observation of the treatments showed that the semi-systemic suckericide application resulted in retardation in growth of the axillary buds and their colour turned yellow and remained as rudimentary structures. In the plots where Decanol application, followed the Flumetralin or Pendemethalin application, the retarded suckers were burnt and the axils were clean with total sucker control. To measure the extent of sucker control, observations on sucker number, sucker fresh weight and sucker dry weight were recorded. The results showed that sucker number was lower in 3% Decanol + 2% flumetralin applied plots in both the counts taken 10 days and 20 days after suckericide application. Sucker count, sucker fresh weight and sucker dry weight were higher in 4% Decanol as compared to all the other treatments. Chemical analysis of the cured leaf samples collected from the treatments showed that there was no significant difference among the quality constituents, nicotine, sugars and chlorides during the two crop seasons.

Float culture seedling production

Traditionally tobacco seedlings are produced in raised beds with overhead irrigation and sometimes in flatbeds with flood irrigation. 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 major problems and their effective control decides the success of the nursery. Sterilization of soil is effective in controlling soil borne diseases and nematodes but the chemicals used for this purpose are banned. To overcome these problems, a new method of seedling production system is required. Keeping these objectives in view, seedling production in float bed system was tried. In this method, 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. Preliminary investigations were undertaken on soil-less medium and tested for its suitability for seedling production. Direct sowing of the seed in trays is required in float-bed seedling production and attempts were made to achieve this using simple technique. Pelleted seed is convenient for faster sowing in trays and techniques of seed pelleting have to be adopted for achieving this.

Requirement of float-bed size, tray size, number of cells per tray, cell volume, water and nutrient requirements were studied for small scale operation. Float beds were constructed in poly-house and in open place. Plastic trays were filled with non-soil medium and sown with seeds of flue-cured tobacco variety Kanchan floated on float-bed water with major nutrients. Overhead irrigation on trays was avoided totally and the water level in the float-beds was maintained to wet the medium in the cells of the trays. Observations were recorded on germination, seedling growth, root:shoot ratio and vigour of the seedlings. Temperatures in both poly-house and open place were monitored. Temperature in poly-house was 5 ^{o}C higher than open place and this resulted in poor germination of the seed sown in trays. Whereas the seed sown in trays placed outside the poly-house germinated well and the growth of the

seedlings was fast. Seedling growth in float beds when compared with soil beds was faster and less number of days were required for production of transplantable seedlings. The seedlings produced from float-beds were intact root seedlings whereas seedlings produced in soil-beds were bare root seedlings. The proportion of root to shoot ratio was much higher for seedlings from float culture than seedlings from soil beds. These intact root seedlings and bare root seedlings were planted in soil pots at CTRI main building complex and also at CTRI farm Katheru, and 100% seedling establishment was recorded in float-bed seedlings as compared to seedlings from traditional nursery beds. The float-bed produced intact root seedlings did not undergo transplanting shock and initial growth in the field as well as in pots was better as compared to traditionally grown seedlings.

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

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

Two sand culture experiments were conducted using Mc Murtrey's nutrient medium. In the first experiment, three levels of potassium (8, 12 and 16 g/plant) was applied and its uptake and utilization were recorded. In the second experiment effect of magnesium on uptake and utilization of potassium was studied (Table 3). In the experiment on the effect of magnesium on potassium uptake and utilization, two levels of potassium (8.0 and 12.0 g/plant) were applied along with four levels of magnesium (1.2, 2.4, 3.6 and 4.8 g/plant). Nutrient solution prepared as per the formula of Mc Murtrey was applied in five split doses and waterings were given as scheduled. Harvesting and curings were completed and the leaf samples were collected and processed for chemical analysis. Results of chemical quality analysis showed that levels of potassium did not influence the green leaf or cured leaf yield. However, there was an increasing trend with higher levels potassium dose. Nicotine and sugars tended to increase with higher dose of K both in L and T leaf positions though the differences were non-significant and chloride content also was not affected by the treatments. In the study on interaction potassium and magnesium at higher levels of magnesium, both green leaf and cured leaf yield decreased in the two levels of potassium tested. Nicotine increased with increasing potassium level and decreased with increasing magnesium level whereas sugars and chlorides were not affected by the levels of potassium or magnesium.

Chloride nutrition of flue-cured tobacco

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

Pot culture experiment was conducted with six levels of chloride (0, 5, 10, 15, 20, 25 g Cl/plant) in light soil using recommended package of practices. Plants were topped and suckers were controlled using Decanol.

Table 3: Correlation coefficients (r values) among leaf burn, lamina chloride, leaf moisture and leaf thickness

	Leaf burn	Lamina chloride	Leaf moisture	Leaf thickness
Leaf burn	1.00			
Lamina chloride	- 0.787**	1.00		
Leaf moisture	- 0.692**	0.795**	1.00	
Leaf thickness	- 0.442**	-0.137	0.174	1.00

*, ** significant at 0.05 and 0.01 probability, respectively

Harvested leaf was cured in an electric barn. Yield and yield components were recorded. Cured leaf samples collected from X, L and T positions were analysed for leaf burn, leaf thickness, leaf moisture content, chlorides, nicotine and reducing sugars. The analysis of N and K are in progress. Results showed that chloride levels did not influence the final leaf area, yield characters and quality parameters. Leaf chloride content increased with increased level of applied chloride and leaf burn reduced with increased leaf chloride concentration at X, L and T-positions. Leaf moisture content and leaf thickness increased with increased concentration of applied chloride. Leaf thickness was more in T-position followed by L and X-positions. The association among lamina chloride, leaf burn, leaf thickness and leaf moisture contents were given as correlation matrix (Table). Leaf burn showed negative correlation with leaf chloride, leaf moisture and leaf thickness. Lamina chloride showed positive correlation with leaf thickness. The relationship between leaf burn and lamina chloride could be expressed as Y = 5.92 – 1.71 X. Where Y is leaf burn in seconds and X is per cent lamina chloride. Based on the regression analysis, it is concluded that the critical limit of lamina chloride for optimum leaf burn (> 4 seconds) is 1% for flue-cured tobacco variety Kanchan grown in northern light soils.

Nitrogen nutrition of flue-cured tobacco

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

Pot culture experiment was 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. The soil pH is 6.6 and EC is 0.12 dS/m with 1.22% organic carbon. Nitrogen content 42 kg/ha. The available P and K are 32 and 184 kg/ha respectively. At the age of 50 days, observations were recorded on photosynthetic rate, stomatal conductance, transpiration rate, Chlorophyll Content Index (CCI) and 9th leaf was sampled and dried in hot air-oven and leaf samples were analysed for nitrogen. Plants were topped and suckers were controlled using Decanol. Leaves were collected at the time of harvest and dried in an oven and harvested leaf collected from other three replicates was cured in an electric barn and yield was recorded. Cured leaf samples collected from X, L and T-positions were analysed for nicotine, reducing sugars and chlorides. Results showed that increased application of nitrogen increased net photosynthetic rate, stomatal conductance, transpiration rate, chlorophyll content index and lamina nitrogen content. No nitrogen treatment recorded more specific leaf weight compared to all other treatments. SLW reduced due to high level of applied nitrogen (12 g N/plant) whereas it did not show significant difference at X and L positions. Leaf area, cured leaf yield and grade index increased with increased level of applied nitrogen up to 9.6 g N/plant, thereafter a decline in yield characters was observed. But significant cured leaf yield was observed up to 4.8 g N/plant only. 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 and T-positions.

Influence of curing on chemical composition of chewing tobacco varieties grown in Tamil Nadu

(K. Siva Raju and J.A.V. Prasad Rao)

Chewing tobacco varieties (I-64, Bhagyalakshmi, Meenakshi, Abirami, Maragadam, Thangam and Vairam) were cured under three methods (sun-curing, pit-curing and smoke-curing) of curing. Curing methods significantly influenced the biochemical composition of chewing tobacco grown in Tamil Nadu.

Nicotine: 1.67 to 4.08%

- No significant variation among the varieties except
- Significantly low in variety Maragadam
- Significantly lower in smoke-cured samples compared to pit-cured and sun-cured samples

Chlorides: 4.01 and 5.61%

Reducing sugars: 0.07 to 0.82%

Total chlorophylls: 0.531 to 1.835 mg/g

- Significantly higher in smoke-cured samples compared to pit- cured and sun-cured samples
- Higher in pit-cured samples compared to sun-cured samples

Chlorophyll a: 0.284 to 1.289 mg/g

- Significantly higher in smoke-cured samples (2.5 to 4.5 times higher over sun-cured samples)
- Significantly higher in pit-cured samples compared to sun-cured samples

Chlorophyll b: 0.159 to 0.415 mg/g

- Significantly higher in smoke-cured and sun-cured samples compared to pit-cured samples

Carotenoids: 0.189 to 0.784 mg/g

- Significantly higher in sun-cured samples over smoke-cured and pit-cured samples
- Significantly higher in smoke-cured samples compared to pit-cured samples Significantly higher in Abirami (sun-cured)

Rutin: 0.62 and 7.29 mg/g

- Significantly higher in sun-cured and smoke-cured samples over pit-cured samples
- Smoke-cured > Pit-cured

Chlorogenic acid: 1.64 to 4.37 mg/g

- Significantly higher in the variety I-64 except Bhagyalakshmi
- Significantly higher in pit-cured samples compared to sun-cured and smoke- cured samples
- Significantly higher in sun-cured samples over smoke-cured samples

Starch: 0.39 to 2.5 mg/g

- Significantly higher in sun-cured and pit-cured samples
- Lower levels in smoke-cured samples when compared to pit-cured and sun-cured samples

Free fatty acids (FFA): 8.66 to 68.63 µ moles/ 5g

- 1.9 and 5.6 times more in pit cured-samples compared to smoke-cured and sun- cured samples, respectively

Total carbonyls: 189.66 to 663.43 mg/100g

- Significantly higher in the variety Thangam
- Significantly higher in smoke-cured samples compared to sun-cured and pit-cured samples

Protein: 6.54 to 14.26 mg/g

- Significantly higher in varieties I-64, Bhagyalakshmi and Abirami
- Significantly higher in sun-cured samples compared to pit-cured and smoke- cured samples

Nitrate nitrogen: 0.37 to 5.52 mg/g

- Significantly higher in the variety Meenakshi over other varieties except I-64 Significantly higher in smoke-cured samples
- Significantly higher in sun-cured samples compared to pit-cured samples

Petroleum Ether Extractives (PEE): 5.90 to 15.07%

- Significantly higher in varieties I-64 and Meenakshi 69.96 and 89.95% higher in pit-cured samples compared to smoke-cured and sun-cured samples, respectively

Leaf Testing Laboratory

During the period under report, **10,463** 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 analyzed for various chemical quality parameters viz., nicotine, reducing sugars, chlorides and total N (Tables 4 & 5).


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Table 4: Chemical quality parameters of FCV tobacco in different centres (2007-08)

Soil Type	Varieties	Nicotine (%)	Reducing sugars (%)	Chlorides (%)
NBS	Hema	1.97 - 2.30	11.88 - 14.66	0.92 - 1.43
	VT 1158	1.36 - 2.78	11.58 - 18.00	0.81 - 1.64
	Siri	1.72 - 2.78	11.90 - 13.45	0.83 - 1.48
CBS	Siri	1.58 - 2.66	10.71 - 15.82	0.16 - 0.25
	VT 1158	1.80 - 2.32	14.02 - 17.12	0.23 - 0.28
	Hema	1.93 - 1.97	15.20 - 15.98	0.20 - 0.37
	Hemadri	1.51 - 2.23	11.76 - 17.30	0.18 - 0.28
SLS	Hema	2.71 - 2.82	5.52 - 7.96	0.47 - 0.51
	Kanthi	2.85 - 2.96	6.31 - 8.99	0.41 - 0.61
	Siri	2.32 - 2.59	8.86 - 10.40	0.36 - 0.46
Chemical quality parameters of FCV tobacco in different areas (2007-08)				
NLS	Kanchan (X)	1.20 - 2.35	9.73 - 13.25	0.93 - 1.51
	(L)	1.75 - 2.57	8.92 - 18.67	0.81 - 1.00
KLS	Kanchan (X)	0.79 - 1.18	13.00 - 19.37	0.10 - 0.13
	(L)	0.87 - 1.18	12.74 - 15.98	0.09 - 1.11
	Rathna (X)	0.44 - 1.32	14.31 - 21.77	0.11 - 0.14
	(L)	0.89 - 1.26	13.94 - 17.44	0.10 - 1.08
	Thrupthi (X)	0.96 - 1.35	15.69 - 18.66	0.11 - 0.12
	(L)	1.03 - 1.26	12.46 - 17.89	0.09 - 1.19

Table 5: Chemical quality parameters of *Bidi* tobacco (2007-08)

Centre	Varieties	Nicotine (%)	Reducing sugars (%)	Chlorides (%)
Araul	A 119	1.48	9.49	1.57
	GT 5	1.86	6.44	1.78
Nandyal	A 119	3.42	3.43	1.75
	GT 7	1.40	6.20	0.65
	Bhavyasree	2.20	5.66	0.95
Nipani	A 119	5.42	7.89	1.76
Chemical quality parameters of *Natu* tobacco (2007-08)				
Berhampur	Gajapati	5.35	1.08	0.36
Guntur	Prabhat	2.23	0.60	0.64
	Natu special	1.52	0.86	0.26
	Viswanath	1.01	0.46	0.27
	Bhairavi	1.38	0.23	0.19
	WAF	1.12	0.44	0.21
Jeelugumilli	Kommugudem Melmi	2.78	0.84	1.57
	Kommugudem Gulla	1.99	0.75	1.13
	Rangapuram Melmi	2.79	0.81	1.17
	Rangapuram Gulla	1.22	0.73	1.09
Chemical quality parameters of HDBRG and *Rustica* tobaccos (2007-08)				
		HDBRG		
Guntur	HDBRG 1	2.71	0.42	0.23
	HDBRG 2	2.63	0.42	0.37
		Rustica		
Araul	ST 1	5.75	1.11	1.33

Soil and Water Conservation Engineering

Effect of micro-sprinklers and fertigation on tobacco seedlings production

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

Experiment on micro-sprinklers and fertigation for tobacco nurseries was conducted to reduce the labour cost and improve water and nutrient-use-efficiency. Geometry of micro-sprinklers, uniformity, coverage, growth of seedlings, number of transplantable seedlings and labour requirement under micro-sprinklers were studied and compared with control (water applying with rose cans). The study indicated that the placing the lateral and micro-sprinklers in between beds of 1 m width of each and 4 sprinklers are required for irrigating two beds of 1 m width and 10 m length of each. The optimum spacing between laterals was found to be 2.5 m and the spacing between micro-sprinklers was 2.5 m under the operating pressure of 1.25 to 1.5 kg/cm^2. The root volume, weight and height of the seedlings were higher in case of seed beds irrigated by micro-sprinklers when compared to rose-cans. The results of the study revealed that the transplantable seedlings were more and seedlings growth under micro-sprinkler was rapid and were ready for transplanting in 45 days as compared 60 days in traditional water application. The cost of micro-sprinklers was Rs.85,000/ ha. Applying water to tobacco seed beds through micro-sprinklers reduced the labour cost by Rs.1,45,000/ha (Table 6).

CTRI Research Station, Jeelugumilli

Moisture and nutrient depletion/utilization pattern under NLS conditions

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

Significant differences were observed in the cured leaf and grade index of tobacco due to N and K levels. Among the three levels, application of N @ 115 and 140 kg/ha being on par recorded significantly higher green leaf, cured leaf and grade index whereas significantly lower green and cured leaf yields and grade index were observed at 90 kg N/ha.

Observations on soil moisture content showed that during the crop growth period, more amount of irrigated water was absorbed by the root system from 20 cm depth, indicating that most of the root system is confined to the upper layers and not going into

Table 6: Comparison between water application with micro-sprinklers and rose-cans

Particulars	Water applied through	
	Rose-cans	Micro-sprinklers
Labour cost/ha (Rs.)	1, 80, 000	18,000
System cost/ha (Rs.)	Nil	85,000
Annual cost (includes labour and system costs)/ha	1,80,000	35000
Application Uniformity	Poor	Good
Average Root Volume of the plant (ml)	0.7	1.1
Mean height of the plant (cm)	5.4	11.4
Average weight of the plant (g/plant)	8	12
Days to transplanting	60	45
Number of transplantable seedlings/m^2 bed in first pulling	243	462
Total number of transplantable seedlings/m^2 bed	648	862


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deeper layers. When the root system was removed, the tap root length varied between 10 to 14 cm and the tip was bending and was not straight. Profuse growth of lateral roots was observed spreading within 20 to 25 cm below the ground level and tap root growth was restricted (Fig. 11).

2006-07 season

N and K uptake at 30, 60 and 90 days after planting was computed. Uptake was higher at 90 days after transplanting (DAT). Reducing sugars increased from P to L position and decreased in T-position. With increase in N levels, reducing sugars decreased in all the positions whereas potassium increment increased the sugars. Nicotine content increased from 'P' to 'T' position. Increase in N and K levels increased nicotine content in all the positions. Chlorides were within the acceptable limits.

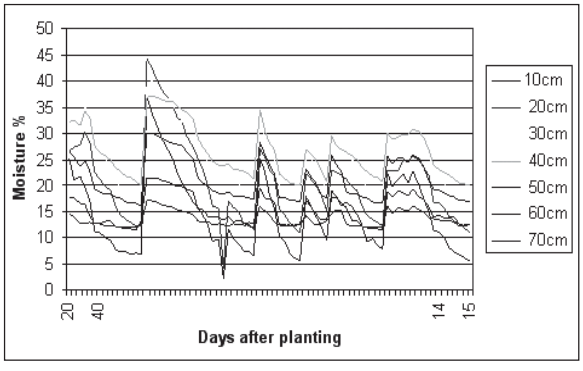

Fig. 11: Moisture utilization pattern by cv. Kanchan (20 to 150 DAT)

Nitrogen budgeting for FCV tobacco variety Kanchan in irrigated Alfisols

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

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

In general, reducing sugars increased from P (12.95) to X (13.87) and L (21.02) positions and decreased in T (12.97%) position. Nicotine content increased gradually from P (1.71) to T (2.37%) position. Reducing sugars/ nicotine ratio decreased from P (7.97) to X (7.36) position and increased from X to L (9.98) position and was lowest in T (5.53) 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 and reducing sugars/nicotine. Chlorides were well within the acceptable limits (<1.5%).

BTRC, Jeddangi

Effect of spacing and nitrogen levels on yield and quality on Burley tobacco hybrid: YBH-1

(R. Subba Rao and P. Harishu Kumar)

To study the effect of various spacing and nitrogen levels on yield and quality of Burley tobacco hybrid JBH-1, three spacings (0.8 x 0.45 m, 0.9 x 0.45 m and 1.0 x 0.45 m) as main plots and four levels of N (100,120,140 and 160 kg N/ha) as sub-plots were tested in split plot design replicated thrice.

The results indicated that the spacing 0.8 x 0.45 m for this hybrid is sufficient to produce significantly maximum cured leaf over other spacing. The pooled analyses indicated that application of 140 kg N/ha recorded significantly higher cured leaf yield over 100,120 and 160 kg N/ha.

Studies on the influence of plant population and nitrogen levels on yield and quality of Oriental tobacco. (Variety: Izmir)

(R. Subba Rao, P. Harishu Kumar)

To develop crop management practices for oriental tobacco var. Izmir, four spacings (0.3 x 0.12 m, 0.3 x 0.15 m, 0.4 x 0.12 m and 0.4 x 0.15 m) as main plots and four levels of nitrogen (0,5,10 and 15 kg N/ha) as sub-plots were tested in a split plot design, replicated thrice.

The results indicated that a spacing of 0.30 x 0.12 m recorded more cured leaf and at par with 0.30 x 0.15 m both in 2007 and also in pooled data. The pooled data indicated that all nitrogen levels are at par and significantly superior to control.

Studies on N and K interaction effects on Oriental tobacco leaf yields (variety : Izmir)

(P. Harishu Kumar, R. Subba Rao and C. Chandrasekhararao)

Only nitrogen could influence both the green and cured leaf yields. Potassium influenced only green leaf. N x K interaction on green leaf and cured leaf production was not significant. Nitrogen application @ 15 kg/ha recorded a maximum of 3,389 kg green leaf and significantly superior to other levels. Potash @ 30 kg /ha recorded maximum green leaf yield of 3,159 kg/ha and significantly superior to other levels. Since, K levels and N and K interaction were not significant, the lowest level of K i.e., 10 kg K/ha with 15 kg N/ha is beneficial.

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

(P. Harishu Kumar and R. Subba Rao)

Response of white Burley tobacco to vermicompost (2, 4 and 6 t/ha) was studied at three levels of nitrogen (100,120 and 140 kg/ha). Application of vermicompost and nitrogen levels significantly influenced Burley cured leaf yields in light soils. Maximum cured leaf of 2,683 kg/ha was produced with 4 t vermicompost + 120 kg N/ha and at par with the leaf produced with of 4 t vermicompost + 140 kg N/ha. It is concluded that 4 t vermicompost + 120 kg N/ha would be sufficient to harvest maximum cured leaf.

Growth and development of white Burley tobacco variety: Banket-A1

(P. Harishu Kumar, R Subba Rao and C. Chandrasekhararao)

In order to study the growth and development of Burley tobacco, a field study was conducted by taking observations on staggered planted Burley tobacco plants at an interval of 10 days. The observations were made from 20 days after transplanting (DAT) to 110 DAT at 10 days interval.

The increment in plant height was low up to 50 DAT (0.87 cm/day). The plant height shot up from 50 to 60 DAT at a higher rate (4.3 cm/day) and then maintained a low rate up to 80 DAT (0.85 cm/day). From 80 DAT to 110 days, the rate of growth was maximum (3.27 cm/day). It clearly indicated that the rate of growth was maximum from 50 to 60 DAT closely followed by from 80 to 110 DAT.

The cured leaf production increased from 20 to 40 DAT @ 1.25 g/day while it was 5 g/day from 40 to 60 DAT. From 60 DAT to 110 DAT; it was 1.41 g/day. It was noted that the leaf moisture reduction was not there, concomitant with improvement in leaf number and leaf dry matter accumulation. It is it is inferred that the leaf moisture at 40 – 60 DAT is very crucial for development of Burley tobacco.

The Burley plant recorded about 68 g dry matter at 110 DAT on an average. The root dry matter followed the track of the stem dry matter. The root dry matter recorded 36.76% of the total weight from 50 to 60 DAT indicating 25% improvement from 40 to 50 DAT. The next improvement of root dry matter was 19.12% from 80 to 90 DAT.

It is therefore concluded that for the Burley tobacco, variety Banket-A1, the growth phase from 40 to 70 DAT is very crucial for the crop and may be a critical phase in its life cycle. Hence, it is recommended to give proper


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crop nutrition in terms of nutrients and water for expression of its full potential in terms of leaf yields and quality.

Uptake of N, P, K on whole plant basis

Though, nitrogen accumulation is seen throughout the growing period up to 110 days, there is a spurt from 40-50 DAT and thereafter improved by 1.00 to 1.50 g/plant at every 10 days interval recording a maximum of 12.99 g/plant at 110 DAT.

Total phosphorus uptake showed a quantum jump from 40 to 50 DAT and thereafter increased reaching to 1.6564 g p/ plant at 110 DAT.

Potassium uptake showed a quantum jump from 40 to 50 DAT in the plant and there after showed improvement to 18.40 g/plant at 110 DAT. The Burley tobacco variety Banket A1 starts putting up high dry matter in all the three parts i.e. leaf, stalk and root from 40 days after planting coinciding with the maximum growth rate of leaf dry matter at 50 DAT. It is concluded that the growth phase from 40 to 50 days after planting is very crucial for dry matter accumulation and also N P K nutrients accumulation (Table 7).

Table 7: N, P, K accumulation by the whole plant (g/plant) of Banket A1

DAT	Nitrogen (g/plant)	Phosphorus (g/plant)	Potassium (g/plant)
20	1.454	0.1408	1.18
30	2.200	0.1915	1.70
40	2.963	0.2736	2.53
50	5.670	0.6874	5.22
60	7.130	0.8145	7.04
70	8.380	0.9946	8.43
80	9.810	1.3276	13.69
90	11.19	1.4878	15.67
100	11.60	1.4268	16.65
110	12.99	1.6564	18.40

Analysis of leaf nicotine and reducing sugars on whole leaf basis indicated that nicotine concentration increased up to 60 DAT and thereafter, with the maturity of leaf it reduced gradually. The reducing sugars also increased up to 60 DAT and thereafter decreased, almost maintaining the same trend.

Studies on nutrient concentration of white Burley tobacco under the combination of chemical and biofertilizers

(P. Harishu Kumar and C. Chandrasekhararao)

Four schedules of treatments DAP, CAN, SOP, K-mobilizers, *Trichoderma* and PSB were tested on 500 plants under each set were tested. The middle and upper middle pick leaves were cured and NPK concentrations were estimated.

The results indicated that application of DAP, CAN, and SOP recorded 3.98% leaf N. Addition of *Trichoderma* + PSB along with DAP, CAN, SOP increased the leaf N to 4.67% whereas when SOP was substituted with K mobilizers along with DAP, CAN, Tricho and PSB, the leaf N content was 4.62 %. Addition of DAP, CAN, SOP, K-mobilizers Tricho and PSB marginally increased the leaf N (4.40%) to sole inorganic fertilizers (3.98%).

Application of DAP, CAN and SOP recorded 4.45% leaf K. Addition of Tricho and PSB to DAP, CAN and SOP increased leaf K to 4.60%. Whereas substitution of SOP with K-mobilizers increased leaf K to 4.80%. Addition of DAP, CAN, SOP K-mobilizes, Tricho and PSB recorded 5.35% K in the leaf.

Leaf phosphorus concentration was 0.46% due to application of inorganic fertilizers i.e., DAP, CAN and SOP. Addition of biofertilizes *Trichoderma* and PSB did not show any improvement in leaf P. Substitution of SOP with K-mobilizers have slightly improved leaf P but addition of both SOP and K-mobilizers recorded 0.46% leaf P as that of DAP, CAN and SOP applied plots. It is indicative that K-mobilizers application in the absence of SOP is beneficial in terms of leaf P. However, addition of all chemical and biofertilizers have improved leaf K in Burley tobacco besides

improvement in leaf N compared to application of inorganic fertilizer.

Row alignment studies in Burley tobacco on cured leaf production

(P. Harishu Kumar)

As the labour force is becoming scarce, it was proposed to change the row alignment in order to operate the tractor in the main field for inter-culture. In this context, four row alignments were tested. It is clear from the data that any altercation from the recommended spacing of 0.9 x 0.45 m adversely affects the cured leaf production. Hence, mechanization of intercultural operations with the tractor is questionable.

Control of sheet erosion on hilly terrain

(P. Harishu Kumar)

Due to hilly terrain of the agency area, the hills from as catchments area for the low land. The water courses during rainy season take a greater momentum resulting into sheet erosion. Due to this erosion, the ridges and furrows are damaged and the crop suffers. In order to save the crop and the soil, gullies of medium size were diverted and smaller gullies were plugged with brush wood dams. These brush wood dams were bamboo splits interwoven to each other and placed across the gullies. The flow of water was arrested and it took to a steady state of flow so that the soil erosion is avoided. In order to save the fertile soil and to recycle it, trenches of 1.5 x 1.5 x 1.5 m depth were dug in across the water flow and the water was diverted to these trenches. Brush wood dams were placed at the outlet of the trench. The filtered water from the check point I, reaches to the trench, stabilizes, the silt is accumulated and excess water flows out through the check point II. Therefore, the damage to the crop is controlled to a larger extent.

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Ridge rakers

(P. Harishu Kumar)

Weeds are major problem in white Burley tobacco. Due to heavy rainfall, water along with weed seeds from the hill slopes settle down in the fields and cause lot of concern. In order to minimize the weed growth and also to loosen the compacted ridges, rakers were developed locally to rake the ridges immediately after the rain. This raking process not only loosens the soil but also disturbs the germinating seed. The raker is made up of mild steel consisting of 10" blade fitted with 30 iron pointers, with one handle rod fixed at 60^0 angle for operational ease. Two manual workers can rake one acre field in two hours time on both sides of the ridge.

CTRI Research Station, Guntur

Development of organically grown FCV tobacco in central Vertisols

(P. Harishu Kumar and G. Raghupathi Rao)

In situ green manuring with *pillipesara* produced significantly higher yields of FCV tobacco followed by incorporating *bajra* crop *in situ* when compared with sunnhemp and control (without *in situ* green manuring).

As regards sub-plot treatments, treatment consisting of application of *Azospirillum* + VAM +PSB produced significantly higher yield of all the characters compared to all other treatment combinations, followed by application of *Azotobacter* + PSB in the production of FCV tobacco in Central Vertisols.

The interaction effect of Main x Sub-plot treatments did not give favourable response in the production of cured leaf and bright leaf production while in respect of green leaf and grade index production, sunnhemp (GM) with *Azospirillum* + VAM + PSB proved superior over all other treatment combinations.

Response of Oriental tobacco types to N and K fertilization under different agro-climatic conditions

(P. Harishu Kumar and G. Raghupathi Rao)

Four varieties viz., Izmir, Bergam, Xanthi and Komo were evaluated separately in RBD with three replications at Giddalur, LK Doddi and Munagal areas. It is evident that the variety Bergam at all the three locations Giddalur,

LK Doddi and Munagal showed superior performance in producing higher cured leaf yields of 627 kg/ha, 935 kg/ha and 976 kg/ha, respectively with 20 kg N and 7.5 kg K_2O/ha. Next best is Xanthi , Izmir and Izmir for Giddalur, Raichur and Munagal locations, respectively.

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. Chandrasekhararao)

Farmers using water containing chlorides up to 500 ppm have succeeded in growing nurseries in some seasons with variable results. An experiment was conducted in nursery using water containing 28, 50, 100, 200, 300, 400, 500 and 600 ppm chlorides in main plots and two fertilizer levels viz., recommended dose of fertilizer (RDF) and 1½ times to RDF in sub-plots. The germination count tended to decline significantly in response to increased chloride content beyond 200 ppm. The diseases occurring in nursery viz., damping-off and blight showed a slight tendency to decline with increased chlorides in irrigation water. However, the differences were non-significant. The damping-off and blight incidence were relatively more at increased fertilizer dose compared to RDF. The growth of seedlings as indicated by fresh and dry weight decreased significantly with increase in chlorides in irrigation water beyond 200 ppm. The differences were significant in dry weight of seedlings only. The weight of seedlings was more under increased fertilizer level especially when water with high chlorides was used. The yield of transplantable seedlings decreased with increase in chlorides in water. The reduction was steep beyond 200 ppm chlorides. Significantly, higher number of transplantable seedlings was recorded under increased fertility level especially with water containing high chloride.

Part of the experiment was carried out in pot culture also, to observe the effects of main plot treatments more clearly. The increase in chloride content in water decreased the germination count significantly, especially beyond 200 ppm. The effect on damping-off and blight were non-significant. Growth of seedlings indicated by fresh and dry weights were affected more severely compared with the study in nursery. Yield of transplantable seedlings was reduced significantly beyond 200 ppm chlorides in irrigation water.

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

(R. Sreenivasulu and K. Nageswara Rao)

To find out the effective sucker control agent, some new chemicals at varying concentrations were tried along with recommended practices/chemicals. Prime + (Flumetralin) and Stomp (Pendimethalin) were tried @ 0.75, 1.00, 1.25 and 1.5% along with Sucker out, hand suckering and no topping control.

Topping improved the yields of cured leaf and bright leaf by 8.5 and 5.3%, respectively over no topping (control). When cured leaf yields were considered, the yields were almost similar between hand suckering, Prime + at 1.50%, 1.25%, 1% stomp at 1.25% and 1%, and Decanol 4%, Suckerout 4% with topping and in no suckering, the yields tended to go down by 4.8%. From these results, it may be seen that Prime + at 1.25%, and Stomp at 1.50% are promising for sucker control under SLS conditions. The mean values of nicotine, reducing sugars and chlorides in leaf were, 3.33, 16.33 and 0.43%, respectively and nicotine tended to increase due to topping and sucker control.

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)

An experiment was laid with three dates of planting (September III week, October II week and October IV week) and three varieties

(high yielding variety, Siri, promising line, N-98 and popular variety 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. The results indicated maximum yields in variety Siri followed by N-98 and Hema. Variety Hema was out yielded by Siri and N-98 by 21.76 and 19.4 % in first date of planting, by 17.6 and 15.6% in second date and by 3.7 and 7.3 % in third date i.e., late planting indicating early planting as the major requirement for Siri and N-98 under SLS conditions.

When averaged over varieties and fertilizer levels, the yield improvement due to early planting was 44% and middle date of planting was 39% compared to delayed planting. The mean bright grade out turn was 60.4% in early plating, 55.5% in middle planting and 44.5% in late planting. Variety Siri and line N-98 were on par and superior to Hema in early and middle date of planting. However, all the three varieties were on par in late planting. Yields increased with increase in fertilizer level up to 100-60-80 NPK kg/ha. However, differences between 80-60-70 and 100-60-80 NPK kg/ha were non-significant. The mean values of nicotine, reducing sugars and chlorides in leaf samples were 2.75, 13.97 and 0.26%, respectively with minor variations between treatments. Nicotine showed an increase with delay in planting and it was relatively low in Siri compared to line N-98 and cv. Hema.


SIRI

Yields of FCV tobacco variety Siri as affected by nitrogen levels and topping treatments

(R. Sreenivasulu)

FCV tobacco variety Siri released by CTRI, Rajahmundry during the year 2006 proved highly successful in black soils (SBS) and light soils (SLS). Encouraged by the results, farmers of SLS area are trying to take up this variety to improve the yield levels. Hence, a feeler trial was conducted to study the response of variety to nitrogen levels and topping treatments. The experiment was laid out with three levels of nitrogen @ 50, 60 and 70 kg/ha with and without topping in RBD design with four replications.

The results indicated improvement in yields with increasing nitrogen dose from 50-70 kg N/ha. However, the bright leaf outturn tended to go down beyond 60 kg N/ha. Topping improved the cured leaf yield by 8.3% at 50 kg N/ha to 5.8% at 70 kg N/ha. Maximum cured leaf yields were recorded at 70 kg N/ha under topped condition followed by topped crop at 60 kg N/ha and untopped crop at 70 kg N/ha. The mean values of nicotine, reducing sugars and chlorides were 2.52, 16.06 and 0.25%, respectively.

The nicotine content tended to increase with topping at increased N dose. However, sugar levels showed minor variations due to treatments. Keeping in view the steadily decreasing market price, differences between higher and medium grades; higher cured leaf yields may be aimed at even with increased nitrogen level, however, this needs in depth study.

CTRI Research Station, Hunsur

Integrated nutrient management in FCV tobacco

(M. Mahadevaswamy)

Integrated Nutrient Management practices involving different organic: inorganic ratios and various sources of organics were evaluated. The final year trial confirmed that 25:75 ratio as the optimum INM package for realizing maximum productivity of both Cured Leaf Yield (CLY) and Top Grade Equivalent (TGE) compared to 50:50 or 75:25 ratios.

The 25:75 ratio recorded higher productivity of both CLY and TGE compared to fully inorganic treatment also. This INM practice was also similar in productivity to recommended NPK + recommended FYM schedule indicating 25% saving in fertilizer N. Among the different sources of organic manures tried, vermicompost was found to be better followed by press-mud application.

The INM practices with 25:75 and 50:50 organic:inorganic ratio recorded comparatively

higher nicotine values and lower Reducing sugars compared to 75:25 ratios whereas recommended packages (recommended FYM + NPK) and 100% inorganic (recommended NPK only) treatments recorded higher nicotine values compared to all the INM practices (Fig.12).

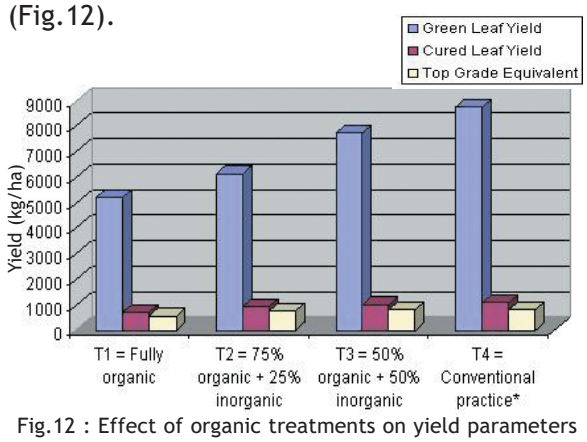

Fig.12 : Effect of organic treatments on yield parameters

Effect of organic treatments on yield parameters

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

(M. Mahadevaswamy)

The regular recommended spacing of 100 x 55 cm (18,181/ha) was found superior to 100 x 60 cm (16,666/ha) spacing in both the varieties.

Topping at 18 leaves was found to increase the yield by 4.9% in FCH 201. The positive response up to 70 kg N/ha was observed in FCH 196 while 60 kg N/ha was found to be sufficient for FCH 201. N level at 70 kg N/ha increased the productivity by 4.5% in FCH 196 compared to the recommended dose of 60 kg N/ha. Topping at 18 leaves stage and application of 70 kg N/ha slightly increased the leaf nicotine values (in both X and L) compared to 20 leaves topping and lower N doses (50 and 60 kg/ha) in the variety FCH 196.

Feasibility of producing organic tobacco under KLS

(M. Mahadevaswamy)

Feasibility of producing organic tobacco using various organics (vermicompost @ 6 t/ha, use of biofertilizers @ 10 kg/ha, green manuring with sunnhemp, use of neem based organic and bio-pesticides etc. is being attempted on a permanent site at Sollepura farm since 2006-07 season. The results of the second year trial indicated that fully organic treatment resulted in 36% loss in productivity to an extent of green leaf yield, and 32.8% in TGE. However, the bright grade out turn from the total cured leaf production was 81.6% in organic treatment while it was only 76.5% in the conventional practice. The yield reduction with respect to 75:25 and 50:50 (organic: inorganic) ratios was 16% and 6.4%, respectively compared to conventional practices. Leaf nicotine values were low in the fully organic treatment compared to conventional practice.

CTRI Research Station, Dinhata

Permanent manurial trial on *Motihari* tobacco

(S. Amarnath and S. Roy)

Data on permanent manurial trial showed that the application of 112 kg N + 112 kg P_2O_5 + 112 kg K_2O/ha significantly increased the green (15,300 kg/ha), cured (2,596.1 kg/ha) and first grade (1,613.8 kg/ha) leaf yield of *Motihari* tobacco 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 or 25 and 50 tonnes FYM/ha. It is clear from data that the application of nitrogen is essential for yield and quality of *Motihari* tobacco. FYM at 50 tonnes/ha was significantly superior to 25 tonnes FYM/ha for green leaf yield only.

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. The per cent recovery (62.2%) of first grade leaf was highest in NPK and closely followed by NK and NP applied plots. There was no significant impact of application of phosphorus either alone or in combinations of different inorganic

fertilizers and FYM on the P content in the leaves of *Motihari* tobacco. Significantly highest K content in the leaf was recorded in the potassium applied treatments.

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

(S. Amarnath)

To find out an optimum spacing and nitrogen level for the new advanced breeding line Torsa, the experiment was conducted in split plot design with 2 spacings, 3 N levels and 3 replications along with the check variety Bitri. Analysis of data indicated significantly higher cured leaf yield in genotype Torsa than Bitri (Fig. 13). Lower spacing i.e. 45 x 45 cm registered higher cured leaf yield. Non-significant difference was observed between lower and higher levels of spacing in cv. Bitri. However, first grade leaf yield was found to be significantly higher at higher level of spacing i.e., 60 x 45 cm with higher recovery of quality leaf. There was significant increase in cured leaf yield with addition of nitrogen from 100 kg/ha to higher levels (125 and 150 kg/ha), however, the yield was at par in 125 and 150 kg N/ha. The trend remained the same in the case of first grade leaf yield but the yield at 150 kg/ha was significantly superior to 125 kg N/ha.

CTRI Research Station, Vedasandur

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

(M. Kumaresan and K. Palanichamy)

Two advanced breeding lines viz., HV 2000-2, HV 2000-6 and along with check Abirami were tested under two spacings viz., 75x75 cm and 90 x 75 cm and at two N levels 75 and 100 kg N/ha in split plot design with three replications.

Fig.13: Hookah tobacco variety, Torsa

The results of the pooled data revealed that FGLY (2,559 kg/ha) and TCLY (3,204 kg/ha) was significantly higher with HV 2000-6. The spacing 75 x 75 cm gave significantly higher FGLY (2,631 kg /ha) and TCLY (3,339 kg/ha). Nitrogen levels did not influence the yields of chewing tobacco. The line HV 2000-6 recorded significantly higher leaf length as well as leaf width at topping stage. The line HV2000-6 recorded significantly higher leaf length at harvest stage, whereas leaf width was not influenced by the genotypes at harvest. Leaf length at topping as well as harvest stage was not influenced by levels of spacing. At harvest stage, 90 x 75 cm spacing recorded significantly higher leaf length and width. Whereas, leaf length at topping, leaf width at topping/harvest stage were not influenced by levels of N. The advanced breeding line HV 2000-6 recorded higher FGLY and TCLY under 75 x 75 cm spacing and 75 kg N/ha.

Phosphorus management in chewing tobacco under Vedasandur conditions

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

The results of the first year of the second cycle revealed that the existing practice of applying 100% P was comparable with 100% P + PSB, 50% P + PSB, 75% P + PSB with respect to first grade leaf (FGLY) and total cured leaf (TCLY). Similar trend was observed with respect to growth attributes viz., leaf length and leaf width at topping as well as harvest stage. Lower FGLY and TCLY were recorded with no P. Significantly higher gross returns (Rs. 72,527/ha) were recorded with 100% P + PSB. Lower gross returns (Rs. 58,732/ha) were recorded with no P. Higher net returns (Rs. 30,542/ha) were recorded with 50% P + PSB followed by 100% P + PSB. B:C ratio did not show significant differences between treatments. However, 50% P + PSB recorded higher B : C ratio.

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)

Nitrogen uptake ranged between 102.72 to 115.47 kg/ha in chickpea and 217.91 to 249.91 in the soybean – chickpea system. Phosphorus uptake ranged between 12.76 to 15.28 kg/ha in chickpea and 24.6 to 29.74 in the soybean – chickpea system. Potassium uptake ranged between 72.24 to 80.38 kg/ha in chickpea and 137.80 to 159.68 in the soybean – chickpea system. Lower values for NPK uptake were observed in the plots where only inorganic fertilizers were given to soybean. Higher values for NPK uptake were observed in the plots where vermicompost was given to soybean. In case of *rabi* crop, application of nutrients at RDF recorded more uptake as it gave higher yields than 25% reduction in either N or P.

CTRI Research Station, Jeelugumilli

Effect of *Rhizobium* and PSB inoculation on blackgram yield and its residual effect on succeeding FCV tobacco cv. Kanchan under irrigated Alfisols

(S.V. Krishna Reddy, S. Kasturi Krishna and C. Chandrasekhararao)

Pooled results of the project showed that combined application of *Rhizobium* and PSB inoculations to blackgram increased blackgram grain yield significantly as compared to single inoculation of either *Rhizobium* or PSB. Single inoculation of either *Rhizobium* or PSB also resulted in significantly higher yields as compared to no inoculation. Blackgram yield was higher in 2005-06 seasons as compared to 2006-07.

Sunnhemp -Tobacco recorded significantly higher green leaf, cured leaf and grade index as compared to other treatments. Dual inoculation of *Rhizobium* and PSB to blackgram increased tobacco green leaf yield by 13.37%, cured leaf yield by 11.85%, and grade index by 13.85% as compared to blackgram without inoculation. Single inoculation of blackgram with either *Rhizobium* or PSB also increased succeeding tobacco yields as compared to blackgram without inoculation. There was a progressive and significant increase in green leaf yield, cured leaf yield and grade index with increased N dose from 95 to 135 kg N/ha. Green leaf, cured leaf and grade index were significantly higher with 135 kg N/ha as compared to 115 kg N/ha.

Combined inoculation of *Rhizobium* and PSB to blackgram seed increased blackgram grain yield significantly as compared to single inoculation of either *Rhizobium* or PSB or no inoculation. Sunnhemp - Tobacco (N=115 kg/ha) recorded significantly higher green leaf, cured leaf and grade index as compared to other treatments with biofertilizer inoculation to black gram followed by tobacco.

Effect of cropping systems on nitrogen requirement of tobacco

(S.V. Krishna Reddy, S. Kasturi Krishna and C. Chandrasekhararao)

All the *Kharif* crops performed well and the yields are above average. Significant differences were noticed between the green leaf, cured leaf and grade index of tobacco due to different cropping systems and nitrogen levels.

Tobacco grown after sunnhemp (*in situ* green manuring) recorded significantly higher green leaf, cured leaf and grade index as compared to tobacco grown after other preceding crops. Groundnut - tobacco, sunflower - tobacco and fallow- tobacco recorded higher yields followed by soybean - tobacco. Maize - tobacco recorded significantly lower yields. There was progressive and significant increase in green leaf yield, cured leaf yield and grade index with increased N levels. Application of 135 kg N/ha recorded significantly higher green leaf, cured leaf and grade index as compared to 95 and 115 kg N/ha (Table 8).

Tobacco (with N @115 kg/ha) grown after sunnhemp *in situ* green manuring, recorded significantly higher green leaf, cured leaf and grade index as compared to tobacco grown after other preceding crops. Groundnut - tobacco, sunflower - tobacco and fallow - tobacco need 135 kg N/ha to tobacco.

Effect of cropping system, source and ratios of organic manures on nitrogen requirement of tobacco

(S.V. Krishna Reddy, S. Kasturi Krishna and C. Chandrasekhararao)

Pooled analysis of the data revealed that the green leaf yield, cured leaf yield and grade index were significantly higher with sunnhemp *in situ* green manuring - tobacco as compared to fallow - tobacco. Green leaf yield, cured leaf yield and grade index were significantly higher with 25:75 proportions of organic N: fertilizer N as compared to 0:100 and 50:50 proportions organic N: fertilizer N. Green leaf yield and cured leaf yield increased significantly with progressive levels of N applied. Application of 150 kg N/ha and 120

Table 8: Effect of preceding crop and nitrogen level to tobacco on yield and quality of FCV tobacco cv. Kanchan under irrigated Alfisols (Pooled data)

Treatments	Tobacco yield (kg/ha)		
A. Cropping system	Green leaf	Cured leaf	Grade index
S'hemp (*in situ* GM) – tobacco	15286	2148	1366
Groundnut – tobacco	13369	1945	1213
Soybean – tobacco	12807	1888	1176
Maize – tobacco	11777	1784	1084
Sunflower – tobacco	13190	1935	1191
Fallow – tobacco	13368	1942	1163
SEm ±	327	40	26
CD (P=0.05)	963	118	75
C V %	10.42	8.76	9.03
B. Nitrogen Level (kg/ha)			
95	11570	1733	1089
115	13584	1982	1221
135	14744	2106	1287
SEm ±	134	17	12
CD (P=0.05)	371	47	33

kg N/ha both being on par recorded significantly higher grade index as compared to 90 kg N/ha.

Sunnhemp *in situ* green manuring - tobacco with application of 120 kg N/ha in 25:75 proportions of organic N: fertilizer N gave significantly higher green leaf yield, cured leaf yield and grade index.

Studies on feasibility and economic viability of intercropping in FCV tobacco under irrigated Alfisols (NLS) conditions

(S.V. Krishna Reddy, S. Kasturi Krishna, C. Chandrasekhararao, P. Harishu Kumar and K. Siva Raju)

Pooled analysis of the data showed that among the intercrops grown, radish, palak and amaranthus performed well followed by carrot and onion (Table 9). The performance of coriander and fenugreek was below average. There were significant differences in tobacco green leaf yield between different intercropped treatments. Tobacco intercropped with spinach, amaranthus, fenugreek, coriander, carrot, onion, garlic recorded significantly higher GLY as compared to tobacco intercropped with radish and sole tobacco. There were no significant differences between cured leaf and grade index between different intercropped treatments and sole tobacco. Due to intercropping, earthing up of tobacco was not done and also more number of irrigations were given to intercropped tobacco than normally required, to sustain the intercrops at early stages of crop growth. Highest net returns (Rs 75,839/ha) and benefit: cost ratio (1.89) accrued from tobacco + radish followed by green leafy vegetables.

Studies on feasibility and economic viability of relay-cropping in FCV tobacco under irrigated alfisols (NLS) conditions

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

Pooled analysis revealed that there were no significant differences between GLY, CLY and grade index due to different relay crops grown. Tobacco yields were not affected by sowing on one side of the ridge or on both sides of the ridge (Table 10). Among the relay crops grown, bottle gourd, cucumber, cluster bean, groundnut and watermelon performed better. The performance of ridge gourd was below average. Sowing on both sides of the ridge gave

Table 9: Yield of tobacco and intercrops in FCV tobacco based inter cropping system in NLS conditions (Pooled data: 2005-07)

Treatments	Tobacco yield (kg/ha)			Intercrop yield (kg/ha)
	Green leaf	Cured leaf	Grade index	
Tobacco + Spinach/ palak	17726	2350	1419	4706
Tobacco + Amaranthus	16480	2368	1379	4342
Tobacco + Fenugreek (Menthi)	17071	2440	1376	3787
Tobacco + Coriander (for culinary purpose)	17256	2480	1436	3205
Tobacco + Carrot	16821	2354	1387	3650
Tobacco + Radish	15801	2305	1371	22539*
Tobacco + Onion	16891	2460	1409	3556
Tobacco + Garlic	17239	2525	1431	2407
Sole tobacco	15420	2318	1473	*No of radish tubers
SEm ±		370	50	31
CD (P=0.05)		1026	NS	NS

Table 10: Yield and economics of tobacco based intercropping systems (mean of two seasons 2005-07)

S. No.	Treatments	Yield (kg/ha)		Cost of cultivation (Rs/ha)			Net returns (Rs/ha)	B:C ratio
		Base crop **	Inter-crop	Base crop	Inter-crop	Total		
1.	Tobacco + spinach/ palak	2350	4706	78500	7200	85700	74124	1.86
2.	Tobacco + amaranthus	2368	4342	78500	6500	85000	74448	1.88
3.	Tobacco + fenugreek	2440	3787	78500	7300	85800	75748	1.88
4.	Tobacco + coriander	2480	3205	78500	7600	86100	75520	1.88
5.	Tobacco + carrot	2354	3650	78500	7500	86000	69840	1.81
6.	Tobacco + radish	2305	22539*	78500	6500	85000	75839	1.89
7.	Tobacco + onion	2460	3556	78500	8000	86500	75324	1.87
8.	Tobacco + garlic	2525	2407	78500	17000	95500	72256	1.79
9.	Sole tobacco	2318	–	78500	–	78500	60580	1.77

higher yields than sowing on one side of the ridge.

Sowing on both sides of ridge accrued higher net returns and benefit: cost ratio compared to sowing on one side of the ridge. Tobacco + bottle gourd sowing on both sides of ridge accrued higher net returns (Rs 1,10, 326/ ha) and benefit: cost ratio (2.28) followed by tobacco + cucumber.

SIRI

CTRI Research Station, Hunsur

Integrated Farming System Model

An Integrated farming system model comprising of Agri-Horti, silvipasture, cropping system and animal husbandry is being developed and evaluated since 2005-06 season in one acre operational area at Hunsur farm.

During 2007-08, Agri-Horti system was further developed and Jatropa / border tree cultivation was taken up and large scale drumstick cultivation was taken up in subsidiary components. The various enterprises were taken up as per the technical programme in individual systems. The third year economic evaluation of the model indicated maximum monetary returns from the subsidiary components as in the previous two years which includes animal husbandry, vegetable/kitchen garden, vermicompost production and other enterprises, followed by cropping system components (Hybrid cotton, Red gram + ground nut). A total amount of Rs.20,534/- was generated from the one acre model with a net profit of Rs.13,004/- resulting in C:B ratio of 2.73 from all the components in the system.

CTRI Research Station, Dinhata

Studies on nitrogen requirement of *Jati* tobacco variety Manasi in relation to different sequential cropping systems

(S. Amarnath, S. Roy and C. Chandrasekhararao)

Among the various cropping sequences, highest grain yield (4245.6 kg/ha) of *Aman* rice was recorded when preceding crop of sesame was grown in the system followed by jute and *Aman* rice. Application of 125 kg N/ha recorded highest grain and stover/stick/straw yield of all pre-*kharif* and *kharif* crops grown in the system. However, minimum grain and stover/ stick/straw yield of various pre-*kharif* and *kharif* crops was recorded with the application of 75 kg N/ha.

Highest green (12,306.7 kg/ha), cured (1,812.7 kg/ha) first grade leaf (1,382.5) yield and recovery of quality leaf (62.8 %) were recorded in jute - *dhaincha* - tobacco as compared to others followed by Jute – fallow - tobacco (62.3), jute - *Aman* rice - tobacco (61.8 %), maize - *Aman* rice - tobacco (60.4%) cropping sequences. However, highest gross and benefit : cost ratio were obtained by jute – *Aman* rice – Tobacco followed by jute – *dhaincha* (GM) – tobacco cropping sequences.

Application of 125 kg N/ha recorded highest green (12088.4), cured (1784.8 kg/ha) and first grade (1136.1 kg/ha) leaf yield of *Jati* tobacco as compared to 100 and 75 kg N/ha. The increase in green, cured and first grade leaf yield was 7.6, 6.8 and 12.3%, respectively with the application of 125 kg N/ha over 75 kg N/ha. Highest recovery of first grade (63.6%) was obtained with the application of 125 kg N/ha followed by 100 kg N/ha (60.6%) and 75 kg N/ha (57.8%).

Jute – *Aman* rice – tobacco cropping sequence fetched maximum gross (Rs 1,55,930/ha) and net (Rs 97,593/ha) returns followed by jute – *dhaincha* – tobacco for gross (Rs. 1,28,162) and net (Rs. 72,817) return, respectively. Maximum benefit: cost ratio (2.68) was recorded in jute – *Aman* rice – tobacco followed by jute - *dhaincha* (GM) – tobacco (2.54) cropping sequences. Minimum gross (Rs 103167/ha) and net (Rs 56,798/ha) returns were obtained in sesamum – *Aman* rice - tobacco cropping sequence. Application of highest dose of nitrogen i.e. 125 kg N/ha recorded maximum gross (Rs. 1,27,619/ha) and net (Rs. 74,433/ha) returns as well as benefit: cost ratio (2.40).

Higher organic carbon content was restored in the soil in jute - *dhaincha* – tobacco (0.70 %) followed by jute - *Aman* rice - tobacco (0.68%). Higher available P (21.1 kg/ha) and K (170.2 kg/ha) was restored in the soil in Jute - *dhaincha* (GM) – tobacco followed by jute – fallow – tobacco (20.2 & 153.2 kg/ha, respectively) cropping sequence as compared to other cropping sequences.

Highest nicotine, P , K and chloride content in cured leaf was obtained in jute – fallow - tobacco, jute - *dhaincha* (GM) - tobacco, sesamum - *Aman* rice - tobacco and Boro rice - *Aman* rice - tobacco cropping sequence, respectively. Highest nicotine content (4.95 %) in 125 kg/ha and 100 kg/ha as well as P (0.23%) and K (2.86 %) with the application of 125 kg N/ha and chloride (0.77%) content in cured leaf was recorded with the application of 75 kg N/ha .

Among six cropping sequences tried for three years (2005-2008), jute- *dhaincha* (GM)-tobacco sequence recorded highest green, cured, first grade leaf yields and recovery of quality leaf. However, highest gross and net returns and benefit : cost ratio was recorded by jute – *Aman* rice – tobacco cropping sequence followed by jute – *dhaincha* (GM) – tobacco cropping sequence.

PROGRAMME 6

BIO-ECOLOGICAL AND PATHOLOGICAL STUDIES ON PESTS AND DISEASES

Plant Pathology

CTRI, Rajahmundry

Studies on Broomrape of tobacco

(C.A. Raju)

Reaction of *Nicotiana species* to *Orobanche*

Out of 30 *Nicotiana* species raised in sick plots, only in one entry (TW 110) incidence of *Orobanche* was less than 25% while all other entries showed higher incidence.

Six hundred and thirty six tobacco plants belonging to 54 different *Nicotiana* species were screened against *Orobanche* under natural conditions in a sick field. The *Orobanche* incidence ranged from 0 to 100% in different accessions. However, five entries showed no incidence. Six other entries showed less than 25% incidence. Tobacco seed was collected from all these species/plants which showed low or no incidence were selected for further assessment during the next year.

Incorporation of TMV resistance in FCV varieties and *Natu* tobacco cultivars

A total of 10,331 plants belonging to different breeding lines involving parents *viz.*, *Kanchan,* advanced breeding lines/hybrids have been artificially inoculated with TMV sap and their reaction to TMV was recorded by observing local lesions. A total of 7,621 plants showed local lesions indicating their resistance to TMV. Trials to incorporate TMV resistance in *Natu* and FCV tobacco cultivars, *Pyruvittanam* and *Kanchan*, *Siri*, respectively, were undertaken.


SIRI

Incorporation of black shank resistance in FCV tobacco varieties and advanced breeding lines

In an attempt to incorporate black shank resistance in newly evolved varieties, progenies of the crosses were artificially inoculated with black shank pathogen, *Phytophthora parasitica* var. *nicotianae*. A total of 1,651 plants were artificially inoculated with the pathogen and the reaction of the individual plants was recorded. A total of 565 plants were identified as resistant. Two hundred and eighty nine plants completely died, showing highly susceptible reaction. The remaining plants were partially affected with black shank disease to varying intensity.

Similarly, a total of 421 tobacco plants of different accessions of plant breeding section were inoculated with CMV sap to test their reaction against CMV.

Artificial inoculation with CMV sap on selections of Banket A-1, a Burly variety at BTRC, Jeddangi and the seed was collected from the plants that have not taken up the infection, for further studies.

Laboratory studies

Effect of Ridomil of different companies and expiry dates on *P. aphanidermatum* (Pathology-N & Murari-F isolates) at 50 ppm

Longevity of Metalaxyl + mancozeb combinations

An experiment was conducted to study the bio-efficacy of metalaxyl + mancozeb combinations, irrespective of the brand, with different expiry dates and the samples from 1996 (date of manufacture) to 2006, with an expiry period of two years as given by the company. All the fungicides were tested at 50 ppm concentration at which, the pathogen was suppressed completely in our earlier experiments. Two observations after 24 and 48 hours after incubation were recorded. It was observed that even the product stored for nearly a decade remained chemically active and showed efficacy in suppression of the pathogen at 50 ppm concentration, though slight variation was observed with different isolates.

Monitoring resistance in *P. aphanidermatum* against Metalaxyl + mancozeb

Ten isolates of the pathogen, *P. aphanidermatum* obtained from different crops / locations were compared for their sensitivity to Ridomil @ 10, 25 and 50 ppm, just to study whether any of the isolates have developed resistance to the fungicide in the recent past. All the ten isolates grew at 10 and 25 ppm concentrations whereas all were completely suppressed at 50 ppm concentration, indicating that all the isolates from different crops/locations are still sensitive to Ridomil and none of the isolates developed resistance against the fungicide.

CTRI Research Station, Hunsur

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

(M. M. Shenoi and S. Ramakrishnan)

A replicated trial was conducted with organics enriched with commercial formulations of following three bio-agents viz., *Paecilomyces lilacinus*, *Trichoderma viride* and *Aspergillus niger*. Treatment differences could not be made due to low incidence of the disease. The trial is being carried out during 2008-09 season.

Two promising wilt resistant lines viz., FCH 221 & FCH 222 were evaluated in highly sick soils for disease incidence and its spread. The disease incidence was 0 - 3.3% in line FCH 221 & FCH 222 as against 25.3% in the susceptible variety Bhavya. Vanderplank's formula was applied for calculating rate of spread of the disease per unit per day. The rate of spread ('r') of wilt disease from 35 to 75 days after transplanting in resistant lines in highly sick soil was in the range of 0.0 to 0.0017 per unit/day.

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 first year 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 FCV tobacco nursery. The disease control in various treatments was in the range of 57.6 - 96.0% and 50.0-93.3% at 40 & 50 days after sowing (DAS), respectively. The results suggested high efficacy of propiconazole, a triazole compound for the control of disease even at 50 DAS. This active ingredient has effected 88 - 96% and 88 - 93.3% control at 40 and 50 DAS, respectively. The next best chemical identified was carbendazim. The incidence of soreshin disease in untreated check was 12.5 and 15.0% at 40 & 50 DAS, respectively. However, the yield of total healthy transplants was not significant and was in the range of 600 to 625/sq.m in propiconazole schedules as against 438/sq.m in untreated control.

CTRI Research Station, Dinhata

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

(S. Amarnath and S. Roy)

The trial was initiated for screening germplasm accessions to brown spot in *Jati* and *Motihari* tobacco under natural conditions and hollow stalk of *Motihari* tobacco under artificial inoculation in pots.

A total of 60 and 185 germplasm lines were screened for *Jati* and *Motihari* tobacco, respectively. As compared to severe epidemic year during 2006-07, the overall incidence of brown spot in *Jati* and *Motihari* tobacco was much less in 2007-08. Brown spot incidence was less in *Jati* tobacco compared to *Motihari* tobacco during 2007-08. Based on AUDPC rating in *Jati* tobacco, 21 accessions were found to be resistant with a range of 0-100. Under moderately resistant category (100.1-200), 18 accessions were categorized and in moderately susceptible and highly susceptible category 18 and 3, respectively. Under resistant category Vaishali Special, PT-76 and Gandakbahar were

found to be resistant in both the years. The entries viz., II-1a-7-80, GT-6 and Sona which were moderately resistant during 2006-07 were found to be resistant in 2007-08. Hence, all the 6 accessions viz. Vaishali Special, PT-76, Gandakbahar, II-1a-7-80, GT-6 and Sona along with the remaining 15 accessions will be screened for brown spot resistance during crop season 2008-09.

In *Motihari* tobacco, none of the lines were found to be resistant. However, 76 lines were registered under moderately resistant category, 105 under moderately susceptible and 4 lines highly susceptible category. Fifteen accessions viz., Kanpur local, Chaithar, Rustica-6, NP-222, Tangua Manda, Saraiya Range, Damadaha, C-21, Daiya Kharwa, Aligarh local, Harpur Sadi, Gosaigaon-2, and NP-220 along with 61 accessions under moderately resistant category will be screened for brown spot resistance in the ensuing crop season.

A total of 90 accessions of *Motihari* tobacco were resistant to hollow stalk disease under artificial conditions in pots. Except for varieties/accessions, the data were non-significant for inoculation sites (topped stem end and axil of leaf) as well as for their interaction. The linear length of soft rot of pith tissue in 90 accessions of *Motihari* tobacco ranged from 0.62 - 4.87 cm. A total of 29 accessions were categorized to have statistically at par least disease reaction. The linear length of soft rot of pith tissues showing least disease reaction ranging from 0.62 - 2.40 cm in 18 accessions will be screened in the crop season 2008-09 for resistance to hollow stalk under artificial condition in pots.


SIRI

Nematology

CTRI Research Station, Hunsur

Survey for plant parasitic nematodes associated with tobacco

(S. Ramakrishnan)

Under a long term project, fields in Hunsur and Sollepura farms were surveyed for the association of 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* and root lesion nematode, *Pratylenchus* sp. were also noted. However, population of both the nematodes in FCV tobacco rhizosphere was below pathogenic level. The root-knot index in various fields on 0 - 5 scale ranged from 1.0 to 2.7 and 1.8 to 4.2 in Hunsur and Sollepura farms, respectively. The root-knot nematode incidence was more in Sollepura as compared to Hunsur farm.

Screening of tobacco germplasm against root-knot nematodes

(S. Ramakrishnan and K.N. Subrahmanya)

A total of twelve advanced FCH 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, roots were washed free of soil and scored for Root-Knot Index (RKI) under 0-5 scale. Experimental results revealed that the following materials viz., FCH 205, 206, 211, 212, 215 and 216 recorded RKI of d" 2.0 and were most promising against root-knot nematodes. These materials will be further subjected to intensive screening under both field and artificial inoculated conditions for further confirmation. Among the 17 hybrid tobacco lines screened for resistance against root-knot nematodes under sick field conditions with appropriate check varieties, HB-13, 14 & 15 recorded RKI of 1.80, 1.86 and 1.86, respectively and were found promising.

In addition to above, 18 new germplasm entries were also subjected to screening against root-knot nematodes under sick field conditions. Results revealed that the following lines viz., CH-39, A-1, FCH 201, LV-2, SBS-1, and 56-3 were promising against root-knot nematodes with RKI d" 2.0 under 0 - 5 scale.

Entomology

CTRI, Rajahmundry

Development and validation of weather based forewarning system for the major pests of FCV tobacco

(J.V. Prasad, U. Sreedhar and K.C. Chenchaiah)

The experiment was conducted under three dates of planting and data on pest incidence were recorded at weekly intervals from 10 random plants in each grid (each field was divided into 10 grids of equal size) and were regressed with weather parameters.

Incidence of major pests as influenced by dates of planting

During early (Sept. 25th) and middle (Oct. 10th) planting, damage by *S. litura* was markedly high during the month of January resulting in severe defoliation of lower leaves. The incidence of bud worm, *H. armigera* was relatively low during the last crop season, though it recorded a slight increase with the advancement of planting date. When the planting was delayed till the 3rd week of October, the crop was mainly affected by the aphids (*M. nicotianae*) which resulted in severe sooty mould development in the infested plants. The incidence of stem borer and CMV was also on the raise during late planting (Table 11).

Spatial distribution of major insect pests in FCV tobacco

The spatial distribution of major pests in FCV tobacco under different dates of planting revealed that the spatial distribution of the incidence of *M. nicotianae* is aggregated in all the dates of planting, the degree of aggregation being highest in case of middle planting followed by early and late planting. The spatial distribution of plants with skeletonized leaves due to damage by *S. litura* was highly aggregated across all the dates of planting, the degree of aggregation being maximum during middle planting followed by late planting. Though, the spatial distribution of plants damaged by migratory population of *S. litura* was observed to be aggregated in all dates of planting, the highest aggregation was recorded in the late planting. During early and middle planting, the degree of aggregation was low suggesting more or less uniformity in the distribution of the damage.

Relationship between the pest incidence and weather parameters

The relationship between weather parameters and the pest incidence in the three dates of planting revealed that during the first date of planting 66% of variability in the numbers of the mirid bug (*Nesidiocoris tenuis*) was explained by weather parameters and minimum temperature had a significant negative influence on the activity of this predator. Highly significant association was noticed between the incidence of *S. litura* and minimum temperature during this date of planting. During middle planting, weather parameters, could not explain the variability in pest incidence as no significant association was noticed between weather parameters and pest incidence during this period. During the

Table 11 : Incidence of major pests of FCV tobacco under different dates of planting

Date of Planting	Mean per cent incidence of major pests		
	S. litura	*H. armigera*	*M. nicotianae*
Early (25th Sept.)	92.00 ± 10.80*	2.75 ± 0.58	14.00 ± 15.69
Middle (10th Oct.)	93.00 ± 11.47	3.50 ± 1.53	49.00 ± 26.73
Late (25th Oct.)	75.00 ± 9.67	7.50 ± 1.15	55.00 ± 13.17

* Mean ± Standard deviation of 20 observations

late planting (October 25th), 64% variability in the number of *N. tenuis* per plant could be explained by weather parameters though no significant association with any of the weather parameters could be noticed. Weather parameters influenced the incidence of *M. nicotianae* to an extent of 88% during late planting and a significant negative association was recorded with minimum temperature. Similar association was noted between minimum temperature and the number of adult aphids during this period.

Studies on the ecological role of *Nesidiocoris tenuis*, an omnivorous mirid bug in tobacco ecosystem

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

The predatory potential of *N. tenuis* against different stages of tobacco pests revealed that the predation of eggs of lepidopteran pests by *N. tenuis* increased with the advancement of age of the eggs. It was also established that the predation of the eggs of *H. armigera* was low compared to those of *Spodoptera* sp. The predatory ability of the mirid bug is inversely proportional to the larval age and it had ceased by the 6th day in all the cases except with *S. exigua* where the predation stopped after the larvae attained 4 days of age. The mirid bug *N. tenuis* could feed on the nymphs of *M. nicotianae* to some extent (27.33%) but it was not found predating on either parthenogenetic adults or winged adults.

The predatory potential of *N. tenuis* as influenced by tobacco types and other host plants showed that the tobacco types influenced predatory potential of the bug. The tobacco types viz., *Lanka, Bidi*, Burley and *Natu* supported very high predation whereas the least predation was recorded in the back ground of Oriental tobacco. Marigold and Bengalgram which are not natural hosts of the omnivore, did not support any predation of neonate *H. armigera* larvae.

It was observed that during the tobacco growth period, the activity of *N. tenuis* remained low and varying till the flower bud initiation after which it increased steadily and reached the peak during flowering and early capsule formation stages. The activity of the bug started declining drastically after the capsules hardened.

Life table studies on *Spodoptera exigua* in tobacco

(S. Gunneswara Rao and J.V. Prasad)

The highest female survivorship of 0.18 was recorded on *Amaranthus viridis* followed by *C. arietinum* (0.14) *Boerhavia diffusa* 0.07, and Burley tobacco (0.05). Comparison of various parameters like intrinsic rate of increase, mean generation time, annual rate of increase, doubling time showed that *A. viridis* supports the best growth and development of *S. exigua* followed by *B. diffusa*, *C. arietinum* and Burley tobacco. *S. exigua* did not complete its life cycle on other types of tobacco and certain *Nicotiana* species tested. It is concluded that *S. exigua* causes damage to tender tobacco seedlings particularly to Burley tobacco and it survives on the weeds *viz.*, *A. viridis* and *B. diffusa* in tobacco nursery ecosystem and migrates to tobacco seedlings.

CTRI Research Station, Guntur

Screening of tobacco germplasm against aphids *M. nicotianae* under artificial infestation

(G. Raghupathi Rao)

Fifty lines each of 50 plants were raised in 5 lines. All the plants were artificially infested with 500 aphids/plant at 45 days of planting and observations were recorded at 15 days after infestation.

The following five lines 2006-82-1, 2006-102-13, 2006-161-13, 2006-195-19 and 2006-231-3 have exhibited tolerance by showing lowest aphid rating of 0.2 - 1.0 (<50 aphids/plant) and were selected for further studies.


SIRI

Studies on population dynamics and management of tobacco aphid

(G. Raghupathi Rao)

Aphid and whitefly incidence after 2 days of spraying was significantly low in the treatment viz., planting maize as border crop + insecticidal spray, closely followed by spray of Imidacloprid. Similar trend was noticed after 4, 6 and 8 days after spraying. All the yield characteristics were significantly superior in maize as border crop + insecticidal spray closely followed by insecticidal spray (Imidacloprid). Temperature (max & min) relative humidity (max) and rainfall had negative influence on the aphid incidence.

CTRI Research Station, Kandukur

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

(K.C. Chenchaiah)

An experiment was laid out with 22 accessions and 2 checks in augmented design to evaluate FCV tobacco germplasm for tolerance to *S. litura*. Each accession has 2 x 8 plant population. The accessions were screened with the natural infestation of *S. litura* and with the inoculated egg mass.

All the entries were screened as per the damage rating of *S. litura*. Most of the germplasm (11 entries) have low infestation (0-20% leaf damaged) which were classified as tolerant, four entries have 20-30% leaf damage which were categorized into medium and the two check varieties have high leaf damage (>30%) were termed as susceptible. Three entries, 11-17,702 and 703 not damaged by *S. litura* were treated as resistant. A batch each of egg mass of *S. litura* was inoculated on four selected test plants under each treatment and observations were recorded. It was found that neonate larvae did not survive, indicating treatments except checks are not supporting the young caterpillars.

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

(K.C. Chenchaiah)

The experiment was laid out with 24 accessions and 2 checks in augmented design to evaluate for aphid resistance. Each accession has 2 x 8 plant population. The accessions were screened under natural and artificial conditions.

The results from the aphid inoculation revealed that aphid development on the lines was very poor and the aphid count on the top leaf, visual damage rating and spread of aphid was recorded on 4th day of inoculation. Nine entries (11-7, 15-11, 43-20, 82-1, 113-1, 116-11, 148-14, 182-17 and 194-14) have no infestation with '0' rating. Twelve entries with damage rating 1, 3 entries with damage rating 2 and the two checks with damage rating 3 were recorded.

The experiment with natural population revealed that the infestation is very less and very few aphids were noticed on the top three leaves (13 entries:0, 8 entries:11-20, 3 entries:>20) while check varieties have recorded 62 aphids on Hema and 48 aphids on VT 1158.

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. The results indicated that the early planted crop almost escaped the attack of the aphid. The normal planted crop and the late planted crop suffered aphid infestation from first week of January till harvest. However, the intensity was very less and ranged from 1-20 per plant only. The important biotic factors noticed are *Necidiocaris* sp., ladybird beetles, syrphids *Chrysopa* sp. and very few mummified aphids.

CTRI Research Station, Hunsur

Survey for assessment of insect pest incidence in KLS tobacco

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

Main Field

A survey was conducted for assessment of insect pest incidence in KLS tobacco. Five tobacco growing areas/taluks viz., Hunsur, H.D. Kote, Periyapatna, K.R.Nagar and Ramanathapura, covering 74 villages and 235 fields were selected for the study. Aphid, *Myzus nicotianae* incidence was recorded in all the five areas. Budworm, *Helicoverpa armigera* was noticed in four areas viz., Hunsur, Periyapatna, K.R.Nagar and Ramanathapura. Stemborer, *Scrobipalpa heliopa* incidence was recorded in H.D.Kote, Periyapatna and K.R.Nagar. Tobacco caterpillar, *Spodoptera litura* incidence was very less and was noticed in few fields of Periyapatna area only. The per cent fields infested by aphids, stemborer, budworm and caterpillar were 36.6, 20.0, 21.7 and 2.9, respectively. The average infestations of these pests in the infested fields were 9.3, 4.7, 5.6 and 4.9%, respectively. The overall infestations in the area were 2.8, 1.1, 1.0 and 0.1%, respectively (Table 12).

Nursery

A survey covering 85 villages and 340 nurseries was conducted for assessment of insect pest incidence in KLS tobacco nurseries. Out of them, 81.5% nurseries were infested by tobacco caterpillar, *S. litura*. The infestation ranged from 0 - 58%. Among the infested nurseries, 40.1% had infestation above ET level (> 5%). The average infestation within the infested nurseries was 5.6%. The overall infestation of the pest in the entire area was 4.6%. Among the five taluks surveyed, the overall infestation of the caterpillar was more in H.D. Kote (7.6%) followed by Periyapatna (4.8%), Hunsur (4.7%), K.R.Nagar (3.3%) and Ramanathapura (2.8%). The Infestation levels at CTRI Research Station, Hunsur farm and Sollepura farm were 3.9 & 1.8%, respectively.

Feeler Trial V: Survey on insect pest incidence in tobacco based cropping sequence

Survey on tobacco based cropping sequence was carried out in the KLS tobacco growing area. *Ragi*, field bean, horsegram, niger, cowpea, maize, chillies, redgram and dry paddy were the major crops grown in *Rabi*. Overall pest incidence was below ET level. Pod borer, *H. armigera* incidence was recorded on field bean (2%) and aphid, *Aphis croccivora* was recorded on cowpea (1%). Natural predators like dragonflies, wasps, spiders and Coccinellids were predominant in the region.

Table 12 : Insect pest incidence in KLS region

Sl. No.	Particulars	Aphids	Stem borer	*H. armigera*	*S. litura*
1	No. of Villages surveyed	74	74	74	74
2	No. of fields visited	235	235	235	235
3	No. of fields infested	86	47	51	7
4	Fields infested (%)	36.6	20.0	21.7	2.9
5	Range of infestation (%)	3-18	2-8	2-12	2-7
6	Average infestation (%) in the infested fields	9.3	4.7	5.6	4.9
7	Overall infestation (%) of the pest in the area	2.8	1.1	1.0	0.1
8	Range of pest population (Score)	1-2	-	-	-

PROGRAMME 7

INTEGRATED PEST AND DISEASE MANAGEMENT

Entomology

CTRI, Rajahmundry

Evaluation of trap crops against bud worm in FCV tobacco

(U. Sreedhar)

A field experiment was conducted to find out the effectiveness of trap crop along with foliar spray of neem seed kernel suspension (NSKS) on FCV tobacco in reducing the infestation of budworm, *H. armigera*.

Budworm infestation in tobacco

A significant reduction in budworm infestation was observed in tobacco plots with trap crops + NSKS spray as compared to plots with trap crop and without NSKS spray or NSKS spray alone.

Population of budworm on trap crops

All the trap crops planted around FCV tobacco plots sprayed with NSKS recorded significantly higher number of eggs as compared to trap crops planted around tobacco without NSKS spray. Marigold-mw without NSKS spray on tobacco recorded least number of eggs among all the treatments (5 eggs/plant). As regards larval population *rustica* tobacco and marigold-sw with NSKS spray on tobacco recorded higher larval population (6.33 – 8.00) in all the observations and were on par with each other. Marigold-mw + NSKS recorded significantly less population as compared to *Rustica* + NSKS and marigold-sw +NSKS at 50 and 60 DAP. Marigold-sw + NSKS and marigold -mw + NSKS were on par with each other only at 40 DAT. All the trap crops with NSKS spray on tobacco recorded significantly more larval population as compared to trap crops without NSKS spray on tobacco.

Natural enemy activity

On tobacco *Nesidiocoris* sp., coccinellids, spiders and syrphids were recorded of which *Nesidiocoris* sp. was predominant. There was not much difference in the activity of *Nesidiocoris* species on tobacco with and without trap crops. On trap crops *Nesidiocoris* species was not recorded except on *Rustica* tobacco. Coccinellids and syrphids were more on marigold-mw and their activity trespassed to tobacco also. The population of syrphids was least on *Rustica* tobacco. Higher spider population was noticed on marigold-mw followed by marigold-sw as was with other predators and parasitoids. No parasitoids were observed on *Rustica* tobacco. NSKS spray was safe to activity of natural enemies on tobacco. Among the treatments, marigold-sw + NSKS and *rustica* tobacco + NSKS spray recorded higher bright leaf yield. Similar trend was observed for grade index also.

Influence of proportion of trap crop to the main crop on the infestation of *H. armigera* in FCV tobacco

Experiment conducted to find out the optimum proportion of trap crop to main crop to minimise the infestation of budworm, *H. armigera* in FCV tobacco revealed that infestation in tobacco at 40 DAT was highest (18.39) in 2% trap crop plots and it was least (12.45%) in 20% trap crop plots up to 50 DAT. At 60 DAT, the infestation in tobacco plots with 2.67, 4, 8, 10 and 20% trap crop to main crop were on par with each other.

Development, validation and refinement of IPM module for Burley tobacco

(U. Sreedhar and R. Subba Rao)

Three modules viz., IPM, biological control and chemical control were tested in Burley

tobacco at BTRC, Jeddangi. The components of IPM were cultural, biological and need based application of selective insecticides. Sorghum was grown as border crop around tobacco in the IPM plot. In biological control plot, sprays each of NSKS 0.5%, *Sl* NPV and *Ha* NPV were carried out. Insecticide sprays were given in chemical control plot with imidacloprid; chlorpyrifos and acephate at 20, 30, 40, 50 and 60 DAT. The results showed that the infestation of tobacco budworm and stem borer was more during the season followed by tobacco caterpillar. The infestation of insect pests was more in biological control plot as compared to IPM and chemical control plots. Stem borer infestation ranged from 6.40 – 10.80 in biological control, 4.0 – 5.80 in IPM and 4.20 – 6.80 in chemical control plot. Leaf curl incidence was 2.80 - 8.20 in biological control, 0.80 – 2.20 in IPM and 0.60 – 3.0 chemical control plot. The infestation of *S. litura* in IPM plot ranged from 1.40- 6.60 whereas it was 3.60 – 10.80 in biological control and 0.80 - 8.20 in chemical control plot. Budworm infestation was lowest in IPM plot (0.40 – 6.00) and highest in biological control plot (1.60 - 12.20) whereas it was 0.60 - 6.80 in chemical control plot. On sorghum border crop around IPM plot, more coccinellids (0.5 - 12.80/plant) were recorded as compared to other predators during the season. Among others, spiders were predominant (4.60 -6.80) followed by syrphids (0.60 - 4.80) and wasps (0.60 - 2.20). *Harpactor* species, chrysopids, mantids, damselflies and pentatomid bugs were the other predators recorded. Green leaf yields in IPM, chemical control and biological control plots were 12,450, 11,100 and 8,920 kg/ha and the cured leaf yields were 1,650, 1,540 and 1,338 kg/ha, respectively. It was concluded that in IPM practice the insect infestations were lower compared to chemical control and by using biopesticides alone in biological control plots, the infestation of insect pests was on higher side. Hence, a combination of trap crop, biopesticides and need based insecticide sprays as IPM practice can be adopted for suppression of insect pests in Burley tobacco.


SIRI

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

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

The effect of crude sugar ester fractions from *N. glutinosa and N. plumbaginifolia* on tobacco aphid (*M. nicotianae)* revealed that between the two extracts tested, the sugar ester fraction from *N. glutinosa* was more toxic to the aphids than the sugar ester fraction obtained from *N. plumbaginifolia*. The highest mortality was recorded in case of 2% crude sugar esters from *N. glutinosa*. The aphids died of desiccation after being sprayed with the crude sugar ester fraction.

AICRP Biological Control

Studies on the influence of water quality on the efficacy of entomopathogens against tobacco pests

(S. Gunneswara Rao)

Effect of water quality (pH) on Sl NPV (Nursery)

The results of the experiment established the fact that for satisfactory control of *S. litura* in tobacco nurseries using *Sl* NPV, the pH of spray solution must be in the range of 6 to 8. It was observed that pH below 6 or above 8 is detrimental to *Sl* NPV under field conditions and the pH of *Sl* NPV solution from 5 - 9 was not affecting the mortality of *S. litura* under laboratory conditions.

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

(S. Gunneswara Rao)

Performance of *Sl* NPV strains

NPV isolates collected from different tobacco growing areas in Andhra Pradesh were purified and multiplied to test their

comparative efficacy in suppressing *S. litura*. The results of the replicated field experiment revealed that per cent leaves damaged at 7 days after spraying were lowest in plots which received spray of *Sl* NPV strains from Rajahmundry, Jeelugumilli and Jeddangi without significant differences among them. Plots received spray of *Sl* NPV from Guntur and Nandyal recorded significantly higher damage while the Nandyal strain was least effective.

Studies on biological control options for suppression of tobacco stemborer *Scrobipalpa heliopa* Low (Lepidoptera Gelichidae

(S. Gunneswara Rao)

Larval mortality on leaf

A strain of B.*t*. was obtained from PDBC, Bangalore and serial dilutions were prepared from 10 to 10^6. Tobacco stemborer pupae were collected from left over tobacco nurseries and reared in the laboratory. Tobacco plants were planted in pots and stemborer (*S. heliopa*) eggs were artificially inoculated on them. Immediately, the B.*t* solutions were sprayed. Observations recorded daily revealed that the per cent larval mortality on the tobacco leaves was significantly different in the treatments. Highest larval mortality was observed at dilutions 1:10 followed by $1:10^2$ to 10^6 in the descending order. Least mortality was observed in control.

Larval mortality in veins or stem

Significantly higher larval mortality was obtained in the case of dilutions 1:10 followed by $1:10^2$ to 10^5 in descending order. Lowest mortality was observed at the dilution 10^6 and control (water spray). B.t. (PDBC strain) at 1:10 and 1:100 dilutions were moderately effective with 40 - 62% and 28 - 44% mortality of larvae of *S. heliopa*.

Egg parasitoids

Telenomus remus was not able to develop on eggs of *S. heliopa* as the eggs were too small for the development of the parasitoid embryo.

CTRI Research Station, Guntur

Evaluation of Imidacloprid application methods for the control of sucking pests

(G. Raghupathi Rao)

Incidence of aphids

Efficacy of imidacloprid 200 *Sl* @ 50g /ha was evaluated under field conditions by applying through different application methods against tobacco aphid, *M. nicotianae* on FCV tobacco along with acephate 75 sp@ 750 g ai/ ha., as check.

Observations were recorded periodically on aphid population. Most of the treatments showed significantly less aphid population as compared to control. At 2 days after treatment (DAT), aphid population was significantly low in the plots treated with Imidacloprid foliar application (4.9/plants) and was on par with foliar application of acephate. Similar trend was observed at 4, 6 and 8 DAT.

Incidence of whiteflies

Whitefly incidence was, in general, very low. Among the treatments, foliar application of imidacloprid followed by acephate showed lowest whitefly population.

Natural enemy activity

The plots treated with foliar application of imidacloprid followed by acephate showed lowest natural enemy population. Highest activity of natural enemy was observed in untreated control. The activity of coccinellids was more in stem application followed by transplantation method. Foliar application of Imidacloprid and acephate did not support the coccinellids. Similarly, higher population of syrphids was recorded in stem application followed by transplantation. In general, stem application of Imidacloprid showed more natural enemies as against foliar application.

Yield

All the treatments recorded significantly higher green, cured, bright leaf yields and grade index as compared to control. Highest

green leaf yield was recorded in foliar application of imidacloprid followed by acephate. Among the treatments, lowest green leaf yield was recorded in stem application. Similar trend was observed for cured leaf yields. As regards bright leaf, highest yield was recorded in foliar application of Imidacloprid followed by acephate. Maximum grade index was recorded in foliar application of Imidacloprid followed by acephate.

Evaluation of high pressure sprayer for the management of insect pests of FCV tobacco

(G. Raghupathi Rao)

Incidence of aphids

Incidence of aphids was recorded at 2, 4, 6 and 8 days after spraying. The aphid population data based on overall means indicated superior performance of high pressure sprayer @ 2 lit/min at every row with 40 cm swath width closely followed by spraying through high pressure sprayer @ 1 lit/min at every row with 60 cm swath width.

Incidence of whitefly

The whitefly population was significantly low of 2.2/plant in the plots treated through high pressure sprayer @ 2 lit/min at every row with 40 cm swath width and most of the treatments, except spraying through motorised Knapsack sprayer were found at par.

Incidence of *H. armigera*

As a consequent to the three sprayings, data based on mean larval population and infestation indicated superiority of spray through high pressure sprayer @ 2 lit/min at every row with 40 cm swath width in minimizing the incidence of *H. armigera* on tobacco to an extent of 65% over control.

Yield

All yield characters are found to be high in plots received spray through high pressure sprayer @ 2 lit/min at every row with 40 cm swath width followed by spray through high pressure sprayer @ 1 lit/min at every row with 40 cm swath width. Data based on incidence on aphids, *H. armigera* and yield showed that the plots receiving the treatments through high pressure sprayer @ 2 lit/min at every row with 40 cm swath width are superior in minimizing the pest incidence resulting in higher yields.


SIRI

CTRI Research Station, Hunsur

Nematology

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

(S. Ramakrishnan)

Experimental results revealed that there was no adverse effect of various treatments on tobacco seed germination. At 60 DAS, *Paecilomyces lilacinus* @ 100 g/m^2 recorded RKI of 2.05 compared to 3.75 in untreated check and was on par with the treatments, *P. lilacinus* + neem cake (1.87) and *P. lilacinus* + vermicompost (1.82). *P. lilacinus* in combination with neem cake significantly reduced the number of egg mass/g root and root-knot nematode soil population to the extent of 40.5 and 55.1%, respectively. Application of *P. lilacinus*, increased the root-knot free healthy transplants by 32.1% over untreated check and was on par with *P. lilacinus* + neem cake and *P. lilacinus* + vermicompost. The VAM fungi, *Glomus fasciculatum* was not effective in decreasing the root-knot nematode incidence or in increasing the number of healthy transplants in tobacco nursery. Further evaluation of nursery treated seedlings in field revealed that there was no significant difference in FCV tobacco cured leaf yield among the treatments over untreated check.

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. Results of the trial indicated that, application of *P. fluorescens* and *A. niger* enriched FYM @ 4 kg/m^2 recorded 50.6% increase in number of root-knot free healthy transplants (690.0/m^2) and was on par with recommended chemical schedule (657.0/m^2).

Similarly at 60 DAS, *P. fluorescens* + *A. niger* enriched FYM, *P. fluorescens* + *T. viride* enriched FYM and chemical check were on par with each other in recording reduced RKI of 1.92, 2.10 and 1.90, respectively compared to 3.75 as RKI in untreated check. Similarly, FYM enriched with *P. fluorescens* + *A. Niger,* FYM enriched with *P. fluorescens* + *T. viride* and chemical check were on par with each other by significantly reducing the final soil population compared to untreated check. Reduction in final soil nematode population compared to untreated check ranged from 36.4 to 52.2% in treated beds.

Bio-agents enriched FYM recorded significant decrease in damping-off at 35 DAS (46.6 to 60%), damping-off + blight at 45 DAS (44.4 to 61.1%) and black shank (31.3 to 56.8%) compared to untreated check. But the treatments also significantly differed from chemical schedule, which was superior in decreasing the damping-off by 94.6%, damping-off + blight by 93.3% and black shank by 95.7% compared to untreated check.

Entomology

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

(P. Venkateswarlu and M. M. Shenoi)

Bio-efficacy of *Verticillium lecanii* against tobacco aphid, *Myzus nicotianae* in KLS

An entomopathogenic fungus, *Verticillium lecanii* was evaluated at four different doses viz., 0.1, 0.2, 0.3 and 0.4% on tobacco aphid *Myzus nicotianae* under field conditions. All the treatments were significantly superior over control in reducing aphid population. The bioagent at 0.4% exhibited 42.3 and 41.6% protection to top and middle leaves, respectively after ten days of second spray. Insecticides, acephate and imidacloprid offered more than 80% protection. Though, the efficacy of bioagent was moderate due to intermittent rains, it showed good promise under glass house conditions.

Management of tobacco caterpillar, *Spodoptera litura* under KLS conditions

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

Screening of tobacco germplasm against caterpillar, *Spodoptera litura*

A total of 203 germplasm lines were screened for caterpillar under natural infestation. Out of 203 entries screened, 30 were free from infestation, 68 under 10% infestation, 62 under 20%, 23 under 30%, 16 under 40%, 2 under 50% and remaining 2 under > 50%. Although lines were more in the range of 10-20% infestation, the severity of damage on affected plant was below 10%. The entries need further confirmation both in nursery and field crop.

Predator population in Entomophage Park

An Entomophage park was laid out with an objective of maintaining natural enemy population throughout the year. Various crops are grown regularly and systematically. Observations on predator population per m^2 are recorded periodically in each botanical species during the peak vegetative growth phase. Among the crops raised in the park, Maize harboured more predators (28) followed by Jowar (23), *Tagetes* (21), Redgram (19), Sunnhemp (17), *Bajra* & Castor (12), Cassia (9), Cotton (8) and *Ragi* (7). Among the predators, spiders were dominant (63) followed by coccinellids (44), predatory bugs (17), syrphid flies (11), dragon flies (7), wasps (6) and damsel flies (3).

Plant Pathology

CTRI Research Station, Dinhata

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

(S. Roy and S. Amarnath)

The trial was conducted to verify the efficacy of microbial bioagents in suppressing the damping-off disease. Inoculums of *Trichoderma viride* (Tv) and *Pseudomonas fluorescens* (Pf) cultured separately in talc were enriched in vermicompost (4 g of inoculum was mixed @ one kg of vermicompost). For a nursery bed of 3 m^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.

Observations on damping-off of seedlings were recorded in nursery beds treated with Pf, Pf + Single Super Phosphate (SSP) and in two checks, SSP and without SSP. The level of disease in Pf (10.49%) and Pf + SSP treated plots were on par with each other. Maximum disease was recorded in check plots treated without SSP (25.08%) followed by SSP (21.95%). The results indicated that there is disease suppressing activity in Pf as the incidence of damping-off was significantly lesser than in checks.

The root and shoot length as well as fresh and dry weight of stem and roots in biocide treated plots are significantly higher than checks (SSP and without SSP).

The production of healthy transplants was significantly higher in biocide treated plots. Plots devoid of SSP had the lowest recovery of healthy transplants in 0.5 m^2 area.

Field evaluation of *Jati* tobacco was carried out during 2006-07 crop season in order to assess the influence of biocide treated nursery seedlings on yield and quality of leaf as well as possible disease suppressing activity against brown spot. The foliar spray of biocides was very effective in controlling the brown spot of *Jati* tobacco under field conditions However, treatments Pf, Pf + SSP and Tv + Pf + SSP were highly effective in the management of brown spot under field conditions.

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

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

Survey and epidemiology

Bacterial wilt caused by *Ralstonia solanacearum* was observed in *Motihari* tobacco at 8 locations from December, 2007 to January, 2008 with the incidence ranging from 0.63 – 5.13%. Highest incidence of the disease was recorded at village Bholachatra (5.13%) followed by Okrabari (East) (4.49%). Minimum incidence of the disease was recorded at Alokjhari (0.63%) followed by Petla (0.89%).

IDM of Bacterial Wilt

The IDM of bacterial wilt was adopted for the second year in sick plots with bacterial drench inoculation being common to all the treatments @ 10^8 cfu/ml.

Incidence of bacterial wilt (7.95%) caused by *R. solanacearum* was found to be lowest in treatment with soil liming @ 560 kg/ha + fallowing of land for 30 days + bacterial inoculation (drenching of experimental plots) of bacteria @ 10^8 cfu/ml. As compared to check (24.34%), treatment having liming + fallowing of land for 30 days + bacterial inoculation, the disease was significantly lower (12.88%) followed by fallowing of land + green manuring + bacterial inoculation (15.34%) and fallowing of land + bacterial inoculation (17.44%).

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


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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: Fertility survey of flue-cured tobacco soils of Shimoga, Davanagere and Chikkamagalur districts and chewing tobacco soils of Chitradurga district, Karnataka

(V. Krishnamurthy, C. Chandrasekhararao and M. Mahadevaswamy)

Soil fertility survey

Soil available nutrient status, nutrient requirement and soil related constraints of FCV tobacco growing districts of Shimoga, Davanagere and Chikkamagalur and chewing tobacco growing areas of Chitradurga district of Karnataka were evaluated by analysing 182 surface and corresponding sub-soils collected from 39 villages. Soil test summaries of 39 villages and the four districts as whole were prepared with a view to know the general fertility levels of N, P and K in these soils. Nutrient index values for each district were computed from soil test summary data.

Nutrient indices

Nutrient indices of different districts revealed that, FCV tobacco growing soils of Shimoga district were low in organic carbon (1.07), high in available phosphorus (2.65) and in available potassium (2.86) in surface soils. In sub-soils, organic matter was low, phosphorus was medium and potassium was high. FCV tobacco soils of Davanagere were low in organic carbon in surface soils and medium in sub-soils. Available phosphorus both in surface as well as sub-soils was in medium range. Available potassium was high in surface soils and medium in sub-soils. FCV tobacco growing soil of Tarikere taluk of Chikkamagalur district were low in organic carbon, high in available P and medium in available K status in both surface as well as sub-soils. Chewing tobacco soils of Hiriyur taluk of Chitradurga district were low in organic carbon, high in available P and medium in available potassium content.

Low organic matter content of the soils in these districts indicate that the soils do not contain adequate nitrogen for maximum crop production and chances of getting profitable crop response to nitrogen fertilization is high. Higher Phosphorus index values might be due to continuous P fertilizer application and negligible leaching losses. Potassium index values were high in Shimoga and Davanagere districts and medium in Chikkamagalur and Chitradurga districts. Since, K status is medium, potash fertilizers are to be applied to the soils of Chikkamagalur and Chitradurga districts. Thus, rational fertilization of FCV tobacco and chewing tobacco crop in different villages, taluks and districts can precisely made on the basis of soil test information provided.

Nutrient uptake by *Sabari lanka* tobacco grown in Sabari river banks in Khammam district

Lanka tobacco is grown in the islands of river Sabari to an extent of 5,000 acres in Kunavaram, Vara Ramachandra Puram and Chintur mandals of Khammam district. During 2007-08 season, *Lanka* tobacco plant samples were collected at harvesting stage (103 days), dried and nutrient uptake in different plant parts was determined from which total nutrient (N, P & K) uptake was computed. Results revealed that N, P & K uptake at harvesting stage in *Lanka* tobacco was 148 kg N, 16.1 kg P and 102 kg K/ha (Table 13).

Table 13 : Dry matter and nutrient uptake (kg/ha) by *Sabarilanka* tobacco grown in islands of Kunavaram

	Lamina	Midrib	Stem	Root	Total
Dry matter	2394	721	1320	837	5272
Nitrogen	76	17.6	33.9	20	148
Phosphorus	6.86	2.64	4.48	2.12	16.1
Potassium	37.1	28.4	27.6	8.89	102

Soil fertility survey of chewing tobacco growing areas of Tamil Nadu

To assess the soil fertility status of the chewing tobacco growing villages of Tamil Nadu, 50 surface and corresponding sub-surface soil samples and water samples were collected. Processing and analysis of these soil samples is in progress.

Determination of critical level of zinc for FCV tobacco in soils of NLS area

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

Influence of zinc on FCV tobacco

Application of zinc sulphate @ 0, 10, 20, 30, 40 and 50 kg/ha did not significantly influence green leaf yield, cured leaf yield and grade index of FCV tobacco. However, the high values of CV obtained in the present study is attributed to the presence of viral diseases affecting the plants. Since, there was no response in yield to the zinc levels, further analysis of yield data to find out the critical level of zinc in soil was not attempted.

Influence of zinc on leaf chemical quality

Lamina nicotine concentration ranged from 1.53 to 2.20% with a mean of 1.84% in P position, from 1.32 to 1.96% with a mean of 1.77% in X position and from 1.86 to 2.33% with a mean of 2.06% in L position. Lamina reducing sugars concentration ranged from 8.84 to 11.87% with a mean of 10.58% in P position, from 14.82 to 18.92% with a mean of 16.85% in X position and from 15.72 to 19.31% with a mean of 17.55% in L position. Lamina chlorides concentration ranged from 0.44 to 0.60% with a mean of 0.51% in P position, from 0.41 to 0.46% with a mean of 0.43% in X position and from 10.50 to 0.70% with a mean of 0.59% in L position. Zinc levels did not show any significant influence on the above leaf chemical quality parameters. All the leaf chemical quality parameters were in the acceptable range of good quality leaf in all the treatments.

Influence of zinc application on N, P, K and Zn concentration in lamina and other plant parts

Lamina N concentration ranged from 2.03 to 2.49% with a mean of 2.33% in P position, from 1.90 to 2.24% with a mean of 2.08% in X position and from 1.98 to 2.40% with a mean of 2.19% in L position. Lamina P concentration ranged from 0.24 to 0.30% with a mean of 0.26% in P position, from 0.22 to 0.26% with a mean of 0.24% in X position and from 0.23 to 0.26% with a mean of 0.25% in L position. Lamina K concentration ranged from 2.23 to 2.74% with a mean of 2.54% in P position, from 1.92 to 2.30% with a mean of 2.09% in X position and from 1.66 to 2.25% with a mean of 1.99% in L position. Lamina Zn concentration ranged from 31.6 to 69.5 mg/kg with a mean of 50.2 mg/kg in P position, from 29.34 to 50.9 mg/kg with a mean of 40.0 mg/kg in X position and from 32.3 to 45.0 mg/kg with a mean of 40.2 mg/kg in L position. Zinc levels did not show any significant influence on lamina N, P and K concentration. Levels of zinc sulphate application showed significant influence on zinc concentration of leaf lamina in P and X positions. Application of 20 kg zinc sulphate/ha resulted in significant increase in lamina zinc concentration in P and X positions over no application of zinc sulphate. Zinc concentration of lamina in L position increased with increase in zinc sulphate application levels from 0 to 50 kg/ha but the increase was not statistically significant.


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

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

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 were analysed for per cent gravel which ranged from 0.15 to 61.18% with a mean of 15.51% in surface layer and from 0 to 70.4% in sub-soil with a mean of 31.2%. In addition to the gravel, rock fragments such as cobbles, flagstones, stones and boulders are also observed in surface as well as sub-soils in a few locations.

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

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

Twenty eight surface soil (0-9") samples collected from SLS and SBS areas of Prakasam and Nellore Districts were analysed for equilibrium phosphate potential (EPP) and also buffering capacity (BC). EPP and BC values were correlated with related soil properties viz., avail P, exch. Ca, clay, Al-P, Fe-P, Ca-P and occluded P. Results revealed that FCV tobacco growing soils of Prakasam and Nellore districts showed marginal variations in phosphate potential. EPP values were slightly higher in SLS soils compared to SBS soils. Buffering capacity values were high in Southern black soils compared to Southern light soils indicating that they have more replenishing capacity. EPP values were positively correlated with Fe-P and occluded Fe-P values only. Buffering capacity values were positively correlated with all the parameters except occluded - P. Exch - Ca, pH and clay contents showed significant positive correlations with buffering capacity (Table 14).

Table 14: Correlation coefficient (r) values EPP and BC with soil properties

	BC	Avail. p	pH	Exch. Ca	Clay	Al-P	Fe-P	Ca-P	Occl-Fe-P	Occl-Al-P
EPP	-0.030	-0.172	-0.107	-0.315	-0.148	-0.175	0.104	-0.232	0.295	-0.041
BC		0.07	0.492	0.624	0.638	0.219	0.208	0.322	-0.210	-0.227

PROGRAMME 9

ALTERNATIVE USES OF TOBACCO AND REDUCTION OF HARMFUL SUBSTANCES

CTRI Research Station, Vedasandur

Breeding for high seed and oil yield in tobacco

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

Replicated evaluation trial

Twenty one out of 145 germplasm accessions of chewing, cigar and country cheroot tobacco and 15 accessions of other tobacco types that gave more than 1,000 kg/ha of seed yield in the preliminary evaluation trial in the augmented block design during 2005-06 were planted in a replicated yield trial with three replications under 60 x 50 cm spacing.

Statistical analysis of data recorded on seed yield revealed that significant differences were seen among the entries and the checks both for leaf priming and no priming for seed yield. Variety A 119 recorded significantly higher seed yield of 1,149 and 1,408 kg/ha under leaf priming and no priming as against the checks Bhagyalakshmi and Abirami, respectively (Fig. 14). Varieties A 145, Regional Connecticut, Manila Gold, Penswar, GT 6 and Yellow Butt Priyar recorded seed yield of more than 800 kg/ha under no priming. Varieties GT 6, Yellow Butt Priyar and Manila Gold recorded seed yield of 750 kg/ha under leaf priming.

Variety A 119 recorded significant seed yield of 683 kg/ha in suckers under no priming against the check Bhagyalakshmi. Under leaf priming also, A 119 recorded significant seed yield of 691 kg/ha in suckers followed by A 145 of 438 kg/ha against the check Meenakshi.

Fig.14: Seed crop of A 119

With respect to leaf yield, none of the accessions were significantly superior to the checks Meenakshi, Abirami and Bhagyalakshmi. But the accessions Manila Gold, Penswar and GT-6 recorded leaf yield of 1,832, 1,743 and 1,705 kg/ha, respectively, in addition to high seed yield which can profitably be used for chewing purpose or extraction of phytochemicals. The estimation of seed oil content of the accessions and the checks is in progress.

A set of 40 F1 crosses made with promising germplasm accessions that gave more than 1,000 kg/ha seed yield using Bhagyalakshmi, Meenakshi, Thangam and Abirami as males during 2006-07 were raised in progeny rows in 75 x 75 cm spacing. Seed yield and leaf yield were recorded. It was observed that cross A 119 x Thangam recorded 1,475 kg/ha seed yield with 1,343 kg/ha cured leaf yield of lower quality. This was followed by cross GT 6 x Thangam which recorded 1,248 kg/ha seed yield and 2,222 kg/ha cured leaf yield. Other promising crosses that recorded more than 1,000 kg/ha seed yield were A 145 x Thangam, GT 6 x Bhagyalakshmi, NP 47 x Thangam, NP 19 x Thangam, A 119 x Bhagyalakshmi, and GT 6 x Abirami.

CTRI Research Station, Dinhata

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

(S. Amarnath)

Fifty four germplasm lines of *Jati* tobacco *(N. tabacum*) were evaluated for their seed

yield and oil content during 2007-08. Each line was grown in rows with 20 plants each. Five plants in each line were observed for plant height, Number of main branches, number of sub-branches, number of capsules/plant and seed yield/plant. The data collected indicated wide range and mean indicating wide variations for different characters studied. Minimum height observed in cv. A 145 (58.7 cm), number of main branches in cv. Sel.28-10 (3.3), number of sub-branches (4.0) in cvs. Sel.28-10, HDJ 1, GT 6, number of capsules/plant in cv. Lichavi (444) and seed yield/plant (0.041 kg) and per hectare in cv. Sel. I-397/2 as well as maximum plant height in cv. Sel.II-2a-7-82 (219.3 cm), number of main branches in cv. Sel.II-1a-7-79 (15.7), number of sub branches in cv. A-145 (26.3), number of capsules/plant in cv, GT-7 (1,255), seed yield/plant (0.148 kg) and per hectare (1,827 kg) in cv. J-7 were observed. Analysis of oil content of each line is in progress.

Six cultivars/lines of *Jati* tobacco viz., J-7, J-12, PT-76, Sel.II-1a-7-79, Sel. III-148 and Bhagyalakshmi were selected based on their high seed yield/ha and low to moderate capsule number for their further evaluation in a replicated trial.

CTRI, Rajahmundry

Evaluation of tobacco hybrids for leaf biomass and seed yields

(P. Harishu Kumar, C.V. Narasimha Rao, K. Siva Raju, M. Anuradha and R.V.S. Rao)

Four tobacco varieties (A 145, TI-163, HDBRG and G T-7), their hybrids and reciprocals (total 16) were evaluated in RBD with three replications at a fertility level of 100 kg N + 50 kg P_2O_5 + 50 kg K_2O + 50 kg sulphur per hectare at a spacing of 80 x 40 cm in Vertisols for the production of leaf biomass, phytochemicals, seed and seed oil yields. The crop received one irrigation (2.5 cm depth) at 35 DAT and one rain (20 mm) at 50 DAT.

The leaf biomass was harvested under three categories i.e. bottom leaf, middle leaf and top leaf with 10-15 days interval after the crop showed full development of the leaves under topped conditions. The green leaf weights were recorded at each time and total of the three positions were added up and subjected to statistical analysis.

Maximum leaf biomass (fresh weight basis) was recorded in the cross HDBRG x GT-7 (39.3 t/ha) closely followed by its reciprocal cross i.e., GT-7 x HDBRG (39.50 t/ha) and on par with (1) HDBRG (2) HDBRG XA- 145 (3) T1-163 x HDBRG (4) HDBRG x T1-163 (5) T1-163 x G T7 (6) GT8 x T1-163 (7) HDBRG x GT-7(8) GT-7 X HDBRG (9) HDBRG x GT-8 (10) GT-7 x GT-8 (11) GT-8 x GT-7. However, the cross HDBRG x GT-7 recorded an increase of biomass by 13.09% over HDBRG and 28.57% over GT-7 parents.

Performance of A -145, A - 145 x HDBRG and HDBRG x A 145 in the production of seed yield

(P. Harishu Kumar)

Two hundred plants each of the above variety and crosses were grown in bulk in Vertisols for seed purpose. The seed yield data at 80 x 40 cm spacing under 100 kg N level/ha with one irrigation are presented in Table 15.

Table 15 : Tobacco seed yields

Variety/ hybrid	Seed yield (kg/ha)
A - 145	1,562
A - 145 x HDBRG	1,640
HDBRG x A - 145	1,781

Biochemical characterization of tobacco seed oil

(K. Siva Raju, C.V. Narasimha Rao, R.V.S. Rao and V. Krishnamurthy)

Tobacco seed oil content was estimated in 108 tobacco germplasm accessions of various tobacco types. Among the 43 germplasm accessions of exotic air-cured type, the oil content varied between 33.06 (EAC 145) to 44.94% (EAC 101). Among the Burley accessions, the oil content varied from 23.09

(BGP 33) to 45.61% (BGP 35). The peroxide value increased from 8.24 to 84.24 (milliequivalents of peroxide/kg) within 90 days from the date of extraction, whereas it varied between 6.24 to 50.12 within 90 days in sunflower oil (Crystal).

Evaluation of smoke constituents in tobacco and tobacco products

(C.V. Narasimha Rao)

Sixty eight flue-cured tobacco samples of 2006-07 & 2007-08 crop seasons were collected from NLS, SLS, KLS, SBS, CBS and NBS and analysed for smoke constituents (TPM, Tar, nicotine, CO and solanesol) and leaf constituents (nicotine, reducing sugars, chlorides, potassium, petroleum ether extractives and solanesol).

The following trends were observed from the mean values (samples of the crop season 2007-08) in smoke constituents: tar (NLS > SLS > KLS); nicotine (SLS > KLS> NLS); carbon monoxide (NLS > SLS > KLS); solanesol (NLS > SLS > KLS) and leaf constituents: nicotine (SLS > NLS > KLS); reducing sugars (KLS > NLS > SLS); potassium (KLS > NLS > SLS); petroleum ether extractives (NLS > SLS > KLS); solanesol (NLS > SLS > KLS). In general, lower TPM/Tar values were recorded in samples with low nicotine, low solanesol and high potassium content.

Studies on Tobacco Specific Nitrosamines (TSNA) in tobacco and tobacco products

(C.V. Narasimha Rao)


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The objective of the investigations under the project is to find out the levels of TSNA in different types of tobacco produced under varying agro-ecological situations of the country, so as to examine the factors such as genetic, agronomic, cultural and post-harvest processing which play a major role for exploring the possibilities of reducing the levels of these compounds in leaf to make tobacco less harmful.

The levels of TSNA in FCV tobacco from KLS (0.35 ppm) were lower when compared to samples from SLS (0.38 ppm) and NLS (0.75 ppm). The differences between NLS and SLS and NLS and KLS were highly significant. However, the differences between SLS and KLS were not significant and were at par. A similar trend was noticed in the case of leaf nicotine (KLS tobacco: 11.80 mg/g: SLS tobacco: 17.47 mg/g; and NLS tobacco: 29.30 mg/g) and nornicotine (KLS tobacco: 0.33 mg/g: SLS tobacco: 0.38 mg/g; and NLS tobacco: 0.50 mg/g). Nitrate content was marginally lower in NLS samples (1.10 mg/g) when compared to samples from KLS (1.25 mg/g) and SLS (1.54 mg/g). It was observed that TSNAs were higher in samples with lower reducing sugar/ nicotine ratio i.e. high nicotine and low sugars. It was also observed that Nitrasoanatabine (NAT) was predominant TSNA (60.07 – 72.53%) followed by NNN (5.67 – 23.39%) in FCV tobacco.

It is inferred from the t-values that a highly significant difference exists between Burley and chewing tobacco (WB) and HDBRG and chewing tobacco (WB). However, differences among Burley and HDBRG, Burley and Chewing tobacco (TN), HDBRG and Chewing tobacco (TN) were significant. Higher levels of TSNAs in cured leaf were observed in HDBRG (10.02 ppm) followed by chewing tobacco samples from Tamil Nadu (2.94 to 8.44 ppm) and West Bengal (2.47 ppm). In air-cured tobaccos also, NAT was the predominant TSNA (32.42 - 79.90%) followed by NNN (12.42 – 40.41%). The levels of nitrate, nicotine and nornicotine showed similar trend. Chewing tobacco samples from West Bengal showed the highest levels of nitrate: 3.49 mg/g; nicotine: 51.28 mg/g and nornicotine: 1.39 mg/g followed by HDBRG tobacco samples, nitrate: 1.90 mg/g; nicotine: 30.19 mg/g and nornicotine: 0.38 mg/g. The lowest values of nitrate: 1.58 mg/g; nicotine: 26.81 mg/g and nornicotine: 0.23 mg/g were observed for chewing tobacco samples from Tamil Nadu. Storage studies conducted on chewing tobacco samples from Tamil Nadu showed that TSNAs increased during storage. In the Burley tobacco germplasm lines,

nicotine/nornicotine conversion varied from 0 to 29.71.

In chewing tobacco from Tamil Nadu, method of curing, particularly smoke-curing, had pronounced and significant influence on the levels of TSNA. It is concluded from the data that the effect of curing on TSNA levels was highly significant. Significantly higher levels were recorded in smoke cured samples (24.49 to 49.50 ppm) when compared to pit-cured (1.38 to 3.87 ppm) and sun-cured (0.63 to 12.36 ppm) samples. However, the influence was not significant among varieties. The higher levels in smoke-cured samples might be attributed to the presence of combustion products, particularly, NO_x compounds responsible for the nitrosation of alkaloids.

Monitoring of pesticide residues in tobacco samples from different areas

(C.V. Narasimha Rao)

Pesticide residue analysis in FCV tobacco leaf samples received from different auction platforms in NLS, SLS, SBS, NBS and KLS revealed that in general, all the pesticide residues are within the Guidance Residue Levels (GRL) except in a few cases (Table 16).

Table 16 : Pesticide Residue levels in flue-cured tobacco (Crop season: 2007-08)

Sample No.	Total BHC	Gama BHC	Chlor-pyriphos	Dieldrin	Endrin	Total Endo-sulfan	Total DDT
Guidance Residue Level (ppm)	0.50	0.50	0.50	0.05	0.05	1.00	0.40
NLS (20)	ND-0.56	ND-0.38	ND-2.20	ND-0.08	ND	ND-5.10	0.03-1.90
KLS (30)	ND-0.06	ND-0.03	ND-0.09	ND	ND	ND-0.15	N-D-0.04
SLS (30)	ND-0.47	ND-1.20	ND-0.57	ND-0.10	ND	ND-1.83	ND-0.42
SBS/CBS/NBS(20)	ND-0.44	ND-0.08	ND-0.50	ND-0.06	ND	ND-0.21	0.01-0.06

PROGRAMME 10

AGRICULTURAL EXTENSION AND INFORMATION TECHNOLOGY

Agricultural Extension

Evaluation of Tobacco Portal System

(Y. Subbaiah and S. K. Naidu)

Tobacco portal system was evaluated through structured interview schedule. The experimental and controlled areas were compared. The number of hits were reduced by 97% in 2006 as compared to initial year 2002. Rank-wise utilization pattern indicated that the item, market information received highest number of hits i.e., 56% followed by Good Agricultural Practices (GAP) with 44% hits.

It is observed that there is positive and significant difference between respondents in experimental & control groups with regard to gain in knowledge, positive attitude and adoption. A critical analysis of impact of portal system in terms of gain in knowledge, attitude & adoption has clearly indicated that the portal has shown its positive impact on the variables. Considering the impact of portal system and on elicitation of suggestions from different stake-holders of tobacco, an integrated strategy is formulated for improving the effectiveness of tobacco farmer's portal.

Changing scenario of the cropping pattern stress analysis of tobacco farmers of A.P.

(K. Suman Kalyani and S. K. Naidu)

The data was collected from NLS farmers regarding various parameters like annual family income, permanent house, material possession, vehicles, membership in various organizations, agricultural implements, cattle wealth, education of the children, number of bank accounts, and number of loans over a period of 30 years by dividing them into 6 blocks i.e. 1981-85, 1986-90, 1991-95, 1996-2000, 2001-05 & 2006 onwards.

Total cost of production per acre during 2008-09 for small farmer was around Rs. 48,000 and Rs. 54,050 for big farmer, including the expenditure incurred for preparatory cultivation, seedlings, manures, fertilizers, weeding, interculture, transplanting, pesticides, suckericide, harvesting, firewood, curing, grading, bulking, transportation, land lease, barn lease, irrigation and interest on fixed capital. Total labour cost per acre for small farmer was around Rs.16,500 and Rs. 20,000 per acre for big farmer which includes weeding, interculture, transplantation, spraying, suckericide application, harvesting, curing and grading & bulking.

Regarding trend analysis, the farmers are continuing tobacco cultivation because of the loan facilities and ensured market which is not seen in other crops. They were benefited after introduction of auction system from 1984-1985 onwards because of prompt payment through banks.

Banks have come forward to offer bank loans for tobacco farmers and the interest rates were reduced on crop loans from 12 % to 7% and the loan amount was increased to Rs. 1.75 lakhs per barn. After the introduction of FCV tobacco variety Kanchan by CTRI, which is a high yielding variety recommended for Northern light soils, the yields have increased to 10-12 q/acre.

During 2008, the price level reached its peak and the economic status of tobacco farmers has improved. Electronic auction system was introduced on 26th May, 2008 to create international demand and better participation. About 158 countries are working under this system. NLS tobacco has fetched a maximum price of Rs. 140.40 per kg (2008) and followed by Rs. 160.00 per kg (2009), which


SIRI

is more than 3 $. Diversified cropping situation exists in NLS region. The big farmers are also cultivating other crops viz., cashew, mango, coconut, oil palm, eucalyptus, sugarcane, paddy and chillies along with tobacco. Increase in the cost of fuel and labour resulted in 15% to 20% increase in the cost of cultivation. The rate of consumption of fuel has increased due to the non-repair of flue pipes, furnaces and barn roofs.

Front line demonstration on Siri (CY-135) in NBS area of AP

(S. K. Naidu, Y. Subbaiah, K. Suman Kalyani and K. Sarala)

The Front Line Demonstrations (FLD) with the newly released variety Siri were conducted at Damaracharla and Velerupadu in NBS zone of Khammam District. The variety was compared with control, VT-1158. The crop growth and cultural practices were regularly monitored. All the recommended package of practices were scrupulously followed by the farmers. Farmers have shown interest to grow Siri variety because of its vigorous growth and high yield potential and opined that Siri variety needs more nitrogen. At Damaracharla, the variety Siri yielded 2,935 kg/ha cured leaf with 78% bright grades. The check variety VT-1158 yielded 2,500 kg/ha with 70% bright grade out turn. The variety Siri showed 17.4 % increase in cured leaf and 30.8% increase in bright grade yield over control, VT1158. Due to the untimely rains in the month of February, 2008, the trial plots at Velerupadu were completely inundated and did not yield valid results.

Observations were recorded on the incidence of pests and diseases. The incidence of ground beetle and *Spodoptera* were found to be negligible in both the plots at both the locations. The incidence of stem borer was 4% in experimental as well as control plots at Damaracharla while at Velerupadu 8% incidence was observed in Siri and 6% in VT-1158. Incidence of bud worm was also noticed. However, severe incidence of aphids was recorded. The recommended pest management practices were advocated for adoption by the farmers. With respect to the diseases, low incidence of leaf curl was noticed at both the locations. However, the incidence of TMV was recorded to an extent of 10-12% in Siri plot.

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

(Y. Subbaiah and S. K. Naidu)

The enhanced yields due to adoption of improved varieties and innovative technologies & price fluctuations warrant a through analysis of trends in cost of production and price behaviour of FCV tobacco in SLS area. Sampling was done by adopting stratified random sampling procedure. All the auction platforms being operated under SLS area were selected. One village under each auction platform and 20 farmers from each village were selected. Thus, 120 farmers were formed as sample for the study.

Critical analysis of the empowerment of farm-women in tobacco growing agency area of East Godavari district

(K. Suman Kalyani and S. K. Naidu)

The staple food for tribal population is rice followed by minor millets like sorghum, pearl millet and tapioca. They also raise commercial crops like cotton, tobacco, chillies, pulses like redgram, blackgram, greengram, *rajmah*, cowpea; oil seeds like groundnut, gingelly; plantation crops like cashew, rubber, coffee and orchards like mango, banana, citrus, pineapple etc.

The occupation of the tribal families include *podu* cultivation, hunting, fetching forest products, like *adda* leaf, gum *karaya*, honey and fire-wood. The tribal women are not in a position to utilize the amount for economic activities. Burley tobacco occupies approximately 15,000 acres in East Godavari district spreading in Rajavommangi, Addathegala, and Koyyuru mandals of agency area. The tribal women were cultivating Burley tobacco varieties like Banket A-1 and Potharam

varieties. The area under commercial crops like cotton and vegetables is increasing. Majority of the respondents belong low income groups and are involved in self-help activities. Skill oriented training programmes viz., Jam & juice making, Vermicompost making, Backyard Kitchen Gardening, package of practices in Burley tobacco were conducted for 200 tribal farm-women at Bornagudem and Vattigadda villages for improvement of their family income.

ARIS Cell

Creation of web pages for CTRI

(H. Ravi Sankar, J.A.V. Prasad Rao and C.V. Narasimha Rao)

Research information in web pages viz., technologies developed, varieties released, success stories, agronomic practices, tobacco in Indian economy were updated. Information regarding tenders, photo gallery, press releases and other information related to institute was uploaded as and when received from different divisions/sections. Content in the web pages were updated at regular intervals.

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 Andhra Pradesh. It will be useful for identification of various insects and pathogens attacking various crops and necessary precautions. Debugging and testing of each module with sample data has been completed. Coding was Debugged in some of the modules and tested with the data. Created the setup program and tested its compatibility. Data entry for the diseases of tobacco crop 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 assess the quality of the FCV tobacco leaf based on physical and chemical quality parameters and manufacturing properties. Testing the software with sample data has been completed. Data forms were given to the concerned scientists/technical officers for various parameters to enter the data. Data for chemical parameters has been received and stored in the database.

Designing algorithms for data classification

(H. Ravi Sankar)

Using a new technique for classification of data, software entitled Expert system for the diagnosis of nutrient deficiencies has been developed. Testing, Debugging and data entry has been completed. A CD-ROM has been designed for portable execution of this software. The system enables the viewer to match the observed visual deficiency symptoms in the leaf with the different symptoms displayed on the system and identify the problem as well as remedial measures. With user-friendly menus, it is easy to execute this system and retrieve the information as per requirements. Anyone who has preliminary knowledge on computer applications can easily identify the nutrient deficiency and retrieve the corrective measures instantaneously.


SIRI

TECHNOLOGY ASSESSED AND TRANSFERRED

- The FLDs on cv. Siri revealed that the new cultivar recorded higher yield and bright grade outturn over the check variety VT-1158 by 17.4% and 30.8%, respectively.

- Seedlings growth under micro-sprinkler was rapid, transplantable seedlings were more and ready for transplanting in 45 days as compared to 60 days in traditional water application, while reducing the labour cost by Rs.1,45,000/ha.

- Sunnhemp *in situ* green manuring - tobacco with application of 120 kg N/ha in 25:75 proportions of organic N: fertilizer N gave significantly higher green leaf yield, cured leaf yield and grade index under NLS conditions.

- The integrated barn comprising of Ventury furnace and modified flue-pipe system was found to utilise 4.11 kg of wood fuel to get one kg cured leaf under Shimoga conditions. Coffee husk was used as alternative fuel for curing FCV tobacco and 5.11 kg of coffee husk was consumed to obtain one kg cured leaf.

- The Burley tobacco variety Banket A1 recorded significantly higher cured leaf yield of 2,683 kg/ha at 120 kg N level with 4 t/ha vermicompost.

- The farmers of middle Gujarat Agro-climatic zone - III growing *Bidi* tobacco (Variety GTH 1) are advised to apply 187 kg N (AS + Urea in 1:3) + *Azotobacter chroococcum*, ABA 1 or 187 kg N (AS + Urea in 1:3) + *Azospirillum lipoferum* ASA 1 + FYM @ 12.5 t/ha for saving 15% N and getting higher yield of tobacco. These farmers are also advised to use 8 kg seed/ha for raising *Rustica* tobacco nursery to obtain more transplants and higher net returns.

- In Tamil Nadu, sunnhemp raised as a green manure crop and ploughed *in situ* at 45 days + *Azospirillum* @ 10 kg/ha + Phosphorus Solubilizing Bacteria @ 10 kg/ha along with 100% recommended dose of fertilizer (75 kg N+100 kg P_2O_5+50 kg K_2O/ha) to chewing tobacco significantly increased the growth attributes, yield and net returns.

- In Vertisols, Proclaim (Emamectin benzoate) @ 11 g a.i./ha was highly effective against *S. litura* in tobacco seed beds and *H. armigera* in the field crop.

- Planting of marigold (single whorl) and *Rustica* tobacco as border along with foliar spray of NSKS @ 0.5% on FCV tobacco proved effective in reducing the infestation of *H. armigera* in FCV tobacco and increased the trapping of budworm population.

- In *Bidi* tobacco at Anand, IPM module having castor and marigold as trap crops and one spray of 2% NSKS reduced *S. litura* incidence up to 50% over unsprayed plot. The module having marigold and castor played important role in increasing activity of natural enemies like coccinellids, syrphids, chrysophids, spiders and *N. tenuis*.

- For integrated management of root-knot nematodes, frog-eye spot and leaf curl disease in *Bidi* tobacco fields, farmers of middle Gujarat are advised to plant their crop during 1st to 3rd week of September.

EDUCATION AND TRAINING

The Central Tobacco Research Institute has undertaken educational activities like training the farmers, field days, *Kisan Melas*, exhibitions, workshops and meetings in collaboration with Tobacco Board, Agricultural Market Committees, State Agricultural Universities, State Agricultural Departments, M/s. ITC Ltd., ILTD Division, and M/s. Maddi Lakshmaiah & Co., at Village level to increase the tobacco productivity coupled with quality, during the year under report 2008-09.

Tobacco Farmers Training Programme on "Tobacco Nursery Management" was organized at CTRI RS, Dinhata in collaboration with Krishi Vigyan Kendra, Uttar Banga Krishi Vishwavidyalaya on 25.09.2008.

Tobacco Farmers Training Programme on "Tobacco Disease Management" was organized at CTRI RS, Dinhata in collaboration with Krishi Vigyan Kendra, Uttar Banga Krishi Vishwavidyalaya on 02.12.2008.

Training programmes was imparted by Scientists and Technical personnel of this Research Station to the Tobacco farmers of village Kuchlibari, Mekhliganj Sub-division of Cooch Behar district. The training was imparted on field know-how pertaining to Crop Improvement, Crop Production, Crop Protection and Nutrient deficiencies in tobacco.

Sl. No.	Programme & Participant (s)	Date & Place
Farmers' training programme on field crop management		
1.	Dr. M. M. Shenoi & K. N. Subrahmanya	21.05.2008 at Melur
2.	Dr. M. M. Shenoi & K. N. Subrahmanya	22.05.2008 at K.G.Koppalu
3.	Dr. M. M. Shenoi & K. N. Subrahmanya	23.05.2008 at H.Ramenahally
4.	K. N. Subrahmanya	27.05.2008 at Makodu
5.	Dr. M. Mahadevaswamy	28.05.2008 at Hosaveedu
6.	Dr. M. M.Shenoi	29.05.2008 at Karnakuppe
7.	Dr. M. M.Shenoi	30.05.2008 at Haranahally
8.	K. N. Subrahmanya & Dr. M. Mahadevaswamy	30.05.2008 at Lakkur & Kadanur
9.	Dr. M. M. Shenoi	31.05.2008 at Thimrapura
Rythu Sadassu		
10.	Dr. K. Nageswara Rao & Dr. S.V. Krishna Reddy	05.06.2008 at Devarapalli
11.	S. Nageswara Rao & K. Sesha Sai	06.06.2008 at Repallevada
12.	Dr. K. Nageswara Rao	08.06.2008 at Etukulankota
Training on "Good Agricultural Practices in FCV Tobacco in KLS"		
13.	Scientists & Technical Officers of CTRI RS, Hunsur	06.06.2008 at Hunsur


SIRI

Sl. No.	Programme & Participant (s)	Date & Place
Post Harvest Product Management		
14.	K.N.Subrahmanya	11.08.2008 at Maduvinahally 19.08.2008 at Moodala Koppalu
15.	Dr. M. M. Shenoi	11.08.2008 at Konasur 18.08.2008 at Ittigehally Koppalu 19.08.2008 at Harve Ramenahally
16.	K.N.Subrahmanya & Dr.M.Mahadevaswamy	12.08.2008 at Gangur & Mallapura
Farmers' training on storage and grading/NTRM		
17.	K.N.Subrahmanya & Dr.M.Mahadevaswamy	12.08.2008 at Mallapura & Vaddarahally
18.	K.N.Subrahmanya	11.08.2008 at Yashavanthapura 14.08.2008 at H. Hebbagilu & Melur 18.08.2008 at Kanagala & Makodu 19.08.2008 at Bannikuppe 28.08.2008 at Maduvinahally 01.09.2008 at D.G.Koppalu 04.09.2008 at Chennakeshavapura 05.09.2008 at Shettayyanakopalu
19.	Dr. M. M. Shenoi	11.08.2008 at Ankanahally 14.08.2008at Haranahally & Adgur 27.08.2008 at Mugalur & Bannur 18.08.2008 at Karanakuppe & Agrahara 28.08.2008 at Ankanahally 01.09.2008 at Chittekyathana-hally 04.09.2008 at Chikkabylalu 05.09.2008 at Hunsegala
Training programme on nursery management		
20.	Dr. K.C. Chenchaiah	04.09.2008 at Kaligiri
Farmers' Meeting		
21.	V. Venkateswarlu	05.09.2008 at D.C.Palli
Training programme on nursery management		
22.	Dr. A.R. Panda	08.09.2008 at Pamuru
23.	Dr. A.R. Panda	09.09.2008 at Chodavaram
Training on storage, grading / NTRM		
24.	K.N.Subrahmanya	12.09.2008 at Bannikuppe

Sl. No.	Programme & Participant (s)	Date & Place
Training programme on "Nursery management"		
25.	Dr. V. Krishnamurthy	17.09.2008 at Tekubaka
Farmers' Meeting		
26.	V. Venkateswarlu	17.09.2008 at Podili
Training programme on nusery management		
27.	Dr. A.R. Panda & Dr. K.C.Chenchaiah	18.09.2008 at Pamuru & Tanguturu
28.	Dr. A.R. Panda	19.09.2008 at Podili & KV Palem
29.	Dr. K.C.Chenchaiah	19.09.2008 at SN padu & Ammanabrole
Training programme on nursery management		
30.	Dr. S.V. Krishna Reddy, S. Gunneswara Rao & Dr. S.K. Dam	30.09.2008 at Mirthpadu
Farmers' Meeting		
31.	Dr. A.R. Panda	06.10.2008 at Kanigiri & Podili
32.	V. Venkateswarlu	17.10.2008 at Markondarayapalem
33.	R. Sreenivasulu	30.10.2008 at Tangutur
34.	V. Venkateswarlu	31.10.2008 at Podili
Training programme		
35.	Dr. A.R. Panda & R. Sreenivasulu	08.10.2008 at Yallampalli, Addanki, Talluru &Vittalapuram
FCV tobacco field crop management in NLS		
36.	Dr. S.V. Krishna Reddy & Dr. K. Nageswara Rao	11.11.2008 at Yerrampeta
Field crop management		
37.	Dr. A.R. Panda	12.11.2008 at Tangutur
Farmers' Meeting		
38.	V. Venkateswarlu	18.11.2008 at D.C.Palli
Field crop management		
39.	Dr. A.R. Panda	19.11.2008 at Kondasamudram

Sl. No.	Programme & Participant (s)	Date & Place
40.	Dr. A.R. Panda	20.11.2008 at Vellampalli & Bollampadu
Field crop management		
41.	Dr. C.C.S. Rao, S. Gunneswara Rao & Dr. S.K. Dam	25.11.2008 at Vadisileru
Pest and disease management		
42.	Dr. U. Sreedhar, Dr. S.V. Krishna Reddy & Dr. S.K. Dam	27.11.2008 at JR Gudem
Tobacco Board meetings		
43.	Dr. A.R. Panda	27.11.2008 at Ongole & Mangamuru
44.	Dr. A.R. Panda	28.11.2008 at Ongole
Field crop management		
45.	Dr. K.C. Chenchaiah	27.11.2008 at Raparla
46.	Dr. K.C. Chenchaiah	28.11.2008 at Kondepi
Field Day on organic paddy cultivation		
47.	Dr.M.Mahadevaswamy	01.12.2008 at Hosur
Field crop management		
48.	Dr. A.R. Panda	01.12.2008 at Kondepi, Ongole & Lingamgunta
49.	Dr. A.R. Panda	07.12.2008 at Polinenepalem, Doobhagunta
Role of Women in Agriculture		
50.	Dr. M. M. Shenoi	04.12.2008 at Shanubhoganahalli
Visit to Nisha cyclone affected tobacco areas		
51.	V. Venkateswarlu	08.12.2008 at Kondepi
52.	Dr. A.R. Panda, R. Sreenivasulu & Dr. K.C. Chenchaiah	10th & 11th Dec. 2008 at Ongle II & Podili I & II Tangutur & Kandukur I

Sl. No.	Programme & Participant (s)	Date & Place
Field crop management		
53.	Dr. A.R. Panda & V. Venkateswarlu	12.12.2008 at D.C.Palli, Kaligiri, & Narisetty varipalem
54.	R. Sreenivasulu	06.01.2009 at Siddavaram & Peda Alavapadu
55.	R. Sreenivasulu & Dr. K.C. Chenchaiah	12.01.2009 at Ippagunta
56.	R. Sreenivasulu	20.10.2009 at Malakonda & Rayunipalem
Farmers' Day		
57.	Dr. M. M. Shenoi	23.12.2008 at Hunsur
Topping & Desuckering, harvesting, curing and P.H.P.M.		
58.	Dr. S.V. Krishna Reddy & Dr. K. Siva Raju	06.01.2009 at Murari
59.	Dr. K. Siva Raju & Dr. K. Nageswara Rao	07.01.2009 at Saripalli & Kommugudem
60.	Dr. S. Kasturi Krishna & Dr. K. Sarala	09.01.2009 at Peddapuram
61.	Dr. K. Siva Raju & Dr. M. Anuradha	12.01.2009 at Kamaiahpalem
Visit to on-farm trials in NLS		
62.	Dr. K. Nageswara Rao & Dr. G. Raghupathi Rao	20.01.2009 at Cherukumilli
Field crop management		
63.	Dr. S.V. Krishna Reddy	22.01.2009 at CTRI, Rajahmundry
Farmers' interaction meeting on organic farming		
64.	Dr.M.M.Shenoi, K. N.Subrahmanya, Dr.M.Mahadevaswamy, Dr.P.Venkateswarlu, S.Ramesh & T.Venkatesh	24.01.2009 at JSS, KVK, Suttur
Field Day		
65.	Dr. C.A. Raju & Dr. P. Harishu Kumar	28.01.2009 at Dippakayalapadu
Farmers' meeting		
66.	R. Sreenivasulu	28.01.2009 at Regada
67.	R. Sreenivasulu	03.02.2009 at Revellavari Palem
68.	R. Sreenivasulu	05.02.2009 at Kondasamudram

Sl. No.	Programme & Participant (s)	Date & Place
	Training to the dealers of Agricultural Extension Services	
69.	Dr. S.V. Krishna Reddy, Dr. G. Raghupathi Rao & Dr. S.K. Dam	01.02.2009 at Jangareddygudem
	Field crop management	
70.	Dr. S.V. Krishna Reddy	05.02.2009 at CTRI, Rajahmundry
	Topping & Desuckering, harvesting, curing and P.H.P.M.	
71.	Dr. C.A. Raju, Dr. P. Harishu Kumar & Dr. K. Nageswara Rao	06.02.2009 at Devarapalli
	Training to the Input dealers of MANAGE	
72.	Dr. S. Kasturi Krishna,S. Gunneswara Rao & V. Venkateswarlu	08.02.2009 at CTRI, Rajahmundry
	Workshop on Bamboo cultivation	
73.	Dr.M.M.Shenoi & K.N.Subrahmanya	09.02.2009 at Hunsur
	Field day	
74. 75.	Dr. K. Nageswara Rao Dr. K.C. Chenchaiah	10.02.2009 at Narasannapalem 12.02.2009 at Kambalapadu
	Micro-irrigation and Farm Mechanization	
76.	Dr. B. Krishna Rao	16.02.2009 at Aswaraopet
	Tobacco Production Technology	
77.	Dr.M.M.Shenoi & K.N.Subrahmanya	20.02.2009 at Kaggundi.
	Meeting on Organic Farming	
78.	Dr.M.M.Shenoi & Dr.M.Mahadevaswamy	26.02.2009 at Bangalore.
	Training on Banana Fibre Extraction	
79.	R. Sudhakar	February 26-27, 2009 at CIH, Nagaland

Sl. No.	Programme & Participant (s)	Date & Place
Field day		
80.	Dr. K.C. Chenchaiah	27.02.2009 at Sitarampuram
Kisan Mela		
81.	S. Jitendranath	March 6-7, 2009 at Maruteru
Field day		
82.	Dr. K.C. Chenchaiah	23.03.2009 at Vellampally
GUEST LECTURES/ ORIENTATION PROGRAMMES		
1.	Dr. H. Ravi Sankar	Invited lecture on "Data mining techniques"at Hindu College P.G. Course, Guntur on 16.02.2009
2.	Dr. B. Krishna Rao	Farmers training programme on "Micro-irrigation and Farm Mechanization" at Agricultural College, Aswaraopet on 16.02.2009

RADIO TALKS

Sl. No.	Name	Topic, Station & Date of broadcast
1.	Dr. J.V. Prasad	Management of tobacco caterpillar and white fly in tobacco field crop (22.04.2008, AIR, Visakhapatnam)
2.	Dr. B. John Babu	Pasu Kranthi Padhakam (29.04.2008, AIR, Visakhapatnam)
3.	V.V. Lakshmi Kumari	Role of leafy vegetables in health management - Interview (18.05.2008, AIR, Vijayawada)
4.	Dr. P.V.V.S. Siva Rao	Advantages of backyard rearing of Grama Priya poultry - Interview (25.05.2008, AIR, Vijayawada)
5.	Dr. S. Kasturi Krishna	Importance of summer ploughing and organic fertilizers in tobacco cultivation (15.05.2008, AIR, Visakhapatnam)

Sl. No.	Name	Topic, Station & Date of broadcast
6.	J.V. R. Satyavani	Post harvest technologies in cashew (28.05.2008, AIR, Vijayawada)
7.	Dr. B. John Babu	Gynaecological diseases in cattle - Prevention (07.06.2008, AIR, Vijayawada)
8.	Dr.K.C.Chenchaiah	Role of botanical pesticides in IPM of tobacco (15.06.2008, AIR, Vijayawada)
9.	Dr. K. Sarala	Production of phytochemicals from tobacco – Prospects (21.06.2008; AIR, Visakhapatnam)
10.	S. Jitendranath	Importance of modern agricultural implements (29.06.2008; AIR, Visakhapatnam)
11.	Dr. C.C. S. Rao	Suitable soils for FCV tobacco cultivation- Importance of soil testing (29.07.2008, AIR, Visakhapatnam)
12.	S. Gunneswara Rao	Disease and pest management in tobacco nurseries (28.08.2008, AIR, Visakhapatnam)
13.	J. V. R. Satyavani	Integrated fertilizer and pest management in brinjal cultivation (28.08.2008, AIR, Visakhapatnam)
14.	S. Jitendranath	Development of oil seeds and pulses – Importance (13.09.2008, AIR, Vijayawada)
15.	Dr. P. V. Venugopala Rao	High yielding varieties of FCV tobacco – Characteristic features (25.09.2008, AIR, Visakhapatnam) (30.11.2008, AIR, Vijayawada)
16.	E.Vijaya Prasad	Tips for higher yields in vegetable production (27.09.2008, AIR, Visakhapatnam)
17.	Dr. P. R. S. Reddy	Fertilizer management in Virginia tobacco (22.11.2008, AIR, Visakhapatnam)
18.	Dr. Y. Subbaiah	Income generation activities to rural youth through KVK (30.11.2008, AIR, Vijayawada)
19.	R. Sudhakar	Profitable leaf plate making (11.12.2008, AIR, Visakhapatnam)

Sl. No.	Name	Topic, Station & Date of broadcast
20.	Dr. K.C. Chenchaiah	Control measures for whitefly, leaf curl and tobacco caterpillar in tobacco field crop (26.12.08, AIR, Vijayawada)
21.	J.V.R. Satyavani	Improved package of practices for vegetable production (27.12.2008; AIR, Visakhapatnam)
22.	Dr. U. Sreedhar	Safe use of pesticides on tobacco (28.12.2008, AIR, Visakhapatnam)
23.	J.V.R. Satyavani	Control of **tea musquito hoppers** in Mango (Mamidilo tenemanchu purugu nivarana) (01.01.2009; AIR, Vijayawada)
24.	Dr. B. John Babu	Turkey Poultry Rearing (01.01.2009; AIR, Visakhapatnam)
25.	V.V. Lakshmi Kumari	Role of balanced nutrition in controlling aneamia in aduloscent boys and girls - (05.01.2009; AIR, Vijayawada)
26.	Dr. B. Johan Babu	Fodders for high milk yield - An Interview (22.01.2009; AIR, Vijayawada)
27.	E. Vijaya Prasad	Plant protection in Mango (29.01.2009; AIR, Vijayawada)
28.	Dr. K. Nageswara Rao	Precautions to be taken in topping and harvesting of Virginia tobacco (15.02.2009, AIR, Visakhapatnam)
29.	Dr. P.V.V.S. Siva Rao	Backyard poultry rearing (26.02.2009; AIR, Vijayawada)
30.	Dr. K. Suman Kalyani	Transfer of technology to tobacco farmers - Role of CTRI (21.02.2009, AIR, Visakhapatnam)
31.	Dr. S. Kasturi Krishna	Need for summer deep ploughing and organic manure application to tobacco crop (21.02.2009, AIR, Visakhapatnam)
32.	S. Jitendranath	Maize cultivation in Godavari Lanka lands - An Interview (08.03.2009, AIR, Vijayawada)


SIRI

TV PROGRAMMES

1.	Dr. V. Krishnamurthy, Dr. S. Amarnath, Dr. S. Roy & S.K. Dhar	High yielding Hookah and Chewing tobacco for North Bengal	23.04.2008
2.	Dr. M.M.Shenoi	FCV tobacco varieties in KLS	23.07.2008
3.	Dr. M. Mahadevaswamy	Manures and fertilizers application in FCV tobacco	01.08.2008
4.	Dr. M. M. Shenoi	Pests and disease management in FCV tobacco	08.08.2008
5.	Dr. M. Mahadevaswamy	Integrated Farming System for rain-fed Eco-system	12.09.2008
6.	S. Chanda	Tobacco nursery raising	23.09.2008
7.	S. Chanda	Tobacco planting	12.11.2008
8.	Dr. S. Roy	Management of Leaf curl in tobacco	24.12.2008

EXHIBITIONS

★ An exhibition Stall of CTRI Research Station was arranged during the *Rabi* crop workshop & Exhibition at Hunsur on 09.06.2008.

★ An exhibition Stall of CTRI Research Station was arranged during the Grameena Dasara Exhibition at Hunsur on 05.10.2008.

KRISHI VIGYAN KENDRA, KALAVACHARLA

Krishi Vigyan Kendra of CTRI has completed 25 years of yeoman service to the rural and tribal youth, farmers, farm-women and other beneficiaries. It has disseminated proven viable technologies and conducted number of short term, long term, on and off campus training programmes in major disciplines viz., Crop Production, Crop Protection, Horticulture, Animal Science, Rural Crafts and Home Science sections.

Significant Achievements

- A total of 127 training programmes were conducted for 5,243 people constituting practicing farmers, farm women, rural youth and extension functionaries.
- Conducted at total of 16 Front Line Demonstrations (FLDs) and 11 On-farm Testings in agriculture and allied areas.
- Introduced Banana Fibre Extractor (BFE) machines in North Eastern region under National Technology Mission (NTM).
- Intercropping of redgram with soybean was identified as most remunerative intercrops and popularized in upland areas.
- A total of 20,000 mango seedlings were grafted for supply to the needy farmers. A total of 40,000 Casuarina clones were supplied to the beneficiaries.
- Designed and developed homestead units viz., bamboo-slicer cum incense stick making machine and low cost chaff-cutter suitable for rural youth.
- Fodder cultivars viz., Co FS-1 (Sorghum), Co- 4 (Napier *Bajra*) were tested at KVK and found suitable as fodder crops.
- Introduced backyard poultry units in agency area and supplied a total of 2,100 Gramapriya chicks to the rural farmers.
- A total of 45 self-help groups were facilitated to start income generation activities.
- **University of West Indies** was supplied two Banana Fibre Extractor machines from KVK.
- Three collaborative training programmes of one week duration were conducted to the community health volunteers from LAYA, Addateegala and World Vision, Srikakulam on 'Integrated Health and Nutrition Management'.
- Organized two long duration training programmes viz., word processing in computers and garment making to the rural girls.
- Conducted training programme on 'Banana Fibre Extraction' to the twenty Subject Matter Specialists of different KVKs in the **North Eastern region** at Kalavacharla from 31-01-2009 to 06-02-2009 in collaboration with Zonal Coordination unit (Zone-III), Barapani.

SMS trainees from NE region being trained in Banana fibre extraction

Director, CTRI presenting certificate to the trainee

SIRI

- Organized training on 'Banana Fibre Extraction' for 60 state Government officials of North Eastern region from 28-02-2009 to 2-03-2009 at Medziphema, Nagaland sponsored by Central Institute of Horticulture, Nagaland.
- Five demonstrations were conducted on 'Cashew Apple Utilization through value-addition' in collaboration with Directorate of Cashew and Cocoa Development, Cochin during 24-03-09 to 31-03-09. Post harvest technology on cashew processing were demonstrated to the rural women through training programmes.

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 centres and State Line Departments
- Organized ex-trainee meets
- Adopted family approach to train key communicators
- Facilitated direct marketing to achieve higher levels of income from vocational activities

Success Stories of KVK

- Refined and popularized Paddy Drum Seeder for direct sowing in paddy
- Gramapriya eggs and chicks were supplied throughout the state
- Produced 20,000 mango & cashew grafts for supply to the needy farmers
- Clonal multiplication of Casuarina and Eucalyptus species

Technology Assessed & Refined

- Transplantation of 15 days aged seedlings in SRI system of rice outscored the yield by 6% as compared to recommended 8-12 days aged seedlings.
- Direct seeding in rice by Row seeder proved viable and reduced the crop duration by at least 10 days, increased the grain yield by 5% and gave additional net income of Rs.3,500/- per acre.
- Balanced fertilizer application for higher yields of Cashew in light soils has improved nut yields of cashew in light soils from 3.4 kg to 8.0 kg per tree.
- In citrus, pruning and training of trees and timely spraying of recommended insecticides, swabbing the tree trunk with neem oil/Bordeaux paste to a height of 1 m has increased the net income by Rs.6,000/- per ha.
- Deworming in pregnant buffaloes and administering antihistamines has reduced the disease incidence and increased the milk yield by 400 lts/ animal/year
- Feeding of turkey poults (up to 45 days) with concentrates has reduced the mortality by about 80% and improved the weight by 110 g.
- Coir yarn making through motorized ratts proved viable and enhanced the yarn yield by about 60% coupled with quality.
- Cattle treated with E care se – 10 ml injection 20 days prior to calving shed the placenta in time and reduced the incidence of infections.
- Cost : benefit ratio in respect of soil test based fertilizer application in rice was enhanced to 2.08 from 1.84 (general recommendation) in the delta area of East Godavari district.

Silver Jubilee Celebration of KVK

Silver Jubilee celebrations of KVK – CTRI were held on 20-10-2008 at Krishi Vigyan Kendra, Kalavacharla. Dr. S.D. Sikhamani, Vice-Chancellor, Andhra Pradesh Horticultural University, Venkataramannagudem, West Godavari district has graced the occasion as Chief Guest. Dr. V. Krishnamurthy Director, CTRI presided over the programme. Dr. A. Satyanarayana Reddy, Associate Director of Research, RARS, Maruteru, Dr. N. Sudhakar, Zonal Coordinator, Z.C. Unit, Zone-V, Sri M.A. Sivaprasad, Station Director, All India Radio, Vijayawada, Dr. Y. Subbaiah, Programme Coordinator, KVK, Kalavacharla and scientists, representatives from line departments in the district & NGOs, farmers, farm women, rural youth have participated in the Silver Jubilee celebrations.

On this momentous occasion, Silver Jubilee Stupa was unveiled by Dr. V. Krishnamurthy, Director, CTRI. KVK Staff, Heads of Divisions of CTRI, Scientists/staff from CTRI, Officials from all line departments, NGOs, progressive farmers, entrepreneurs, farm-women, rural youth and members of rythu clubs have participated. Five progressive farmers & two women entrepreneurs were felicitated. A total of 750 participants attended the function. Six publications viz., Tobacco Nursery Management, Technology Assessment and Refinement - An Intervention of Krishi Vigyan Kendra, Empowerment of Rural and Tribal women - Through Income Generation Programmes, Profitable Technologies for Integrated-Rural Development, Integrated Nutrition for Good Health and Krishi Vigyan Kendra at A Glance were released on the occasion.

AWARDS AND RECOGNITIONS

- Dr. B. Krishna Rao, Scientist (Soil and Water Conservation Engineering) was selected for the "NAAS Young Scientist Award" for the biennium 2007-08. He was also selected for the "Young Engineer Award" by the Institution of Engineers India, Kolkata.

- B. Narasimha Rao, LDC, CTRI, Rajahmundry was given the "Best Administrative Worker Award" for the year 2008.

- Best paper presentation award was given to Dr. K. Suman Kalyani, Dr. V. Krishnamurthy, Dr. C.C.S. Rao and N. Aruna Kumari for the paper entitled "Innovative methodologies for sustainable productivity among tribals of East Godavari District, Andhra Pradesh" at the 5th National Extension Education Congress held at CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh during 5th -7th March, 2009.

- The CTRI exhibition stall arranged in the Southern Regional Agricultural Fair- 2008 organized by the Ministry of Agriculture, Govt. of India, Govt. of Andhra Pradesh and ANGRAU at Acharya N.G. Ranga Agril. University Campus, Rajendranagar, Hyderabad from 20th to 23rd December, 2008 was adjudged as the First Best Stall among the ICAR and other Institutions.

Presentation of Best Administrative Worker Award to Sri B. Narasimha Rao

Visitors in the CTRI Stall at ANGRAU, Hyderabad

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 Agril. 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, Directorate of Tobacco Development, Chennai, 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 and 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 of 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	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. 2.	CORESTA, France ISO-TC126, Berlin, Germany	Evaluation of pest and disease resistant varieties Development of international standards for tobacco and tobacco products


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ALL INDIA NETWORK RESEARCH PROJECT ON TOBACCO

The release proposal of FCV tobacco line, KST 28 from Shimoga centre was discussed in the V Group Meeting and suggested that as KST 28 was compared with Thrupthi and Bhavya, it can be released for replacing Thrupthi and Bhavya in scarce rainfall zones of Karnataka. The house endorsed to take the line to Karnataka State Variety Release Committee (KSVRC) with the above modification. This has been accepted for release in the meeting held at UAS, GKVK, Bangalore on 17-10-2008 as Sahyadri by the (KSVRC).

The release proposal of root-knot resistant *Bidi* tobacco line, ABD 105 from Anand centre was discussed with the proposed name of Anand *Bidi* Tobacco 10. After thorough discussion, the V Group Meeting recommended to endorse the release after completing the AVT II testing and Agronomy trials. This has been released by the Gujarat State Variety Release Committee (GSVRC) in 2008-09 as ABT 10.

The release proposal of FCV tobacco line, N 98 from Kandukur centre was discussed in the V Group Meeting and suggested putting the proposal for Andhra Pradesh State Variety Release Committee (APSVRC) after obtaining the trade opinion which is due from M/s VST industries Ltd.

FCV tobacco hybrids, CH 1 and CH 3 are showing promise in KLS and NLS.

The promising entries in IVT of 2007-08 were promoted to AVT I at different centres. A few advanced breeding lines from AVTs showing significant superiority in yield were promoted for conducting bulk trials during 2008-09 (two FCV tobacco entries, 54-30-21 and V 4212 at Rajahmundry, one FCV tobacco entry, 147Mx1-21 at Guntur, one FCV tobacco entry, KST 29 at Shimoga, one *Bidi* tobacco line at Anand, two *Bidi* tobacco entries, lines NBD 154 and ABD 100 at Nandyal and one *Natu* tobacco entry, line 45-90 at Jeelugumilli).

Two low tar FCV tobacco lines, JS 62 and JS 117 are further assessed for tar content.

In the trial on assessing early maturing *Bidi* tobacco lines for yield potential, line 80-12-56 was promising for yield over checks.

Exploratory trials on *Rustica* and Chewing tobaccos in Orissa are in progress. In the exploratory trial on *Rustica* tobacco, Thangua Manda, Aligarh local, Kanpur local and Hemti ranked 1st for preparation of Tobacco Paste and rest genotypes ranked 2nd position as per trade assessment.

With the integrated barn comprising of Ventury furnace and modified flue-pipe system, on an average, a quantity of 4.11 kg of wood fuel was consumed to cure FCV tobacco leaf yielding one kg cured leaf. Alternative fuel, coffee husk was used for curing FCV tobacco and about 5.11 kg of coffee husk was consumed to cure FCV tobacco leaf yielding one kg cured leaf.

In a study on the economic viability of different alternative cropping systems to FCV tobacco in KLS region, none of the high intensity intercropping system was found to be superior to sole crop of FCV tobacco in terms of tobacco equivalent yield. However, the cost benefit ratio obtained by high intensity intercropping systems like Maize + Pigeonpea (1:2.04), Cotton + Chilli + French bean (1:2.02) and Cotton + Chilli + Groundnut (1:2.01) was higher when compared to that of sole crop of FCV tobacco (1:1.70).

Green manuring with sunnhemp or application of FYM @ 12.5 t/ha every year was found effective in increasing the productivity of *Bidi* tobacco at Anand.

The farmers of middle Gujarat Agro-climatic zone - III growing *Bidi* tobacco (Variety GTH 1) are advised to apply 187 kg N (AS + Urea in 1:3) + *Azotobacter chroococcum*, ABA 1 or 187 kg N (AS + Urea in 1:3) + *Azospirillum*

lipoferum ASA 1 + FYM @ 12.5 t/ha for saving 15% N and getting higher yield of tobacco.

These farmers of (AESII) are also advised to use 8 kg seed/ha for raising *Rustica* tobacco nursery to obtain more transplantable seedlings and economic return.

Bulk trial on the economics of *Pikka* tobacco-tomato intercropping system at Berhampur confirmed that *Pikka* Tobacco + Tomato grown at 2:4 ratio recorded higher tobacco equivalent yield of 1,670 kg/ha with higher net return of Rs 15,560/ha.

Bulk trial on the economics of *Pikka* tobacco-chilli intercropping system at Berhampur confirmed that *Pikka* tobacco + chilli grown at the ratio of 2:4 recorded higher tobacco equivalent yield of 1,450 kg/ha and net return of Rs 12,800/ha.

Bulk plot trial at Berhampur confirmed that application of 80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha along with Azotoplus @ 1.5 kg/ha recorded highest cured leaf yield of 1,530 kg/ha compared to application of 80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha without Azotoplus (1,220 kg/ha).

In the study on the efficacy of organic and inorganic N fertilization on yield and quality of *Pikka* tobacco variety, Pyruvithanam, application of 30 kg N from poultry manure and 90 N from inorganic (120 N kg/ha) to *Pikka* tobacco cv. Gajapati recorded the highest cured leaf yield with good leaf quality.


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Sunnhemp raised as a green manure crop and ploughed *in situ* at 45 days + *Azospirillum* @ 10 kg/ha + Phosphorus Solubilizing Bacteria @ 10 kg/ha along with 100% recommended dose of fertilizer (75 kg N+100 kg P_2O_5+50 kg K_2O/ha) to chewing tobacco at Vedasandur significantly increased the growth attributes, yield and net returns.

Integration of press mud with *Trichoderma harzianum* was most effective in controlling black shank disease in FCV tobacco in KLS region besides, increasing yield and TGE of FCV tobacco.

Evaluation of *Paecilomyces lilacinus* in combination with organics against root-knot nematodes in FCV tobacco nursery in KLS is initiated.

Jowar as barrier crop against aphid played a major role in obstructing the movement of aphid in main field of *Bidi* tobacco at Nandyal. Like wise, trap crop, castor played an important role in trapping the larvae and egg-mass of *Spodoptera*.

Occurrence of mealy bug on *Bidi* tobacco was recorded for the first time in Kurnool district of Andhra Pradesh.

IPM module having castor and marigold as trap crops and one spray of NSKS 2% reduced *S. litura* incidence up to 50% over unsprayed plot in *Bidi* tobacco at Anand. The module having marigold and castor played important role in increasing activity of natural enemies like coccinellids, syrphids, chrysophids, spiders and *N. tennis*.

Results of Integrated disease management in *Bidi* tobacco nursery in Gujarat using physical, cultural and chemical means revealed that nematode population reduced at seeding due to integrated disease management. Significantly higher number of seedlings was recorded in treatment soil solarization + carbosulfan + metalaxyl Mz + carbendazim.

For integrated management of root-knot nematodes, frog- eye spot and leaf curl disease in *Bidi* tobacco field, farmers of middle Gujarat are advised to plant their crop during 1st -3rd week of September.

Investigation on management of mealy bug in *Bidi* tobacco through chemicals at Anand revealed that methomyl @ 0.08% was found significantly superior to rest of the insecticides but remained at par with carbaryl @ 0.2% and profenophos @ 0.1%.

Hollow stalk infection was recorded for the first time in *Jati* tobacco during 2007-08 from Natabari and CTRI RS, Dinhata in West Bengal.

The highest oil content of tobacco seed (39.39%) was recorded in genotype, 693-4-29-23. Line, 169-23-16 produced highest seed yield (1,163 kg/ha). While comparing the oil yield potential, GT 4 recorded the highest oil content of 389 kg/ha. GTH 1 had highest potential for protein, nicotine and organic acids at 90 days after transplanting of tobacco.

Line ABD 28 significantly superior in seed yield, oil content of seed, *khakhri* yield and nicotine content of *khakhri* and thereby oil and nicotine yield potential were also higher than A 145. Neither spacing nor nitrogen levels significantly altered the seed yield and oil content of seed. However, the closest spacing produced significantly highest *khakhri*. Similarly, the oil and nicotine yield potentials were also highest at closest spacing and highest nitrogen level. The increase in oil content of seed decreased the nitrogen content of seed cake.

In the studies on the seed yield and oil content of indigenous *pikka* tobacco cultivars of Orissa, the indigenous tobacco cultivar, RG 13 recorded a seed yield 1,000 kg/ha with highest oil content of 30.68%.

V Group Meeting

The V Group Meeting of All India Network Research Project on Tobacco was held at CTRI, Rajahmundry from June 19th to 20th, 2008. Scientists of all AINRPT centres attended and presented research results for the year 2007-08 and finalized the technical programme for the year 2008-09.

Inauguration of V Group Meeting of AINRPT

V Group Meeting of AINRPT

EMPOWERMENT OF WOMEN IN AGRICULTURE

- Three on-campus training programmes were conducted on "Capacity building to Adarsha Rythus" to upgrade the knowledge and skills in improved agriculture and allied aspects and 279 model farmers (Adarsha rytus) were trained.
- Two on-campus training programmes on "Integrated Health and Nutrition Management" were conducted for twenty three community health volunteers of Vizianagaram district of Gantyada mandal from 21.4.2008 to 27.4.2008 and 9.3.2009 to 13.3.2009, respectively.
- Two training programmes on "Skill up-gradation in garment-making" were conducted for 23 rural girls of Gadarada village in East Godavari district from 10.12.2008 to 22.12.2008 and 02.02.2009 to 12.02.2009, respectively. These beneficiaries are able to earn Rs.3,000/- per month by practicing the skills.
- Five training programmes of one-day duration were conducted on "Cashew apple utilization" from 24.03.2009 to 31.03.2009. In general, cashew apple is not used and thrown away as waste material. Cashew apple juice, syrup, jams, pickle and chetney were prepared and demonstrated to rural women.
- Twenty one tribal community health practitioners of Addateegala and Rampachodavarm mandals of East Godavari district were trained on "Prevention of malnutrition in tribals of Agency area" from 28.07.2008 to 31.07.2008.
- One on-campus income generation training programme was conducted on coir door-mat making from 07.07.2008 to 17.07.2008. Ten rural girls participated from S.T.Rajapuram village of Rajanagaram mandal.
- Two weeks duration training programmes on coir 2-ply yarn making over automatic machines were conducted at Muramanda, from 04.08.2008 to 10.08.2008 and from 03.11.2008 to 13.11.2008, respectively. Twenty rural girls participated in the programmes.

Training programme on Coir door-mat making

Training in Coir 2-ply yarn making on automatic machine

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Subbaiah, Y. and V. Krishnamurthy (2008) *Technology Assessment and Refinement: An intervention of Krishi Vigyan Kendra*, CTRI, Rajahmundry, A.P. pp. 1-28.

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LIST OF APPROVED ON-GOING PROJECTS

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP IMPROVEMENT		
1	Cy.5b.	Maintenance of the genus *Nicotiana* Dr. T.G.K. Murthy and Dr. R.V.S. Rao
2	G.S.1	Germplasm acquisition maintenance, multiplication, evaluation and utilization Dr. R.V.S. Rao and Dr. T.G.K. Murthy
3	Br.6.1.4(a)	Incorporation of disease resistance for tobacco mosaic virus (TMV) Dr. P.V. Venugopala Rao and Dr. C.A. Raju
4	Br.2	Evolving superior varieties of FCV tobacco through hybridization Dr. P.V. Venugopala Rao
5	Cy.7(i)	Tissue culture studies in tobacco (I) Interspecific hybridization Dr. T.G.K. Murthy and Dr. K. Sarala
6	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
7	Cy.2.1 (f)	Incorporation of aphid resistance from *N. gossei. N. repanda, N x. umbraticanesophila and N x benthamianarepanda* Dr. T.G.K. Murthy, Dr. R.V.S. Rao, Dr. U. Sreedhar and Dr. K. Siva Raju
8	Bio-tech-4	Development of virus tolerant tobacco lines under *in vitro* Dr. K. Sarala, Dr. C.A. Raju, Dr. P. Venkateswarlu and Dr. K. Sivaraju
9	Br.7	Developing hybrid FCV tobacco suitable for traditional black soil area of Andhra Pradesh Dr. T.G.K. Murthy, Dr. R.V.S. Rao, Dr. P.V. Venugopala Rao and Dr. K. Sarala
10	MB-9	Evaluation of advanced breeding lines for yield and quality Dr. K. Sarala, Dr. R.V.S. Rao, Dr. P.V. Venugopala Rao and Dr. T.G.K. Murthy
11	Biotech-5	Maintenance, evaluation and characterization of tobacco transgenics Dr. K. Sarala, Dr. J.V. Prasad and Dr. K. Sivaraju
12	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 and Dr. P.V. Venugopala Rao
13	Biotech-7	Development of tobacco specific microsatellite markers Dr .K. Sivaraju and Dr. K. Palanichami
14	Biotech-8	Molecular mapping of genes responsible for production of solanesol and nicotine in tobacco Dr. K. Sarala, Dr. T.G.K Murthy, Dr. K. Sivaraju and Dr. C.V.N. Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP PRODUCTION		
1	AC-1	Permanent manurial trial R. Subba Rao, Dr. P. Harishu Kumar and Dr. D.V. Subhashini
2	A-70	Integrated rainwater and nutrient management in tobacco based cropping system under rainfed vertisols Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy, Dr. P. Harishu Kumar and Dr. V. Krishnamurthy
3	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
4	A -75	Evaluation of tobacco hybrids for leaf biomass and seed yield Dr. P. Harishu Kumar, Dr. C.V.N. Rao, Dr. K. Siva Raju and Dr. R.V.S. Rao
5	Ag. Extn.F.S	Development of farming systems through inter-dependable entrepreneurship under irrigated and unirrigated conditions of black soils of East Godavari district M. Sannibabu, Dr. S. Kasturi Krishna and Dr. P. Venkateswarlu
6	Ag. Eng.5	Design and development of tobacco leaf stringing machine M. Sannibabu and I. Srinivas
7	Ag.Engg-6	Developing and constructing solar barn at CTRI Farm, Katheru M. Sannibabu
8	Ag.Extn-33	Assessment of identified slow moving technologies in NLS tobacco growing zones of Andhra Pradesh Dr. Y. Subbaiah and S.K. Naidu
9	Ag.Extn-34	Evaluation of tobacco portal system Dr. Y Subbaiah and S.K. Naidu
10	Ag. Extn-36	Stress analysis of tobacco farmers and changing scenario of the cropping pattern Dr. K. Suman Kalyani and S.K. Naidu
11	Ag.Extn-38	FLD on Cy 135 in NBS areas of Andhra Pradesh S.K. Naidu, Dr. K. Suman Kalyani and Dr. K. Sarala
12	Ag.Extn-39	Trend analysis of cost of production and price behaviour of FCV tobacco in SLS area of Andhra Pradesh Dr. Y. Subbaiah and S.K. Naidu
13	Ag.Extn-40	Critical analysis of the Empowerment of farm women in tobacco growing agency area of East Godavari District Dr. K. Suman Kalyani and S.K. Naidu

Sl. No	Institute Code	Title of the project and Investigator(s)
14	Ag. Engg.7	Fertigation system for tobacco nurseries to reduce labour and improve Water & Nutrient use efficiency Dr. B. Krishna Rao, Dr. C.C.S. Rao, Dr. V. Krishnamurthy and Dr. P. Harishu Kumar
15	Ag. Engg.8	'Bale pressing & packing machine for marketing of FCV tobacco' Dr. V. Krishnamurthy, Dr. B. Krishna Rao, Dr. C.C.S. Rao and Dr. S. Kasturi Krishna
16	ARIS ENT-1	Information system on agricultural pests of coastal Andhra Pradesh Dr. U. Sreedhar and H. Ravi Sankar
17	ARIS-2	Creation and maintenance of WEB pages of CTRI H. Ravi Sankar, Dr. C.V. Narasimha Rao and Dr. V. Krishnamurthy
18	ARIS-9	Expert System for different diseases of major crops in Andhra Pradesh H. Ravisankar and Dr. C.A. Raju
19	ARIS-10	Decision support system for quality evaluation of flue-cured tobacco H. Ravi Sankar and Dr. V. Krishnamurthy
20	ARIS-11	Designing algorithms for data classification H. Ravi Sankar
CROP CHEMISTRY AND SOIL SCIENCE		
1	AC-1	Permanent manurial experiment Dr. J.A.V. Prasad Rao
2	Ag.SS-2	Soil fertility Investigations: Soil fertility survey of tobacco growing soils of India : a) Soil fertility evaluation of FCV tobacco soils of Periyapatna Taluk, Mysore dist., Karnataka Dr. V. Krishnamurthy and Dr. C.C.S. Rao
3	OC-10	Evaluation of smoke constituents in materials from some plant breeding experiments 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	OC-21	Studies on tobacco specific nitrosamines (TSNA) in Indian tobaccos and tobacco products Dr. C.V. N. Rao
6	BC-8	Electrophoretic characterization of tobacco cultivers Dr. K. Sivaraju and Dr. K. Nageswara Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
7	SSMB-7	Plant growth-promoting *Rhizobacteria* (PGPR) in tobacco based cropping systems Dr. D.V. Subhashini and Dr. C.C.S. Rao
8	Phy-68	Response of light intensity in relation to nitrogen fertilization in flue-cured virginia tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao, Dr. K. Sivaraju and Dr. V. Krishnamurthy
9	SS-23	Investigations on lead and cadmium contents in Indian tobaccos Dr. C.C.S. Rao and Dr. P.R.S. Reddy
10	BC -10	Development of molecular markers for Fusarium wilt in tobacco Dr. K. Siva Raju and Dr. K. Subrahmanya
11	SS-25	Investigations on phosphorus and potassium characteristics of FCV tobacco growing soils of Prakasam and Nellore districts Dr. C.C.S. Rao, Dr. V Krishnamurthy and Dr. P.R.S. Reddy
12	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
13	BC-11	Biochemical characterization of tobacco seed oil Dr. K. Siva Raju, Dr. CVN Rao, Dr. R.V.S. Rao and Dr. V. Krishnamurthy
14	PHY- 70	Carbohydrate metabolism as influenced by nitrogen and potassium nutrition in flue-cured tobacco grown in NLS Dr. K. Nageswara Rao, Dr. M. Anuradha, Dr. C.V.N. Rao and Dr. V. Krishnamurthy
15	PHY-71	Chloride nutrition in flue-cured tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao, Dr. C.C.S. Rao and Dr. V. Krishnamurthy
16	PHY-72	Dynamics of potassium absorption, utilisation and re-translocation in FCV tobacco Dr. K. Nageswara Rao, Dr. M. Anuradha and Dr. V. Krishnamurthy
17	PHY-73	Sucker control in flue-cured tobacco grown in NLS Dr. K. Nageswara Rao and Dr. M. Anuradha
18	C 83	Influence of curings on chemical composition of chewing tobacco Dr. K. Siva Raju and Dr. J.A.V. Prasad Rao
19	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
20	Phy-74	Nitrogen nutrition of FCV tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao, Dr. C.C.S. Rao and Dr. V. Krishnamurthy

Sl. No	Institute Code	Title of the project and Investigator(s)
21	SSMB-9	Effect of K mobilizing bacteria and VAM on the growth, yield and quality of NLS tobacco Dr .D.V. Subhashini
22	SSMB-10	Prospects biofertilizers in tobacco nursery management Dr .D.V. Subhashini
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	E53	Integrated pest and disease management CORESTA collaborative study on insect host plant resistance studies Dr. U. Sreedhar
4	EC-58	Studies on persistency and dissipation of insecticides in tobacco Dr. U. Sreedhar, Dr. C.V.N. Rao and Dr. J.V. Prasad
5	E-59	Evaluation of trap crops against budworm, (*H.armigera*)in FCV Tobacco Dr. U. Sreedhar
6	E-62	Development and validation of weather based forewarning system for major pests of FCV tobacco Dr. J.V. Prasad, Dr. U. Sreedhar and Dr. K.C. Chanchaiah
7	E-63	Assessment of avoidable yield loss due to insect pests in FCV tobacco under northern light soil conditions. Dr. J.V. Prasad and Dr. P. Venkateswarlu
8	E-65	Studies on stem application of insecticides for management of tobacco aphid, *Myzus nicotianae* Dr. U. Sreedhar and Dr. J.V. Prasad
9	E-69	Development, validation and refinement of IPM module for Burley tobacco Dr. U. Sreedhar and R. Subba Rao
10	E-70	Studies on the ecological role of *Nesidiocoris tenuis*, an Omnivorous mired bug in tobacco ecosystem Dr. J.V Prasad, S. Gunneswara Ra, Dr. U. Sreedhar and Dr. K. Sivaraju
11	E-71	Life table studies of *Spodoptera exigua* on certain types of tobacco and *Nicotiana* species S. Gunneswara Rao and Dr. J.V. Prasad


SIRI

Sl. No	Institute Code	Title of the project and Investigator(s)
12	E.72	Efficacy of various aqueous leaf extracts against tobacco stem borer, *Scrobipalpa heliopa* Lower Dr. P. Venkateswarlu, Dr. K. Siva Raju and S. Gunneswara Rao
13	E-73	Studies on compounds with insecticidal value from wild *Nicotiana* species against the major pests of FCV tobacco Dr. J.V. Prasad and S. Gunneswara Rao
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 Prades. 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 A.P. 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, Dr. R.V.S. Rao and Dr. K. Sarala
5	JL.Br.4	Evaluation of flavourful exotic lines for their suitability in NLS area of Andhra Pradesh Dr. T.G.K. Murthy, Dr. R.V.S. Rao and Dr. C.V.N. Rao
6	Br C2(4)	Evaluation of advanced breeding lines for yield and tar content under NLS conditions Dr. K. Sarala, Dr. C.V.N. Rao, Dr. T.G.K. Murthy and Dr. R.V.S. Rao
7	JLA-22	Evaluation of drip irrigation system on NLS grown FCV tobacco M. Sannibabu
8	JLA-23	Effect of level and time of potassium application on yield and quality of tobacco in northern light soils of Andhra Pradesh Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. P. Harishu Kumar and Dr. J.A.V. Prasad Rao
9	JLA-24	Technology for production of flavourful tobacco: Effect of foliar spray of Zn, Mg and topping levels on yield and quality of cv Kanchan in irrigated Alfisols of A.P. Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. P. Harishu Kumar and Dr. P.R.S. Reddy
10	JLA-31	Studies on tobacco based Crop Production system 1) Effect of cropping systems on nitrogen requirement of tobacco 2) Effect of cropping systems and ratios of organic manures and nitrogen requirement of tobacco Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna and Dr. C.C.S. Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
11	JLA-32	Studies on feasibility and economic viability of intercropping in FCV tobacco under irrigated alfisols (NLS) conditions
	JLA-32 (a)	Studies on feasibility and economic viability of intercropping / relay cropping in FCV tobacco under irrigated alfisols (NLS) conditions Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. C.C.S. Rao, Dr. K. Sivaraju and Dr. P. Harishu Kumar
12	SS-27	Crop growth modeling in FCV tobacco in NLS Dr. C.C.S. Rao, Dr. M. Anuradha, Dr. K. Sivaraju, Dr. S. Kasturi Krishna and Dr. H. Ravisankar
13	JLA-33	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
14	JLA-34	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
BTRC, JEDDANGI		
1	By.Br.1	Evaluation of advanced Burley breeding lines for productivity and quality Dr. P.V. Venugopala Rao, Dr. T.G.K. Murthy, Dr. R.V.S. Rao and R. Subba Rao
2	By.Br.2	Evaluation of Burley tobacco hybrids suitable for Burley growing areas of Andhra Pradesh Dr. P.V. Venugopala Rao, Dr. T.G.K. Murthy, Dr. R.V.S. Rao and R. Subba Rao
3	By.Br.3	Developing high yielding Burley cultivars with low TSNA levels Dr. T.G.K. Murthy, Dr. P.V. Venugopala Rao, Dr. R.V.S. Rao, Dr. C.V. N Rao, R. Subba Rao and Dr. K. Sarala
4	AB-27	Effect of spacing and nitrogen levels on yield and quality of Burley tobacco Hybrid JBH-1 R. Subba Rao and Dr. P. Harishu Kumar
5	AO-1	Studies on the influence of plant population and nitrogen level on yield and quality of oriental tobacco. R. Subba Rao and Dr. P. Harishu Kumar
6	AO-2a	Studies on N and K interaction effects on oriental tobacco production and its quality Dr. P. Harishu Kumar, R. Subba Rao and Dr. C.C.S. Rao
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	AB-28	Response of Burley tobacco var. Banket A1 to varying levels of vermicompost and nitrogen Dr. P. Harishu Kumar


SIRI

Sl. No	Institute Code	Title of the project and Investigator(s)
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
7	EG-9	Evaluation of imidacloprid application method for the control of sucking pests of FCV tobacco Dr. G. Raghupathi Rao
8	EG10	Evaluation of high pressure sprayer for the management of insect pests of FCV tobacco Dr. G. Raghupathi Rao
9	EG-11GNT	Studies on population dynamics and management of tobacco aphid Dr. G. Raghupathi Rao
CTRI RESEARCH STATION, KANDUKUR		
1	K.Br 5	Evaluation of new line N-98 for yield and quality under SLS conditions Dr. P. V. Venugopala Rao, R. Sreenivasulu, V. Venkateswarlu and Dr. J.V. Prasad
2	EK-11	Management of insect pests of tobacco by plant extracts Dr. K.C. Chenchaiah
3	EK-12	Management of cigarette beetle of tobacco by plant extracts and in organic slats Dr. K.C. Chenchaiah
4	K.Br.6	Breeding FCV tobacco variety for yield and quality under SLS conditions Dr. A.R. Panda, V. Venkateswarlu, Dr. K.C. Chenchaiah, Dr. P.V. Venugopala Rao, Dr. T.G.K. Murthy, Dr. K.N. Subrahmanya, Dr. A.V.S.R. Swamy and Dr. C.V.N. Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
5	EK-13	Evaluation of IPM modules for insect pests of FCV tobacco under SLS conditions Dr. K.C. Chenchaiah
6	AK-18	Studies on the influence of quality of irrigation water on growth and production of healthy seedlings from tobacco nurseries under SLS conditions R. Sreenivasulu and Dr. C.C.S. Rao
7	K Br 7	Evaluation of FCV tobacco hybrids for yield and quality under SLS conditions Dr. A.R. Panda
8	EK-14	Bio-ecology and Management of Tobacco Aphid under SLS conditions . Dr. K.C. Chenchaiah
9	EK-15	Evaluation of FCV tobacco germplasm for the tobacco caterpillar tolerance under SLS conditions Dr. K.C. Chenchaiah
10	EK-16	Evaluation of FCV tobacco germplasm for the aphid tolerance under SLS conditions Dr. K.C. Chenchaiah
11	AK-19	Effect of different chemicals on sucker control in FCV tobacco under SLS R. Sreenivasulu and Dr. K. Nageswara Rao
12	AK-20	Agro-techniques for productivity enhancement in FCV tobacco under SLS condition R. Sreenivasulu, Dr. A.R. Panda and 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	BR-17	Imparting resistance to brown spot in the high yielding FCV tobacco varieties/advanced lines suitable for KLS K.N. Subrahmanya and Dr. M.M. Shenoi
3	BR.18	Breeding for resistance to Fusarium wilt disease in Flue-cured Virginia tobacco for Karnataka light soils K.N. Subrahmanya and Dr. M.M. Shenoi
4	P.3.2	Screening of tobacco germplasm against root-knot nematode Dr. S. Ramakrishnan and K.N. Subrahmanya
5	N 1.1	Survey for plant parasitic nematodes infecting tobacco Dr. S. Ramakrishnan
6	A-36	Integrated nutrient management for FCV tobacco in KLS Dr. M. Mahadeva Swamy


SIRI

Sl. No	Institute Code	Title of the project and Investigator(s)
7	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
8	N.17	Bio-intensive management of root-knot nematode and soil-borne fungal diseases in FCV tobacco nursery Dr. S. Ramakrishnan and Dr. M.M. Shenoi
9	P.19	Further studies on *Fusarium* wilt and wilt complex in FCV tobacco crop Dr. M.M. Shenoi and Dr. S. Ramakrishnan
10	P.20	Studies on Soreshin disease *(Rhizoctonia)* in FCV tobacco nursery in KLS Dr. M.M. Shenoi
11	A.37	Agronomic evaluation of promising pipeline varieties (FCH 196 and FCH 201) of FCV tobacco in KLS Dr. M. Mahadeva Swamy
12	A.38	Feasibility of producing organic tobacco under KLS situation Dr. M. Mahadeva Swamy, Dr. M.M. Shenoi, Dr. P. Venkateswarlu and Dr. S. Ramakrishnan
13	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
14	EH-1	Survey for assessment of insect pest incidence in KLS tobacco Dr. P. Venkateswarlu, Dr. M.M. Shenoi and Dr. S. Ramakrishnan
15	EH-2	Integrated Management of tobacco aphid, Myzus nicotianae under KLS conditions Dr. P. Venkateswarlu and Dr. M.M. Shenoi
16	EH-3	Management of tobacco caterpillar, Spodoptera litura under KLS condition Dr. P.Venkateswarlu and Dr. M.M. Shenoi
CTRI RESEARCH STATION, VEDASANDUR		
1	G.S.1	Evaluation and maintenance of germplasm Dr. K. Palanichamy
2	B.48	Studies on heterosis breeding in chewing tobacco (*N. tabacum*) Dr. K. Palanichamy
3	B.49	Synthesis of broad-based gene pool in chewing tobacco (*N. tabacum*) enhancing selection gain Dr. K. Palanichamy

Sl. No	Institute Code	Title of the project and Investigator(s)
4	A-98	Phosphorus management in chewing tobacco under Vedasandur conditions Dr. M. Kumaresan, Dr. P. Harishu Kumar and Dr. C.C.S. Rao
5	B.50	Breeding for high seed and oil yield in tobacco Dr. K. Palanichami and Dr. C.V.N. Rao
CTRI RESEARCH STATION, DINHATA		
1	A-10	Permanent manurial experiment with *Motihari* tobacco Dr. R.L. Arya and Dr. S. Roy
2	A-68	Studies on nitrogen requirement of *Jati* tobacco variety Manasi in relation to different sequential cropping systems Dr R.L. Arya, Dr. S Amarnath, Dr. S. Roy and Dr. C.C.S. Rao
3	B-17	Dialliel analysis in *Motihari* tobacco (*N.rustica*) Dr. S. Amarnath
4	A 69	Studies on effect of plant population and fertility levels on seed yield of *Jati* tobacco cv. Manasi Dr. R.L. Arya, Dr. S. Roy, Dr. S. Amarnath and Dr. C.C.S. Rao
5	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
6	PP-7	Management of bacterial wilt in *Motihari* tobacco and biochemical and molecular characterization of pathogenic isolates Dr. S. Roy, Dr. S. Amarnath, Dr. R.L. Arya and Dr. K. Siva Raju
7	PP-8	Role of biocides against damping-off of seedlings and growth promotion activity in *Jati* and *Motihari* tobacco nurseries Dr. S. Roy, Dr. S. Amarnath and Dr. R.L. Arya
8	B-18	Screening for higher seed yield and oil recovery in *Jati N. tabacum* L.) tobacco accessions in North Bengal Dr. S. Amarnath
9	9BA-49	Spacing cum nitrogen requirement for the early maturing *Motihari* tobacco pipeline Dr. S. Amarnath and Dr. S. Roy

RAC, QRT, IRC AND IMC MEETINGS

RESEARCH ADVISORY COMMITTEE

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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. Narasimha Rao — MEMBER-SECRETARY
Principal Scientist,
CTRI, Rajahmundry - 533 105

▲ Research Advisory Committee (RAC) meeting was held on 30.01.2009 at CTRI, Rajahmundry.

RAC meeting held on 30.01.2009

QUINQUENNIAL REVIEW TEAM

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 Biocontrol (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
Professor & Former Director of Extension,
G.B. Pant University of Agriculture
and Technology, Pantnagar,
Udhamsingh Nagar - 263145
Uttarakhand

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

Field visit of QRT at CTRI RS, Vedasandur

QRT with scientists of CTRI RS, Hunsur and AINRPT Centre, Shimoga

INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

The Institute Research Committee Meetings of CTRI were held from June 23-26, 2008 at CTRI. Scientists of CTRI, its Research Stations, AINRPT Centres, Tobacco Board officials and esentatives of trade and industry participated in the meetings. The progress of research work carried out during the year 2007-08 was reviewed and the technical programme for the crop season 2008-09 was discussed and finalized.

INSTITUTE MANAGEMENT COMMITTEE

Dr. V. Krishnamurthy
Director & Chairman

Dr. K.C. Jain Asst. Director General (CC), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi – 110 114	MEMBER	Dr. S. Amarnath Principal Scientist & Head-in-Charge, CTRI Research Station, Dinhata – 736 135, West Bengal	MEMBER
Director of Agriculture Govt. of Andhra Pradesh, Opp. L.B. Stadium, Basheerbagh, Hyderabad. Andhra Pradesh	MEMBER	Dr. M. Mahadevaswamy Sr. Scientist CTRI Research Station, Hunsur- 736 135 Karnataka	MEMBER
Director of Agriculture Govt. of Karnataka No.1, Seshadri Road, Bangalore – 560 001 Karnataka	MEMBER	Sri Dama Ankaiah Naladalapur Village V.V. Palem Mandal, Prakasham Dist. Andhra Pradesh	MEMBER
Director of Research (Agriculture) ANGRAU, Rajendranagar, Hyderabad – 500 407 Andhra Pradesh	MEMBER	Sri Kanneboina Nageswara Rao H.No.16-15-207, Yadav Street, Old Guntur, Guntur Andhra Pradesh	MEMBER
Finance & Accounts Officer, NAARM, Rajendranagar, Hyderabad – 500 407 Andhra Pradesh	MEMBER	Dr. K. Nageswara Rao Sr. Scientist & Head, CTRI Research Station, Jeelugumilli – 534 456 Andhra Pradesh	MEMBER
Dr. Harveer Singh Principal Scientist Directorate of Oilseeds Research, Rajendranagar, Hyderabad – 500 507 Andhra Pradesh	MEMBER	Sr. Administrative Officer, CTRI, Rajahmundry - 533 105. Andhra Pradesh	MEMBER- SECRETARY

- The Institute Management Committee Meetings were held on 12.9.2008 and 30.01.2009 at CTRI, Rajahmundry.


IMC meeting held on 12.09.2008


IMC meeting held on 30.01.2009

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS AND SYMPOSIA

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. C.C.S. Rao	Seminar on "Clean development mechanism and carbon trading opportunities in agriculture and allied sectors"	May 8-9 , 2008 at CRIDA, Hyderabad
2.	V.V. L. Kumari Dr. B. John Babu J.V.R. Satyavani S. Jitendranath E. Vijaya Prasad R. Sudhakar	Discipline wise Action Plan Review Meeting of KVKs	May 10-11, 2008 at Hyderabad
3.	Dr. B. John Babu S. Jitendranath	State level technical programme meeting of KVK	May 13-14, 2008 at E.E.I., Hyderabad
4.	Dr. U. Sreedhar	International Workshop-cum-training programme on IPM	May 26-30, 2008 at Hyderabad
5.	Dr. C.V. Narasimha Rao Dr. T.G.K. Murthy Dr. P.V. Venugopala Rao Dr. K. Sarala	Training-cum-workshop on "IP and Technology Management in the ICAR system"	May 29-31, 2008 at NAARM, Hyderabad
6.	Dr. C.C.S. Rao	Meeting of the Input Committee for A.P.	10.07.2008 at Tobacco Board, Guntur
7.	Ch.Sudhakara Babu	Training programme on Website Design and development	21-7-08 to 1-8-08 at Z.C. Unit, CRIDA, Hyderabad
8.	Dr. S.V. Krishna Reddy	ZREAC meeting of North Coastal Zone, Vizianagaram	August 1-2, 2008 at Vizianagaram
9.	Dr. K. Sarala	Regional Conference on 'Women in Science'	02.08.2008 at Visakhapatnam
10.	S.V. Ramana, UDC	Training programme on Website Design and Development	August 4-18, 2008 at Z.C. Unit, CRIDA, Hyderabad
11.	Dr. V. Krishnamurthy Dr. C.V.N. Rao	6th Meeting of Tobacco & Tobacco Products Sectional Committee, FAD 4	12.08.2008 at BIS, New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
12.	Dr. V. Krishnamurthy	Meeting on "Alternative crops/ cropping systems to *Bidi* tobacco and related issues"	21.08.2008 at New Delhi
13.	Dr. V. Krishnamurthy	1st meeting of the Technical Specification Committee for capacity building of tobacco testing & research labs under National Tobacco Control Programme"	22.08.2008 at New Delhi
14.	Dr. S. Amarnath	Scientific Advisory Committee meeting of Cooch Behar KVK	22.08.2008 at UBKV, Pundibari
15.	E.Vijaya Prasad	Training programme on Website Design and development	Sep. 1-12, 2008 at Z.C. Unit, CRIDA, Hyderabad
16.	Dr. M. M. Shenoi	Farmers meet on FCV tobacco in Karnataka	16.09.2008 at Vidhana Soudha, Bangalore
17.	Dr. J.V. Prasad Dr. S.V. Krishna Reddy	Meeting on presence of PCP chemical residues and NTRMs in tobacco leaf	16.09.2008 at Tobacco Board, Guntur
18.	R.Sudhakar	Training programme on LAN & VAN	Sep. 22-26, 2008 at Z.C. Unit, CRIDA, Hyderabad
19.	Ch.Sudhakara Babu,	Training programme on LAN &VAN	26.09.2008 to 03.10.2008 at Z.C. Unit, CRIDA, Hyderabad
20.	Dr. J.V. Prasad Dr. S.V. Krishna Reddy	Meeting on "Presence of PCP chemical residues and NTRMs in tobacco leaf"	23.09.2008 at Tobacco Board, Guntur
21.	Dr. V. Krishnamurthy	XIX meeting of Regional Committee No.11 (RCM-11)	Sep. 26-27, 2008 at OUAT, Bhubaneswar
22.	Dr. Y. Subbaiah,	Annual Zonal Workshop of KVKs of Zone – V	October 3-5, 2008 at KVK, Jalna
23.	Dr. V. Krishnamurthy	124th Meeting of Tobacco Board	06.10.2008 at Hyderabad

Sl. No.	Participant (s)	Programme attended	Date and place
24.	Dr. V. Krishnamurthy	ASRB Foundation Day celebrations	04.11.2008 at NASC Symposium Hall, New Delhi
25.	Dr. M.M. Shenoi	Inauguration of the Pilot project 'e-auction"	09.11.2008 at Hunsur
26.	Dr. K. Siva Raju Dr. M. Anuradha	Golden Jubilee Conference on "Challenges and emerging strategies for improving plant productivity"	Nov. 12-14, 2008 at IARI, New Delhi
27.	Dr. V. Krishnamurthy	Regional Advocacy Workshop on Tobacco Control Laws & Measures" and related issues	14.11.2008 at Chennai
28.	Dr. J.V. Prasad	A.P. Science Congress – 2008	Nov. 14-16, 2009 at Osmania University, Hyderabad
29.	Dr. H. Ravi Sankar M.N.P. Kumar	National Workshop on Heuristic Evaluation of Web sites of ICAR Fisheries Research Institutions"	17.11.2008 at CIBA, Chennai
30.	Dr. D.V. Subhashini	49th Annual Conference of AMI	Nov. 18-20, 2008 at University of Delhi, Delhi
31.	Dr. M. Kumaresan	National Symposium on New paradigms in Agronomic Research	Nov. 18-20, 2008 at Navsari
32.	Dr. M. M. Shenoi	Seminar on "Alternative Crops to FCV Tobacco in KLS region	20.11.2008 at Tobacco Board Mysore
33.	Dr. M. Kumaresan	National Symposium on "New Paradigms in Agronomic Research"	Nov. 19-21, 2008 at the Navsari Agricultural University, Navsari, Gujarat
34.	Dr. V. Krishnamurthy	Selection Committee meeting of AP Horticultural University	24.11.2008 at Secunderabad
35.	M.N.P. Kumar	Training programme on "Web Standards Technologies and Standardization"	Dec. 3-12, 2008 at NAARM, Hyderabad.

Sl. No.	Participant (s)	Programme attended	Date and place
36.	Dr. U. Sreedhar Dr. S. Ramakrishnan	Leslie Coleman Memorial National Symposium on Plant Protection	Dec. 4-6, 2008 at UAS, Bangalore
37.	Dr. M. M. Shenoi	Workshop on 'Role of Women in Agriculture' organized by KVK, JSS, Suttur.	04.12.2008 at S.B.Halli, Hunsur Taluk.
38.	Dr. Y. Subbaiah	3rd National Conference of KVKs	Dec. 27-29, 2008 at GBPUAI, Pantnagar
39.	Dr. B. Krishna Rao	XXII National Convention of Agricultural Engineers (NCAE-2009)	January 20-21, 2009 at Palampur
40.	Dr. K. Nageswara Rao	SAC meeting of BCT-KVK	05.02.2009 at BCT-KVK, Haripuram Farm
41.	Dr. K. Sarala	Workshop for DBT nominees and IBSC members for strengthening regulatory compliance by IBSCs	24.01.2009 at Hyderabad
42.	S. Jitendranath	Meeting cum Workshop on Frontline Demonstrations (Oilseeds & Pulses)	February 2-3, 2009 at KVK, Nellore
43.	Dr. C.C.S. Rao Dr. U. Sreedhar	Meeting of the Inputs Committee - Karnataka crop season, supply of inputs, price negotiations	13.02.2009 at Directorate of Auctions, Tobacco Board, Bangalore
44.	Dr. Y. Subbaiah	National Seminar on Agriculture Extension	February 27-28, 2009 at NASC Complex, New Delhi
45.	Dr. M. M. Shenoi	Scientific Advisory Committee of KVK	04.03.2009 at JSS, Suttur
46.	Dr. M. M. Shenoi	State Level Workshop on Microbiology	05.03.2009 at the JSS College, Mysore

Sl. No.	Participant (s)	Programme attended	Date and place
47.	Dr. K. Suman Kalyani	5th National Extension Education Congress – 2009 on Extension Perspective in Changing Agri-rural Environment	March 5-7, 2009 at Azad University of Agriculture & Technology, Kanpur
48.	Dr. V. Krishnamurthy	14th World Conference on Tobacco or Health (WCTOH)	March 8-9, 2009 at Mumbai
49.	S. Jitendranath	ZREAC meetings of Godavari Zone for Kharif, 2009	March 19-20, 2009 at I.A.D.P. Hall, Eluru
50.	V.V. Lakshmi Kumari	Workshop on 'Reorienting Home Science Activities in KVK's	March 19-20, 2009 at S.V.B.P. U.A. & T, Modipuram, Meerut
51.	Dr.M.M.Shenoi Dr.M.Mahadevaswamy	Workshop on "Organic Farming" organized by ARTEE, an NGO	26.02.2009 at Bangalore
52.	Dr.M.M.Shenoi K. N.Subrahmanya Dr.M.Mahadevaswamy Dr.P.Venkateswarlu	National Conference on "Plant Bio-diversity and Bio-prospecting"	March 16-17, 2009 at University of Mysore, Mysore
53.	Dr.M.M.Shenoi K. N.Subrahmanya	Workshop on "Plant Variety Protection and Farmers' Rights Act".	18.03.2009 at JSS, KVK, Suttur

WORKSHOPS, SEMINARS AND FARMERS' DAYS ORGANISED

The 61st Institute 'Foundation Day' was celebrated on 01.04.2008 at CTRI, Rajahmundry.

Fourth Meeting of 10th IJSC meeting was held on 22.05.2008 at CTRI Research Station, Dinhata, West Bengal.

The Tobacco Institute Club celebrated its 55th Annual Day on 10.06.2008 at CTRI, Rajahmundry.

Dr. V. Krishnamurthy, Director, CTRI was nominated by the Ministry of Health & Family Welfare, Govt. of India to participate in the World Health Organization (WHO)- Framework Convention on Tobacco Control (FCTC), Convention of Parties (COP) 2nd Study Group Meeting on "Economically Sustainable Alternatives to Tobacco Growing" held in Mexico City, Mexico during 17-19 June, 2008. On behalf of Govt. of India, Director gave a presentation on "Alternative Crops to Bidi and Chewing Tobacco in India" on 18.6.2008. Delegates from twenty countries have participated in the meeting and deliberated on crop substitution and alternative livelihoods to tobacco farmers & workers. The action points of this meeting will be discussed and finalized at the 3rd Study Group Meeting to be held from 17-21 November, 2008 at Durban in South Africa.

A view of the WHO-FCTC-COP 2nd Meeting at Mexico City

Farmers' Workshop was organized at Sollepura farm of CTRI Research Station, Hunsur, Karnataka on 08.07.2008.

The Institute Bio-safety Committee (IBSC) meeting of Central Tobacco Research Institute, Rajahmundry was held on 21.07.2008 at this Institute.

IBSC Meeting

Project Monitoring and Evaluation Team consisting of Director and a team of scientists visited Karnataka during August 4-7, 2008 for monitoring the Institute research projects and AINRPT trials at CTRI Research Station, Hunsur and to survey the general crop in KLS.

A workshop on "FCV tobacco crop management in KLS" was organized at Sollepura farm of the CTRI Research Station, Hunsur on 08.08.2008.

The Hindi fortnight celebrations were organized at CTRI, Rajahmundry from September 15-29, 2008 and Sri S. Narayanan, Chief General Manager, Gas Authority of India, Rajahmundry was the Chief Guest for the valedictory function.

Valedictory function of Hindi Fortnight Celebrations

A seminar on "Alternative crops to FCV tobacco in Andhra Pradesh" was organized by the Indian Society of Tobacco Science in collaboration with Tobacco Board at CTRI, Rajahmundry on 19.08.2008 to bring awareness on viable alternative crops to FCV tobacco in Andhra Pradesh.

Tobacco Variety Release Committee meeting for West Bengal was held on 28.08.2008 at CTRI Research Station, Dinhata in which tobacco variety 'TORSA' was approved for release for cultivation in West Bengal.

Tobacco workshop on 'Latest developments in FCV tobacco production (SLS & SBS)' was held at CTRI Research Station, Kandukur on 15.09.2008 in coordination with CTRI-ITC-GPI.

Training programme on "FCV tobacco nursery and field crop management in NLS" was organized on 16.09.2008 at CTRI Research Station, Jeelugumilli, West Godavari district. Officials from Tobacco Board and State Agriculture Department, faculty members of Agricultural College, Aswaraopeta, representatives of tobacco trade and industry and tobacco farmers participated in the programme.

A field day was organized at CTRI Research Station, Hunsur jointly with Tobacco Board on 20.09.2008 which was attended by 300 farmers.

The Ministry of Health & Family Welfare, GOI, New Delhi has sanctioned the Pilot Project on "Alternative crops to *Bidi* and chewing tobacco in different agro-ecological sub-regions" and an amount of Rs 2,17,26,800/- has been released as first installment for initiating the work under the project.

The Ministry of Health and Family Welfare, New Delhi has organized a Regional Advocacy Workshop on "Tobacco Control Laws & Measures and related issues in India" at Cancer Institute, Adayar, Chennai. Dr. V. Krishnamurthy, Director, CTRI has presented an invited paper on "Alternative crops to tobacco in different States" on 14.11.2008.


SIRI

A one day seminar on "Alternative Crops to FCV Tobacco in Karnataka" was organized by the Directorate of Auctions, Tobacco Board, Bangalore on 20.11.2008 in Mysore, Karnataka. Dr. V. Krishnamurthy, Director, CTRI, Dr. M.M. Shenoi, Head, Dr. M. Mahadevaswamy, Sr. Scientist, CTRI Research Station, Hunsur and other scientists of Hunsur participated in the Seminar.

Workshop on Good agricultural Practices in FCV Tobacco Cultivation (For SLS and SBS Region) was organized on 21.11.08 at CTRI Research Station, Kandukur.

NISA cyclone of December, 2008 has affected the standing tobacco crop in 39,678 ha in Prakasam and 5,510 ha in Nellore districts. A team consisting of scientists from CTRI, Rajahmundry, officials from Tobacco Board, GPI and ITC visited the cyclone affected areas in SLS and SBS regions from 10.12.2008 to 12.12.2008 and suggested the remedial measures to improve the productivity and quality of FCV tobacco in SLS/ SBS.

With a view to promote the use of Hindi among the staff members, workshops on "Use of Hindi as an Official Language" were held at CTRI, Rajahmundry on 28.04.2008, 19.07.2008 and 26.12.2008.

A Training programme entitled "Computer Training for self employment" was conducted to KVK rural girls from 23.01.2009 to 09.02.2009.

The Head, CTRI RS, Dinhata organized the Tobacco field day in farmer's field at Kuchlibari, Mekhliganj on 13.01.2009 for the benefit of farming community.

A workshop on 'How to improve the yield and quality of Virginia tobacco?' was organized jointly by Tobacco Board and CTRI at CTRI RS, Jeelugumilli on 14.02.2009.

The Scientific Advisory Committee meeting of Krishi Vigyan Kendra, Kalavacharla was held on 25.02.2009 at CTRI, Rajahmundry.

The first meeting of XI IJSC was held on 30.03.2009 at CTRI, Rajahmundry.

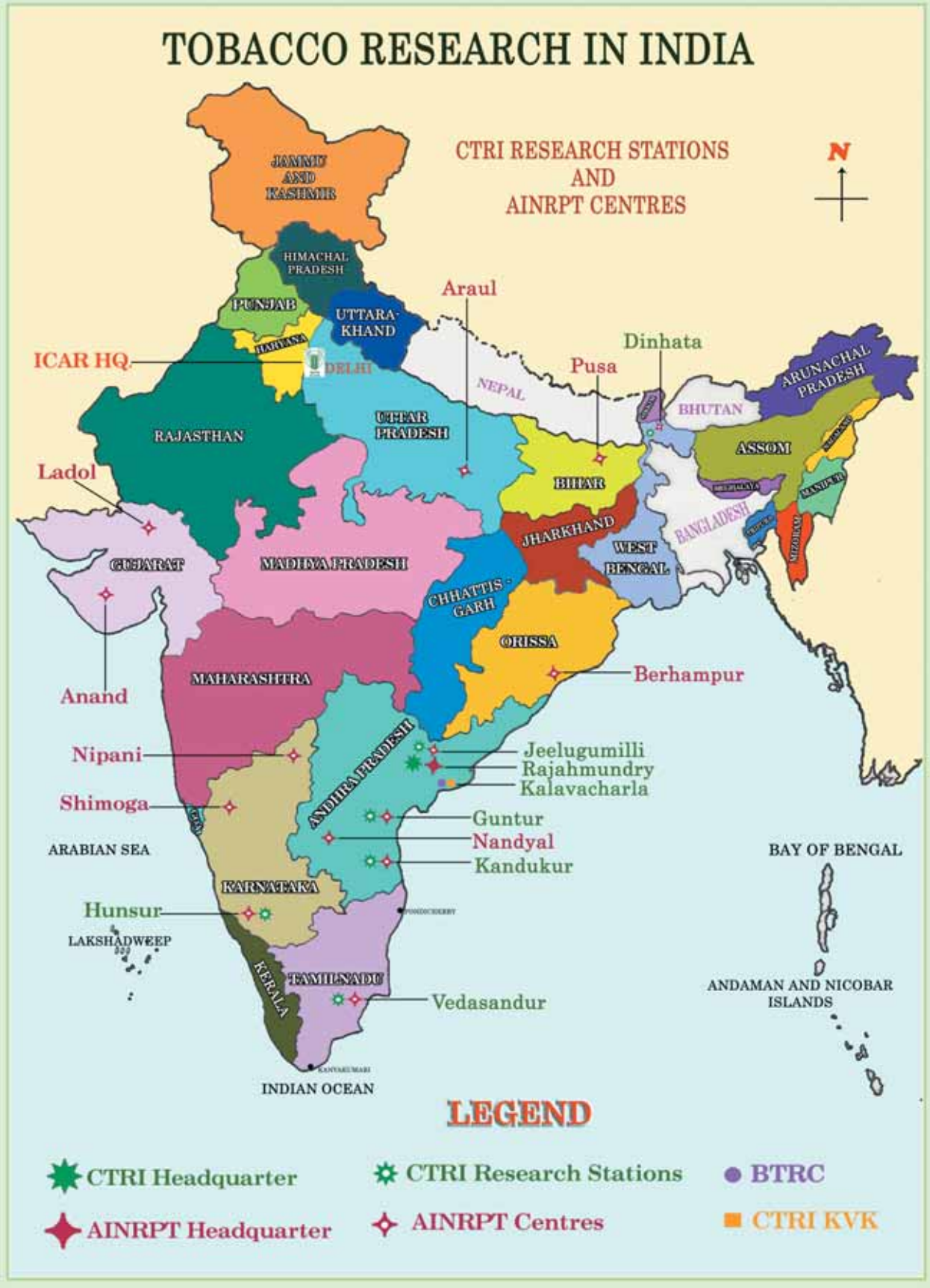
DISTINGUISHED VISITORS

Date	Name	Address
CTRI, Rajahmundry - 533 105		
24.04.2008	Prof. K. V. Mohana Rao Prof. K. V. Sankar	Project Director, Former Additional Commissioner, University of Petroleum and Energy Studies, New Delhi
15.08.2008	Bejon Mishra	Executive Director, Consumer VOICE, New Delhi
06.11.2008	QRT team headed by Dr. O.P. Dubey	Former ADG, (PP), ICAR Indian Institute of Natural Resins and Gums, Namkum, Ranchi, Jharkhand
23.01.2009	Dr. N. K. Tyagi	Member, Agricultural Scientists Recruitment Board, New Delhi
CTRI RS, Hunsur - 571 105		
01.05.2008	Smt. Manju Prasannan Pillai, IPoS	Director (Auctions), Tobacco Board, Bangalore, Karnataka
09.06.2008	Dr. Vishakanta	JDA, Department of Agriculture, Mysore, Karnataka
22.07.2008	Ricardo L Boettcher & Chandrakant Kamble, IAS	Manager, Agricultural Programme, Asia Pacific, Philip Moris, Philippines Executive Director, Tobacco Board, Guntur
12.08.2008	Dr. Suresh Babu, IAS	Chairman, Tobacco Board, Guntur
12.08.2008	C.H. Vijayashankar	Hon'ble MP, Mysore
16.08.2008	Dr. M. Mahadevappa Dr. M. Mani	Former Chairman, ASRB, ICAR, New Delhi R&D Manager, Research Division, M/s ITC Ltd., ILTD Division, Rajahmundry
10.09.2008	Mr. Normelio Limberger	Agronomy Manager, Universal Leaf (Asia) Pvt. Ltd., Manila, Philippines
20.09.2008	Mr. Leonardo V. Casuso	Global Product Integrity Manger, Alliance One, Farm Ville, NC State, USA
CTRI RS. Dinhata - 736 135		
26.08.2008	Dr. A. K. Singh Dr. T.K.Hath	ZC, KVK, Zone II, ICAR, Kolkata Director, Extension Education, UBKV, Pundibari, Cooch Behar

PERSONNEL

(As on 31-3-2009)

Director	:	**Dr. V. Krishnamurthy**
Heads of Divisions/ Stations/Sections		
Crop Improvement	:	Dr. R.V.S. Rao (up to 31.07.2008) Dr. T.G.K. Murthy (from 01.08.2008)
Crop Production	:	Dr. P. Harishu Kumar (up to 15.01.2009) Dr. C.C.S. Rao (from 16.01.2009)
Crop Protection	:	Dr. C.A. Raju (up to 27.03.2009) Dr. U. Sreedhar (from 28.03.2009)
Crop Chem. & Soil Science	:	Dr. J.A.V. Prasad Rao (up to 30.04.2008) Dr. P.R.S. Reddy (from 01.05.2008)
CTRI Research Station, Guntur	:	Dr. G. Raghupathi Rao (upto 26.05.2008) Dr. J.V. Prasad (from 26.05.2008)
CTRI Research Station, Kandukur	:	Dr A.R. Panda
CTRI Research Station, Hunsur	:	Dr. M.M. Shenoi
CTRI Research Station, Vedasandur	:	Dr. A.V.S.R. Swamy
CTRI Research Station, Dinhata	:	Dr. S. Amarnath
CTRI Research Station, Jeelugumilli	:	Dr. K. Nageswara Rao
BTRC, Kalavacharla	:	Dr. P. Harishu Kumar
RMC Unit	:	Dr. C.V. Narasimha Rao
AINRP(T)	:	Dr. P.R.S. Reddy
ARIS Cell	:	Dr. U. Sreedhar
Seed Production	:	Dr. R.V.S. Rao (up to 31.07.2008) Dr. T.G.K. Murthy (from 01.08.2008)
KVK, Kalavacharla	:	Dr. Y. Subbaiah
Lib. & Documentation Services	:	N. Syam Prasad
Agricultural Extension	:	S.K. Naidu
CTRI Farm, Katheru	:	N. Prabhakara Rao (upto 14.05.2008) T. Krishna Reddy (from 14.05.2008)
Senior Administrative Officer	:	A. Muthuraman (upto 19.07.2008) Dr. K. Nageswara Rao (from 19.07.2008 upto 29.09.2008) B.K. Sinha (From 29.09.2008)
Asst. Fin. & Accounts Officer	:	P.V.S. Bharathi


TOBACCO RESEARCH IN INDIA
CTRI RESEARCH STATIONS
AND
AINRPT CENTRES
N
JAMMU AND KASHMIR
HIMACHAL PRADESH
PUNJAB
UTTARA-KHAND
HARYANA
DELHI
ICAR HQ
Araul
Dinhata
Pusa
NEPAL
BHUTAN
ARUNACHAL PRADESH
RAJASTHAN
UTTAR PRADESH
ASSOM
Ladol
BIHAR
JHARKHAND
WEST BENGAL
BANGLADESH
GUJARAT
MADHYA PRADESH
CHHATTIS-GARH
ORISSA
Berhampur
Anand
MAHARASHTRA
Nipani
Jeelugumilli
Rajahmundry
Kalavacharla
ANDHRA PRADESH
Shimoga
Guntur
Nandyal
Kandukur
ARABIAN SEA
BAY OF BENGAL
KARNATAKA
Hunsur
LAKSHADWEEP
KERALA
TAMILNADU
Vedasandur
ANDAMAN AND NICOBAR ISLANDS
INDIAN OCEAN
LEGEND
CTRI Headquarter
CTRI Research Stations
BTRC
AINRPT Headquarter
AINRPT Centres
CTRI KVK

KANCHAN CURED LEAF FROM KLS