वार्षिक प्रतिवेदन
Annual Report
2011 - 12

VDH-3

FCH-222

Thungabhadra

केन्द्रीय तम्बाकू अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद)

राजमन्द्री - 533 105, आन्ध्र प्रदेश

CENTRAL TOBACCO RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

RAJAHMUNDRY - 533 105, ANDHRA PRADESH, INDIA

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CTRI Annual Report 2011-12

Published by

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Preface

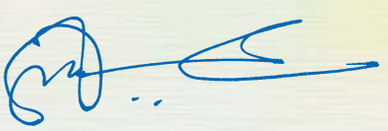
The Central Tobacco Research Institute, Rajahmundry has made impressive strides in the field of tobacco research and extension since its inception way back in 1947. Over the years, it has undoubtedly benefited the tobacco farming community and other stakeholders dealing with tobacco in the country. It is indeed my pleasure to present the CTRI Annual Report: 2011-12 as it is my maiden opportunity to do so.

The Annual Report 2011-12 embodies the important research and institutional activities and salient accomplishments during the reporting period. The publication of this report coincides with the last year of XI Plan and as the process of formulation of XII Plan has been initiated, it is appropriate to take stock of the progress and achievements made during the XI Plan. It is heartening to note that satisfactory progress has been made in the development of high yielding varieties and hybrids with a yield potential of ~3,000 kg/ha in FCV tobacco & 4,000 kg/ha in non-FCV tobacco. In FCV tobacco, three improved varieties, Kanthi, Hemadri and Siri were released by Andhra Pradesh State Variety Release Committee for commercial cultivation. The first CMS hybrids viz., CH - 1 and CH – 3 were identified for cultivation in NLS and KLS, respectively, a high-yielding selection N-98 under rainfed conditions of Southern Light Soils of Andhra Pradesh and the *Fusarium* wilt tolerant line FCH 222 for Karnataka were identified for release. In non-FCV tobacco, one rainfed natu variety, Bhairavi for Andhra Pradesh and one narrow leaf country cheroot tobacco variety Sangami for Tamil Nadu were released. The chewing tobacco hybrid VDH-3 for Tamil Nadu and the improved Oriental tobacco variety Thungabhadra for Andhra Pradesh were identified for release. Also, significant success has been achieved in the other important areas of tobacco research such as improving the input-use-efficiency, adopting IPM strategies & experimenting with new chemicals with low active ingredients for efficient plant protection as well as reducing pesticide residues and identifying high seed bearing lines for exploiting tobacco as an oil seed crop. Apart from the scientific achievements, the Institute has made noteworthy contribution to resource generation. Also, good progress has been made in infrastructure development through procurement of sophisticated equipment for research in the frontier areas.

In the context of emerging national and international tobacco scenario and to meet the specific research requirements of different tobacco growing regions of the country, the thematic research areas of the institute are reoriented placing special emphasis on (i) Development of high yielding FCV tobacco varieties with superior quality, (ii) Improving input-use-efficiency, (iii) Development of suitable management interventions for biotic and abiotic stresses in tobacco production, (iv) Mechanization of tobacco production and processing to reduce depending on labour, (v) Improving and exploiting tobacco for phytochemicals and value-added products and (vi) Promoting alternative crops or cropping systems to tobacco to enhance economic returns to tobacco farmers.

The institute will continue to foster the established linkages with national and international organizations in the coming years to promote R & D activities. The close linkages with line-departments of the State Governments, Tobacco Board (Ministry of Commerce, GOI) and other agencies concerned with tobacco industry and trade are of particular interest to finetune our future location specific and need based research initiatives. The recent seminars on 'Alternative crops to tobacco' held in A.P. and Karnataka are expected to help crystallize an action plan and a road map for promoting alternative crops to tobacco in compliance with FCTC. I am extremely happy to note that the Ministry of Agriculture, Republic of India and Ministry of Agriculture & Rural Affairs, Republic of Turkey signed a Work Plan on agriculture cooperation. As a part of the Work Plan, CTRI, Rajahmundry and Aegean Agricultural Research Institute (AARI), Izmir, Turkey have been identified for exchange of experts, material and research information on tobacco. We have initiated action for collaboration between CTRI and AARI in tobacco germplasm exchange, and scientific and technical cooperation.

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



Date : 30.06.2012

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

कार्यकारी सारांश

केन्द्रीय तम्बाकू अनुसंधान संस्थान का अधिदेश उत्पादकता वृद्धि तथा उत्पाद गुणवत्ता सुधार पर विशेष ध्यान देते हुए तम्बाकू के विभिन्न किस्मों पर अनुसंधान कराना है। इस अवधि के दौरान संस्थान का ध्यान तम्बाकू के किस्मों में सुधार, संधारणीय तम्बाकू के उत्पादन के लिए कृषि प्रौद्योगिकी का विकास, उत्पादन क्षमता एवं उत्पादन की गुणवत्ता के लिए संसाधन अवरोधों का प्रबंधन, जैविक दबावों का समेकित प्रबंधन एवं वैकल्पिक फसलों की पहचान एवं वैकल्पिक उपयोगों के लिए तम्बाकू का उपयोग के अनुसंधान पर था। विशेष अनुसंधान उपलब्धियों को नीचे दिया गया है :

तम्बाकू का किस्म सुधार

- इस वर्ष के दैरान 56 जंगली प्रजातियों के 195 आगमनों एवं 14 अंतरविशेष संकरों के अलावा *एन. टबाकम* एवं *एन. रस्टिका* के कुल 1520 जननद्रव्यों के आगमनों का रखरखाव किया गया। जीन बैंक में बासट नए जननद्रव्यों वंशावलियों को जोड़ा गया।

- भारी मूल्यांकन जांचों में, जांचे गए किस्मों की तुलना में टी बी एस टी 2, एन एल एस एच-1 (कम तार वाला संकर), जे एस 117 (कम तार वाली वंशावली), वी डी एच-3 (संकर) प्रविष्टियां महत्वपूर्ण रूप से बेहतर पाए गए।

- आई आर सी 2011 ने कर्नाटक की हल्की मृदाओं में मुझानग्रस्त रोग से पीडित क्षेत्रों के लिए स्पेइट जी.33 एवं डिक्सी ब्राइट 101 को डोनर प्रतिरोधी के रूप में उपयोग कर विकसित किए गए, *फ्युजेरियम* विल्ट प्रतिरोधी वंशावली एफ सी एच-222 को विमोचन के लिए अनकूल पाया। इस वंशावली ने करीब 3000 कि.ग्रा. प्रति हक्टेयर संसाधित पत्ता उत्पादन एवं उच्च गुणवत्ता वाला उत्पादन दर्ज किया। एफ सी एच 222 *फ्युजेरियम* विल्ट रोग का प्रतिरोधी होने के साथ ही साथ फसल उत्पादन कमियों से उभरने में सहायता करता है।

- कर्नाटक एवं आंध्र प्रदेश के कम वर्षा वाले क्षेत्रों में विशेष कर वर्षा आधारित परिस्थितियों के अंतर्गत निम्न एवं सामांत मृदाओं में लगाने के लिए, स्थानीय रूप से उगाए जाने वाले विगलक से ओरिएनटल तम्बाकू किस्म, तुंगभध्रा को चुना गया। पत्ता गुणवत्ता के अलावा जांचे गए किस्मों जैसेकि इजमिर (624 कि.ग्रा. प्रति हेक्टेयर), एक्संती (522 कि.ग्रा. प्रति हेक्टेयर), एवं कोमो (585 कि.ग्रा. प्रति हेक्टेयर) की तुलना में इसकी उत्पादन क्षमता करीब 767 कि.ग्रा. प्रति हेक्टेयर है।

- दो वर्षों के दौरान आयोजित किए गए दोहरे जांचों में, कंचन की तुलना में दो सोमाक्लोन, एन एल सी एम (के) एवं एन एल सी आर-1-11-10 ने महत्वपूर्ण रूप से बेहतर (31-26 प्रतिशत) उत्पादन दर्ज किया।

- चौदह अग्रिम बर्ली प्रजनन वंशावलियों में, दोहरे जांचों में श्रेष्ठ पाए गए किस्म बैंकट ए-1 की तुलना में वाई बी-22 एवं वाई.बी.-19 ने महत्वपूर्ण रूप से बेहतर (46 एवं 43 प्रतिशत) एवं अधिक संसाधित पत्ता उत्पादन दिया।

- नियंत्रण की तुलना में उत्पादन एवं गुणवत्ता के लिए जाती तम्बाकू (*एन. टबाकम*) के अग्रिम प्रजनन वंशावलियों के मूल्यांकन जांचों में, वंशावली डी जे-1 एवं डी जे -2 ने क्रमशः 52.7 एवं 48.4 प्रतिशत महत्वपूर्ण रूप से बेहतर संसाधन एवं 58.5 तथा 40.8 प्रतिशत बेहतर प्रथम श्रेणी पत्ता उत्पादन दिया। जबकि, नियंत्रण (49.8 प्रतिशत) की तुलना में, केवल डी जे-1 (51.8 प्रतिशत) में ही गुणवत्ता पत्ता उत्पादन बेहतर था।

- कुल 16575 कि.ग्रा. स्थापना बीज उत्पादन की पैदावार की गई।

संधारणीय तम्बाकू उत्पादन के लिए कृषि प्रौद्योगिकी का विकास एवं प्रौद्योगिकी हस्तांतरण को सशक्त बनाना

- ट्रे पौधा रोपण के लिए उगाऊ माध्यम के रूप में नारियल की जटा को कंपोस्ट के रूप में उपयोग करने से प्रोफ्युस जड़ प्रणाली सहित स्वस्थ एवं सशक्त पौधों का उत्पादन प्राप्त हुआ।
- चार रोपण-पूर्व शाकनाशी जांचो में, तम्बाकू नर्सरी में एलक्लोर एवं मेट्रीकुजिन ने बीज अंकुरण पर बिना कोई प्रतिकूल प्रभाव डाले खरपतवारों को प्रभावी रूप से नियंत्रित किया।
- सूक्ष्म छिड़कावों द्वारा उर्वरीकरण से करीब 20 प्रतिशत उर्वरकों की बचत की जा सकती है। नर्सरियों में सूक्ष्म छिड़कावों से पोटाशियम नाइट्रेट जैसे घुलनशील उर्वरकों का छिड़काव किया जा सकता है।
- ड्रिप सिंचाई द्वारा घुलनशील उर्वरकों से 80 प्रतिशत सिफारिश किए गए उर्वरकों का उर्वरीकरण से उत्पादन में सुधार एवं 20 प्रतिशत उर्वरकों की मात्रा में बचत होगी।
- एफ सी वी तम्बाकू संकर सीएच-1 एवं किस्म कंचन ने उत्तरी हल्की मृदाओं (एन एल एस) के अंतर्गत उनके नाइट्रोजन एवं पोटाश उपयोग क्षमताओं में नाम मात्र का अंतर दर्शाया। नाईट्रोजन एवं पोटाश के सभी पोषक उपयोग क्षमता सूचकों में नाइट्रोजन एवं पोटाश के निम्न स्तरों पर नाइट्रोजन एवं पोटाश के सूचक अधिक थे एवं नाइट्रोजन एवं पोटाश के स्तरों में वृद्धि से इनके सूचकों में कमी आई।
- खरपतवार मुक्त जांच की तुलना में रोपण के 15+75 एवं 60+90 दिनों के बाद क्विज़ालोफोइथेल (Quizalofopethyl) के पोस्ट एमरजेंस छिड़काव से खरपतवारों को प्रभावी रूप से नियंत्रित किया जा सका एवं उत्पादन भी समान था।
- अजैविक रूप में 90 कि.ग्रा. नाइट्रोजन सहित 30 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर समतुल्य जैव-सक्रिय जैविक खाद के प्रयोग से 160 कि.ग्रा. अजैविक नाइट्रोजन के समान तम्बाकू पत्ते का उत्पादन प्राप्त हुआ।
- कर्नाटक की हल्की मृदाओं में जैविक तम्बाकू के उत्पादन पर किए गए क्षेत्रीय अध्ययनों ने स्पष्ट किया कि अजैविक एवं जैविक प्लाटों के बीच उत्पादन अंतर 35 प्रतिशत (प्रथम वर्ष) से 10 प्रतिशत (चौथे वर्ष) हो गया। इसके अलावा, जैविक रूप से उगाए गए तम्बाकू में विद्यामान हानिकारक घटकों जैसेकि तार, कार्बन मोनोआक्साइड, तम्बाकू विशेष नाइट्रोसोमेन्स (टी एस एन ए) में महत्वपूर्ण रूप से कमी आई। संपूर्ण जैविक उपचारों के अंतर्गत संसाधित पत्ता के उजले श्रेणी उत्पादन में 6-10 प्रतिशत की वृद्धि हुई।
- पोटाशियम प्रयोग की अनुपस्थिति में, मूल गाठ ग्रस्त मृदाओं में अधिकतर आर के आई (RKI) देखा गया जिसके परिणामस्वरूप उत्पादन में कमी आई। पोटाशियम के स्तरों में वृद्धि से पत्ता के पोटाशियम मात्रा में सकारात्मक वृद्धि हुई विशेष कर निम्न परिस्थिती में।
- आंध्र प्रदेश के पूर्वी गोदावरी जिले के आदिवासी क्षेत्रों में बेहतर प्रौद्योगिकियों / प्रबंधन हस्तक्षेपों को प्रभावी रूप से अपनाने के लिए कुल 13 क्षेत्र स्तरीय प्रदर्शनों, 22 प्रशिक्षण कार्यक्रमों, 4 क्षेत्रीय दिवसों, 12 निदानार्थ दौरों एवं 6 पद्धति प्रदर्शनों का आयोजन किया गया। जिसके परिणामस्वरूप आदिवासी किसानों के सुग्राहीकरण ने उनकी कृषि उत्पादकता एवं आय में वृद्धि की।
- उत्तरी हल्की मृदा एवं दक्षिणी हल्की मृदा के किसानों द्वारा संसाधन उपयोग के क्रांतिक विश्लेषणों ने स्पष्ट किया कि एन एल एस क्षेत्र के लिए नाइट्रोजन एवं पोटाशियम उर्वरीकरण, स्व-स्थाने हरित खाद, कीटनाशक उपयोग, एन बी एस क्षेत्र के लिए अंतरसस्ययन, कीटनाशक उपयोग एवं ऊर्जा बचत तकनीकों सहित प्रौद्योगिकियों का प्रदर्शन एवं हस्तांतरण की आवश्यकता है।
- फार्म पर किए गए जांचों के अंतर्गत, किस्म बेंकेट ए1 की तुलना में बर्ली अग्रिम प्रजनन वंशावली वाई बी-4 एवं वाई बी-10 ने क्रमशः 31 तथा 22 प्रतिशत बेहतर उत्पादन दिया।

उत्पादन क्षमता एवं उत्पादन गुणवत्ता के लिए संसाधन अवरोधों का प्रबंधन

- प्रकाशम जिले के कंदुकूर मंड़ल के 17 तम्बाकू उगाने वाले गांवो में सिंचाई के लिए उपयोग करने वाले भूमिगत जल की गुणवत्ता का मूल्यांकन किया गया एवं विषयक जल गुणवत्ता मानचित्रों का विकास किया गया।
- तमिलनाडु के नागपटनम, कडलुरू एवं इरोड जिलों के चबाऊ तम्बाकू उगाने वाले क्षेत्रों की जल की गुणवत्ता का मूल्यांकन किया गया। इन क्षेत्रों के जल में अत्यधिक क्लोराइड मात्रा सहित अधिक नमकीन पाया गया।
- अधिकतम लीफ बर्न (4 सेकेंड़) के लिए क्लोराइड के देहली स्तरों को स्थापित किया गया। आई डब्ल्यु में यह 52 पी पी एम एवं पत्ता लेमिना में 1.17 प्रतिशत है।
- दिनहाटा के *मोतिहारी* तम्बाकू उगाने वाले क्षेत्र के अंतर्गत मृदा जैविक पूलों पर लंबी अवधि उर्वरक नीति के प्रभाव का मूल्यांकन किया गया। कार्बन पूल जैसेकि C_I, C_L, C_{WS} एवं C_{MB} ने संतुलित उर्वरीकरण से सुधार दर्शाया। संतुलित नाइट्रोजन, फासफोरस एवं पोटोशियम के लिए मृदा गुणवत्ता माप के रूप में सी एम आई सबसे अधिक था उसके बाद अहाता खाद से उपचारित क्षेत्र थे।
- तम्बाकू पत्ता में पोटोशियम जांच के लिए एक साधारण सस्ती वाटर एक्सट्रैक्शन पद्धति का विकास किया गया एवं इसके विश्लेषणात्मक सटीकता एवं परिशुद्धता का मूल्यांकन किया गया। इस नए पद्धति में 0.5 ग्राम भूमिगत पादप उत्तक से निहित पोटाशियम निकालने के लिए 1:100 अनुपात में डिसटिल पानी को मिलाकर 20 मिनट तक घुमाया जाता है तथा फ्लेम फोटोमेटरी द्वारा पोटोशियम को मापने से पहले छान लिया जाता है। 25 तम्बाकू पत्ता नमूनों ने दर्शाया कि वाटर एक्सट्रैक्शन पद्धति पोटाशियम की पहचान करने के लिए स्थापित पद्धतियों में यह सबसे सटीक एवं बेहतर पद्धति है।
- प्रयोग किए गए पोटाशियम से पोटाशियम उपयोग क्षमता एवं प्रतिक्रिया पर आधारित 18 एफ सी वी तंबाकू जीनरूपों में से पांच (आर टी-51, टी ओ बी आई ओ एस-2, आर टी-67-3 एवं आर टी-36-1) बेहतर एवं अनुक्रियात्मक पाए गए।
- एफ.सी.वी. तम्बाकू पर नाइट्रोजन के विभिन्न दरों से आयोजित किए गए क्षेत्रीय आथ्ययनों ने स्पष्ट किया कि 80 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर तक फासफोरस का उद्ग्रहण, 120 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर तक पोटाशियम, मेगनीशियम एवं सल्फर का उद्ग्रहण एवं 160 कि.ग्रा. नाइट्रोजन प्रति हेक्टेयर तक कैलशियम के उद्ग्रहण में वृद्धि हुई।
- क्षेत्रीय परिस्थितियों के अंतर्गत एफ सी वी तम्बाकू के लिए एजोस्पिरिल्लम, *बी सबटिलिस* एवं *एफ. ओरनटिआ* के कल्चरों को पोषक आपूर्ति / वाहक के रूप में मूल्यांकन किया गया।
- बी आई एस द्वारा प्रायोजित सहयोगी अध्ययन में, चार व्यवसायिक बीड़ी श्रेणियों से निकोटिन मुक्त शुष्क पारटीकुलेट पदार्थ (एन एफ डी पी एम), निकोटिन एवं कार्बन मोनोआक्साइड का लगातार धुंआ उत्पादन क्रमशः 27.41 से 39.71 मि.ग्रा. प्रति बीडी, 1.63 से 2.93 मि.ग्रा. प्रति बीडी एवं 19.01 से 27.87 मि.ग्रा. प्रति बीडी था।
- एफ सी वी एवं बर्ली तम्बाकुओं में ए बी एल के निष्पादन का मूल्यांकन किया गया। एफ सी वी तम्बाकू में सिफारिश किए गए परिष्कृत नाइट्रोजन एवं पोटाशियम उर्वरक हस्तक्षेपों का मूल्यांकन किया गया।

जैविक दबावों का समेकित प्रबंधन

- एफ सी वी तम्बाकू के रोपित फसल में तना बेधक से अच्छी सुरक्षा के लिए, *स्कोरोबीपलपा हेलिओपा* तना बेधक के प्रबंधन के लिए राइनॉक्सपिअर 25 एस सी 0.0075 प्रतिशत के दर से या फ्लुबेलडियामिडे 480 एस सी 0.012 प्रतिशत के दर से या स्पिनोसैड 45 एस सी 0.018 की दर से दो छिडकाव (पहल नर्सरी से पौधों को निकालने के 10 दिन पहले एवं दूसरा पुनः रोपण के 10 दिनों के बाद) या उपरोक्त कीटनाशकों का दो बार (पहला रोपण के 10 दिनों के बाद एवं दूसरा रोपण के 20 दिनों के बाद) अनुक्रमिक छिड़काव करें।

- नर्सरियों में तम्बाकू इल्ली, *स्पोडोप्टेरा लिटुरा* के विरूद्ध रसायनिक कीटनाशकों क्लोरोफायरीफॉस 20 ईसी (89.66 प्रतिशत) एवं नोवालुरान 10 ईसी (83 प्रतिशत) के बाद दो जैविक अभिकरणों जैसेकि एस.एल एन पी वी एवं *बेसिल्लस थुरिनजियनसिस* वार. कुरस्टाकी बेहतर (संदूषण की कमी 72 एवं 71.66 प्रतिशत) पाए गए।
- जांचे गए पद्धति की तुलना में प्रकाशयुक्त नर्सरी बेड़ो में 2 कि.ग्रा. प्रति मी^{2} की दर से पायसिलोमाइसिस लिलासिनस (Paecilomyces lilacinus) युक्त वर्मीकंपोस्ट के प्रयोग से मूल गांठ के सूचक के 50.5 प्रतिशत एवं मृदा सूत्रकृमी के सूचक में 51.0 प्रतिशत की कमी आई। जांचे गए पद्धति की तुलना में स्वस्थ रोपण पौधों की कुल संख्या में अनुवर्ती वृद्धि करीब 68 प्रतिशत थी।
- सामूहिक जांचों के अंतर्गत सभी स्थानों पर ट्राइकोडेरमा विरिडे + स्युजोमोनास फ्ल्युरेसेंस + एसएसपी के उपचार के परिणामस्वरूप महत्वपूर्ण रूप से अधिकतम संसाधित एवं प्रथम श्रेणी पत्ता उत्पादन प्राप्त हुआ। उसके बाद ट्राइकोडेरमा विरिडे + एसएसपी एवं एसएसपी का स्थान रहा।
- एन बी ए आई आई, बंगलौर एवं केन्द्रीय तम्बाकू अनुसंधान संस्थान, राजमन्द्री के एच ई या एन पी वी विगलकों को 1.5 x 10 पीआईबी प्रति हेक्टेयर का प्रयोग तम्बाकू के फसलों से *हेलिकोवेरपा आरमिजेरा* से होने वाले क्षति को कम करने में प्रभावी पाया गया।
- पेट में होने वाले प्रतिक्रिया द्वारा *एस. लिटुरा* के विरूद्ध उनके विषैलेपन के लिए जांचे गए दस कीटनाशकों में, इमामेकटिन बेनजोएट (emmectin benzoate) न्यूनतम एल सी$_{50}$ मूल्य दर्ज किया गया इसके बाद रिनाक्सिपाअर एवं नोवालुरन वृद्धि नियामक का स्थान था।
- 11 कीटनाशकों से *एच. आरमिजेरा* के प्रतिरोधी डेटा आधार से संपर्क कार्रवाई का निर्माण किया गया एवं रिनाक्सिपाअर से न्यूनतम एल सी$_{50}$ मूल्य दर्ज किया गया इसके बाद थियोडीकार्ब एवं स्पिनोसेड था।
- एफ सी वी तम्बाकू के प्रकाशयुक्त नर्सरी बेड़ो में 100 ग्राम प्रति मी^{2} की दर से नेमाटोड अंड़ा परजीवी कवक, पोचानिया क्लामीडोसपोरिआ (पीडीबीसी विगलक) 108 स्पोर्स के उपयोग से जांचे गए पद्धति की तुलना में स्वस्थ रोपण में 57.8 प्रतिशत की वृद्धि, मूल गाठ सूचक में 50.7 प्रतिशत की कमी एवं अंतिम मृदा सूत्रकृमि की संख्या में 51.8 प्रतिशत की कमी आई।
- तीन स्थानों पर सामूहिक जांचों के अंतर्गत, ट्राइकोडेरमा विरिडि + स्युडोमोनास फ्लूरेसेंस + एसएसपी युक्त उपचार के परिणामस्वरूप जाती तम्बाकू में अत्यधिक संसाधित एवं प्रथम श्रेणी पत्ता उत्पादन प्राप्त हुआ। इसके बाद ट्राइकोडेरमा विरिडि+एस एस पी का स्थान रहा।

वैकल्पिक फसलों की पहचान एवं वैकल्पिक उपयोगों के लिए तम्बाकू का उपयोग

- जांचे गए 14 संकरों एवं दो किस्मों में, एच डी बी आर जी (बी एम) ने बेहतर बायोमॉस दर्ज किया उसके बाद ए-145 x जी टी-7 (पी4) एवं एच डी बी आर जी x ए-145 संकरों का स्थान रहा। टी आई 163 x ए-145 से बेहतर सोलनेसाल प्राप्त किया गया। जबकि ए-145 x जी टी-7 (पी4) ने बेहतर निकोटिन दिया। यद्यापि जी टी-7 (पी4) x टी आई 163 में बेहतर तेल प्रतिशत था, पर टी आई 163 x ए-145 में बेहतर बीज उत्पादन के कारण अधिक तेल उत्पादन प्राप्त हुआ।
- प्रोटोटाइप एक्सपेल्लर से बीजों को निचोड़ने के द्वारा अधिकतम (44 प्रतिशत) तम्बाकू तेल प्राप्त हुआ, उसके बाद घुलनशील निचोड़ के द्वारा। तम्बाकू बीज तेल में ओमेगा असंतृप्त वसा अम्ल (लेनोलेनिक अम्ल-1.4 प्रतिशत) की पहचान की गई।
- तम्बाकू बीज तेल में निम्नलिखित वसा अम्ल का संगठन है : लाउरिक अम्ल (सी 12) - 0.9 प्रतिशत, माइरिस्टिक अम्ल (सी 14) - 0.65 प्रतिशत, पालमिटिक अम्ल (सी 6) - 6.05 प्रतिशत, लिनोलेइक अम्ल (सी 18:2) - 75.30 प्रतिशत, ऑलेइक अम्ल (सी 18:0) - 3.06 प्रतिशत।

Executive Summary

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

Tobacco cultivar improvement

- A total of 1520 germplasm accessions of *N. tabacum* and *N. rustica*, besides 195 accessions of 56 wild *Nicotiana* species and 14 interspecific hybrids, were maintained during the year. Sixty two new germplasm lines were added to the gene bank.
- In the bulk evaluation trials, entries TBST-2, NLSH-1 (low tar hybrid), JS-117 (low tar line), VDH-3 (hybrid) were found significantly superior over check varieties.
- The IRC 2011 identified for release the *Fusarium* wilt resistant line FCH-222, developed using Speight G.33 and Dixie Bright 101 as resistant donors, for the areas endemic to wilt disease in Karnataka light soils. The line recorded about 3,000 kg/ha cured leaf yield, and high grade out-turn. FCH 222 has resistance to Fusarium wilt disease and it can help to overcome the crop yield losses.
- The Oriental tobacco variety, Thungabhadra, a pure line selection from locally grown strain was identified for cultivation in low rainfall tracts of Karnataka and Andhra Pradesh, particularly on poor and marginal soils under rainfed conditions. The variety has yield potential of about 767 kg/ha compared to the check varieties viz., Izmir (624 kg/ha), Xanthi (522 kg/ha) and Komo (585 kg/ha), besides the required leaf quality.
- In a replicated trial conducted over two years, two somaclones, NLCR-1-11-10 and NLCR 4-7-15 recorded significantly higher (22-31%) cured yield over Kanchan.
- Among the fourteen advanced burley breeding lines, YB-22 and YB-19 recorded significantly superior (46 & 43%) cured leaf yield than the best check variety, Banket A-1 in a replicated trial.
- In a trial on evaluation of advanced breeding lines of *Jati* tobacco (*N. tabacum*) for yield and quality, lines DJ-1 and DJ-2 recorded 52.7 and 48.4% significantly higher cured leaf and 58.5 & 40.8% higher first grade leaf yields, respectively over control. However, quality leaf turnout was superior in DJ-1 (51.8%) only over control (49.8%).
- A total quantity of 16,575 kg foundation seed of different varieties was produced.

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

- Enriched coconut coir pith compost as a growth medium for tray seedling production gave healthy and vigorous seedlings with profuse root system.
- Among four pre-plant herbicides tested, Alachlor and Metribuzin controlled weeds effectively in tobacco nursery without adverse effect on seed germination.
- About 20% of fertilisers can be saved through fertigation with micro sprinklers. Soluble fertilizers like potassium nitrate can be used in fertigation with micro sprinklers in nurseries.
- Fertigation at 80% RDF with soluble fertilizers through drip irrigation improved the yield and saved the fertilizers to an extent of 20%.
- FCV tobacco hybrid CH-1 and variety Kanchan showed only marginal differences in their N and K use efficiencies under NLS conditions. All the nutrient use efficiency indices for N and K were higher at lower levels of N and K and decreased with increase in the level of N and K.
- Post-emergence spraying of Quizalofop-ethyl at 15+75 and 60+90 days after planting effectively controlled the weeds and yields

were comparable with weed free check.

- Application of bio-dynamic organic manures equivalent to 30 kg N/ha along with 90 kg N in the inorganic form produced comparable tobacco leaf yields to that of 160 kg inorganic N.
- The field study on producing organic tobacco in KLS revealed that the yield gap between inorganic and organic plots was reduced from 35% (first year) to 10% (fourth year). Further, there was marked reduction in the harmful constituents like tar, carbon monoxide, tobacco specific nitrosamines (TSNA) in the organically produced tobacco. The bright grade production of cured leaf was higher by 6-10% under fully organic treatment.
- In the absence of potassium application, the RKI was found to be more especially in the root-knot sick soils and their by resulting in lower productivity. Increased levels of K positively increased the leaf K content especially in L position.
- A total of 13 FLDs, 22 training programmes, 2 kisan melas, 4 field days, 12 diagnostic visits and 6 method demonstrations conducted/held for effective adoption of the improved technologies/ management interventions in the tribal belt of East Godavari district of Andhra Pradesh resulted in sensitization of tribal farmers leading to increased farm productivity and income.
- Critical analysis of resource use by NLS and SLS farmers revealed the need for demonstration and transfer of technologies including N & K fertilization, *in-situ* green manuring, pesticide application for NLS; intercultures, pesticide use, energy saving techniques for NBS area.
- Under on-farm trials, burley advanced breeding lines YB-4 and YB-10 recorded higher yield over the check Banket-A1 by 31 and 22%, respectively.

Management of resource constraints for production efficiency and product quality

- Quality of the ground waters used for irrigation in 17 tobacco growing villages of Kandukur mandal of Prakasam District was assessed and the thematic water quality maps developed.
- Water quality of chewing tobacco growing areas of Nagapattanam, Cuddalore and Erode Districts in Tamil Nadu was assessed. The waters in this region are highly saline with high chloride content.
- Threshold level of Chloride for optimum leaf burn (4 seconds) was established as 52 ppm in IW and 1.17% in leaf lamina.
- Impact of long-term fertilizer strategies on soil organic (SOC) pools under *Motihari* tobacco grown in Dinhata was assessed. Carbon pools viz., C_T, C_L, C_{ws} & C_{MB} showed improvement with balanced fertilization. CMI as a measure of soil quality was highest for balanced NPK, followed by FYM treated plots.
- A simple inexpensive water-extraction method for assaying K in tobacco leaf was developed and evaluated for its analytical accuracy and precision. The new method entailed extracting K from 0.5g finely ground plant tissue with distilled water at a 1:100 ratio (w/v) by shaking for 20 minutes and filtering before K measurement by flame-photometry. The results with 25 tobacco leaf samples showed that the water extraction method was comparable in accuracy and superior in precision to the established methods for K determination.
- Based on the K use efficiency and response to applied K, five out of 18 FCV tobacco genotypes (i.e., RT-51-2, RT-57-1, TOBIOS-2, RT-67-3 and RT-36-1) were rated as efficient and responsive (ER).
- Field studies conducted with varying rates of N to FCV tobacco revealed that increase in applied nitrogen increased P uptake up to 80 kg N/ha; K, Mg and S uptake up to 120 kg N /ha and calcium uptake up to 160 kg N/ha.
- Cultures of *Azospirillum*, *B. subtilis* and *F. aurantia* as nutrient suppliers/ mobilisers were evaluated for FCV tobacco under field conditions.
- In a collaborative study sponsored by the BIS, the main stream smoke yields of nicotine-free dry particulate matter (NFDPM), nicotine and carbon monoxide (CO) from four commercial bidi brands were found to range from 27.41 to 39.71 mg/bidi, 1.63 to 2.93 mg/bidi and 19.01 to 27.87 mg/bidi, respectively.

- Evaluated the performance of ABLs in FCV and Burley tobaccos. Assessed the recommended and refined N & K fertilization interventions in FCV tobacco.

Integrated management of biotic stresses

- For the management of stem borer, *Scrobipalpa heliopa* two sprays {first spray 10 days before pulling the seedlings in the nursery and second spray 10 days after transplanting (DAT)} with rynaxypyr 25 SC @ 0.0075% or flubendiamide 480 SC @ 0.012% or spinosad 45 SC @ 0.018% or sequential spray of the above insecticides twice (first 10 DAT and another 20 DAT) gave good protection from the stem borer infestation in the planted crop of FCV tobacco.
- Two bioagents, viz., *Sl* NPV and *Bacillus thuringiensis Var. Kurstaki* proved better (72 and 71.66% reduction of infestation) after chemical pesticides, chlorpyriphos 20EC (89.66%) and novaluron 10EC (83%) against tobacco caterpillar, *Spodoptera litura* in nurseries.
- Application of *Paecilomyces lilacinus* enriched vermicompost @ 2 kg/m^2 in solarized nursery beds caused 50.5% reduction in root-knot Index and 51.0% reduction in soil nematode population compared to check. Subsequent increase in total number of healthy seedlings was to the tune of 68% over check.
- The treatment *Trichoderma viride* + *Pseudomonas fluorescens* + SSP resulted in significantly highest cured and first grade leaf yield at all the locations under bulk testing followed by *Trichoderma viride* + SSP and SSP.
- *He ar* NPV isolates from NBAII, Bangalore and CTRI, Rajahmundry applied @ 1.5 x10^{12} PIB/ha were found effective in suppressing *Helicoverpa armigera* damage to tobacco crop.
- Of the ten insecticides tested for their toxicity against *S. litura* through stomach action, the lowest LC_{50} value was recorded for emamectin benzoate followed by rynaxypyr and the growth regulator novaluron.
- The baseline resistance data of *H. armigera* to 11 insecticides with contact action were generated and the lowest LC_{50} value was recorded with rynaxypyr followed by thiodicarb and spinosad.
- Application of nematode egg parasitic fungi, *Pochania chlamydosporia* (PDBC strain) 10^8 spores @ 100 g/m^2 in solarized nursery beds of FCV tobacco caused 57.8% increase in healthy transplants, 50.7% decrease in root-knot index and 51.8% decrease in final soil nematode population compared to check.
- Under bulk testing at three locations, the treatment comprising *Trichoderma viride* + *Pseudomonas fluorescens* + SSP resulted in significantly greater cured and first grade leaf yield of *Jati* tobacco followed by *Trichoderma viride* + SSP.

Identification of alternative crops and exploiting the tobacco for alternative uses

- Among the 14 crosses and two varieties tested, HDBRG (BM) recorded higher biomass followed by crosses A-145 x GT-7 (P4) and HDBRG x A-145. Higher solanesol was obtained from TI-163 x A-145 (P1) whereas A-145 x GT-7(P4) gave higher nicotine. Though oil percent was higher in GT-7 x TI-163 (P4), TI-163 x A-145 (P3) gave higher oil yield due to its greater seed yield.
- The highest recovery of tobacco seed oil (44%) was achieved by crushing the seed with prototype expeller followed by solvent extraction. Omega unsaturated fatty acid (lenolenic acid – 1.4%) was identified in tobacco seed oil.
- The tobacco seed oil had the following fatty acid composition : Lauric acid (C12)- 0.9%, Myristic acid (C14)- 0.65%, Palmitic acid (C16)- 6.05%, linoleic acid (C18:2)-75.30%, Oleic acid (C18:1)-13.60% and Steric acid (C18:0)- 3.06%.

Introduction

The Central Tobacco Research Institute (CTRI), established in 1947, is a constituent institute of the Indian Council of Agricultural Research, New Delhi and has the exclusive mandate to undertake basic, strategic and applied research on various types of tobacco grown in India. The CTRI in its long march did yomen service to the tobacco farming community in the country. Infact, all the scientific knowledge and technologies concerning tobacco production and its curing in India is credited to the CTRI.

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

MANDATE

- To conduct research on different types of tobacco, with greater emphasis on exportable types, on all phases of production management with a view of attaining economic advantage / benefit to the tobacco growers through improvement in quality and quantity of tobacco.

- To collect tobacco germplasm from world over and to maintain and operate tobacco genetic resources which will be made available to scientists and National / International Institutions.

- To conduct research on economically viable and sustainable cropping systems alternative to tobacco.

- To conduct research on diversified uses of tobacco and development of value-added products viz., phytochemicals.

- To produce and distribute quality seeds of notified varieties of tobacco.

- To publish and disseminate research findings and recommendations of latest technology for the benefit of the tobacco growers, scientific community, policy makers and development agencies.

RESEARCH PROGRAMMES

I. Tobacco cultivar improvement

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

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

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

(D) Germplasm resource management

(E) Biotechnology for tobacco improvement

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

(A) Healthy seedling production

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

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

(D) Post-harvest product management (PHPM)

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

(F) Technology outreach activities

(G) Technology assessment

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

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

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

(C) Identification of potential phytochemicals

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

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

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

(C) Characterization of soil biota and use of biofertilizers

(D) Evaluation of tobacco leaf and product quality

V. Integrated management of biotic stresses

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

(B) Development of IPM technology

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

(D) Monitoring of insect pests and diseases

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

STAFF POSITION AND FINANCIAL STATEMENT

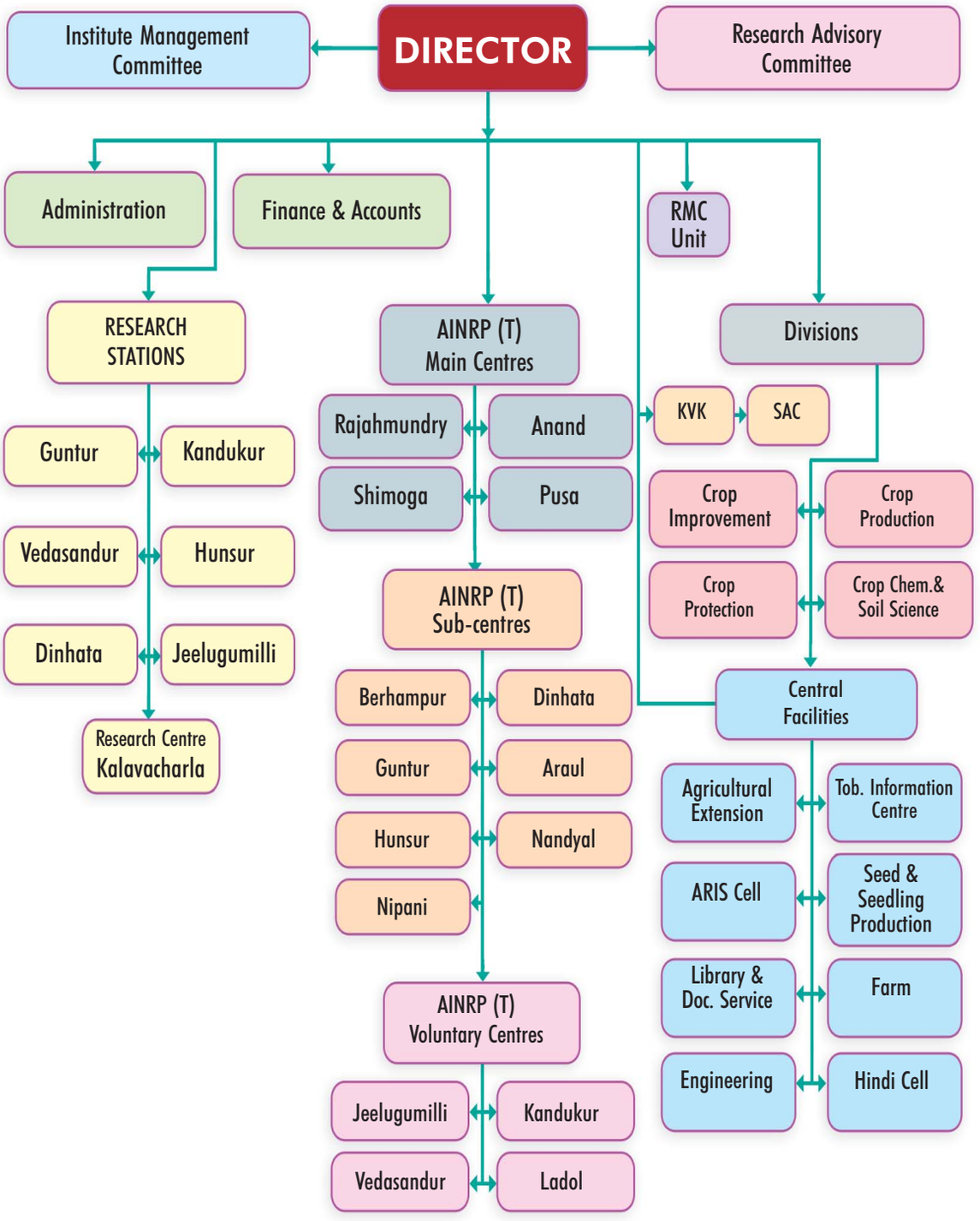
STAFF POSITION AS ON 31.03.2012

Sl. No.	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	55	35	20
2.	Technical	150	123	27
3.	Administration	70	57	13
4.	Skilled Supporting Staff	160	109	51
5.	Casual workers on Temporary Status in position	--	96	--

FINANCIAL STATEMENT FOR THE YEAR 2011-12

Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	1934.50	1933.93
Plan	250.00	250.00
KVK	110.50	110.35
AINRPT	343.00	343.00
Pension & Retirement Benefits	800.00	800.00
Personal Loans & Advances	6.00	6.00
Recurring Deposit Schemes	46.00	32.04
Revolving Fund Scheme	102.47	89.60
Internal Resource Generation	31.33	19.01
Total	3623.80	3583.93
Revenue Receipts	Target 158.76	Achieved 139.90

INSTITUTE ORGANOGRAM



Research Achievements

I. Tobacco Cultivar Development

I (A). Germplasm Resource Management

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

T. G. K. Murthy

Acquisition: During the year, 55 new *Rustica* germplasm lines and 44 wild *Nicotiana* species accessions were imported from the Plant Germplasm Inspection Station, Maryland, USDA-ARS, USA. Also, 59 exotic FCV germplasm imported by M/s ILTD, ITC R&D Centre, Bengaluru, were added to the germplasm bank, thereby increasing the germplasm accessions of CTRI to 2728.

Maintenance of cultivated germplasm : A total of 1520 germplasm lines comprising of 471 Flue-Cured Virginia, 496 non-FCV lines, 55 *N. rustica* lines and 498 elite lines for various important traits (released varieties; lines with high seed bearing, low nicotine, insect pest resistance, disease resistance, root-knot resistance, CMS and high yield potential traits) were maintained.

Maintenance of wild *Nicotiana* species: During the season, 195 accessions of 56 wild *Nicotiana* species and two sub-species were maintained in pots or experimental micro-plots. Also, 9 exotic interspecific hybrids, 5 hybrids developed at CTRI and 4 amphidiploids were maintained. Two non-flowering species were rescued through *in-vitro* micropropagation.

Germplasm enhancement: Interspecific hybrids., viz., *N. sylvestris* x *N. tomentosiformis* and *N. sylvestris* x *N. otophora* which are considered as the progenitors of cultivated species, *N. tabacum* were synthesised and their back cross progenies were raised for infusing additional variation into the cultivated species, *N. tabacum* so as to aid the further genetic improvement of the crop.

Conservation: All the germplasm accessions maintained during the past five years have been kept for medium term storage at -10ºC in the cold storage room and in deep freezer and a sample of each line was also kept under ambient storage conditions. A total of 1007 accessions of FCV, Burley, *Jati*, JAC, EAC, Oriental, Bulgarian, sources of root-knot nematode resistance, and released varieties have been deposited at NBPGR for long term seed storage.

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

Documentation: Data on morphological traits of 55 new *N. rustica* lines were collected for documentation. Data on morphological traits of all the 471 FCV varieties were collected. The computer database entitled *Nicotiana* Species Information System has been finalised by completing data feeding on 90 descriptor traits on 69 identified *Nicotiana* species. A proforma for recording data on 52 morphological traits which can be used for registration of tobacco varieties and germplasm has been designed.

Molecular characterization: Genetic diversity among identified varieties and land races of *N. tabacum* and *N. rustica* was studied using RAPD and SSR markers. Analysis using 5 RAPD primers indicated that the 18 landraces of *rustica* had 11 to 100% genetic similarity. Analysis of amplified fragments using 5 SSR primers indicated 9 to 100% similarity among the *Rustica* accessions. Minimum similarity exhibited by Assam-2 and Tura whereas the similarity was 100% among the landraces viz., Kerala 2, Kerala 3 and Kerala 4. The varieties and landraces of Rustica formed cluster 1 while the second cluster was formed by *N. tabacum*. Genetic diversity among 12 Natu accessions was also studied using 10 RAPD primers. Genetic similarity varied from 73 to 97%. Based on cluster analysis, the 12 Natu lines were divided into 2 main clusters. Varieties Natu Special and Pyruvithanam formed one cluster. The second cluster comprised 2 sub-clusters. The first sub-cluster was formed by Bhairavi, Vishwanath and WAF. The second sub-cluster consisted of Prabhat and Tokaku. These results confirmed

the parentage of Bhairavi and Prabhat varieties. Utilization of 16 SSR primers brought out 58 to 93% similarity among the Natu lines. Presence of 2 clusters and the parentage of Bhairavi was also confirmed by using SSR primers.

Evaluation: (a). Screening against *Orobanche* infestation: Out of the 12 wild *Nicotiana* species screened under artificial field inoculation by the Plant Pathologist during the season, *N. repanda, N. x benthamiana-repanda* and *N. x umbratica-nesophila* were reported to be free from *Orobanche* infestation on artificial inoculation.

(b). Replicated yield trial for seed yield: Among the non FCV germplasm, 19 lines with large and compact inflorescence and large capsule size were evaluated for seed yield and seed oil content along with three checks (HDBRG, A-145 and GT-7) in a RBD with 3 replications for seed yield and related traits. Line A-145, Lanka Special and Sendarapatty Special showed bigger inflorescence size and more capsule number than other entries. While none of the lines showed significantly superior seed yield over the best check, A-145 (743 kg/ha), six lines viz., Lanka Special (Lanka), Chemical mutant (FCV), Erzegovina-93 (Oriental), Sendarapatty Special (Cheroot), Connecticut-7D (Japan Air-cured) and Trapizond-7 (EAC) showed comparable performance. The seed oil content analysed, by the NMR Spectrometer was highest in Lanka Special (32.7%) while lowest in an advanced derivative of cross Gauthami x Erzegovina (26.4%).

(c). Preliminary evaluation for seed oil content: Twenty three lines with large and compact inflorescence and large capsule size were evaluated during 2009-10 season for seed yield and related traits along with three checks (HDBRG, A-145 and GT-7) in a RBD with 3 replications. Only Erzegovina-93 showed significant improvement (by 28%) over A-145. Seed oil content was estimated using the Soxhlet method. None of the entries showed significantly higher oil content than the best check, A-145 (38.9%). Two lines viz., Katsuy and Visoka (Air-cured), however, showed marginally higher oil content. Also, about 180 accessions of identified FCV and non-FCV germplasm and wild *Nicotiana* species were used for estimation of seed oil content (Soxhlet method) and fatty acid profiling. Among the 9 wild species evaluated, the oil content varied from 26 to 37%. The exotic Air-cured line Montgomery Dwarf exhibited highest (40%) oil content. Seed protein content in these lines varied from 15.0 to 19.5%. Globulin was the major fraction and glutilins were minor fractions. In another study, 103 germplasm accessions including 66 chewing and 37 country cheroot lines, were evaluated for seed oil content (Soxhlet method). In the chewing lines the oil content varied from 26.7 to 33.6% while in country cheroot lines, the oil content varied from 22.1 to 32.8%. In a collaborative study undertaken with Agronomist, seed oil content was estimated by using the Nuclear Magnetic Resonance (NMR) Spectrometer in 66 identified germplasm lines of FCV and non-FCV types. The seed oil content varied from 16.6 to 33.5%. Three lines viz., Maigiginya (EAC), Speight G-10 and TI-1112 exhibited around 33% seed oil.

(d). Resistance to TMV disease: Nineteen lines, previously recorded as TMV resistant, were screened against TMV disease under artificial inoculation for confirmation. Thirteen lines were uniformly resistant, while others segregated for susceptible plants. Resistant plants were selfed for further purification of the lines for resistance.

Germplasm maintenance of *Nicotiana tabacum* varieties / lines *[CTRI RS, Hunsur]*

C. Panduranga Rao

Maintenance of germplasm: Active stock of 600 germplasm accessions is being maintained. Under the periodical multiplication programme, 213 germplasm accessions were regenerated. Fifteen inter-specific cross derivatives under advanced generation were assessed and were found to be with root-knot index ranging from 1.0 to 2.8 under natural infestation in mixed population in field. Male sterile lines of Kanchan and Rathna were maintained.

Evaluation and maintenance of germplasm *[CTRI RS, Vedasandur]*

A.V.S.R.Swamy

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

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

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

S. Amarnath

Maintenance of germplasm: Ten plants of from each group of *N. tabacum* [(*Jati* (65), Cigar Wrapper (94) and Cigar Filler (82)] and 185 lines of *N.rustica* (*Motihari*) tobacco were grown and 3 healthy plants in each line were selfed and collected separately for use in the ensuing season.

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

Evolving superior varieties of FCV tobacco through hybridization *[CTRI, Rajahmundry]*

P.V. Venugopala Rao

SP-1: Evaluation of advanced breeding lines for yield and quality

Yield parameters: A replicated yield trial with ten advanced breeding lines viz., V-4835, V-4837 V-4846, V-4848, V-4852, V-4853, V-4854, V-4948 V-4954 and V-4955 along with two controls viz., VT-1158 and Siri was conducted for the second year. Significant difference between the treatments was recorded in green leaf yield, cured leaf yield, bright leaf yield and grade index. Among the entries, nicotine, reducing sugars and chlorides ranged from 2.09 to 2.85%, 11.82 to 15.70% and 0.86 to 1.36%, respectively. Based on the overall performance, V-4948, V-4853 and V-4852 are better performers among the entries studied.

SP-2: Evaluation of advanced breeding lines for yield and quality

Yield parameters: A replicated yield trial was conducted with ten advanced breeding lines viz., V-4994, V-4995, V-4996, V-4997, V-4998, V-4999, V-5000, V-5003, V-5015, V-5027, V-5029, V-5033, V-5039 and V-5041 along with two controls viz., VT-1158 and Siri for the second year. Significant difference between the treatments was recorded in all the four yield characters. Among the entries, nicotine, reducing sugars and chlorides ranged from 2.09 to 2.85 %, 8.01 to 16.27% and 0.63 to 1.05% respectively. Based on the overall performance, V-5033, V-5003 V-5000 and V-5015 are better performers among the entries evaluated.

Preliminary evaluation of advanced breeding lines in row trial: Thirty advanced breeding lines were evaluated in a row trial along with the controls viz., VT-1158, Hema and Siri to identify the potential lines with higher yield. Thirty eight selections were made and selfed seed collected to take up for further evaluation during 2010-11. In another set of one hundred F_3s, fifty six selections were made and seed collected to raise F_4 during 2011-12.

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

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

Replicated trial (1st year): Four somaclones and nine advanced breeding lines were tested in a replicated trial with three controls Hema, VT 1158 and Siri. Significant differences were observed among the tested lines for all the yield characters. Morphological characteristics of the lines with respect to plant height, total number of leaves, leaf length and leaf width were found to be significant among the lines tested. The chemical quality characteristics of breeding lines viz., nicotine ranged from 1.44% in RS-11 to 3.07% in Siri and reducing sugars from 7.17% in RS-18 to 12.74% in RS-11. Chlorides in all these

lines were found to be in acceptable limits (0.96-1.15%). All the six lines tested at CTRI RS, Jeelugumilli were promising for leaf yield. Out of 55 promising lines assessed for yield under row trial at Katheru farm, 12 lines were found to be promising for yield. Seventy lines including 50 breeding lines, 18 germplasm lines and two F_2s were screened for TMV resistance and resistant plants selfed and selfed seed collected.

Evolving FCV tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh *[CTRI RS, Jeelugumilli]*
T.G.K. Murthy

Preliminary evaluation of advanced breeding lines: A progeny-row trial was conducted with 90 lines (F_6-F_{12}) along with the check variety Kanchan to identify selections suitable to NLS area. The lines varied for important morphological and agronomical traits. Thirteen lines with high yield potential (CLY 2222-2980 against 1800 kg in Kanchan) and desirable leaf qualities were identified. Ninety five single plant selections showing good plant type and leaf characteristics suitable for NLS besides high yield potential, were advanced for further evaluation. Five of the lines were identified as resistant to TMV on artificial inoculation. In Rajahmundry, 14 selections resembling variety Kanchan besides having resistance to TMV were selected for further evaluation at Jeelugumilli. In addition to high yielding selections, four semi-dwarf selections with compact plant type and very short internodes, suitable for close spacing were also identified and advanced for further study.

Replicated yield trials: (1). Trial RYT-11 (2nd year): Nine medium green/ green cast advanced breeding lines were evaluated along with check Kanchan for yield and leaf quality traits in a RBD with three replications for the second year in succession. Three of the lines were 'flat' leaf types while others were 'Kanchan' type. Five of the lines viz., SM12-2, ABL10-1, ABL13-1, ABL24-1 and ABL 45-5 were resistant to TMV. Check variety, Kanchan was more severely affected by brown spot and ring spot virus than the other entries during the season. Analysis of data indicated significant differences in cured leaf yield as ABL10-1 (88%), ABL13-1 (65%), ABL8-1 (57%), SM26-1 (43%), ABL24-1 (34%), ABL49-1 (37%) and SM12-2 (37%) over Kanchan. Among the test entries viz., ABL10-1, ABL36-2, ABL13-1, ABL49-1, SM26-1 & SM12-2 possessed good physical attributes of cured leaf such as colour, size and body. The leaf attributes in other cultures were also desirable. Nicotine and chlorides were within admissible limits while reducing sugars were low in four entries.

(2). Trial RYT-12 (2nd year): Nine medium/ green cast advanced breeding lines were evaluated along with check Kanchan for yield and leaf quality traits in a RBD with three replications for the second year in succession. Four of the lines were 'flat' leaf types while others were 'Kanchan' type. Three lines viz., RT19-1, RT9-1 and RT31-1 were resistant to TMV. Three lines viz., RT31-1, ABL49-2, RT18-1, and ABL48-1 & RT19-1 showed significantly higher green leaf yield, cured leaf yield and grade index. The increase for different traits over check Kanchan was 22 to 92% in these lines. Cured leaf colour, size and body in all the test entries (except RT 9-1 and RT 11-1) were comparable with that of Kanchan. In general, the nicotine and chlorides were within admissible limits while reducing sugars were low.

(3). Trial RYT-13 (1st year): In a new trial, thirteen medium/ green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications. Seven lines viz., RT57-1, RT40-1, RT102-1, F3-20-2, RT42-1, F3-18-1 and RT36-1, showed significantly higher green leaf yield, cured leaf yield and grade index than the check, Kanchan. The increase for different traits over Kanchan was 14 to 48%, 21-63% & 26-86% for green leaf yield, cured leaf yield and grade index, respectively in these lines. Cured leaf colour, size and body in all the test entries were comparable with or better than Kanchan. Nicotine and chlorides were within admissible limits while reducing sugars were slightly lower.

(4). Trial RYT-14 (1st year): In another new replicated trial, 13 medium/ green cast

advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications. Ten lines showed significantly higher green leaf yield, cured leaf yield and grade index. The increase for different traits over check Kanchan was 28 to 115%, 50-130% & 50-147% for green leaf yield, cured leaf yield and grade index, respectively in these lines. Cured leaf colour, size and body in all the test entries were comparable with that of Kanchan. Nicotine and chlorides in cured leaf were within admissible limits while reducing sugars were lower.

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

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

Replicated yield trial: A replicated trial was conducted with fourteen advanced breeding lines along with three controls viz., Banket A1, Burley-21 and Swetha with three replications. Significantly superior cured leaf yield was recorded in YB-22 as 1541 kg/ha cured leaf with an improvement of 46% followed by YB-19 as 1505 kg/ha with 43% improvement over better control BA1.

Evaluation of segregating material: Progeny row trial was conducted involving 101 progenies and fifty seven selections were made based on the morphological characters like leaf size, shape, colour of leaf, stem and veins, number of leaves, inter nodal length spotting, etc., and these selections will be evaluated further during 2011-12. Thirty five selections (F_4) were evaluated and eight plants were selected and these selections were made for further evaluation during 2011-12.

Incorporation of male sterility (CMS) in burley varieties: The BC6 crosses involving the male sterile hybrids BRK-1, BRK-2, TN-97, NCBH-127 and NC-3 were raised and back crossed with the respective male fertile recurrent parent viz., Banket A1, Burley-21, VA-510, Banket-127. The seed was collected to raise the BC7 seedlings during 2011-12.

Development of FCV tobacco varieties suitable for cultivation in CBS and SBS of Andhra Pradesh *[CTRI RS, Guntur]*

C. Nanda

Results of combined analysis (2009-2011): Five entries viz., GH-9#1, GH-9#23, GH-9#25 (derived from the cross V-3703 X KST-26), GH-10#35 (V3703X Cy-79) and GH-14#33 (V-3703 X Hema) along with three popular checks were raised under CBS conditions (at CTRI RS, Guntur) and another 6 viz., GH-9#1, GH-9#14, GH-9#22, GH-9#23, GH-9#25 (derived from the cross V-3703 X KST-26), GH-10#35 (V3703X Cy-79) were tested under SBS in bulk plots. The treatments differed significantly for all the four yield characters *viz*., green, cured and bright leaf yields and grade index. The seasons and seasons × entries interaction were not significant. Entries GH-9#1, GH-9#23, GH-9#25 and GH-10#35 have performed well in terms of significantly high green, cured and bright leaf yields as well as high grade index over the check Siri. Cured leaf yield was maximum in case of selection GH-9#25 (3195 kg/ha) followed by GH-10#35 (3180 kg/ha) and GH-9#1 (3117 kg/ha) with an improvement of 21, 20 and 18%, respectively over Siri. Grade index was significantly high in GH-10#35 (2762) followed by GH-9#25 (2722) and GH-9#1 (2695) with an increase of 23, 21 and 20%, respectively over Siri. The four advanced lines *viz*., GH-9#1, GH-9#23, GH-9#25 and GH-10#35 have proved superior to check Siri consecutively for two seasons under CBS and SBS conditions and hence will be included in IVT for the coming season.

FCV bulk trial: New pipeline entries viz., 56-3, TBSH-1 and TBST-2 were raised along with the check Siri in bulk plots. Of the three, line TBST-2 has out yielded the check Siri in terms of green leaf yield (17143 kg/ha) by 12%, cured leaf yield (2950 kg/ha) by 22%, bright leaf yield (1243 kg/ha) by 23% and grade index (2349) by 16%. This was followed by TBSH-1.

***Natu* bulk trial:** The *Natu* entry II-1873 gave maximum green leaf (20274 kg/ha) and cured leaf yield (2762 kg/ha) compared to checks WAF and Bhairavi.

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

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

Row trial: Segregating material in F5 generation of the crosses 1) H-3 (Yellow speck x Hema), 2) H-4 (F-212 x Hema), 3) H-10 (Bright capsule x Hema), 4) H-11 (Delcrest x Hema), 5) H-13 (Candle x Hema 6) H-15 (Kothari Hicks x Hema) were grown in single plant progeny row. From this, 4 single plants from H-13 and one plant from H-15 were selected which will be grown in progeny row trial in the next season.

In the F4 generation, 7 single plants were selected from the cross SH-12 (Hema /NC-3150) and one single plant was selected from the cross SH-1 (VT-1158 /NLS-1).

Caterpillar tolerance: F1 plants from the crosses of aphid and caterpillar tolerant lines with Siri and N-98 were grown. On the basis of F1 vigour seed are collected from 10 crosses only for growing the F2 generation.

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

A.V.S.R. Swamy

Diallell selective mating: Twelve selections (HV.2009-1 to HV. 2009-12) derived from the broad based genetic population of diallell selective mating approach were grown in a replicated trial along with Bhagyalakshmi and Abirami for the second year for assessing their yield and quality. The selection HV.2009-3 recorded significant superiority registering 3951 kg/ha total leaf yield against the check varieties Bhagyalakshmi and Abirami. This was followed by selections HV.2009-5 and HV.2009-8 which recorded significantly higher total leaf yields of 3914 and 3827 kg/ha, respectively against check varieties. In whole leaf yield, only the selection HV.2009-5 exhibited significant superiority to the controls Bhagyalakshmi and Abirami recording 3210 kg/ha whole leaf yield. In respect of morphological characters, selections HV.2009-12, 11 and 8 recorded significant leaf width against the check variety Abirami. Selections HV.2009-3, 1 and 2 recorded significant inter nodal length against the control Bhagyalakshmi. With respect to stem girth, selections HV.2009-3 and 2 recorded significant stem girth to the best check Abirami.

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

S. Amarnath and S. Roy

Diallel crosses: 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_1s viz. Black Queen x Manda, Black Queen x DD-437, C-25 x Snuff-2 and C-25 x Tangua were selected to grow them in F2 population during 2007-08 with fifteen hundred plants each.

Inter and inter-se crosses: Inter and inter-se crosses were made between 4 best selections of each of the four F_2 population to reshuffle the genetic constitution so as to exploit superior genotypes with maximum genotypic potential for higher yield and superior quality. Inter-mating series progeny indicated 1.05 % and 18.05 % superiority of total cured and first grade leaf yield respectively, over the pedigree series. No segregation was observed in different families. Nine best plant selections from seven families would be evaluated for their yield and quality in a replicated trial during the ensuing season.

Evaluation of advanced breeding lines of *Jati* tobacco (*N. tabacum*) for yield and quality performance

S. Amarnath and S. Roy

Yield and quality evaluation: Six advanced breeding lines viz. DJ-1 to DJ-5 of *Jati* tobacco (*N. tabacum*) were evaluated for their yield and quality performance with control Podali in a replicated trial. Results revealed significant superiority of line DJ-1 and DJ-2 with 52.7 and 48.4% higher cured leaf yield and 58.5 & 40.8% higher first grade leaf yield over control,

DJ-1 a high yielding Jati tobacco breeding line

respectively. However, quality leaf turnout was superior in DJ-1(51.8%) over control (49.8%).

I (C). Interspecific Hybridisation for Tobacco Improvement

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

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

Maintenance of interspecific cross derivatives: During 2010-11 season, a total of 99 stabilized aphid and caterpillar resistant / tolerant advanced lines derived from the above crosses were grown in progeny rows along with 12 check varieties. Also, 11 derivatives developed from crosses *N. gossei x N. tabacum* and *N. umbratica x N. tabacum*, screened and identified as tolerant to leaf curl disease in collaboration with Entomologist were maintained. Seventy of the lines were morphologically uniform and stable. Based on suitability of plant type, leaf number, plant height, cured leaf yield and cured leaf colour, size and body and seed bearing nature, 45 promising lines were retained for further agronomic evaluation.

Reaction to natural aphid infestation: Seventy of the derivatives were free from aphid infestation under natural conditions.

Preliminary evaluation for leaf yield potential: Twenty three of the advanced cross derivatives were light cast in nature and possessed high leaf yield potential and showed 20-73% more cured leaf yield than the check variety Siri (CLY = 2030 kg/ha). Also, eight of the derivatives were medium dark cast in nature and showed higher yield potential (22 – 30%) than the check, Kanchan (CLY = 1840 kg/ha). Twelve of the 23 high yielding derivatives showed uniform resistance to TMV disease under artificial inoculation.

Evaluation of advanced lines in RYTs

a) Trial TBL-4 (2nd year): A replicated yield trial was conducted with ten morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 32 to TBST 41) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature. Nine of the derivatives (except TBST-36) were resistant to TMV. Differences among entries were significant for all the four yield traits. Three lines, viz., TBST-33, TBST-36 and TBST 41 showed significant improvement over the best check Siri for all the four leaf yield traits. The increase in these lines over Siri was 12 to 31% for cured leaf yield and 14 to 16% for grade index, respectively. The nicotine content varied from 1.77 to 3.49%, chlorides 0.61 to 1.14% and reducing sugars 8.29 to 14.19% among the lines.

b) Trial TBL-5 (2nd year): Another replicated yield trial was conducted for the second year in succession with ten morphologically stable, aphid resistant/ tolerant light cast advanced cross derivatives (TBST 42 to TBST 51) along with two checks Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. Four of the derivatives (TBST Nos. 43, 48, 50 & 51) showed resistance to TMV. Six derivatives viz., TBST-44, TBST-45, TBST-46, TBST-8, TBST-50 and TBST-51 possessed bigger leaf size. Differences among entries were significant for all the four yield traits. Two lines, TBST-48 and TBST-51 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase in the lines TBST 48 and TBST-51 was 18 and 20% for green leaf yield, 23 and 25% for cured leaf yield, 34 and 36% for bright leaf yield and 30 and 27% for grade index, respectively over Siri. The lines viz., TBST 42 and TBST 49 also showed marginal

improvement over Siri. The nicotine content varied from 2.11 to 3.00%, chlorides 0.74 to 1.27% and reducing sugars 8.74 to 13.19% among the lines.

c) Trial TBL-7 (1st year): A new replicated yield trial was conducted with twelve morphologically stable, aphid resistant/ tolerant, advanced cross derivatives (TBST 52 to TBST 63) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. All the breeding lines were light cast in nature. Most of the test lines showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase in these lines was 18 to 43% for green leaf yield, 16 to 56% for cured leaf yield, 16 to 59% for bright leaf yield and 22 to 59% for grade index, respectively over Siri. The nicotine content varied from 2.64 to 3.98%, chlorides 0.79 to 1.31% and reducing sugars 7.1 to 12.1% among the lines.

d) Trial TBL-8 (1st year): A new replicated yield trial was conducted with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 64 to TBST 75) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. Most of the test lines showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase in these lines was 23 to 58% for green leaf yield, 16 to 45% for cured leaf yield, 16 to 46% for bright leaf yield and 18 to 51% for grade index, respectively over Siri. The nicotine content varied from 2.53 to 3.74%, chlorides 0.74 to 1.35% and reducing sugars 7.42 to 16.19% among the lines.

e) Trial TBL-9 (1st year): A new replicated yield trial was conducted with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 76 to TBST 87) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluating their yield potential and leaf quality. Only one line, TBST 85 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 16% for green leaf yield, 17% for cured leaf yield, 13% for bright leaf yield and 10% for grade index, respectively over Siri. The nicotine content varied from 1.55 to 2.81%, chlorides 0.72 to 1.41% and reducing sugars 8.29 to 14.19% among the lines.

f) Trial TBL-6 (2nd year): An yield evaluation trial was conducted for the second year in succession with 12 'Lanka' type selections. The lines were developed from the initial cross, *N. tabacum x N. gossei*. The derivatives were evaluated in a RBD with 3 replications along with check variety, Lanka Special for their yield potential and leaf quality. Differences among them for cured leaf yield entries were significant in five entries viz., LK2, LK5, LK1, LK8 & LK4. The increase in cured leaf yield over Lanka Special ranged from 14 to 31% among the lines.

g) Bulk evaluation: Advanced breeding lines TBST-2 which proved its superiority over check varieties at Rajahmundry, Guntur and Kandukur was evaluated against Siri for yield and quality in a bulk trial. The cured leaf yield of TBST 2 (CLY 2721 kg/ha) was higher than Siri (1810 kg/ ha). The physical and chemical quality traits of

TBST-2 a high yielding and TMV resistant breeding line

cured leaf in both the entries were (TBST-2: Nic - 1.61%; RS - 11.3%; Siri: Nic - 1.8%; RS - 18.3%) within desirable limits.

Location specific evaluation of cross derivatives: Promising derivatives having resistance to tobacco aphid, caterpillar and those tolerant to leaf curl, identified under the project, were contributed to CTRI RS, Kandukur and CTRI RS, Jeelugumilli and CTRI RS, Hunsur for further evaluation.

Maintenance of other important genotypes: The following genetic stocks/lines were developed under the project and maintained for future use: (i) Corolla-split variants (digenic), (ii) 'Asynaptic line', (iii) 'Translocation heterozygotes', (iv) Variegated mutants, (v) Cream coloured testa (The variant was digenic recessive to brown coloured seed coat), (vi) Probable genetic male sterile (vii) CMS sources.

I (D). Development of Hybrid Tobacco

Developing hybrid tobacco suitable for Traditional black soils of Andhra Pradesh *[CTRI, Rajahmundry]*

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

Replicated yield trial (2nd year): The trial was conducted for the second year in succession with 8 hybrids and two checks viz., VT 1158 and Siri in a RBD with 3 replications. Three hybrids viz., TBSH-66 and TBSH-65, TBSH-61 showed 20%, 16% and 10% improvement in cured leaf yield respectively over the high yielding check Siri. The nicotine content varied from 2.27 to 3.49%, chlorides 0.83 to 1.44% and reducing sugars 8.55 to 15.41% among the lines.

Maintenance of CMS lines: A total of 35 CMS lines with varying cytoplasm sources were maintained.

All the lines were crossed with respective maintainer lines for further maintenance. Also, F_1 hybrids of a new source (MS-87 CHN) collected from China were grown for developing new CMS lines in Siri and Kanchan genetic backgrounds. About 32 crosses, including a 3 x 5 set in L x T mating design, were also made for conducting various RYTs with CMS hybrids and multi-location testing under AINRP (T). Also, four crosses viz., MS-58 x HDBRG, MS-58 x VT-1158, MS-58 x A-145 and MS58 x TI-163 (all in BC3) were made to develop CMS parental lines with high biomass potential.

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

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

Maintenance of CMS lines: Under this project several euplasmic and alloplasmic CMS lines with acceptable yield levels have been developed. During the 2010-11 season, 14 CMS lines in genetic background of ruling variety, Kanchan and other improved lines were maintained and back crossed to recurrent parent.

Bulk evaluation of CMS hybrids: The CMS hybrid

CMS parental lines maintained during 2010-11 season

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

NLSH-1 that had shown significant increase in yield over Kanchan in station replicated yield trials and AVT-2 was evaluated for leaf yield and quality in bulk plot along with check, Kanchan during 2010-11 season. The cured leaf yield in the entries viz., JS 117, NLSH-1, RT-13, FCH-197 and Kanchan was 1948, 2483, 2041, 2363, 1950 kg/ha, respectively.

Replicated yield trial (MSH): Thirteen CMS hybrids, produced from crosses involving identified promising CMS lines and high yielding breeding lines were evaluated along with the check, Kanchan in a RBD with 3 replications. Most of the 13 test hybrids showed significant standard heterosis for all the three yield traits over check, Kanchan. The heterosis ranged from 17 to 37% in green leaf yield, 18 to 45% and 22 to 51% for different traits. Physical quality traits such as colour, body and weight of cured leaf were comparable to Kanchan in most of the CMS hybrids, while the physical leaf quality of MSH-1 and MSH-3 was superior to the check. Nicotine and chlorides were within admissible limits while reducing sugars were lower.

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

A.R. Panda

Hybrid evaluation: Seven F1 hybrids and 4 checks were tried in RBD for the second year. It was observed that the test entries, Siri x F-212 (CLY 1344 kg/ha), Siri x Bell-93 (CLY 1456 kg/ha), and Siri x NC-3150 (CLY 1381 kg/ha), were significantly superior to the best check variety Siri (CLY 1075 kg/ha), in respect of green leaf, cured leaf, bright leaf yields and grade index at 5% level of significance. The chemistry of the leaf for nicotine, R. sugars and chlorides is also in admissible limit.

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

A.V.S.R. Swamy

On-farm trial: The promising hybrid VDH-3 was grown in bulk plots in CTRI Research Station, Vedasandur as well as in three on farm trials in Tamil Nadu along with the best check variety Abirami for assessment of yield and quality. The hybrid VDH-3 uniformly performed well in all the three locations as well as at CTRI RS, Vedasandur recording maximum mean cured leaf yield with an increase of 8.4% over the best check variety Abirami. With respect to morphological characters also, it was observed that VDH-3 recorded the maximum leaf area of 4090.6 cm contributing to higher cured leaf yield. It is proposed to submit variety release proposals of VDH-3 in the Tamil Nadu Tobacco Variety Release Meetings shortly for its release to the chewing tobacco farmers.

Progeny row trial: During 2010-11, twenty two F4 population of promising hybrids were grown in progeny rows along with Bhagyalakshmi and Abirami as controls. Based on the performance of yield and morphological characters, few families were retained from the respective hybrids for replicated assessment along with the controls Bhagyalakshmi and Abirami.

Development and evaluation of F_1 hybrids suitable to Karnataka Light Soil region *[CTRI RS, Hunsur]*

C. Panduranga Rao, M. Mahadevaswamy, S. Ramakrishnan

Hybrid evaluation: The promising lines FCH 201 and FCH 221 based five male fertile hybrids were assessed for three years viz., 2008-09, 2009-10, 2010-11. The yield differences among the fertile hybrids were statistically not significant. Though statistically non-significant, KLSH 18 showed 3.2% increase in green leaf yield and KLSH 19 showed 3.1% increase in cured leaf yield over Kanchan. Male fertile hybrid KLSH 10 recorded 7.4% increase in cured leaf over its counterpart which is significantly superior. Under pooled analysis KLSH 20 showed 5.6% increase over Kanchan in cured leaf yield and is significantly superior. KLSH 10 recorded 6.7% increase in bright grade over Kanchan. The root-knot index in the entries ranged from 1.0 to 4.0 in 1-5 scale.

Progeny row trial: Nineteen progenies under F_4 generation derived from the cross combination of Rathna and Kanchan with Coker 371 Gold and NC 98 were grown under progeny

row trial and 45 selections were made to advance the generation for the studies. Among the progenies derived from cross combination of Kanchan, Bhavya, Rathna, NC 12, PC 18, Yellow Spl., Hema, COR 3 eight have been fairly stable for phenotypic characters with desired curability have been furthered to F_7 generation. These lines have been selected for further assessment to identify the advanced breeding lines for replicated yield trial.

I (E). Biotechnology for Tobacco Improvement

Micropropagation of elite lines and other selections *[CTRI, Rajahmundry]*

K. Sarala and K. Prabhakara Rao

Micropropagation: A total of 567 plantlets of various tobacco lines were maintained under *in vitro* during 2010-11. Around 40 plantlets were transferred to pots for maintenance and further studies.

Lines micropropagated under *in vitro*

S.No.	Entry	No. of plantlets maintained under *in vitro*
Tobacco haploids		
1	HDBRG x TI 163	5
2	Banket A1 x BY 64	40
3	GT 7 x Nisnicotinony-121	15
4	HDBRG x BY 53	110
5	A145 x T1 163	65
6	GT 7 x A 145	25
7	Nisnicotinony 121 x Kumkumathri	18
8	HDBRG x GT7	20
9	HDBRG x BY 53	5
10	VA 510 x Banket A1	20
11	A 145 x GT 7	10
12	Candel x Nisnicotinony-121	5
13	AH8	4
***Nicotiana* species**		
14	TW 72	5
15	R-457	39
16	R-571	27
17	R-573	54
18	R-572	10
19	R-574	4
20	TW 142	5
21	TW 95	4
22	259	27
23	264	15
24	265	20
25	NSM 54	15
	Total	**567**

Development of virus tolerant tobacco lines under *in vitro* *[CTRI, Rajahmundry]*

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

Evaluation of promising Kanchan somaclones:

(a) Yield characterization: Nine somaclones of Kanchan were tested for second year in a replicated trial along with Kanchan (control) at CTRI RS, Jeelugumilli. Significant yield differences recorded among somaclones and control for green and cured leaf, and grade index values. In view of the adverse weather during the season, all the entries recorded low leaf yields. Eight somaclones recorded higher green and cured leaf, and grade index values than Kanchan. Clones, NLCM (k), NLCR-1-11-10, NLCR-4-7-15, NLM-2-6, NLCM-1-5(b)-7 and NLCR-6-10, respectively, recorded significantly higher yields of all types than Kanchan. The green leaf yield in these lines ranged from 9042 to 8250 kg/ha, cured leaf yield from 1389 to 1272 kg/ha and grade index from 707 to 765 kg/ha; an increase of 20-31%, 21-33% and 31-42%, respectively, over control, Kanchan. NLCM-8-2-2 recorded significantly higher green leaf (8222 kg/ha) and grade index (710) over control. Clone NLCR-4-11-2-1 recorded significantly higher grade index values (658).

(b) Morphological characterization: Morphological characteristics of Kanchan somaclones and control were recorded in above replicated trial. Six somaclones recorded higher plant height (95-103 cm), four clones higher number of leaves after topping (27-30) and two clones higher leaf width (23-24 cm) than

Kanchan. Internodal length in somaclones varied from 3.0-5.0 cm. Nicotine at 'X' position ranged from 0.85-3.05% and at 'L' position 1.52-3.59%. Reducing sugars were found to be slightly less and ranged from 1.16 to 4.07% at 'X' position and 4.66 to 8.49% at 'L' position. Chlorides were found to be in acceptable range (0.88-1.25%).

(c) Bulk trials: Seven somaclones and two advance breeding lines were tested in a bulk trial at CTRI RS, Jeelugumilli. All the clones (NLCR, NLCR-4, NLCR-5, NLCR-7, NLCR 7(k), NLCR 10 and NM, and JS 117) recorded higher green and cured leaf, and grade index values than Kanchan. The cured leaf yield in these lines ranged from 853 to 1003 kg/ha and grade index from 407 to 490 per ha as against 806 kg/ha and 388 kg/ha, respectively in Kanchan. This indicates an increase of 6-25% in cured leaf yield and 5-26% in grade index than Kanchan. Nicotine at 'X' position ranged from 0.97-2.22% and at 'L' position 0.98-1.96%. Reducing sugars were found to ranged from 1.71 to 6.37% at 'X' position and 1.07 to 11.75% at 'L' position. Chlorides were found to be in acceptable range (0.93-1.35%).

JS-117, a promising low tar line

Screening of somaclones for yield and resistance in row trial: Among the 108 somaclones tested in a row trial at Katheru Farm, 38 clones found to be promising for leaf yield. At CTRI RS, Jeelugumilli, out of 12 clones tested, seven clones were found promising for leaf yield. Ninteen promising Kanchan somaclones were tested for black shank reaction under artificial conditions at Katheru Farm. All the somaclones recorded higher number of resistant plants (94.1-100%) than Kanchan (56.3%). None of the plants died due to black shank in all the entries. Out of 105 somaclones tested for TMV under artificial condition, 35 were found to be resistant for TMV, one was found to be susceptible and 14 were symptomless. Rest of the lines showed segregation. Out of 46 somaclones tested for CMV, nine lines were found to be resistant and others segregated. Recovery of CMV affected plants were observed in somaclones. Fifty four somaclones were tested for leaf curl resistance under artificial conditions at Rajahmundry. Two resistant plants selected in each clone and selfed seed collected. Forty four cultures were found to be free from leaf curl infection. In others, 1-4 plants showed mild leaf curl symptoms.

Maintenance, evaluation and characterization of tobacco transgenics *[CTRI, Rajahmundry]*

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

Transgenics and transplastomic lines of Hema and Jayasri: Two transgenics, each of Hema and Jayasri; and two transplastomic lines having Cry 9 Aa2 gene under Petit Havana background were maintained in transgenic screen house. The transgenics contains Cry1 A (b) and Cry 1 C genes, Cry 1 A (b) confirms resistance to *Heliothis armigera* and Cry 1 C to *Spodoptera* litura. DNA extracted from the transgenic lines was amplified using NPT-II specific primers. As expected, these primers amplified 612 bps fragment in transgenics. These results clearly indicated the transgenic nature of these lines. 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 7-31 hg/mg and Cry 1C from 12-26 hg/mg green tissue.

Molecular mapping of important tobacco traits *[CTRI, Rajahmundry]*

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

Characterization of parents used in developing mapping populations: (a) TSNA: Molecular polymorphism studied in 11 burley lines (Banket-

A1, SOTA 6506, Harrow Velvet, Burley resistant, By 64, By Sota 51, Ky-10, T-117, BSRB-II, Burley 21 and VA 510), two breeding lines and two crosses (Banket A1 X BY64 and VA 510X Banket A1) using 22 chomosome specific SSR primers. Out of 20 SSR primers amplified 15 produced polymorphic bands between the tobacco lines. Eighty eight different SSR bands were detected of which 42 were polymorphic (48%).

(b) Solanesol and nicotine: Solanesol content of two parents viz., HDBRG and BY-53 and 30 of their cross derivatives were estimated. Among the parents, HDBRG recorded higher solanesol content (1.65%) and BY-53 lowest (1.00%). The solanesol content among the cross derivatives ranged from 0.74% to 2.70%. Chemical quality characteristics of two parents viz., Candel and Nisnicotinony-121 and 30 of their cross derivatives were estimated. Among the parents, Candel recorded higher nicotine (2.92%), reducing sugars (5.39%) and chloride contents (1.46%). The nicotine content among the cross derivatives ranged from 0.70% to 4.04%. Nine lines (HDBRG, Gauthami, Siri, BY-53, Candel, NC-55, Nisnicotinony-121, Kumkumadri and GT-9) differing in their solanesol and nicotine and three crosses (HDBRG x BY-53, Nisnicotinony-121 x Kumkumathri and Candel x Nisnicotinony-121) were tested for their molecular diversities using 18 chomosome specific SSRs. Fourteen SSR primers produced polymorphic bands between the tobacco lines. Eighty nine different SSR bands were detected of which 44 were polymorphic (49%).

(c) Phytochemicals: Five tobacco lines (GT-8, T1-163, HDBRG, GT-7 and A-145) and three crosses (A 145 x GT 7, GT 7 x A 145, TI-163 x A 145, HDBRG x GT 7 and HDBRG x BY-53) were assessed for their molecular diversity using seventeen chromosome specific SSR primers. Seventeen SSR primers produced polymorphic bands between the tobacco lines. Ninety three different SSR bands were detected of which 63 were polymorphic (68%).

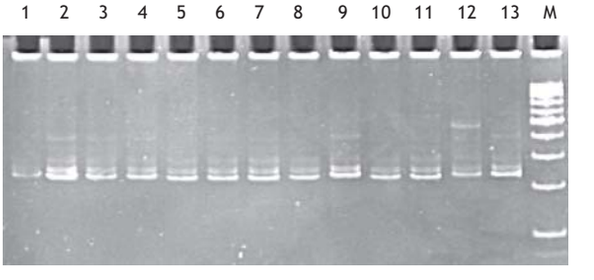
Development of mapping populations: For the development of mapping populations i.e. Recombinant Inbred Lines (RILs), 9 F_1s and 10 mapping populations viz., BY 64 x Banket A1 (F_5/ F_4), VA 510 x Banket A1 (F_5), HDBRG x BY 53 (F_4), HDBRG x GT-7 (F_5), TI 163 x A-145 (F_5/ F_4), Candel x Nisnicotinony 121 (F_5), Kumkumathri x Nisnicotinony 121 (F_5), Nisnicotinony 121 x Kumkumathri (F_5), A 145 x GT 7 (F_6/ F_5) and GT 7 x A 145 (F_5). A total of around 2000 plants were raised and selfed seed collected. Haploid plants developed from 10 crosses and the efforts are on to develop dihaploid lines through mid-vein culture and colchicine treatment. Three dihaploid lines were developed from two crosses viz. HDBRG x BY-53 and Nisnicotinony-121 x Kumkumathri.

DNA finger printing of ruling tobacco cultivars

[CTRI, Rajahmundry]

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

Micro satellite characterization: Simple sequence repeat (SSR) markers and inter simple sequence repeat (ISSR) markers were used for development of DNA fingerprints among the popular Flue-Cured Virginia (FCV) tobacco cultivars and one Burley tobacco variety. The cultivars used in the present study were Gouthami, VT-1158, Hema, N-98, Banket A1, NLS4, CM-12, 16/103, Cy79, Bhavya, Rathna, Hemadri and Siri. Thirty SSR markers, distributed at least one marker on each of 24 chromosomes were used for development of DNA fingerprints of the varieties. All the primers gave reproducible amplification and 11 primers (SSR5, SSR9, SSR11, SSR13, SSR25, SSR28, SSR31, SSR53, SSR64, SSR67 and SSR73) gave specific bands. Seventeen ISSR markers were used for DNA fingerprinting. Seven ISSR primers gave reproducible finger prints and 3 ISSR primers gave specific bands to the three varieties.



Amplification by SSR 5. Lanes:1. Gouthami 2. VT-1158. 3. Hema, 4. N-98, 5. BanketA1, 6. NLS4, 7. CM-12, 8. 16/103, 9. Cy79, 10.

Bhavya, 11. Rathna, 12. Hemadri, 13. Siri and M= DNA ladder

Computational Algorithm for micro-RNA prediction in plants *[CTRI, Rajahmundry]*

H. Ravi Sankar, K. Prabhakara Rao, K. Sarala and K. Siva Raju

Various online miRNA databases viz., miRBASE, miRDEEP, SAM tools, MFOLD were used for understanding and generating miRNA sequences. Collected literature on various methods for identifying the miRNA sequences. General survey of available tobacco databases including EST, cDNA and GSS (Genome Survey Sequences) were carried out for their suitability to annotation. The GSS sequences of tobacco were downloaded and preliminary analyses were conducted with 100 representative sequences using shell scripting code developed. Further development of software for prediction of miRNA for tobacco using shell scripting is in progress.

I (F). Developing Tobacco Cultivars Resistant to Biotic and Abiotic Stresses

Incorporation of disease resistance for tobacco mosaic virus (TMV) *[CTRI, Rajahmundry]*

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

Replicated yield trial: A replicated yield trial was conducted for the second year with fifteen TMV resistant advanced breeding lines viz., V-4856, V-4857, V-4890, V-4908, V-4909, V-4910, V-4912, V-4914, V-4915, V-4917, V-4920, V-4934, V-4936, V-4937 and V-4939 along with the VT-1158, Siri and N-98 as controls. Among the selections, 1 to 11 were the selections from Siri x VT-1158 cross and 12 to 15 were from N-98 x VT-1158. The treatments differed significantly for all the four yield characters studied. The results indicated that the resistant selections V-4908, among the Siri selections and V-4934, among N-98 selections were superior performers during the second year of testing i.e., 2010-11. The trial will be continued for the last year during 2011-12.

I (G). Tailoring of Tobacco Plant Type for Optimizing the Seed Yield and Phytochemicals

Breeding for high seed and oil yield in tobacco *[CTRI RS, Vedasandur]*

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

Replicated yield trial: A new set of 28 crosses made in a diallel fashion utilizing eight high seed yielding parents viz., A.145, A.119, GT-7, GT-8, ABD-28, T.I.163, HDBRG and NP-19 during 2009-10 were grown along with parents in a replicated yield trial for assessment of seed and oil yield as well as to study the mode of gene action. The crosses exhibited significant differences against parents for plant height, leaf length,

Production and distribution of tobacco seedlings (2010)

S.No.	Variety	Number of tobacco seedlings supplied		Total
		Seed plots	CTRI Farm	
1	Hema	5,00,500	2,58,000	7,58,500
2	VT-1158	3,88,400	2,84,000	6,72,400
3	Siri	28,76,500	1,33,500	30,10,000
4	Gauthami	-	35,000	35,000
5	Kanthi	-	35,000	35,000
6	Lanka spl.	-	1,45,000	1,45,000
7	N-98	-	3,81,000	3,81,000
8	Kanchan	-	3,90,000	3,90,000
	Total	37,65, 400	16,61,500	54,26,900

seed yield in suckers and total seed yield (panicle + sucker). While hybrids FI-18, FI-20, FI-19, FI-27, F1-2, FI-15, FI-16, FI-14, F1-3, F1-4, F1-6, FI-22, F1-17, F1-24 were significantly superior to the parent A 145, hybrids F1-18, F1-20, F1-19, F1-27, F1-2, F1-15, F1-16, F1-14, F1-3 were significantly superior to GT-8 in respect of plant height. With regard to leaf length, all the hybrids were significantly superior to A 145 except F1-1, F1-11, F1-12 and F1-14. Hybrids F1-15, F1-22, F1-3, F1-11, F1-20, F1-16 and F1-2 were significantly superior to GT-8. With respect to seed yield in panicle, the hybrids did not show any significant differences against their parents. However, hybrids F1-2, F1-8 and F1-5 were significantly recorded higher seed yields of 985, 926 and 767 kg /ha, respectively over the parents A 145, NP-19, ABD-28,T I 163 and GT-7 in the case of seed yield in suckers. In total seed yield (panicle + sucker), though none of the hybrids recorded significant superiority over NP-19, hybrid F1-8 recorded significant total seed yield of 1442 kg /ha against GT-7. This was followed by F1-2 registering significant total seed yield of 1398 kg /ha against the parents A 119 and ABD-28. The analysis of data for specific combining ability and general combining ability is in progress.

Tobacco Seed Production

During 2010, about 16179.5 kg foundation seed of seven different varieties was sold to farmers through CTRI, Rajahmundry and its Research Stations. An amount of ₹ 1, 29, 43,600/- was realized.

Variety-wise distribution of seedlings to farmers and distribution of seed multiplication plots during 2009-10 season are as follows:

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

II (A). Healthy Seedling Production

Effect of micro-sprinklers and fertigation on tobacco seedling production *[CTRI, Rajahmundry]*

C. Chandrasekhara Rao, V. Krishnamurthy and P. Harishu Kumar

Transplantable seedlings: Soluble fertilizer i.e. Potassium nitrate was used in place of potassium sulphate for the purpose of fertigation in nursery. Fertigation with 100 and 80% recommended dose of fertilizer (RDF) showed 20% increase in transplantable seedlings compared to conventional method of nursery raising. Micro-sprinkler irrigation showed 14% increase in transplantable seedlings. Higher concentration of N and K was observed with 100 and 80% fertigation levels.

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

C. Chandrasekhara Rao, V. Krishnamurthy and R. Sudhakar

Coconut coir pith compost as growth medium for tobacco seedlings production in trays: Different seeding methods with coir pith compost as a medium were tried in tobacco seedling production. (1) The fortified coir pith compost was filled in plastic trays. Seedlings of 20-25 days old raised on coir pith medium were transplanted in these trays. Calcium ammonium nitrate (CAN) and potassium nitrate solution were added to these trays regularly to supplement the nutrients. The seedlings produced were healthy, vigorous and had profuse root system. (2) In another experiment where tobacco seed was planted directly in trays filled with enriched coir pith compost. 3. Tobacco seed germination was done in Petri plates in an incubator. Six days old seedlings were transplanted in trays. Top dressing was done with CAN and potassium nitrate periodically. It was found that transplanting six-day old seedlings resulted in faster growth compared to direct seeding. In addition to that, sowing of seeds in trays is tedious when compared to transplanting of seedlings. In all the three methods tested, sowing of seeds on coir pith beds and transplanting seedlings of 20-25 days in trays filled with enriched compost was the best method for bulk production of healthy seedlings.

Development of float-culture technology for tobacco seedling production *[CTRI, Rajahmundry]*

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

Float-bed system for tobacco seedlings production: A new method of float-bed system was developed for tobacco seedling production. Float-bed size, tray size, number of cells per tray, cell volume, water depth, water quality, pH, nutrient concentration and NPK requirements were standardized. Direct sowing of the seed in trays was done using a simple locally made tool. Seedlings were produced successfully in the trays floating on water with major nutrients. Float beds were constructed in simple poly house structures and poly house was erected using locally available materials. Trays with 288 cells were filled with growth media and the seed sowing was done. Trays were floated on nutrient rich water beds in the poly-house. Overhead irrigation was avoided totally and seedling growth was faster and less number of days was required for production of transplantable seedlings in the float method.

Integrated weed management in FCV tobacco nursery

[CTRI, Rajahmundry]

S. Kasturi Krishna

Comparative evaluation of herbicides: Four pre-emergence herbicides viz. Pendimethalin, Oxyfluorfen, Alachlor and Metribuzin were evaluated for weed control in nursery beds. Sowing was done on 3rd, 7th and 15th day after pre-plant incorporation of herbicides to examine their effect on seed germination and weed control efficiency. Weed control was observed up to 20-25 days after sowing with above herbicides. Herbicides spraying resulted in very less germination with Pendimethalin and Oxyfluorfen whereas 80% germination was observed with Alachlor and 93% with Metribuzin when compared to control. Pendimethalin controlled the weed species except nut grass. *Trianthema* spp. was the major weed found in Alachlor applied plots. Weed dry matter produced was higher in Alachlor and Metribuzin applied plots when compared to other herbicides. Sowing of seed 15 days after herbicide application resulted in higher weed dry matter production

II(B) Optimisation of Water and Nutrient Use for Productivity Enhancement of Different Tobacco Types

Indices for N and K nutrient use efficiency in FCV tobacco grown in irrigated Alfisols *[CTRI RS, Jeelugumilli]*

S. V. Krishna Reddy, S. Kasturi Krishna, D. Damodar Reddy, C. Chandrasekhara Rao, K. Nageswara Rao and V. Krishnamurthy

Nutrient use efficiency of CH 1 and Kanchan: Tobacco hybrid CH1 and popular variety Kanchan were compared for their N and K use efficiency in irrigated Alfisols. Tobacco hybrid CH 1 recorded significantly higher cured leaf yield, grade index, grade index/ cured leaf (%) as compared to cv. Kanchan and the latter recorded higher green leaf/ cured leaf than the former. Agronomic use efficiency of N and K, nutrient use efficiency of N and K, physiological efficiency of N and K, nutrient harvest index of N, internal efficiency of N and K and partial factor productivity of N were slightly higher for CH 1 than cv. Kanchan, whereas nutrient harvest index of K and partial factor productivity of K were slightly higher with cv. Kanchan than CH 1

Table 1: N and K nutrient use efficiencies at different fertilizer levels

Treatment	Agronomic use efficiency (kg yield increase /kg nutrient applied)		Fertilizer-use-efficiency (%)		Physiological efficiency (kg yield increase/kg nutrient taken up from fertilizer)	
Variety	Kanchan	CH 1	Kanchan	CH 1	Kanchan	CH 1
N level						
N_0 P_{60} K_{120}						
N_{40} P_{60} K_{120}	19.10	20.01	55.16	55.94	34.63	35.88
N_{80} P_{60} K_{120}	14.78	15.80	50.14	51.70	29.47	30.56
N_{120} P_{60} K_{120}	11.96	12.68	45.94	47.06	26.03	26.95
N_{160} P_{60} K_{120}	9.91	10.39	41.84	42.51	23.68	24.45
K level						
N_{120} P_{60} K_0						
N_{120} P_{60} K_{40}	7.88	8.33	80.33	97.31	9.80	8.56
N_{120} P_{60} K_{80}	5.29	5.64	62.28	70.65	8.49	7.98
N_{120} P_{60} K_{120}	3.91	4.26	46.59	53.44	8.39	7.97
N_{120} P_{60} K_{160}	1.11	1.34	10.8	11.8	10.3	11.4

(Table 1). All these indices except translocation index/ nutrient harvest index for N and K were higher at lower levels of N and K and decreased with increase in the level of N and K. Nutrient harvest index for N and K gradually increased with increase in the N and K level.

Effect of drip-fertigation on water and fertilizer-use-efficiency in FCV tobacco cultivation in NLS *[CTRI RS, Jeelugumilli]*

C. Chandrasekhara Rao, V. Krishnamurthy, K. Nageswara Rao and P. Harishu Kumar

Crop productivity: During 2010-11, field experiments were conducted to evaluate soluble fertilizer potassium nitrate for use in drip fertigation. Results revealed that, fertigation with 100%, 80%, 60% recommended dose of fertilizer dose (RDF) showed significantly higher green leaf yield, cured leaf yield and grade index over furrow irrigation. Fertigation at 100 and 80% RDF showed significantly higher N and K uptake over drip irrigation and furrow irrigation.

Combined analysis of yield and chemical quality data (2008-10) showed that, fertigation with 100 and 80% RDF showed significantly higher yield over other treatments (Table-2). Decrease in fertigation levels showed reduction in nicotine and increasing in reducing sugars.

Table 2: Effect of different levels of fertigation on FCV tobacco yield parameters (kg/ha) in irrigated Alfisols (Pooled 2008-2010)

Treatments	Green leaf yield	Cured leaf yield	Grade index
Fertigation with 100% RDF	18390	2661	1851
Fertigation with 80% RDF	17537	2545	1721
Fertigation with 60% RDF	15237	2226	1548
Fertigation with 40% RDF	10048	1606	1161
Drip irrigation with RDF	14482	2380	1667
Furrow irrigation with RDF	12482	2011	1451
CD at 5%	1371	135	113

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

M. Mahadevaswamy

Feasibility of producing organic tobacco using various organics (vermicompost @ 6 t/ha, use of biofertilizers @ 10 kg/ha, green manuring in *rabi* season with sun hemp, use of neem based organics and bio-pesticides etc.,) was conducted for 4 consecutive seasons from 2006-07 to 2009-10. The study revealed that the yield gap with continuous application of organic manures reduced from 35% during the initial years to 10% over four years (Table 3) indicating the long time lag required for the organic tobacco production. There was marked reduction in the harmful constituents like tar, carbon monoxide, tobacco specific nitrosamines (TSNA) etc. in the organic tobacco compared to the conventionally produced tobacco from the first crop season itself. In addition to reduction of harmful substances, the bright grade production of cured leaf was higher by 6-10% under fully organic treatment. The study also showed that the incidence of *fusarium* wilt disease as well as the root-knot incidence was considerably reduced in organic treatment.

Effect of graded levels of K on the incidence of root-knot & potassium uptake pattern of FCV tobacco in KLS *[CTRI RS, Hunsur]*

M. Mahadevaswamy, S. Ramakrishnan and V. Krishnamurthy

Tobacco response to K in the root-knot sick and free soils: Two replicated field trials with graded levels of K were taken up separately in

Table 3: Yield parameters (kg/ha) as influenced by organic treatments over the years

Treatments	Cured leaf yield				Top grade Equivalent			
	2006-07	2007-08	2008-09	2009-10	2006-07	2007-08	2008-09	2009-10
Fully organic	979	680	1263	1424	811	563	1004	1164
75:25 ratio	1363	906	1486	1471	1172	752	1156	1175
50:50 ratio	1438	1011	1536	1527	1240	830	1187	1187
inorganic	1526	1080	1658	1585	1160	828	1228	1217
Reduction (%)	36	36.5	24	10.5	30	31.8	18	4.4

root-knot sick (R. Thunga village) and root-knot free (H.M.Patna) soils in Periyapatna zone of KLS. The root-knot incidence was significantly higher at 3.85 RKI in control (without K application) compared to 2.52 RKI at 180 Kg/ha in sick soils. But in the root-knot free soils of H.M.Patna, the reduction in RKI due to increased levels of K was not significant (RKI 1.20 in control as compared to RKI of 0.80 at higher levels of K). Application of K beyond 120 kg/ha did not show significant improvement in the yield levels of cured leaf in the root-knot free soils, while the response to K levels was significant up to 180 kg/ha in root-knot sick soils.

Effect of fertilizer N sources on the incidence of pest and disease and the resultant productivity of FCV tobacco under sandy loam soils of KLS *[CTRI RS, Hunsur]*

M. Mahadevaswamy

Nitrogen source effect on pest and diseases in tobacco: Ammonium sulphate and calcium nitrate as source of N slightly increased the fusarium wilt incidence compared to other sources of N. The mean RKI ranged from 1.60 to 2.80 and was not influenced by the different sources of N. However application of ammonium sulphate or 20:20:0+ CAN slightly increased the incidence of root-knot. The shoot borer incidence or the bud worm infestation were below the thresh hold levels during the season and were not much influenced by the different N sources.

Permanent manurial trial on *Motihari* tobacco *[CTRI RS, Dinhata]*

S. Amarnath and S. Roy

Crop yield and quality: Permanent manurial trial data indicated that application of NPK @ 112 kg each recorded significantly higher green (14,594 kg/ha), cured (2,172 kg/ha) and first grade (1,276 kg/ha) leaf yields of *Motihari* tobacco as compared to control with only FYM @ 10 q/ha. Application of 112 kg N + 112 kg K_2O/ha and 112 kg N + 112 kg P_2O_5/ha was comparable with each other and significantly superior to rest of the treatments for cured leaf yield. The percent recovery of first grade leaf was higher with NPK (58.8%) followed with NK (52.1%) over control. There was no significant difference for nicotine content. Reducing sugar was significantly higher with 50t FYM. Chloride content in the leaf was significantly higher in NK applied plot being at par with PK and NPK applied plots.

Optimization of source and dose of potassium for *Jati* tobacco (*N. tabacum*) varieties grown in alluvial soils of West Bengal *[CTRI RS, Dinhata]*

S. Amarnath, C. Chandrasekhara Rao and S. Roy

The results in second year revealed significant differences with respect to cured leaf yield in variety Chama over Podali whereas difference for first grade leaf yield was non-significant. Variety Chama recorded significantly higher cured leaf yield with application of sulphate of potash (Table 4). Interaction between K source and dose revealed significantly higher yield of cured leaf with muriate of potash at 75 kg/ha. Source of fertilizer had non- significant influence on cured and first grade leaf yields. Dose of fertilizer had non-significant influence on cured leaf yields but first grade leaf yield increased significantly with increase in potassium level from 50 kg/ha to 75 and 100 kg/ha. Economics of different treatments revealed that application of 75 kg K_2O/ha as MOP and 100 kg K_2O/ha as SOP recorded higher gross return (₹ 32,100/ha & ₹ 36,490/ha) in variety Chama followed by (₹ 30,640/ha & ₹ 24,450/ha) in variety Podali, respectively.

Table 4: Interaction effect of varieties and fertilizers on *Jati* tobacco leaf yield (kg/ha)

Treatment	Cured leaf yield		First grade leaf yield	
Varieties	MOP	SOP	MOP	SOP
CHAMA	1236	1429	422	480
PODALI	1056	930	431	488
CD at 5%	174.4		N.S.	

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

Designing algorithms for data classification *[CTRI, Rajahmundry]*

H. Ravi Sankar

New software for weather data management: Developed a new module using decision tree technology in data mining for weather parameters of substations of CTRI and linked to Meteorological Database Information System (MDIS) of CTRI, Rajahmundry. Ten parameters viz., Maximum and minimum temperature, soil temperature, vapour pressure, relative humidity, sunshine hours, total rainfall, no. of rainy days, wind velocity and evaporation were taken into the consideration for development of this software. Software module for storing, retrieving and updating of the data on various weather parameters was developed. Software development for generating reports of various kinds such as Daily / Monthly / Fortnight / Weekly weather reports was completed. Testing of the software and providing graphical interface for the report generation were also undertaken. Using graphical interface, the user is allowed to retrieve the required data on combination of weather parameters in the form of hard / soft copy where in required information will be displayed in text along with graphs.

Effect of trap crops on the emergence of Orobanche in FCV tobacco under Vertisols *[CTRI, Rajahmundry]*

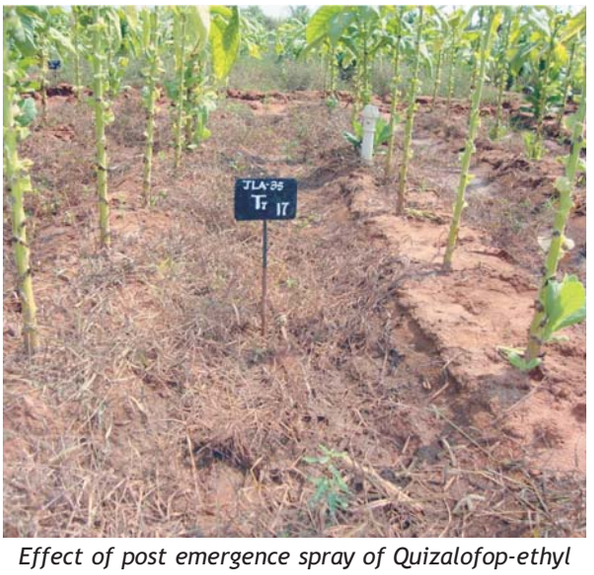
S. Kasturi Krishna, S.V. Krishna Reddy and C.A. Raju

Orobanche biomass and tobacco yield: Trap crops viz., green gram, sesame and sorghum were evaluated for their effects on the emergence of Orobanche in tobacco. Fresh weight of *Orobanche* was higher when tobacco is grown after two year rotation of trap crops than one year rotation by 12.5, 10 and 3%, respectively for green gram, sesame and sorghum. In general, the fresh weight of Orobanche recorded in tobacco after trap crop rotation and in sole tobacco was less than previous season crop. This might be due to late planting and /or also due to removal of Orobanche before seed formation during previous season. Cured leaf, bright leaf and grade index were higher in Sesame-tobacco and lower in sole tobacco

Integrated weed management in FCV tobacco grown under irrigated Alfisols *[CTRI RS, Jeelugumilli]*

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

Evaluation of Quizalofop-ethyl and Pendimethalin: Quizalofop-ethyl as post-emergence application controlled the weeds 6-10 days after its application. Pendimethalin incorporation 3 days before planting provided effective control against all weeds, except nut grass, throughout the crop period. Integrated weed management practices including Pendimethalin and Quizalofop-ethyl recorded the green and cured yields which were on par with that of weed free check. Spraying of Quizalofop-ethyl at 15+75 days after planting effectively controlled the weeds and also gave higher yields when compared to weed free check. Statistically lower yields were observed in the un-weeded check. In general, weed control efficiency was higher where ever integrated weed control was followed. Weed



Effect of post emergence spray of Quizalofop-ethyl on monocot weeds

control efficiency on the basis of weed dry matter production was higher in the treatments including spraying of Quizalofop-ethyl at 60, 75 days, 60+90 days and in 75+125 days after planting. Leaf quality parameters were within the acceptable limits.

Development and testing of Bio dynamic manures suitable for white burley tobacco production *[BTRC, Kalavacharla]*

P. Harishu Kumar, C. Chandrasekhara Rao, K. Sivaraju, M. Anuradha and D.V. Subhashini

Efficacy of organic manures: Different organic manures equivalent to 30 kg N was prepared and compared with inorganic N application. Application of bio- dynamic organic manures equivalent to 30 kg N/ha along with 90 kg N in the inorganic form produced tobacco leaf yields comparable to that of 160 kg inorganic N.

Effect of date of planting on the leaf yields and quality of Advanced Breeding Lines (ABL) YB-4 and YB-10 *[BTRC, Kalavacharla]*

P. Harishu Kumar, C. Chandrasekhara Rao and P.V.V. Venugopala Rao

Planting date effect on yield and quality: In order to assess the optimum date of planting for tapping the potential leaf yields with good quality burley tobacco, ABL YB-4 and YB-10 were planted with 10 days interval starting from August 20th to Sep 20th. Planting of ABL YB-4 and YB-10 after 20th Aug reduced the leaf yields due to reduction of leaf weight. Reducing sugar values were higher in all the dates of planting. Nicotine and chlorides were within the acceptable range

Effect of spacing and nitrogen levels on the leaf yields and quality of ABL YB-4 and YB-10 *[BTRC, Kalavacharla]*

P. Harishu Kumar, C. Chandrasekhara Rao and P.V.V. Venugopala Rao

Intra-row spacing and N effects on yield and quality: In order to work-out the optimum spacing and nitrogen requirement of ABLs of burley tobacco YB-4 and YB-10, an experiment was laid out with three spacings 90 x 45 cm, 90 x 55 cm and 90 x 65 cm and four N levels viz., 100,120,140 and 160 kg/ha. The data indicated that all the biometrical characters such as plant height, number of leaves, Harvest Index and cured leaf yield did not show any significant variation due to the treatments. However, maximum cured leaf was recorded at 140 kg N followed by 160 kg N under 90 x 45 cm spacing. In general, nicotine and reducing sugars increased from bottom to top position leaf.

Agronomic evaluation of promising FCV tobacco varieties *[CTRI RS, Hunsur]*

M. Mahadevaswamy

Field experiments were conducted to evolve suitable agronomic packages for promising pre-release wilt resistance lines FCH 221& FCH 222. The pooled analysis of two crop seasons data confirmed that 100 x 55 cm spacing (18181 plants/ha) and topping at 20-22 leaves are ideal cultural practices for optimizing the productivity of the promising lines FCH 221 and FCH 222. Application of N at 60 kg/ha was found to be optimum compared to other levels (50 or 70 kg/ha). The quality parameters were in the optimum range and were not altered by the various agronomic practices adopted.

Performance of advance breeding lines of chewing tobacco under different levels of Nitrogen *[CTRI RS, Vedasandur]*

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

The advanced breeding line BSR1 was compared with check variety Kaviri under three levels of nitrogen in a FRBD with four replications. First grade leaf yield (FGLY) and total cured leaf yield (TCLY) significantly increased with the advance breeding line BSR1 over Kaviri. The increase in FGLY and TCLY was 14 and 9%, respectively over the Kaviri. Nitrogen significantly increased the leaf length/width, FGLY and TCLY. The response of N was up to 150 kg/ha. Gross return, net return and B:C ratio were higher with the advance breeding line BSR1 and with 150 N kg/ha.

II (D). Post Harvest Product Management

Investigations on coir pith utilization in tobacco curing *[CTRI, Rajahmundry]*

C. Chandrasekhara Rao, V. Krishnamurthy and R. Sudhakar

Coconut coir briquettes as alternative fuel for tobacco curing: Briquettes prepared with saw dust and coir pith were obtained from the Briquette factory located in Anaparthi mandal. These briquettes were tested as a fuel for curing FCV tobacco at CTRI farm Katheru. Results revealed that total quantity of briquettes consumed was 1,419 kg as against 1,200 kg coal per charge. In order to improve the efficiency of coir briquettes, fire bars are to be adjusted. Compaction of briquettes is to be increased while preparing so that fire holding capacity will be increased. Instead of small briquettes, briquette rods may reduce the quantity consumed.

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

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

K. Suman Kalyani and S.K. Naidu

Tobacco farmers in NLS region: The FCV tobacco farmers in NLS area cultivate the Virginia tobacco varieties viz., Kanchan, ITC special and Hybrids viz., GL-26, CH-1 and CH-3. The other crops in NLS include oil palm, coconut, cocoa, cashew, sugar cane and paddy. Almost all the tobacco farmers in this region use either green manure (sunnhemp) or vermicompost. The cost of cultivation ranged from ₹ 76,100 (upper NLS) to ₹ 86,100 (middle and lower NLS). The farmers have reported that the tobacco cultivation in 2010-11 resulted in economic loss due to heavy rains in November – December months.

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

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

Development and evaluation of Integrated Farming System model for rainfed eco-system of KLS *[CTRI RS, Hunsur]*

M. Mahadevaswamy

Economic benefits: During the crop season of 2011-12, the overall gross returns from the model Integrated Farming System developed on 1.0 acre area under rainfed conditions was ₹ 15,030, with a C:B ratio of 2.41. However, the maximum revenue of ₹ 9,850 was generated from the subsidiary systems (Animal components, Vermicompost and kitchen garden) of the model alone, indicating the role of subsidiary systems in stabilizing the farm income in this rained zone.

III(B). Agro-techniques for Higher Biomass and Seed Yield

Selection of tobacco hybrid progenies for leaf biomass and seed yield *[CTRI, Rajahmundry]*

P. Harishu Kumar, C. V. Narasimha Rao, K. Sivaraju, M. Anuradha and T. G. K. Murthy

Tobacco genotypes with high leaf and seed yield potential: Among the 14 crosses and two varieties tested, HDBRG (BM) recorded higher biomass followed by crosses A-145 x GT-7 (P4) and HDBRG x A-145. Higher solanesol was obtained from TI-163 x A-145 (P1) whereas A-145 x GT-7(P4) gave higher nicotine. Though oil percent was higher in GT-7 x TI-163 (P4), TI-163 x A-145 (P3) gave higher oil yield due to its greater seed yield.

III(C). Identification of Potential Phytochemicals

Biochemical characterization of tobacco seed oil *[CTRI, Rajahmundry]*

K. Siva Raju, C.V. Narasimha Rao, T.G.K. Murthy and V. Krishnamurthy

Tobacco seed oil extraction: Tobacco seed oil was extracted from 3000 kg seed from oil extraction mill at Kavali. The oil recovery was nearly 30%. The seed cake contained nearly 10% of oil extractable with solvent extraction (Hexane). Oil extraction from tobacco seed was tried at Ambajipeta where the seed was crushed maximum in a prototype extraction unit but the oil was not expelled out. Such highly crushed seed meal was extracted at laboratory with hexane, where the oil recovery was 44%.

Fatty acid composition of oil: The tobacco seed oil had the following fatty acid composition Lauric acid (C12) - 0.9%, Myristic acid (C14) - 0.65%, Palmitic acid (C16) - 6.05%, linoleic acid (C18:2) - 75.30%, Oleic acid when tested at CTRI (C18:1)- 13.60% and Stearic acid (C18:0) - 3.06%. Fatty acid composition of tobacco seed oil estimated at National Institute of Nutrition was: Myristic acid (C14) - 0.1%, Palmitic acid (C16) - 7.8%, linoleic acid (C18:2) - 75.1%, Oleic acid (C18:1) - 10.80% and Stearic acid (C18:0) - 4.1% and Linolenic acid (C18:3) - 1.4%.

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

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

IV(A). Evaluation of Soil Fertility, Water Quality and Plant Nutrition Constraints for Tobacco and their Management

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

L.K. Prasad, D. Damodar Reddy and V. Krishnamurthy

The status of natural resources (Land and Water) in the seventeen villages of *Kandukur* mandal (15^{0}07'01.17 to 15^{0}19'40.0 N latitude & 79^{0}50'26.35 to 79^{0}58'39.32 E longitude) was recorded for characterization during transact and sampling of the area in the pre-monsoon period.

Landforms and soil resources: Land forms in Kandukur mandal are uplands, low lands, river alluviums and uncultivated barren lands. The area is a conglomerate of red, black and red-black mixed soils. Red sandy loams to sandy clay loams are found in uplands. Depth of the soil is very shallow (<30 cm) to moderate. Very shallow soils are seen in *Ananthasagarm, Kanchragunta and Kovur* villages. In lowlands soil type is black clay loams to clay spread over villages of *Machavaram, Dondapadu, Mopadu and Anandapuram*. Some patches are seen with mixed soils. Some lands in *Vikkiralapeta, Pandulapadu, Palukuru and Machavarm* villages are on river beds of *Manneru* and *Paleru* where the soil is alluvium (Sandy loams to silty loams) in nature.

Water sources: Irrigation facilities available in the study area are dug wells, dug-cum-bore wells, shallow & deep tube wells, tanks and filter points near streams. Local streams like *Manneru and Paleru* help in maintaining shallow water table and better water quality in the areas. *Kandukur* mandal is having a total of 27 wet tanks including *kuntas* and 6 dry ponds. Ground water wells/bores depth ranged between 25-160 feet.

Geo-referencing and digitization of village boundaries: Land marks (Tanks, Ponds and permanent structures) were identified in all the 32 villages (Kandukur and Tangutur mandals) of the study area and geo referencing of village maps was done with the help of longitude and latitude points extracted from digital spatial data sources. Boundaries of 32 villages were digitized with the help of digitizing tool of natural resource data base software.

Soil and water sampling and methodology: Based on spatial distribution of identified land forms (Uplands, low lands, river alluviums and uncultivated barrens), cropping pattern and natural water sources in the study villages, the soil and water samples were collected from 17 villages of *Kandukur* mandal (SLS). Two hundred and six soil samples (2 depths) and forty seven water samples from dug wells, dug-cum-bore wells, and bore wells were collected. Surface water samples from rivers, streams and ponds

were collected for quality comparison with ground water.

Distribution of anions in irrigation water: Chloride concentration in the ground water samples varied from 0.9 meq/L (Oguru) to 87.1 meq/L (Kondamudusupalem). Carbonates concentration ranged from 0.0 to 4.4 meq./l, whereas bicarbonate content ranged from 1.8 (Ananthasagarm) to 23.8 (Mahadevapuram) meq/l. Bicarbonates were high in the ground water of red soil areas. High concentrations of all these anions are observed in irrigation tube wells and shallow bore wells only. The distribution of ion concentration in ground water is depicted in Fig.1. Relationship of anions showed that with increase in carbonate concentration chloride concentration decreased. There was inverse relationship between bicarbonate and carbonate levels. Bicarbonate levels were higher in samples with lower carbonate and chloride concentration. Anion domination in the system followed the order: Chlorides > Bicarbonates > Carbonates.

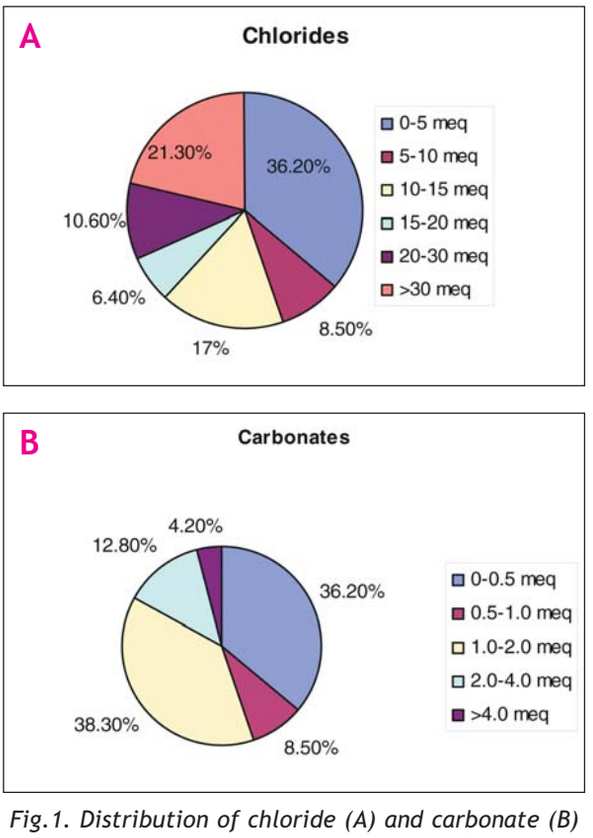


Fig.1. Distribution of chloride (A) and carbonate (B) concentration in ground water samples of Kandukur mandal.

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

[CTRI, Rajahmundry]

V. Krishnamurthy, C. Chandrasekhara Rao and A.V.S.R. Swamy

Soil sample collection from chewing tobacco growing areas of Tamil Nadu: In order to assess the soil fertility status of chewing tobacco growing areas of Nagapattanam, Cuddalore and Erode districts in Tamil Nadu, a total of 405 surface and subsurface soils samples collected from 32 villages. Among the three districts, 300, 32 and 73 soil samples were collected from Nagapattanam, Cuddalore and Erode, respectively. The study areas included 6 villages of Vedaranyam taluk in Nagapattanam, 3 villages of Chidambaram taluk in Cuddalore and 23 villages of Bhavani, Kangayam, Satyamangalam and Gopichettipalayam in Erode.

Water quality in chewing tobacco growing region of Tamil Nadu: Fifty eight irrigation water samples were collected from 26 chewing tobacco growing villages of Nagapattanam, Cuddalore and Erode Districts of Tamil Nadu. These water samples were analysed for pH, EC, Calcium, Magnesium, Sodium, Carbonates, Bicarbonates and Chlorides. Residual Sodium Carbonate (RSC) and Sodium Adsorption Ratio (SAR) values were computed. Irrigation water pH was more or less similar in all the three districts. In Nagapattanam district, 25% of waters tested were neutral and 75% were in alkaline range. In Erode district, 39% samples were in neutral and 61% were alkaline in reaction. All the water samples of Cuddalore were alkaline in reaction. Electrical conductivity (EC) and chlorides in all the water samples irrespective of the location was high. Sodium Adsorption Ratio (SAR) was low in all the samples of Nagapattanam, Cuddalore and Erode districts Residual sodium carbonate (RSC) was low in 89% samples and medium in 11% samples, while all the samples of Cuddalore and Erode district were low in Residual sodium carbonate (RSC). Since the waters are highly saline with high chlorides, there is a need to cutdown the quantum of irrigation water to possibly reduce the salinity and chloride levels in soil and tobacco leaf.

Chloride Nutrition of Flue-Cured Tobacco *[CTRI, Rajahmundry]*

M. Anuradha, K. Nageswara Rao, C. Chandrasekhara Rao and V. Krishnamurthy

Soil and water chloride effect on leaf quality: Pot culture experiments were conducted to study the influence of chloride in soil and irrigation water (IW) on flue-cured tobacco. The relationships of applied chloride and chloride in IW with lamina chloride and leaf burn were established. Higher concentration of Cl^- resulted in abnormal growth, undesirable quality with very brittle, thickened leaf with low leaf burn. Increase in chloride levels in soil and IW did not influence the yield significantly. Leaf chloride concentration increased with increase in chloride level in soil and IW and reverse was the trend with leaf burn. Increase in chloride levels accumulated more chloride in lamina than in midrib per unit dry weight. Leaf chloride content, leaf moisture and thickness increased and leaf burn decreased with increased level of applied chloride. Chloride content in irrigation water had significant positive correlation with lamina chloride, while showing a significant negative correlation with leaf burn. Regression equations were developed to predict leaf burn and lamina chloride concentration from the chloride concentration of irrigation water. From the regression equations it was predicted that to get optimum leaf burn (4 seconds), the lamina chloride and chloride in irrigation water should not exceed 1.17% and 52 ppm, respectively.

IV(B). Soil Quality and Nutrient Use Efficiency in Relation to Input Management

Long-term impact of fertilizer regimes on soil organic carbon pools and carbon sequestration under *Motihari* tobacco production system in North Bengal *[CTRI, Rajahmundry]*

D. Damodar Reddy, V. Krishnamurthy and S. Amarnath

Soil organic carbon (SOC) is the most critical determinant of soil quality for sustainable crop production. An understanding of SOC change in response to fertilizer and manure application is essential to make decisions on appropriate management interventions. Long-term fertilizer experiment on rustica tobacco at CTRI RS, Dinhata, was used to (i) to assess the changes in soil organic carbon (SOC) and its various labile fractions in response to long-term contrasting fertilizer regimes and (ii) evaluate fertilizer regimes for their C- sequestration potential and effects on soil quality sustainability.

Nine treatments of the permanent manurial experiment were chosen to represent a contrast in fertilizer regimes. They include: Control (no fertilizer) N, P, K, NP, NK, PK, NPK and FYM @ 25 t ha^{-1}. The annual rate of N, P and K application was 112 kg N ha^{-1}, 112 kg P_2O_5 ha^{-1} and 112 kg K_2O ha^{-1}, respectively. Representative soil samples from all selected long-term plots were analyzed for SOC pools (C_T, C_L, C_{NL}, C_{WS}, C_{MB}). Additionally, a soil sample from adjacent undisturbed area was collected and used as reference in computing carbon management index (CMI). Based on the crop yield trends over the past 36 years, long-term fertilizer regimes were evaluated for production sustainability in terms of sustainable yield index (SYI). Nature of relationships amongst SOC pools and between CMI and SYI was elucidated.

Total organic carbon (C_T): The total organic carbon (C_T) content of surface soil (0 – 0.15m depth) differed significantly among contrasting long-term fertilizer regimes (Table 1). The treatment receiving 25 t FYM ha^{-1} annually showed highest soil C_T content (10.35 g C kg^{-1}), while the control treatment resulted in the lowest C_T value of 7.88 g C kg^{-1}. The balanced NPK fertilizer regime with a C_T content of 9.88 g C kg^{-1} was comparable to FYM treatment and significantly superior to all other unbalanced fertilizer regimes (N, P, K, NP, NK and PK) for maintaining SOC. The C_T with NPK fertilization was 13.6, 12.7, 17.9, 8.7, 14.8 and 10.8% more than that with N, P, K, NP, NK and PK, respectively. In comparison to the undisturbed reference soil (12.12 g C kg^{-1}), the soils under continuous cropping with different fertilizer regimes showed a decline in SOC (15 to 35%).

Labile (C_L) and non-labile carbon (C_{NL}): Potassium permanganate oxidizable SOC is considered as labile organic carbon (C_L), while

non-labile carbon (C_{NL}) represents the difference between C_T and C_L. Both C_L and C_{NL} were significantly affected by fertilizer regimes. The NPK (465 mg C_L kg^{-1}) and FYM (450 mg C_L kg^{-1}) treatments significantly increased C_L over other fertilizer treatments, all of which in turn showed distinctly greater C_L over the control with lowest C_L value (240 mg C_L kg^{-1}) (Table 1). The fertilizer regimes receiving N either alone or in combination with other nutrients (N, NP, NK and NPK) resulted in greater mg C_L than the fertilizer treatments receiving no N (P, K and PK). The lowest and highest C_{NL} contents were found in the control and FYM treatments. For the chemical fertilizer treatments, the balanced NPK application showed a significantly higher C_{NL} content over N, P, K, NK and PK. The C_L and C_{NL} contents as proportion of Ct varied from 3.05 to 4.71% and 95.29 to 96.95%, respectively among different treatments.

Water soluble and microbial biomass carbon: Water soluble carbon (C_{WS}) and soil microbial biomass carbon (C_{MB}) were significantly impacted by the fertilizer regimes. The C_{WS} varied from 166 mg kg^{-1} (control) to 309 mg kg^{-1} (FYM). Among chemical fertilizer treatments, the NPK and NP treatments maintained higher C_{WS} compared to N, P, NK and PK. There was no significant difference in C_{WS} between K alone treatment and the control. All fertilizer treatments led to increased C_{MB} over the control. However, FYM and NPK treatments resulted in greater C_{MB} as compared to other fertilizer treatments. For the different treatments, C_{WS} and C_{MB} accounted for 2.11–3.01%, and 1.23–2.35% of C_T, respectively.

Soil carbon management index: Soil carbon management index (CMI) for different fertilizer regimes was computed on the basis of changes in quantity and quality of SOC of treatments relative to an undisturbed reference soil. The ratio of C_T in treatment to C_T in reference soil yielded carbon pool index (CPI), while the lability index (LI) refers to the ratio of carbon lability between treatment and reference soils. The CPI ranged from 0.65 for the control soil to 0.81 for FYM treated soil (Table 1). Balanced NPK treatment resulted in relatively higher CPI than all other unbalanced fertilizer treatments. The LI was lowest for the control soil (0.645) and showed an improvement in all other fertilizer regimes. Unlike CPI, the lability and LI were relatively higher for NPK treatment than for FYM treatment. The CMI values across fertilizer regimes followed the same trend as LI did (Table 1). The NPK treatment had highest CMI (0.83) followed closely by FYM treatment (0.80), while the unfertilized control resulted in the lowest CMI of 0.42. The CMI for different long-term fertilizer regimes followed the order: NPK > FYM > NK > NP > N > PK > P > K > Control.

Crop productivity and sustainability: Productivity of *Motihari* tobacco not only varied widely among different fertilizer regimes but also showed marked year to year variability (Fig. 2). The current (2010-11) and mean yield (over past 36 years) of tobacco were highest for NPK treatment and lowest for the control. The fertilizer regimes with N as a component (N, NP, NP and NPK) produced consistently greater yields over the years as compared to the treatments receiving no N (P, K and PK) and no fertilizer control. Sustainable yield index (SYI), computed on the basis of mean yield, yield deviation and maximum yield attained in past 36 years, showed lowest value for control (0.289) and highest value for NPK treatment (0.634) (Table 1). This implied that NPK treatment was more sustainable than all other treatments. All fertilizer regimes that received N were relatively more sustainable over the other treatments with no N.

Relationships among C pools, CMI and SYI: Statistical analysis confirmed positive correlations among various soil C pools and between C fractions and CMI. Though the CMI had highly significant correlation with all C pools, correlation coefficient (r) between CMI and C_L was highest. The current crop yield and SYI also showed positive correlation with various C fractions. However, the r values for relation between C_T and crop yield, C_{NL} and Crop yield and C_{NL} and SYI were not significant. The SYI was found significantly and positively correlated with C_T, C_L, C_{WS}, C_{MB} and CMI and the correlation coefficient of SYI with CMI and C_L was greater than that of SYI with C_T, C_{WS} and C_{MB}.

Potassium supply strategies for improved productivity, quality and potassium-use-efficiency of FCV tobacco grown on irrigated Alfisols *[CTRI RS, Jeelugumilli]*

D. Damodar Reddy, M. Anuradha and V. Krishnamurthy

A field experiment with FCV tobacco grown on Irrigated Alfisol was conducted at CTRI RS Farm, Jeelugumilli to evaluate the effect of potassium supply strategies on tobacco growth, yield and quality, (ii) assess the K uptake and use efficiency, and (iii) monitor changes in exchangeable potassium status of soil in relation to potassium application strategies. Potassium supply strategies varied in rate, number of splits and timing of K application.

Crop productivity: The potassium applied at the rate of either 120 or 80 kg K_2O ha^{-1} led to significant increase in green leaf yield, cured leaf and grade index of tobacco over the no-fertilizer control and NP fertilizer use alone. This indicated a clear crop response to K supply on Alfisols characterized by low native K reserves and low CEC coupled with high vulnerability to leaching losses. On average, the K supply rate of 120 and 80 kg K_2O ha^{-1} enhanced cured leaf yield by 59 and 44%, respectively over no-K treatment. Potassium application in 4 splits (1:1:1:1 at 10, 25, 40 and 70 DAT) resulted in higher yields as compared to its addition in 3 splits (1:2:1 at 10, 25 and 40 DAT or 25, 40 and 70 DAT). For the 3 different strategies of timing 3 splits (1:2:1) of K application, the tobacco

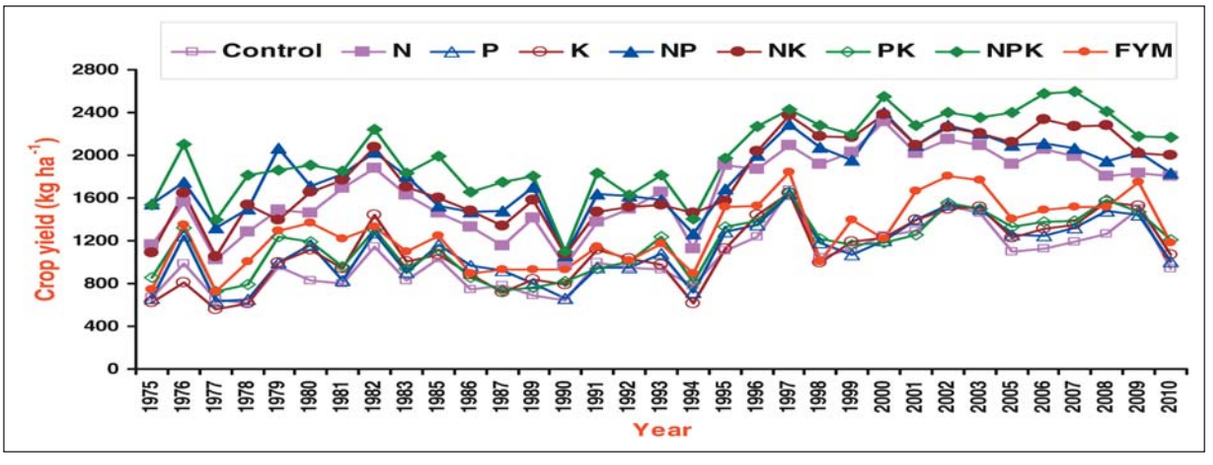


Fig 2. Crop productivity trends under different fertilizer regimes over the past 36 years

Table 1: Long-term fertilizer regime effects on SOC pools, carbon management index (CMI) and sustainable yield index (SYI) under *Motihari* tobacco.

Treatments	TOC (g kg^{-1})	C_L (mg kg^{-1})	CPI	LI	CMI	SYI
Control	7.88	240	0.65	0.645	0.42	0.289
N	8.70	375	0.72	0.925	0.66	0.503
P	8.77	315	0.72	0.765	0.55	0.318
K	8.38	308	0.69	0.782	0.54	0.305
NP	9.09	390	0.75	0.920	0.69	0.576
NK	8.60	398	0.71	0.994	0.71	0.537
PK	8.92	330	0.74	0.789	0.58	0.342
NPK	9.88	465	0.81	1.014	0.83	0.634
FYM	10.35	450	0.85	0.933	0.80	0.369
LSD (p=0.05)	0.78	38.5	-	-	-	-

TOC= Total organic carbon; C_L= Labile carbon; CPI= Carbon pool index; LI= Lability index; CMI= Carbon management index; SYI= Sustainable yield index.

yields were significantly higher with K supply timing of 25, 40 & 70 DAT than with K supply timing of 10, 25 & 40 DAT. The cured leaf yield obtained with 80 kg K_2O ha^{-1} applied in 4 splits (1:1:1:1) at 10, 25, 40 and 70 DAT was more or less identical to the yield resulting from application of 120 kg K_2O ha^{-1} in 3 splits (1:2:1) at 10, 25 & 40 DAT. Grade index was relatively greater with 4 splits than with 3 splits at both rates of K supply.

Nutrient uptake and use-efficiency: Potassium application led to enhancement of N, P and K uptake by tobacco. K applied in 4 splits resulted in relatively higher nutrient uptake compared to its addition in 3 splits. The harvest index of K remained more or less same (0.60 to 0.67) across all K supply strategies. This implied that about 60 to 67% of total K uptake was translocated to economic part (i.e. leaf) in all the treatments. The potassium partial factor productivity (PFP_K), agronomic efficiency (AE_K), physiological efficiency (PE_K) and recovery efficiency (RE_K) values ranged from 7.82 to 12.90 kg kg^{-1}, 2.36 to 4.70 kg kg^{-1}, 14.14 to 18.76 kg kg^{-1} and 12.96 to 26.45%, respectively. Application of K in 4 splits generally resulted in greater K use efficiency (PFP_K, AE_K and RE_K) as compared to K addition in 3 splits only. The RE_K values were lower at higher rate of K application.

Leaf quality in relation to K supply strategies: The lamina nicotine reducing sugar (RS) and K contents were significantly affected by K supply strategies, while chloride content remained unaffected. In general, K application promoted Nicotine and RS over no K treatment. The leaf K concentration improved significantly with K application either at 120 or 80 kg K_2O ha^{-1}.

Potassium use-efficiency of flue-cured tobacco genotypes: Potassium (K) is the key nutrient required in large quantity for optimum yield and quality of tobacco (*Nicotiana tabacum* L.) grown on K-deficient Alfisol under NLS conditions. Identification and use of genotypes efficient in K in uptake and utilization may be a promising strategy to improve yield and reduce costly input of K fertilizers (SOP) in FCV tobacco production. A field experiment on K deficient Alfisol at CTRI Research Station, Jeelugumilli was conducted to evaluate FCV tobacco genotypes for their potassium use efficiency and to find out the parameters associated with higher use efficiency and resource to K application. Treatments for the field experiment included eighteen flue-cured tobacco genotypes (16/103, Mc nair-12, CM-12, Kanchan, NLSH-1, NLST-2, NLST-3, NLST-4, TOBIOS-2, RT-30-1, RT-36-1, RT-42-1, RT-47-1, RT-51-2, RT-57-1, RT-67-3, RT-90-1, RT-102-1) grown with and with no K (Ko) 100 kg K ha^{-1} (K_{100}). The K use efficiency of genotypes was computed in terms of agronomic efficiency (AE), physiological efficiency (PE), recovery efficiency (RE) and Shoot dry matter yield under Ko condition. In absence of K addition, all the genotypes showed a significant reduction in biomass production. Among the genotypes, highest biomass was recorded for RT-51-2 followed by RT-42-1. Genotypes showed differential yield response to applied potassium. Among genotypes, RT-51-2, RT-57-1 and TOBIOS-2 recorded higher AE and RT-57-1, RT-47-1, RT-67-3 and Kanchan showed greater PE. The RE and IUE were highest in RT-51 and NLST-3, respectively. Based on AE and shoot dry matter yield under Ko condition, genotypes were classified as efficient and responsive (ER), non-efficient and responsive (NER), efficient and non-responsive (ENR) and non-efficient and non-responsive (NENR) (Fig. 3). The efficient genotypes produced greater biomass in the absence of K application, while the responsive genotypes produced greater biomass with the K application. In this study, ER genotypes were RT-67- 3, RT-36-1, RT-51-2, RT-57-1 and TOBIOS-2. Genotypes including NLST-3, NLST-4, NLSH-1, RT-30-1, RT-90-1 and CM-12 are categorized as ENR. The genotypes viz., RT-47-1, RT-42-1, McNair, Kanchan and RT-102-1 come under NER

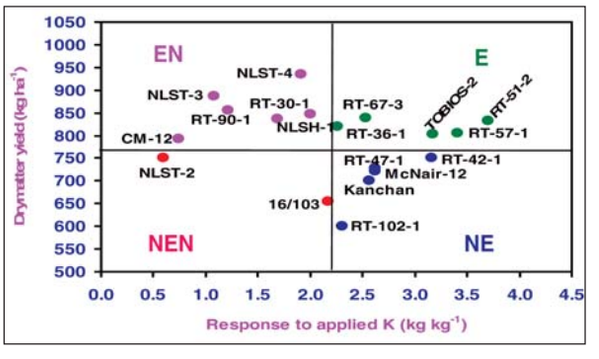


Fig 3. Potassium Use Efficiency of genotypes

category. The NENR was represented by NLST-2 and 16/103. ER genotypes are to be selected while evolving the varieties for enhanced productivity and improved K use efficiency.

Water extraction method for determination of K in tobacco leaf tissue: Potassium (K) in plant tissue is not bound to organic compounds and occurs in soluble forms, thus indicating ease of its extractability. The conventional methods of plant sample preparation for K determination are often tedious and time-consuming and/or require chemicals making the analysis expensive. A water-extraction method for assaying K in tobacco leaf tissue was developed and evaluated for its analytical accuracy and precision in comparison to the established methods viz., triacid digestion, 1 N NH4OAc (CH_3COONH_4) extraction and 0.5 N HCl - extraction. The new method entailed extracting K from 0.5g finely ground plant tissue (<0.5mm sieve) with distilled water at a 1:100 ratio (sample weight to water volume, w/v) by shaking for 20 minutes and filtering before K measurement by flame-photometry. Results with 25 tobacco leaf samples having a wide range in K concentrations showed a close agreement between the values of K determined by the water extraction method and the established methods. The mean K concentration obtained with water extraction method was within 3 to 6% of those measured by established methods. The correlations between the K values obtained by the established methods and the water extraction method were highly significant (p=0.01) and the relationships best described by linear regression equations with high values of R^2 (>0.99). Analytical variability of K determination by different methods was low as borne out from the small values of standard errors (SE) of mean K in both low-K and high K samples, resulting in coefficient of variation (CV) less than 4% (Table 2). The CV associated with different methods was more or less similar for low K and high K samples, suggesting little or no influence of leaf K concentration on precision of K determination. The K measured using the water extraction method had the lowest CV of 1.36% for low K sample and 1.41% for high K sample. The standard errors (SE) and coefficient of variation (CV) for K measurements by different methods followed the order: water extraction < HCl extraction < triacid digestion < NH_4OAc extraction. The results suggested that the water extraction method was comparable in accuracy and superior in precision to the established methods for K determination.

Nitrogen nutrition of flue-cured tobacco *[CTRI, Rajahmundry]*

M. Anuradha, K. Nageswara Rao, C. Chandrasekhara Rao and V. Krishnamurthy

Effects of N application on uptake of major nutrients in tobacco: In a field experiment, effects of varying rates of N application (0, 40,

Table 2: Precision of tobacco leaf tissue K concentration assayed by different digestion/extraction methods

Method	K concentration (%) in tobacco leaf tissue[a] Range	Mean	SE	CV (%)
		Low K sample		
Triacid digestion	0.62 - 0.66	0.648	0.008	2.76
NH_4OAc extraction	0.64 - 0.68	0.660	0.010	3.03
HCl extraction	0.64 - 0.67	0.653	0.006	2.05
Water extraction	0.64 - 0.66	0.656	0.004	1.36
		High K sample		
Triacid digestion	2.38 - 2.56	2.484	0.034	3.09
NH_4OAc extraction	2.52 - 2.78	2.672	0.043	3.61
HCl extraction	2.59 - 2.69	2.637	0.019	1.57
Water extraction	2.54 - 2.62	2.572	0.016	1.41

[a] = based on five independent analyses; SE = standard error of mean; CV = coefficient of variation (%)

80, 120, 160 and 200 kg/ha) on the concentration and uptake of major nutrients (N, P, K, Ca, Mg and S) were assessed and the results presented in Fig. 4. The nitrogen content of lamina increased with increase in nitrogen from 80 kg N/ha where as N content of midrib, stem and root increased from 160 kg N/ha level onwards. Nitrogen uptake increased with increase in nitrogen fertilization up to 160 kg N/ha. Phosphorus content decreased with increase in nitrogen fertilization in all plant parts. Phosphorus uptake increased with increase in applied nitrogen up to 120 kg N/ha, there after declined. Potassium content decreased with increase in nitrogen fertilization in midrib, stem and root and no significant difference was observed in leaf K. Where as potassium uptake increased with increase in level of applied nitrogen up to 120 kg/ha. Calcium content increased with increase in nitrogen level in lamina and midrib where as specific trend was not observed in stem and root. More calcium content is recorded when nitrogen was not applied. Calcium uptake increased with increase in nitrogen level from 0 to 200 kg N/ha. Magnesium content in lamina and midrib is more when nitrogen was not applied compared to all other levels of nitrogen. Magnesium content in stem and root decreased with increase in applied nitrogen up to 160 kg N/ha. Magnesium uptake increased with increase in nitrogen fertilization. Due to nitrogen application much variation was not recorded in sulphur content except that the no nitrogen treatment contained more sulphur content in midrib, stem and root. Sulphur uptake increased with increase in nitrogen fertilization.

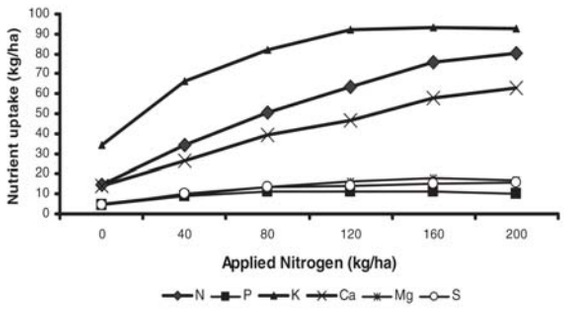


Fig.4: Influence of applied nitrogen on nutrient uptake

Nitrogen use efficiency of FCV tobacco Genotypes: A field experiment was conducted at CTRI Research Station, Jeelugumilli with two levels of nitrogen (0, 120 kg N/ha) and eighteen flue-cured tobacco genotypes (16/103, Mc Nair-12, CM-12, Kanchan, NLSH-1, NLST-2, NLST-3, NLST-4, TOBIOS-2, RT-30-1, RT-36-1, RT-42-1, RT-47-1, RT-51-2, RT-57-1, RT-67-3, RT-90-1, RT-102-1) in three replications to assess the variability in tobacco genotypes for N use efficiency.

N stress effects on FCV genotypes: Nitrogen stress reduced biomass production of all the genotypes. Reduction in leaf and shoot biomass ranged from 52 -73% and 58-77%, respectively among the genotypes. Root/shoot ratio is not affected by nitrogen stress significantly. Among the genotypes 16/103, CM-12, NLST-2, NLST-3, RT-47-1 and Mc Nair-12 showed more root / shoot ratio compared to other genotypes. Root volume reduced due to nitrogen stress and among the genotypes, McNair, 16/103, RT-30-1, RT-36-1 showed more root volume compared to other genotypes. Nitrogen content of leaf, stem and root; and nitrogen uptake (shoot) reduced due to nitrogen stress in all genotypes. Among the genotypes Mc Nair-12, RT-102-1 and NLST-2 recorded more N content compared to other genotypes. Nitrogen uptake is reduced by more than 70% due to nitrogen stress. Among the varieties RT-52-2 and RT-57-1 recorded more nitrogen uptake. K and P content increased while their uptake (shoot) reduced due to nitrogen stress. RT-51-2 showed highest P and K uptake under nitrogen stress.

Yield and N use efficiency: Cured leaf yield and grade Index reduced due to nitrogen stress. The reduction in yield among the varieties varied from 12-70%. Mc Nair-12 showed less reduction in yield and NLST-2 recorded maximum reduction. The increase in percent reduction in cured leaf yield in different varieties are in the order of Mc Nair-12, CM-12, RT-90-1, 16/103, RT-102-1, RT-47-1, RT-67-3, NLSH-1, NLST-3, NLST-4, RT-57-1, Kanchan, RT-36-1, TOBIOS-2, RT-30-1, RT-51-2, RT-42-1, NLST-2. N use efficiency of genotypes is expressed as agronomic efficiency (AE), and internal use efficiency (IUE). Genotypes RT-51-2, RT-57-1, TOBIOS-2 and NLST-4 recorded more

AE and RT-30-1. RT-36-1, RT-67-3 and NLST-4. recorded greater IUE.

IV(C). Characterization of Soil Biota and Use of Biofertilizers

Development of bioconsortia for optimizing nutrient supplementation through microbes for tobacco crop production *[CTRI, Rajahmundry]*

D.V. Subhashini, M. Anuradha, D. Damodar Reddy and V. Krishnamurthy

Soil microorganisms play a key role in the biogeochemical cycling of both inorganic and organic nutrients in the soil and in the maintenance of soil quality. In particular, microbial activity in the rhizosphere is a major factor that determines the availability of nutrients to plants.

The nursery and field experiments were conducted to evaluate different bio-fertilizers and their combination on seedling growth of tobacco and to assess nutrient availability with the use of bio fertilizers. The treatments included: T1 = Control; T2 = 100 % recommended dose of fertilizer (RDF); T3 = 75% recommended dose of fertiliser (RDF); T4 = 75% RDF+ *Azospirillum* @ 1x 10^8 ; T5 = 75% RDF+ *Bacillus subtlis* @ 1x 10^9 / g ; T6 = 75% RDF+ *Frateuria aurantia* @ 1x 10^9 CFU ; T7 = 75% RDF (*Azospirillum* + *B. subtlis*) ; T8 = 75% RDF (*Azospirillum* + *F. aurantia*) ; T9 = 75% RDF (*B subtlis* + *F. aurantia*) ;T10=75% RDF (*Azospirillum* + *B. subtlis* + *F. aurantia*) ;T11= 75%RDF+ *Azotobacter*+ *B.subtilis* +*F. Aurantia* ; *T12*= 75% RDF + *Azotobacter* + *F. aurantia*. The field experiment was carried out in Vertisols at CTRI Research Farm, Katheru.

Bio-consortia effects on tobacco seedlings: The combined inoculation of *Azospirillum* + *B. subtlis* + *F. aurantia* and *Azotobacter*+ *B.subtlis* + *F. aurantia* increased the seedling height, germination per cent, dry matter production, nutrient content of the seedlings and number of transplantable seedlings. Combination of any two bioinoculants also showed the enhancement in the growth parameters over single inoculation of the bioinoculant and uninoculated control.

Inoculum establishment in the rhizosphere of field crop: The low level of fertilization resulted in a higher level of microbial population in the rhizosphere and a larger community of *A. chroccoccum* or *Azospirillum* in the rhizosphere. Combination of all the three bioinoculants resulted in the highest population of introduced microorganisms exhibiting synergistic effect and positive interaction among these bioagents.

Bio-consortia effects on crop growth, yield and nutrient uptake: Photosynthetic rate, transpiration rate, foliage index and chlorophyll content of tobacco increased due to triple inoculation. The triple inoculation of rhizobacteria resulted in a significant increase of cured leaf, bright leaf yield and grade index. The maximum yield of cured leaf (2199 kg/ha), bright leaf (1190 kg/ha) and grade index (1747) were obtained with the treatment 75% RDF + *Azospirillum* + *B. subtlis* + *F. aurantia* followed by 75% RDF+ *Azotobacter* + *B. subtlis* +*F. aurantia*. Triple inoculation with rhizobacteria was also most effective in improving plant nutrient uptake.

Genotypic differences in tobacco for VAM association: Tobacco genotypes exhibited wide variation in percentage root colonization by AM fungi in traditional black soils. This variation in percentage colonization could be ascribable to the interaction between host genotype and preference of AM species. The average spore density in the rhizosphere soils of tobacco genotypes ranged from 40 to 294 /50 g soil. Spore morphology revealed the occurrence of *Acaulospora, Gigaspora, Glomus fasciculatum, Glomus microcarpum, Glomus intraradices* and *Glomus mossae* indicating that AM colonization in the roots of tobacco genotypes could be attributable to these species.

Effect of temperature and pH on *Pythium aphanidermatum*: Among the major production constraints in tobacco, damping-off caused by *Pythium aphanidermatum* is very serious. The growth and sporulation of the fungus varied significantly at different temperatures and pH values. Maximum growth and sporulation was recorded at 25^{0}C as compared to 30, 20 and

10^{0}C. Similarly maximum growth and sporulation of the fungus was recorded at pH 7.0.

IV(D). Evaluation of Tobacco Leaf and Product Quality

Effect of organic and inorganic fertilizers on chemical and biochemical quality constituents of burley tobacco *[CTRI, Rajahmundry]*

P. Harishu Kumar, C. Chandrasekhara Rao, K. Sivaraju, M. Anuradha and D.V. Subhashini

Chemical and biochemical constituents responsible for aroma and quality of tobacco are influenced by quantity and source of manures, leaf position on stalk, climatic conditions, cultural practices, genotypes and method of curing. The effects of organic and inorganic manures on the quality constituents of burley tobacco (variety Banket A1) were evaluated. Four formulations of organic manures having Neem cake, Pongamia cake, filter press cake, poultry manure, FYM and vermi compost in different ratios (Manure A-2:2:2:2:1:1; Manure B- 1.5:2:4.5:2:1.5:1.5; Manure C-1.5:1.5:5:2:2:2 and Manure D-1.5:1.5:3.5:1.5:5:5) and two levels of inorganic fertilizers (120 kg N/ha and 160 kg N /ha) were tested at Burley Tobacco Research Station, Kalavacharla, East Godavari district.

Nitrogen and manure effects on burley tobacco quality constituents: The chlorophyll content varied from 0.164 to 0.293 mg/g among the different treatments. Tobacco from manure treatments showed higher levels of carotenoids compared to nitrogen treatments. The carotenoid content decreased marginally with increase in applied nitrogen from 120 to 160 kg N/ha. Nitrate nitrogen content varied from 4.685 to 5.842 mg/g among the different treatments. Tobacco from manure A treatment showed minimum content of nitrate nitrogen whereas it was maximum in 160 kg N/ha treatment. Petroleum ether extractives (PEE) varied from 5.61 to 6.92% among the different treatments. Tobacco from manure treatments showed higher levels of PEE over the inorganic nitrogen treatments. Proline content decreased significantly with increased nitrogen application from 120 to 160 kg N/ha. Tobacco from manure treatments showed higher levels of nicotine (1.25%) compared to the nitrogen treatments (1.19%). Manure treatments showed higher levels of reducing sugars (RS) over the nitrogen treatments with exception of manure B where RS content was lower than the nitrogen treatments. Manure A and manure C application improved the quality characters compared to nitrogen application alone. Manure treatments not only increased the content of carotenoids, proline, PEE, reducing sugars, solanesol and free fatty acids which play an important role in the quality of tobacco but also decreased the levels of polyphenols and nitrate nitrogen, which were negatively correlated with the quality of tobacco.

Studies on chemical constituents responsible for smoke flavour in FCV tobacco grown under different agro-climatic zones *[CTRI, Rajahmundry]*

C.V. Narasimha Rao

Neutral volatile compounds: With the objective of analysis of neutral volatile compounds responsible for smoke flavour of FCV tobacco, 23 samples from KLS and 12 samples from NLS were subjected to steam distillation and the distillates were further processed by treating with tartaric acid for removal of nicotine, extracted with dichloromethane and concentrated for GC-MS analysis. It is inferred from the GC – MS analysis that solanone, megastigmatrienone, 4-megastigmatrienone, solavetivone, 3-hydroxy solavetivone and neophytadiene are the major neutral volatile compounds present in FCV tobacco samples from KLS.

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

C.V. Narasimha Rao

Pesticide residue levels in tobacco: Pesticide residue analysis in 208 FCV tobacco leaf samples received from different Tobacco Board auction platforms in KLS, NLS, SLS, SBS and NBS revealed that in general, organochlorine pesticides are within the Guidance Residue Levels (GRL) except in a few cases (Table 3).

Table 3: Organochlorine pesticide residues (ppm) in FCV tobacco

Region	Gamma BHC	BHC ($\alpha+\beta+\delta$)	Chlor-pyriphos	Dieldrin	Endrin	Total Endo-sulfan	Total DDT
KLS(96)	ND (ND-0.01)	0.02 (0.01-0.06)	0.01 (ND-0.22)	ND	ND	0.02 (ND-0.24)	0.02 (ND-0.06)
NLS(40)	0.01 (ND-0.04)	0.03 (0.01-0.11)	0.02 (ND-0.19)	ND	ND	0.16 (ND-0.98)	0.01 (ND-0.07)
SLS(40)	0.01 (ND-0.06)	0.04 (0.01-0.07)	0.09 (ND-0.42)	ND	ND	0.22 (0.01-0.58)	0.06 (0.01-0.17)
SBS(26)	0.02 (ND-0.05)	0.04 (ND-0.07)	0.13 (ND-0.39)	ND	ND	0.20 (0.01-0.81)	0.07 (ND -0.19)
NBS(6)	0.03 (0.01-0.04)	0.04 (0.02-0.05)	0.04 (ND-0.11)	ND	ND	0.23 (0.17-0.40)	0.08 (0.03-0.20)
GRL	0.50	0.07	0.50	0.05	0.05	1.00	0.20

Evaluation of smoke constituents in materials from some plant breeding experiments *[CTRI, Rajahmundry]*

C.V. Narasimha Rao

a) ISO collaborative study on cigarette smoking: A collaborative study sponsored by the International Organisation for Standardization (ISO) was undertaken to estimate the main stream smoke yields of nicotine-free dry particulate matter (NFDPM), nicotine and carbon monoxide (CO) from eight commercial cigarette brands and two reference cigarettes/monitor test pieces smoked under ISO and Health Canada Intense (HCI) machine smoking regimes. The study was taken up by 35 participating laboratories from 21 countries. Higher levels of TPM (mg/cig), nicotine (mg/cig) and carbon monoxide (mg/cig) were recorded with the HCI method (TPM: 30.16 to 52.47; Nicotine: 1.24 to 3.08; CO: 17.32 to 25.14) as compared to the ISO method (TPM: 0.92 to 17.78; Nicotine: 0.10 to 1.59; CO: 0.57 to 11.27).

b) BIS collaborative study on *bidi* smoking: A collaborative study sponsored by the Bureau of Indian Standards (BIS) was undertaken to estimate the main stream smoke yields of nicotine-free dry particulate matter (NFDPM), nicotine and carbon monoxide (CO) from four commercial bidi brands for validation of the bidi smoking method. Four laboratories have participated in the study. Analysis of the physical parameters of bidis revealed that the average weight ranged from 0.3779 to 0.5754 g, the filler content in the bidis ranged from 40.9 to 47.6% and the wrapper content ranged from 45.2 to 58.1%.

The data of all the three laboratories of all the parameters were statistically analysed and the mean, standard deviation, coefficient of variation values and mean values of the three laboratories are presented. It is inferred from the data that the ranges of TPM, nicotine, NFDPM and CO are 43.39 – 64.45 mg/bidi, 1.63 – 2.93 mg/bidi, 27.41 – 39.71 mg/bidi and 19.01 mg/bidi, respectively.

V. Integrated Management of Biotic Stresses

V (A). Monitoring of Insect Pests and Diseases

Monitoring of insect pests of tobacco with pheromone traps *[CTRI, Rajahmundry]*

U. Sreedhar

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

Tobacco nursery: Perusal of correlation matrix showed that there was highly significant and positive correlation between trap catch, egg masses, larvae and percent seedlings damaged. The fitted multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains only 38.4% of variation in the moth catches in pheromone traps and about 61% variation in the dependent variable was unexplained. The linear regression equation fitted for per cent seedlings damaged vs. moth catch in the pheromone traps showed that 72% variability of the seedlings damaged was explained by pheromone trap catch and only 28% variation in the seedlings damaged by *S. litura* went unexplained. The fitted multiple linear regression equation for per cent seedlings damaged vs. moth catch and weather parameters explains 78.6% variability of the dependent variable by pheromone trap catch together with weather parameters and 21% variation in the seedlings damaged by *S. litura* is unexplained (Table 1).

Tobacco field crop: The results indicated that with the increase in the trap catch (lagged variable) there was an increase in the egg masses on the tobacco in the following week and subsequent increase in the larval population and damage two weeks after. For correlation the per cent increase in infested plants was taken into consideration. During the crop season the trap catch was highest in the 7th standard week (83/trap) followed by 8th (72.5) and 9th (69.5) standard weeks. The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was highly significant in all the four blocks. Perusal of correlation matrix shows that there was a highly significant and positive correlation between trap catch, egg masses, larvae and increase in percent plants damaged.

Studies on relationship of pheromone trap catch of *H. armigera* with field incidence and weather parameters in tobacco, cotton (Bt and Non-Bt) and Bengal gram *[CTRI RS, Guntur]*

J.V. Prasad

Incidence of *H. armigera* in different crops: The peak catch of moths of *H. armigera* in pheromone traps was noticed during the third week of November. In cotton the incidence of boll worms has been on a raise since November II week and it peaked during November IV week followed by a decline. The incidence of boll worms was almost negligible in transgenic cotton hybrids, both single and double genes. The highest incidence of the pest was recorded

Table 1: Relationship between seedlings damaged vs. *Spodoptera litura* moth catch in traps and Weather parameters

Intercept (a)	Moth catch (x1)	Max. Temp.	Min. Temp. (x2)	Rain fall (x3)	R.H. M (x4)	R.H.N (x5)	R^2 (x6)
12.48	0.110	0.528	-0.227	-0.002	-0.258	-0.014	0.786**

during II week of January in tobacco. Peak infestation of the pest was observed in Bengal gram during the IV week of December. There was no significant association of any of the weather parameters with the trap catches.

Pest incidence - weather relationship: The relationship between field incidence of *H. armigera* in cotton (Bt and non-Bt) and bengal gram with weather parameters showed that rainfall had a significant positive effect on the incidence of this pest. Seventy four percent of the variability in the incidence of *S. litura* in the field crop could be explained by weather parameters and rainfall was observed to have significant positive influence on this pest. The variability in the field incidence of *H. armigera* in case of Non-Bt cotton could be explained by weather parameters to a tune of 78%. Rainfall had a significant positive influence on this pest where as minimum temp had a significant negative effect. The association of field incidence of *H. armigera* with weather parameters in case of bengal gram or tobacco was non-significant owing to very low incidence of the pest.

Population development studies of aphid, *M. nicotianae* under SLS conditions *(CTRI RS, Kandukur)*

K.C. Chenchaiah

Aphid population development: The aphid infestation commenced from the first week of December and continued till the harvest. Initially, the infestation ranged from 1-50 aphids per plant and increased during winter. The important parasites and predators noticed were *Nesidiocoris* sp, ladybird beetles, *Cheilomenes sexmaculata* and *Xanthogramma scutellare*.

Survey for assessment of insect pest incidence in KLS tobacco *[CTRI RS, Hunsur]*

P. Venkateswarlu and S. Ramakrishnan

Insect pest incidence in tobacco nursery: Survey of nurseries infested by tobacco caterpillar, *Spodoptera litura* revealed 0-20% infestation. Among the infested nurseries, 18.5% showed infestation above ET level (> 5%). The overall infestation of the pest in the entire area was 1% which was much below than ETL. Among the five *Taluks* surveyed, the overall infestation of the caterpillar was more in Periyapatna (1.2%) followed by Hunsur and Ramanathapura (1.0%), H.D.Kote and K.R.Nagar (0.8%).

Insect pest incidence in tobacco field crop: Four insect pests of tobacco viz., aphid, *Myzus nicotianae*, budworm, *Helicoverpa armigera*, stem borer, *Scrobipalpa heliopa* and tobacco caterpillar, *Spodoptera litura* were recorded in all the five *taluks* of KLS. The per cent fields infested by aphid, stem borer, budworm and caterpillar were 17.0, 17.0, 30.6 and 10.0, respectively. All the pests were below ET level. (Table 2).

Screening of tobacco germplasm against caterpillar, *Spodoptera litura* under KLS conditions: A total of 300 tobacco varieties/ lines including 210 germplasm accessions, 34

Table 2: Overall insect pest incidence in KLS region

S.No.	Particulars	Aphid	Stem borer	Bud worm	Cater-pillar
1.	No. of Villages surveyed	100	100	100	100
2.	No. of fields visited	300	300	300	300
3.	No. of fields infested	51	51	92	30
4.	Fields infested (%)	17.0	17.0	30.6	10.0
5.	Range of infestation (%) in the infested fields	3-18	2-18	5-22	2-12
6.	Average infestation (%) in the infested fields	8.1	8.9	11.1	6.4
7.	Overall infestation (%) of the pest in the area	1.4	1.5	3.4	0.6
8.	Range of pest population (Score)	1-3	-	-	-

AVT and IVT entries, 30 aphid resistant lines, 15 root-knot resistant lines, 6 advanced breeding lines, 2 promising hybrids and 3 ruling varieties (checks) were screened against caterpillar, *Spodoptera litura* under natural infestation. Among them, two ruling varieties, Kanchan and Rathna, four breeding lines namely, FCH-201, FCH-222, FCH-221, A-3, and two hybrids, CH-39 and KLSH-10 registered relatively more infestations with 18.66, 15.33, 12.66, 11.33, 10.00, 9.66, 8.33 and 7.66%, respectively. In all the remaining lines, infestation ranged from 0 to 5%.

Predator population in entomophage park: An Entomophage park consisting of different crops and flowering plants was laid out with an objective of maintaining natural enemy population throughout the year. Among the predators recorded, the average population of coccinellids was more (11.46) followed by spiders (8.53), syrphids (1.76), wasps (1.69) and predatory bugs (1.53). Coccinellids were more on maize (27), bajra (22) and jowar (21), whereas, spiders were more on *Tagetes* (21), castor (17) and red gram (15). The remaining population of other predators was low (<5) and maize harbored higher number of predators than other crops.

Studies on wilt disease of tobacco *[CTRI, Rajahmundry]*

C.A. Raju

Wilt disease caused by *Fusarium* spp. with conspicuous symptoms of yellowing and wilting of leaves on one side of tobacco plants was observed both in FCV and *Natu* tobaccos in NLS area in very low intensity. In many areas, symptoms were confusing with those of black shank and stem borer.

Weather based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions *[CTRI RS, Dinhata]*

S. Roy and S. Amarnath

Brown spot disease progression in *Motihari* tobacco: The disease was monitored both in normal and late planted crop of *N. rustica* under protected and unprotected conditions. Spotting was initiated at the mean of 66.8 days after planting (DAP) in case of smaller spots compared to 75.8 DAP for bigger spots. The frequency of occurrence of both types was about 1:1 in early planted crop. In normal date of planting the gap between initiation of smaller and bigger spots was 63.8 DAP and frequency ratio was nearly 1:2. In protected crop there was 18 days gap between initiation of smaller spots and occurrence of bigger spots. The frequency was 3:1. In late planted crop nearly similar trend was noticed (Fig.1).

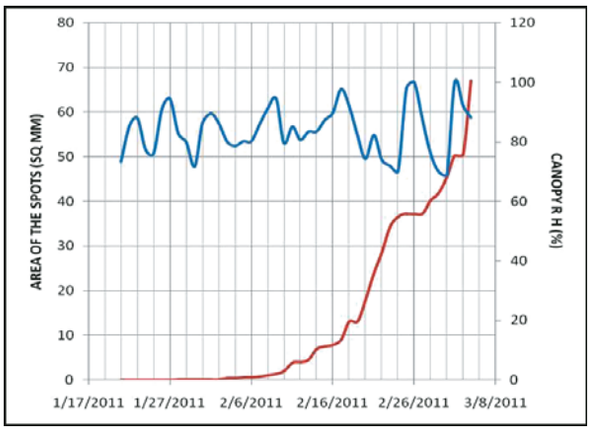


Fig.1: Increment of spot area in relation to canopy R H in early planted crop

The reason attributed to the cause was single spray application of fungicide. Another spray at critical period might have checked the increment both under individual and total area covered by big spots under protected check. In case of late planting, the area covered by big and small spots, either individually (201 and 77.2 sq mm) or in combination (278 sq mm) was significantly low.

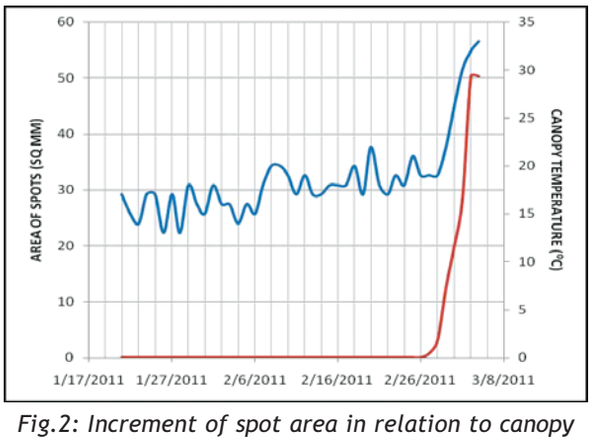


Fig.2: Increment of spot area in relation to canopy temperature in late planted crop

Contrary to small size spots the rate of progression of large size spot was found to be highest (87 sq mm). The graphical trends indicate that single application of fungicide during last week of January was not sufficient enough to contain the disease. Therefore, second therapeutic application of chemical after first fortnight of January, 2011 i.e. by 17th February, 2001 was needed to restrict the progression of large type spots. In late planted crop, the pathogen is not getting sufficient time for disease expression.

Survey for plant parasitic nematodes associated with tobacco *[CTRI RS, Hunsur]*

S. Ramakrishnan and P. Venkateswarlu

Plant parasitic nematodes in tobacco growing areas of KLS: Soil and root samples were drawn randomly from fields of different taluks viz., HD Kote, Hunsur, Periyapatna and Arkalgudu and were processed for enumeration of various nematode populations. Results revealed the presence of five major plant parasitic nematodes viz., *Meloidogyne* spp., *Rotylenchulus reniformis, Helcotylenchus* spp., *Pratylenchus* spp. and *Tylenchus* sp., associated with main field tobacco crop. Community analysis of nematode population in KLS revealed that reniform nematode with absolute frequency of 98.2% was the most frequently associated nematode followed by root-knot nematode (85.5%) in KLS. But root-knot nematode was present in more numbers in most of the samples collected and recorded the absolute density of 46.2 as compared to 30.8 by reniform nematode. Based on the prominence value (PV), root-knot nematode with PV of 2.40 was continuing to be the most important nematode, for which nematode management practices are to be strengthened in KLS.

V (B). Development of IPM technology

Management of tobacco caterpillar, *S. litura* with insecticide baits *[CTRI, Rajahmundry]*

U. Sreedhar and K. Nageswara Rao

Efficacy of insecticide baits against *S. litura* in NLS: Insecticide baits (insecticide + rice bran + jaggery + water) prepared with leufenuron 5 EC, novoluron 10 EC, emamectin benzoate 5 SG Sl NPV + boric acid, *Bacillus thuringiensis* + potassium carbonate and chlorpyrifos were evaluated against *S. litura* on FCV tobacco. Emamectin benzoate bait provided maximum protection to tobacco leaves as shown by less number of leaves damaged (1.80 & 1.904) and was on par with the leaves damaged in novoluron (2.13 & 2.40), lufenuron (2.33 & 2.63) and chlorpyrifos (2.63 & 2.80) bait applied plots. Among the treatments *B.t.k.* bait treated plots recorded highest number of leaves damaged followed by Sl NPV bait treated plots (Table 3). Data on yield parameters showed that emamectin benzoate bait treated plots recorded highest cured leaf yield (1,590 kg/ha) which was on par with novoluron (1550), leufenuron (1482) and chlorpyrifos (1448). Among the treatments *B.t.k.* bait plots recorded lowest cured leaf yield (1199) which was on par with Sl NPV (1210) and control plots (1131). Similar trend was observed for grade index also.

Management of stem borer, *Scrobipalpa heliopa* in tobacco *[CTRI, Rajahmundry]*

U. Sreedhar

Effect of sequential spray of insecticides on stem borer infestation and crop yield: A field experiment was conducted for two seasons to evaluate promising insecticides against stem borer through sequential spray in seed beds as well as planted crop. At 30 DAT, the infestation in control (untreated) plot was significantly high (30.59%) as compared to all the treatments. The infestation was least in rynaxypyr (7.74)

Insecticide bait

followed by flubendiamide (9.50) which was on par with spinosad and emamectin benzoate (11.25 & 12.57). Chlorpyriphos recorded highest (18.84) infestation among the treatments and was found to be on par with that of profenophos (17.77) Similar trend was observed at 40 DAT. The treatment with rynaxypyr recorded highest cured leaf yield (2007) and was on par with the yield in the plots treated with flubendiamide (1967) and spinosad (1920). Among the treatments, chlorpyriphos recorded the lowest yield (1588) which was on par with carbosulfan (1645) and profenophos (1617). All the treatments recorded significantly higher bright leaf yield than control. The bright leaf yield in rynaxypyr, flubendiamide, and spinosad was on par with each other. It was lowest in chlorpyriphos (705) which was on par with profenophos and carbosulfan. The grade index was also highest in rynaxypyr (1433).

Bait on tobacco plant

Effect of scheduled application of insecticides on stem borer infestation and crop yield: Rynaxypyr 25 SC @ 0.0075 and flubendamide 480 SC @ 0.012% recorded least percent infestation followed by spinosad 45 SC @ 0.018% and emamectin benzoate 5 SG @0.001%. The infestation in these treatments was about 40-50% lower than that recorded in conventional treated plots. Pooled analysis of two seasons data showed that all the treatments gave significantly superior protection to tobacco plants from *S. heliopa* infestation than control (24.99, 32.77 and 36.66) at all the observations i.e., 30, 40 and 50 DAT respectively. Rynaxypyr recorded highest green leaf, cured leaf, bright leaf and showed better grade index than others followed by flubendiamide.

Table 3: Management of tobacco caterpillar, *Spodoptera litura* with baits in NLS

S. No.	Treatment	Per cent plants infested		Leaves damaged/ plant		Per cent leaf area damaged	
		4 DAT	10 DAT	4 DAT	10 DAT	4 DAT	10 DAT
1.	Leufenuron bait	14.47 (6.25)	14.47 (6.25)	2.33	2.63	11.15 (3.80)	12.85 (5.00)
2.	Novoluron bait	13.03 (5.20)	13.03 (5.20)	2.13	2.40	10.54 (3.40)	12.32 (4.60)
3.	Emamectin benzoate bait	11.60 (4.16)	11.60 (4.16)	1.80	1.90	8.98 (2.46)	9.61 (2.80)
4.	Sl NPV + H3BO3 bait	23.20 (15.62)	26.33 (19.78)	4.27	4.60	15.91 (7.60)	19.09 (10.80)
5.	B.t.k. + K2CO3 bait	24.80 (17.70)	28.58 (22.91)	4.67	5.23	18.22 (9.86)	20.53 (12.46)
6.	Chlorpyrifos bait	16.70 (8.33)	16.54 (8.33)	2.63	2.80	9.82 (2.98)	10.95 (3.66)
7.	Control (untreated)	27.04 (20.83)	28.54 (22.91)	5.80	6.47	20.66 (12.53)	26.93 (20.60)
	SEm ±	1.36	1.44	0.42	0.42	1.09	1.19
	CD at 5%	4.20	4.44	1.30	1.30	3.35	3.67
	CV (%)	12.68	12.63	21.88	19.80	13.89	12.90

Figures in parentheses: Original Means

Persistent toxicity of promising insecticides to tobacco stem borer, *S. heliopa* on tobacco: Persistent toxicity values showed the superior persistence of the new insecticides over chlorpyriphos. Treatment of rynaxypyr and flubendiamide resulted in 100% mortality up to 18 days after treatment (DAT) and their toxicity was very high (80.8 & 78.6%) up to 12 DAT. These insecticides recorded 100% mortality up to 8 DAT whereas spinosad and emamectin benzoate recorded 100% mortality up to 6 DAT. The PT values were higher for emamectin benzoate and spinosad followed by flubendiamide and rynaxypyr. However, the persistent toxicity index (PTI) was highest (1405) for rynaxypyr followed by flubendiamide (1379) due to their higher persistency for a longer period than others. The lowest PTI (703) was observed in chlorpyriphos treatment. The order of relative persistent toxicity was rynaxypyr > flubendiamide > spinosad > emamectin benzoate > chlorpyrifos.

Spatial distribution and pest succession of insect pests as influenced by cultural practices in burley tobacco in the plains of East Godavari *[CTRI, Rajahmundry]*

G. Raghupathi Rao

An experiment was conducted in split plot design with five dates of plantings (main plots) commenced from II week of July and subsequent four plantings at 15 days interval and two sub plots viz., protected and unprotected conditions.

Insect pest incidence: Incidence of stem borer (Table 4) in different planting dates was highly variable and less consistent. Early planted crop exhibited -ve skewness, indicating necessity of control measures during early stages of the crop growth .Stem borer incidence in early planted crop i.e., II week of July and first week of August showed normal bionomial distribution (NBD). Plantings beyond first week of August exhibited Poisson's bionomial distribution (PBD). The incidence of *S. litura* in different planting dates was highly variable and less consistent. Except planting in first I week of July other succeeding plantings exhibited positive skewness. The incidence of *H. armigera* in different planting dates was highly variable and less consistent. All the planting dates exhibited negative skewness indicating necessity of control measures during early stages of the crop growth i.e. bud worm stage.

Crop yield: The dates of plantings as well as the protected and un protected treatments significantly influenced the cured leaf yields. The protected treatments recorded significantly higher cured leaf yields as compared to unprotected plots. The interaction effects were non significant. The crop planted in III week of Aug (D3) under protected conditions recorded the maximum yield as compared to all the other treatments combinations.

Natural enemies: Occurrence of natural enemies on tobacco at different dates of plantings was negligible.

Incidence of insect pests on other host crops: Incidence of *Spodoptera*, *Heliothis*, aphids and whiteflies were recorded on bhendi, gogu, tomato and beans crops. In general, as the incidence of insect pests on tobacco was low during current season, their occurrence on other hosts was negligible.

Table 4: Spatial distribution of stem borer as influenced by different dates of plantings on Burley tobacco

Stem borer	Mean	Med	Variance	SD	Coeff. Skewness	Coeff. Kurtosis	Dispersion
D1- II wk of July	7.66	9.18	16.46	4.05	-1.67	2.71	NBD
D2- I wk of Aug.	7.06	8.12	8.64	2.93	-1.74	3.16	NBD
D3- III wk of Aug.	5.81	6.37	1.68	1.29	-1.91	3.70	PBD
D4-I wk of Sept.	2.90	2.87	0.30	0.55	0.13	-4.78	PBD
D5- III wk of Sept.	0.81	0.87	0.057	0.23	-0.85	-1.28	PBD

Effects of organic amendments on pest incidence in burley tobacco: Application of nitrogen (25% of recommended N) through organic sources viz. FYM, vermi compost and neem cake relatively reduced the incidence of stem borer, *S. litura* and *H. armigera* compared to check (100% N through inorganic form). Application of FYM and vermi compost, as organic source at 50 DAP resulted in reduction of *H. armigera* infestation. Similarly, application of vermicompost at 60 DAP showed significantly lower infestation as compared to the check. Cured leaf yield was relatively high in vermicompost and neem compost over the check. Though, the differences are non-significant, the organic sources relatively reduced the pest infestation.

Evaluation of organics enriched with bio-agent in integration with soil solarization against root-knot nematodes in FCV tobacco nursery *[CTRI RS, Hunsur]*

S. Ramakrishnan and M.M. Shenoi

Efficacy of bio-agent enriched organic measures against root-knot nematode: Application of *Paecilomyces lilacinus* and *Pseudomonas fluorescens* enriched FYM and vermicompost in both solarized and non-solarised beds did not affect the tobacco seed germination. In general, bioagents enriched organics in both solarized and non solarized beds significantly improved the root-knot free seedlings count and it ranged from 21.1 to 68.9% over check. Further bioagents enriched organics significantly decreased root-knot index and final soil nematode population in treated beds. Similarly, soil solarization significantly increased healthy transplants count and decreased root-knot index in FCV tobacco nursery.

Bio-intensive management of root-knot nematode in FCV tobacco of KLS using tray nurseries *[CTRI RS, Hunsur]*

S. Ramakrishnan

Efficacy of bio agents against root-knot nematode in tray nurseries: The cocoa-peat media used for raising tray seedlings were fortified with bioagents viz., *Pseudomonas fluorescens*, *Trichoderma viride* and *Paecilomyces lilacinus* at dosage levels of 25 and 50 g / tray media. FCV tobacco seedlings raised in such tray medium enriched with above antagonistic organisms were evaluated against root-knot nematodes on FCV tobacco under sick field conditions. The results also revealed that tray seedlings treated with *Paecilomyces lilacinus* @ 50g/ tray media caused 12.2% increase in FCV tobacco cured leaf yield compared to untreated check. It was concluded that decrease in root-knot incidence and final soil nematode population in the experimental plots due to bioagents enrichment ranged from 39.9 to 50.4% and 15.1 to 50.4%, respectively compared to check.

Management of tobacco caterpillar, *Spodoptera litura* in nurseries *[CTRI RS, Hunsur]*

P. Venkateswarlu and S. Ramakrishnan

Chemical and biological control of *S. litura*: The chlorpyriphos 20 EC and novaluron 10 EC proved better against tobacco caterpillar, *Spodoptera litura* in reducing the damage and increasing the transplantable seedlings. Further, two bioagents viz., Sl NPV and *Bacillus thuringiensis* Var. Kurstaki proved better. Botanicals were moderately effective. Two bioagents viz., *Nomuraea rileyi* and EPN were least effective.

Studies on biology and management of mealy bug on FCV tobacco *[CTRI RS, Kandukur]*

K.C. Chenchaiah

Relative efficacy of insecticides against mealy bug: Acephate and Clothianidin at which recommended dose, were equally effective in controlling mealy bugs under SLS condition (97.5%) Thiamethoxam with was next best option (92.5% control).

Nursery and field evaluation of *Trichoderma viride* and *Pseudomonas fluorescens* to brown spot disease and yield and quality of *Motihari* tobacco *[CTRI RS, Dinhata]*

S. Roy and S. Amarnath

Effect of biocides on crop yield: The biocide *T. viride* co-applied with *P. fluorescens* and single super phosphate (SSP) produced significantly higher cured leaf yield (3004 kg/

ha) of *Motihari* tobacco, with the yield increase being 15% over control. The multi-locational bulk trial on *Jati* tobacco conducted at Boro Natabari and Sitala Bosh Salbari and CTRI RS, Dinhata also confirmed the benefits (22-45% yield gain) of co-application of *T. viride* + *P. fluorescens* + SSP.

Studies on influence of water quality on the efficacy of *Bacillus thuringiensis* Var. kurstaki (B.t.*k*.) against *S. litura* in tobacco nursery *[CTRI, Rajahmundry]*

S. Gunneswara Rao

Spray solution EC and pH effects on efficacy of B.t.k: The B.t.*k* @ 1.5 kg/ha sprayed in aqueous solutions with EC ranging from 0.5 to 6.0 dS/m was effective in the management of *S. litura*. Further effective suppression of *S. litura* was achieved by spraying B.t.*k*. @ 1.5 kg / ha sprayed in aqueous solutions with pH of 7.

Studies on the influence of water quality on the efficacy of *Beauveria bassiana* against *S. litura* in tobacco nursery (*CTRI, Rajahmundry*)

S. Gunneswara Rao

Efficacy of *B. bassiana* as related to spray solution EC and pH: The *B. bassiana* @ 10^8 spores/ml in aqueous solutions with E.C. ranging 0.5 to 1.0 dS/m were suitable for effective suppression of *S. litura*. With regarding to water pH the *B. bassiana* @ 10^8 spores/ml in aqueous solutions having pH range of 6 - 8 were suitable for effective suppression of *S. litura*.

Comparative efficacy of *He ar* NPV isolates against *Helicoverpa armigera* in tobacco crop *[CTRI, Rajahmundry]*

S. Gunneswara Rao

Mortality of *H. armigera*: The percent larval mortality of *H. armigera* was highest with the NBAII isolate followed by RJY isolate of *He ar* NPV under laboratory condition. Least mortality occurred in control (without spray).

Damage to tobacco crop: In field trial, the least percent leaves damage was noticed due to NBAII, RJY and PCI isolates. Anand and JML isolates were at par. Highest leaf damage was observed in control. It was concluded that *He ar* NPV isolates @ 1.5 x10^{12} PIB/ha from NBAII and RJY were effective in suppressing *Helicoverpa armigera* damage to tobacco.

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

S. Gunneswara Rao

Economic Injury Levels (EIL) for *H. armigera* on tobacco seed crop: An experiment with varying degrees of larval population of *H. armigera* on tobacco showed a positive and significant (r=0.90) correlation between number of larvae per plant and the percent pod damage. The results showed that (i) reduction in seed yield per incremental larvae was 1.28 g / plant (ii) Per cent capsules damaged per incremental larvae was 7.37 and (iv) EIL was 1.26/1.28 = 1.0. 3rd instar larva/panicle.

Leaf rutin content in different tobacco varieties: Rutin is one of the factors involved in resistance of plants to attack of chewing insects like *H. armigera*. The varieties with higher levels of rutin in their leaves are known to exhibit relatively greater resistance to insect attack. The variety Siri contained very low rutin levels of 3.9 and 6.3 mg/g in leaf primordia at 40 and 50 DAT respectively compared to Kanchan and VT 1158 with rutin levels of 8.0 and 5.1 and 9.3 and 9.4 mg/g, respectively at the same periods.

Biological control of root-knot nematode, *Meloidogyne* spp. in FCV tobacco nurseries *[CTRI RS, Hunsur]*

S. Ramakrishnan

Control of root-knot nematode using parasitic fungi: The nematode egg parasitic fungi, *Paecilomyces lilacinus* and *Pochania chlamydosporia* (both PDBC strains) i.e., carbofuran @ 10 g/m^2 in integration with soil solarization recorded reduced root-knot nematode incidence with RKI of 1.90 and 1.96, respectively compared to check i.e., (3.86). Similarly, these parasitic fungi caused a significant reduction in the final soil nematode population to the tune of 51.8 and 46.8%, respectively compared to check.

V(C). Screening for Host Plant Resistance to Insect Pests and Diseases

Evaluation of FCV germplasm for tolerance to *S. litura* *[CTRI RS, Kandukur]*

K.C. Chenchaiah

Tobacco germplasm screened against *S. litura* under artificial infestation showed that 3 entries recorded low (<20%), 9 entries with medium (20-30%) and 6 entries with high (>30%) damage rating. Two test entries viz., R143-2 and R151-2 were significantly superior to Hema with low caterpillar damage.

Evaluation of caterpillar tolerant lines for yield: Ten promising caterpillar tolerant lines were evaluated for yield parameters. Two test entries, 113-1and 326 were significantly superior to Hema and VT-1158 and at par with Siri in respect of green leaf, bright leaf yields and grade index. The test entry 150-1 is at par with Hema and recorded higher yields. All the yield parameters over the two years (2009-11) were analyzed and the results indicate that the entry 113-1 and 150-1 were significantly superior to Hema and VT-1158 and at par with Siri at 5% level. But the test entry 326 was also superior to the check, Hema with respect to green leaf, crude leaf, and bright leaf yields only and at par with Hema in grade index. Another set of six promising caterpillar tolerant lines identified during 2009-10 were evaluated for yield parameters. The results showed that two test entries, 47-1 and 62-2 were significantly superior to Hema in respect of green leaf, cured leaf, bright leaf yields and grade index. Chemical parameters like nicotine, reducing sugars and chlorides were are within the permissible limit.

Evaluation of FCV tobacco germplasm for the aphid tolerance under SLS conditions *[CTRI RS, Kandukur]*

K.C. Chenchaiah

Aphid tolerant genotypes: Tobacco germplasm were screened against aphids under natural conditions. R178-2 exhibited 4 aphid damage rating and all other entries (21 entries) including checks showed 5 aphid damage rating.

Studies on Broomrape of tobacco *[CTRI, Rajahmundry]*

C.A. Raju

Reaction of *Nicotiana species* to *Orobanche:* Among the 12 entries, three entries viz., R- 567, R-585 and R-591 showed resistance, while entries R-474, R-514 and R-636 showed lower incidence (about 50% incidence).

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

S. Ramakrishnan and K.N. Subrahmanya

Promising FCV genotypes against root-knot nematodes: Out of 37 advanced breeding lines NLST-3, TBST 18, V 4367, V 4343, V 4344, FCH 209, TOBIOS 1, TOBIOS 6, FCH 209 and hybrids, KLSH19 & KZLSH20 recorded RKI of < 2.0 and were found promising against root-knot nematodes.

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

S. Amarnath and S. Roy

Screening for *N. tabacum* germplasm accessions to brown spot: A total of 21 germplasm accessions of *N. tabacum* under resistant category (AUDPC range of 0-100) during 2009-10 were subjected to artificial inoculation in the crop season 2010-11 in addition to natural screening under field conditions. Nineteen accessions were resistant.

Screening for *N. rustica* germplasm accessions to brown spot: Thirty germplasm accessions of *N. rustica* with varied levels of resistance to brown spot under natural conditions were subjected to artificial inoculation. As per AUDPC ranking 26 accessions were found resistant and 9 were moderately resistance.

Screening of *N. rustica* germplasm accessions to hollow stalk disease caused by *Erwinia carotovora sub. sp. Carotovora*: Based on linear measurement of pith/soft rot after artificial inoculation, five accessions of *N. rustica* were classified under resistant category

(linear pith/soft rot 0-2 cm) and four under moderately resistant category (linear pith/ soft rot 2-3 cm). Five resistant and four moderately resistant entries were tested under artificial conditions. Bengthuli, an entry from Assam exhibited consistency in giving resistant disease reaction for two successive years. SH-31 tested moderately resistant (linear pith/soft rot 2-3 cm).

V(D). Monitoring and Management of Pesticide Resistance and Pesticide Residues

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

J.V. Prasad and U. Sreedhar

Base line resistance data of S. *litura*, and *H. armigera* for insecticides through stomach action: Among the ten insecticides tested for their toxicity against *S. litura* through stomach action, the lowest LC_{50} value was recorded with emamectin benzoate followed by rynaxypyr and the growth regulator novaluron. Treatment with rynaxypyr resulted in very quick cessation of feeding followed by heavy mortality of the test insect in bio-assays. Out of the eleven insecticides against which base line resistance data of *H. armigera* were generated, the lowest LC_{50} value was recorded with emamectin benzoate followed by indoxacard, spinosad and rynaxypyr establishing their efficacy at very low concentrations (Table 6).

Table 6: Base line resistance data of *S. litura* to insecticides (stomach action)

Insecticide	Chi ^{2}	LC 50 (mg/l)	LC 90 (mg/ml)
1. Novaluron	20.45	2.74	5.64
2. Spinosad	49.55*	231	547
3. Thiodicarb	17.34*	1265	2561
4. Fipronil	20.34	53	142
5. Rynaxypyr	52.25*	0.275	0.720
6. Acephate	32.12*	2396	5634
7. Indoxacarb	30.25*	25	45
8. Emamectin benzoate	30.12	0.078	0.175
9. Chlorpyriphos	16.64	220	483
10. Endosulfan	20.36*	160	336

* Significant at P = 0.05

Base line resistance data of S. *litura*, and *H. armigera* for insecticides through contact action: The baseline resistance data of *H. armigera* to 11 insecticides with contact action were generated and among them the lowest LC_{50} value was recorded with rynaxypyr followed by thiodicarb and spinosad. In case of *S. litura* resistance data were generated for nine insecticides with contact action and among them lowest LC_{50} value was recorded for emamectin benzoate followed by chlorpyriphos and profenophos (Table 7).

Table 7: Base line resistance data of *S. litura* to insecticides (contact action)

Insecticide	Chi ^{2}	LC 50 (mg/l)	LC 90 (mg/ml)
1. Cypermethrin	9.12	3223	4996
2. Methomyl	11.24*	4523	6247
3. Thiodicarb	2.35	7442	10231
4. Emamectin benzoate	30.35	1.523	3.89
5. Acephate	20.11	1814	3564
6. Profenophos	34.06	1257	2586
7. Quinolphos	2.03	1509	2325
8. Chlorpyriphos	30.45*	347	624
9. Triazophos	9.22 *	4494	8063

* Significant at P = 0.05

Technology Assessed and Transferred

On-farm trial with new pipeline selections V-4219 and V-4230 in comparison with Siri as control in NBS & CBS zones of A.P. *[CTRI, Rajahmundry]*

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

On-farm evaluation of V-4219 and V-4230: The performance of advance breeding lines viz., V-4219 and V-4230 with Siri as better check were evaluated at two locations in East Godavari district. Superior cured leaf yield was recorded in V-4219 (1900 kg/ha) and V-4230 (1730 kg/ha). The V-4219 and V-4230 lines out-yielded the check, Siri (1636 kg/ha) by 16.2% and 5.8%, respectively. Plant height, number of leaves, leaf length & width, were observed to be higher in V-4219 as compared to that of Siri. Farmers' have expressed that V-4219 is acceptable to their situations in view of its suitability and high yielding character.

On-farm demonstration of production technology for Sabari Lanka tobacco *[CTRI, Rajahmundry]*

V. Krishnamurthy, Y. Subbaiah, S.K. Naidu, C. Chandrasekhara Rao and S. Nageswara Rao

Technology demonstration and farmers' feedback: Sabari lanka tobacco farmers often resort to imbalanced application of N and K fertilizers, non-judicious pest control measures and growing tobacco using cost-intensive technologies. Therefore, the production technology involving recommended spacing (70 x 70cm), dose and method of N & K fertilizer application (300 kg N + 50 kg K in three splits by dollop method), chemical control of suckers through application of 4% decanol (fatty alcohol) and IPM measures was demonstrated on-farm at Rekhapalli village, VR Puram mandal, Khammam district for improving yield and quality and to reduce cultivation cost of Sabari lanka tobacco. The results indicated that the demonstration plot out-yielded the control plot by 15%. Though the farmers are applying 200% extra nitrogen over and above the recommended N level, % nitrogen in green leaf was found to be 4.75 and 4.62 in demonstration and control plots respectively. The trend showed higher fertilizer-use efficiency in the demonstration plot. Further, cost of cultivation was reduced by 12% with a saving of ₹ 18,150/ha. B:C ratio was 1.17 in farmers practice and 1.53 in demonstration plot. Farmers have realized the importance of demonstrated technologies and majority of the farmers in the village have expressed their willingness to adopt the demonstrated technologies from the next season.

On-farm testing of new lines in burley tobacco *[CTRI, Rajahmundry]*

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

Evaluation of YB-4 and YB-10: The performance of burley advanced breeding lines viz., YB-4, YB-10 was evaluated in comparison to Banket A-1 as better check under real farm situation. All the Good Agricultural Practices were adopted in both the experimental and control plots. Superior cured leaf yield was recorded in YB-4 (1770 kg/ha) and YB-10 (1531 kg/ha). The yield improvement over better control Banket-A1 (1405 kg/ha) was 26% and 9% respectively. Data on yield parameters over the

Burley tobacco variety YB-4

two seasons indicated that Burley ABLs YB-4 and YB-10 out yielded the better check Banket-A1 by 31% and 22%, respectively. Examination of data on leaf quality parameters indicated that there are no perceptible variations in leaf quality parameters (nicotine, reducing sugars and chlorides) of ABLs and better check. ABLs YB-4 and YB-10 recorded markedly higher BCR i.e. 1.52 and 1.36 over Banket-A1 (1.19). As perceived by the farmers, Medium height with small internodal length, more leaf width and more leaf thickness, acceptable colour with spotting, more interval between the harvests, withstands delayed harvests, more stem girth and withstands strong winds are the advantageous characteristics of YB-4. Further stated YB-4 has given superior yield coupled with quality as compared to that of YB-10 and better control Banket A-1 and realized more prices in the market. YB-4 is acceptable to all the situations. Hence, preference for YB-4 over YB-10 and better control Banket A-1. YB-10 appears to be dark cast in nature with more internodal length was affected more due to heavy rains.

Assessment of N and K fertilization in NLS area of Andhra Pradesh *[CTRI, Rajahmundry]*

Y. Subbaiah, D. Damodar Reddy, V. Krishnamurthy and M. Anuradha

Effect of interventions in fertilization strategy on tobacco yield and quality: Recommended N and K fertilization practice along with farmers' practice and two refined interventions were assessed on the farmers' fields. Four treatments viz., farmers practice, recommended practice, refined intervention-I and refined intervention-II were formulated and assessed. In the refined intervention-I potassium was applied in 4 splits at 10, 25, 40 and 70 DAT. In the refined intervention-II, potassium was applied in four splits at 10, 30, 50 and 70 DAT and nitrogen was applied in 3 splits at 10, 30 and 50 DAT. Application time & numbers of splits are modified for K and application time is modified for N.

Superior cured leaf yield was recorded in recommended practice (1628 kg/ha), refined intervention I (1679 kg/ha) and refined intervention II (1696 kg/ha). The yield improvement over farmers practice (1470 kg/ha) was 10.8, 14.2 and 15.4%, respectively. The refined interventions I and II out yielded recommended practice by 3.05 and 4.13%, respectively. Superior bright grade outturn was recorded in recommended practice (72.65%), refined intervention-I (81.58%) & refined intervention-II (75.22%). Reducing sugars / nicotine ratio in both the X and L positions of recommended practice and refined intervention I was markedly higher and more desirable. Recommended practice, refined intervention-I and refined intervention-II recorded markedly higher BCR i.e. 1.51, 1.56 and 1.57 over farmers' practice (1.29). Further, refined intervention-I and refined intervention-II exhibited slight increase of BCR over recommended practice.

A critical analysis of resource utilization in NLS and SLS FCV tobacco growing areas of Andhra Pradesh *[CTRI, Rajahmundry]*

Y. Subbaiah, S.K. Naidu and K. Varalakshmi

Resource utilization in NLS and SLS: Attempted to measure the productivity in FCV tobacco in terms of the efficiency with which different factor inputs are converted to output. A well structured schedule was developed and pre-tested out of the dominance to ascertain the data on available bio-physical and socio-economic resources. Micro-zones, villages and respondents were selected through multistage random sampling procedure. Data collection on utilization of farm resources, socio-personal, situational and economic parameters is in progress.

Technology dissemination through diagnostic visits: Suitable technologies were identified for demonstration and transfer through diagnostic visits in NLS, NBS, Sabari Lanka tobacco and burley tobacco growing areas. Required technologies included balanced N & K fertilization, *in-situ* green manuring, topping time, management of black shank, pesticide application technology, use of curometers & energy saving techniques for NLS; intercultures,

management of *Orobanche*, management of viral diseases, pesticide application technology, use of curometers & energy saving techniques for NBS area; selection of seedlings, spacing, 'K' fertilization, management of black shank, stem borer & leaf curl and NTRM for burley tobacco area; spacing, N & K fertilization, chemical control of suckers, management of black shank & tobacco caterpillar for lanka tobacco growing region.

Decision support system for transfer of technology *[CTRI, Rajahmundry]*

H. Ravi Sankar, Y. Subbaiah and V. Krishnamurthy

Database creation and management for transfer of technology on tobacco production: The database for effective transfer of technology in FCV tobacco production was created and software in the form of website with main parameters viz., cultivars, field preparation and transplantation, field crop management, harvesting and post-harvest management was developed. Each parameter consists of various sub-parameters which are designed as web pages. For example, the parameter field 'Crop management' consists of sub-parameters viz., fertilizer management, cultural practices, integrated pest management, disease management, irrigation management, topping and desuckering and green leaf management.

Empowerment of tribals through agro-ecological conservation and biotechnological approaches in East Godavari District of Andhra Pradesh (Funded by DBT) *[CTRI, Rajahmundry]*

K. Suman Kalyani, V. Krishnamurthy and C. Chandrasekhara Rao

Impact of technology demonstration and scientific interventions in tribal region of East Godavari District: This project was implemented in the tribal area of Rampachodavaram mandal of East Godavari District. A total of 13 Front Line Demonstrations and twenty two training programmes were conducted during the year. Extension activities viz., 2 kisan melas, 4 field days, 12 diagnostics visits, 6 method demonstrations were conducted for effective adoption of the improved technologies. The yield and productivity of the field crops were increased. An additional yield up to an extent of 800-1000 kg/ha in Paddy, 30% yield improvement in cashew were observed. The family income level of the tribal families were significantly improved to an extent of Rs. 10, 000 – 15, 000/- per annum. The seed village concept was popularized in Bandapalle and Pedagaddada villages where the seed was multiplied and supplied to the entire villages. The paddy row seeder technique has saved the time and labour cost. Health and nutritional status of the tribal population in adopted villages was improved significantly. By the introduction of bio-gas units the family expenditure on fuel consumption, pollution, other associated health problems and deforestation were minimized. The farming system was intensified with the poultry, kitchen gardening and horticultural components. As a result of breed up-gradation programme, milk yields in cattle (5 litres per day) and egg laying capacity in poultry (120 – 150 eggs per year) were improved. After introduction of agricultural implements (dry land weeders, pedal operated winnowing fans) the drudgery of farm women was reduced to an extent of 50% and efficiency of farm work was improved.

Education and Training

Central Tobacco Research Institute has organized different extension activities viz., trainings, Scientist-farmer interface meetings, field days, *kisan melas*, exhibitions, workshops and meetings. Added emphasis has been accorded for collaborative activities with Tobacco Board, Tobacco Industry, State Line departments and Agricultural Universities to achieve increased productivity, enhanced quality and to get more net returns at real farm situation.

S.No.	Training imparted	Resource person	Date and place
1.	Paddy Field Crop Management Practices	Dr. K. Suman Kalyani	27.04.2011, Pedageddada village
2.	Nursery management	Dr. M. Mahadevaswamy	11.05.2011 at Ballenahally & Kampalapura and 25.05.2011 at H.M.Patna
3.	Nursery management	Dr. S. Ramakrishnan	18.05.2011 at Somanahally & Bannikuppe
4.	Nursery management	Dr. P. Venkateswarlu	25.5.2011 at Kampalapura and 30.5.2011 at Hunsur
5.	Nursery management	Dr. S. Ramakrishnan	01.06.2011 at Madugirikoppalu Bannikuppe
6.	Nursery management/ Field crop management	Dr. M. Mahadevaswamy	01.06.2011 at Bellathur & Chittenahally, 09.06.2011 Adaganahally, Adagur, 15.06.2011 at Sanyasipura & Aishwal and 29.06.2011 at Ayaithnahally, Nandipura, Kelaganahally, Thammadahally
7.	Field crop management	Dr. S. Ramakrishnan	15.06.2011 at Ramenahally and 22.06.2011 at Reddykoppalu & Beejaganahally
8.	Field crop management	Dr. P. Venkateswarlu	29.6.2011 at Kallahalli, Kanagalu & Heggandur
9.	Field crop management	Dr. C. Mahadeva	06.07.2011 at Dalagowdanahally, Badikyathanahally & Hangal
10.	PHPM	Dr. S. Ramakrishnan	06.07.2011 at Elemudanahally & Bachally

S.No.	Training imparted	Resource person	Date and place
11.	Field crop management	Dr. C. Mahadeva	13.07.2011 at Mardur & Guddenahally
12.	Field crop management / PHPM	Dr. M. Mahadevaswamy	13.07.2011 at Adaganahally & Harnahally and 21.07.2011 at Malangi, Bellathur & Kampalapura
13.	Field crop management	Dr. P. Venkateswarlu	13.7.2011 at Kalabuchanahalli, Kademanuganahally & Panchavalli and 10.8.2011 at Hunsur
14.	Field crop management	Dr. C. Mahadeva	20.07.2011 at Mundagodu, 22.07.2011 at Dadadahally, Thathanahally & Madihally and 27.07.2011 at Hagadahally
15.	OFT/PHPM	Dr. S. Ramakrishnan	20.07.2011 at Harave & Ramenahally
16.	Field crop management/ OFT	Dr. M. Mahadevaswamy	27.07.2011 at HM Patna, Sanyasipura & Ayaithnahally
17.	OFT/PHPM	Dr. S. Ramakrishnan	27.07.2011 at Nanjenayakanahally
18.	PHPM	Dr. C. Mahadeva	09.08.2011 at Nilangala and 19.08.2011 at Siddapura & Chikka bemmathi
19.	PHPM	Dr. P. Venkateswarlu	7.9.2011 at Harinahally & Kalabuchanahalli
20.	PHPM	Dr. M. Mahadevaswamy	09.09.2011 at Thammadahally
21.	OFT	Dr. M. Mahadevaswamy	12.09.2011 at Thippalapura & Niluvagilu and 13.09.2011 at NDG Koppalu & Gorahally
22.	OFT	Dr. P. Venkateswarlu	14.9.2011 at Bekya
23.	Seed bed preparation, nursery management, pest & disease control in seed bed	Dr. K. Nageswara Rao	16.09.2011 at Jeelugumilli, Aswaraopeta & Utlapalli villages
24.	Nursery management, pest & disease control in seed beds	Dr. S.V. Krishna Reddy Dr. R.K. Ghosh Dr. S.K. Dam	22.09.2011 at Bandapuram, Pallantla, Krishnampalem and Sangaigudem villages

S.No.	Training imparted	Resource person	Date and place
25.	Tobacco nursery management	Dr. Y. Subbaiah	22.09.2011 at Bandapuram, Krishnampalem, Sangaigudem
26.	Nursery management	Dr. G. Raghupathi Rao S. Nageswara Rao	26.09.2011 at Mettagudem, M.V. Gudem, Mariagudem, Markendeyapuram
27.	Nursery management	Dr. S.V. Krishna Reddy Dr. R.K. Ghosh	28.09.2011 at Dippakayalapadu, K. Kannapuram villages
28.	Nursery management	Dr. S. Gunneswara Rao	28.09.2011 at Gopalapuram
29.	Seed bed preparation, nursery management, pest & disease control in seed beds	M. Nageswara Rao	30.09.2011 at Rajahmundry rural and Dommeru
30.	Fertiliser application, intercultural operations, irrigation management and IPM in FCV tobacco	Dr. S.V. Krishna Reddy S. Nageswara Rao	03.11.2011 at Pothavaram and Yerrampeta
31.	Main field preparation, fertilizer application, ridge information, plantings, interculti-vation, IPM & irrigations	Dr. S. Kasturi Krishna Dr. M. Anuradha	09.11.2011 at Gandhinagaram, Cherukumilli and Krishnampalem
32.	Main field, fertilizer application, ridge formation, interculti-vations, IPM and irrigations	Dr. S.V. Krishna Reddy Dr. S.K. Dam	25.11.2011 at Chinnaigudem, Vadlakunta, Gopalapura, V.Ch. Gudem, Peddapuram and Chityala
33.	Main field, fertilizer application, ridge formation, interculti-vations, IPM and irrigations	Dr. S. Kasturi Krishna Dr. S.K. Dam	02.12.2011 under Jangareddygudem-II auction platform jurisdiction
34.	Visit the tobacco nursery areas of farmers' main fields and advice on various matters along with Tobacco Board officers	S. Nageswara Rao M. Nageswara Rao Dr. S.K. Dam	Devarapalli, Gopalapuram, JR Gudem-I & II, Koyyalagudem & Thorredu in SBS area

S.No.	Training imparted	Resource person	Date and place
35.	Main field preparation, fertiliser application, plantings, inter-cultivations & IPM	Dr. K. Sarala Dr. D.V. Subhashini	16.12.2011 at Vadisileru and Butchempeta villages
36.	Main field management, control of pest & disease and topping & desuckering	Dr. G. Raghupathi Rao Dr. S. Gunneswara Rao	28.12.2011 at Reddyganapavaram, Surapuvarigudem & Pattennapalem
37.	Topping, de-suckering, harvesting, curing, grading & PMPM operation	S. Nageswara Rao M. Nageswara Rao	18.01.2012 under JR Gudem-II jurisdiction and 27.01.2012 at Bandapuram and Sangaigudem villages
38.	Harvestings & curings	Dr. K. Nageswara Rao	09.02.2012 at Vadullakunta, Gopalapuram and Rajampalem villages
39.	Training programme on 'Extension and developmental schemes on harvesting, curing, grading & PHPM & NTRM	Dr. S. Kasturi Krishna	24.02.2012 at Ragolapalli, Pochavaram and Thadipudi villages
40.	On-farm trial	Dr. K. Sarala	01.03.2012 at Routhugudem
41.	Field Day	Dr. S. Gunneswara Rao	09.03.2012 at Katavaram village and 20.03.2012 at Gopalapuram
42.	Field Day	Dr. K. Nageswara Rao	14.03.2012 at Pothavaram village
43.	Field Day	Dr. Y. Subbaiah	16.03.2012 at T. Kattupalli village
44.	Training on "Elimination of NTRMs in tobacco"	M. Nageswara Rao	31.03.2012 at Jangareddygudem

Field Friends Programmes

S. Nageswara Rao, Dr. M. Nageswara Rao. Dr. S.K. Dam, B. Krishna Kumar, M. V. Jaya Krishna, I. Jagadish Chandra and D. Bala Krishna Technical Officers and Technicians of CTRI, Rajahmundry & CTRI RS, Guntur & Kandukur were nominated in the 'Field Friends Programme' organized by Tobacco Board, consisting of Tobacco Board Officers and Executives from the trade to visit the tobacco nursery areas and main fields to advise the growers on various aspects of tobacco nursery in NBS, NLS, SBS, SLS and ELS areas.

VISITS BY MONITORING TEAM

- Director, CTRI and Nodal Officer, AINRPT visited the farmers' field and AINRPT experiments at Araul centre during 13-16 April, 2011.
- Project Monitoring and Evaluation Committee with Dr. V. Krishnamurthy, Director, CTRI as the Chairman and the Heads of Divisions, Nodal Officer, AINRPT and PSO as Members visited CTRI Research Station, Hunsur to monitor the progress of research work being carried out under the Institute and AINRPT projects and also to survey the FCV tobacco growing areas in KLS during August 3-6, 2011.
- The Project Monitoring and Evaluation Committee visited CTRI Research Station, Jeelugumilli on 04.02.2012 to monitor the progress of research work being conducted under Institute and AINRPT projects.
- The Project Monitoring and Evaluation Committee visited CTRI Research Stations, Guntur and Kandukur on 13th and 14th February, 2012 to monitor the progress of research work being conducted under Institute and AINRPT projects.

Field Days

Date	Theme of the Field Day	Place / Village
08.02.2012	Performance of new variety, use of bio-fertilizers and IPM practices	Krishnampalem under Tobacco Board APF, Devarapalli.
23-02-2012	Performance of new variety, use of bio-fertilizers, vermi-compost and IPM practices	Ramanujapuram under Tobacco Board APF, Jangareddygudem-1
16.03.2012	New variety and use of bio-fertilizers in FCV	T. Kothapalli village under Tobacco Board APF, Koyyalagudem.

TV PROGRAMMES

- E-TV (Annadata Bangla) telecast on tobacco nursery and it's after care - S.Chanda, Technical Officer, T5 on 19.10.2011
- E-TV (Annadata Bangla) telecast on Disease management of brown spot of tobacco - Dr. S.Roy, Principal Scientist (Plant Pathology) on 14.02.2012
- E-TV (Annadata Bangla) telecast on Disease management of mosaic disease of tobacco - Dr. S.Roy, Principal Scientist (Plant Pathology) on 15.02.2012
- E-TV (Annadata Bangla) telecast on Disease management of mosaic disease of tobacco - Dr. S.Roy, Principal Scientist (Plant Pathology) on 16.02.2012
- E-TV (Annadata Bangla) telecast on Disease management of mosaic disease of tobacco - Dr. S.Roy, Principal Scientist (Plant Pathology) on 03.03.2012
- E-TV (Annadata Bangla) telecast on Harvesting and curing operations in tobacco - S.Chanda, Technical Officer, T5 on 18.03.2012

Krishi Vigyan Kendra, Kalavacharla

The Krishi Vigyan Kendra of CTRI working under the aegis of Indian Council of Agricultural Research, New Delhi was established in 1983. It has disseminated proven scientific know –how and viable technologies relating to agriculture and allied sectors including off-farm income generating activities in the East Godavari District of Andhra Pradesh. The KVK's approach to the technology transfer and sensitizing farming community on various farm related activities is through conducting/organizing on-farm trials, FLDs, training programmes, developing entrepreneurship among rural youth etc. The salient achievements and other activities of KVK during the period under report are enlisted below:

- A total number of 13 OFTs and 32 FLDs were conducted
- A total of 145 training programmes (both on and off campus) were organized covering 5,840 beneficiaries.
- Rice Variety JGL-11470 and Mugad Siri-1253 recorded 12% and 16% higher yields, respectively over the local check BPT-5204.
- Direct sowing through Drum seeder technology advanced the maturity of rice crop by 10 days and cut down the labour cost by Rs.10, 300/- per ha.

- Integrated crop management in rice recorded 15.6% increase in yields over farmer's practice.
- China Aster 'Kamini' recorded higher yields (6.44 t/ha) over local Chrysanthemum (6.20 t/ha) in irrigated black soils.
- Supplementation of nutrients and growth hormone in mango crop resulted in higher yields with cost benefit ratio of 1:3.3 over farmer's practice 1:2.1.
- In tapioca, 90% reduction in incidence of scale insect damage was achieved by spraying of neem oil @ 5 ml/lit and malathion @ 2 ml/l at 20-30 days interval.
- Mites and thrips management in chilli increased the green chilli yield by 28%.
- A total of 30 demonstrations on pulse production in the district were undertaken. In these demonstrations, Blackgram var. LBG-752 showed 117% yield increase over the local check.
- CoFS-29 fodder seed (50 kg) was produced under seed village concept at Rangampet for supply to farmers.
- Coconut Husk Remover was designed and fabricated in collaboration with Bharatiya Kisan Sangh, Mukkamala and Rakhi Industries, Kakinada.
- Master Trainers were sent to Maredumilli, Devarapalli, J.Kothuru (Srikakulam) and Kothapalli (Rajavommangi) villages, to impart training on Bamboo Sheath Cup making.
- Fodder block with different varieties of fodder was maintained and 22 tonnes of fodder slips were supplied to farmers.

- Two district level seminars on Cashew and Cocoa were conducted in collaboration with the Directorate of Cashewnut and Cocoa Development (DCCD), Cochin, on 22.2.2012 and 27.3.2012.

- Two days training programme on 'Cashew Apple Utilisation' was organized during May 5-6th, 2011 to rural unemployed women.
- Implemented orientation training programmes on Food & Nutrition to Gross root level personnel of ICDS in collaboration with Community Food & Nutrition Extension Unit, Govt. of India.
- Vocational training programmes on making of 2-ply coir yarn, leaf plate, bamboo sheath cups, garments, hill broom making and maggam embroidery were conducted for providing livelihood opportunities to rural women.
- SAC meetings were conducted both in *Rabi* and *Kharif* seasons on 14.10.2011 and 10.04.2012.

- Implemented mobile advisory service to farmers on various disciplines.
- Technology Week was celebrated in collaboration with ATMA from 24.1.2012 to 30.01.2012 with different themes and popularized improved production technologies of various crops.
- A total number of 31 Banana Fibre Extraction machines were supplied to different entrepreneurs.
- Produced and supplied 66.5 quintals of paddy seed to needy farmers.
- Supplied 5,717 fertile eggs of poultry birds and 1,525 fertile eggs of turkey to popularize backyard poultry in the district.
- A total number of 1343 mango grafts and 4,683 cashew grafts were supplied to needy farmers.
- Produced and supplied 241.25 quintals of sugarcane seed material to farmers.

Awards and Recognitions

- Dr. K. Prabhakara Rao, Scientist, Div. of Crop Improvement received "Pran Vohra Award" of the Indian Science Congress Association (ISCA) for the year 2011-12 presented during the 99th Indian Science Congress held at KIIT University, Bhubaneswar from January 3-7, 2012.

- Dr. S. Amarnath, Principal Scientist and Head, CTRI RS, Dinhata (West Bengal) was elected Fellow of the Indian Society of Tobacco Science at the XIV National Symposium on Tobacco held at CTRI, Rajahmundry, India from 20-22 December, 2011.

- Dr. K. Siva Raju, Principal Scientist was elected Fellow of the Indian Society of Tobacco Science at the XIV National Symposium on Tobacco held at CTRI, Rajahmundry, India from 20-22 December, 2011.

- ISTS Award for outstanding contribution in tobacco research and development for the research paper "Characteristics of seed oil and nutritional composition of seed cake in Indian tobacco" was presented to Dr. K. Sivaraju, Dr. C.V.Narasimha Rao and Dr. V. Krishnamurthy during the XIV National Symposium on Tobacco held at CTRI, Rajahmundry, India from 20-22 December, 2011.

- The paper entitled 'Indigenous Technical Knowledge in the Tribal area of East Godavari District' presented by Dr. K. Suman Kalyani got the best paper award at V National Seminar on 'Multi-sectoral Innovations for Rural Prosperity', organized by Society for Community Mobilization for Sustainable Development' held at NDRI, Karnal from 19-21 May, 2011 and was selected for best paper presentation Award - 2011.

- KVK-East Godavari was chosen to display its success stories in the exhibition at the 6th National Conference of KVKs held during 3-5th December, 2011 at JNKVV, Jabalpur (M.P).

- KVK-East Godavari Exhibition stall won the second best prize in 'Global Conference on Women in Agriculture' held at New Delhi during 13.3.2012 to 15.3.2012. The award was presented by Her Excellency Dr(Smt.) Prathibha Singh Patil, President of India.

Linkages and Collaborations

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

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

Sl. No.	Name of the Collaborating Agency	Project title/Activity
a) National Institutes/Agricultural Universities		
1.	Ministry of Health & Family Welfare, Govt. of India, New Delhi	Pilot project on "Alternative crops to *Bidi* and Chewing tobacco in different AESRs in the country"
2.	Bureau of Indian Standards, New Delhi	Development of Indian standards for tobacco and tobacco products
3.	Department of Biotechnology, New Delhi	Empowerment of tribals through agro-ecological conservation and bio-technological approaches in East Godavari district of Andhra Pradesh
4.	Tobacco Board, Guntur	Field Friends Programmes and on-farm trials for improving yield and quality of FCV tobacco in different zones
5.	National Bureau of Soil Survey & Land Use Planning, Nagpur	Soil resource mapping of tobacco growing soils in India
6.	National Bureau of Plant Genetic Resources, New Delhi	National Active Germplasm Site (NAGS)
7.	Directorate of Oil Palm Research, Pedavegi	Production technology for oil palm and intercropping of FCV tobacco in oil palm
8.	Department of Agriculture in different states	Transfer of technology in non-FCV types and supply of inputs
9.	Indian Meteorology Dept., Pune	Maintenance of meteorological observatories at different Stations
10.	M/s ITC Ltd. ABD-ILTD M/s. Godfrey Phillips India Ltd., M/s. VST Industries Ltd. and ITA, Guntur	Research and development activities, organising training programmes, field trials on latest packages, variety release proposals, manufacturing tests and storage tests
11.	PDBC, Bangalore	Coordinated trials in Biological control
(b) International Institutions		
1.	CORESTA, France	Evaluation of pest and disease resistant varieties
2.	ISO-TC126, Berlin, Germany	Development of international standards for tobacco and tobacco products

All India Network Research Project on Tobacco

Salient research findings emanated from the experiments conducted at different centres of AINRPT (Rajahmundry, Anand, Shimoga, Nipani, Nandyal, Berhampur, Araul, Hunsur, Guntur, Dinhata, Ladol, Kandukur, Jeelugumilli and Vedasandur) during the period under report are summarized below.

The most promising lines identified in Co-ordinated varietal trials (IVT & AVT) conducted at different Centres are listed in Table 1 & 2.

Table 1: Initial Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	TBST-16, TBST-17, TBST-2B
Kandukur	TBST-17, V-4344, NLST-6
Hunsur	Tobios-2, Tobios-3, NLST-3, NLST-4, TBST-2B
Jeelugumilli	Tobios-6, Tobios-7, NLST-5, NLST-6
Natu tobacco	
Berhampur	Sel 47
Bidi tobacco	
Anand	ABD 119, ABD 120, ABD 122
Araul	ABD 119, ABD 120, ArBD-04
Nandyal	ABD 115, ABD 116, ABD 118
***Rustica* tobacco**	
Anand	AR 104
Araul	LR 68, ArR-24
Ladol	ArR 24, LR 65, LR 67

Table 2: Advanced Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	TBST 2, NLST-3 & HYBRID: SH 1
Kandukur	TBST-2, V-4278 & HYBRID: SH 1
Hunsur	FCH 196, FCH 196 & HYBRIDS: KLSH 10, CH 96
Jeelugumilli	Tobios-2, NLST-3, NLST-4, NLST 2, FCH 221, FCH 222, A-13
Bidi tobacco	
Anand	ABD 115, ABD 116, ABD 117, ABD 118
Araul	ABD 115, SB 154,
Nandyal	ABD 112, ABD 115, ABD 116
***Rustica* tobacco**	
Anand	AR 100, LR 64
Ladol	LR 58
Dinhata	LR 62
***Chewing* tobacco**	
Dinhata	DJ 1

Centre-wise research achievements

ANAND

- In bidi tobacco, the entries ABD 119, 120 and ABD 122 in IVT, ABD 115, ABD 116, ABD 117 and ABD 118 in AVT, showed significant superiority for cured leaf yield over respective better checks. The Line ABD 101 showed significant superiority for cured leaf yield over better checks GT 4 and GT 7 in the drought trial.

- In *rustica* tobacco, the Line AR 104 in IVT and AR 100 & LR 64 in AVT registered maximum yield.

- The nicotine content was significantly highest with application of 12.5 t FYM/ ha every year and 180 kg N /ha from AS, 90 kg P_2O_5 /ha from SSP, 135 kg K_2O/ ha from SOP. Application of bulky manures significantly improved the potassium content compared to no bulky manure. All the bulky manures significantly improved the organic carbon, phosphorus and potassium status of soil.

- Topping and nitrogen levels did not exert significant effects on yield and yield attributes of bidi tobacco variety ABT 10. However, the topping levels significantly influenced the nicotine and reducing sugars contents.

- Significantly higher yield (2957 kg/ha) was obtained with MRGTH 1 variety and it was at par with GT 7. Significantly the highest yield (2,881 kg/ha) was observed under August 3rd week, planting.

- Covering with green net 75% recorded significantly higher transplantable seedlings in bidi tobacco nursery.

- Application of sulphur @ 40 kg S/ha recorded significantly higher seed yield, oil yield and *khakhri* yield in bidi tobacco.

- Bidi hybrid MRGTH 1 recorded significantly higher green leaf and protein yield at 90 days after transplanting. All the yield parameters increased significantly with N application up to 260 kg N / ha.

- IPM module involving castor or marigold as trap crops and one spray of NSKS 2% reduced *S. litura* damage up to 34.60% over unsprayed control plot besides increasing the activity of natural enemies in bidi tobacco.

- Lowest (10.79/plant) mealy bug population was observed on the plants treated with phenthoate @ 0.1%.

- In a trial on evaluation of new fungicides for the management of frog-eye disease in bidi tobacco nursery the results revealed that application of fungicides significantly reduced frog-eye spot disease compared to control with minimum disease in the treatment of carbendazim 12% + mancozeb 63% @ 0.225 %.

ARAUL

- In AVT-I on Bidi tobacco, two entries viz., SB-154 and ABD-115 were found significantly superior in yield to the checks A-119 and K-Local.

- In IVT (Bidi) the lines viz., ABD-120, ABD-119 & ArBD-04 were significantly superior in yield to checks A-119 and K-Local.

- In IVT on *Hookah* tobacco, two entries viz., LR-68 and ArR-24 proved their significant superiority in yield over the better check, ST-1.

BERHAMPUR

- Among nine genotypes of *pikka* tobacco tested during *Kharif* 2010, Sel-47 produced highest cured leaf yield (1,333 kg/ha) which is 16% higher yield over the check variety 'Gajapati' (1,148 kg/ha) and significantly superior over the rest of the entries.

- A three year experimentation, on use of vermicompost indicated that application of vermicompost @ 2.0 t/ha +RDF (80-40-40 NPK kg /ha) recorded the highest cured leaf yield of 1,398 kg/ha with a B:C ratio of about 1.71. It can be recommended for cultivation of Pikka tobacco variety Gajpathi.

- Cured leaf yield increased with increase in nitrogen level from 0 to 120 kg /ha and was maximum at 120 kg/ha (1,205 kg/ha). The cured leaf yield also increased with increase in potassium level from 0 to 90 kg /ha and was maximum at 90 kg/ha (1,040 kg /ha) which was at par with 60 kg K/ha. Application of 120-40-90 kg NPK/ha

recorded the highest cured leaf yield of 1420 kg/ha and was 167% higher over 0-40-0 NPK kg/ha and was at par with 120-40-60 NPK kg/ha (1390 kg cured leaf /ha), 80-40-90 NPK kg/ha (1365 kg/ha). The highest net return of ‘ 23,885/ha was obtained from 120-40-90 NPK kg/ha followed by 80-40-90 NPK kg/ha (‘ 23195/ha). B:C was highest 1.56 with 80-40-90 NPK kg/ha.

- Planting on 1st August with a spacing of 75 x 50 cm recorded highest cured leaf yield of 1,335 kg/ ha with net return of ‘ 17,470/ha and B:C ratio of 1.77 which is at par with planting on 10th August planting.

DINHATA

- In IVT on *rustica* tobacco, two lines viz., LR-68 and ArR-24 exhibited significantly higher (35% and 27%) cured leaf yield, than the best control Dharla. However, the first grade leaf outturn was significantly inferior to the controls.

- In AVT-I on *rustica* tobacco, line LR-62 exhibited about 16% significantly higher cured leaf yield but exhibited significantly inferior yield of first grade leaf over the control.

- In the advanced varietal trial (2009-11), the chewing tobacco line DJ-1 showed significantly superior performance with 35 & 28% higher cured and first grade leaf yield, respectively over the check variety, Podali.

- In multi-location evaluation also, line DJ-1 exhibited superior performance with 70, 82 and 7% higher cured, first grade leaf yields and quality leaf outturn, respectively over the control.

GUNTUR

- In Advanced Varietal Trial-II, the advanced breeding line TBST-2 out yielded all the three checks i.e., Hemadri, VT-1158, Siri in all the four yield characters (green, cured and bright leaf yields and grade index).

- In the Advanced Varietal Trial-II with Hybrids, the entry SH-1 recorded significantly high green leaf, cured leaf and bright leaf yields and grade index in comparison to checks Hemadri , VT-1158, and Siri

- In AVT 1 the entry NLST-3 out yielded all the entries including the three checks i.e. Hemadri, VT-1158, Siri in all the four yield characters.

- In the Initial Varietal Trial, three entries viz., TBST-16, TBST-17 and TBST-2B yielded significantly higher green, cured and bright leaf yields and grade index over the check varieties.

- *S. litura* and Aphid incidence is observed to be negligible in all the entries evaluated in different trials conducted while, mild incidence of TMV and leaf curl was observed in most of the entries tested in different trials.

HUNSUR

- The brown spot disease resistant line FCH 210 as well as *Fusarium* wilt resistant lines FCH 221 & FCH 222 registered superiority over Kanchan in yield parameters, with a potentiality of > 2200 kg/ha cured leaf yield.

- Two CMS hybrids, KLSH 10 and CH 96 recorded 6 to 10% standard heterosis over check variety Kanchan, with a production potential of >2200 kg/ha during the first year of Advanced Varietal Trial.

- Eleven new entries under Initial Varietal Trial were found highly susceptible to *Fusarium* wilt disease under natural conditions.

- Five IVT entries viz., Tobios2, Tobios3, NLST3, NLST4 and TBST 2B were found promising and promoted to AVT.

- Application of nematode egg parasitic fungi, *Paecilomyces lilacinus* in combination with

poultry manure in FCV tobacco nursery beds caused 58% reduction in root-knot index and was on par with *P. lilacinus* in combination with neem cake (57%) as compared to untreated check. Subsequent increase in root-knot free and healthy transplants count was to the tune of 59% and 55% respectively.

JEELUGUMILLI

- Among the 14 entries evaluated in IVT, eight lines recorded significantly superior leaf yield over the check variety, Kanchan with an increase of 13 to 48% in green leaf yield, 37 to 79% in cured leaf yield and 21 to 85% in grade index respectively. Also, one line TOBIOS-6 recorded significantly higher cured leaf yield and grade index than Kanchan. On the basis of plant and leaf type and acceptability, four lines viz., TOBIOS-6, TOBIOS-7, NLST-5 and NLST-6 were identified for the Advanced Varietal Trial.
- In AVT-1, all the three test lines TOBIOS-2, NLST-3 and NLST-4 showed significant improvement over Kanchan for leaf yield. The increase was 27-56% for green leaf yield, 31-60% for cured leaf yield and 36-81% for grade index over Kanchan
- Pooled analysis of AVT indicated that three advanced breeding lines viz., NLST-2, FCH-222 and FCH-221 showed significant superiority over check, Kanchan for all the three leaf yield traits. They recorded 15-16% increase in green leaf yield, 12-21% in cured leaf and 8-21% in grade index, over the check kanchan. Also, the fourth entry, A-13 recorded higher yield than check, Kanchan with 15% and 14% increase respectively for green and cured leaf.

KANDUKUR

- In AVT-2, the test line TBST-2 was significantly superior to best check variety Siri and showed 32 to 45% increase for different yield characters.
- In AVT-1, line V-4278 was significantly superior to the best check variety Siri for all the four leaf yield traits.
- In the AVT-1 trial with hybrids, SH-1 was significantly superior to the best check variety Siri.
- In IVT three test lines, viz., TBST-17, V-4344 and NLST-6 were significantly superior to the best check variety Siri for all the four leaf yield traits.

LADOL

- In AVT-II trial, line LR 58 out yielded (6094 kg/ha) with 18.05 percent increase.
- In IVT, the entry ArR 24 recorded 10% high cured leaf yield (5636 kg/ha) over best check DCT 4 (5105 kg/ha). This was followed by LR 65 (5579 kg/ha) and LR 67 (5404 kg/ha).
- In Initial Evaluation trial, with twelve *nicotiana* entries, LR 09-3, LR 09-10 and LR 09-4 showed consistently superior performance over check variety and were selected for promotion to IVT.

NANDYAL

- In Advanced Varietal Trial I of Bidi tobacco, lines, ABD 115 (1480 kg/ha), ABD 116 (1391 kg/ha) recorded significantly higher cured leaf yield than check A 119 (943 kg/ha).
- In Advanced Varietal Trial – II (Bidi), significantly higher cured leaf yield was recorded by ABD 112 (1026 kg/ha) over the check A 119 (674 kg/ha).
- In Bulk Yield Trial, line NBD 154 recorded higher cured leaf yield of 1,117 kg/ha, against 933 kg in A 119.
- In On Farm Trial, line NBD 119 recorded higher cured leaf yield (1,284 kg/ha) than the check variety A 119 (1040 kg).

- Among the different cropping systems tried as alternative cropping systems for Bidi tobacco growing areas, Maize- Blackgram has recorded significantly higher tobacco equivalent yields (2294 Kg/ha) and higher Net returns (‘ 64, 443/- per ha) with B.C. ratio of 3.14 followed by maize-sunflower with TEY of 2203 Kg/ha and net returns of ‘ 57, 847/- per ha. Significantly lower TEY (875 kg/ha), lower net returns (‘ 14,875/- per ha) with B.C. ratio of 0.85 was recorded with Fallow-Tobacco cropping systems.

- Post harvest soil analysis of the *Kharif* crops revealed higher available N content after soybean crop when compared with foxtail millet and maize crops both under surface (0-15 cm) and subsurface (15-30 cm). Higher available N was observed under Red gram, Black gram and Bengal gram under surface soil analysis after *rabi* crops.

- Application of 130 Kg N/ha in organic-inorganic proportion of 25:75 with organic component of vermicompost recorded significantly higher plant height (42.3cm), Leaf length (37.1 cm), Leaf width (13.8 cm) and Cured leaf yield (994 kg/ha) and net returns (₹ 14,652/- per ha).

- Significantly higher leaf nicotine content (4.55%) and lower reducing sugars (4.37%) are recorded with application of 130 Kg N/ ha with 25% organic proportion of FYM and 75% in inorganic form.

- Post harvest soil analysis indicates higher available N status under Farm Yard Manure treatments compared to vermicompost and inorganic treatments.

- The pooled analysis of data on cured leaf yield for three years (2008-09 to 2010-11) indicates that higher cured leaf yield (1792 kg/ha) was recorded with application of 130 kg N/ha in organic – inorganic proportion of 25:75 with organic component of vermicompost.

- Significantly higher dry matter production (18.75 t/ha) and N (2.73%) were recorded in Daincha. Leaf length, leaf width and cured leaf yield (1,114 kg/ha) was recorded under the treatment of green manuring with Daincha along with application of RDF.

- During 2010-11, the studies of insect pests of tobacco revealed that grass hopper peak infestation (2.8%) was noticed 40th std. week. As in case of ground beetles maximum infestation 3.4% was noticed 41st std. week In case of *Spodoptera litura* peak incidence 8.8% was noticed during 44th standard week and *H. armigera* peak incidence 1 % was noticed during 2nd standard week. Aphid infestation started during 49th standard week and severe infestation noticed until up to harvesting stage of the crop and mealy bug was noticed during 6th std week i.e. at the time harvesting stage. With the increase in Aphid population during 49th std week, simultaneous increase of *Coccinellids* beetles population was noticed from 50th std week up to harvesting stage of the crop Peak *Coccinellids* beetles population 8.4% was noticed 5th std week.

- During 2010-11, in station Hybrid trials 16 entries were screened for the incidence of *S. litura* and aphids. Lowest (2.56) *Spodoptera litura* infestation was noticed on NyBTH 44 followed by NyBTH 57(5.71). In case of aphid 6 entries recorded zero score and 6 entries recorded 1 score and 4 entries recorded 2 score.

- In AVT 1 trial lowest (11.36) *Spodoptera litura* infestation was noticed ABD 117. In case of aphid all 5 entries recorded 1 score. In AVT 2 trial lowest (8.69) *Spodoptera litura* infestation was noticed in ABD 117. In case of aphid, all 3 entries recorded 1 score. In case of Bulk yield trial and on farm trial lowest (8.2) *Spodoptera litura* infestation was noticed in NBD 119. In case of aphid all 2 entries recorded one score.

NIPANI

- In the station trials, line NBD-239-2 and among hybrids NBTH-137 were promising for cured leaf yield.

- Variety A-145 produced maximum leaf and seed yield as compared to A-119 and GL-54. Closer spacing recorded higher leaf yield and fertilizer did not influence the leaf yield.

- The poultry manure can serve as an alternate source to farm yard manure and press mud as a bedding material in the nursery.

- The incidences of brown leaf spot disease positively correlated with rainfall, rainy days, minimum temperature and relative humidity prevailed during September and November months.

- The tobacco entry ABD-112 from Advanced Varietal Trial-I showed moderately resistant reaction against brown spot and root-knot diseases.

- The new fungicides Fenamidone 10% + Mancozeb 50 WG (Sectin 60 WG) @ 0.3% (3 g/l) and Azoxystrobin 23 SC (Amistar) @ 1 ml/l were equally effective to as that of recommended check fungicide Metalaxyl M 4% + Mancozeb 64% WP (Ridomil Gold 68 WP) @ 2.5 g/l in reducing the incidence of damping off disease and there by increasing the healthy transplantable seedlings.

- Out of four test entries in AVT I, ABD-112 (2120 kg/ha) produced significantly higher leaf yield as compared to check entries Bhavyashree (1825 kg/ha) and A-119 (1795 kg/ha).

- In IVT, out of six entries, ABD-115 recorded highest leaf yield (2365 kg/ha) and was significantly higher than ABD-116, SB-154 and A-119.

RAJAHMUNDRY

- Out of the fourteen lines evaluated in IVT, four entries viz., TBST-2B, TBST-11, V-4344 and TBST-16 showing 14 to 31% increase in leaf yield over best check Siri.

- In AVT II, TBST-2 recorded significantly superior green leaf (11962 kg/ha), Cured leaf (1608 kg/ha), Bright leaf (996 kg/ha) and grade index (1318 /ha) with 24, 18, 20 and 20 per cent improvement respectively over better check, Siri. Based on its superior performance in AVT, TBST-2 is proposed for testing in bulk plot trial during 2011-12 along with the control Siri.

- Among the lines tested in AVT I, V-4270 and V-4278 recorded significantly superior leaf yield with 7 to 16% increase over the better check, Siri for various traits.

- In AVT with hybrids, one fertile hybrid, SH-1 recorded higher leaf yield over better control Siri with 7 to 10% increase for various leaf yield traits.

SHIMOGA

- After two cycles of crop rotation, tobacco followed by tobacco performed best followed by tobacco - chillies harvested for green yield and tobacco-maize sequence.

- Coffee husk 150 kg + areca husk 300 kg + maize rinds 739 kg were successfully used for curing tobacco leaves. Wood along with coconut husk was also used successfully for traditional furnaces.

- Among the genotypes tested for lamina potassium content, hybrids CH 39 and CH 96 recorded higher laminar potassium content both in X and L positions as compared to other genotypes and check entries.

- Among the FCV tobacco genotypes tested using the PEG technique Sahyadri, Kanchan, NLST-6 and TBST-7 recorded higher pollen and seed germination. Among chewing tobacco genotypes, A 145 and Abirami recorded higher pollen and seed germination.

- Fifteen FCV tobacco entries were screened in sick plots for assessing their reaction to black shank disease. Observations revealed that among the entries screened only one entry, CH-3 was found resistant where as ten entries were showed moderate resistance.

- Out of 34 entries, screened for frog eye leaf spot disease, moderate resistance was observed in Sahyadri, TBST-18, Tobios-6, Kanchan, CH-39, Rathna x Cy-139, Cy-149 x Cy-139.

- Among the 15 germplasm/advanced breeding lines screened against root-knot nematode, Sahyadri (2.0), Thrupthi (2.3), Bhavya (2.3), V-4343 and CH-3 (2.6) recorded least root-knot indices.

- In the study on eco-friendly approaches for management of root-knot nematode, maximum cured leaf yield and TGE were recorded in treatment Vermicompost + Poultry manure + Neem cake (VC+PM+NC) which also recorded least RKI (1.2). Pooled analysis indicated that the treatment combination of VC+PM+NC recorded maximum cured leaf and TGE yield with least RKI (2.25).

- The treatment Vermicompost + Poultry manure + Neem cake (VC+PM+NC) recorded higher cured leaf yield, TGE, least RKI (1.2).

- In the study on efficacy of bioagents in integration with organic amendments for the disease management, it was observed that the treatment combination of *Paceliomyces* and Poultry manure yielded maximum transplants (633). Least root-knot index was observed in *Trichoderma* treated beds.

- In the study on management of tobacco budworm *Helicoverpa armigera* (Hubner), different biopesticides and synthetic groups were evaluated. Flubendiamide and spinosad performed better with respect to control in larval number as well as cured leaf yield.

- Maximum population of predatory bugs viz.; coccinellids; chrysopa; syrphids and spiders were found in tobacco, cotton, redgram, maize and marigold than bengalgram as observed in natural enemies through entomophage bio-diversity park.

Proposals for technology recommendations to the farming community

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

- For the effective management of black shank disease of tobacco in the field application of 2.5 kg *Trichoderma harzianum* a bio-control agent along with 4.5 tonnes of farm yard manure before transplanting to soil is promising. The results of the 11 trials on farmers field also indicate significant reduction in the incidence of black shank with the use of *Trichoderma*.

XX All India Network Research Project on Tobacco Workshop held during 30th September to 1st October, 2011

Empowerment of Women in Agriculture

To promote empowerment of women in rural and tribal areas, the following strategies are adopted for promoting home stead and micro enterprises in rural and tribal areas of East Godavari District.

Group approach, master trainer concept, multiple skill concept, family approach, trainee trader concept, linkage with financial institutions and regular follow-up visits are the strategies adopted.

- Banana Fibre Extraction : Two training programmes of one month duration each were conducted on extraction of banana fibre from banana pseudostems and peduncle and making of various types of house hold and decorative articles with fibre.

- Coir Unit: Three training programmes of one week duration were conducted for 40 rural women in extraction of coir fibre from coconut husk, making of 2-ply yarn over automatic machinery and making of different types of doormats.

Coir doormat making

- Eco friendly cups and plate making : Four training programmes of one week duration were conducted for 80 rural and tribal women on making of biodegradable eco friendly cups, tiffin and buffet plates with bamboo sheaths, leaves and paper.

Bamboosheath cups

- Maggam Embroidery : Two training programmes of two months duration each were conducted for 40 rural women in making embroidery with beads, kundans, mirrors etc., over fabric materials.

Maggam embroidery

- Value addition in cashew apple: Two training programmes were conducted for 50 rural women in preparation of squashes, jam and pickle with cashew apple.

- Bakery products: Long duration skill oriented training programmes were organized on 'Bakery products with minor millets' in Pedageddada and Thallapalem villages for one week i.e. 10.07.11 to 17.07.11. About 50 Tribal farm women were trained from these villages by which the women are earning additional family income.

- Nutrition and health education: Training was imparted to tribal farm women on 'Health and nutrition education', 'Backyard nutritional gardening' and 'Supplementary diets with locally available foods' on 12.08.2011, 18.08.11 & 02.09.11. High yielding varieties of vegetables (IIHR, Bangalore), orchards (banana, mango, coconut, papaya and guava) and greens (gogu, palak, coriander, methi and amaranthus) were supplied to the tribal backyards in order to provide vegetables through out the year and to enrich the quality of regular diets of the vulnerable groups.

Millet based value-added bakery products

- Value addition to MFP (Minor Forest Produce): Long duration skill oriented training programmes were organized on Adda leaf plate making and hillbroom making in Pedageddada and Devarapalle villages in the last fortnight of January 2012. About 50 tribal farm women were trained from these villages by which seasonal employment was provided. Technical backup and marketing assistance was provided in establishment of homestead units.

- Fruit and vegetable preservation techniques: Three training programmes were organized on fruit and vegetable preservation techniques in Chinageddada, Bandapalle and Thallapalem villages from on 20.02.12 to 22.02.12. About 75 Tribal farm women were trained and acquired skills in preservation technology.

Fruit preservation techniques

- Value added palm products : Training programme on 'Value added palm products' was organized at Pandirimamidi Horticultural Research Station, YSR Horticultural University. Twenty tribal women were imparted skills in preparation of tadi jaggery, tadi neera and tadi gelly.

- Drudgery Reduction through improved agricultural implements: Low cost, improved farm agricultural implements were popularized among farm women in tribal area. The pedal operated winnowing fan was developed in the project which is very simple, low cost, easily operated by single woman. The wind energy can be effectively used to winnow the paddy seed after threshing. The farm women were trained in operation of these drudgery reducing agricultural implements (dry land weeders, pedal operated winnowing fans, adda leaf plate making machine, paddy row seeder) by which the farm efficiency was enhanced and the occupational health hazards and drudgery of farm women were reduced.

List of Publications

Abrar A. Khan, S. Rama Krishnan, Mujeebur R. Khan, V. Krishnamurthy and S. Kausar. (2011). Nematode Infestation in tobacco. In "Nematode Infestations, Part II: Industrial Crops" (Eds. Mujeebur Rahman Khan & M. Shanim Jairajpuri). The National Academy of Sciences, Allahabad, India. pp.58-81.

Amarnath, S., V. Krishnamurthy, K. Deo Singh, S. Roy and R.L. Arya (2011). Torsa - A high yielding early maturing *Motihari* tobacco (*N. rustica* L.) variety for *Terai* region of West Bengal. Environment and Ecology 29(2): 639-42.

Arya, R.L., P. Harishu Kumar, S. Roy, C. Chandrasekhara Rao, S. Amarnath and S. Chanda (2011). Effect of integrated nutrient management on yield, quality and economics of *Motihari* tobacco (*Nicotiana rustica*) in Terai region of North Bengal. Tobacco Research 37(1):42-5.

Arya, R.L., V. Krishnamurthy, K.D. Singh, S. Amarnath, S. Roy and C. Chandrasekhara Rao (2011). Effect of spacing and fertilizer levels on seed yield of *Jati* tobacco under Terai region of west Bengal. Tobacco Research 37(1):18-21.

Arya, R.L., V. Krishnamurthy, S. Amarnath, S. Roy, C. Chandrasekhara Rao and S. Chanda (2011). Effect of spacing and topping levels on yield and quality of *Jati* tobacco (*Nicotiana tabacum*) grown in North Bengal. Tobacco Research 37(1):40-1.

Ghosh, R.K. and N. Singh (2012). Sorption of metolachlor and atrazine in flyash amended soils: Comparison of optimized isothom models. Journal of Environmental Science and Health, Part – B, 47: 718-727

Ghosh, R.K. and N. Singh (2012). Adsorption – desorption of metolachlor and atrazine in Indian soils: Effect of flyash amendments: Environmental Monitoring and Assessment [DOI. 10.1007/s10661-012-2671-4]

Hyun, T.K., K. Kumar, K.P. Rao, A.K. Sinha and T. Roitsch (2011). Role of á-tocopherol in cellular signaling: á-tocopherol inhibits stress induced mitogen activated protein kinase activation. *Plant Biotechnology Reports* 5(1):19-25.

Kasturi Krishna, S., S. V. Krishna Reddy, P. Harishu Kumar, C. Chandrasekhara Rao and V. Krishnamurthy (2011). Effect of blackgram (*Vigna mungo*) stubble and nitrogen management on FCV tobacco (*Nicotiana tabacum*) in blackgram – tobacco cropping system. J. Indian Soc. Coastal agric. Res. 29(2): 21-28.

Krishnamurthy, V. and M. Anuradha (2011). Nitrogen nutrition of flue-cured tobacco. Tobacco Research 37(1):1-17.

Kumar, K., K.P. Rao, D. Biswas and A.K. Sinha (2011). Rice WNK1 is regulated by abiotic stress and involved in internal circadian rhythm. Plant Signaling and Behaviour 6 (3):316-320.

Kumaresan, M., A.V.S.R. Swamy, V. Krishnamurthy, K. Palanichamy and R. Athinarayanan (2011). Production potential of advanced breeding lines of chewing tobacco under different agronomic practices. Tobacco Research 37(1):46-7.

Kumaresan, M., V. Krishnamurthy, P. Harishu Kumar, A.V.S.R. Swamy and R. Athinarayanan (2011). Agro-techniques to improve the seed and oil yield of chewing tobacco grown in Tamil Nadu. Tobacco Research 37(1):34-6.

Prasad, J.V. and U. Sreedhar (2011). Life parameters of tobacco caterpillar, *Spodoptera litura* as influenced by transgenic (Bt) cotton hybrids. Indian J. Entomology 73(4):312-6.

Ramakrishnan, S. and M. Nagesh (2011). Evaluation of beneficial fungi in combination with organics against root-knot nematode *Meloidogyne incognita*, in FCV tobacco nurseries. J.Biol. Control 25(4):311-5.

Ramesh, K., D. Damodar Reddy, A.K. Biswas and A. Subba Rao (2011). Zeolites and their potential uses in Agriculture. Advances in Agronomy, 113: 215-236

Rao, K.P., G. Vani, K. Kumar, D.P. Wankhede, M. Mishra, M. Gupta and A.K. Sinha (2011). Arsenic stress activates MAP kinase in rice roots and leaves. Archives of Biochemistry and Biophysics 506 (1):73-82.

Siva Raju, K. (2011). Genetic diversity in Indian chewing tobacco *(Nicotiana tabacum)* as revealed by RAPD and SSR markers. Indian J Agric. Sci. 81: 12-17.

Siva Raju, K and V. Krishnamurthy. (2011). Effect of genotype and method of curing on quality constituents of chewing tobacco *(Nicotiana taqbacum* L*)* grown in Tamil Nadu. Indian journal of plant physiology 16: 112-217.

Sreenivasulu, R., C. Chandrasekhara Rao, L.K. Prasad, A.R. Panda, V. Venkateswarlu and I. Jagadish Chandra (2011). Influence of chlorides in irrigation water and fertilizer levels on tobacco seedlings under rainfed light soils of Prakasam and Nellore districts. Tobacco Research 37(1):29-33.

Subhashini, D.V., C. Chandrasekhara Rao and K. Padmaja (2011). Phosphorous content and occurrence of *Glomus fascieulatum* in tobacco soils. Tobacco Research 37(1): 37-9.

Subhashini, D.V. and K. Padmaja (2011). Population dynamics and screening of phosphate-solubilizing bacteria isolated from tobacco (*Nicotiana tabacum*) – based cropping systems. Indian Journal of Agricultural Sciences 81(8): 740-3.

Subhashini, D.V. and S. Ramakrishnan (2011). Interaction of VA Mycorrhiza and root-knot nematode on tobacco plants. Effects of nematode inoculum density, soil texture and soil sterilization. Indian Journal of Nematology 41(1):56-61.

Subhashini, D.V. (2011). *In vitro* antagonism of *Pseudomonas fluorescens* ctri-9 against *Alternaria alternate*. Indian Journal of Plant Protection 39(4): 327-328.

Subhashini, D.V. (2011). Studies on the beneficial bacteria obtained from tobacco rhizosphere. Indian Phytopath 64(3): 300-302.

Suman Kalyani, K., V. Krishnamurthy, C. Chandrasekhara Rao and N. Aruna Kumari (2011). Role performance of tribal women in agriculture - A study in agency area of East Godavari district, Andhra Pradesh. Journal of Dairying, Foods and Home Sciences, 2011 Vol.30 (3): 221-224.

Suman Kalyani, K., C. Chandrasekhara Rao, T.G.K. Murthy, S.K. Naidu and N. Aruna Kumari (2012). Tribal life style in East Godavari district - Agricultural Technologies for Development. Book published by Director, CTRI, March, 2012 (1-116).

Suman Kalyani, K., S.K. Naidu, S. Nageswara Rao and N. Aruna Kumari (2012). Changing socio-economic scenario of FCV tobacco farmers in NLS area of Andhra Pradesh. Agricultural Science Digest 32(1): 55-57.

List of Approved On-going Projects

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP IMPROVEMENT		
1	G.S.1	Germplasm acquisition maintenance, multiplication, evaluation and utilization Dr. T.G.K. Murthy
2	Br.6.1.4 (a)	Incorporation of disease resistance for tobacco mosaic virus (TMV) Dr. P.V. Venugopala Rao & Dr. C.A. Raju
3	Br.2	Evolving superior varieties of FCV tobacco through hybridization Dr. P.V. Venugopala Rao
4	Cy.7(iii)	Tissue culture studies in tobacco (III) Micropropagation of elite lines and other selections Dr. K. Sarala & Dr. T.G.K. Murthy
5	Cy.2.1 (f)	Incorporation of aphid resistance from *N. gossei*. *N. repanda, N x. umbratica-nesophila and N x benthamiana-repanda* Dr. Dr. T.G.K. Murthy, Dr. U. Sreedhar & Dr. K. Siva Raju
6	Biotech-4	Development of virus tolerant tobacco lines under *in vitro*. Dr. K. Sarala, Dr. C.A. Raju & Dr. K. Sivaraju
7	Br.7	Developing hybrid FCV tobacco suitable for traditional black soil area of Andhra Pradesh Dr. T.G.K. Murthy, Dr. P.V. Venugopala Rao & Dr. K. Sarala
8	MB-9	Evaluation of advanced breeding lines for yield and quality Dr. K. Sarala, Dr. P.V. Venugopala Rao & Dr. T.G.K. Murthy
9	Biotech-5	Maintenance, evaluation and characterization of tobacco transgenics Dr. K. Sarala & Dr. K. Sivaraju
10	Biotech-6	Molecular mapping of tobacco traits: Tobacco specific nitrosamines in burley Dr. K. Sarala, Dr. T.G.K. Murthy, Dr. C.V.N Rao, Dr. K. Siva Raju & Dr. P.V. Venugopala Rao
11	Biotech 9	Transcript profiling and identification of candidate genes resistant to damping-off in tobacco Dr. K. Prabhakara Rao
CROP PRODUCTION		
1	A-78	Effect of *Rabi* crops on the emergence of *Orobanche* Dr. S. Kasturi Krishna, Dr. S.V. Krishna Reddy & Dr. C.A. Raju

Sl. No	Institute Code	Title of the project and Investigator(s)
2	A-80	Investigations on coirpith utilization in tobacco production Dr. C.C.S. Rao & Dr. V. Krishnamurthy
3	A-82	Effect of spacing and nitrogen on yield and quality of ABL TBST-2 Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna & Dr. C.C.S. Rao
AGRL. EXTN. & AGRL. ENGG.		
1	Ag. Ext. 36	Stress analysis of tobacco farmers and changing scenario of the cropping pattern Dr. K. Suman Kalyani & S.K. Naidu
2	Ag. Engg.7	Fertigation system for tobacco nurseries to reduce labour and improve water & nutrient use efficiency Dr. C.C.S. Rao, Dr. V. Krishnamurthy & Dr. P. Harishu Kumar
3	Ag. Engg.8	Designing and testing of tobacco bale pressing and packing machine Dr. C.C.S. Rao & Dr. Kasturi Krishna
4	Ag. Ext. 41	On-farm testing of new pipelines viz., V-4219 and V-4230 S.K. Naidu, Dr. P.V. Venugopala Rao & Dr. Y. Subbaiah
5	Ag. Ext. 44	On-farm trial on testing of irrigated Natu variety L-45-90 vs. Kommugudem variety Dr. K. Suman Kalyani & Dr. T.G.K. Murthy
6	Ag. Ext. 46	On-farm testing of new lines/selections (YB-4, YB-10) in burley tobacco Dr. Y. Subbaiah & S.K. Naidu
7	Ag. Ext. 45	On-farm demonstration of production technology for Sabari *lanka* tobacco in Khammam District S.K. Naidu, Dr. Y. Subbaiah & Dr. C.C.S. Rao
8	Ag. Ext. 47	Assessment of N&K fertilization for FCV tobacco in NLS area of AP Dr. Y. Subbaiah, Dr. D. Damodar Reddy & Dr. M. Anuradha
9	Ag. Ext. 48	Critical analysis of resource use by the FCV tobacco farmers – A case study approach Dr. Y. Subbaiah & S.K. Naidu
ARIS		
1	ARIS-11	Designing algorithms for data classification Dr. H. Ravi Sankar
2	ARIS-12	Decision support system for transfer of technology Dr. H. Ravi Sankar & Dr. Y.Subbaiah
3	ARIS-13	Computational algorithm for micro RNA prediction in plants Dr. H. Ravi Sankar

Sl. No	Institute Code	Title of the project and Investigator(s)
	CROP CHEMISTRY AND SOIL SCIENCE	
1	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. C.C.S. Rao & Dr. M. Mahadeva Swamy
2	OC-10	Evaluation of smoke constituents in materials from some plant breeding experiments Dr. C.V. N. Rao
3	PR-1	Monitoring of pesticide residues in .tobacco samples collected from different areas Dr. C.V. Narasimha Rao
4	BC-8	Electrophoretic characterization of tobacco cultivars Dr. K. Siva Raju & Dr. K. Nageswara Rao
5	BC-11	Biochemical characterization of tobacco seed oil Dr. K. Siva Raju & Dr. C.V.N. Rao
6	PHY-71	Chloride nutrition in flue-cured tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao & Dr. C.C.S. Rao
7	PHY-72	Dynamics of potassium absorption, utilisation and re-translocation in FCV tobacco Dr. K. Nageswara Rao & Dr. M. Anuradha
8	SS 28	Characterization of soil phosphorus and potassium in FCV tobacco growing soils of Karnataka Dr. C.C.S. Rao
9	Phy-75	Development of float culture technology for tobacco seedling production Dr. K. Nageswara Rao & Dr. M. Anuradha
10	SS-30	Long-term impact of fertilizer regimes on soil organic carbon pools and carbon sequestration under *Motihari* tobacco production system in Dr. D. Damodar Reddy & Dr. S. Amarnath
11	SSMB-11	Development of bio-consortia for optimizing nutrient supplementation through microbes for tobacco crop production Dr. D.V. Subhashini
12	OC-24	Studies on chemical constituents responsible for smoke flavour in FCV tobacco grown under different agro climatic zones Dr. C.V. Narasimha Rao & Dr. K. Siva Raju

Sl. No	Institute Code	Title of the project and Investigator(s)
13	Phy-76 Sub-project	Impact of excess water stress and adaptive strategies to minimize its negative effects on productivity and quality of tobacco Dr. M. Anuradha, Dr. D. Damodar Reddy, Dr. T.G.K. Murthy & Dr. K. Siva Raju
CROP PROTECTION		
1	P.Orb-1	Studies on broomrape of tobacco Dr. C.A. Raju
2	P.78	Studies on wilt disease of tobacco Dr. C.A. Raju
3	E-73	Studies on compounds with insecticidal value from wild *Nicotiana* species against the major pests of FCV tobacco Dr. J.V. Prasad & Dr. S. Gunneswara Rao
4	E 74	Monitoring of insect pests of tobacco with pheromone traps Dr. U. Sreedhar
5	E 75	Management of stemborer, *Scrobipalapa heliopa* in tobac co Dr. U. Sreedhar
6	E-78	Management of tobacco caterpillar, *S. litura* in tobacco with eco-friendly insecticide baits Dr. U. Sreedhar & Dr. K. Nageswara Rao
7	E-80	Studies on *Helicoverpa armigera* with special reference to influence of plant variety, field ecology, eco-toxicology and seed production Dr. S. Gunneswara Rao & Dr. U. Sreedhar
8	E-81	Bio efficacy and field evaluation of new insecticides against tobacco pests Dr. U. Sreedhar
CTRI RESEARCH STATION: JEELUGUMILLI		
1	JL. Br.2.1	Evolving flue-cured tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh Dr. T.G.K. Murthy
2	JLN-2	Developing new varieties of irrigated Natu tobacco for A.P. Dr. T.G.K. Murthy
3	JL Br.3	Developing hybrid FCV tobacco suitable for northern light soils (NLS) of Andhra Pradesh Dr. T.G.K. Murthy & Dr. K. Sarala

Sl. No	Institute Code	Title of the project and Investigator(s)
4	SS-27	Crop growth modelling in FCV tobacco in NLS Dr. C.C.S. Rao, Dr. M. Anuradha, Dr. K. Siva Raju, Dr. S. Kasturi Krishna & Dr. H. Ravisankar
5	Ag. Engg-9	Fertigation system for tobacco to reduce labour and improve Water & Nutrient use efficiency Dr. C.C.S. Rao, Dr. V. Krishnamurthy, Dr. K. Nageswara Rao & Dr. P. Harishu Kumar
6	Phy.74	Nitrogen nutrition of FCV tobacco Dr. M. Anuradha, Dr. K. Nageswara Rao & Dr. C.C.S. Rao
7	JLA-35	Integrated weed management in FCV tobacco grown under irrigated Alfisols" Dr S. Kasturi Krishna, Dr. S.V. Krishna Reddy & Dr. K. Nageswara Rao
8	JLA-36	Indices for N and K nutrient use efficiency in FCV tobacco grown in irrigated Alfisols Dr. S.V. Krishna Reddy, Dr. S. Kasturi Krishna, Dr. D. Damodar Reddy, Dr. C.C.S. Rao & Dr. K. Nageswara Rao
9	SS-29	Potassium supply strategies for improved productivity, quality and potassium use efficiency of FCV tobacco grown on irrigated Alfisols Dr. D. Damodar Reddy & Dr. M. Anuradha
BTRC, Kalavacherla		
1	By.Br.1	Evaluation of advanced burley breeding lines for productivity and quality Dr. P.V. Venugopala Rao & Dr. T.G.K. Murthy
2	By.Br.2	Evaluation of burley tobacco hybrids suitable for burley growing areas of Andhra Pradesh Dr. P.V .Venugopala Rao & Dr. T.G.K. Murthy
3	EB-79	Spatial distribution and pest succession of insect pests as influenced by cultural practices in Burley tobacco in the plains of East Godavari Dr. G. Raghupathi Rao
4	AB-29	Development and testing of bio-dynamic manure suitable for Burley tobacco production Dr. C.C.S. Rao, Dr. P. Harishu Kumar, Dr. K. Siva Raju, Dr. M. Anuradha & Dr. D.V. Subhashini
CTRI RESEARCH STATION: GUNTUR		
1	Br.14	Development of FCV tobacco varieties suitable for cultivation in SBS of AP Dr. C. Nanda

Sl. No	Institute Code	Title of the project and Investigator(s)
2	EG-12	Studies on relationship of pheromone trap catch of *H. armigera* with field infestation and weather parameters in tobacco, cotton (Bt and non-Bt) and Bengal gram Dr. J.V. Prasad
3	EG-13	Development of base line resistance data of *H. armigera S. litura* to conventional insecticides and insecticides with novel chemistries Dr. J.V. Prasad
CTRI RESEARCH STATION : KANDUKUR		
1	K.Br.6	Breeding FCV tobacco variety for yield and quality under SLS conditions Dr. A.R. Panda, Dr. K.C. Chenchaiah, Dr. P.V. Venugopala Rao, Dr. T.G.K. Murthy, Dr. A.V.S.R. Swamy & Dr. C.V.N. Rao
2	EK-14	Evaluation of FCV germplasm for Aphid tolerance under SLS conditions Dr. K.C. Chnachaiah
3	EK-15	Evaluation of FCV tobacco germplasm for the tobacco caterpillar tolerance under SLS conditions Dr. K.C. Chnachaiah
4	EK-16	Studies on population development of tobacco aphid, *M. nicotianae* under SLS conditions Dr. K.C. Chnachaiah
5	K Br 8	Evaluation of FCV tobacco hybrids for yield and quality under SLS conditions Dr. A.R. Panda
6	EKC-1	Economics of FCV tobacco cultivation in SLS & SBS K. Varalakshmi & Dr. L.K. Prasad
7	EKC-2	Tend analysis of area, production and productivity of major crops in SLS and SBS (Prakasm & Nellore districts) K. Varalakshmi & Dr. K. Sunman Kalyani
8	SSK-1	Investigations on soil fertility and irrigation water quality in SLS and SBS regions of Andhra Pradesh Dr. L.K. Prasad & Dr. D. Damodar Reddy
9	EK-18	Management of *Bemisia tabaci* in FCV tobacco Dr. K.C. Chanchaiah
CTRI RESEARCH STATION: HUNSUR		
1	BR.12	Germplasm maintenance of *Nicotiana tabacum* varieties/lines Dr. C. Panduranga Rao

Sl. No	Institute Code	Title of the project and Investigator(s)
2	P.3.2	Screening of tobacco germplasm against root-knot nematode Dr. S. Ramakrishnan
3	N 1.1	Survey for plant parasitic nematodes infecting tobacco Dr. S. Ramakrishnan
4	BR-19	Development and evaluation of F1 hybrids of FCV tobacco suitable to Karnataka Light Soil region Dr. C. Panduranga Rao, Dr. M. Mahadeva Swamy & Dr. S. Ramakrishnan,
5	A.37	Agronomic evaluation of promising pipeline varieties (FCH 196 and FCH 201) of FCV tobacco in KLS Dr. M. Mahadeva Swamy
6	A.38	Feasibility of producing organic tobacco under KLS situation Dr. M. Mahadeva Swamy, Dr. P. Venkateswarlu & Dr. S. Ramakrishnan
7	EH-1	Survey for assessment of insect pest incidence in KLS tobacco Dr. P. Venkateswarlu & Dr. S. Ramakrishnan
8	EH-2	Integrated management of tobacco aphid, Myzus nicotianae under KLS conditions Dr. P. Venkateswarlu
9	P-21	Monitoring the incidence and severity of pests and disease in nursery and field crop of KLS tobacco at different intervals of sowing and transplantation Dr. S. Ramakrishnan & Dr. P. Venkateswarlu
10	A-39	Effect of graded levels of K on the occurrence and intensity of root-knot incidence and K utilization pattern of FCV tobacco in KLS Dr. M. Mahadeva Swamy & Dr. S. Ramakrishnan
11	N-19	Bio-intensive management of nematodes in FCV tobacco of KLS using tray nurseries Dr. S. Ramakrishnan & Dr. M. Mahadeva Swamy
CTRI RESEARCH STATION: VEDASANDUR		
1	G.S.1	Evaluation and maintenance of germplasm Dr. A.V.S.R. Swamy
2	B.48	Studies on heterosis breeding in chewing tobacco (*N. tabacum*) Dr. A.V.S.R. Swamy
3	B.49	Synthesis of broad-based gene pool in chewing tobacco (*N. tabacum*) enhancing selection gain Dr. A.V.S.R. Swamy

Sl. No	Institute Code	Title of the project and Investigator(s)
4	B.50	Breeding for high seed and oil yield in tobacco Dr. A.V.S.R. Swamy & Dr. C.V.N. Rao
5	BA-54	Performance of advance breeding lines of chewing tobacco with varying levels of nitrogen under Vedaranyam conditions Dr. M. Kumaresan
6	A-101	Drip fertigation in chewing tobacco Dr. M. Kumaresan
CTRI RESEARCH STATION: DINHATA		
1	A-10	Permanent manurial experiment with *Motihari* tobacco Dr. S. Amarnath & Dr. S. Roy
2	B-17	Dialliel analysis in *Motihari* tobacco (*N.rustica*) Dr. S. Amarnath
3	DBP-1	Screening for resistance against brown spot and hollow stalk in germplasm accessions of *Jati* (*N. tabacum*) & *Motihari* (*N. rustica*) tobacco in North Bengal Dr. S. Amarnath & Dr. S. Roy
4	PP-10	Weather based disease prediction model for brown spot of *Motihari* tobacco under North Bengal conditions Dr. S. Roy & Dr. S. Amarnath
5	PP-11	Nursery and field evaluation of *Trichoderma viride* and *Pseudomonas fluorescens* to brown spot disease and yield and quality of *Motihari* tobacco Dr. S. Roy & Dr. S. Amarnath

RAC, QRT, IRC and IMC Meetings

RESEARCH ADVISORY COMMITTEE

Dr. P. Murugesa Boopathi — CHAIRMAN
Vice-Chancellor,
Tamil Nadu Agril. University,
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Tamil Nadu

Dr. V.S. Korikanthimath — MEMBER
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ICAR Research Complex, Goa)
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Dr. R. Sridhar — MEMBER
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(Plant Pathology), CRRI, Cuttack]
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Santosh Nagar Ext.,
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Chennai – 600 116, Tamil Nadu

Dr. V. R. Rao — MEMBER
[Former Principal Scientist (Microbiology) &
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Dr. N. Gopalakrishnan — MEMBER
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Director – Acting,
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Rajahmundry – 533 105

Shri Cherukuri V. Swami, — MEMBER
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Andhra Pradesh

Shri Ch. Suryanarayana, — MEMBER
Member – IMC – CTRI
Dappalampadu Village & PO,
Gudluru Mandal,
Prakasam district,
Andhra Pradesh

Dr. C. V. N. Rao — MEMBER-SECRETARY
Principal Scientist &
Nodal Officer, PME Cell,
CTRI, Rajahmundry - 533 105

RAC Meeting

- Research Advisory Committee (RAC) meeting of CTRI was held during April 19-20, 2011 at Central Tobacco Research Institute, Rajahmundry under the Chairmanship of Dr. P. Raghava Reddy, Former Vice Chancellor, ANGRAU, Hyderabad. Dr. V. Krishna Murthy, Dr. Nazir Ahmed Khan, Dr. M. Mani, Dr. Kanwal Raj, Dr. R. Samiyappan and Sri Cherukuri Venkataswamy, Members of RAC attended the meeting. The Committee reviewed the Action Taken Report of previous RAC, progress of the research work, achievements during XI Plan (2007-12) and the XII Plan (2012-17) research priorities during the meeting.

- The Research Advisory Committee meeting was held during March 12-13, 2012 at CTRI, Rajahmundry. Dr. P. Murugesa Boopathi, Vice-Chancellor, Tamil Nadu Agril. University, Coimbatore & Chairman, RAC, Dr. V.S. Korikanthimath, Retd. Director, ICAR Research Complex, Goa, Dr. R. Sridhar, Former Principal Scientist (Plant Pathology), CRRI, Cuttack, Dr. V. R. Rao, Former Principal Scientist (Microbiology) & Head, Crop Production Division, CRRI, Cuttack, Sri

Cherukuri V. Swami, Member, IMC Dr. T.G.K. Murthy, Director - Acting, Heads of Divisions, Heads of Regional Stations and Scientists participated in the meeting. The Committee reviewed the Action Taken Report of previous RAC, progress of the research work, achievements (2011-12) and the XII Plan (2012-17) research priorities during the meeting.

Inauguration of RAC Meeting held during April 19-20, 2011

RAC Meeting held during March 12-13, 2012

QUINQUENNIAL REVIEW TEAM

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

Prof. S. Kannaiyan — CHAIRMAN
Former Chairman,
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17 C-A1, Sapthaswara Apartment,
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Tamil Nadu

Dr. D. N. Yadav — MEMBER
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Anand – 388 001
Gujarat

Dr. R. B. Sharma — MEMBER
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IGKVV Campus,
Raipur – 492 006
Chattisgarh

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

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

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

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

INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

The Institute Research Committee Meetings of CTRI were held from 18th to 20th August, 2011 at this Institute. Scientists of CTRI, its Research Stations, Tobacco Board officials and representatives of trade and industry participated in the meetings. The progress of research work carried out during the year 2010-11 was reviewed and the technical programme for the crop season 2011-12 was discussed and finalized.

INSTITUTE MANAGEMENT COMMITTEE

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

Dr. N. Gopalakrishnan, MEMBER
Assistant Director-General (CC),
Indian Council of Agricultural Research,
Krishi Bhawan, New Delhi – 110114

Smt. V. Usha Rani, IAS MEMBER
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Agriculture Directorate,
Dept. of Agriculture, Chepauk,
Chennai – 600 005

Dr. R. Veera Raghavaiah, MEMBER
Associate Dean,
Agricultural College, ANGRAU,
Rajahmundry – 533 105

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Directorate of Oilseed Research,
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Central Tobacco Research Institute,
Rajahmundry – 533 105

Dr. S.V. Rao MEMBER
Principal Scientist,
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Rajendranagar, Hyderabad – 500 030

Dr. I. Srinivas, MEMBER
Sr. Scientist,
CRIDA, Santosh Nagar,
Hyderabad – 500 059.

Dr. K. Sivanarayana Varaprasad, MEMBER
Director,
Directorate of Oilseed Research,
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Shri Cherukuri V. Swami, MEMBER
Peda Alvala Padu P.C.
Palli-Mandalam,
Prakasam district, Andhra Pradesh

Shri Ch. Suryanarayana, MEMBER
Dappalampadu Village & PO,
Gudluru Mandal,
Prakasam district,
Andhra Pradesh

Sri Y. Prabhakar MEMBER-
Asst. Administrative Officer, SECRETARY
Central Tobacco Research Institute,
Rajahmundry – 533 105

Participation of Scientists in Conferences, Meetings, Workshops and Symposia

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. U. Sreedhar	3rd Congress on Insect Science	18-20 April, 2011 at PAU, Ludhiana
2.	Dr. A.V.S.R. Swamy Dr. M. Kumaresan	Meeting of Tamil Nadu Chewing Tobacco Farmers, Manufacturers, Dealers and Workers Association	24.4.2011 at Patlur
3.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy	Meeting of the Core Committee	10.05.2011 at Tobacco Board, Mysore
4.	Dr. V. Krishnamurthy	Meeting of the Directors of Crop Science Division of ICAR	12.05.2011 at New Delhi
5.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy	Scientific Advisory Committee Meeting	18.05.2011 at JSS, Krishi Vigyan Kendra, Suttur
6.	K. Suman Kalyani	5th National Seminar on 'Multi-Sectoral Innovations for Rural Prosperity'	19-21 May, 2011 at IARI, New Delhi
7.	Dr. S. Ramakrishnan	National Symposium on "Harnessing Biodiversity for Biological Control of Crop Pests"	May 25-26, 2011 at NBAII, Bangalore
8.	Dr. T.G.K. Murthy Dr. C.C.S. Rao Dr. U. Sreedhar Dr. D. Damodar Reddy Dr. C. Panduranga Rao Dr. S. Amarnath	Meeting-cum-Workshop on "Towards More Effective Role of Heads of Divisions and Regional Stations in ICAR Institutes"	14-15 June, 2011 at CIAE, Bhopal
9.	Dr. V. Krishnamurthy	Interaction Meeting of Project Directors/Project Coordinators of ICAR Institutes	16.06.2011 at CIAE, Bhopal
10.	Dr. V. Krishnamurthy	Interaction Meeting of Project Directors/Project Coordinators of Crop Science Division	23-24 June, 2011 at ICAR, New Delhi
11.	Dr. V. Krishnamurthy	17th Meeting of Food & Agriculture Division Council (FADC)	29.06.2011 at BIS, New Delhi

Sl. No.	Participant (s)	Programme attended	Date and place
12.	Dr. V. Krishnamurthy	Directors' Conference of the ICAR Institutes	15.07.2011 at NBPGR, Pusa, New Delhi
13.	Dr. V. Krishnamurthy	83rd ICAR Foundation Day and Award Ceremony of DAC, PPVFRA & ICAR	16.07.2011 at NASC Complex, New Delhi
14.	Dr. V. Krishnamurthy	One-day Meet of the Presidents/ Secretaries/ Key Functionaries of Professional Societies	22.07.2011 at NASC Complex, New Delhi
15.	Dr. T.G.K. Murthy	Workshop on "NBPGR-NAGS: Partnership for Efficient Management and Use of Plant Genetic Resources"	29-30 July, 2011 at NBPGR, New Delhi
16.	Dr. K. Suman Kalyani	Annual Review Meeting of DBT Project	3-4 August, 2011 at DBT, New Delhi
17.	Dr. K. Siva Raju Dr. M. Anuradha	Brainstorming Session on "Prioritization of Plant Physiology and Biochemistry Research for 12th Five Year Plan Period"	5-6 August, 2011 at IARI, New Delhi
18.	Dr. U. Sreedhar Dr. J.V. Prasad Dr. P. Venkateswarlu	National Meeting on 'Agricultural Entomology for the 21st Century : The Way Forward"	25-26 August, 2011 at NBAII, Bangalore
19.	Dr. S.V. Krishna Reddy	ZREAC Meeting of North Coastal Zone for *Rabi*, 2011	5th and 6th September, 2011 at RARS, Anakapalle
20.	S. Jitendranath	Rabi ZREAC Meeting	7th and 8th September, 2011 at RARS, Chintapalle
21.	Dr. V. Krishnamurthy	2nd Special Meeting of Vice-Chancellors and Project Coordinators of AINRPTs	26-27 Sept., 2011 at NASC Complex, New Delhi
22.	Director, CTRI, Heads of Divisions, Research Stations, Scientists of CTRI & its Research Stations	AINRPT Meeting	30.9.2011 and 01.10.2011 at CTRI, Rajahmundry
23.	Dr. C.V. Narasimha Rao Dr. K. Siva Raju	Brainstorming Session on 'High-value Compounds/ Phytochemicals'	03.10.2011 at IISR, Calicut

Sl. No.	Participant (s)	Programme attended	Date and place
24.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy Dr. P. Venkateswarlu Dr. S. Ramakrishnan	National Seminar on "Alternative Crops to FCV Tobacco in Karnataka"	17.10.2011 at Rao Bahdur Institute of Management, University of Mysore, Mysore
25.	Dr. M. Mahdevaswamy	Meeting of the Committee on Cost of Cultivation	19.10.2011 at Office of the Regional Manager Tobacco Board, Mysore
26.	Dr. U. Sreedhar	Training Programme in 'XVI Management Development Programme in Agricultural Research'	20-25th October, 2011 at NAARM, Hyderabad
27.	Dr. K. Prabhakara Rao	Training course on 'Molecular Plant Breeding in Crop Improvement'	7-18 November, 2011 at ICRISAT, Hyderabad
28.	Dr. V. Krishnamurthy Dr. T.G.K. Murthy Dr. C.V.N. Rao R. Sudhakar	Meeting on 'Innovations 4 Industry Meet in Crop Science'	19.11.2011 at NAARM, Hyderabad
29.	Dr. K. Siva Raju Dr. M. Anuradha	National Seminar on 'Sustainable Crop Productivity through Physiological Intervention"	24-26 November, 2011 at the Department of Life Science, Mumbai
30.	Dr. H. Ravishankar	Interaction Meet with Scientists Trained Abroad in Frontier Areas of Agricultural Sciences	28-30 November, 2011 at NASC Complex, New Delhi
31.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy	Scientific Advisory Committee Meeting	28.11.2011 at JSS, Krishi Vigyan Kendra, Suttur
32.	Dr. H. Ravishankar	International Conference on 'Advanced Computing Methodologies'	9-10 December, 2011 at GRIET, Hyderabad
33.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy Dr. P. Venkateswarlu Dr.S.Ramakrishnan	One-day Workshop on "Reducing Fuel Wood Consumption in FCV Tobacco in KLS"	12-12-2011 at CTRI RS Hunsur

Sl. No.	Participant (s)	Programme attended	Date and place
34.	Director, CTRI, Heads of Divisions, Research Stations, Scientists of CTRI and its Research Stations	National Symposium on Tobacco	20-22 December, 2011 at Rajahmundry
35.	Dr. K. Prabhakara Rao	99th Indian Science Congress	2-7 Jan., 2012 at KIIT University, Bhubaneswar
36.	Dr. C. Panduraga Rao Dr. M. Mahdevaswamy Dr. P. Venkateswarlu Dr. S. Ramakrishnan	KVK Krishi Mela and Seminar on "Agriculture & Allied Subjects"	21.01.2012 at JSS Suttur, Mysore Dist.,
37.	Dr. Satyajit Roy	National Seminar on 'Recent Advances in Microbial Biotechnology'	10th & 11th January, 2012 at Kabi Nazrul Colleage, Murarai
38.	Dr. D.V. Subhashini	3rd Global Conference on 'Plant Pathology for Food Security'	10-13 January, 2012 at Udaipur
39.	Dr. R.K. Ghosh	National Training on "Naturally Occurring Nutraceuticals, Crop Protectants and other Biomolecules for Application in Human and Crop Health	23rd January to 2nd February, 2012 at IARI, New Delhi
40.	Dr. U. Sreedhar	Regional Workshop on "Consortium for e-Resources in Agriculture"	24.01.2012 at SV University, Tirupati
41.	Dr. Satyajit Roy	National Symposium on "Frontiers of Microbiological Research: Concepts and Application"	2-4 February, 2012 at Kolkata
42.	Dr. C.V.N. Rao	Workshop on 'Half-Yearly Performance Monitoring (HYPM)'	13.02.2012 at NAARM, Hyderabad
43.	Dr. H. Ravisankar	Seminar-cum-workshop on "National Knowledge Network"	15.02.2012 at NGRI, Hyderabad
44.	Dr. T.G.K. Murthy	Interface Meeting of Vice-Chancellors of Agril. Universities and ICAR Directors	17-18 Feb., 2012 at New Delhi
45.	Dr. S. Amarnath Dr. S. Roy	Agriculture Technology Week- 2012	20-23 Feb., 2012 at UBKV, Pundibari

Sl. No.	Participant (s)	Programme attended	Date and place
46.	Dr. C.V.N. Rao	Meeting of RFD Nodal Officers of Crop Science Division in ICAR	21.02.2012 at New Delhi
47.	Dr. T.G.K. Murthy Dr. C.C.S. Rao	ZTM-BPD Annual Meeting-cum-workshop	24-25 Feb., 2012 at Cochin
48.	Dr. C.V.N. Rao	Meeting of BIS Sectional Committee on Tobacco and Tobacco Products – FAD 4	28.02.2012 at BIS, New Delhi
49.	Dr. U. Sreedhar	'National Seminar – 2012 : Emerging Pest Problems and their Bio-rational Management'	2-3 March, 2012 at MPUAT, Udaipur
50.	R. Sudhakar	Global Conference on "Women in Agriculture"	13-15 March, 2012 at ICAR, New Delhi
51.	Dr. H. Ravishankar	International Conference on "Science and Innovative Engineering"	31st March to 1st April, 2012 at Chennai

Inauguration of National Symposium on Tobacco held during December 20-22, 2011

Innovations 4 Industry Meet in Crop Science held on 19.11.2011 at NAARM, Hyderabad

Workshops, Seminars and Farmers' Days Organised by the Institute

- A two-day seminar on 'Alternative crops to FCV tobacco in A.P. was organized from 19.09.2012 to 20.09.2012 at CTRI, Rajahmundry. Scientists from CTRI, DOPR and ANGRAU, and the officials from the Tobacco Board, Ministry of Commerce; Ministry of Health & Family Welfare, GOI; Indian Tobacco Association; and the representatives of tobacco growers participated in the seminar.
- Institutional Bio-Safety Meeting (IBSC) was conducted on 04.05.2011 under the chairmanship of Dr. T. G. K. Murthy, Head, Division of Crop Improvement.
- Hindi Workshop on 'Implementation of Official Language in Region C' was organized on 4th May 2011 at the institute.
- The Foundation Day of Central Tobacco Research Institute was celebrated on 1st April, 2011.
- The VII Group Meeting of All India Net work Research Project on Tobacco (AINRPT) was held at CTRI, Rajahmundry from 30.09.2011 to 01.10.2011.
- The Scientific Advisory Committee (SAC) meeting of KVK was organized at KVK, Kalavacharla on 14-10-2012 under the chairmanship of Dr. V. Krishnamurthy, Director, CTRI.
- Two district level seminars on Cashew and Cocoa were conducted in collaboration with the Directorate of Cashewnut and Cocoa Development (DCCD), Cochin on 22.2.2012 and 27.3.2012.

Distinguished visitors

Date	Name	Address
CTRI, Rajahmundry - 533 105		
25.04.2012	Sri G. Kamalavardhana Rao, IAS	Chairman, Tobacco Board, Guntur
21.10.2012	Dr. Ashok Gulati	Commisioner, Commission for Agricultural Costs and Prices (CACP)
	Dr. Ashok Vishandas	Member, CACP
27.01.2012	Sri Sandeep Das	News Editor, The Financial Express
19.01.2012	Dr. N.K. Krishna Kumar	Director, National Bureau of Agriculturally Important Insects (NBAII), Bangalore

Personnel (As on 31.03.2012)

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

DIVISION OF CROP IMPROVEMENT

Dr. T.G.K. Murthy, Principal Scientist & Head
Dr. P.V. Venugopalarao Senior Scientist
Dr. K. Sarala, Principal Scientist
Dr. K. Prabhakara Rao, Scientist
Smt. K. Santinandivelu, Technical Officer T-5
Sri A.D.V. Prasad, Technical Officer T-5
Sri M. Trinadh, Technician T-4
Sri S. Rajeswara Rao, Technician T-4
Sri T. Lakshmana Rao, Technician T-3
Sri M.M. Ali, Technician T-3
Sri S. Rama Raju, Technician T-1
Sri A. Mutyam, Technician T-1
Sri K. Suryanarayana, SSS
Sri Y.N.V.V.S.N. Murty, SSS

DIVISION OF CROP PRODUCTION

Dr. C.C.S. Rao, Principal Scientist & Head
Dr. S.V. Krishna Reddy, Senior Scientist
Dr. S. Kasturi Krishna, Senior Scientist
Dr. K. Varalakshmi, Scientist
Sri M. Nageswara Rao, Technical Officer T-6
Sri D.S.R. Sastry, Technician T-2
Sri K.V.S.S. Bhaskara Rao, SSS

DIVISION OF CROP PROTECTION

Dr. U. Sreedhar, Principal Scientist & Head
Dr. G. Raghupathi Rao, Senior Scientist
Dr. S. Gunneswararao, Sr. Scientist
Sri K. Sesha Sai, Technical Officer T-6
Dr. S.K. Dam, Technical Officer T-5
Sri V. Narasimha Murthy, Technician T-4
Sri V.V. Ramana, Technician T-3
Sri A. Nageswara Rao, SSS
Sri V.V.P.L. Acharyulu, SSS

DIVISION OF CROP CHEMISTRY & SOIL SCIENCE

Dr. D. Damodar Reddy, Principal Scientist & Head
Dr. C.V.Narasimha Rao, Principal Scientist
Dr. K. Sivaraju, Principal Scientist
Dr. D.V. Subhashini, Senior Scientist
Dr. M. Anuradha, Senior Scientist
Dr. R.K. Ghosh, Scientist.
Sri R. Athinarayanan, Technical Officer T-(7-8)
Smt. Y. Ramabai, Technical Officer T-6
Smt. D.V.L. Satyavathi, Technical Officer T-6
Smt. J. Vasanthi, Technical Officer T-5
Smt. K. Padmaja, Technical Officer T-5
Sri V. Annadurai, Technical Officer T-5
Sri B.V. Srinivas, Technician T-3
Sri M. Satyanarayana, Technician T-3
Sri N. Jhonson, Technician T-3
Sri P. Narayana Rao, Technician T-1
Smt. P. Satyavathi, SSS
Smt. P. Subbayamma, SSS
Smt. M. Srilatha, SSS
Sri B.S.S. Sai, SSS
Sri K.V. Narasimha Raju, SSS

AGRICULTURAL EXTENSION

Sri S.K. Naidu, Principal Scientist
Dr. K. Suman Kalyani, Senior Scientist
Dr. Y. Subbaiah, Senior Scientist
Sri S. Nageswara Rao, Technical Officer T-(7-8)
Smt. N. Aruna Kumari, Tech. Officer T-(7-8)
Sri P.E. Jemmy, Technical Officer T-5
Sri D.V.S.C. Sastry, Technician T-3
Sri P. Girija Sankar, Technician T-3
Sri G.Sarveswara Rao, SSS

AKMU

Dr. H. Ravisankar, Senior Scientist
Sri Md. Bajuddin, Technical Officer T-5
Sri M.N.P. Kumar, Technical Officer T-5
Smt. K. Pushpa, SSS
Sri K. Satyanarayana, SSS

PME CELL

Sri C.V.K. Reddy, Technical Officer T-6
Smt. Ch. Lakshmi Narayani, Personal Assistant
Smt. R. Sarada, SSS

LIBRARY

Sri Ch. Srirama Rao, Assistant Director (Hindi)
Sri Md. Elias, Technical Assistant T-3

CTRI FARM, KATHERU

Sri T. Krishna Reddy, Technical Officer T-(7-8)
Sri V. Madhava Rao, Technical Officer T-5
Sri G.H. Mohana Charyulu, Technician T-4
Sri P.S.S. Prakasa Rao, Technician T-4
Sri K. Bhyravaswamy, Technician T-2
Sri M.S. Asokan, Technician T-2
Sri Y.V. Subramanyam, Technician T-2
Sri B. Durga Rao, Technician T-2
Sri P.V.V.V. Prasad, UDC
Sri P. George, SSS
Sri S. Ganga Raju, SSS
Sri D.V. Rama Rao, SSS
Sri B. Nageswara Rao, SSS
Smt. Ch. Papa, SSS
Sri D. Balarama Reddy, SSS
Smt. Y. Jayalakshmi, SSS
Sri A. Srinivas, SSS

AINRPT

Sri M. Appa Rao, Technical Officer T-(7-8)
Smt. B. Krishna Kumari, Technical Officer T-5
Sri R. Satyanarayana, Technician T-1

SEED PRODUCTION

Sri G. Adinarayana, Technical Officer T-6
Sri N. Veerraju, Technician T-4
Sri Garaga S.N.Murthy, Technician T-4
Sri K.V. Ramana, Technician T-1
Sri N. Endayya, Technician T-1
Sri P.V. Ramana, SSS
Sri G. Prasada Rao, SSS

AGRICULTURAL ENGINEERING

Sri N. Sreedhar, Technical Officer T-5
Sri N. Gopinadh, Technical Officer T-5
Sri G. Nagesh Kanth Rao, Technical Officer T-5
Sri V.V. Sivaram, Technician T-4
Sri K.V.V. Satyanarayana, Technician T-2
Sri G.S.N. Murthy, Technician T-2
Sri N.V.V.S. Narayana, Technician T-1
Sri G. Adinarayana, SSS
Smt.Y. Nirmala Kumari, SSS
Sri G. Kaleswara Rao, SSS

TRANSPORT

Sri N.D. Suresh, Technical Officer T-6
Sri N. Ayyappa Naidu, Technician T-3(Driver)
Sri Y. Yesu, Technician T-3(Driver)
Sri P.Ch.S.N. Murthy, Technician T-2(Driver)
Sri S. Ramakrishna, Technician T-2(Driver)
Sri M. Yesuratnam, Technician T-1-3(Driver)
Sri P.V.V.R. Srinivasa Rao, SSS

ADMINISTRATION

Sri S.C. Sheet, Administrative Officer
Smt. P.V.S. Bharathi, Finance & Accounts Officer
Sri A.V.G.K. Murthy, Asst. Administrative Officer
Sri P. Ram Kumar, Asst. Administrative Officer
Sri Y. Prabhakar, Asst. Administrative Officer
Sri T.S.N. Murthy, Asst. Fin. & Accounts Officer
Smt. N. Maheswari, Personal Assistant
Sri K.T.R. Singh, Personal Assistant
Sri D. Seethapathi Rao, Assistant
Sri K. Krishna Murthy, Assistant
Sri V. Narayanacharyulu, Assistant
Sri P.V. Ratnam, Assistant
Sri G.V.V.S. Rambabu, Assistant
Sri P. Prabhakara Murthy, Assistant
Sri A. Sreedhar, Assistant
Sri P.V. Satyanarayana, Assistant
Sri N. Suryanarayana, Assistant
Sri D. Sreerama Murthy, Assistant
Smt. T. Syamala Devi, Assistant
Smt. M.H. Uma, Assistant
Smt. K. Savithri, Assistant
Sri P. Devanagaraju, Assistant
Sri N. Veerabhadra Rao, Assistant
Sri R.L. Ramachandra Rao, UDC
Sri V. Narasimha Rao, UDC
Sri Ch. Jayaram, UDC
Sri P.J.F. Moses, UDC
Sri M.S.S.R. Sastry, UDC
Sri S. Pradeep Kumar, UDC
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Smt. G.M.B. Sujatha, LDC
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