



भारत
ICAR

ICAR - CTRI

वार्षिक प्रतिवेदन Annual Report

2014-15



भारत - केन्द्रीय तम्बाकू अनुसंधान संस्थान
राजमन्दी - 533 105, आन्ध्र प्रदेश

ICAR - CENTRAL TOBACCO RESEARCH INSTITUTE
RAJAHMUNDRY - 533 105, ANDHRA PRADESH, INDIA

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Published by

Dr. D. Damodar Reddy

Director

ICAR-Central Tobacco Research Institute

Rajahmundry - 533 105, Andhra Pradesh, India

Phone: 0883-2449871-4, Fax: 0883-2448341, 2410555

e-mail : ctri-ap@nic.in

Website : www.ctri.org.in

Edited by

Dr. U. Sreedhar

Dr. A.V.S.R. Swamy

Dr. Y. Subbaiah

J. Poorna Bindu

Compiled by

Dr. C. Chandrasekhararao

Dr. K. Sarala

C.V.K. Reddy

Assisted by

Ch. Lakshminarayani

Md. Elias

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Phones : 0866 2435553

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ICAR - CTRI Annual Report 2014-15



Preface



It is indeed a privilege for me to place before you the Annual Report: 2014-15 of the ICAR-Central Tobacco Research Institute (CTRI) as it is the maiden opportunity for me as the Director of the institute to do so. The ICAR-CTRI, established in 1947, is one of the oldest and premier research institutes functioning under the aegis of the ICAR, New Delhi and has an exclusive mandate of conducting basic, strategic and applied research on myriad aspects of different tobacco types grown in India. The institute, with its headquarters at Rajahmundry in AP, has six research stations and a research centre located in major tobacco production zones and also coordinates research under All India Network Project on Tobacco. Since its inception, the CTRI has been making impressive contribution to the development of tobacco sector as a whole in the country. It immensely benefited the tobacco farming community and all other stake-holders by developing a number of improved varieties, and economically viable and eco-friendly agro-technologies for tobacco production efficiency and product quality.

For ICAR-CTRI, 2014-15 has been a time of change and evolution. The institute witnessed a change in its leadership with the appointment of Dr. D. Damodar Reddy as its regular Director, and Dr. S. Kasturi Krishna and Dr. C. Chandrasekhara Rao as Heads of Divisions. During 2014-15, the new QRT under the leadership of Dr. R.R. Hanchinal also initiated the reviewing of research programs executed and achievements made. We have been busy taking stock of many issues of tobacco sector in the country and drafting the VISION 2050 for the institute against a backdrop of emerging conflicting concerns about tobacco and changing milieu of national and international policy regimes. We have earnestly set in motion the process of reorienting and prioritizing our research programs in tune with the institute's long-term vision.

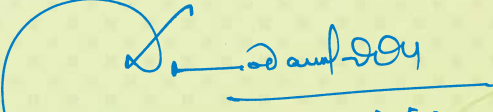
This Annual Report embodies various research, extension and institutional activities undertaken and significant achievements made by ICAR-CTRI during 2014-15. On crop improvement front, four varieties (two FCV - JS 117 and TBST 2; one *bidi* - NBD 209; one chewing tobacco - BSR 1) were identified for their potential for high yield with premium quality, and special traits of low tar, resistance to TMV/aphid, brown spot and black shank, respectively. Remarkable progress was registered in DNA finger printing of some popular and pipeline varieties of tobacco. The CTRI tobacco germplasm bank was enriched by adding 178 *bidi*, 3 *rustica*, 75 *Natu* and 5 exotic FCV lines, and thereby taking total tally of accessions to 3369. Some promising agro-techniques/innovative interventions in critical areas of resource management, biotic and abiotic stress management, new CPAs for high protection efficiency and reduced pesticide residues load, integrated nutrient and water management, nutrient supplementation through non-conventional sources and input use efficiency etc were identified/developed. Possibilities for diversified uses of tobacco using different innovative approaches were explored and documented. Further, the institute, with its two Krishi Vigyan Kendras (KVKs) located at Kalavacharla (East Godavari Distt.) and Kandukur (Prakasam Distt.) in AP, have made commendable contribution to agro-technology and knowledge transmission and empowering rural youth and

women through FLDs, training and capacity building programs. Apart from research and extension, the institute has produced 9,850 kg of tobacco seed and supplied to the farmers during 2014-15. The institute has successfully coordinated the joint efforts of ICAR institutes (AP and Telangana), ANGRAU and Dr.YSRHU in making prompt assessment of impact of the **HUDHUD CYCLONE (2014)** on crops and farm structures in Andhra Pradesh. For the first time, the institute has successfully formulated and implemented **Intervention Action Plan for Tribal Agriculture** in Seethappagudem panchayat of West Godavari district in AP under ICAR-CTRI Tribal Sub-plan. Further, the institute has successfully implemented an array of activities as part of **Swachh Bharat Abhiyan** during 2014-15.

During the reporting period the Institute published quite a good number of research papers in high impact national and international scientific journals. The research accomplishments of the Institute scientists have been widely recognized and bagged many prestigious awards that include Crystal National Agri Award-2014, Dr. R.P. Srivastava Memorial National Award, Swamy Sahajanand Saraswati Outstanding Extension Scientist Award of ICAR, Plant Biotechnologist-2014 and Computational Biologist-2014. I appreciate all scientists for their commitment to excel in their research endeavours.

I place on record my gratitude to Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, Government of India for his inspirational leadership and guidance. I express my sincere and special thanks to Dr. J.S. Sandhu, DDG (Crop Sciences), Prof. S. K. Datta, Former DDG (Crop Sciences) and Dr. N. Gopalakrishnan, ADG (CC) who have been the prime source of motivation and institutional support essential for effective execution of research and organizational programs of the institute. Myriad forms of encouragement and guidance received from Dr. R.R. Hanchinal, QRT chairman and Dr. P. Murugesha Boopathi, RAC chairman are gratefully acknowledged with thanks. I place on record my appreciation for the commendable effort put in by the editorial committee, PME Cell and LDS in bring out this annual report in time. Finally, I thank the Former Director (Acting), Heads of Divisions/Research Stations and all scientific, technical, administrative, audit & accounts, and supporting staff for their help and cooperation ensuring effective functioning of the institute.

24th June, 2015
Rajahmundry



(D. DAMODAR REDDY)
Director

कार्यकारी सारांश



भाकृअनुप-केन्द्रीय तम्बाकू अनुसंधान संस्थान एक प्रमुख संस्थान है, जिसका अधिदेश विभिन्न प्रकार के तम्बाकू पर अनुसंधान करना है विशेषकर उत्पादकता वृद्धि और उत्पाद की गुणवत्ता में सुधार की दिशा में। इस अवधि के दौरान संस्थान ध्येय तम्बाकू किस्मों में सुधार, सतत तम्बाकू उत्पादन के लिए कृषि प्रौद्योगिकियों का विकास, जैविक स्ट्रेस का समग्र प्रबंधन, तम्बाकू के वैकल्पिक फसलों की पहचान तथा तम्बाकू के वैकल्पिक उपयोग की ओर रहा है। प्रमुख अनुसंधान उपलब्धियां निम्न लिखित हैं।

तम्बाकू के किस्मों का विकास

- रिलीज करने हेतु एफसीवी तम्बाकू के दो किस्मों जेएस-117 एवं टीबीएसटी-2 तथा एक गैर एफसीवी तम्बाकू किस्म, बीएसआर-1 की पहचान की गई।
- जेएस-117 तम्बाकू किस्म की पहचान इसमें टार की कम मात्रा (20.53 मि.ग्रा./सिगरेट) तथा उच्च उपज क्षमता (2500 कि.ग्रा./हे.) के कारण की गई जो आन्ध्र प्रदेश के उत्तरी हल्की मृदाओं में उत्पादन के लिए उपयुक्त है।
- उच्च उत्पादन उपज क्षमता वाले किस्म (3300 कि.ग्रा./हे.) टीबीएसटी-2 की पहचान तम्बाकू मोजैइक वायरस (टीएमवी) तथा एफिड संक्रमण के प्रति इसकी प्रतिरोधी क्षमता के कारण की गई जो आन्ध्र प्रदेश के प्रकाशम एवं नेल्लोर जिलों की दक्षिणी हल्की मृदा तथा दक्षिणी काली मृदा क्षेत्रों के लिए उपयुक्त है।
- उच्च उपज क्षमता 3,400 कि.ग्रा./हे. वाले चवर्ण तम्बाकू वंशक्रम बीएसआर-1 की पहचान ब्लाक शैंक रोग के प्रति प्रतिरोधी क्षमता के कारण की गई है और यह किस्म तमिलनाडु के तटीय प्रदेश में उगाने के लिए उपयुक्त है।
- उच्च उपज वाले 10 उन्नत प्रजनन वंशक्रमों के मूल्यांकन के उद्देश्य से बहुस्थानीय परीक्षण हेतु एआईएनपीटी भेजा गया।
- विभिन्न पुनरावृत्ति परीक्षणों में, 7 उन्नत प्रजनन वंशक्रम, 4 उपजाऊ संकर किस्मों, 7 सीएमएस संकर किस्मों, 20 संतुलित एफिड प्रतिरोधी/सहिष्णुता वाले उन्नत संकर व्युत्पत्तियां उपचारित पत्ती उपज के संदर्भ में सामान्य किस्म सिररी की अपेक्षा अत्यन्त बेहतर (10-39%) पायी गयी हैं।
- उत्तरी हल्की मृदा में बड़े पैमाने पर किए गए परीक्षणों में कंचन की तुलना में टोबियोस-2, टोबियोस-6, टोबियोस-7 एवं एनएम प्रविष्टियों से तथा जेएस-117 किस्म से 4-21 प्रतिशत अधिक उपचारित पत्ती उपज प्राप्त हुई।
- उत्तरी हल्की मृदा में सामान्य किस्म कंचन की अपेक्षा 7 सीएमएस संकरों, 3 सोमाक्लोन तथा एक प्रजनन वंशक्रम में उपचारित पत्ती उपज अधिक (22 से 51%) पायी गयी।
- केन्द्रीय तम्बाकू अनुसंधान संस्थान के प्रादेशिक स्टेशन जीलगूमिल्ली में सामान्य किस्म कोम्मूगूडेम (2,020 कि.ग्रा./हे) की तुलना में नाटू के 12 उन्नत प्रजनन किस्मों से उच्च उपचारित पत्ती उपज (16 से 34%) प्राप्त हुई।
- तमिलनाडु के किसानों के खेत में चयनित चवर्ण तम्बाकू किस्म एचवी 2009-3 से उपचारित पत्ती की औसत उपज 4053 कि.ग्रा./हे. दर्ज की गई जो सामान्य किस्म अबिरामी की तुलना में 9% अधिक है।
- जर्मप्लाज्म बैंक में बीडी के 178, रस्टिका के 3 तथा नाटू तम्बाकू के 75 किस्मों के अलावा एफसीवी तम्बाकू के 5 विदेशी वंशक्रमों को जोड़कर के.त.अ. सं. की आनुवांशिक संसाधनों की संख्या को 3369 तक पहुंचा दिया गया।
- मुख्य किस्म सिररी, टीबीएसटी-2 तथा विशिष्ट जर्मप्लाज्म 324सी को 53 आकृतिमूलक डीयूएस अभिलक्षणों के लिए परीक्षण किया गया।
- फिंगर प्रिंटिंग के लिए उपयोग किए गए 15 मार्करों में से 5 मार्कर 5 पाइपलाइन किस्मों नामतः टोबियोस-2, जेएस 117, एनएलएसटी-4, टीबीएसटी-2 तथा वाईबी-4 तथा लोकप्रिय किस्मों कंचन एवं बैंकेट के अलावा एक जर्मप्लाज्म वंशक्रम 324सी में बहुरूपी पाए गए।
- टीएनएसए, निकोटीन तथा सोलनेसॉल गुणों के चित्रण के लिए विकसित जनकों एवं भारी मात्रा में आरआईएल समिष्टियों में 8 मार्कर बहुरूपी पाए गए हैं।
- जांच किए गए चार हाउसकीपिंग जीनों में Rbcs एवं EF-1 α जीन विभिन्न समय अन्तराल में पैथियम संक्रमित

तम्बाकू जीनोटाइप्सों में स्थिर अभिव्यक्तियां दर्शाया है।

- ❑ चयनित निकोटियाना वंशक्रमों के 3 प्लांट बारकोड लोसी स्क्रीनिंग में *trnH-psbA* से एम्प्लीकॉन लेंथ पॉलीमार्फिज्म तथा *rbcL* एवं *matK* सबबप से लोवर लेंथ वेरिएशन दर्ज किया गया।
- ❑ विभिन्न तम्बाकू नर्सरी क्षेत्रों से एकत्रित 17 पैथियम आइसोलेट्स के आईटीएस रीजनस का सीक्वेंसिंग पूरा कर लिया गया।
- ❑ आठ विभिन्न किस्मों के 9,850 कि.ग्रा. आधार बीज किसानों को बेचा गया जिससे रु. 98,50,000 की राशि प्राप्त हुई।

सतत तम्बाकू उत्पादन तथा प्रौद्योगिकी हस्तांतरण को सुदृढ़ता प्रदान करने हेतु .षि प्रौद्योगिकियों का विकास

- ❑ उत्तरी काली मृदा वाली स्थितियों में एफसीवी तम्बाकू में रसायनों नामतः नीम खली (49.4%) ए/एस का छिड़काव (47%), उत्पन्न होने से पूर्व अलकलार का उपयोग (66.3%), पिंडीमेथालीन (36.0), उत्पन्न होने के पश्चात 50 तथा 70 दिनों पर ग्लाइफोसेट का उपयोग (64.9% एवं 80.9%) तथा 50 एवं 70 दिनों पर (71.7% एवं 82.8%) इमेजथापैर के उपयोग करने पर सामान्य स्थितियों की तुलना में ओरोबंचे भार में कमी आई है।
- ❑ उत्तरी काली मृदा वाली स्थितियों के अंतर्गत रोपण कार्य को डेढ़ महीने देर से तथा पौध की दूरी 60 X 40 सें.मी. रख कर एनपीके उर्वरक खुराक 150:75:75 कि.ग्रा. प्रति हेक्टेयर देने पर तीन अन्य वंशक्रमों की तुलना में एचडीबीआरजी किस्म में उच्च पत्ती उपज (38.68 टन प्रति हेक्टेयर) प्राप्त हुई, इसके बाद का स्थान आरटी46-1 (36.68 टन प्रति हेक्टेयर) का रहा।
- ❑ बर्ले तम्बाकू के संदर्भ में पत्ती उपज तथा गुणवत्ता पर उर्वरक स्रोतों का कोई विशेष प्रभाव नहीं देखा गया है। परंतु प्रथम खुराक के रूप में सीएएन के साथ डीएपी तथा दूसरे खुराक के रूप में ए/एस देने तत्पश्चात प्रथम खुराक के रूप में सीएएन के साथ डीएपी तथा दूसरी खुराक के रूप में सीएएन देने पर उपचारित पत्ती उपज में वृद्धि देखी गई।
- ❑ उत्तरी हल्की मृदा वाली स्थितियों में कुंड सिंचाई (फर्रो इरीगेशन), सामान्य नवोद्भिद पौध तथा रोपण के पश्चात 10, 25-30 तथा 40-45 दिनों पर मृदा

में उर्वरकों के उपयोग करने की तुलना में टपक सिंचाई, ट्रे सीडलिंग्स, रोपण के पश्चात 3, 20-25 तथा 40-45 दिनों पर ड्रिप फर्टिगेशन से एफसीवी तम्बाकू की उपचारित पत्ती उपज में 367 कि. ग्रा. (15.5%) की वृद्धि हुई।

- ❑ उत्तरी हल्की मृदा वाली स्थितियों के अंतर्गत सिंचाईयुक्त अल्फीसॉल में एबीएल एनएलएसटी-4 किस्म में नाइट्रोजन खुराक 115 कि.ग्रा./हे. तथा 26 पत्तियों पर टॉपिंग से एफसीवी तम्बाकू उपज एनएलएसटी-3 तथा सामान्य किस्म कंचन से अधिक प्राप्त हुई।
- ❑ सिंचाई युक्त अल्फीसॉल में उगाई गई एफसीवी तम्बाकू के संदर्भ में कम टार वाले एबीएल जेएस 117 किस्म में नाइट्रोजन खुराक 115 कि.ग्रा./हे. की दर से तथा 26 पत्तियों पर टॉपिंग करने पर उपचारित पत्ती उपज सामान्य किस्म कंचन के समान ही रही।
- ❑ उत्तरी हल्की मृदा क्षेत्र में सीएमएस संकर एनएलएसएच 1 से अनुकूलतम उत्पादन प्राप्त करने हेतु पौध के बीच 100 X 60 सें.मी. की दूरी, 120 कि.ग्रा./हे. नाइट्रोजन तथा 26 पत्तियों पर टॉपिंग की आवश्यकता हुई।
- ❑ चवर्ण तम्बाकू में ड्रिप 100% ETc + 100% RDN से प्रथम श्रेणी पत्ती उपज, कुल उपचारित पत्ती उपज, शुद्ध आय तथा डब्ल्यूई में विशेष वृद्धि हुई है।
- ❑ हंसूर फार्म में जैविक तम्बाकू उत्पादन पर किए गए परीक्षण में उपज में 33.0% की कमी देखी गई (केएलएस क्षेत्र में परंपरागत रूप से उगाई गई तम्बाकू से उच्च श्रेणी सुवर्ण पत्ती उपज में 7.8% अधिक तथा पत्तियों में निकोटीन की न्यूनतम मात्रा है)। 75% जैविक 25% अजैविक तथा 50% जैविक 50% अजैविक उपचारों से उपज की कमी काफी कम (क्रमशः 20.0 और 8.6%) पाई गई।
- ❑ केएलएस स्थितियों में एफसीवी तम्बाकू नर्सरियों में सिफारिश की गई 25 कि.ग्रा./हे.पोटैशियम ऑक्साइड खुराक की तुलना में पोटैशियम ऑक्साइड 75 या 100 कि.ग्रा./हे. 3-4 किशतों में डाले जाने पर उत्साहजनक परिणाम देखे गए जिससे प्रतिरोपण योग्य नवोद्भिद पौध की संख्या प्रति यूनिट काफी अधिक पाई गई।
- ❑ केएलएस स्थितियों में एफसीवी तम्बाकू के उपचार में 'टर्बो फैन' के उपयोग से कुल लकड़ी ईंधन आवश्यकता में तकरीबन 11% की बचत हुई।

- ❑ मोतिहारी तम्बाकू पर स्थाई खाद परीक्षणों में सामान्य किस्मों (गोबर की खाद 10 किं./हे. दर से) की तुलना में मोतिहारी तम्बाकू में 112 कि.ग्रा. नाइट्रोजन 112 कि. ग्रा. फास्फोरस पैन्टाऑक्साइड 112 कि. ग्रा. पोटैशियम ऑक्साइड देने पर उपचारित पत्ती उपज (2707 कि. ग्रा./हेक्टेयर) तथा प्रथम श्रेणी पत्ती उपज (1555 कि. ग्रा./हेक्टेयर) में उल्लेखनीय वृद्धि दर्ज की गई।
- ❑ एसएलएस तथा एसबीएस क्षेत्र में सामान्य किस्मों में बेहतर किस्म सिरी की तुलना में आशाजनक टीबीएसटी-2 वंशक्रम से क्रमशः 15% तथा 14% अधिक उपज प्राप्त हुई।
- ❑ खेत निरूपणों में हाथों से खरपतवार साफ करने तथा इंटरकल्चर (1.37) की तुलना में खरपतवार नाशको के उपयोग क्विजालोफोप-इथायल 60 जीएआई/हे. की दर से रोपण के 15 तथा 75 दिनों पर उपयोग + इंटरकल्चर से उच्च बीसीआर दर (1.42) दर्ज की गई।

उत्पादन दक्षता तथा उत्पाद की गुणवत्ता हेतु संसाधन अवरोधों का प्रबंधन

- ❑ टंगटूरू मंडल के लिए सिंचाई जल गुणवत्ता सूचकांक विकसित किया गया तथा डब्ल्यूक्यूआई मूल्यों तथा डब्ल्यूक्यूआई प्रकारों के उपयोग से भौगोलिक सूचना प्रणाली के अंतर्गत स्थानिक मानचित्र विकसित किए गए। अधिकांश सिंचाई जल की उपयुक्तता मध्यम स्तर की है।
- ❑ विभिन्न नाइट्रोजन स्तरों के अंतर्गत (रिलेक्टेंस स्तर: 0.05–0.238) एफसीवी तम्बाकू पत्ती का हाइपर स्पेक्टरल रिलेक्टेंस का आकलित कुल पत्ती क्लोरोफिल (0.753–3.103 मि.ग्रा./ग्रा) से विपरीत संबंध है तथा दिए गए नाइट्रोजन का सहसंबंध गुणांक क्रमशः आर $r = -0.72 + 0.03, -0.86$ है। हाइपर स्पेक्टरल बैंड्स की संवेदनशीलता विप्लेशन से स्पष्ट होता है कि निकोटीन तथा घटती शर्करा में विशिष्ट संवेदनशील बैंड्स मौजूद हैं। हाइपर स्पेक्टरल बैंड से निकोटीन मात्रा का नकारात्मक सहसंबंध है जबकि घटती शर्करा का सहसंबंध सकारात्मक है।
- ❑ अम्लीय मृदा में राख न डालने की नियंत्रित स्थिति की तुलना में बायोमास राख डालने पर, मृदा के पीएच स्तर में काफी वृद्धि देखी गई। उपयोग की गई राख की मात्रा बढ़ाने से मृदा के पीएच स्तर में

वृद्धि हुई तथा उष्णयन समय बढ़ने पर इसमें कमी आने लगी है। मृदा में पीएच स्तर की वृद्धि इस क्रम में है : पीएसए > सीएसए > टीएसए > ईडब्ल्यूए।

- ❑ बायोमास राख डालने पर मृदा की पोटैशियम उर्वरता में बदलाव आया है, वृद्धि का यह महत्व बायोमास राख में पोटैशियम की सांद्रता के अनुरूप है। राख जिस प्रकार की भी हो, राख के परिमाण में वृद्धि से पोटैशियम की उपलब्धता में वृद्धि हुई। बायोमास राख में पोटैशियम उपलब्धता में वृद्धि का क्रम इस प्रकार रहा है – सीएसए > टीएसए > पीएसए > ईडब्ल्यूए।
- ❑ हंसूर में किए गए एक खेत प्रयोग में, फसल अवशेष/तम्बाकू डंटल, कपास डंटल, अरहर के डंटल तथा यूकलिप्टस लकड़ी (खलिहान के राख) की राख को अकेले ही या एसओपी के साथ (50% 50%) 100 कि.ग्रा. पोटैशियम प्रति हे. की दर से डालने पर तम्बाकू की पत्ती उपज में काफी वृद्धि हुई। केवल एसओपी देने की तुलना में केवल बायोमास राख या एसओपी के साथ देने पर फसल की उत्पादकता तुलनात्मक रहा। विभिन्न प्रकार के बायोमास राख में सीएसए पोटैशियम स्रोत के रूप में अधिक प्रभावकारी पाया गया। बायोमास राख के उपचार से पत्ती की गुणवत्ता प्रभावित नहीं हुई।
- ❑ परीक्षण किए गए पोषण तत्वों/वृद्धि हारमोन/पोलियामाइन्स में पोटैशियम नाइट्रेट को किनेटिन स्प्रे 50 पीपीएम की दर से 10 दिनों के अंतराल पर दो बार मृदा में डालने पर फलू क्यूर्ड तम्बाकू पर अत्यधिक जल के दुष्प्रभाव कुछ हद तक दूर करने का उपाय हो सकता है।
- ❑ फलू क्यूर्ड तम्बाकू के संदर्भ में पोटैशियम न डालने की स्थिति में वृद्धि कम हुई है, गौण पोषण तत्वों न दिए जाने पर भी कोई प्रभाव नहीं देखा गया चूंकि गौण पोषक तत्वों की कमी के प्रभाव को पोटैशियम की कमी छिपा दिया है। पर्याप्त पोटैशियम आपूर्ति की स्थिति में एक एकल या बहु पोषण तत्वों का लोप से कमी के लक्षण दृष्टिगत होते हैं, पौध की वृद्धि में कमी तथा पोषक तत्वों के उद्ग्रहण में भिन्नता परिलक्षित होती है।
- ❑ 75% आरडीएफ पर पीजीपीआर (नाइट्रोजन, फास्फोरस तथा पोटैशियम मोबिलैजर्स) के मिश्रण से टीकाकरण से टीकाकरण के बिना पूर्ण उर्वरता की अपेक्षा बेहतर एवं गुणीय उपज की प्राप्ति हुई।





- अजैविक रूप से उगाए गया बर्ले तम्बाकू (120 कि. ग्रा. नाइट्रोजन/हे) की तुलना में जैविक रूप से (25% नाइट्रोजन जैविक के रूप में) उगाए गए तम्बाकू में तटस्थ वाष्पशील सुगंध यौगिक उच्च मात्रा में देखा गया।
- ओरियंटल तम्बाकू में ऊपर की पत्तियों में अधिक मात्रा में तटस्थ वाष्पशील सुगंध यौगिक देखे गए हैं।
- बर्ले, ओरियंटल तथा एफसीवी तम्बाकू में निम्नीकृत वर्णक चयापचयों सहित 12 वर्णक यौगिकों की पहचान की गई। एफसीवी तम्बाकू में निम्नीकृत वर्णक तत्व कम पाए गए हैं।

जैविक स्ट्रेस का समेकित प्रबंधन

- तम्बाकू नर्सरियों तथा रोपित फसल में सोडोपटेरा लिटूरा फ़ैब्रिसियस के प्रति नए कीटनाशक क्लोरोफेनापैर 10 एससी 0.01% की दर से तथा क्लोरोलौजरॉन 504 ईसी 0.03% प्रभावकारी पाए गए हैं।
- एफसीवी तम्बाकू में तम्बाकू एफिड माइजस निकोटियाने ब्लैकमैन संक्रमण के नियंत्रण में लोनिकामिड 50 डब्ल्यूजी तथा पैमेट्रोजाइन 50 डब्ल्यूजी 0.02% प्रभावकारी पाया गया। एफिड परभक्षियों कोकिनेल्लारेपंडा थनबर्ग तथा जन्तोग्रामा स्कूटेल्लारे फ़ैब्रिसियस के लिए ये दोनों कीटनाशक अहानिकर पाया गया।
- ग्राउंड बीटल मेसोमार्फस विल्लीगर ब्लैककार्ड को सीडलिंग रूट डिप-इमिडाक्लोप्रिड 70 एएफ @ 0.14% या इमिडाक्लोप्रिड 200 एसएल @ 0.005% से प्रतिरोपण जल उपचार से प्रबंधन किया जा सकता है।
- समान रूप से छिड़काव, छिड़काव द्रव्य की मात्रा में बचत तथा परिचालक के समय को बचाने की दृष्टि से कम्प्रेसर स्प्रेयर की तुलना में हाइ टेक स्प्रेयर 550सीसी/मिनट से रोपण के 50 दिनों बाद छिड़काव द्रव्य का उपयोग करना लाभदायक है। रोपण के 65 दिनों बाद हाइ प्रेशर नैपसैक स्प्रेयर 1200सीसी/मिनट, 5.5 से 6 केएमपीएच का उपयोग हाई टेक स्प्रेयर से बेहतर है।
- रोपण के 35 दिनों के पश्चात हाइ टेक स्प्रेयर से निकला स्प्रे स्पेक्ट्रम तथा रोपण के 80 दिनों के पश्चात हाइ प्रेशर नैपसैक स्प्रेयर से निकला स्प्रे स्पेक्ट्रम बेहतर है जैसे बूंदों का उच्च घनत्व, निम्न

एनएमडी, निम्न वीएमडी, बूंदों के आकार में हल्की भिन्नता से स्पष्ट होता है।

- रोपण से 50 दिनों के पूर्व हाइ टेक स्प्रेयर से 550 सीसी/मिनट की दर से दो बार छिड़काव तथा इसके बाद हाइ प्रेशर नैपसैक स्प्रेयर से 550 सीसी/मिनट की दर से दो बार छिड़काव करने से पत्ती खाने वाली कैटरपिल्लर स्पोंडोपटेरा लिटूरा फ़ैब्रिसियस, बड वार्म हेलिकोवरपर्मीगेरा (हब्बर) तथा एफिड मयजस निकोटियाने ब्लैकमैन के प्रकोप को कम करने में प्रभावकारी पाया गया।
- एफसीवी तम्बाकू फसल के खेतों में सेरकोस्पोरानीकोटियाने इल्लीस तथा इवेर से होने वाले फ्रॉग आइ लीफ स्पॉट रोग को नियंत्रित करने में पैराक्लोसट्रोबिन 5%, मेटिराम 55% डब्ल्यूजी 0.2% का उपयोग काफी प्रभावी पाया गया।
- ट्राइकोडर्मा विराइड एवं पेसिलोमाइसेस लिलासीनस, ट्राइकोडर्मा विराइड तथा पोचानिया केलिमडासपोरिया के साथ रिडोमिल तथा यूरार्डॉन का उद्भासित नर्सरी क्यारियों समेकित उपयोग से रूट नॉट इंडेक्स (क्रमशः 47 एवं 50%) को कम करने तथा नर्सरी क्यारियों में डेम्पिंग ऑफ ब्लाइट रोग प्रकोप को सामान्य स्थितियों की तुलना में 63% तक कम करने में एक दूसरे के समान ही पाया गया है।
- टी. विराइड पी. लिलासीनस पी. केलिमडासपोरिया से समृद्ध ट्रे सीडलिंग्स के रोपण से सामान्य रोपण की तुलना में उपचारित पत्ती उपज में वृद्धि (12%), रूट नॉट इंडेक्स में कमी (53%) तथा विल्ट रोग में कमी (51%) पायी गयी है।

वैकल्पिक फसलों की पहचान तथा तम्बाकू के वैकल्पिक उपयोग

- चवर्ण तम्बाकू एनुअल मोरिंगा इन्टरक्रॉपिंग स्थिति में, 75 आरडीएफ की अपेक्षा 125 आरडीएफ के साथ उपचारित कुल पत्ती उपज में वृद्धि हुई है। चवर्ण तम्बाकू 100% एनुअल मोरिंगा समिष्टि से उच्च आय दर्ज हुई।
- बीज उपज के लिए 28 एफ1 तथा 8 जनकों का मूल्यांकन किया गया, ईसी 554900 X टीआई-163, ए-119 X जीटी-8 तथा ईसी 554900 X ए-145 संकरों से उच्च कुल बीज भार दर्ज की गई।
- एचडीबीआरजी X वीडीएस-3 (10278 कि.ग्रा./हे.), एचडीबीआरजी X एनपी-19 (8819 कि.ग्रा./हे.) तथा एचडीबीआरजी X ए-119 संकरों से उच्च हरित पत्ती



उपज तथा कुल बायोमास (क्रमशः 11601, 10435 तथा 9563 कि.ग्रा./हे.) दर्ज की गई।

कृषि विज्ञान केन्द्र (के.वी.के.), कलवाचेर्ला

- कृषि विज्ञान केन्द्र ने बागवानी फसलों, पशु पालन, गृह विज्ञान तथा ग्रामीण शिल्पकारी से संबंधित अनेक आउटरीच कार्यक्रमों का आयोजन किया जैसे ओएफटी (12), एफएलडी (17), परिसर एवं परिसर बाहर जागृति कार्यक्रम (31), व्यावसायिक प्रशिक्षण (14), क्षमता निर्माण कार्यक्रम (6)।
- गन्ना उत्पादन में रोपण सामग्री के रूप में सेट प्लांटिंग के स्थान पर सिंगल बडेड नॉड्स के उपयोग से लागत खर्च को ₹30,000/हे. कम किया।
- कृषि विज्ञान केन्द्र द्वारा प्रोन्नत बीएलबी सहिष्णुता वाले चावल किस्म आरपी-बायो-226 को किसानों ने अपने जिले में अपनाया तथा इसे अब 2500 हे. में उगाया जा रहा है।

कृषि विज्ञान केन्द्र (के.वी.के.), कंदूकूर

- कृषि विज्ञान केन्द्र द्वारा जिले में प्रवेश कराया गया नेपियर बाजरा चारा का कार्बन टेट्राक्साइड किस्म को किसानों ने अच्छी तरह अपना लिया है।

जनजातीय उपयोगना

भाकृअनुप-केन्द्रीय तम्बाकू अनुसंधान संस्थान की जनजातीय उपयोगना को ₹ 10.00 लाख की वित्तीय प्रावधान से आन्ध्र प्रदेश के पश्चिमी गोदावरी जिले के सीथप्पागूडेम पंचायत में कार्यान्वित किया गया। उपयुक्त तकनीकी हस्ताक्षेपों जैसे गांव के तालाब से गाद निकालना, खाद्यान्न भंडारण की स्थायी व्यवस्था, उच्च उपज वाले काजू किस्में, घर के पिछवाड़े में वनराजा मुर्गी पालन, तम्बाकू में ट्रे सीडलिंग्स उत्पादन आदि की पहचान कर कार्यान्वित किया गया। इस कार्यक्रम के अंतर्गत आय उत्पन्न करने हेतु पलमिरा रेशा उत्पादन भी सम्मिलित किया गया।





Executive Summary



The ICAR-Central Tobacco Research Institute is a premier institute with a mandate 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 tobacco cultivar improvement, development of agro technology for sustainable tobacco production, management of resource constraints for production efficiency and product quality, integrated management of biotic stresses, identification of alternative crops to tobacco and exploiting the tobacco for alternative uses. The salient research achievements are highlighted hereunder.

Tobacco Cultivar Development

- Two FCV tobacco cultivars, JS-117 and TBST-2, and a non-FCV cultivar, BSR-1 were identified for release.
- The cultivar, JS-117 is identified for its low tar content (20.53 mg/cigarette) and high yield potential (2500 kg/ha) and has the suitability for cultivation in the northern light soils region of Andhra Pradesh.
- The high yielding (3300 kg/ha) FCV tobacco cultivar TBST-2 is identified for its resistance / tolerance to TMV and aphid infestation. It is suitable for cultivation in Southern Light Soils and Southern Black Soils regions of Prakasam and Nellore districts of Andhra Pradesh.
- Chewing tobacco line, BSR-1 with the potential of yield of 3,400 kg/ha has been identified for its resistance to Black shank (*Phytophthora parasitica*) disease and is suitable for cultivation in coastal belt of Tamil Nadu.
- Ten high yielding ABL lines were advanced to AINPT multi-location trials for evaluation.
- In various replicated trials, seven advance breeding lines, four fertile hybrids, seven CMS hybrids, 20 stable, aphid resistant/ tolerant advanced cross derivatives were found significantly superior (10-39%) over control, Siri in cured leaf yield under black soil condition.
- Entries Tobios-2, Tobios-6, Tobios-7 & NM and JS-117 recorded 4-21% higher cured leaf yields than Kanchan in bulk trial at NLS.
- Seven CMS hybrids, three somaclones and a breeding line recorded significantly higher cured leaf yield (22 to 51%) over control, Kanchan at NLS.
- Twelve *Natu* advanced breeding lines recorded significantly higher cured leaf (16-34%) than check, Kommugudem (2020kg/ha) at CTRI RS Jeelugumilli.
- In the farmers' field, the chewing tobacco selection, HV 2009-3 recorded a mean cured leaf yield (4053 kg/ha) increase of 9% over the control, Abirami in Tamil Nadu.
- The CTRI genetic resources were raised to 3369 by adding 178 *bidi*, 3 *rustica* and 75 *Natu* besides 5 exotic FCV lines to the germplasm bank.
- Ruling variety Siri, cultivar TBST-2 and unique germplasm, 324C were characterized for 53 morphological DUS characteristics.
- Out of fifteen SSR markers used for finger printing, five markers found polymorphic among five pipeline varieties viz., Tobios-2, JS-117, NLST-4, TBST-2, and YB-4, two popular varieties Kanchan and Barket A1, and a germplasm accession, 324C.
- Eight SSR markers were found to be polymorphic between the parents and bulks of RIL population developed for the mapping of TSNA, nicotine and solanesol traits.
- Among the four housekeeping genes (Rbcs, EF-1 α , L25 and tubA1) screened Rbcs and EF-1 α showed relatively stable expression in *Pythium* infected tobacco genotypes at different time intervals.



- Among the three plant barcode loci screening in selective *Nicotiana* accessions, trnH-psbA showed higher amplicon length polymorphism and rbcL and matK loci recorded lower length variation.
- Completed the sequencing of ITS regions of 17 *Pythium* isolates collected from different tobacco nursery regions.
- A total of 9,850 kg foundation seed of eight different varieties was sold to farmers and an amount of Rs. 98,50,000 was realized.
- ABL NLST-4 with 115 kg N/ha and topping at 26 leaves showed significantly higher FCV tobacco yields than NLST-3 and control, Kanchan in irrigated Alfisols under NLS conditions.
- Low tar ABL JS 117 with 115 kg N/ha and topping at 26 leaves performed on a par with control, Kanchan with regard to cured leaf yield under irrigated Alfisols grown FCV tobacco.

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

- *Orobanche* weight was reduced by the application of chemicals viz., neemcake (49.4%), A/S spray (47%), pre emergence application of Alachlor (66.3%), pendimethalin (36.0%), post emergence application of glyphosate at 50 and 70 days (64.9% & 80.9%) and imazethapyr at 50 and 70 days (71.7% & 82.8%) when compared to control in FCV tobacco under NBS conditions.
- HDBRG recorded significantly higher leaf yields (38.68 t/ha) followed by line RT 46-1 (36.68 t/ha) compared to other three lines at 60 x 40 cm spacing and a fertiliser dose of 150:75:75 kg NPK/ha with one and half month delay in planting under NBS conditions.
- Sources of fertilisers did not show any significant affect on leaf yields and quality in burley tobacco. However, higher cured leaf was observed when CAN along with DAP in 1st dose and A/S in 2nd dose followed by CAN along with DAP in 1st dose and CAN in 2nd dose was applied.
- The treatment consisting of drip irrigation, tray seedlings, drip fertigation at 3, 20-25 and 40-45 DAP increased cured leaf yield of FCV tobacco by 367 kg (15.5%) when compared with furrow irrigation, normal seedlings, soil application of fertilizers at 10, 25-30 and 40-45 DAP in NLS.
- CMS hybrid NLSH 1 required a spacing of 100 X 60 cm, nitrogen dose of 120 kg N/ha and topping at 26 leaves in NLS region for optimum production.
- Drip at 100% ETc+100% RDN significantly increased the first grade leaf yield, total cured leaf yield, net return and WUE in chewing tobacco.
- In the trial on the organic tobacco production conducted at Hunsur, yield reduction of 33.0% (7-8% higher bright grade production and lowest leaf nicotine compared to the conventionally grown tobacco in KLS region) was observed. Yield reduction in the 75% organic + 25% inorganic as well as in 50% organic + 50% inorganic treatments was considerably less (20.0 and 8.6% respectively).
- Application of 75 or 100 kg K₂O/ha in 3-4 splits in FCV tobacco nursery gave encouraging resulted higher number of transplantable seedlings per unit area compared to recommended dose of 25 kg K₂O/ha under KLS conditions.
- The use of 'turbo fan' in curing of FCV tobacco economized the total fuel wood requirement to an extent of 11% in KLS conditions.
- Application of 112 kg N + 112 Kg P₂O₅ + 112 Kg K₂O /ha recorded significantly highest cured leaf (2707 kg/ha) and first grade leaf (1555 kg/ha) yields of Motihari tobacco as compared to control (FYM @10 t/ha) in permanent manurial trial on *Motihari* tobacco.

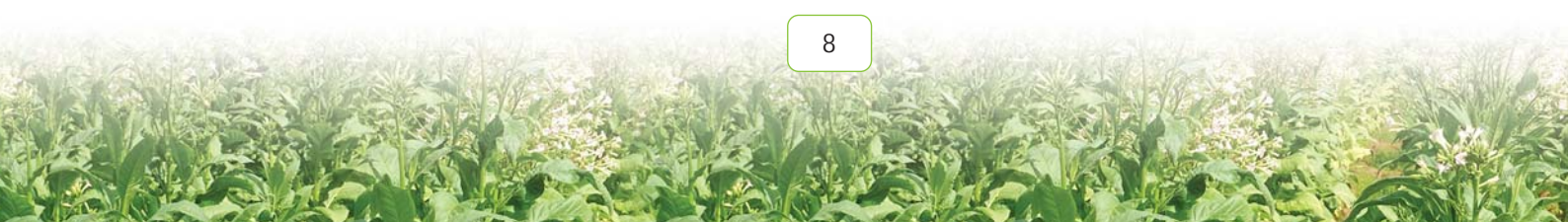




- Promising line TBST-2 out yielded the better control Siri by 15% and 14% in SLS and SBS areas, respectively.
- FLDs on integrated weed management including application of weedicide, quizalofop-ethyl @ 60 g a.i./ha at 15 and 75 DAP + intercultures recorded higher BCR (1.42) over hand weeding + intercultures (1.37).
- In a field experiment at Hunsur, application of crop residue/wood ashes from tobacco stems, cotton stems, pigeon pea stems and eucalyptus wood (barn ashes) either alone or in combination with SOP (50% + 50%) on 100 kg K ha⁻¹ equivalent basis caused a significant increase in leaf yield of tobacco. Effects of biomass ashes alone or their combinations with SOP on crop productivity were comparable with that of SOP alone. Among the biomass ashes, the CSA proved relatively more effective source of K supplementation. The leaf quality was not affected by the biomass ash treatments.

Management of resource constraints for production efficiency and product quality

- Irrigation water quality indices were developed for Tanguturu mandal and by using WQI values GIS spatial maps were developed. Most of the irrigation water is in moderately suitable class followed by suitable class for conjunctive use.
- Hyper spectral reflectance of FCV tobacco leaf under different nitrogen levels (reflectance values: 0.05 - 0.238) had inverse relation with estimated total leaf chlorophyll (0.753 - 3.103 mg/g) and applied nitrogen with a coefficient of correlation $r = -0.72 \pm 0.03$, -0.86 , respectively. Sensitivity analysis of hyper spectral bands showed that specific sensitive bands were observed for nicotine and reducing sugars. Nicotine content was negatively correlated where as reducing sugars were positively correlated to hyper spectral bands.
- Addition of biomass ashes to an acid soil caused a sharp rise in soil pH over the no-ash control. The increments in soil pH were larger with the increase in ash application rate and tended to decrease with the progress of incubation time. The magnitude of increase in soil pH followed the order: PSA > CSA > TSA > EWA.
- Addition of biomass ashes brought of a marked change in K fertility of soil, with magnitude of increase being consistent with K concentration of biomass ashes. Irrespective of ash type, increasing rates of ash addition resulted in greater increase in k availability. Among the biomass ashes, the increase in K availability followed the order CSA > TSA > PSA > EWA.
- Among the nutrients/growth hormones/polyamines tested, KNO₃ soil application in combination with kinetin spray @ 50 ppm twice at 10 days interval could mitigate the ill effects of excess water to some extent in flue-cured tobacco.
- Under no potassium condition the plant growth is less and omission of secondary nutrients didn't show any effect as the K deficiency symptoms masked the effects of secondary nutrients in flue-cured tobacco. Under sufficient K supplied condition omission of single and multiple nutrients showed visual deficiency symptoms, reduction in plant growth and showed variation in uptake of nutrients.
- Inoculation with the mixture of PGPR (N, P and K mobilizers) at 75% RDF produced significantly superior yield better than the full fertility rate without inoculants.
- Higher levels of neutral volatiles aroma compounds were observed in organically grown burley tobacco (25% N in the form of organics) when compared to inorganically grown burley tobacco (120 kg N/ha).
- Top position leaves showed higher levels of neutral volatile aroma compounds in oriental tobacco.
- Twelve pigment compounds including degraded pigment metabolites were identified in burley, oriental and FCV tobacco. Pigment degraded products were less in FCV tobacco.



Integrated Management of biotic stresses

- New insecticides chlorfenapyr 10 SC @ 0.01% and chlorfluazuron 5.4 EC 0.03% were found effective against *Spodoptera litura* Fabricius in tobacco nurseries as well as planted crop.
- Flonicamid 50 WG and pymetrozine 50 WG @ 0.02% effectively controlled tobacco aphid, *Myzus nicotianae* Blackman infestation in FCV tobacco. These two insecticides were found to be safe to the aphid predators, *Coccinella repanda* Thunberg and *Xanthogramma scutellare* Fabricius.
- Ground beetle *Mesomorphus villiger* Blanchard could be managed with seedling root dip in imidacloprid 70 AF @ 0.14% or transplant water treatment with imidacloprid 200 SL @ 0.005%.
- Application of spray fluid at 50 DAP, through Hi tech sprayer @ 550 cc/min was superior over compression sprayer in terms of providing uniform coverage, reduced quantity of spray fluid and operator's time. At 65 DAP high pressure knapsack sprayer @1200 cc/min, 5.5 to 6 kmph was superior to Hi tech sprayer.
- Spray spectrum emitted through Hi tech sprayer at 35 DAP and high pressure knapsack sprayer at 80 DAP was superior as shown by spray characteristics viz., high droplet density, low NMD, low VMD, with lower deviation of droplet size.
- Application of sprayings twice before 50 DAP through Hi tech sprayer @ 550 cc/min and thereafter subsequent two sprayings through high pressure knapsack sprayer @1200 cc/min was more effective in reducing the incidence of leaf eating caterpillar, *Spodoptera litura* Fabricius, bud worm, *Helicoverpa armigera* (Hubner) and aphids, *Myzus nicotianae* Blackman.
- Application of *pyraclostrobin* 5% + metiram 55% WG @ 0.2% was highly effective in suppressing frog eye leaf spot disease caused by *Cercosporanicotianae* Ellis & Everh in field crop of FCV tobacco.

- Integrated application of *Trichoderma viride* & *Paecilomyces lilacinus*, *Trichoderma viride* and *Pochania chlamydosporia* along with ridomil and furadon in solarised nursery beds were on par with each other in recording decreased root knot index (47 and 50%, respectively) and also decreased damping-off + blight disease incidence in nursery beds to the tune of 63% over untreated check.
- Planting tray seedlings enriched with *T. viride* + *P. lilacinus* + *P. chlamydosporia* significantly increased the cured leaf yield (12%), decreased the root knot index (53%) and also decreased the wilt disease (51%), respectively over check.

Identification of alternative crops and exploiting tobacco for alternative uses

- In chewing tobacco+ annual moringa intercropped situation, the total cured leaf yield of tobacco significantly increased (19%) with 125% RDF over the 75% RDF. Higher net return was recorded with chewing tobacco + 100% annual moringa population and at 125% RDF applied to both chewing tobacco and annual moringa.
- Among the 28 F₁ hybrids and 8 parents evaluated for seed yield, crosses EC 554900 X TI-163, A-119 X GT-8 and EC 554900 X A-145 recorded significantly higher seed yield.
- The crosses HDBRG X VDH-3 (10278 kg/ha), HDBRG X NP-19 (8819 kg/ha) and HDBRG X A-119 (8417 kg/ha) exhibited higher green leaf yield and total biomass (11601, 10435 and 9563 kg/ha, respectively).

Krishi Vigyan Kendra (KVK) Kalavacharla

- KVK conducted field outreach activities like OFTs (12), FLDs (17), on/ off campus awareness programmes (31), vocational trainings (14), capacity building programmes (6) covering field and horticulture crops, animal husbandry, home science and rural crafts.



- Cost of cultivation in sugar cane was reduced by Rs.30,000/ha by using single budded nodes as seed material in place of set planting.
- BLB tolerant rice variety RP-Bio-226 promoted by KVK was adopted by the farmers in the district and now it is being cultivated in 2,500 ha.

Krishi Vigyan Kendra (KVK), Kandukur

- CO₄ variety of Napier bajra fodder introduced by the KVK in the district was well adapted by the farmers.

Tribal Sub-Plan

Tribal sub plan of ICAR-CTRI was implemented in Seethappagudem panchayat of West Godavari district in Andhra Pradesh with a total financial outlay of Rs.10.00 lakhs. Suitable technological interventions *viz.*, de-silting of village pond, permanent grain storage bins, high yielding cashew varieties, backyard poultry with Vanaraja birds, tray seeding production in tobacco, farm implements etc. were identified and implemented. Under this programme income generating activities like Palmyrah fibre production were also included.



Introduction

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

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

MANDATE

- To conduct research on different types of tobacco, with greater emphasis on exportable types, on all phases of production management with a view of attaining economic advantage / benefit to the tobacco growers through improvement in quality and quantity of tobacco.
- To collect tobacco germplasm from world over and to maintain and operate tobacco genetic resources which will be made

available to scientists and National / International Institutions.

- To conduct research on economically viable and sustainable cropping systems alternative to tobacco.
- To conduct research on diversified uses of tobacco and development of value-added products viz., phytochemicals.
- To produce and distribute quality seeds of notified varieties of tobacco.
- To publish and disseminate research findings and recommendations of latest technology for the benefit of the tobacco growers, scientific community, policy makers and development agencies.

RESEARCH PROGRAMMES

I. Tobacco cultivar improvement

- (A) Developing tobacco varieties / hybrids possessing higher leaf yield and resistance to biotic and abiotic stresses to stabilize productivity
- (B) Tailoring of tobacco plant type for optimizing the seed yield and phytochemicals
- (C) Production and distribution of foundation seed of ruling tobacco varieties
- (D) Germplasm resource management
- (E) Biotechnology for tobacco improvement

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

- (A) Healthy seedling production
- (B) Optimization of water and nutrient use for productivity enhancement of different tobacco types
- (C) Evolving site-specific cultural management practices in different agro-ecological sub-regions
- (D) Post-harvest product management (PHPM)
- (E) Analysis of socio-economics for stratification and to formulate appropriate strategies





(F) Technology outreach activities

(G) Technology assessment

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

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

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

(C) Identification of potential phytochemicals

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

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

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

(C) Characterization of soil biota and use of biofertilizers

(D) Evaluation of tobacco leaf and product quality

V. Integrated management of biotic stresses

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

(B) Development of IPM technology

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

(D) Monitoring of insect pests and diseases

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

STAFF POSITION AND FINANCIAL STATEMENT

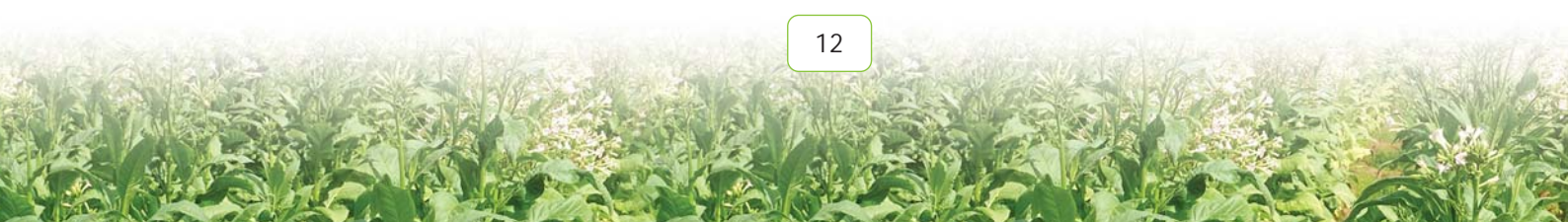
STAFF POSITION AS ON 31.03.2015

Sl. No.	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	54+1*	27+1*	27
2.	Technical	147	118	29
3.	Administration	70	53	17
4.	Skilled Supporting Staff	158	115	43

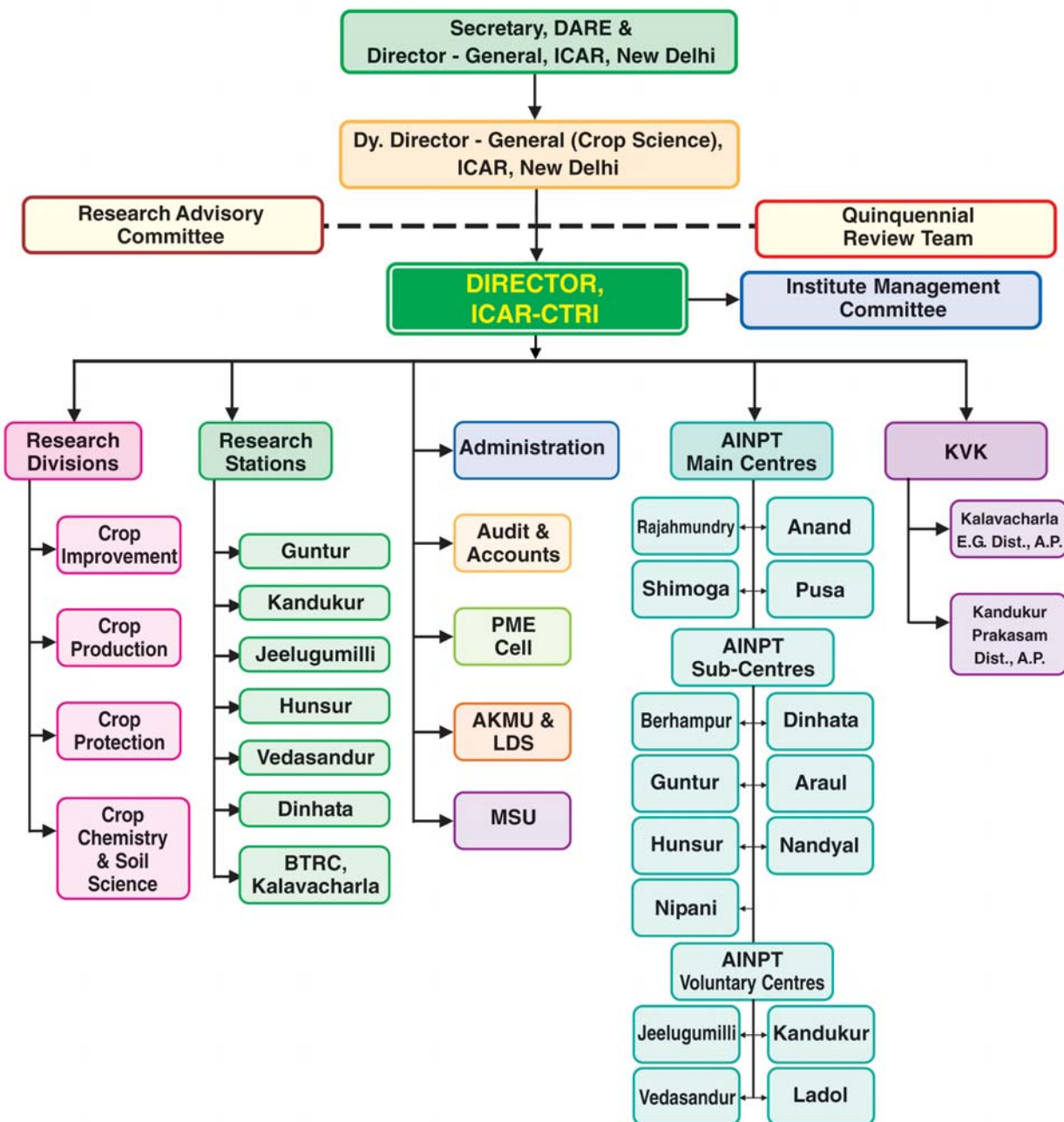
* RMP position

FINANCIAL STATEMENT FOR THE YEAR 2014-15

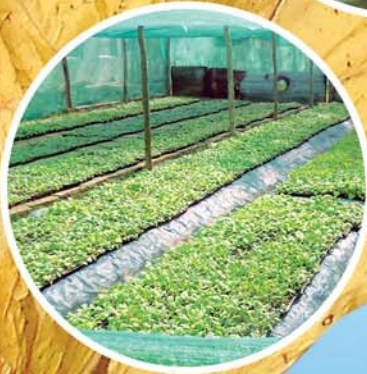
Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	2314.00	2313.40
Plan	173.00	173.00
KVK	149.63	147.90
AINPT	416.00	416.00
Pension & Retirement Benefits	1300.00	1299.85
Personal Loans & Advances	18.00	17.87
Recurring Deposit Schemes	12.07	17.03
Revolving Fund Scheme	104.70	85.65
Internal Resource Generation	7.35	11.87
Revenue Receipts	157.63	



ORGANOGRAM



Research Achievements



I. Tobacco Cultivar Development

I. (A) Developing tobacco varieties with higher leaf yield and quality (CTRI, Rajahmundry)

Evolving superior varieties of FCV tobacco through hybridization
P.V. Venugopala Rao

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

A replicated yield trial was conducted for the first Year with ten advanced breeding lines viz., V-5047, V-5050, V-5051, V-5057, V-5058, V-5059, V-5060, V-5061, V-5063 and V-5068 and two controls viz., VT-1158 and Siri.

Among the lines evaluated, V-5058 recorded significantly superior green leaf yield of 16430 kg/ha, followed by V-5057 (15756 kg/ha) and V-5063 (14568 kg/ha). The improvement over better control ranged from 11 to 25 per cent. V-5058, and V-5057 recorded 25 and 20 per cent higher green leaf yield over the better control, Siri (13140 kg/ha) respectively.

Cured leaf yield was significant in V-5058 (2650 kg/ha) followed by V-5057 (2517 kg/ha) and V-5063 (2329 kg/ha) compared to the better control Siri (2122 kg/ha) and the yield improvement over the Siri ranged from 10 to 25 per cent.

Bright leaf yield was significant in V-5058 (1601 kg/ha) and V-5057 (1536 kg/ha) compared to the better control Siri (1324 kg/ha) and the yield improvement over the Siri was 22 and 17 per cent respectively.

Grade index was significant in V-5058 (2190 /ha) and V-5057 (2091 /ha) compared to the better control Siri (1774 /ha) and the improvement over Siri was 23 and 18 per cent respectively.

Chemical quality parameters

The nicotine (%) in the entries ranged from 1.58 to 2.85 and the reducing sugars (%) ranged from 12.99 to 15.69.

Based on the performance, V-5058 and V-5057 are better performers among the entries evaluated.

Preliminary evaluation of advanced breeding lines:

Advanced breeding lines (41) were evaluated in a row trial along with the control Siri and forty selections were made for further evaluation to identify the potential lines with higher yield. Another set of 43 selections were raised and sixty three selections were made for further evaluation.

Evaluation of advanced breeding lines for yield and quality (CTRI, Rajahmundry)

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

Thirteen advanced breeding lines were tested in a replicated trial for first year along with two controls, VT 1158 and Siri.

Lines RS 22, RS 23, RS 24 and RS 32 recorded significantly higher green (18924-19167 kg/ha) and cured leaf yields (3062-3128 kg/ha), bright leaf (1651-1694 kg/ha) and grade index (2527-2577 kg/ha) than the better control, Siri. The range of yield increase in these lines over Siri(c) was 17-19% in green leaf, 19-22% in cured leaf, 20-23% in bright leaf and 21-23% in grade index.



ABL RS-23





Differences were significant among total number of leaves, number of curable leaves, leaf length & width and intermodal length while differences were non-significant for plant height among the lines tested. RS-23 and Siri recorded more number of curable leaves (27). RS-32 recorded maximum leaf length (65 cm) and RS-24 and RS-26 maximum leaf width (38 cm).

The chemical quality characteristics of breeding lines *viz.* nicotine range from 1.1% in RS-28 to 1.97% in RS-22 and reducing sugars from 10.52% in RS-32 to 20.24% in RS-20.

Screening of breeding lines in row trial

Out of 75 breeding lines assessed for yield under row trial, 17 lines found to be promising for yield. One hundred advanced breeding lines were raised and seed collected for maintenance. One hundred and seventy two lines including breeding lines, germplasm lines and F_2 s were screened for TMV resistance and the seeds were collected from selfed plants.

Twenty promising Kanchan somaclones and twelve VT-1158 somaclones were inoculated with black shank under artificial conditions at Katheru Farm and seed collected from resistant plants.

In the twenty white and two black seed breeding lines and five germplasm lines assessed for seed oil content, the oil content ranged from 35.44% to 41.48%.

Evaluation of breeding lines at CTRI RS, Jeelugumilli

Twelve soma clones and two breeding lines were tested for second year in a replicated trial along with Kanchan (control). Significant yield differences recorded among the entries for green and cured leaf, and grade index values. Clones, NLCR-1-9-2-13, VLCR-12-15-14-5, NLCR-9-2 and Pasidi Kanchan P2 recorded significantly higher yields of all types than Kanchan. The green leaf yield ranged from 13083 to 14111 kg/ha, cured leaf yield from 2327 to 2501 kg/ha and grade index from 1634 to 1717 kg/ha; an increase of 23-32%, 23-32% and 33-36%, respectively was recorded, over control,

Kanchan. Entry, NLCR-BT1-P2 recorded significantly higher cured leaf yield (2224) and entry, NLCR-BT2-P9 significant cured leaf yield (2231kg/ha) and grade index values (1589kg/ha)

Pasidi Kanchan P2 recorded highest plant height (117 cm), NLCR-8 and VLCR-12-15-14-5 higher number of leaves after topping (29), NLCR-1-9-2-13 higher leaf length (80 cm), and NLCR-10-7-2-1 higher leaf width (41 cm) values than all the other lines.

Nicotine at 'X' position ranged from 1.42-3.22% and 'L' position from 1.57-4.19%. Reducing sugars at 'X' position ranged from 8.00 to 15.73% and 'L' position from 5.53-11.36%.

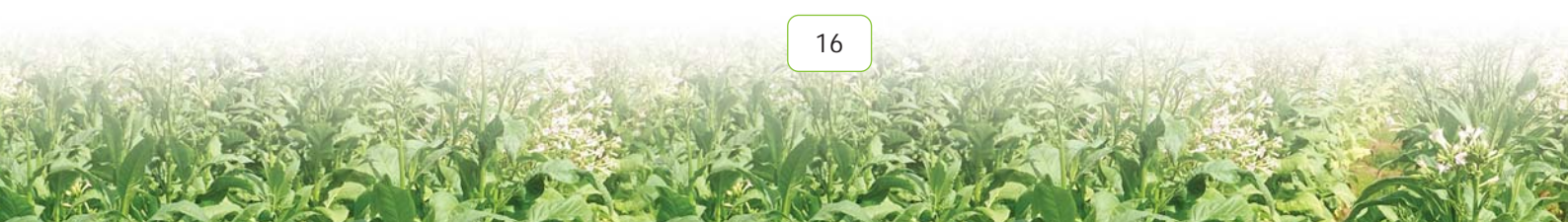
Five entries were tested in a bulk trial (200 plants each) along with Kanchan. All the entries *viz.*, four somaclones (Tobios-2, Tobios-6, and Tobios-7 & NM) and a breeding line, JS-117 recorded higher leaf yields than Kanchan. The increase in cured leaf yields ranged from 4-21% and grade index from 8-23% in Tobios-7 and Tobios-2, respectively.

Chemical quality characteristics of entries tested at the bulk trial showed that nicotine at 'X' position found to range from 1.47-2.77% and 'L' position from 1.9-3.46%. Reducing sugars at 'X' position found to range from 7.04 to 14.22% and 'L' position from 4.78-10.66%.

In the analysis conducted by ITC-ILTD Ltd., advanced breeding line, JS-117 recorded lower tar (22.8 mg/cigarette) and CO (10.9 mg/cigarette) values than Kanchan (24.1 and 11.0, respectively).

Estimation of nicotine and chlorides in released varieties

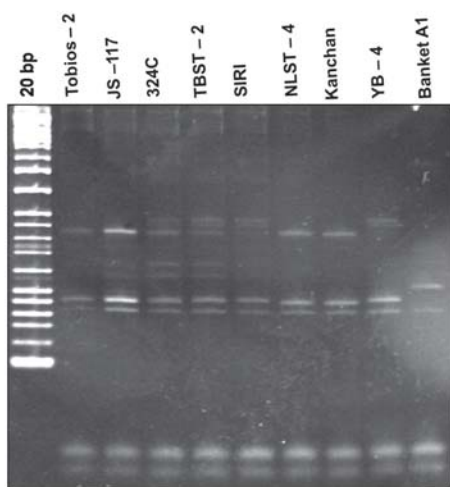
The nicotine content in the entries ranged from 0.33% in Gandak Bahar to 3.53% in HD-65-40 and chlorides from 1.23% in Lichhavi to 4.29% in Hemti. Average nicotine and chloride content in released varieties of various tobacco types indicate that nicotine content is low in cheroot (0.91%) and high in hookah and chewing (2.17%). Chlorides were found to be low in *bidi* (1.9%) and high in hookah and chewing (3.12%).





Molecular finger printing of pipeline varieties/germplasmaccessions

In order to develop varietal fingerprints, five pipeline varieties *viz.*, Tobios-2, JS-117, NLST-4, TBST-2, and YB-4, two popular varieties Kanchan and Banket A1, and a germplasm accession, 324C were screened with fifteen SSR markers. Primers, NSTM-12, PT-51706, PT-53418, TBM-36 and TM-10163 were found polymorphic.



Amplification of pipeline varieties profile with PT-53418 primer

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

T.G.K. Murthy

I. Generation advancement & selection:

Thirty F_7 progenies of crosses involving Kanchan as one of the parents were raised and 26 of the lines were identified as TMV resistant. Single plant selections showing plant type suitable to NLS besides having high leaf number (30-45 per plant) and/or resistance to TMV were selfed for further testing.

II. Preliminary evaluation of advanced breeding lines

A progeny-row trial was conducted with 166 lines (F_6) along with the check variety Kanchan to identify selections suitable to NLS

area. Fourteen lines with high yield potential (CLY 3000-3530 kg/ha against 1900 kg in Kanchan) and desirable leaf quality were identified. Twenty six of the lines were identified as resistant to TMV on artificial inoculation. Seventy five single plant selections showing good plant type and leaf characteristics suitable for NLS besides high yield potential were advanced for further evaluation.

III. Replicated yield trials

1. Trial RYT-15 (2nd year)

A set of 13 green cast advanced breeding lines were evaluated. Plant and leaf type were better in RT entries 3-1, 4-1, 4-3, 27-1, 29-1, 29-2, 33-1, 47-1, and 49-1 than others. Line RT9-1 showed resistance to TMV.

Six lines (RT3-1, RT4-3, RT9-1, RT10-1, RT29-1 and RT33-1) showed significantly higher green leaf yield, cured leaf yield and grade index than check, Kanchan. The increase was 21 to 61% for green leaf yield, 27-68% for cured leaf yield and 29-72% for grade index. Line RT4-1 recorded significantly higher green leaf yield (18%) and cured leaf yield (23%) than check, Kanchan. Cured leaf colour, size and body in the test entries *viz.*, RT Nos.3-1, 10-1, 27-1, 48-1, and 49-1 were better than or comparable with that of Kanchan.

2. Trial RYT-16 (2nd year)

In another replicated trial, 13 more medium/ green cast advanced breeding lines were evaluated. Plant and leaf types were good in RT Nos. 55-1, 57-1, 96-1, 81-1, 108-1, 66-1 and 91-1. Lines RT92-1 and RT96-1 were TMV resistant.

Five lines (RT91-1, RT92-1, RT94-1, RT96-1 and RT108-1) showed significantly higher green leaf yield, cured leaf yield and grade index than check, Kanchan. The increase was 13 to 49% for green leaf yield, 19-57% for cured leaf yield and 21-55% for grade index. Cured leaf colour, size and body in the test entries RT Nos. 54-1, 55-1, 57-1, 92-1, 94-1 and 108-1 were comparable with that of Kanchan.

3. Trial RYT-17 (1st year)

A new replicated yield trial was conducted with 13 green cast advanced breeding lines. Five lines (RT54-1, RT56-1, RT113-2, RT124-1 and RT125-4) showed significantly higher green and cured leaf yield and grade index than check, Kanchan. The increase was 18 to 33% for green leaf yield, 19-32% for cured leaf and 19-31% grade index. Cured leaf colour, size and body in the test entries RT Nos. 107-1, 56-1, 108-1 and 109-1 were comparable with that of Kanchan.

4. Trial RYT-18 (1st year)

A new replicated trial with 13 more medium/ green cast advanced breeding lines was conducted. Two lines viz., RT 127-1 and RT137-2 showed significantly higher leaf yield and grade index than Kanchan. The increase was 14 and 33 % for green leaf yield, 14 and 28% cured leaf yield and 17 and 36% for grade index, respectively in the two promising lines. Cured leaf colour, size and body in the test entries in entries viz., RT Nos. 127-1, 132-1, 143-2, 145-2 and 146-1 were comparable with Kanchan.

Developing new varieties of irrigated natu tobacco for Andhra Pradesh T.G.K. Murthy

1. Bulk evaluation

Fourteen advanced breeding lines, identified as superior to checks in previous bulk assessment trials, were grown in progeny bulks along with check, Kommugudem. Among all the lines, Sel 47, Sel 45, and 45-90 were promising and recorded 10, 11 and 10% increase in cured leaf yield over Kommugudem (1625 kg/ha).

2. Evaluation of promising lines in replicated trial - I (2nd year):

Fifteen green cast Natu type advanced breeding lines with high yield potential and / or TMV resistance, were evaluated for the third year in succession. Plant type and leaf colour, body and size were good in NF3-12-2, NF3-12-1, NF3-15-1, NF3-10-2, NF3-20-2, PVM8-1, NF3-8-1 and NF3-11-1.

Entries No. 1, 2, 4, 5, 7, 8 and 9, recorded significantly higher cured leaf (18-34%) than check, Kommugudem (2026 kg/ha). Based on aroma, colour, leaf size, leaf blemish and weight, expert farmers identified the lines viz., NF3-5-1, NF3-6-2, NF3-12-2 and NF3-15-1 along with Kommugudem possessed leaf aroma and flavor suitable for irrigated condition.

3. Evaluation of promising lines in replicated trial - 2 (1st year):

Fifteen green cast Natu type advanced breeding lines with high yield potential and / or TMV resistance, were evaluated. Plant type and leaf colour, body and size were good in entries 1, 2, 3, 6, 7, 10, 11, 12 and 14. Five test entries (# 1, 2, 3, 13 and 14) showed significantly higher (16 to 22%) cured leaf yield than check Kommugudem.

Chemical quality of cured leaf: Nicotine levels varied from 1.27 to 4.62% while total reducing sugars varied from 0.58 to 1.34 %.

4. Generation advancement and selection: F₆ generation of the crosses viz., Singarajupalem x Kommugudem and Kommugudem x 45-90 was grown and 28 single plant selections with desirable plant type (less height, close phyllotaxy, *Katta* type leaf shape, less internode length, dark green foliage and more leaf number) were selected for further studies.

5. Breeding TMV resistant irrigated Natu tobacco

Eight Natu type derivatives (F₆) of cross Pyruvithanam x JMR identified as segregating for resistance to TMV during previous season were grown in progeny rows and three lines with TMV resistance and suitable to irrigated conditions were selected.

Evaluation of advanced burley breeding lines for productivity and quality P.V.Venugopala Rao and T.G.K.Murthy

Evaluation of segregating material

Progeny row trial was conducted involving 51 progenies and 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. Ten selections made (YB-26 to YB-35) and these will be evaluated in a replicated trial during 2014-15.

Maintenance of Burley germplasm:

One hundred and twenty one germplasm lines ByGP-1 to ByGP-121 were planted and selected plants are selfed and seed collected for further maintenance.

Incorporation of Male sterility (CMS) in burley Varieties:

The BC₈ 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, and Banket-127. The seed was collected.

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

P. Venkateswarlu

Eight FCV tobacco lines were evaluated for assessing their performance in respect of yield, quality and disease resistance along with two check varieties *viz.*, Hemadri and Siri. All the test lines were significantly superior over the check, Hemadri. Compared to another check Siri, significant difference in all the yield parameters was observed only with the line, RT 42-1. Maximum green leaf of 17,797 kg, cured leaf of 2,782 kg and bright leaf of 2,074 kg/ha was recorded in RT 42-1 followed by RT 44-1 with 16,011, 2,328 and 1,632 kg/ha of green, cured and bright leaf, respectively.

Chemical analysis of cured leaf revealed that in all the entries tested, nicotine, reducing sugars and chlorides were at acceptable limits. Tobacco mosaic virus was not noticed in any of the varieties. Leaf curl (whitefly) incidence varied from 0 to 3%. Aphid infestation was more than 5% in all the varieties.

Evaluation of advanced breeding lines

A replicated trial with 6 advanced lines (obtained from CTRI, Rajahmundry) and three

checks was carried out to evaluate for their yield potential. Analysis of data indicated that, compared to the check, Hemadri, all the treatments were significantly superior in respect of all yield parameters. Statistically significant difference was not observed among the six entries for green leaf and cured leaf yield. In case of bright leaf, significant difference among some treatments was recorded. Among all the treatments, line T-61 was superior with green leaf yield of 17,261 kg/ha, cured leaf of 2,550 kg, bright leaf of 2,135 kg and grade index of 2,161 kg followed by T-63 with 17,142, 2,351, 1,846 and 2,126 kg/ha of green leaf, cured leaf, bright leaf and grade index, respectively. In case of cured leaf, there was no significant difference between treatments and two checks, Siri and VT-1158.

Chemical analysis of cured leaf indicated that nicotine, reducing sugars and chlorides were at permissible limits. Regarding pest incidence, aphid infestation was above threshold level in all the varieties including three checks.

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. Murty and A.V.S.R.Swamy

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

Five single plants selections from the F₄ single plant progeny rows of the following crosses with aphid resistant lines were made.

Cross	No plants
Siri X 15-2	2
Siri X 10-1	3

B. Five single plants selections from the F₄ single plant progeny rows of the following crosses with caterpillar resistant lines were made.

Cross	No. plants
Siri X 155-2	3
Siri X 113-1	2



C. F₂ generation of Siri X 47-1, Siri X 62-2 and Siri X 151-2 were grown and 25 single plants from F₂ population were selected.

Cross	No. plants
Siri X 47-1	10
Siri X 62-2	10
Siri X 151-2	5

Development and evaluation of advanced breeding lines suitable to Karnataka Light Soil region. (CTRI RS, Hunsur)

C. Nanda, M. Mahadevaswamy, S. Ramakrishnan

Forty five progenies under seventh filial generation derived from the crosses involving Bhavya, Rathna, Kanchan with Coker 371 Gold & NC 89 were grown under progeny row trial. Among these lines twenty two were promising based on the plant type and cured leaf quality. From these three selections of Kanchan and five selections of Rathna with Coker 371 G and NC 89 were promoted to 2014-15 replicated trial.

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

M. Kumaresan

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



Hv 2009-3

Kethaiyurambu, along with the control variety Abirami for assessment of yield and quality. Both the broad based selections HV.2009-3 and HV.2009-5 performed well recording cured leaf yield of 2401 and 2363 kg/ha an increase of 5.9 and 4.2 percent respectively against the control variety Abirami (2266 kg/ha). With respect to morphological characters, the selection HV.2009-3 registered maximum leaf area (LxW) of 3050 cm² and stem girth of 10.4 cm contributing to higher yield.

At out station centers in two farmers' field, the broad based selection HV.2009-3 performed well recording mean cured leaf yield of 4053 and kg/ha an increase of 9.0 percent over the control Abirami.

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

S. Mandi

The diallel analysis in *Motihari* tobacco all three pedigree selections (C-25 x Snuff-2, B.Q x Manda and B.Q x DD- 437), one interse-crosses (B.Q x Manda) x (B.Q x Manda) and two inter-mating, (B.Q x Manda) x (B.Q x DD.437) and B.Q x Manda) x (B.Q x DD.437) recorded significantly superior cured leaf yield over check, DD-437. The pedigree, C-25 x Snuff-2 and B.Q x DD- 437 along with interse-crosses (B.Q x Manda) x (B.Q x Manda) showed significant superiority over all three checks viz., Dharla, DD-437 and Torsa.

In case of first grade leaf, none of the selection found to be superior over checks viz. Dharla and Torsa though one pedigree, C-25 x Snuff-2 and interse-crosses (B.Q x Manda) x (B.Q x Manda) recorded at par with check, DD-437. Data indicate that all the selections, quality leaf outturn ranged from 38-49%, which was not superior over three checks.

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

S. Mandi

Based on replicated trial data showed that all three selections (Bengthulisada x Torsa S-1, Bengthulisada x Torsa S-2 and Bengthulisada x Torsa S-3) recorded significantly superior cured

leaf yield over checks viz. Bitri and Bengthulisada. However, none of the three selections recorded significant over check Torsa.

In case of first grade leaf yield, none of three selections (Bengthulisada x TorsaS-1, Bengthulisada x Torsa S-2 and Bengthulisada x Torsa S-3) exhibit superior to control viz. Torsa and Bitri for cured leaf yield. However, S-3, recorded 1008 Kg ha⁻¹ yields at par with check Bitri (1028 kg ha⁻¹) but all selection recorded significantly higher yield over to control Assam variety BengthuliSada.

In all the selections, quality leaf outturn ranged from 32-42 % which is lower than check Torsa and at par with check Bitri.

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

During the year, two replicated yield trials were conducted, one with CMS and fertile hybrids.

1. Replicated yield trial with hybrids

a. Trial Br. 7.11 with fertile hybrids:

The replicated yield trial was conducted with 15 fertile hybrids produced between 3 female parents viz., TBST 70, TBST 71 and TBST 100 and five male parents, TBST 69, TBST 84, TBST 88, TBST 102, TBST 104 in a line x tester design along with checks Siri and VT 1158 in a RBD with 3 replications.

Analysis of data revealed significant differences for all the yield characteristics among the entries. Standard heterosis in the hybrids varied from 16-35% for green leaf yield, 17-33% for cured leaf, 14-36% for bright leaf and 16-37% for grade index.

Four of the five hybrids involving female parent TBST 70, showed significant heterosis over both parents for all the four yield traits, while two crosses in each involving the two

other CMS parents, TBST 71 and TBST 100 showed significant heterosis. Except TBST 69, the other four male parents contributed two heterotic hybrids each.

b. Trial Br 7.12 (1st year):

A new replicated yield trial was conducted with 30 CMS hybrids produced between 5 identified CMS parents viz., CMS74, CMS 89, CMS92, CMS95 and CMS 103 and six male parents, TBST 55, TBST 61, R-141, R-156, TBST 2 and Siri, in a line x tester design along with checks Siri and VT 1158 in a RBD with 3 replications.

Most of the hybrids showed significant standard heterosis over the parents. The heterosis varied from 17-58% for green leaf yield, 16-61% for cured leaf, 16-45% for bright leaf and 17-57% for grade index among the hybrids. The six best performing CMS hybrids will be subjected to further studies.

The colour, size and body of cured leaf in most of the hybrids were better than Siri and VT 1158.

2. Maintenance of CMS lines: A total of 63 CMS lines with varying cytoplasm sources were maintained, as detailed below:

CMS parental lines maintained during 2013-14 season

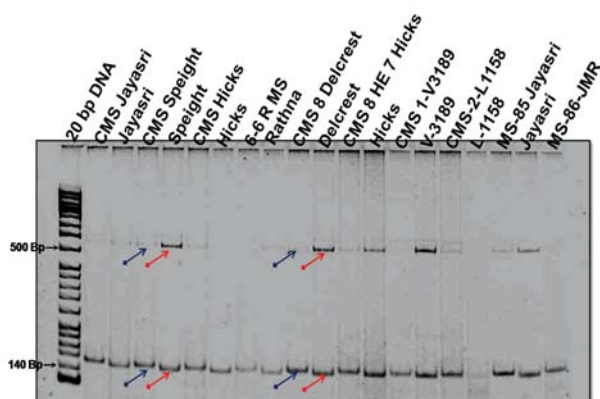
S. No.	Cytoplasm	Genetic background
1.	<i>N. undulata</i>	MS Delcrest, MS SPG 28, MSVT1158, Hema, Kanchan, Hicks, Gauthami
2.	<i>N. plumbaginifolia</i>	MS 85, MSB, MS19
3.	<i>N. tabacum</i>	AP1-8, Hicks, Speight G 28, VT 1158
4.	<i>N. gossei</i>	6-6MS, MS34, CR73MS, 72-21MS, MS58, 140MS, 16-17-17MS
5.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



All the lines were crossed with respective maintainer lines for further maintenance and use.

3. Molecular markers for CMS: Out of 10 gene-specific mitochondrial primers two primers that target sub-units of ATP synthase gene in mitochondrial genome were identified. The two primers could effectively differentiate CMS and fertile lines. Primer NTM could amplify a 550 bp & a 130 bp fragments in maintainer and a 135 bp amplicon in CMS lines. Another primer, ATP-2 amplified a polymorphic 400 bp amplicon in CMS only. The results were validated in 28 CMS lines.

Four crosses viz., MS-58 x HDBRG, MS-58 x VT-1158, MS-58 x A-145 and MS58 x TI-163 (all in BC₇) were made to develop CMS parental lines with high biomass potential.



Gene specific amplification of CMS lines

Developing hybrid FCV tobacco suitable for NLS area of Andhra Pradesh (CTRI RS, Jeelugumilli)

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

1. Maintenance of CMS lines

Fifteen CMS lines in genetic background of ruling variety, Kanchan and other improved lines were maintained and back crossed to recurrent parent.

2. Replicated yield trial with CMS hybrids:

Sixteen CMS hybrids, produced from crosses involving identified promising CMS lines and high yielding breeding lines were evaluated along with the check, Kanchan.

Seven hybrids (MSH-1, MSH-4, MSH-5, MSH-8, MSH-9, MSH-12 and MSH-15) showed significant standard heterosis for all the three yield traits over check, Kanchan with 15 to 51% increase in green leaf yield, 22 to 51% in cured leaf yield and 20 to 51% increase in grade index.

Physical quality traits such as colour, body and weight of cured leaf were comparable to Kanchan in the CMS hybrid entries 1, 4, 5 and 8.

Chemical quality of leaf: Nicotine and reducing sugars were within admissible limits.

Exploitation of heterosis and hybrid vigour for improving tobacco yield and quality (CTRI RS, Kandukur)

Evaluation of FCV Tobacco lines for yield and quality under SLS conditions

A.R. Panda

Three breeding lines from CTRI RS, Kandukur viz., FC-1 a dwarf variant of Siri with smaller internodes identified from the bulk population of Siri, FC-2 from the crosses of Hema X NC 3150 and FC-3 from Candle X Hema were contributed along with seven breeding lines received from CTRI, Rajahmundry in the project KBr-9 to test their superiority over the check varieties. The results indicate that the test entry, R-11, R-15, R-20 and R-57 are significantly superior to all check varieties in respect of all yield parameters at 5% level of significance. The test entries R-51 and R-59 are also significantly superior to all check varieties in respect of green leaf yield only.

The leaf chemistry of the test entries indicates that there is an increase in the nicotine percent in the leaf.

Exploitation of heterosis and hybrid vigour for improving tobacco yield and quality (CTRI RS, Veda sandur)

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

M.Kumaresan

Ten F₇ populations of promising hybrids (HV.2011-1 to HV.2011-10) assessed for their

quality and yield. Due severe drought during the crop season, the yield was adversely affected. Significant differences were observed for plant height, leaf length and leaf breadth. None of the selections were found significantly superior to the checks Bhagyaklakshmi and Abirami in whole leaf and total leaf yield. However the selections HV.2011-4, HV.2011-1 HV.2011-9 HV.2011-7 and HV.2011-2 were numerically superior to the controls Bhagyalakshmi and Abirami recording 1642, 1568, 1519, 1506 and 1432 kg /ha whole leaf yield respectively. In total leaf yield, selections HV.2011-9, HV.2011-4, HV.2011-1 HV.2011-7 and HV.2011-10 were numerically superior to the controls Bhagyalakshmi and Abirami recording 2556, 2407, 2309, 2296 and 2210 kg/ha total leaf yield respectively. With respect to morphological characters, selections HV.2011-3 and HV.2011-7 were significantly superior in plant height over the control Abirami. Selection HV.2011-3 was significantly superior to Abirami in leaf breadth.

Interspecific hybridization for tobacco improvement.

Incorporation of aphid resistance from *N. gossei*, *N. repanda*, *N x umbratica-nesophila* and *N x benthamiana-repanda* (CTRI, Rajahmundry)

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

1. Maintenance of interspecific cross derivatives

A total of 137 stabilized aphid and caterpillar resistant/tolerant advanced lines and those having high yield potential, derived from crosses involving *N. tabacum* as one parent and aphid resistance donors viz., *N. gossei*, *N. excelsior*, *N. x benthamiana-repanda*, and *N. umbratica* as the other parents, were grown in progeny rows along with 8 check varieties. This includes 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.

Table Cy 2.1F-1: Details of inter specific cross derivatives maintained during 2013-14

S.No.	Initial Cross
1.	(<i>N. gossei</i> x cv. CM-12)
2.	cv. HR 62-9 x <i>N. gossei</i>
3.	[(<i>N. x gossei-excelsior</i>) x CM-12]
4.	(<i>N. x benthamiana-repanda</i>) x cv. CM-12
7.	Delcrest x [<i>N. gossei</i> x <i>N. glutinosa</i>] x CM-12]
8.	Delcrest x [<i>N. gossei</i> x <i>N. glutinosa</i>] x [cv.HR 62-9 x <i>N. gossei</i>] x Bhavya]
9.	<i>N. umbratica</i> x <i>N. tabacum</i>

Susceptible checks: Siri, Hema, VT 1158, Kanchan, Rathna, Bhavya, Kanthi and Gauthami

Immune parent: *N. gossei*

2. Reaction to aphids under natural condition: In general aphid infestation was less during the season.

3. Preliminary evaluation for leaf yield potential: Eighty one light cast derivatives with high leaf yield potential (CLY 2400 - 3790 kg/ha) as compared to check variety, Siri (CLY- 1840 kg/ha) were identified. After evaluation of plant type, leaf number, plant height, floral, fertility traits along with cured leaf colour, size and body, and seed bearing nature, 20 most promising uniform lines were retained for further evaluation in replicated yield trials.

Evaluation of advanced lines in RYT

a) Trial TBL-10 (2nd year)

A replicated yield trial was conducted with twelve morphologically stable, aphid resistant/tolerant advanced cross derivatives (TBST 88 to TBST 99) along with two checks, Siri and VT 1158 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature. Eleven





of the derivatives (except TBST-95) were resistant to TMV also. Derivatives TBST-89, TBST-93, TBST-94, TBST-98 and TBST-99 showed better colour, body as well as size of cured leaf than Siri.

Four lines viz., TBST 92, TBST 93, TBST 98 and TBST 99 showed significant improvement over best check, Siri. The increase varied from 16-27% for green leaf yield, 15-22% for cured leaf, 15-26% for bright leaf and 17-24% for grade index.

b) Trial TBL-11 (2nd year)

Another replicated yield trial was conducted with twelve morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 100 to TBST 111) along with two checks, Siri and VT 1158. All the breeding lines were light cast in nature. Ten of the derivatives (TBST Nos. 100-105 and 107-110) were resistant to TMV also.

Derivatives TBST-100, TBST-101, TBST 104, TBST-107, TBST 108, TBST 109, TBST 110 and TBST-111 showed good colour, body as well as the size of cured leaf, as compared to check varieties.

Five lines, viz., TBST Nos., 100, 101, 104, 108 and 110 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 15 to 43% for green leaf yield, 15 to 39% for cured leaf yield, 18 to 46% for bright leaf yield and 19 to 45% for grade index, respectively, over Siri.

c) Trial TBL-12 (1st year)

A new replicated yield trial was conducted with eight morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 112 to TBST 119) 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. Five of the derivatives (TBST112-116) are resistant to TMV also. The experiment suffered from moisture stress during flowering period and hence leaf yield levels were relatively low.

All the entries along with checks showed good colour, body as well as the size of cured leaf.

Three lines, viz., TBST Nos., 112, 116, and 117 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 13 to 19% for green leaf yield, 13 to 17% for cured leaf yield, 16 to 22% for bright leaf yield and 15 to 21% for grade index, respectively.

d) Trial TBL-13 (1st year)

A new replicated yield trial was conducted with eight morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 120 to TBST 127) 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. Three of the derivatives, TBST 125, 126 and 127 are resistant to TMV also.

The entries viz., TBST 120, 121, 124, 125 and 126 showed better colour, body as well as the size of cured leaf than checks.

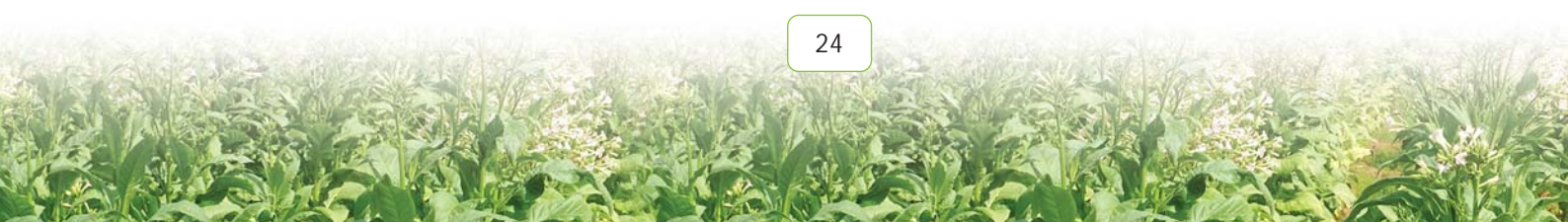
Differences among entries were significant for all the four yield traits. Four lines, viz., TBST Nos., 122, 125, 126 and 127 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 22 to 36% for green leaf yield, 17 to 31% for cured leaf yield, 22 to 36% for bright leaf yield and 20 to 33% for grade index, respectively.

e) Trial TBL-14 (1st year)

Another new replicated yield trial was conducted with eight morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 128 to TBST 135) along with two checks, Siri and VT 1158. All the breeding lines were light cast in nature. Three of the derivatives, TBST 133, 134 and 135 are resistant to TMV also.

Seven entries viz., TBST 128 to 134 showed colour, body as well as the size of cured leaf similar to checks.

Differences among entries were significant for all the four yield traits. Four lines, viz., TBST Nos., 129, 130, 132 and 134 showed significant improvement over the best check,



Siri for all the four leaf yield traits. The increase was 13 to 27% for green leaf yield, 13 to 23% for cured leaf yield, 17 to 34% for bright leaf yield and 13 to 29% for grade index, respectively.

Bulk and on-farm evaluation:

Advanced breeding line TBST-2 which showed superiority over check varieties at Rajahmundry, Guntur and Kandukur in multilocation trials was evaluated against Siri for yield and quality in a bulk trial. The leaf yield potential of TBST 2 (CLY 2450 kg/ha, BLY 1480 kg, GI 2000) was higher than Siri (CLY 2011 kg, BLY 1227 kg and GI 1650).

The line TBST-2 was also given for on-farm trials in SBS and SLS areas. The feedback from the farmers was positive. The line was reported to be slower maturing than Siri, thereby enabling leaf harvest intervals to suit barn availability. Farmers also reported that TBST-2 was also higher yielding (10-20%) than Siri in addition to having resistance to TMV, tolerance to aphid and leaf blight (in nursery). Cured leaf size, body and colour were also comparable or better than Siri.

Location specific evaluation of cross derivatives

Promising derivatives having resistance to tobacco aphid, caterpillar and tolerance to leaf curl, identified under the project, were contributed to CTRI RS Kandukur (30 FCV lines), CTRI RS Guntur (20 FCV lines) and CTRI RS Jeelugumilli (11) and CTRI RS, Hunsur (66) for further evaluation.

Developing tobacco cultivars resistance to biotic and abiotic stresses

Incorporation of disease resistance for Tobacco Mosaic Virus (TMV) (CTRI, Rajahmundry)

P.V. Venugopala Rao and S.K. Dam

Incorporation of Black Shank resistance in FCV varieties/ advanced breeding lines:

Black shank resistance incorporation in the recently released variety Siri and the advanced breeding lines N-98 and Cy-142 are in progress.

These lines were crossed with the resistant donors Beinhart 1000-1 and 1129SR.

Five hundred and twenty four progenies were evaluated under artificial inoculation with the pathogen. The same lines will be tested again as there was no disease after artificial inoculation due to delayed planting during the year. These lines will be tested again under artificial inoculation during 2014-15.

Maintenance of the TMV resistant lines

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

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

Developing tobacco cultivars for high seed yield, oil content, high biomass and other phytochemicals (CTRI, Rajahmundry)

A.V.S.R.Swamy, T.G.K. Murthy, K. Siva Raju and S. Kasturi Krishna

Two sets consisting of 28 F1 hybrids along with 8 parents in each are evaluated in replicated yield trails. The first set is assessed for seed yield and oil content while the second set is evaluated for green leaf, total biomass and phytochemicals like nicotine, solanesol and protein content. In first set (RYT-I) crosses TI-163 X NP-19 and A-119 X NP-19 exhibited higher number of primary branches (4.40 and 3.87) and the differences are significant. The parents TI.1112 and GT-8 (6.27 & 6.13), crosses TI-1112 X A-119 and TI-1112 X A-119 (6.13 & 6.07) exhibited higher number of secondary branches and the differences are significant. The crosses GT-8 X NP-19 (334.00), EC.554900 X NP-19 (331.00) and EC.554900 X A-119 (327.67) recorded high weight of single capsule and the differences are significant. EC.554900 X TI-163 (295), A-119 X GT-8 (282) and EC.554900 X A-145 (279) exhibited higher total seed weight with significant differences.

In the second set of crosses (RYT-II) evaluated HDBRG X GT-8 (2.55), GT-8 X NP-19 9 (2.41) and Abirami X A-119 (2.32) exhibited





higher nicotine per kg leaf and the differences are not significant. For the character solanesol per kg leaf Abirami X GT-8 is the only cross exhibited higher content i.e 2.39 and the differences among the entries are not significant. For the character protein percent A-119 X NP-19 (3,279), A-145 X VDH-3 (3.253), Abirami X VDH-3 (3.209) and NP-19 X VDH-3 (3.209) showed higher values. The crosses HDBRG X VDH-3 (10278), HDBRG X NP-19 (8819) and HDBRG X A-119 (8417) exhibited higher green leaf production and the crosses exhibited significant differences among each other and also showed higher total biomass i.e 11601, 10435 and 9563 kg/ha.

Breeding for high seed and oil yield in tobacco (CTRI RS, Veda sandur)

M. Kumaresan

Sixty six F4 populations of the following promising crosses for high seed yield were grown under 60 cm x 60cm spacing and selections were made which recorded seed yield ranging from 1600 - 2500 kg/ ha were retained for advancement of generation and further study.

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

One of the main activities of the Central Tobacco Research Institute is the production and distribution of pure seed and quality seedlings of approved tobacco varieties to the farmers. The "Revolving Fund scheme" of CTRI has been well appreciated by the ICAR, New Delhi and the tobacco farmers.

Seed sales

During 2013, 14,897 kg foundation seed of seven different varieties was sold to farmers through CTRI, Rajahmundry and its Research Stations. An amount of Rs. 1,48,97,000 was realized.

During 2014, 9,850 kg foundation seed of eight different varieties was sold to the farmers and an amount of Rs. 98,50,000/- was realized.

Nursery Management

An area of about 6 acres was put under tobacco nursery. Eight varieties viz., Siri, Hema, VT 1158, N-98, Gauthami, Kanthi, Kanchan and

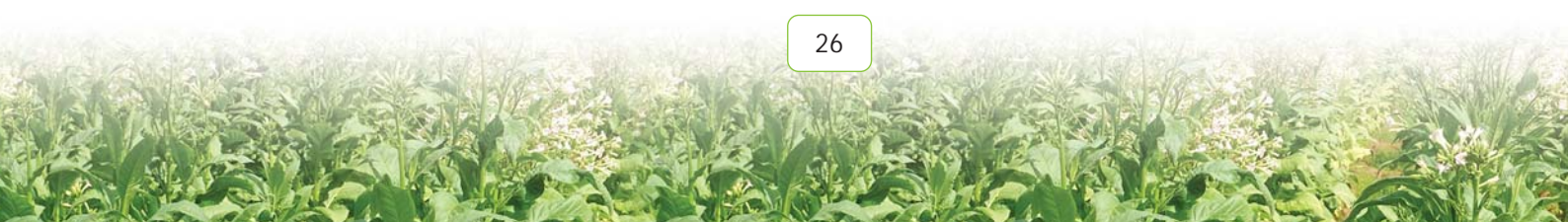
Lanka special were sown for distribution of seedlings to the seed plot growers and CTRI research farms of Katheru and Guntur. The germination and seedling stand were satisfactory.

Planting of tobacco seed plots commenced from 2nd week of October. Pure and healthy seedlings were produced and a total of 54,34,600 seedlings were distributed to identified growers, Katheru Farm and CTRI-RS Guntur for production of foundation seed. A total area of 374 acres was planted for seed multiplication in 4 villages viz., Katavaram, Kunavaram, R.D. Puram and Buchampeta, Katheru farm (CTRI) of East Godavari district and CTRI-RS, Guntur.

Regular monitoring was done during all phases of crop production and timely advice was given for raising healthy crop by all the farmers. Rouging of all the plots was done by the breeders and well trained technicians for collection of pure seed. Panicles ready for harvesting were collected from the farmers' fields and brought to the Seed Production Unit at Rajahmundry. Drying and further processing of Seed of varieties viz., Siri, VT 1158, Hema, Gauthami, Kanthi, N-98, Kanchan (all FCV) and Lanka Special is in progress. Seed was packed in the hologram affixed seed packets for distribution of the same to the needy farmers at cost. Variety-wise distribution of seedlings to seed multiplication plots (including CTRI Farms Katheru and Guntur) during 2013 is as follows.

Production and distribution of tobacco seedlings (2013)

S. No	Variety	Number of seedlings supplied
1	Hema	61600
2	VT-1158	718100
3	Siri	3625600
4	Gauthami	9000
5	Kanthi	8600
6	Lanka spl.	53500
7	N-98	26400
8	Kanchan	122000
Total		54,34,600



Production and distribution of tobacco seedlings (2014)

S. No	Variety	Total seedlings supplied
1	Hema	3,77,500
2	VT-1158	5,71,700
3	Siri	39,27,400
4	Gauthami	7,500
5	Kanathi	5,500
6	Lanka spl.	54,000
7	N-98	2,62,000
8	Kanchan	1,53,500
9.	TBST-2	80,700
Total		54,39,800

I. (D) Germplasm resource management

Germplasm Acquisition, Maintenance, Evaluation and Utilization (CTRI, Rajahmundry)
T.G.K. Murthy

A. Acquisition

One hundred and seventy eight bidi, 3 rustica and 75 Natu besides 5 exotic FCV lines were added to the germplasm bank, thereby increasing the CTRI genetic resources to 3369.

Table GS1-1: Germplasm status at CTRI, Rajahmundry(As on 1.8.2014)

S. No.	Details	Number of accessions
1.	Released/ Identified Varieties	94
2.	AINPT Lines	51
3.	Low nicotine lines	11
4.	Root Knot resistant	21
5.	Disease resistant	15
6.	Insect pest resistant lines	167
7.	Mutants	16
8.	Advanced breeding lines	53
9.	New germplasm	110
10.	CMS parental lines	66
11.	Wild <i>Nicotiana</i> accessions	218
12.	FCV Indigenous	41
13.	FCV exotic	470

14.	Northern Light Soils	9
15.	<i>Jati</i> tobacco	61
16.	Cigar wrapper	75
17.	Turkish tobacco	49
18.	Bulgaria tobacco	13
19.	Exotic air cured	151
20.	Japan air cured	54
21.	Black tobacco	3
22.	Fire-cured tobacco	5
23.	Air cured cigarette tobacco	11
24.	Burley germplam	121
25.	Chewing	174
26.	Bidi	206
27.	Country cheroot	175
28.	Cigar filler	82
29.	<i>N. rustica</i>	834
30.	Lanka	13
Total		3369

B. Maintenance

(i) **Cultivated germplasm:** A total of 1742 germplasm lines were rejuvenated. They comprised 59 Flue-cured Virginia, 1080 non-FCV lines and 613 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).

(ii) **Wild *Nicotiana* species:** A total of 218 accessions of 56 wild *Nicotiana* species and two subspecies were maintained in pots / experimental micro plots. Also, 9 exotic interspecific hybrids, 5 hybrids developed at CTRI and 4 amphidiploids were maintained. Eleven non-flowering accessions were rescued through *in-vitro* micropropagation.

C. Germplasm enhancement: Interspecific hybrids, viz., *N. sylvestris* x *N. tomentosiformis* and *N. sylvestris* x *N. otophora* which are considered as the progenitor crosses of cultivated *N. tabacum* were synthesised and their back cross progenies (BC₂S₂) were advanced for infusing additional variation into the cultivated species and enhancing the scope for further genetic improvement of the crop. A number of selections with normal *N. tabacum* plant type were selected for further studies.



D. Conservation

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

E. Distribution

During the year a total of 120 accessions of both wild and cultivated *Nicotiana* species were supplied to 15 different researchers/organizations.

F. Molecular Characterization

a. Molecular markers for CMS: One bar coding primer, trnH-psbA was identified as having potential for grouping and cataloguing the species of genus *Nicotiana*, besides cytoplasm nature.

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

c. DUS characterization: During the year three genotypes viz., ruling variety Siri, promising advanced interspecific cross derivative TBST-2 and unique germ, 324C were characterized for

53 morphological DUS characteristics. Study on molecular characteristics is underway.

G. Evaluation

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

e. Evaluation for seed yield: In a preliminary row trial, 29 genotypes comprising identified germplasm lines, advanced derivatives of eight crosses and one pureline selection made within HDBRG population were evaluated along with three check varieties viz., HDBRG, A-145 and GT-7, for seed yield. The seed yield realized was 95 kg, 171 kg and 376 kg/ha in HDBRG, GT-7 and A-145. In the test entries, it varied from 85 kg (Bhairavi selection) to 407 kg/ha (derivative of A-147 x GT-7). In general the seed yield was very low during the season due to late planting (Last week of December, 2013) and less flowering period.

Maintenance of other important genotypes

In addition to the above, the following genetic stocks/lines were also developed under the project and maintained for future use:

- (i) Corolla-split variants (digenic),
- (ii) 'Asynaptic line',
- (iii) 'Translocation heterozygotes',
- (iv) Variegated mutants,
- (v) Cream coloured testa (digenic recessive to brown),
- (vi) Probable genetic male sterile.
- (vii) CMS sources
- (viii) Dwarf mutants (digenic recessive)
- (ix) Enation mutant
- (x) High biomass
- (xi) Bigger leaf size
- (xii) Compact inflorescence

Evaluation and maintenance of germplasm (CTRI RS, Vedasandur)

M.Kumaresan

Maintenance of germplasm:

As a regular programme, 85 chewing and 60 cigar and cheroot germplasm accessions were

raised, self pollinated and seed collected for maintenance.

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.

Germplasm maintenance of *Nicotiana tabacum* varieties /lines (CTRI RS, Hunsur) C. Nanda

Active stock of around 635 germplasm accessions is maintained. Under the periodical seed multiplication programme, 250 germplasm accessions were regenerated.

Male sterile lines of Kanchan and Rathna were maintained and incorporation of male sterility from varied sources into Kanchan, Rathna, Coker 371G, FCH 201, FCH 221 and FCH 222 was carried out.

Collection, evaluation and maintenance of *Jati*, *Motihari*, *Cigar Wrapper* & *filler tobacco* germplasm (CTRI RS, Dinhata) S. Mandi

Maintenance of germplasm

Ten plants each of 70 lines of *N. tabacum* (*Jati* tobacco) and 185 lines of *N. rustica* (*Motihari*) tobacco were grown and 3 healthy plants in each line were selfed and selfed seeds of each line were collected separately for use in the ensuing season.

I. (E) Biotechnology for Tobacco Improvement

Micropropagation of elite lines and other Selections (CTRI, Rajahmundry) K. Sarala and K. Prabhakara Rao

Micropropagation of elite lines:

Nicotiana species, R-466 and haploids of crosses, A -145 X GT-7, VA 510 x BA-1, HDBRG x GT 7, Barket A1 x BY 64, Nisnicotinony-121 X Kumkumathri and TI 163 x A 145 were micropropagated during 2013-14.

Molecular mapping of important tobacco traits(CTRI, Rajahmundry)

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

Characterization of parents and mapping populations

Thirty SSR markers were screened to identify the polymorphism between the parents and bulks of RIL population developed for the mapping of TSNA, nicotine and solanesol traits. Eight SSR markers viz., TM10163, TM10645, PT52585, PT52944, PT60792, PT50528, PT52979 and PT30173 were found to be polymorphic.

Solanesol content was estimated in a solanesol molecular mapping population from the samples collected from 2012-13 crop season. Solanesol in the mapping population found to be in the range of 0.05-2.40%. Out of 248 entries analyzed in the mapping population highest population found to be in the range of 0.5-1.0% and 1.0-1.5%. This indicates that wide variation is created in the mapping population.

Development of mapping populations

For the development of mapping populations i.e. Recombinant Inbred Lines (RILs), 9 F_1 s and 11 mapping populations viz., BY 64 x Barket A1 (F_8 / F_7), VA 510 x Barket A1 (F_8), HDBRG x BY 53 (F_7), HDBRG x GT-7 (F_8), TI 163 x A-145 (F_8 / F_7), Candel x Nisnicotinony 121 (F_8), Kumkumathri x Nisnicotinony 121 (F_8), Nisnicotinony 121 x Kumkumathri (F_8), A 145 x GT 7 (F_9 / F_8), GT 7 x A 145 (F_8) and A 145 x Jayalakshmi-WS (F_8) (a total of around 2200 plants) were raised and selfed seed collected. Haploid plants developed from 9 crosses and the efforts are on to develop dihaploid lines through mid-vein culture and colchicine treatment. 24 dihaploid lines were developed from six crosses were maintained.

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

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

Molecular characterization of damping-off disease pathogen

Molecular characterization of 17 *Pythium* isolates collected from different tobacco





nursery regions were carried out using complete ITS (Internally Transcribed Sequences). The genomic DNA was isolated, purified and amplified with ITS region specific primers. The amplified ITS gene regions comprising ITS1, 5.8S and ITS2 segments were sequenced and the sequences were analyzed using NCBI BLAST. The results revealed that

Transcript analysis using semi quantitative RTPCR

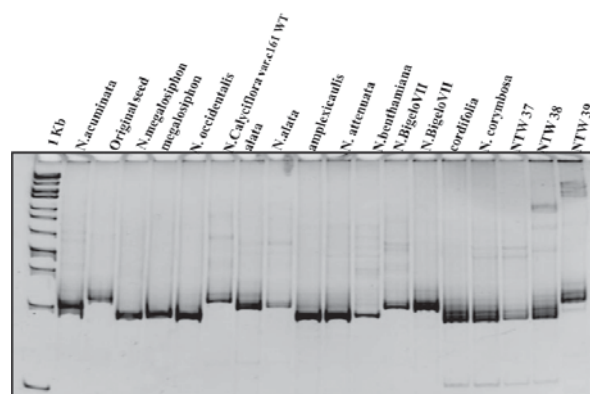
Pythium infection studies under simulated conditions were carried out with tobacco genotypes Coker1, GT9 and GT5 at different time intervals. Coker1 being highly susceptible to damping off, complete collapse of seedlings were observed within 36 hrs after infection where as GT9 and GT5 has shown moderate tolerance during the period. Hence samples were collected at different time intervals up to 36 hrs after infection and RNA was isolated from all the samples. The isolated RNA was converted in to cDNA using reverse transcriptase PCR and the transcripts were analyzed for the expression of known set of genes using semi quantitative RT PCR. A set of house keeping genes comprising Ribulose biphosphate carboxylase small subunit (Rbcs), Elongation factor 1 α (EF-1 α), L25 ribosomal protein (L25) and α -Tubulin (tubA1) were screened for their persistent expression in all the samples irrespective of the stress condition. Among the house keeping genes Rbcs and EF-1 α has shown relatively stable expression in stress condition compared to others. A set of defense related genes comprising signaling pathway genes salicylic acid-activated MAP kinase (NtSIPK), mitogen-activated protein kinase (Ntf4) and mitogen-activated protein kinase 2 (NtMEK2) and other effector protein genes pathogenesis-related protein (PR1a), phenylalanine ammonia-lyase 1 (PAL1) and Beta-1,3-glucanase gene (Glunse) were also analyzed among the samples for their expression. Majority of these genes has shown differential expression pattern in control and infected samples.

Molecular characterization and cataloguing of genus *Nicotiana* using DNA barcoding (CTRI, Rajahmundry)

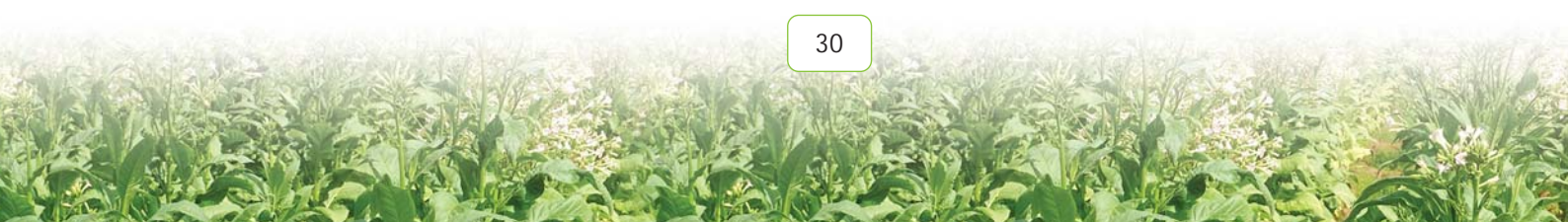
K. Prabhakara Rao, K. Sarala and T.G.K. Murthy

Identification of candidate plant barcode loci in *Nicotiana* accessions

A multilocus DNA barcoding system was suggested by (CBOL Plant Working Group, 2009) in which slowly evolving loci delineate individuals into families, genera, or groups within genera and the more rapidly evolving loci differentiate species within those higher groups. Hence a combination of 3 plant barcode loci *rbcL* (ribulose 1, 5-bisphosphate carboxylase enzyme large subunit) and *matK* (maturase K gene) from slow evolving loci and *trnH-psbA* (intergenic spacer region) from rapid evolving loci were selected for pilot screening. Genomic DNA was isolated from 160 accessions and preliminary screening was done in selective *Nicotiana* accessions using loci specific Polymerase Chain Reaction (PCR) and the amplicons were analyzed in Poly acrylamide Gel Electrophoresis (PAGE). The results revealed that *trnH-psbA* is highly polymorphic and has shown amplicon length polymorphism, where as *rbcL* and *matK* loci has lower variation in amplicon length among the selected accessions. These PCR amplicons will be sequenced and analyzed for the sequence variation among the accessions.



Amplification profile with barcode primer, *trnH-psbA*





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

II (A) Healthy Seedling Production

Investigations on coir pith utilization in tobacco seedling production (CTRI, Rajahmundry)

C. Chandrasekhararao and K.Sivaraju

Effect of different media on seed germination: Results revealed that on 7th day 39% seed germination was observed in 100% composted coir pith (CCP) and 33.7% seed germination in 75% CCP+25% FYM, compared to no germination in 100% FYM. Highest seed germination (83%) percentage was observed in 100% CCP after 16 days.

Effect of different media on seedling growth: Increase in FYM increased the transplantation shock, decreased the dry weight and leaf area. Mixing soil (50%) in the media showed less dry weight and leaf area. The treatments 100% CCP and 75% CCP+25% FYM showed significantly higher dry weight and leaf area compared to 100% FYM, 25% CCP + 75% FYM and 50% CCP+ 50% FYM treatments.



Different media on seedling growth

Growth curve of seedlings: Increase in days after transplanting increased the dry weight and leaf area. Beyond 65 days, rate of increase is less

Effect of seed rate on germination: Among the different seed rates, 1g/1sq m. showed



Seed rate on germination

maximum seedlings and less disease incidence. Increase in seed rate increased the disease incidence.

Effect of different fertilizers on seedling growth: For assessing the effect of fertilizers on seedling growth, a stock solution of 50 g CAN and 50 g Potassium sulphate was dissolved in one litre of water. Different amounts of fertilizer solutions were dissolved in 500 ml water for obtaining different treatments. Application of 25 ml, 50 ml, 75 ml at 5, 15 & 25 days respectively showed significantly higher dry weight of 0.311 g/plant over other treatments.

II (B) Optimization of Water & Nutrient Use for Productivity Enhancement of Different Tobacco Types

Effect of drip irrigation and tray seedlings on the productivity of NLS tobacco. (CTRI RS, Jeelugumilli)

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

The experiment was conducted with nine treatments consisting of drip irrigation, tray seedlings, normal seedlings, drip fertigation and soil application of fertilizers at 3, 25-30, 40-45 days after planting or at 10, 25-30, 40-45 days after planting. The experiment was conducted



Tray seedlings with drip fertigation



Conventional seedlings with furrow irrigation



in RBD to find out the advantages of tray seedlings compared to normal seedlings, drip irrigation compared to furrow irrigation and drip fertigation compared to soil application of fertilizers and application of basal dose of fertilizers at 3rd day compared to 10th day after planting.

Yield: There were significant differences between the treatments with regard to the characters studied. Drip irrigation, tray seedlings, drip fertigation at 3, 20-25 and 40-45 DAP followed by Drip irrigation, Tray seedlings, drip fertigation at 10, 25-30 and 40-45 DAP recorded higher green leaf yield, cured leaf yield, grade index, green leaf/cured leaf yield and grade index/ cured leaf (%) when compared to other treatments. The treatment consisting of Drip irrigation, tray seedlings, drip fertigation at 3rd, 20-25 and 40-45 DAP increased green leaf yield by 3224 kg (22.7%), cured leaf yield by 367 kg (15.5%) and grade index by 409 kg (22.2%) when compared with furrow irrigation, normal seedlings, soil application of fertilizers at 10, 25-30 and 40-45 DAP.

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

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

Ten treatments were evaluated with the combination of fertilizer source for N and P nutrients. Potassium was supplied through SOP. Continuous rains in August and September during growth period affected the growth and resulted in average yields. Hence the treatment differences were not significant. Sources of fertilizers affected the yield and quality of tobacco. Application of CAN along with DAP in 1st dose and CAN with A/S in 2nd dose gave higher green leaf yield followed by A/S with SSP in 1st dose and A/S with CAN in 2nd dose. Higher cured leaf was observed when CAN with DAP in 1st dose and CAN with A/S in 2nd dose followed by CAN with DAP in 1st dose and CAN with CAN in 2nd dose. Lower green and cured yields were observed when A/S is given in both the doses along with SSP in 1st dose. The nicotine and reducing sugars are within in the desirable

limits. Chloride values are on higher side. Treatment differences are not significant.

Feasibility of producing organic tobacco in KLS (CTRI RS, Hunsur)

M. Mahadevaswamy and S. Ramakrishnan

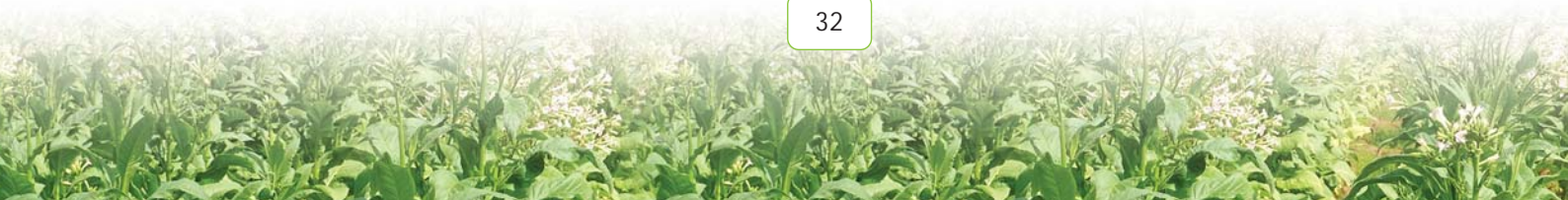
The 3rd year study indicated that the reduction in the productivity of the organic tobacco was 33.0% compared to the reduction of cured leaf to an extent of more than 50% and 42.7% in the first and second crop season respectively. The INM treatments involving organic and inorganic at 75:25 and 50: 50 ratios resulted in comparatively lower reduction in the yield (19.1 and 8.6% respectively). Similarly the total top grade leaf production reduced by 27.5% in the organic treatment while the same in the INM treatments (75:25 and 50: 50) resulted in 14.0 and 6.8% reduction respectively. However, the bright grade production was higher by 7-8% in the organic treatment. With respect to the cured leaf quality characteristics, the nicotine in the X position was lower (0.91%) in the organic treatment when compared to the inorganic treatment (1.37%). The L position leaf also showed similar trends with recommended NPK treatment recording the higher nicotine value of 1.73% compared to 1.05% in the organic treatment. With regard to the disease incidence, there was reduction in the root knot incidence by about 44.5% in the fully organic treatment.

Potassium nutrition management strategies for productivity and quality enhancement of FCV tobacco grown under rain fed environment in KLS

(CTRI RS, Hunsur)

M. Mahadevaswamy, and C. Chandrasekhar Rao

Application of K @ 100 kg/ha (in 4 splits) recorded the maximum seedling vigour, seedling growth as well as dry matter production followed by K @ 75 kg/ha (in 3 splits). The seedlings from the best nursery treatment were selected for planting in the main field to evaluate the different K levels with varied split application methods to meet the K requirement of the tobacco crop for optimizing the productivity and quality.



Drip fertigation in chewing tobacco (CTRI RS, Vedasandur)

M. Kumaresan and C. Chandrasekhararao

Three year pooled data on the first grade leaf yield (FGLY) indicated that drip at 100 % ETc +100 % RDN recorded significantly higher FGLY over the surface irrigation. The FGLY increase was 13% over the surface irrigation. The FGLY recorded with drip 100 % ETc +100 % RDN and surface irrigation was 3.40 and 3.02 t /ha respectively. Total cured leaf yield (TCLY) significantly increased by 17% with drip 100% ETc +100% RDN over the surface method of irrigation. The TCLY recorded with drip 100% ETc + 100% RDN and surface irrigation was 2.22 and 3.60 t /ha respectively. Higher net returns (₹ 2,19,600/ha) and B:C ratio (2.87) was recorded with drip 100% ETc+ 100% RDN followed by drip 100% ETc+80% RDN. Preferable chewing quality scores were recorded with all the treatments. However, higher chewability score of 69 out of 80 was recorded with drip 100% ETc + 100% RDN. Water use efficiency (WUE) was higher with drip 100% ETc + 100% RDN (21.9 kg/ha-mm) and lower with surface irrigation (7.5 kg/ha-mm). It could be concluded that drip 100% ETc+100% RDN increased the FGLY, TCLY, Net Return and WUE.

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

S. Mandi

Data on permanent manurial trial showed that the application of 112 kg N + 112 Kg P₂O₅ + 112 kg K₂O ha⁻¹ recorded significantly highest green leaf (18982 kg ha⁻¹), cured leaf (2707 kg ha⁻¹) and first grade leaf (1555 kg ha⁻¹) yields of *Motihari* tobacco as compared to control, only. Application of 112 kg N + 112 kg ha⁻¹ K₂O ha⁻¹ and 112 kg N + 112 kg P₂O₅ ha⁻¹ was comparable with each other and significantly superior to rest of the treatments for green leaf, cured leaf yield and first grade leaf yield. It is clear from data that the application of nitrogen is essential for yield and quality of *Motihari* tobacco. Application of phosphorus and potassium alone or in combination with each other and only 25 or 50 t FYM applied plots gave minimum green, cured and first grade leaf yield as compared to application of nitrogen

alone or in combination of phosphorus and potassium. The per cent of recovery of first grade leaf was highest in NPK (57.44%) followed by NK (53.45%), N P (45.51%) and N (45.4%) applied plots.

Application of 112 kg N ha⁻¹ + 112 kg P₂O₅ ha⁻¹ + 112 kg K₂O ha⁻¹ recorded highest gross (₹ 135450 ha⁻¹) return followed by 112 kg N ha⁻¹ +112 K₂O ha⁻¹ (₹ 125550 ha⁻¹) and 112 kg N ha⁻¹ + 112 kg P₂O₅ ha⁻¹ (₹ 117900 ha⁻¹). Though price of tobacco was high in this year, higher cost of inputs like fertilizer and FYM resulted in negative net return in some treatments were negative. The highest benefit: cost ratio (1:1.66) in 112 kg N ha⁻¹ + 112 kg P₂O₅ ha⁻¹ + 112 kg K₂O ha⁻¹ at par with 112 kg N ha⁻¹ +112 K₂O ha⁻¹ (1:1.65) followed by 112 Kg N ha⁻¹ (1:1.53), 112 kg N ha⁻¹ + 112 kg P₂O₅ ha⁻¹ (1:1.51) and 112 K₂O ha⁻¹ (1:1.01).

Optimisation dose of N, P, K with spacing in pipe line variety DJ-1 of Jati tobacco in North Bengal (CTRI RS, Dinhata)

S. Mandi and S.Kasturi Krishna

The data indicated that green, cured and first grade leaf yield of *Jati* tobacco variety DJ-1 was significantly different with different spacings. Spacing 75X 75 cm recorded highest green (7444 kg ha⁻¹) and cured leaf yield (1423 Kg ha⁻¹). Spacing 90 X 75 cm was recorded highest first grade leaf yield (806 kg ha⁻¹) and quality outturn (61.72 %) of leaf. Spacings 75 x 75 cm and 90 x 75 cm are at par in green and first grade leaf yield.

The different nitrogen doses in subplots treatments recorded significantly different yields. Nitrogen dose 150 kg ha⁻¹ recorded highest green (7109 Kg ha⁻¹) and cured leaf yield (1373 kg ha⁻¹) and were at par with nitrogen dose 125 kg ha⁻¹ which has recorded 6980 kg ha⁻¹, 1335 kg ha⁻¹ green and cured leaf yield respectively. Nitrogen @ (125 Kg ha⁻¹) recorded highest first grade leaf yields (848 kg ha⁻¹) and leaf quality outturn (63.56 %). Interaction effect between spacing and nitrogen dose was non-significant among different treatments.

Spacing 75 X 75 cm in combination with application of 150 Kg ha⁻¹ nitrogen recorded





maximum gross return (Rs 120781 /ha), net return (Rs 45620 /ha) and B: C ratio (1:1.61) followed by spacing 75 X 75 cm in combination with application of 125 Kg ha⁻¹ nitrogen recorded Rs 114251, 40766 /ha and 1:1.55 gross returns, net returns and B: C ratio respectively.

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

Chemical management of *Orobanche* in FCV tobacco (CTRI, Rajahmundry)

S. Kasturi Krishna, S.V. Krishna Reddy and VSGR. Naidu

Pre emergence herbicides (Alachlor and pendimethalin), post emergence herbicides (glyphosate and imazethapyr), oils (neem and soybean), neemcake, ammonium sulphate (A/s) spray and Amino acid were evaluated for their effect on the *Orobanche* emergence.

Weight of *Orobanche*: Significant reduction in weight of *Orobanche* was observed due to chemical method of *Orobanche* control. Application of chemicals reduced the *Orobanche* weight (Neemcake application by 49.4% , A/S spray 47% , pre emergence application of Alachlor 66.3%, Pendimethalin 36.0%, Post emergence application of glyphosate at 50 & 70 days by 64.9 & 80.9% and Imazethapyr at 50 & 70 days by 71.7 & 82.8 % when compared to Control.



Effect of Neem cake on *Orobanche* emergence

Yield: The data revealed that significant differences were observed with regard to leaf yields of tobacco due to chemical method of *Orobanche* control. Higher cured leaf yields were observed in neemcake application

(12.8%), A/S spray (12.0%) , Neem oil (12.7%), soybean oil (12.9%) and lower yields were observed in pre emergence application of Alachlor (-2.79%), Pendimethalin (-22.5%), in Post application of glyphosate & Imazethapyr and in Control (-4.73%) when compared to hand removal of *Orobanche*. Post emergence application of glyphosate & Imazethapyr reduced the quality drastically.

Leaf Quality: Leaf quality in terms of nicotine and reducing sugars are affected by chemical control of *Orobanche* and are within the desirable limits. Higher chlorides ranging from 2.44% to 3.25% were recorded in all the treatments.

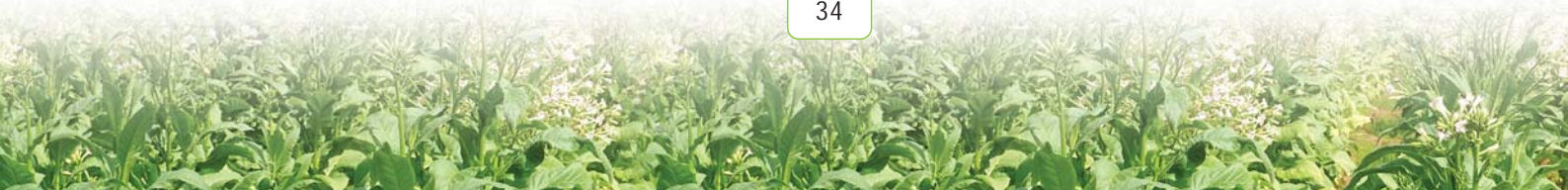
Studies on false maturity and its mitigation strategies in FCV tobacco growing zones of Andhra Pradesh (CTRI, Rajahmundry)

S. V. Krishna Reddy, M. Anuradha, S. Kasturi Krishna and P. Venkateswarlu

A field survey was conducted during crop season in tobacco growing areas involving the auction platforms of Kandukuru I and II, Podili I and II, Ongole I and 2, Vellampalli I and II in SLS and SBS regions, Devarapalli, Gopala- puram, Koyyalagudem, Jangareddygudem 1 and 2 in NLS area and Thorredu in NBS area. Occurrence of false maturity is a recurring problem in FCV tobacco growing zones of Andhra Pradesh. The problem is aggravating year after year. It may be resultant of multiple factors viz., genetic factors, edaphic factors (deficit and excess soil moisture, soil compaction), agronomic management factors (imbalanced fertilization, water management, and non availability of nutrients), climatic factors (temperature, sunshine hours, RH) and pest and disease



Effect of moisture stress on false maturity



problems. The possible reasons responsible for false maturity are also analysed and summarized.

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

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

The experiment was conducted in a factorial RBD with two advanced breeding lines of FCV tobacco viz. NLST-3 and NLST-4 along with control cv. Kanchan and three nitrogen levels viz. 100, 115 and 130 kg N/ha and two topping levels viz. topping at 24 and 26 leaves to find out most suitable advanced breeding line with optimum nitrogen dose, topping level for higher yield and better quality

Yield and quality: ABL NLST- 3 and NLT-4 showed varied response to graded levels of nitrogen and topping with regard to the yield characters studied. There were no significant differences between the varieties with regard to green leaf yield. ABL NLST-4 recorded significantly higher cured leaf yield, grade index and grade index/ cured leaf (%) as compared to ABL NLST-3 and control cv. Kanchan. Green leaf/cured leaf was higher with NLST-3 followed by cv. Kanchan and NLST-4. Green leaf yield and cured leaf yield increased progressively and significantly with increase in N dose from 100 to 130 kg N/ha. Application of 115 and 130 kg N/ha being on a par recorded significantly higher grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 130 kg N/ha. Grade index/cured leaf (%) increased from 100 to 115 kg N/ha and decreased with further increase in nitrogen dose. Green leaf yield and cured leaf yield were not influenced by topping levels. Grade index and Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping while grade index/ cured leaf (%) was higher at 26 leaves topping than at 24 leaves topping. Interaction effects between advanced breeding lines, nitrogen and topping were not significant for all the characters studied.

It can be inferred that ABL NLST-4 performed well and gave significantly higher yield than

NLST-3 and control cv. Kanchan. A nitrogen dose of 115 kg N/ha and topping at 26 leaves are optimum.

Effect of nitrogen and topping on yield and quality of advanced breeding line JS 117. (CTRI RS, Jeelugumilli)

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

The experiment was conducted in a factorial RBD with two varieties i.e. low tar advanced breeding line JS 117 along with control cv. Kanchan and three nitrogen levels viz. 100, 115 and 130 kg N/ha and two topping levels topping at 24 and 26 leaves to find out optimum nitrogen dose, topping level, for higher yield and better quality of JS 117.

Yield and quality: FCV tobacco low tar ABL JS 117 showed varied response to graded levels of nitrogen and topping with regard to the yield characters studied. There were no significant differences with regard to green leaf yield and cured leaf yield between low tar ABL JS 117 and control cv. Kanchan and were on a par with each other. Grade index and grade index/ cured leaf (%) of cv. Kanchan was significantly higher than JS 117 while green leaf/ cured leaf of JS 117 was higher than that of cv. Kanchan. Green leaf yield increased progressively and significantly with increase in N dose from 100 to 130 kg N/ha. Application of 115 and 130 kg N/ha being on a par recorded significantly higher cured leaf yield and grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 130 kg N/ha. Grade index/cured leaf (%) increased from 100 to 115 kg N/ha and thereafter decreased with increase in nitrogen dose. Green leaf yield, cured leaf yield and grade index were not influenced by topping levels. Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping. Grade index/cured leaf (%) was higher at 26 leaves topping than at 24 leaves. Interaction effects between advanced breeding line JS 117, nitrogen and topping were not significant for all the characters studied. From the results, it can be inferred that the low tar ABL JS 117 performed on a par with control cv. Kanchan with regard to green leaf yield and





cured leaf yield. A nitrogen dose of 115 kg N/ha and topping at 26 leaves are optimum.

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

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

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

Yield and quality: FCV tobacco CMS hybrid NLSH 1 showed significant differences with regard to the yield characters studied. Lower plant spacing of 100 X 60 cm recorded significantly higher green leaf yield and cured leaf yield as compared to higher plant spacing of 100 X 70 cm. Green leaf/ cured leaf was higher at lower plant spacing than at higher plant spacing. Grade index/ cured leaf (%) was higher at higher plant spacing and decreased with decrease in plant spacing.

Green leaf yield increased progressively and significantly with increase in N dose from 100 to 140 kg N/ha. Application of 120 and 140 kg N/ha being on a par recorded significantly higher cured leaf yield and grade index as compared to 100 kg N/ha. Green leaf yield/ cured leaf yield increased significantly with increase in N dose from 100 to 140 kg N/ha. Grade index/cured leaf (%) increased from 100 to 120 kg N/ha and thereafter decreased with increase in nitrogen dose. Green leaf yield, cured leaf yield and grade index were not influenced by topping levels. Green leaf/ cured leaf was higher at 24 leaves topping than at 26 leaves topping and grade index/ cured leaf (%) was higher with 26 leaves topping than at 24 leaves topping. From the results, it can be inferred that for CMS hybrid NLSH 1, a spacing of 100 X 60 cm, nitrogen dose of 120 kg N/ha and topping at 26 leaves are optimum.

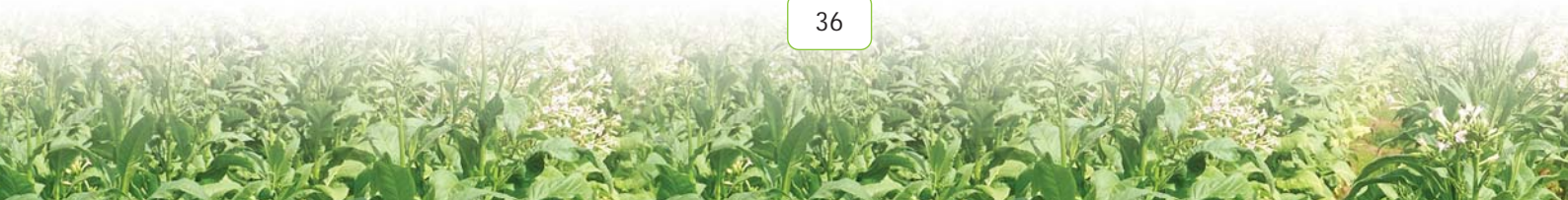
Studies on climate risk management in FCV tobacco based cropping systems in STZ of Karnataka (CTRI RS, Hunsur)

M. Mahadevaswamy, and C. Chandrasekhararao

The study was initiated by collecting the various weather parameters for diagnosis climate change. Rainfall data of 40 years were subjected to analysis for arriving at drought frequency, abnormal years, normal years and the rainfall variability at the Research Farm. The analysis indicated that out of 40 years, 9 years were drought and 9 years were excess rainfall years or wet years while the remaining 22 years (55%) were normal rainfall years. This indicates that in 45 % of the years, the climate especially the rainfall is not conducive for normal productivity and quality of the crop during which period mitigation or management strategies are required to reduce the loss in productivity/quality. The co-efficient variation was 19.8 %.

Productivity and leaf quality parameters like nicotine, reducing sugars and chlorides were also studied to know the impact of climate on productivity and quality of FCV tobacco under KLS conditions. Preliminary studies indicated that the total rainfall (Annual rainfall) as such did not exhibit any correlation with productivity or quality of tobacco. However the rainfall during the crop growth season (June-Aug) did influence the leaf nicotine and the chloride content. Even though the correlation was not strong enough, the study indicated a decreasing trend in leaf chloride and the leaf nicotine with the increase in the amount of rainfall received during the crop growth period. However, the reducing sugars were not influenced by the rainfall pattern.

Two contrasting years with respect to weather extremes were observed in KLS during 2012-13 (dry/drought season) and 2013-14 (Wet season/Excess rainfall year). The drought season of 2012-13 recorded comparatively higher leaf nicotine (1.5-2.0%) compared to wet season of 2013-14(0.9-1.5%). Reducing sugars were slightly higher in wet season compared to dry season. With respect to the leaf chlorides, the wet year recorded lower chlorides



compared to the dry season. The low grade tobacco production was comparatively higher (33.4%) in wet season compared to 30.2% in the dry season indicating the effect of rainfall on the overall performance of the crop.

II (D) Post Harvest Product Management

Investigations on coir pith utilization in tobacco curing (CTRI, Rajahmundry)

C. Chandrasekhararao and K.Sivaraju

Agri-waste briquettes as alternative fuel for curing tobacco:

Briquettes prepared with coir waste were compared with wood in Northern Light Soils of Andhra Pradesh. Results revealed that the requirement of coir waste briquettes per kg cured leaf yield is 3.3 kg as against 4.55 kg of wood. Cost of fuel per kg cured leaf was Rs.



Coir briquettes for curing

7.28/- and Rs. 13.65/- for coir waste briquettes and wood respectively.

Externally funded project on 'Reducing wood fuel usage in curing of FCV tobacco in KLS' (Funded by Western Ghats Task Force (WGTF), Department of Forest, Govt. of Karnataka)

Curing studies on the usage of turbo fan for curing FCV tobacco in KLS indicated a saving of fuel wood requirement by 10.9% in 16'X16'x 16' barn compared to control barn. While control barn (without the use of turbo fan) required 4.94 kg of wood for cuing every kg of cured leaf, the turbo fan fitted barn required only 4.40 kg of wood to cure one kg of cured leaf. The cured leaf quality parameters and the physical quality characters were normal.

The new energy conservation technologies involving modification of flue pipes with mud wall duct instead of normal flue pipe inside the barn was evaluated in 16x16x16 barn. The first season trial indicated a saving of 8.3% in the total wood requirement compared to control. Another new technology involving construction of artificial floor (fixing of horizontal metal plate over the central duct) was found to be more effective with a saving of 17% wood fuel over the control.



Mud wall duct for curing

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

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

K. Suman Kalyani and Y. Subbaiah

Analyzed the extent of cultivation of next best economical crops grown by the tobacco farmers in NLS region. A total of 500 NLS farmers were randomly selected from five NLS auction platforms. Out of total area surveyed (3, 260 acres), the percent area occupied by different crops viz., Tobacco (57.43%), Eucalyptus (26.68%) Oil palm (9.8%), Maize (3.14%), Sugarcane (2.94%).

Impact Analysis of CTRI Technologies (CTRI, Rajahmundry)

Y. Subbaiah and K. Sarala

The technologies which have completed three years period from year of release were selected for the study. Selected technologies related to NLS, SLS and SBS areas were studied the impact is assessed through identified





parameters of impact pathway viz., yield, quality and income. The results have clearly indicated that there was a significant improvement in productivity and income of technology adopters. Adoption of cultivars (CH-3 in NLS and Siri in SLS & SBS areas), recommended NPK fertilization and insect control measures improved the farmers income by Rs. 70,365/-, Rs. 36,196/- and Rs.38,257/- per ha in NLS, SLS and SBS areas respectively. The results revealed further that the impact was higher in adoption of cultivars followed by protection and production technologies.

Nutritional security in tribal areas of East Godavari district through community based approaches (DBT project)

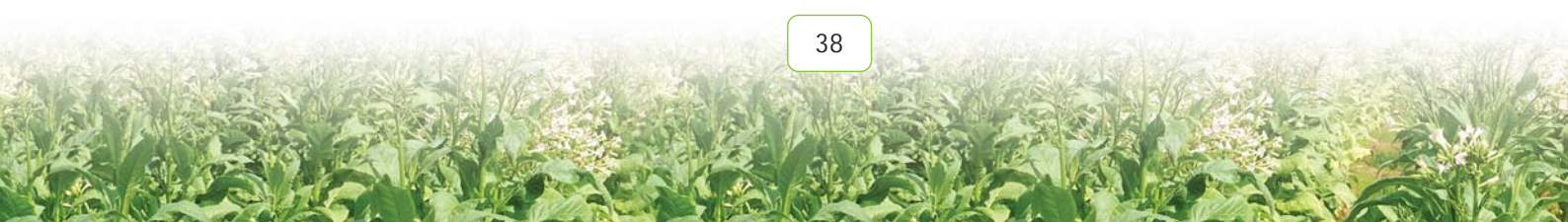
K. Suman Kalyani T.G.K. Murthy

The tribal farm women were trained in various self employment and income generation programmes and alternative subsidiary programmes viz., kitchen gardening, poultry, agricultural implements, mushroom production, fodder production, dairy management, medicinal plants, occupational health hazards and health and nutrition education,

supplementary diets and weaning foods etc.

The seed village concept was popularized in two villages for multiplication of seed among tribal area. Low cost improved agricultural equipment viz., weeders (paddy), wheel hand hoes (vegetable crops) and pedal operated wind mills (winnowing) were introduced for saving time and reducing drudgery. Improved poultry breeds (vanaraja & Turkey) were supplied for improving the family income and nutritional status of the tribal families.

Need based training programmes and method demonstrations were conducted for the benefit of tribal farm women in the adopted villages of Maredumilli, Rampachodavaram, Devipatnam and Addateegala mandals. They were educated in the areas of health care and management, child rearing practices, communicable diseases, water borne diseases and their preventive measures, backyard nutritional kitchen garden management, soya based food processing, establishment of poultry units, importance of pulses in body building, backyard poultry keeping, occupational health hazards for farm women.



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

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

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

M.Mahadevaswamy

The Integrated Farming System model initiated during 2005-06 season in 1.0 acre operational area. The various agro-forestry systems like Agri-horticulture, silvipasture with fodder production were maintained. The proven rainfed cropping systems involving Red gram + finger millet intercropping system (2:8 ratio) and Hybrid cotton were raised in individual cropping systems blocks. Productivity levels of both Hybrid cotton and red gram+ Ragi intercropping systems were higher during this season compared to the last season due to the better rainfall and favourable climatic conditions. The subsidiary components involving vermicompost, vegetable production and fodder cultivation continued, while the border tree plantation was maintained. The IFS model developed is being demonstrated to several farmers including FCV tobacco growers for its sustainability and adoptability by the small & marginal farmers.



Cropping systems in IFS



Subsidiary components of IFS

Crop productivity, soil quality and economic returns under chewing tobacco + Annual moringa intercropping system in response to nutrient management. (CTRI RS, Veda sandur) M. Kumaresan and D. Damodar Reddy

Annual moringa at different populations viz., 100, 75 and 50% was inter cropped with chewing tobacco under 100% population with 3 levels of fertilizers (75, 100 and 125% RDF). The experiment was conducted in a split plot design.



Chewing tobacco + Moringa intercropping

Second year results revealed that the different population levels of annual moringa viz., 100, 75, 50% did not affect the FGLY or TCLY of chewing tobacco. Fertilizer levels viz., 75, 100 and 125% RDF showed a significant difference between treatments. FGLY significantly increased with 125% RDF to chewing tobacco. There was an increase of 9% FGLY with 125% RDF over the 100% RDF. The FGLY recorded was 2796 kg/ha with 125% RDF. Different levels of annual moringa population did not influence the TCLY. TCLY significantly increased with 125% RDF by 19% over the 75% RDF. TCLY with 125% RDF and 100% RDF are comparable. Higher net returns were recorded with tobacco + 100% annual moringa population at 125% RDF applied to both tobacco and annual moringa.

Soil pH did not vary with different intercrop treatments as well as with levels of fertilizers. The TSS decreased with the levels of fertilizers at the second depth (22.52 - 45 cm). The values range between 0.88 to 0.93. Whereas with intercrop treatments and in the first depth (0 to 22.5 cm), at fertilizers levels, the values ranged between 1.09 to 1.24.





The organic C% showed a decreased trend less than 0.31 with the second depth. Similar trend was seen with the available P i.e. less than 9.0kg/ha. Potassium showed a higher values in the second depth.

Plant chemistry has indicated that the chemistry of tobacco leaf, stem and root showed that higher values of N and P were recorded in the leaf lamina followed by stem and root. The K concentration was higher in the stem followed by lamina and stem.

III (B) Identification of Potential Phytochemicals

Leaf biomass improvement in advanced breeding lines for alternative uses (CTRI, Rajahmundry)

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

Five breeding lines (HDBRG, GT-7x A-145, TI-163 X A-145, RT 46-1, RT 51-1) three spacings (60 X 40 cm , 70 X 40 cm, 80 x 40 cm) and two fertiliser levels (100:50:50 and 150:75:75 kg NPK/ha) were tested in split plot design with three replications.

Biometric observations: Observations taken during crop growth stage showed significant treatment variations with regard to plant height, no. of leaves, leaf length and leaf width. Line TI-163 recorded significantly higher plant height of 200.6 cm followed by HDBRG (163.3 cm), RT 46-1 (148.6 cm), TI-163xA-145 (115.8 cm) and GT-7XA-145 (113.3 cm). Regarding spacing S1 (60x40 cm) recorded higher plant height followed by S2 (70x40 cm) and S3 (80x40 cm) where as fertilizer level (100:50:50 kg NPK / ha) recorded higher plant height. Though TI-163 recorded higher plant height, significantly more no. of leaves was recorded by line HDBRG. Spacing 60X40 cm and fertiliser level 100:50:50 kg NPK / ha recorded significantly more no. of leaves.

Leaf biomass: Regarding leaf yield HDBRG produced significantly higher yield due to more no. of leaves and HI. Line TI-163 though recorded higher plant height, less no. of leaves and lower leaf length and width resulted in lower yields. Narrow spacing of 60X40 cm

resulted in higher yields because of limited growth period available during this season.

HDBRG recorded significantly higher leaf yields of 38.68 q/ha followed by line RT 46-1 with an yield of 36.68 q/ha as compared to other three lines with 60 x40 cm spacing and a fertiliser dose of 150:75:75 kg NPK/ha. Interactions of tobacco with breeding lines and spacing for plant height, leaf width and breeding line and spacing, spacing and fertiliser dose for leaf biomass yield were significant.



HDBRG

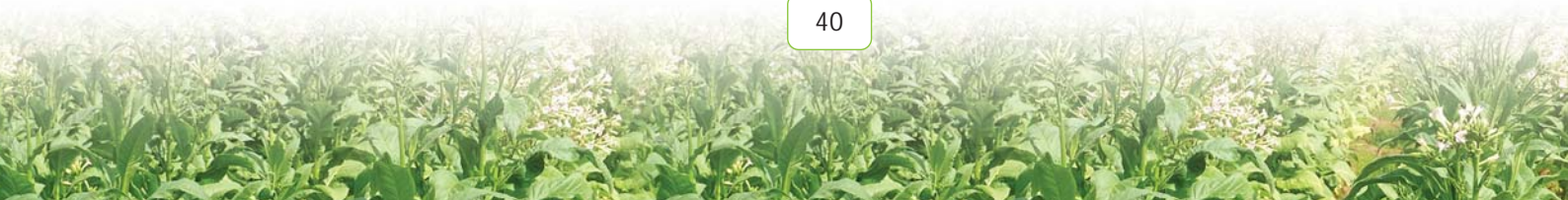
Nicotine Yield: Line RT 46-1 recorded significantly higher nicotine 95.44 and 88.02 kg/ha with a spacing of 80 X 40 cm at 150:75:75 and 100:50:50 doses respectively followed by cross TI-163 X A-145.



RT 46-1

Solanesol yield: Cross TI-163 X A-145, recorded significantly higher solanesol of 64.26 and 60.26 kg/ha at 150:75:75fertiliser dose with a spacing of 70 X 40 and 80X40 respectively followed by line RT 51-1and HDBRG.

Protein yield: Cross TI-163 X A-145, recorded significantly higher protein yield of 1247.7 kg/ha at 150:75:75 fertiliser dose with a spacing of 70 X 40 cm.



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

Knowledge of natural resources and their production potentials and constraints is of paramount importance for optimizing resource use in an agro-ecosystem. The resource characterization and identification of soil and water related constraints to tobacco is critical not only for evolving soil and water management techniques but also for improving input use 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 and D. Damodar Reddy

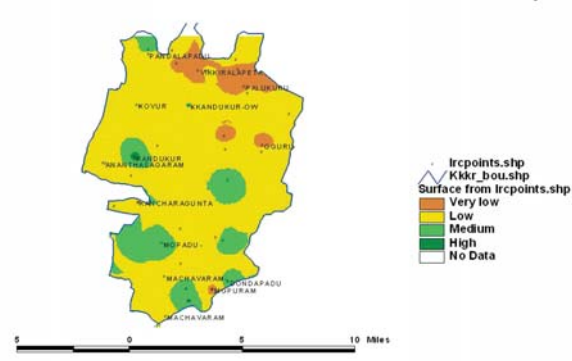
Spatial variation in water quality index classes in Tangutur Mandals: Irrigation water quality indexes were developed for Tanguturu mandal based on WQI equation and using WQI values GIS spatial maps were developed. Irrigation water was classified and most of the irrigation water is moderately suitable. Only 14 % is suitable. Conjunctive use can be done in case of 20% of the samples and 6% of the samples are un suitable.

Spatial variation in Soil fertility in Kandukur and Tangutur Mandals: Soil organic carbon content in Kandukur mandal is low in 80% of the area followed by medium and in few pockets it is very low. In Tanguturu mandal the soil organic carbon content in most of the area is low and in few patches it is very low. (Fig.IV-1). Soil available phosphorus variation in Tangutur mandal studied with the help of spatial maps indicated that 60 % of the area is in low to medium range and 30 % area is under medium to high range. Low and High phosphorus containing soils are in few patches. Spatial map

of soil available phosphorus showed that in Kandukur mandal 30% area is in high range and 20 % area is in medium to high range. Low phosphorus areas are in 25 %. Some accumulation of available phosphorus is seen in the soils. Variation in soil available potassium in Kandukur mandal studied with the help of spatial maps indicated that 60% of the area is in high range and 30 % area is in medium range remaining area is in very high range. While, in Tangutur mandal 50% area is under medium range, 43 % area is in high range and 7% area is in very high range.



Spatial variation of soil organic carbon in Kandukur mandal



Spatial variation of % Soil organic carbon in Tangutur mandal

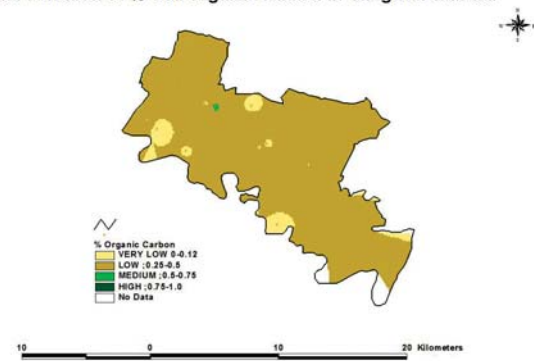


Fig. IV-1 Spatial maps of soil organic carbon in a) Kandukur b) Tangutur mandals

Assessment of leaf quality of FCV tobacco using hyper - spectral remote sensing and growth parameters: [CTRI-RS, Kandukur]
L.K. Prasad, M. Anuradha, M. Prabhakar and D. Damodar Reddy



An investigation on assessment of leaf quality of FCV tobacco using hyper - spectral remote sensing and growth parameters was initiated with the objectives of (i) Identification of spectral variables and relationship with the FCV tobacco leaf quality constituents, (ii) Development of indexes and statistical relations to assess the leaf quality.

Leaf quality assessment studies of green leaf showed that, hyper spectral reflectance of FCV tobacco leaf under different nitrogen levels (reflectance values: 0.05 - 0.238 at 480, 510, 645, 652, 663 nm) had inverse relation with estimated total leaf chlorophyll (0.753 - 3.103 mg/g), Chlorophyll a, b and applied nitrogen with a coefficient of correlation ($r = -0.72 \pm 0.03$). Correlation for nitrogen dose and hyper spectral reflectance at standard bands of chlorophyll was $r = -0.86$. Total chlorophyll and N dose had positive correlation with r value = 0.97. Sensitivity analysis of hyper spectral bands in relation to nitrogen, chlorophyll, reducing sugars and nicotine were done in order to explore the sensitive wave length bands to leaf chemical constituents. Sensitive bands observed for nitrogen 667 and 773 nm while for chlorophyll 670 and 2105 nm. Sensitive bands observed for nicotine and reducing sugars were 1481 and 1898 & 1406 and 1885 nm. Nicotine content was negatively correlated with respective sensitive bands. While, reducing sugars were positively correlated to the hyper spectral reflectance. (Fig.IV-2).

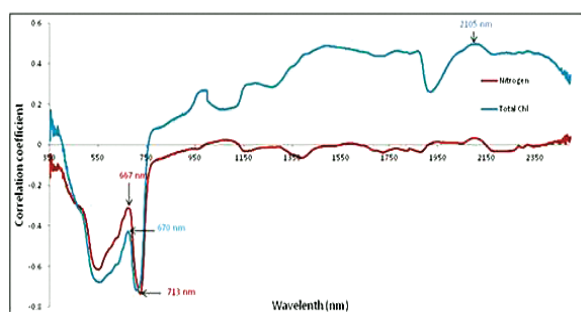


Fig. IV-2 Sensitive hyper spectral bands for nitrogen and chlorophyll in different tobacco leaf samples

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

Evaluation of Crop Residue and Wood Ashes - Effects on Soil Fertility and Potassium Nutrition of Tobacco [CTRI, Rajahmundry]
D. Damodar Reddy, J.P. Bindu, S. Kasturi Krishna, M. Mahadeva Swamy, L.K. Prasad and K. Nageswara Rao

Biomass ashes resulting from burning of crop residues and other farm wastes are the oldest mineral fertilizers. Disposal of crop residues (especially tobacco, cotton, pigeon pea etc. having little or no economic value) by burning them on or off the field is a common practice in vogue in many areas. Similarly, combustion of wood (such as eucalyptus, mango, cashew nut, acacia etc.) in tobacco curing barns also generates large quantities ash. The recycling of biomass ashes in agriculture is important to supplement nutrient cycles in soils and reduce dependency on chemical fertilizers. Because of their properties and their influence on soil chemistry, the utilization of biomass ashes is particularly suited for the fertility management of tropical acid soils. Of particular interest in the use of biomass ashes is the K contained in them. Relatively large amount of fertilizer K (@ 100 kg K ha⁻¹ as SOP) is required for FCV tobacco production on Alfisols that are light textured, K deficient and acidic in reaction (i.e. NLS and KLS). The high cost SOP coupled with large K requirement makes management of K an important issue in FCV tobacco production on Alfisols.

Effects of biomass ashes on soil acidity and K fertility: The changes in pH and fertility of an acid soil (from Shimoga) amended with crop residue and wood ashes were assessed in a 90d incubation experiment. Four ashes viz., tobacco stem ash (TSA), cotton stem ash (CSA), pigeon pea (PSA) and eucalyptus wood ash (EWA) at three rates of addition (0.1, 0.2 and 0.4%) and a control (no biomass ash) were included in the incubation experiment. Addition of biomass ashes caused a marked increase in soil pH over the no-ash control (Fig. IV-3). The increments in soil pH were larger with the increase in ash application rate. For the all the biomass ashes



and at all the application rates, soil pH tended to decrease with the progress of incubation time. The magnitude of increase in soil pH also differed between different biomass ashes and followed the order: PSA > CSA > TSA > EWA. The addition of biomass ashes brought of a distinct change in availability of K in the soil. All treatments with biomass ashes enhanced the K availability in soil as compared to the no-ash control throughout the incubation period (Fig. IV-4). Irrespective of ash type, increasing rates of ash addition resulted in greater increase in K availability. The biomass ash induced increase in K availability was proportional to the amount of K added through ashes. Among the biomass ashes, the increase in K availability followed the order: CSA > TAS > PSA > EWA. This trend is consistent with K concentration of biomass ashes.

Effects of biomass ashes on yield and quality of flue cured tobacco grown on a Alfisol (KLS): Application of crop residue/wood ashes from tobacco stems, cotton stems, pigeon pea stems and eucalyptus wood (barn ashes) either alone or in combination with SOP (50% + 50%) on 100 kg K ha⁻¹ equivalent basis caused a significant increase in GLY, CLY and TGE leaf as compared to the control. The control plot (without potassium application) recorded the minimum yield while the K supply through 100% SOP recorded the maximum cured leaf yield.

Though SOP gave highest productivity, it was statistically at with all other biomass ashes alone or their combinations with SOP particularly for CLY and TGE yield. Among the biomass ashes, the CSA proved relatively more effective source of K supplementation. The quality parameters viz., nicotine, reducing sugars and chloride content for both X and L position leaves were not affected by the biomass ash treatments alone or in combination with SOP. These results imply that use of biomass ashes as K sources for FCV tobacco can significantly improve the productivity without adversely affecting the leaf quality, and results in reduced dependency on costly SOP fertilizer.

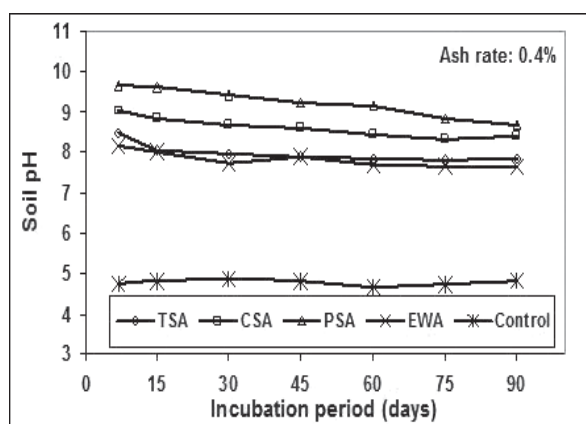
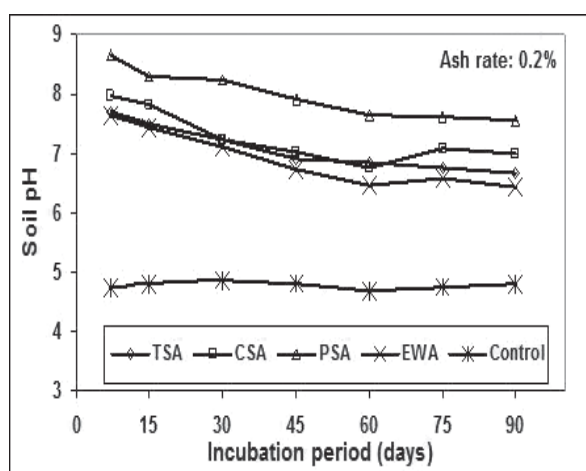
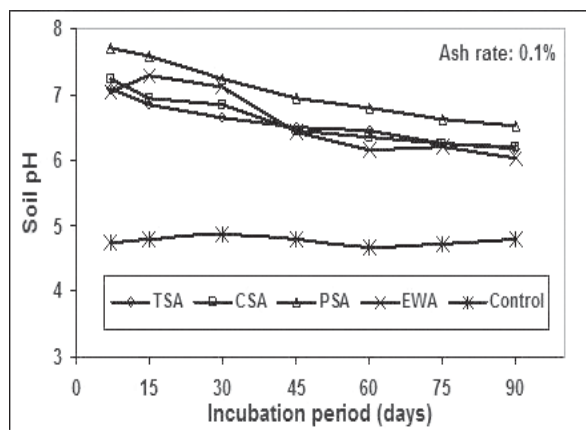


Fig IV-3. Changes in soil pH as induced by different biomass ashes at varying rates of application

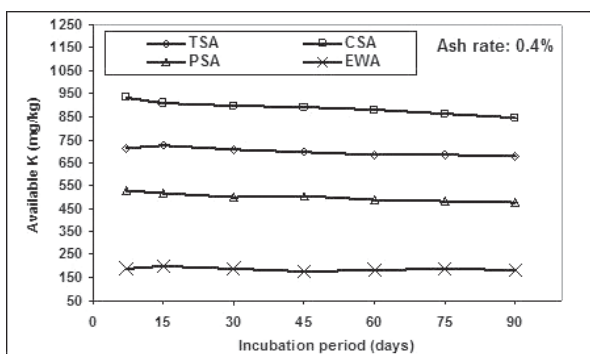
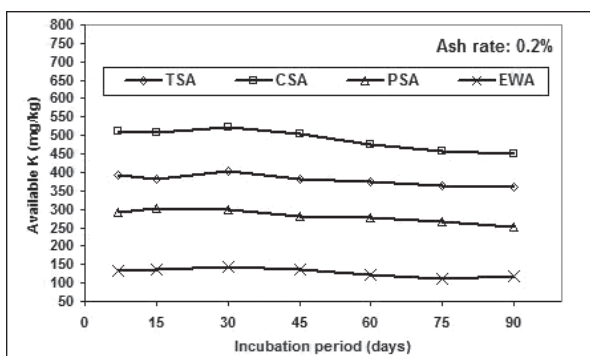
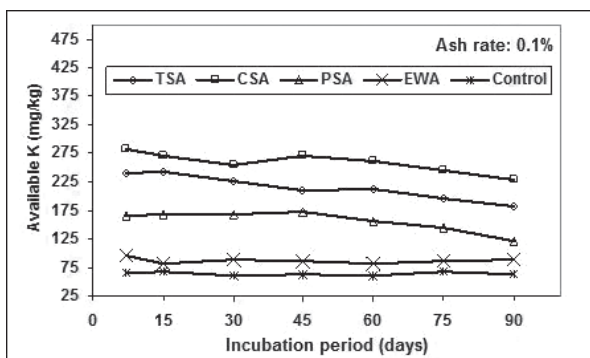


Fig IV-4 : Changes in soil K availability as induced by different biomass ashes at varying rates of application

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

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

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

Response of identified tolerant (T) and susceptible (S) varieties of different tobacco types to excess water stress: A pot culture experiment was conducted to study the differential response of identified tolerant (T) and susceptible (S) varieties of different tobacco types to excess water stress. Results showed that excess water stress reduced the chlorophyll content. The reduction in chlorophyll content is higher in susceptible varieties compared to tolerant varieties. The chlorophyll content was higher in top leaves compared to bottom leaves. The activity of different enzymes increased due to excess water stress and the reduction is more in tolerant varieties under stress compared to susceptible varieties. Excess water stress affected the yield and quality of all the tobacco types. The reduction in yield is higher in susceptible varieties compared to tolerant varieties.

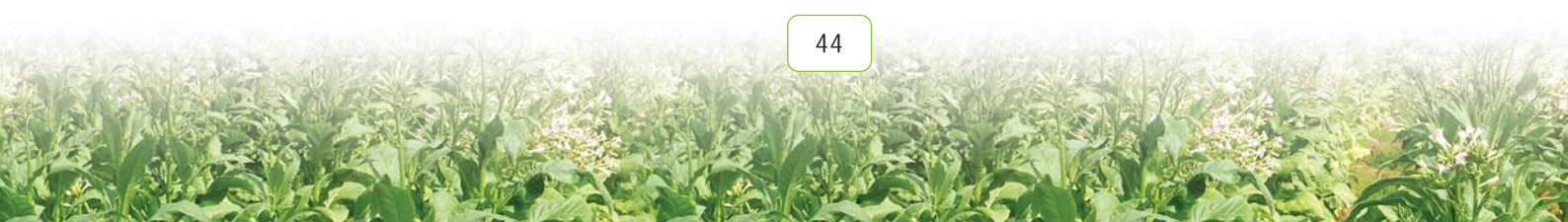
Evaluation different mitigation strategies for excess water stress effects in flue-cured tobacco in relation to yield:

A field experiment was conducted at CTRI research farm, Katheru to evaluate the possible measures to alleviate the effects of excess water stress in flue-cured tobacco. Excess water stress reduced the yield and quality. When the excess water stress was not considerably low, application of KNO_3 and foliar spray of kinetin and putriscine increased the yield. When excess water stress damaged the crop to a considerable extent, the soil application of KNO_3 and kinetin spray could mitigate the excess water stress effects to some extent.

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

Secondary nutrient deficiency effects on potassium nutrition:

Sand culture experiments were conducted to study the single and multiple nutrient deficiencies under sufficient and deficient conditions of potassium on plant growth, development and nutrient uptake. Single and multiple nutrient deficiencies reduced all the





Secondary nutrient deficiencies in relation to potassium supply

growth characters, net photosynthetic rate, chlorophylls. Under nutrient stress the concentration of anti-oxidative enzymes increased to counteract the ill effects of stress. Under no potassium condition the plant growth is less and omission of secondary nutrients didn't show any effect as the K deficiency symptoms masked the effects of secondary nutrients. Under sufficient K supplied condition omission of single and multiple nutrients showed visual deficiency symptoms, reduction in plant growth and showed variation in uptake of nutrients.

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

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

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

Utility of microorganisms that improve soil fertility and enhance plant nutrition has continued to attract attention due to the increase in cost of fertilizers and their negative impact on environment. The objectives of this field experiment with tobacco were to determine reduced rates of inorganic fertilizer coupled with microbial inoculants that enhance plant growth, yield and nutrient uptake levels equivalent to those with full rates of fertilizers and the minimum level to which fertilizer could be reduced when inoculants were used. The microbial inoculants used in the study were plant growth promoting bacteria viz., *Azospirillum*, *Azotobacter*, *Bacillus subtilis* and *Frateuria aurantia* alone or a mixture of them in combination with 75% recommended dose of fertilizer. Results showed that supplementing

75% of the recommended fertilizer rate with inoculants produced plant growth, yield and nutrient (N, P and K) uptake that were statistically equivalent to the full fertilizer rate without inoculants. When inoculants were used in single, double or triple with 75% RDF the beneficial effects were usually not consistent however, inoculation with the mixture of PGPR (N, P and K mobilizers) at 75% RDF produced significantly superior yield better than the full fertility rate without inoculants. Without inoculants use of fertilizer rates lower than the recommended resulted in significantly less plant growth, yield and nutrient uptake. The results suggest PGPR based inoculants can be used and should be further evaluated as components of integrated nutrient management strategies.

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

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

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

Effect of organic manures (Neem cake, Pongamia cake, filter press cake, poultry manure, FYM and vermi compost in different ratios; 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) on the neutral volatile aroma compounds in burley tobacco was studied. The results showed the following neutral volatile aroma compounds (NVAC) significantly contributed to smoke flavor based on their relative proportions; neophytadiene, thunbergol, megastigmatrienone isomers, 3-hydroxysolavetivone, solavetivone, solanone and Z-Abienol. The terpinoid content was maximum in the manure B treatment when compared to all other treatments. Thunberganoid content decreased by 8.8% with increase in N application from 120 to 160 kg / ha. Neophytadiene content decreased by 11.5% and 14.9% in manure C and D respectively when compared 120 kg N/ha. Thus the present study showed that NVAC were more in the organic manure treatments when compared to recommended dose of nitrogen (120 kg/ha).





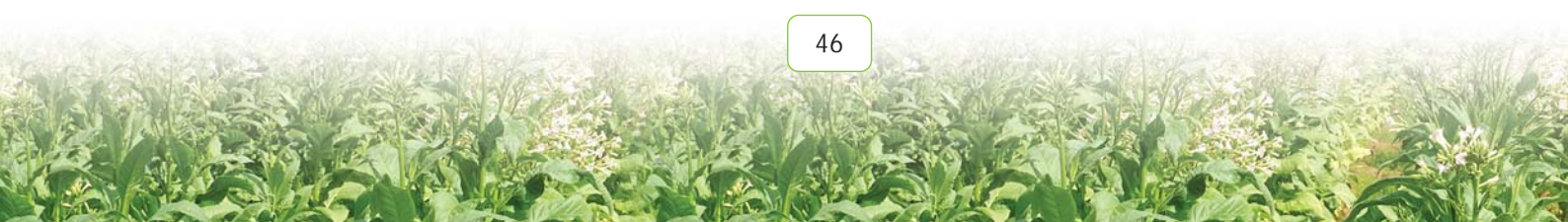
Higher levels of nitrogen (160 kg/ha) showed similar/ less content of NVAC when compared to recommended level of nitrogen (120 kg N/ha). Higher levels of neutral volatiles aroma compounds were observed in organically grown burley tobacco (25% N in the form of organics) when compared to inorganically grown burley tobacco (120 kg N/ha).

Fatty acid composition of burley tobacco: A maximum of 9 fatty acids were recorded. Palmitate, linolenate and linoleate are the major fatty acids recorded in different treatments. Tobacco samples from manure C and D showed higher levels of palmitate compared to manure B and 120 kg N/ha. With increase in N application from 120 to 160 kg N/ha, the relative content of all fatty acids decreased whereas the linoleate content was increased by 3.04 times. There was not much variation in the relative composition of fatty acids between bottom and middle position leaves but there was an increase in all fatty acids except linoleate. The linoleate content decreased by 2.73 times in top position leaves compared to bottom and middle position leaves.

NVAC in Oriental tobacco: Effect of leaf position on NVAC in Oriental tobacco was studied. Terpinoid content increased with change in leaf position on the stalk from bottom to top. Middle and top position leaves contained nearly the same content of terpinoids. The terpinoid content increased by 2.28 times in the middle and top position leaves when compared to bottom position leaves. The carotenoid content varied from 9.47 to 13.79% among the leaf positions. The top position leaves showed maximum levels of carotenoids. Thunberganoids were maximum in bottom position leaves and decreased with increase in leaf position from bottom to top. Neophytadiene increased with increase in leaf position from bottom to top and top position leaves contained 60.9% higher levels of neophytadiene compared to bottom position leaves. Nearly 9 carotenoid degraded compounds were identified in all leaf positions and all isomers of megastigmatrienone were present. Megastigmatrienone isomers were maximum in top position leaves followed by middle and bottom position samples. Among the

thunberganoids, duvatriendiols, solanone, norsolanadione and thunbergol are present in the bottom and middle position leaves whereas solanone was absent in the top position leaves.

Effect of curing methods on leaf pigments and their derivatives in tobacco: The effect of curing methods on leaf pigments and their derivatives in air cured (Oriental) and Flue-cured Virginia (FCV) tobacco was investigated. The pigments identified include chlorophylls, carotenoids, pheophytin, chlorophyllide, protoporphyrin and magnesium protoporphyrin. Total chlorophyll (Tchl) content varied from 158 to 231 µg/g among the positions and types of tobacco. Tchl content was at a par between Oriental and FCV tobacco but bottom position leaf of Oriental tobacco showed significantly higher levels of Tchl when compared to the middle and top position leaves. The carotenoid content varied from 197 to 456 µg/g among the leaf positions and types of tobacco. FCV tobacco showed significantly higher levels of carotenoids, More Polar Carotenoids (MPC) and Less Polar Carotenoids (LPC) compared to Oriental tobacco. The carotenoid content was at a par among the leaf positions. Pheophytin a (Phe a) content was identical for Oriental and FCV tobacco while pheophytin b (Phe b) was significantly higher in Oriental tobacco. FCV tobacco contained significantly lower levels of protoporphyrin and magnesium protoporphyrin when compared to Oriental tobacco. Chlorophyllide a (Chlide a) content varied between 1.73 to 3.4 µ mole/g among the leaf positions and types of tobacco and its content decreased significantly with change in leaf position from bottom to top. Top position leaf of Oriental tobacco showed significantly lower levels of Chlide a when compared to bottom position leaf of both tobacco types. Chlorophyllide b (Chlide b) content also showed same trends as Chlide a but its content was significantly lower in FCV than in Oriental tobacco. Pheophorbide compounds were not detected in both types of tobacco. The results revealed that the end product of the chlorophyll degradation may be chlide in tobacco and the degradation of chlorophyll pigments due to curing was greater in FCV tobacco when compared to Oriental tobacco.



V. Integrated Management of Biotic Stresses

V (A). Monitoring of Insect pests and Diseases

Survey for assessment of insect pest incidence in tobacco and tobacco based cropping systems of CBS and SBS (CTRI RS, Guntur)
P. Venkateswarlu

Tobacco

Survey covering villages 7 in CBS and 12 in SBS and 57 nurseries was conducted. Out of these, 38.1% nurseries were infested by tobacco caterpillar, *Spodoptera litura* in CBS and 30.6% in SBS. The infestation ranged from 0-15% in CBS.

In main field survey, 10 villages in CBS and 15 in SBS were selected. Aphid, *Myzus nicotianae*, budworm, *Helicoverpa armigera*, caterpillar, *Spodoptera litura* and leaf curl caused by whitefly, *Bemisia tabaci* were recorded in both areas. The average infestations of these pests in the infested fields were 8.3, 5.4, 4.8 and 3.6% in CBS and 7.9, 6.0, 4.4 and 3.8% in SBS, respectively. The overall infestations of these four pests in the area were 6.1, 3.1, 1.3 and 1.5% in CBS and 5.1, 3.5, 1.1 and 2.1% in SBS, respectively.

Cotton

Occurrence of sucking pests like, leaf hoppers (jassids), *Amrasca biguttula biguttula* and mealy bugs, *Penacoccus solenopsis* was more than other insect pests. Per cent fields infested by leaf hoppers and mealy bugs were 56.6 & 16.6 and 46.6 & 23.3 in CBS and SBS areas, respectively. Average infestations in the infested fields were 23.8 & 10.8 (CBS) and 22.6 & 11.6% (SBS). Leaf hopper population was more in CBS and mealy bug was more in SBS.

Chillies

Incidence of sucking pests like, mites, *Polyphagotarsonemus latus* and thrips, *Scirtothrips dorsalis* was more. Per cent fields infested by mites and thrips were 26.7 & 20.0 and 36.7 & 20.0 in CBS and SBS areas, respectively. Average infestations in the

infested fields were 13.8 & 9.2 (CBS) and 15.4 & 10.6% (SBS).

Pigeon Pea

Leaf webber, *Maruca vitrata* and pod borer, *Helicoverpa armigera* infestations were more than other pests. Average infestation of pods in the infested fields was 11.6 & 8.0 (CBS) and 10.8 & 7.8% (SBS).

Chickpea

Only two insect pests viz., pod borer, *Helicoverpa armigera* and *Spodoptera exigua* were recorded in the area. Per cent fields infested by *H. armigera* and *S. exigua* were 55.0 & 30.0 and 45.0 & 15.0 in CBS and SBS areas, respectively. Average infestation of pods and plants in the infested fields were 8.6 & 6.4 (CBS) and 8.0 & 4.8% (SBS). Pest infestation was more in CBS than SBS and among these two pests.

Survey for plant parasitic nematodes associated with tobacco (CTRI RS, Hunsur)
S. Ramakrishnan

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

Weather based disease prediction model for brown spot of Motihari tobacco under North Bengal conditions (CTRI RS, Dinhat)
S. Mandi

The symptoms appeared 48 days after planting irrespective of the dates of planting. The average temperature and RH under macro-weather variable ranged from $16 \pm 2.2^{\circ}$ C and 75 ± 5 % respectively and the average canopy temperature and RH under micro-weather variable ranged from $18.57 \pm 2.1^{\circ}$ C and 83.85 ± 9.59 %, respectively. Under macro - weather variable, the area under disease progress curve





(AUDPC) was higher (> 1600) under normal planting date followed by early (399) date of planting. However, in late planted crop and normal check the AUDPC was much lower (< 26 and 152), where temperature and RH varied from 14 - 18.5° C and 70 -81 % respectively. In case of micro-weather variable viz. canopy temperature and relative humidity (RH) influence disease progression. Disease progression suddenly increases in normal planting after infection. Whereas in early planting disease progression gradually increased. Disease progression was increased as canopy temperature increased and RH% decreased.

V. (B) Development of IPM technology

Bio-efficacy and field evaluation of new insecticides against tobacco pests(CTRI, Rajahmundry)

U.Sreedhar and S. Gunneswara Rao

i. Evaluation of new insecticides against *Spodoptera litura* Fabricius in tobacco nurseries

The new insecticide chlorfluazuron 5.4 EC was evaluated against tobacco caterpillar, *S. litura* in tobacco nurseries along with recommended insecticides. Emamectin benzoate 0.0025% recorded least (6.19%) seedling damage followed by chlorfluazuron 0.03% (7.40) and novoluron 0.01% (7.84) at all the observations.

ii. Evaluation of new insecticides against tobacco aphid, *Myzus nicotianae* Blackman on FCV tobacco

Flonicamid 50 WG @ 0.02%, pymetrozine 50 WG @ 0.02%, spiromesifen 240 SC @ 0.2%, spirotetramet + imidacloprid 240 SC @ 0.018% were evaluated against tobacco aphid, *M.nicotianae* on FCV tobacco. At 2 days after spray (DAS) flonicamid recorded the lowest aphid population (3.06) followed by pymetrozine and spirotetramet+ imidacloprid (3.58). At 4, 8 and 16 DAS all the treatments except spiromesifen recorded cent per cent mortality of the aphids. Data on yield parameters showed that flonicamid recorded highest cured leaf yield (2000 kg/ha), bright leaf yield (1050 kg/ha) and grade index (1600) followed by pymetrozine (1980, 986 & 1566).

Effect of new insecticides on the aphid predators

Experiments were conducted in laboratory with new insecticides for aphid control to determine their safety to the predatory coccinellid beetle *Coccinella repanda* Thunberg and syrphid predator *Xanthogramma scutellare* Fabricus.

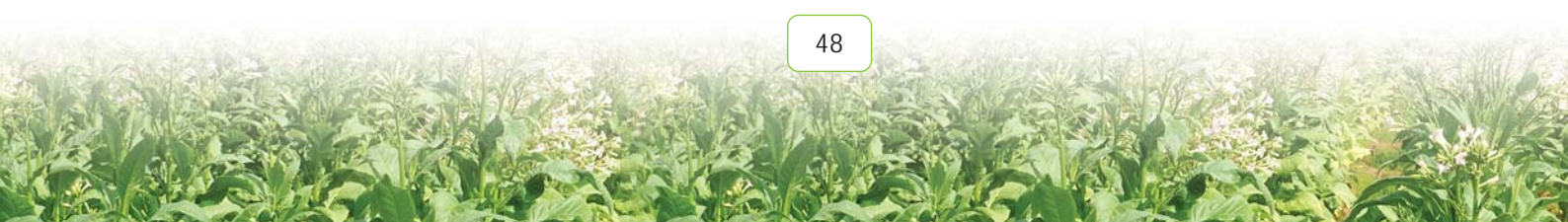
It was found that for the larvae of *C.repanda* flonicamid and pymetrozine were harmless. Thiamethoxam and imidacloprid were slightly harmful. In case of the adult beetles, flonicamid pymetrozine and thiamethoxam were harmless where as imidacloprid was slightly harmful.

Effect of insecticides on *Coccinella repanda* Thunberg larvae

Treatment	Per cent mortality (LM)	E (%)	Class
Flonicamid 0.02%	8.90 (16.70)	17	1
Pymetrozine 0.02%	13.90 (21.70)	22	1
Thomethoxam 0.005%	49.90 (44.90)	45	2
Imidacloprid 0.005%	76.5 (61.40)	62	2
Control	0.0 (0.0)		
S.Em±	2.3		
CD (P=0.05)	7.0		
CV %	18.5+		

Figures in parentheses are arc sign transformed values

IOBC Classification: LM(%)=larval mortality (%)=(1-Vt/Vc) 100, where E is the effect of pesticide measured as the larval mortality compared to the untreated.





Effect of insecticides on *Coccinella repanda* Thunberg adults

Treatment	Per cent mortality (AM)	E (%)	Class
Flonicamid 0.02%	11.90 (20.90)	4	1
Pymetrozine 0.02%	15.90 (23.30)	7	1
Thomethoxam 0.005%	37.30 (37.50)	24	1
Imidacloprid 0.005%	49.90 (44.90)	33	2
Control	10.4 (18.10)		
S.Em±	2.4		
CD (P=0.05)	7.30		
CV %	19.3		

Figures in parentheses are arc sign transformed values

IOBC Classification: AM(%)=adult mortality:E(%)=(1-Vt/Vc) 100, where E is the effect of pesticide measured as the larval mortality compared to the untreated.

Effect of insecticides on *Xanthogramma scutellare* Fabricius larvae

Treatment	Per cent mortality (LM)	E (%)	Class
Flonicamid 0.02%	12.0 (20.50)	4	1
Pymetrozine 0.02%	13.60 (21.20)	5	1
Thomethoxam 0.005%	59.60 (50.60)	60	2
Imidacloprid 0.005%	100 (89.90)	88	3
Control	9.0 (17.20)		
S.Em±	1.7		
CD (P=0.05)	5.2		
CV %	9.9		

Figures in parentheses are arc sign transformed values

IOBC Classification: LM(%)=larval mortality:E(%)=(1-Vt/Vc) 100, where E is the effect of pesticide measured as the larval mortality compared to the untreated, Vt is the larval survival observed on each pesticide treatment and Vc is the larval survival observed on the untreated (control).

Effect of insecticides on *Xanthogramma scutellare* Fabricius adults

Treatment	Per cent mortality (AM)	E (%)	Class
Flonicamid 0.02%	16.0 (23.30)	7	1
Pymetrozine 0.02%	22.0 (27.50)	12	1
Thomethoxam 0.005%	42.0 (40.30)	28	1
Imidacloprid 0.005%	100 (89.90)	88	3
Control	12.0 (17.90)		
S.Em±	3.0		
CD (P=0.05)	8.90		
CV %	17.10		

Figures in parentheses are arc sign transformed values

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



It was observed that for the larvae of *Xanthogramma scutellare* flonicamid and pymetrozine were harmless. Thiamethoxam was slightly harmful and imidacloprid was moderately harmful. In case of the adult syrphids, flonicamid, pymetrozine and thiamethoxam were harmless where as imidacloprid was moderately harmful.

ii. Evaluation of new insecticides against tobacco whitefly *Bemisia tabaci* (Gennadius) on FCV tobacco

Diafenthiuron 50 WP @ 0.05% recorded least whitefly population at all the observations. At 7 days after first spray (DAIS) the population in diafenthiuron (0.77) was on par with that in pymetrozine (0.89) and flonicamid (0.98), it was significantly less than all other treatments at all the other observations. At 15 DAIS flonicamid (1.40) was found to be on par with pymetrozine (1.43), imidacloprid & thiamethoxam (1.46) and spiromesifen (1.54). At 7 days after second spray (DAIS) diafenthiuron (0.61) and pymetrozine (0.84) recorded significantly less population than all other treatments except for spiromesifen (0.99) which remained on par with pymetrozine. The treatments of spiromesifen, flonicamid (1.12), thiamethoxam (1.02) and imidacloprid recorded more or less equal number of whiteflies/plant.

At 15 DAII spray, diafenthiuron recorded least population (0.76) followed by pymetrozine (0.93), spiromesifen (1.03) and flonicamid (1.12). At 30 DAII spray diafenthiuron continued to be the most effective with least whitefly population (0.88) followed by pymetrozine (1.03) which was on par with that in spiromesifen (1.09), flonicamid (1.20) and imidacloprid (1.24). Data in per cent leaf curl infected plants showed that all the treatments recorded significantly less leaf curl infected plants as compared to control at all the observations. Diafenthiuron recorded significantly less (3.50) leaf curl infected plants as compared to all other treatments at all the observations. The data on yield parameters showed that pymetrozine recorded highest cured leaf, bright leaf and grade index (1980, 986 kg/ha & 1494) and remained on par with all other treatments except buprofezin.

iii. Filed efficacy of new insecticides against tobacco caterpillar *S.litura* on FCV tobacco

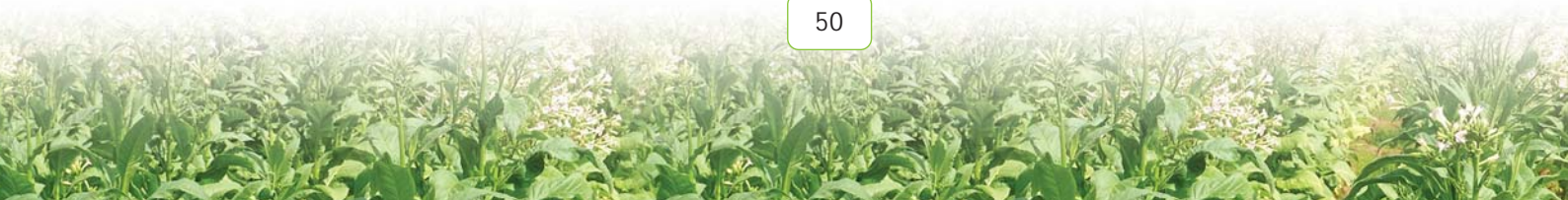
Emamectin benzoate 5 SG @ 0.0025% and chlorfenapyr 10 SC @ 0.01% recorded no damage at 2, 4 and 8 days after spray (DAS) and are significantly superior to all other treatments except metaflumizone. Similar trend was observed for leaf area damaged by the pest. The mean per cent plants infested at DAS was nil in emamectin benzoate and chlorfenapyr treatments. Emamectin benzoate recorded highest cured leaf, bright leaf and grade index followed by chlorfenapyr and metaflumizone.

Chlorfluazuron 5.4 EC was evaluated along with recommended insecticides against *S. litura* on field crop of FCV tobacco. Results indicated that emamectin benzoate 5 SG @ 0.025% recorded least number of leaves damaged (1.00), leaf area damage (0.00) and infestation followed by chlorfluazuron 0.03% (1.09, 2.71 % & 3.50% respectively) at all the observations. Emamectin benzoate 5 SG @ 0.025% and Chlorfluazuron 5.4 EC 0.03% and provided significantly better protection than all other treatments. The data on yield parameters showed that emamectin benzoate recorded highest (1980 kg/ha) cured leaf, bright leaf (996 kg/ha) and grade index (1460) and remained on par with chlorfluazuron 0.03% (1940, 950 & 1460 respectively).

**Evaluation of insecticide application technology for effective spray coverage on FCV tobacco in NLS (CTRI, Rajahmundry)
G. Raghupathi Rao, U.Sreedhar and K.Nageswara Rao**

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

The results showed that at 35 days after planting (DAP), Hi tech sprayer was more efficient in terms of optimum spray fluid (150 l/ha) with considerable saving of insecticide and time over compression sprayer- farmers method (210 l/ha-with out pressure regulating valve and irregular operators speed) and compression sprayer (168 l/ha- with pressure regulating valve and normal operators speed).





At 50 DAP, application through Hi tech sprayer reduced the insecticide quantity to an extent of 41, 29 and 14 % over compression sprayer- farmers' method, compression sprayer and knapsack sprayer, respectively. Further, Hi tech sprayer reduced the operation time to an extent of 26 and 18% over compression sprayer-farmers method, and compression sprayer , respectively. It revealed that up to 50 DAP by considering plant canopy and quantity of spray fluid and insecticide requirement, application through Hi-tech sprayer was more economical over low volume sprayers high power knapsack sprayer (HPKS) and motorised knapsack sprayer (MKS).

At 65 DAP spray fluid applied through low volume sprayers viz., HPKS and MKS was low (109 and 120 l/ha) as against Hi tech sprayer (210 l/ha). It was evident that as the crop grew, the loss of insecticide due to the application of spray fluid through HPKS over Hi tech declined from 34 % at 35 DAP to 3 % at 80 DAP. At 80 DAP spray fluid applied through HPKS and MKS varied from 98 to 110 l/ha as compared to Hi tech sprayer (190 l/ha) with 4.4 and 4.45 hours of operation time, respectively . Application of spray fluid through HPKS followed by MKS was more economical in terms of spray volume requirement and operators time. Further, it is evident that as the crop growth advanced ,the other parameters viz., swath width of canopy , plant height and LAI also increased gradually and thus the loss of spray fluid decreased.

Spray deposition studies:

The data on the deposition of potassium through various sprayers on leaf surface (ig/ sq.cm) at top, middle and bottom canopy indicated that at 35 DAP, Hi tech sprayer (40 PSI, 3.6 kmph) was superior over all other sprayers in depositing maximum quantity of potassium 2.30, 1.35 and 1.15ig/ sq.cm on top, middle and bottom canopy, respectively as against 1.30, 1.50 and 0.38 ig/ sq.cm through MKS. At 95 DAP the spray deposition through HPKS showed superior performance with uniform coverage by showing 2.65, 1.82 and 1.52 ig/ sq.cm on top, middle and bottom canopy, respectively followed by MKS.

Spray characteristics as influenced by different sprayers at different crop growth stages

At 35 DAP, the spray spectrum emitted through Hi tech sprayer on top , middle and bottom canopy was superior as it was characterized by higher droplet density, lower VMD, higher coverage and low uniformity coefficient. On contrast, at 80 days after planting application through HPKS was more effective over MKS and Hi tech sprayers in providing superior spray characteristics viz., high droplet density, low VMD, high coverage with low deviation of droplet sizes.

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

Mean infestation of leaf eating caterpillar, *Spodoptera litura*, aphids, *Myzus nicotianae* and tobacco budworm, *Helicoverpa armigera*, indicated that the lowest infestation of 14.1, 13.1 and 11.4 % respectively was recorded in the plots received initial two sprayings through Hi tech and rest two through HPKS.

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

An experiment with different diameters of disc orifice, viz: 867, 955, 1094, 1109, 1212 and 1576 μm and swirl plate apertures diameters viz; 745, 761, 786, 1174/395, 1453/545, 1688/798 and 2230/1000 μm were selected for the study. The discharge rate of spray fluid emitted through the nozzles comprising above disc and swirl plates using pressure valves of 10, 30 and 40 PSI was calibrated by using Hi-tech sprayer. Results revealed that discharge rate varied from 350 to 1260 ml/min through a disc orifice diameter of 1576 μm with a swirl plate aperture diameter of 745 μm at 10 PSI to a disc orifice diameter of 1576 μm and a swirl plate aperture diameter 2230 / 1000 μm at 40 PSI. It is evident that the discharge of spray fluid increased with increase in pressure and the swirl and disc plate aperture diameters. As a result the operator has a choice of using spray fluid from 220 to 1200 ml/min depending on the pest and the crop stage.

Influence of insecticide formulations, discharge rate and sprayers on the spray characteristics in FCV tobacco

At 25 DAP, irrespective of sprayer, spray spectrum emitted @ 250 cc/min was characterized by more uniformity coefficient (UC) with higher coverage. In contrast at 45 DAP; spray spectrum emitted @ 450cc/min was characterized by more uniformity coefficient (UC) with higher coverage. Hence, it is clear that at 25 DAP, irrespective of formulations, the pest incidence could be managed by applying with Hi tech sprayer- 250 cc/ min. Thereafter, applying through Hi tech @ 450 cc/ min is more preferable for achieving uniform coverage with lower pest infestation.

Management of ground beetle, *Mesomorpha villiger* Blanchard in FCV tobacco (CTRI, Rajahmundry) U. Sreedhar

A replicated field trial was conducted with eight treatments viz., T1 foliar spray (FS) of imidacloprid 200 SL @ 0.005% on the seed bed 1 day before transplanting, T2 Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting, T3 Imidacloprid 200 SL 0.005% in transplant water, T4 Foliar spray of Imidacloprid 200 SL 0.005% a day after transplanting (DAT), T5- T2 + FS of Imidacloprid 200 SL 0.005% 5 DAT, T6- T1 + T5, T7- Neem cake application @ 5g/plant, T8- FS of tray seedlings 1 day before transplanting imidacloprid 200 SL @ 0.005% T9- Untreated Control. The results indicated that at 7 days after planting (DAP) least per cent plant mortality (0.00%) was recorded in T2 Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting and T5. However, T3 Imidacloprid 200 SL 0.005% in transplant water (3.50) remained on par with these two treatments as shown by transplant mortality. These three treatments gave significantly higher protection than all other treatments.

At 15 DAP T5 (T2 + FS of Imidacloprid 200 SL 0.005% 5 DAP) recorded cent per cent protection and significantly superior to all other treatments. T2 (Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting) T3 (Imidacloprid 200 SL 0.005% in transplant water) were the next best treatments and they remained on par with each other and significantly superior to the rest. All other

treatments remained on par with untreated control. At 30 DAP T5 (T2 + FS of Imidacloprid 200 SL 0.005% 5 DAT) recorded least plant mortality (3.5%) followed by T2 (Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting) (7.01%) and T3 (Imidacloprid 200 SL 0.005% in transplant water) (8.49%). Rest of the treatments remained on par with untreated control (24.01%).

Data on yield parameters showed that T5 recorded highest cured leaf yield (2040 kg/ha) followed by T2 (2010 kg) and T3 (1980 kg/ha) which were on par with each other. Similar trend was observed as regards bright leaf yield and grade index.

Efficacy of new fungicides for the management of Frog eyespot disease in Tobacco caused by *Cercospora nicotianae* (CTRI, Rajahmundry) U. Sreedhar and S. K. Dam

The efficacy of certain new fungicides in suppressing the frog eye spot incidence in FCV tobacco was evaluated in a replicated field experiment.

Influence of different treatments on Percent Disease Index (PDI)

Application of pyraclostrobin + metiram 55 WG @ 0.2% and carbendazim 50 WP @ 0.05% sprays were superior to the rest of the fungicide treatments in suppressing the PDI (21.00 and 21.43), respectively. Among the other propiconazole 25 EC @ 0.1% and kresoxim methyl 44.3 Sc @ 0.1% were on par and superior to azoxystrobin 23 SC @ 0.01% (23.96).

Influence of different treatments on green leaf, cured leaf yield and grade index

The maximum green leaf yield 13025 kg/ha was recorded in plots which received the spray of kresoxim methyl (T₃) @ 0.1 per cent followed by 12101 kg/ha in carbendazim @ 0.05 per cent. Whereas, the maximum cured leaf yield of 2050 kg/ha was recorded in plots which received the spray of pyraclostrobin + metiram @ 0.2% followed by carbendazim @ 0.05%. The application of pyraclostrobin + metiram recorded maximum grade index of 842 kg/ha followed by carbendazim and azoxystrobin 727 kg/ha when compared to control (587 kg/ha).

In vitro test:

Among the five fungicidal compounds evaluated against *Cercospora nicotianae*, all were found inhibitory to the fungus with varied degree of inhibition. The results indicate that out of the five fungicides evaluated against the test pathogen, carbendazim was the most effective as it checked 100% growth of fungus at all the concentrations followed by pyraclostrobin + metiram at 500 ppm, propiconazole and kresoxim methyl at 1000 ppm concentrations, respectively. Azoxystrobin was found to be the most effective only at 2000 ppm concentration.

Validation of IPM module against tobacco aphid, *Myzus nicotianae* (CTRI RS, Guntur) **P. Venkateswarlu**

A replicated trial was conducted to know the efficacy of an entomopathogenic fungus, *Verticillium lecanii* on tobacco aphid *Myzus nicotianae* Blackman under CBS conditions. *V. lecanii* @ 0.5% exhibited 34.86% reduction of aphid population. Imidacloprid sprayed at 50 days and thiomethaxam at 60 days after planting gave 80.75% protection. The per cent reduction of infested plants in different treatments over untreated control ranged from 1.12 to 25.80. In control plot, the aphid infested plants were 12.40% at 10 days after second spray, where as it was 9.20% in chemical control plot and 11.85 to 12.26% in *V. lecanii* treated plots. *V. lecanii* at all the doses was at par with untreated control in reducing aphid infestation.

Management of *Bemisia tabaci* in FCV Tobacco (CTRI RS, Kandukur) **K.C. Chenchiah**

An experiment was conducted with and without Jowar as barrier crop with four treatments viz., 1) NSKS 5% spray + Imidocloprid spray at 15 & 30 days 2) NSKS 5% spray + Thiamethoxam spray at 15 & 30 days 3) NSKS 5% spray + diafenthiuron spray at 15 & 30 days 4) NSKS 5% spray and Spirotetramat + Imidocloprid spray at 15 & 30 days and 5) untreated control. Jowar as border crop with application of NSKS 5% spray and spirotetramat + imidocloprid at 15 & 30 days after planting significantly reduced the whitefly infestation with higher yields as compared to other treatments.

Integrated management of root knot nematodes and soil borne fungal diseases in FCV tobacco nursery (CTRI RS, Hunsur) **S. Ramakrishnan**

Results revealed that, integrated application of *Trichoderma viride* & *Paecilomyces lilacinus*, *Trichoderma viride* and *Pochonia chlamydosporia* along with ridomil and furadon in solarised nursery beds were on par with each other in recording 40.5 and 41.3 per cent increased healthy seedling count compared to check. Similarly, both the effective treatments recorded decreased root knot index to the tune of 46.7 and 50.0 percent respectively and also decreased damping-off, blight disease incidence in nursery beds to the tune of 63.3 percent over untreated check.

Evaluation of bio-agents enriched tray seedlings against Root Knot Nematode-Fusarium wilt disease complex in FCV tobacco field crop (CTRI RS, Hunsur) **S. Ramakrishnan**

Results showed that, *T. viride* (50 g) + *P. lilacinus* (50 g) enriched tray seedlings, *T. viride* (50 g) + *P. chlamydosporia* (50 g) enriched tray seedlings and *T. viride* (30 g) + *P. lilacinus* (30g) + *P. chlamydosporia* (30g) were on par with each other in increasing the Cured Leaf Yield by 9.33, 11.7 and 11.8 per cent respectively over check. These effective treatments also decreased the root knot index by 48.4, 48.7 and 52.5 per cent respectively and decreased the wilt disease incidence by 52.8, 53.6 and 51.0 per cent respectively over check. Whereas, the chemical control schedule, furadon + carbendazim at the time of planting was found to be the best in decreasing the Fusarium wilt disease by 59.6 per cent over check under field conditions.

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

The results indicated that disease reaction to hollow stalk in *Motihari* tobacco in terms of linear measurement (cm) was checked in all the treatments in comparison to control. In main plots treatments were found to be non-significant. In sub-plots, the disease reaction was found to be significant over control.



treatment of bio inoculant recorded less disease followed by immuno-modulant and Kocide.

V. (C) Screening of Host plant resistance to insect pests and diseases

Studies on constitutive and induced defence in *Nicotiana Sp.* against herbivory by *Spodoptera litura*, *Helicoverpa armigera* and *Spodoptera exigua* (CTRI, Rajahmundry) J.V. Prasad, U. Sreedhar & S. Gunneswara Rao

The hexane, chloroform and methanol extracts of *N. glauca*, DWFC and *N. trigonophylla* did not show either antifeedant or contact toxicity against the test insect *S. litura*. The dichloromethane leaf surface wash of *N. glauca* proved toxic to the neonate larvae of *S. litura* at 5000 ppm concentration. The insects died mostly because of gumming of mouth parts and inability to move on the treated surface. The DCM wash of leaf of DWFC and *N. trigonophylla* did not have similar effect on the test insect.

Evaluation of FCV germplasm for tolerance to aphid, *M. Nicotiana* (CTRI RS, Kandukur) K.C. Chenchiah

The test entries, R-148, R-149 and R-152 recorded a Damage rating (DR) of 1 while others have recorded 2 to 4. Lowest aphid infested plants (37.7 %) were recorded in the test entry R-188. Lowest % aphid damaged leaves was recorded in R-188 (16.2%) and R-193 (17.4%) while other test entries recorded high leaf damage. The damage rating was low (1) in R-188 under both natural and artificial conditions. In artificial inoculation, all the test plants recorded 2 or higher DR and all the plants inoculated were damaged by the aphid. The test line R-118 differed significantly with Hema and at par with VT-1158 and Siri to all yield parameters and recorded low (1) damage rating.

Evaluation of FCV tobacco germplasm for the tobacco caterpillar tolerance (CTRI RS, Kandukur) K.C. Chenchiah

The results indicated that the test lines, R-188, R-193, R-68 and R-176 are less damaged

by the insect. The % leaves damaged are less in R-188, R-193 and R-176. All the above three test lines have low damage rating (1) when compared to the checks. Two promising caterpillar tolerant lines identified during 2012-13 were evaluated for yield parameters. The results showed that the test line R-130 is significantly superior to Hema and VT-1158 and at par with Siri with respect to all the yield parameters except grade index. The test line R-130 is superior to Hema with respect to green leaf and cured leaf but it is superior to VT-1158 also in case of bright leaf and grade index. The test line, R-148 recorded low damage rating for caterpillar.

Screening of tobacco germplasm against root-knot nematodes (CTRI RS, Hunsur) S. Ramakrishnan

A total of 27 advanced breeding were subjected to intensive screening against root-knot nematodes under sick field conditions. Experimental results revealed that the materials viz., FCR-15, FCR-16, FCR-21, FCR-22, FCI-14 and NLST 4 recorded RKI of d" 1.0 and were found most 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. Mandi

Screening for resistance to hollow stalk in *N. rustica* germplasm accessions

Screening for resistance to hollow stalk under artificial conditions was carried out in sick plot zone for six crosses viz. Bengthuli x Dharla, Bengthuli x DD-437, Bengthuli x WhitePathar, White Pathar x DD-437, White Pathar x Dharla and White Pathar x Bengthuli. The crosses Bengthuli x DD-437 and Bengthuli x Torsa was found to be better as they exhibited disease reaction of 3.96 cm and 5.03 cm respectively. Two crosses viz. Bengthuli x White Pathar and White Pathar x Torsa measured up to 12.8 and 11.9 cm, respectively which was maximum and treated as susceptible.



Technology Assessed and Transferred

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

Evaluated TBST-2 in SBS & SLS areas: On-farm trials were conducted for two consecutive seasons in SLS & SBS areas to evaluate the performance of ABL TBST-2 with control cv. Siri. Adopted all good agricultural practices in both the experimental and control plots. Data were collected on incidence of pests and diseases, morphological characters, yield, quality, benefit-cost ratio, acceptability to farmers and farmers' feedback.

Cured leaf yield: Higher cured leaf yields were recorded in TBST-2 both in SBS (2799 kg/ha) and SLS (2189 kg/ha) which was 13.8% and 15.03% higher than control cv. Siri (2458 & 1903 kg/ha) in both SBS and SLS respectively. Also, TBST-2 has exhibited 100% resistance to TMV as well as tolerance to tobacco aphid.

Leaf quality parameters indicated that there are perceptible variations in leaf quality parameters (nicotine, reducing sugars) of TBST-2 and control cv. Siri. TBST-2 recorded markedly higher BCR i.e. 1.64 over control cv. Siri (1.52) in SBS while TBST-2 recorded higher BCR i.e. 1.52 over control cv. Siri (1.39) in SLS. Good establishment and fast growth, increased harvest interval of 4 more days, short internodal length, resistant to TMV, more leaf length and more yields in TBST-2 are the desirable characteristics and acceptable to all situations as opined by the farmers.

Front Line Demonstrations and On Farm Demonstrations (CTRI, Rajahmundry) Y. Subbaiah

Front Line Demonstrations were conducted on Integrated weed management practices in FCV tobacco grown under irrigated alfisols. Analysis of data showed that the application of Quizalofop-ethyl at 15 and 75 DAP + Intercultures recorded higher BCR (1.42) over hand weeding + Intercultures (1.37). Farmers' have indicated that the weedicide Quizalofop-ethyl controlled grassy weeds only. Plantations

with tray seedlings may not require the weedicide at 15 DAP as intercultures are taken up at 7-8 DAP. In areas where intercultures are undertaken at 8-10 DAP, application of weedicide at 15 DAP is not required. Under such conditions, weedicide application may be taken up at 50-55 DAP.

Computational Algorithms for Micro-RNA Prediction in Plants [CTRI, Rajahmundry] H. Ravisankar, K. Prabhakara Rao, K. Sivaraju and K. Sarala

An algorithm has been designed for prediction of miRNA. As a part of the pipeline, software modules for generating RNA secondary structure, structure of RNA in XML format, RNA structure in pictorial view was developed using shell scripting by imposing various constraints viz., 1) miRNA should be a part of hairpin 2) miRNA length is approximately 21nt and should start from 41st position. 3) The length of hairpin of good miRNA is > 50 nt. Built-in modules viz., samtools and mfold are used in the scripting for generating RNA secondary structure in graphical form and in XML format. These modules were executed with the representative tobacco genome survey sequences and the above structures can be retrieved which are considered as an input for predicting miRNA and generated the output file.

Expert System for Dairy Cattle Management [CTRI, Rajahmundry] H. Ravisankar and V.S.G.R. Naidu

Software development has been completed with user friendly menus for instant accessing of the information on selected parameters viz., Feeding, breeding, diseases, cattle shed management, milking, fodder cultivation and health management related to dairy cattle management. Knowledge base was created with 55 parameters and is classified into 7 modules. The developed system will allow the user to add / modify / access the information on various parameters related to dairy cattle and the displayed report will be exported to Microsoft word for storing and a hard copy of the same can be taken.



ICAR-CTRI Tribal Sub-Plan

As a part of Tribal sub plan of ICAR-CTRI (2014-15) Seethappagudem panchayat in West Godavari district of Andhra Pradesh was identified for implementation of Agri-Intervention action plan with a total financial outlay of Rs.10 lakhs. Five hamlets viz., 1. Seetappagudem 2. Lankalapalli 3. Rachuru 4. Kummarigunata and 5. Pedakapavaram were selected for implementation of identified technological interventions. Through agro-ecosystem analysis and also in consultation with villagers problems were identified, prioritised and suitable technological interventions were identified which includes:

1. De-silting of water pond at Seetappagudem village to enhance the water storage capacity for its efficient use in agriculture and allied activities like cattle rearing and fisheries.



De-silted pond



Water storage in De-silted pond

2. Grain storage structures for reducing the storage losses of farm produce



Grain storage in mud structure



Permanent grain storage

3. Agricultural implements and plant protection equipment to enhance production efficiency - their demonstration and supply



Plant protection equipment



Maize sheller

4. Tray nursery technology or healthy seedling production in FCV tobacco



Tray nursery in FCV tobacco

5. Rejuvenation of horticultural crops through supply of seedlings/ grafts for effective land use.



Cashew seedlings

6. Skill oriented vocational income generation programmes for improvement of the family income



Palmyrah fibre separator

7. Promotion of backyard poultry for enhancing the off-farm income and nutritional security in tribal families



Vanaraja poults for backyard poultry

8. Capacity building on improved agricultural practices and training programmes.

All the technological interventions were implemented and impact analysis will be taken up in 2015.

ASSESSMENT OF HUDHUD CYCLONE IMPACT ON CROPS AND FARM STRUCTURES IN ANDHRA PRADESH

The Hudhud cyclone characterized by heavy wind and moderate rains hit coastal areas of Andhra Pradesh on 12th October 2014 and caused huge damage to various crops and farm structures and affected Vishakhapatnam, Vizianagaram, Srikakulam and parts of East Godavari Districts of AP.

In response to Hon'ble DDG (NRM), ICAR, New Delhi and in consultation with the Hon'ble Vice Chancellors of ANGRAU, Hyderabad and YSR Horticultural University, Venkataramannagudem, A. P., the Central Tobacco Research Institute coordinated the visit of the scientific teams to Hudhud cyclone hit areas of Andhra Pradesh for assessing the nature and extent of damage to crops and farm structures, and suggest crop specific advisories to farming community for mitigating the adverse effects of the cyclone. Three teams were constituted with the scientists representing different disciplines from all the ICAR Institutes located in Andhra Pradesh and Telangana. These teams visited the Hudhud cyclone affected districts of Srikakulam, Vizianagaram and Visakhapatnam, and parts of East Godavari in Andhra Pradesh during 14-17 October 2014. While working in close collaboration with officials from SAU/ SHU, line departments, Krishi Vignana Kendras and DAATT centres, the scientific teams from ICAR institutes assessed the nature and extent of damage to crops and farm structures, and suggested crop specific advisories to farming community for mitigating the adverse effects of the cyclone. On completion of the visit, the scientific teams gave the reports on the cyclone impact and also made some crop specific advisories to the farming community. The key observations on the assessment of the impact of the cyclone include:

- The Hudhud cyclone of 12th October, 2014, characterised by high speed winds (160-180 km/h) and rainfall (100 - 277 mm), inflicted a severe damage to crops and farm structures in Srikakulam, Vizianagaram, Vishakhapatnam and some parts of East Godavari Districts of Andhra Pradesh.

- Field crops viz., Paddy, Sugarcane, Red gram, Maize, Cotton, burley tobacco; horticultural crops Coconut, Cashew, Oilpalm, Banana and Papaya were affected to varying degree.



Sugarcane crop damage in Hudhud

- The crops nearing to harvest were the ones that experienced the maximum damage and economic loss to the farmers.
 - In addition to its affect on agricultural and plantation crops, the cyclone also resulted in uprooting of many avenue trees.
 - Farm structures including animal sheds, agro-processing units, tobacco curing structures, power transmission systems of farm lands were reported damaged in many places.
 - Thatched poultry sheds were completely damaged due to heavy winds and bird mortality was as high as 100% in some cases.
- The team also suggested some corrective measures in different districts.



Coconut crop damage in Hudhud



Infrastructure damage in Hudhud



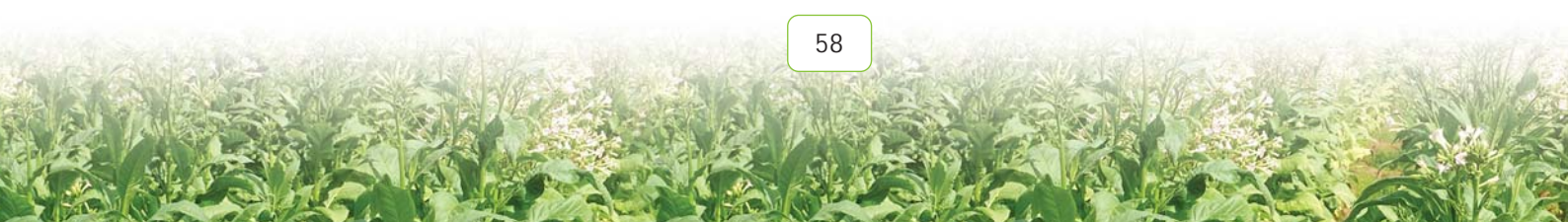


Education and Training

Central Tobacco Research Institute has organized / participated in different extension activities viz. ., training programmes, Scientist-farmer interface meetings, field days, exhibitions, workshops and group meetings. Added emphasis has been accorded for collaborative activities with Tobacco Board, Tobacco Industry and State Agricultural Universities to achieve enhanced productivity, quality and profitability in the real farm situations.



- Training to farmers - 8
 - Training to ARS scientist trainees- 1
 - Field visits 4
 - Diagnostic visits - 4
 - Field Friends Programmes- 39
 - Interactive meetings - 2
 - Farmer discussions - 2
 - Demonstrations - 15
- One day Interactive Training Programme was held on 22.04.2014 at CTRI RS Hunsur with Tobacco Board officials and Trade on research and development activities for 2014-15 crop season.
 - Interaction meeting held with the scientists of Sericulture CSRTI, Mysore on sericulture as alternative crop in ten tobacco growing regions of Karnataka on 27.05.2014
 - One day training programme was held in collaboration with tobacco board and trade / industry on 05.06.2014 at CTRI Hunsur for farmers on drought management in KLS area
 - One day interaction meeting was held with Director (Auctions) Tobacco board, Bangalore and Regional manager, Tobacco Board, Mysore and Periyapatna on improving the Productivity performance and quality of KLS tobacco at CTRI RS Hunsur on 22.07.2014
 - One day farmers training programme on" Tobacco Nursery Management" was conducted at CTRI Regional Station, Vedesandur on 12.08.2014, About 50 farmers attended the training from the nearby villages of Dindigul Dist.
 - Scientists of CTRI participated in the CM-FARMERS Interface held on 16.07.2014 at Kamavarapukota, W.G. Dist. Sri N. Chandrababu Naidu, Hon'ble Chief Minister of Andhra Pradesh Inaugurated the exhibition put up by the different Line Depts. of State Dept. of Agriculture, YSR Horticultural University, RARS & APRRI, Maruteru.
 - Tobacco Board, Guntur has organized an Interaction Session with the Scientists of CTRI, ITC, Trade members on 07.08.2014 at 11.00 AM in the Seminar Hall of CTRI to discuss the focus areas for improving yield and quality of tobacco. The Chairman, Tobacco Board, Guntur attended the meeting.
 - Interaction Session with the Scientists of CTRI, ITC, trade members are arranged on 07.08.2014 at 11.00 AM in the Seminar Hall of CTRI to discuss the focus areas for improving yield and quality of tobacco.



- The Scientists and Technical Officers of CTRI, Rajahmundry and Research Stations, Guntur, Kandukur were nominated in the Field Friends Teams being implemented by the Tobacco Board, Guntur during 2014-15 Crop season in Andhra Pradesh. The teams along with Tobacco Board Officers and Executives from the trade visited the tobacco nursery areas and farmers' main fields and advised on various matters. The Field Friends programme was implemented in the areas of Devarapalli, Gopalapuram, ELS area of Odisha state, E.G. NLS & Thorredu, Koyyalagudem, Jangareddygudem-I & II, & Ongole-I, Vellampalli- I & II auction platforms (SBS + CBS), Ongole II and Tangutur I & II auction platforms (SBS), Kondepi, Podili - I & II, Kandukur - I & II, Kaligiri and D.C. Palli.



S.N.	Resource person	Training imparted	Date and place
1	S.Ramesh	Nursery management	28.04.2014 at Kundenahally
2	Dr. M.Mahadevaswamy	Nursery management	28.04.2014 at Karnekuppe, Sattigala
3	Dr. S.S.Sreenivas	Nursery management	29.04.2014 at Lakkikuppe, Dadadahalli
4	Dr. C.Mahadeva	Nursery management	29.04.2014 at Thippalapura, Nagamangala
5	Dr. M.Mahadevaswamy	Nursery management	30.04.2014 at Somanahalli, Chibukuru
6	S. Ramesh	Field crop management	28.05.2014 at B. Mattikere
7	S. Ramesh	Field crop management	31.05.2014 at K.M.halli Hittenahalli
8	Dr. S.Ramakrishnan S. Ramesh Dr.S.S.Sreenivas	Field crop management in Model project area	02.06.2014 at Mantikoppal
9	Dr. S.Ramakrishnan S. Ramesh	Field crop management in Model project area	05.06.2014 at Rajegowdanhalli
10	S. Ramesh	Field crop management in Model project area	06.06.2014 at Abburu Komalapura, Hunsekoppa Muddenahalli
11	Dr. M. Mahadevaswamy	Field crop management	10.06.2014 at Aduguru, Hittenahalli
12	S. Ramesh	Field crop management	11.06.2014 at G.B.halli, Kundenahalli
13	Dr. M. Mahadevaswamy	Field crop management	13.06.2014 at Malangi, A.N.Halli
14	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	PHPM programme	16.06.2014 at Teliginakoppalu

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S.N.	Resource person	Training imparted	Date and place
15	Dr. S. Ramakrishnan S. Ramesh Dr. S.S. Sreenivas	Field Crop management in Model project Area	17.06.2014 at Mantikoppal, Budanor, Bolenahalli
16	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	CPA & PHPM programme	19.06.2014 at Nagenalli
17	Dr. M. Mahadevaswamy	Guest lecture on IFS for income augmentation in the ISDS training programme	23.06.2014 at Regional Sericulture Research Station, CSR&TI, (CSB) Chamarajnagar
18	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	Farmers' Training programme and Interaction (Field Crop management)	14.07.2014 at Nellur Pala
19	Head, Scientists and Technical Officers	Interaction meeting with Chairman Tobacco Board	15.07.2014 at CTRI RS, Hunsur
20	Head, Scientists and Technical Officers	Technical Interactive session on Yield, Quality, CPA and NTRM issues in FCV tobacco crop organized by Tobacco Board	22.07.2014 at CTRI RS, Hunsur
21	Dr. S. Ramakrishnan Dr. S.S. Sreenivas	Field visit and Farmer interaction on field crop diseases	24.07.2014 at Abdsur, Malangi and Boosanalli
22	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	Scientific Advisory Committee meeting of KVK, Suttur	25.07.2014 at KVK, Suttur, Mysore District
23	Head, Scientists and Technical Officers	Farmers' study tour (Ramanathapura 63)	25.07.2014 at CTRI RS, Hunsur
24	Head, Scientists and Technical Officers	Farmers' study tour (Kampalapura Platform 61 & 62)	26.07.2014 at CTRI RS, Hunsur
25	Head, Scientists and Technical Officers	Farmers' study tour (Periyapatna PF 6)	28.07.2014 at CTRI RS, Hunsur
26	Dr. C.Chandrasekhara Rao Dr. K. Nageswara Rao Dr. Y. Subbaiah Dr. G. Raghupathi Rao	Meeting/ interaction on Good Agricultural Practices, CPA and other issues	02.08.2014 at, Devarapalli

S.N.	Resource person	Training imparted	Date and place
27	Dr. C. Mahadeva	Training programme on PHPM, CPA and NTRM issues and MPA area	04.08.2014 at Rampura and Keregodu
28	S. Ramesh	Training programme on PHPM, CPA and NTRM issues	05.08.2014 at Chittenahalli and Chennenahalli
29	S. Ramesh	Training programme on PHPM, CPA and NTRM issues	11.08.2014 at M.M.Koppalu, Melur.PF.5 and. Sangasetty halli
30	S. Ramesh	Training programme on PHPM, CPA and NTRM issues	12.08.2014at Mardur
31	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	CPA & PHPM programme	14.08.2014at Naganahalli
32	S. Ramesh	Topping , desuckering PHPM,CPA issues	18.08.2014 at Muddanahalli
33	S. Ramesh	Topping, desuckering PHPM,CPA issues	18.08.2014 at Kuppe
34	Dr. S. Ramakrishnan Dr. M. Mahadeva	OFT/Field day	19.08.2014 at Kellur
35	Dr. M. Mahadevaswamy	Topping , desuckering PHPM,CPA issues	19.08.2014 A at H.D.Kote
36	Dr. S. Ramakrishnan S. Ramesh Dr. C. Mahadeva Dr. S.S. Srinivas	Interaction programme on Prod. Technology of FCV tobacco in KLS for Management Trainees of Alliance One Tobacco Company, Guntur	20.08.2014 at CTRI RS, Hunsur
37	Dr. M. Mahadevaswamy	Topping , desuckering PHPM,CPA issues	20.08.2014 at Ramanathapura
38	S. Ramesh	Field day	21.08.2014 at Muddanahalli
39	Dr. C. Mahadeva	Field day	21.08.2014 at Margowdanahalli Kattemalawadi
40	Dr. M. Mahadevaswamy	Field day	21.08.2014 at PenjahalliNaganahalli



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S.N.	Resource person	Training imparted	Date and place
41	Dr. M. Mahadevaswamy	Field day	26.08.2014 at Arenahalli
42	Dr. S. Ramakrishnan Dr. C. Mahadeva	Field day	26.08.2014 at N.D.G.Koppal
43	S.Ramesh	Field day	26.08.2014 at Adaganahalli PF 64
44	S. Ramesh	Field day	27.08.2014 at HK halli
45	Dr. S.Ramakrishnan Dr. M. Mahadevaswamy	Field day	27.08.2014 at Mantikoppal
46	N. Aruna Kumari	Seed bed preparation, nursery management, pest & disease control in seed beds	08-9-2014 at Devarapalli
47	Dr. M. Nageswara Rao	Seed bed preparation, nursery management, pest & disease control in seed beds	08.9.2014 at Koyyalagudem
48	I. Jagadish Chandra	Seed bed preparation, nursery management, pest & disease control in seed beds	08-9-2014 at Jangareddygudem-II
49	K. Sesha sayi	Seed bed preparation, nursery management, pest & disease control in seed beds	09.09.2014 at Jangareddygudem-I
50	J. Siva sai	Seed bed preparation, nursery management, pest & disease control in seed beds	09.09.2014 at Thorredu
51	I. Jagadish Chandra	Seed bed preparation, nursery management, pest & disease control in seed beds	10.09.2014 at Gopalapuram
52	Dr. L.K. Prasad	Farmers Training on Tobacco Nursery Management & field visit	11-09-14 at Ponduru, Tangutur-II
53	Dr. K.C. Chenchiah	Farmers Training on Nursery manage and IPM	11.9.14 Chinarikatla, Podili-I
54	S. Ramesh	MPA	11.09.2014 at Hittnahalli

S.N.	Resource person	Training imparted	Date and place
55	Dr. K.C. Chenchaiiah	Farmers Training on poly treys and sprinkler irrigation in nurseries and IPM	16.9.14 Pydipadu, Kondepi
56	Dr. K.C. Chenchaiiah	Farmers Training on Tobacco Nursery Management	16.09.14 Gorlamitta- Tangutur-II
57	Dr. K.C. Chenchaiiah	Farmers Training on Tobacco Nursery Management	17.09.14 Chirrakurapadu-Tanguturu-I
58	Dr. L.K. Prasad	Farmers Training on Tobacco Nursery Management & field visit	18.09.14 atChodavaram, Tangutur-I
59	Dr. K.C. Chenchaiiah	Farmers Training on Tobacco Nursery growing with new Management practices	24.09.14 Peridepi- Kondepi
60	Dr. K.C. Chenchaiiah	Farmers Training on Tobacco Nursery growing with new Management practices	24.09.14 Chirrakurapadu-Tanguturu-I
61	S. Ramesh	Model project area	25.09.2014 at Maragowdanahally
62	Dr. K.C. Chenchaiiah	Farmers Training on Tobacco Nursery growing with new Management practices	25.09.14 Kandukur-I
63	Dr. M. Mahadevaswamy	PHPM in Model project area	01.10.2014 at J.D. Koppal area
64	Scientists and Technical Officers CTRI RS, Hunsur	Interaction on FCV tobacco production practices in KLS with Members of Tobacco Industry&Marketing board (TIMB), Zimbabwe	09.10.2014 at CTRI RS, Hunsur
65	Dr. M. Anuradha	Good Agricultural Practices	10.10.2014 & 28.10.2014 at Thorredu
66	Dr. Y. Subbaiah	Good Agricultural Practices	13.10.2014 & 29.10.2014 at Devarapalli



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S.N.	Resource person	Training imparted	Date and place
67	Dr. K.C. Chenchaiyah	Farmers Training on IPM in FCV Tobacco	13.10.14 Muppavaram- Kondepi
68	Dr. K. Nageswara Rao	Good Agricultural Practices	14.10.2014 & 30.10.2014 at J.R. Gudem - I 16.10.2014 & 31.10.2014 at J.R. Gudem-II
69	Dr. L.K. Prasad	Farmers Training on Fertiliser use, interculture, IPM and irrigation & field visit	16.10.14 at Chavatapalem, Kandukur-I
70	Dr. K.C. Chenchaiyah	Farmers Training on IPM in FCV Tobacco	16.10.14 Dharmavaram-Kondepi & Kattubativaripalem-Tangutur-I
71	Dr. S.V. Krishna Reddy	Good Agricultural Practices	17.10.2014 & 03.11.2014 at Koyalagudem
72	Dr. L.K. Prasad	Farmers Training on Fertiliser use, interculture, IPM and irrigation	21.10.14 at Petluru, Kondepi.
73	Dr. K.C. Chenchaiyah	Farmers Training on IPM in FCV Tobacco	21.10.14 Gundlasamudram & Kellampally - Podili-I
74	S. Ramesh Dr. C. Mahadeva	Farmers' study tour (Kampalapura Platform, 61 & 62)	22.10.2014 at CTRI RS, Hunsur
75	Dr. K.C. Chenchaiyah	Farmers Training on Fertiliser use, interculture, IPM and irrigation	31.10.14 Pedakallagunta-Kondepi
76	Dr. P. Venkateswarlu	Nursery management in SLS & SBS	17.09.2014 at Korisapadu
77	Dr. P. Venkateswarlu	Nursery management in SLS & SBS	18.09.2014 at Doddavaram
78	Dr. S. Kasturi Krishna	Good Agricultural Practices	20.10.2014 & 04.11.2014 at Gopalapuram
79	Dr. K.C. Chenchaiyah	Mechanization and IPM	21.11.14 Ponnaluru- Kandukur-I
80	Dr. G. Raghupathi Rao	C.P.A. training programme	11.12.2014 at Vadisaleru
81	Dr. K.C. Chenchaiyah	Farmers Training on topping and sucker control	12.12.14 Narasarajupalem-Kondepi

S.N.	Resource person	Training imparted	Date and place
82	Dr. S. Kasturi Krishna Dr. K. Nageswara Rao, Dr. G. Raghupathi Rao,	Growers Awareness Meeting on Good Agricultural Practices, Crop Protection Agents, INM, IPM in tobacco	18.12.2014 at Jeelugumilli
83	I. Jagadish Chandra	Training programme on Topping and Desuckering	18.12.2014 & 23.12.2014 at Katavaram (v) & Muggulla (v)
84	Dr. K.C. Chenchiah	Work shop for progressive farmers of SLS Region on GAPs	23.12.14 at AF-26, Kandukur
85	Dr. K.C. Chenchiah	Farmers Training on Topping and sucker control	24.12.14 Chiowtapalem- Kondepi
86	Dr. P. Venkateswarlu	IPM in SLS & SBS tobacco	06.01.2015 at Naguluppalapadu
87	Dr. K.C. Chenchiah	Harvesting, grading, PHPM and orabanchee control	07.01.15 Vardhinenivaripalem-Kondepi
88	Dr. K.C. Chenchiah	Topping and de-suckering, curing, grading, PHPM and field visit	08.01.15 Chintalapalem-Tangutur-I
89	Dr. K.C. Chenchiah	OFT-TBST-2 and field visit	09.01.15 Konakanmitla- Podili-I
90	Dr. L.K. Prasad	Farmers training on Topping and de-suckering, curing, grading, PHPM and field visit	12.01.15 at Konijedu, Tangutur-II
91	Dr. L.K. Prasad	Farmers training on soil sustainability in agriculture practices in FCV Tobacco	28-01-15 at Tobacco Board, Ongole
92	Dr. L.K. Prasad	Farmers training on soil sustainability in agriculture practices in Vinukonda Burley Tobacco	29-01-15 at Tobacco Board, Ongole
93	Dr. P. Venkateswarlu	Field day on HDBRG tobacco	31.01.2015 at Yeddanapudi

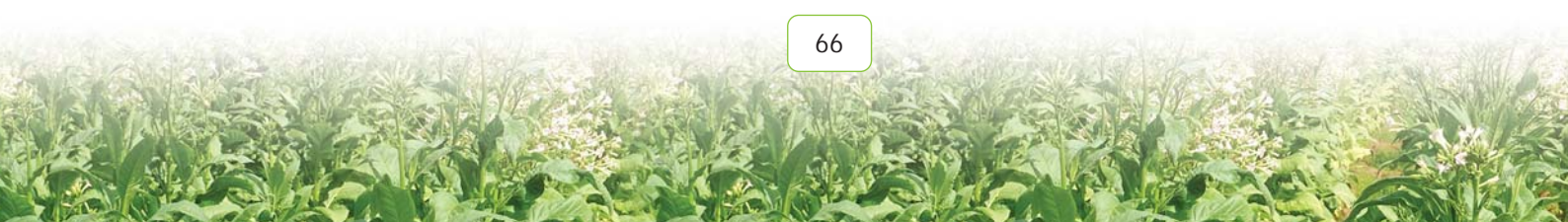




S.N.	Resource person	Training imparted	Date and place
94	Dr. L.K. Prasad	Topping and de-suckering, curing, grading, PHPM and field visit	08.02.15 at Mahadevapuram-Kandukur-I
95	Dr. P. Venkateswarlu	Field day on TBST-2 variety	11.02.2015 at Korisapadu village of Vellampalli-2 APF
96	Dr. P. Venkateswarlu	Field day on VT-1158 variety	13-02-2015 at Vithalapuram of Vellampalli - 1 APF
97	Dr. K.C. Chenchiah	Field Day on TBST-2	23.02.15 Naldalapur- Kandukur-II
98	Dr. P. Venkateswarlu	Field day on TBST-2 variety	23-02-2015 at Rudravaram village of Ongole-1 APF
99	Dr. Y. Subbaiah	Field day on TBST-2 variety	25.02.2015 at Raghudevapuram
100	Scientists and Technical officers	Training programme on Nursery management for selected farmers of KLS in collaboration with Krsihi Vigyana vedike, Mysore	11..03.15 at CTRI RS Hunsur
101	Scientists and Technical officers	Training programme on GAP in Tobacco for seasonal and Tobacco Board field assistants	16.03.2015 at CTRI RS Hunsur

RADIO TALKS

S.No.	Name	Topic, Date of broadcast & Station
1.	R. Sudhakar	Coir industry as an self-employment avenue (AIR, Visakhapatnam; 17.04.2014)
2.	Dr. P.V. Venugopala Rao	High yielding FCV tobacco varieties for higher yields (AIR, Visakhapatnam; 26.05.2014)
3.	E. Vijaya Prasad	Virus diseases in Papaya- control measures (AIR, Visakhapatnam; 05.07.2014)
4.	E. Vijaya Prasad	Package of practices for cultivation of chillies (AIR, Vijayawada; 22.7.2014)
5.	Dr. U. Sreedhar	Safe and judicious use of pesticides (AIR, Visakhapatnam; 27.08.2014)



S.No.	Name	Topic, Date of broadcast & Station
6.	M. Nageswara Rao	Improved production technology for FCV tobacco production(AIR, Visakhapatnam; 09.11.2014)
7.	J. Poorna Bindu	Soils suitable for Virginia tobacco production and integrated nutrient management (AIR, Visakhapatnam; 21.11.2014)
8.	Dr. Y. Subbaiah	FCV tobacco cultivation- present problems - Farmer's welfare programmes (AIR, Visakhapatnam; 14.12.2014)
9.	J.V.R. Satyavani	Insect pest and diseases management in cashew and mango at flowering and fruit-set stages (AIR, Visakhapatnam; 19.12.2014)
10.	V.V. Lakshmi Kumari	Preparation of value added products from minor millets (AIR, Visakhapatnam; 20.12.2014)
11.	Dr. S.V. Krishna Reddy	Improved package of practices for production of quality FCV tobacco (AIR, Visakhapatnam; 25.12.2014)
12.	Dr. K.C. Chenchiah	Management of Insect pests and Diseases in FCV Tobacco 26.12.2014
13.	E. Vijaya Prasad	Scenario of chilli cultivation in Southern Andhra Pradesh -Improved farming methods (AIR, Visakhapatnam; 07.01.2015)



Field visits

- Dr.D. Damodar Reddy, Dr. C.C.S. Rao and Dr. Y. Subbaiah visited Sri Bondala Reddaiah farm, Achiahpalem village, W.G. Dist. on 11.04.2014 and examined the advantages of curing barn modified by the farmer with respect to energy & time saving.
- Dr. Y. Subbaiah visited SLS & SBS areas. Interacted with farmers of varietal OFT plots and obtained farmers feed back about the performance of promising Line TBST-2.

Krishi Vigyan Kendra

Kalavacharla

Major Achievements:

- A total number of 12 On-Farm Tastings (OFTs) and 17 Front-line Demonstrations (FLDs) were conducted during the year 2014-15.
- In sugar cane, use of single budded nodes as seed material recorded 15% increased yield over the normal set planting. The cost of cultivation was also reduced by Rs. 30,000/ha.
- Bacterial Leaf Blight (BLB) tolerant RP Bio-226 (Improved Samba) variety of rice yielded 6.0 t/ha in Kharif against BPT-5204 (4.5t/ha).
- Different horticultural crops like Chilies, Elephant foot yam, Papaya, Guava, Tomato etc in Kadiam and Alamuru mandals were severely damaged by Snails. Effective control was obtained with bait (Jaggery 6 kg in 12 litres of water + 100 gm Methomyl + 25 kg wheat flour) and about 28% mortality was recorded.
- Skirting of banana bunches with 17 GSM non woven bags resulted in increase of bunch weight by 2 - 2.5 kg and early harvest by 7 days.
- Virus free selection of Coccinia planting material from farmer's field recorded 4 t/ha yield in 8 months compared to virus infested crop (1.5 t/ha).
- Direct feeding of nutrients (Cow dung, urea, sulphate of potash) to banana bunches resulted in quality and uniform fingers throughout the bunch.
- Introduced 'Osmanabadi' goats for breed improvement.
- Assessed the performance of Black Bengal goats. It was observed that population build up was quick due to regular twinning and often triplets also.
- Jodipi sheep introduced in the local flocks to reduce inbreeding. After 3rd generation

the progeny was almost similar to the Jodipi and were well adapted to the conditions.

- In collaboration with ATMA-East Godavari, CTRI-KVK promoted 10 milky mushroom units at Katheru, Konthamuru, Choppella, Dowlaiswaram, Chodavaram villages.



Milky mushroom training

- Coconut Husk Remover was demonstrated to about 200 coconut farmers in gangalakurru, Vilasavalli, Isukapudi, Ainavaripalem, Vanapalli, Pasarlupudilanka, Ambajipet and Mukkamala villages in East Godavari district.



Coconut husk remover

- Under Agri-Tech Refinement Programme of ATMA-East Godavari, KVK promoted one automatic coir 2-ply yarn making unit (Sri Vijaya Durga Coir Yarns) at S.T.Rajapuram of Rangampeta Mandal .

Technology Refinement :

- Palmyrah frond crusher machine:** To simplify the fibre extraction process in palm fibre production over Palmyrah fibre separator machine a frond crusher machine was developed.
 - Reduces stress in fibre extraction process
 - increases the fibre production by 15 %
 - increase the shelf life period of nails 20%

- b. **Motorised press mat Device:** To reduce the drudgery involved in making of coir door mats over pressing device. The existing pressing device was fitted with gear box and with the help of 2hp electric motor, the drudgery involved in tightening/pressing the mat was totally reduced. Further the production was increased by 25%.



Motorised press mat device

Collaborative Programmes:

- **Kisan Mela:** In collaboration with ATMA-East Godavari district, KVK organised 'Kisan Mela' during 30-3 March, 2015 at KVK, Kalavacharla.
- **Demonstrations on Cashew Apple Utilisation (May 2014):** Demonstrations on Cashew Apple Utilisation were organised at KVK, Kalavacharla on 8th, 12th, 14th and 16th May, 2014, in collaboration with Directorate of Cashewnut and Cocoa Development (DCCD), Cochin. Four batches of tribal women and youth (100 nos.) from Devipatnam, Rampachodavaram mandals were trained in preparation of various recipes of Cashew apple viz., Cashew apple jam, CA juice, CA chutney, pickle and chips.



Value addition to Cashew apple

- **Cashew Exposure Visit: (18.12.2014 to 22.12.2014):** KVK, Kalavacharla has organised exposure visit of cashew farmers from Andhra Pradesh to Cashew growing areas of Bhubaneshwar (Odisha) during 18-24 December 2014 with the financial support of Directorate of Cashewnut and Cocoa Development (DCCD), Cochin.



Exposure visit of Cashew farmers

- **Training Programme on Cashew:** Organized 'Training Programme on Cashew' during 7-9th January, and 2-4th February, 2015 at KVK, Kalavacharla in with the financial support of the Directorate of Cashewnut and Cocoa Development (DCCD), Cochin, Kerala. A total number of hundred (100) farmers in two batches of 50 participants each were trained in 'Improved Cashew Production Technologies'

Kandukur

- Organized Research-Extension-Farmers' Interface meeting on 'Crop Production and Allied Activities' on 4-08-2014 at KVK, Kandukur. 30 farmers from the KVK adopted villages (Mahadevapuram and Oguru), Asst. Director of Agriculture and Agricultural officer of Kandukur, PC, KVK, Darsi (ANGRAU), representatives of World Vision (NGO) have participated in this meeting. Awareness was created among farmers on fodder production, vegetable cultivation, rearing of backyard poultry and income generation activities for rural youth and women.
- Organized Awareness programme on Protray method of vegetable seedling production on 21 August 2014 at KVK, Kandukur.
- CO₄ variety of Napier bajra fodder introduced by the KVK in the district was well adapted by the farmers.



Awards and Recognitions



- ◆ ICAR, New Delhi has conferred 'Swami Sahajanand Saraswati Outstanding Extension Scientist Award - 2013 to Dr. K. Suman Kalyani, Pr. Scientist (Home Science), Ag. Extension for outstanding contribution in the field of Agricultural Extension on 29.07.2014 in connection with the 86th Foundation Day of ICAR.



- ◆ Dr. U. Sreedhar, Principal Scientist received Crystal National Agri Award 2014 for his exceptional contribution in enriching agricultural practices and outstanding contribution to agricultural research from Krishi Anusandhan and Kisan Vikas Foundation. The Award was presented by Hon'ble Union Agricultural Minister Sri Radha Mohan Singh and Hon'ble Union Minister for Rural Development & Transport Sri Nitin Gadkari on 27th August, 2014 at India Habitat Centre, New Delhi.



- ◆ Dr. K. Sarala, Principal Scientist received the award "Plant Biotechnologist-2014" and Dr. H. Ravisankar received "Computational Biologist-2014" at the

International Conference on "Biosciences : State of the art advancements conducted by Society for Education and Scientific Research on 11th Sept., 2014 at Kumarakom Kerala.



- ◆ Dr. U. Sreedhar, Principal Scientist has been honoured with Dr. R.P. Srivastava Memorial National Award for his outstanding contributions in the field of Entomology. The prestigious Award was presented to Dr. Sreedhar by Dr. N.K. Krishnakumar, DDG (Horticultural Science) on 26th November, 2014 at Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan.



- ◆ The research paper "Evaluation of insecticide application, technology for effective spray coverage on FCV tobacco" by Dr. G. Raghupathi Rao, Senior Scientist and Dr. U. Sreedhar, Principal Scientist was adjudged as best research paper at the International Conference on 'Changing Scenario of Pest Problems in Agri-Horti Ecosystem and their Management' held during 27-29 November, 2014 at Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan.

Linkages and Collaborations

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

1. Externally funded project Funded on “Reducing Wood Fuel Consumption in curing of FCV Tobacco” at CTRI RS, Hunsur,

sponsored by Western-Ghats Task Force, Department of Forest, Govt. of Karnataka

2. Two Collaborative projects are being conducted with ICAR-CRIDA, Hyderabad and ICAR-IASRI, New Delhi at ICAR-CTRI Research Station, Kandukur and ICAR-CTRI, Rajahmundry
4. Data were collected and submitted for the NAARM-IFPRI collaborative Research Project on “Implementing Agricultural Science & Technology Indicators (ASTI) Data collection and Policy Analysis in India”
5. Three contract research projects are being conducted in collaboration with M/s ITC Limited and M/s Rallis India Ltd. at CTRI, Rajahmundry and its Research station, Jeelugumilli



Sl. No.	Name of the Collaborating Agency	Project title/Activity
a) National Institutes/Agricultural Universities		
1	Bureau of Indian Standards, New Delhi	Development of Indian standards for tobacco and tobacco products
2	Department of Biotechnology, New Delhi	Empowerment of tribals through agro-ecological conservation and bio-technological approaches in East Godavari district of Andhra Pradesh
3	Tobacco Board, Guntur	Field Friends Programmes and on-farm trials for improving yield and quality of FCV tobacco in different zones
4	National Bureau of Plant Genetic Resources, New Delhi	National Active Germplasm Site (NAGS)
5	Department of Agriculture in different states	Transfer of technology in non-FCV types
6	Indian Meteorology Dept., Pune	Maintenance of meteorological observatories at different Stations
7	M/s ITC Ltd. ABD-ILTD M/s. Godfrey Phillips India Ltd., M/s. VST Industries Ltd. and Indian Tobacco Association, Guntur	Research and development activities and manufacturing tests
8	TNAU, Coimbatore	PG Studies, Research
9	Nannaya University, Rajahmundry	PG Studies, Research
10	NIFTEM, New Delhi	Training of UG & PG students at KVK
11	PDPC, Bangalore	Coordinated trials in Biological control
(b) International Institutions		
1	ISO-TC126, Berlin, Germany	Development of international standards for tobacco and tobacco products



All India Network Project on Tobacco

Salient achievements from experiments conducted at different AINPT centres during 2014-15 are summarized as follows:



Varieties Released / identified

Four varieties were identified for release:

- JS-117 : Low tar FCV tobacco variety for Andhra Pradesh)
- TBST-2 : FCV tobacco variety having resistance to TMV & tolerance to aphids for Andhra Pradesh.
- NBD-209 : Bidi tobacco variety having moderate resistance to Brown spot disease & Low incidence of aphids for Karnataka.
- BSR-1 : Chewing tobacco variety having resistance to Black Shank disease for Tamil Nadu chewing tobacco growing areas.

Coordinated Varietal Trials

The most promising lines identified in Coordinated varietal trials conducted at different centres were as follows:

Table 1: Initial Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCR-16, FCR-17 & FCR-18
Hunsur	FCR-20, FCR-22 & FCJ-13
Kandukur	FCR-15, FCR-16 & FCJ-11
Jeelugumilli	FCJ-11, FCJ-13 and FCJ-15
Rajahmundry	FCJ-15, FCR-22, FCR-17, FCK-2, FCR-23, FCK-4 and FCK-1
Shivamogga	FCR-10 & FCS-1
Bidi tobacco	
Anand	ABD 131, 129, 123, 138 and 152
Araul	ABD-131, ABD-132, ArBD-25 & ArBD-26
Nipani	ABD 123, ABD 125 , ABD 126, ABD 127, NBD-239 & NBD-259
Nandyal	ABD 131, ABD 132 & NBD 260
Rustica tobacco	
Araul	ArR-33, ArR-38 and LR-75
Ladol	LR-77 & ArR-38
Pusa	ArR 38, LR 75 & ArR 33

Table 2: Advanced Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCR-2, FCR-10, FCR-11, FCG-2 & FCG-3
Hunsur	TBST-2B
Kandukur	FCR-10 & FCR-11
Jeelugumilli	FCJ-1, FCJ-4, FCR-5, FCJ-5, FCJ-6 & FCJ-7
Rajahmundry	FCR-3, FCR-4, FCR-12 & FCG-1
Bidi tobacco	
Anand	ABD-123, ABD-118 & ABD-125
Araul	ArBD-7, ArBD-08 & ArBD-09
Nandyal	ABD 119, ABD 128 , ABD 122, ABD-119 & ABD-124
Rustica tobacco	
Anand	ArR 29, AR 121 & AR 126
Araul	ArR 27 & ArR 29
Ladol	LR-70 & LR-72

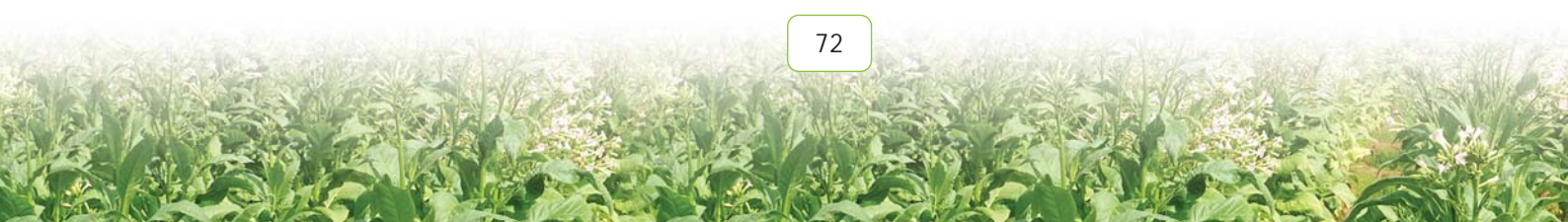
Table 3: Bulk Evaluation Trials

Centre	Promising line(s)
FCV tobacco	
Kandukur	NLST-3, V-4278 & SH-1
Jeelugumilli	Tobios-6, Tobios-7, NLST-3, NLST-4, NLST-5 & NLST-6
Bidi tobacco	
Nandyal	NBD 257

Recommendations to tobacco farmers

The farmers of Middle Gujarat Agro climatic Zone III (AES II) are advised to plant tobacco varieties MRGTH 1 and GT 7 in the month of September either in 1st or 3rd week; ABT 10 during 3rd week of September and A119 either during September 3rd or October 1st week to get maximum benefit in each variety with higher BCR without affecting the quality parameters.

Management of damping off disease in bidi tobacco nursery: For management of damping off disease in bidi tobacco nursery, farmers are advised to apply two to three applications of fungicide fenamidone 10% + mancozeb 50% @ 4



g/l was most effective in reducing the incidence of damping of disease in tobacco nursery and increased the healthy seedlings for transplanting.

Results of three years (2011-14) experiment indicated that, Maize - Bengal gram has recorded significantly higher tobacco equivalent yields (2572 kg/ha) and higher net returns (Rs. 55,802/-per ha) with B.C. ratio of 2.0 followed by Maize-Sunflower with TEY of (2557 kg/ha) and Net returns of Rs. 55,247/-per ha and a B.C. ratio of 2.0. There was significant increase in cured leaf yield due to planting during the 2nd week of August to last week of September. The higher cured leaf yield of bidi tobacco was recorded under 2nd week of September (1451 kg/ha) followed by last week of August (1217 kg/ha).

Centre-wise research achievements are presented below:

ANAND

- Emamectin benzoate 5WG, significantly reduced damage due to insect pests and gave maximum transplantable seedlings.
- Use of agro shade net or wheat straw followed by spray drench of fungicide significantly reduced damped-off in seedlings and significantly increased number of seedlings.
- Surface irrigation method recorded highest tobacco yield as well as yield attributing characters as compared to drip irrigation, with the minimum weight of *Orobanche*.
- Highest green leaf biomass was recorded with line GABT 11, while the protein content was highest with line 22-9-4-6.
- Among cropping sequences, bidi Tobacco - Pearl millet (summer) recorded significantly highest tobacco equivalent yield (3356 kg/ha) over others and gave significantly higher net profit, except sole tobacco.
- In the trial on comparative seed yield and oil content of selected genotypes variety A-145 was most promising while, *khakhari*

yield and nicotine yield potential were highest in variety GABT 11. Seed yield and oil yield potential and yield and nicotine level of *Khakhari* were significantly influenced by nitrogen levels.

- Activities of various bio-agents viz., *Nesidiocoris tenuis*, *Gecoris ochropeterus*, spiders and *coccinellids* were found on different crops raised under Entomophage Biodiversity Park in tobacco based agro ecosystem. *N. tenuis* showed negative significant correlation with minimum temperature.
- Rove beetle and leaf eating caterpillar were found under nursery conditions, whereas the population of whiteflies continued throughout crop period with maximum number during 50th std. week (45/20 plants) under field conditions.

ARAUL

- In Hookah tobacco narrow spacing 45 x 45 cm recorded significantly higher yield over 60 x 45 cm and 75 x 45 cm respectively and topping at 12 leaves significantly improved cured leaf yield.

GUNTUR

- Tobacco aphid, *Myzus nicotianae* was observed to be moderate in all the entries evaluated in different trials. While, mild incidence of TMV and leaf curl was observed in most of the entries tested in different trials.

HUNSUR

- In AVT-II the line, FCJ-3 showed numerical superiority over controls. The line may be assessed in Bulk plot trial and screened for leaf curl tolerance.
- Wood fuel saving technologies in curing of FCV tobacco (energy conservation measure and alternative fuels) was popularized through conducting Workshops/meetings involving Forest Department / Tobacco Board officials / tobacco growers associations.





- The Coconut husks can be effectively utilized as alternative source in combination with fuel wood (consumption of 4.65 kg per kg of cured leaf).
- *Pochania chlamydosporia* + poultry manure and *P. chlamydosporia* + neem cake in solarized beds were on par with each other in significantly reducing root knot index to 1.55 & 1.50 respectively compared to 3.63 in untreated check

JEELUGUMILLI

- All the three lines showed significant superiority over check variety, Kanchan for all the three yield traits, with 21-34% increase in green leaf yield, 23-33% in cured leaf yield and 21-31% in grade index. Since FCJ-1 and FCJ-4 can be tested in bulk as on-farm trials.

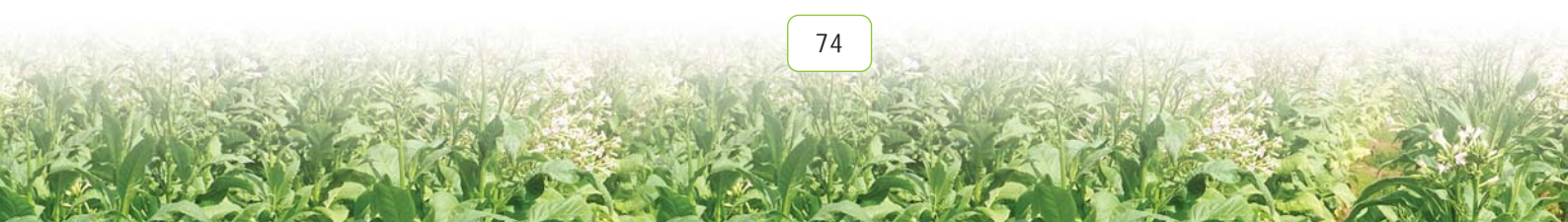
NANDYAL

- Among different cropping systems tried as alternative cropping systems for Bidi tobacco growing areas, Maize - Sun flower has recorded significantly higher tobacco equivalent yields (3429 Kg/ha) and higher Net returns (Rs. 83520/-per ha) with B.C. ratio of 3.0 followed by Maize - Bengal gram with TEY of 3010 Kg/ha and Net returns of Rs . 69813/- per ha. Significantly lower TEY (588 Kg/ha), lower Net returns (Rs. 3,812/per ha) with B.C. ratio of 0.3 was recorded with Fallow - Tobacco cropping systems.
- Time of planting has no significant effect on plant height (66.2 cm), leaf length (31.0 cm), leaf width (14.1 cm) and cured leaf yield in tobacco and effect different age of the seedlings for transplanting was significant with respect to plant height at 60 days (64.8 cm), 45 days (64.6 cm) and cured leaf yield at 45 days (750 kg/ha).
- No significant difference was observed in plant height, leaf length, leaf width and cured leaf yield with increased in level of Nitrogen from 110 Kg/ha Nitrogen to 230 kg/ha Nitrogen. Effect of different topping levels on cured leaf yield that is topping at

12 leaves (812 Kg/ha), 15 leaves (722 Kg/ha) and 18 leaves (756 kg/ha) leaf stage was found no significant difference was observed growth parameters plant height, leaf length and leaf width with increased in levels of Topping from 12 leaves to 18 leaves of tobacco.

NIPANI

- Bhendi, Radish, Cabbage, Cucumber and Onion produced maximum vegetable yield. However, Bhendi Cabbage and Cucumber suppressed the growth and yield of tobacco and tobacco grown along with Clusterbean, Methi, Coriander and Garlic recorded maximum leaf yield. Sole tobacco produced leaf yield of 1021 kg/ha. Tobacco + Cucumber (1:1) intercropping system realized maximum returns of Rs. 2,52,720/- with B:C ratio of 4.26:1 followed by Tobacco + Bhendi (Rs. 97,545/- with 2.26:1) and Tobacco + Radish (Rs. 80,995) net returned of Rs. 1,570/- with B:C ration 1.02:1.
- With the increasing levels of sulphur from 0 to 50 kg/ha, there was increase in the leaf yield. The maximum leaf yield was recorded with the application of 50 kg/ha (1627 kg/ha) as compared to no sulphur application (1286 kg/ha).
- Maximum leaf yield was produced with application of 40 kg potash/ha in two splits (2033 kg/ha) followed by 80 kg potash/ha in two splits (202 kg/ha) as compared to no potash (1681 kg/ha).
- In Station Varietal Trial-I against brown leaf spot disease, moderate resistance reaction was recorded by NBD-284, NBD-288, NBD-289 NBD-290 and Bhavyashre. (The maximum disease grade in A-119 was 5).
- In Station Varietal Trial-II against brown leaf spot disease, the entries NBD-275 and NBD-278 recorded grade 2 indicating moderately resistant reaction.
- Systemic fungicides viz., Difenconazole, Hexaconazole, Propiconazole, Tebuconazole showed cent percent inhibition at all



the concentrations (0.05, 0.10, 0.15%) while non systemic fungicides, bioagents and botanicals showed less than 65 percent inhibition.

SHIMOGA

- Two genotypes viz., NLST-6 and NLST-2 x KST-28-I, were found to be resistant to black shank disease.
- In station selection trial the genotypes 0804-25 (NLST-2 x KST-28) and 0804-40 (NLST-2 x KST-28) were significantly superior to the check Thrupthi (1085 kg/ha) for cured leaf yield.
- Application of 50 kg/ha K through tobacco stem ash and 50 kg/ha through SOP could produce yield and quality on par. Application of K only through composted tobacco stem produced lowest cured leaf yield (1382 kg/ha). There was no significant change in soil properties due to various treatments.
- The new system of heat conveyance inside the curing chamber was found very efficient for curing tobacco leaves. The quantity of wood used was 590 kg with 81 hrs of curing, thereby it saved wood to the extent of 45 per cent. The results on different quality parameters indicate no significant change.
- Among new molecules of fungicides tested, Fenamidone 10% + Mancozeb 50 WG (Section 60 WG) @ 0.3% and Azoxystrobin 32 EC (Amistar) @ 1 ml/lit were equally effective in reducing the incidence of black shank disease in field (12% and 14%) respectively when compared to control (42%).
- Among the tobacco pests, grasshoppers, *Spodoptera* and *Heliothis* were negatively correlated with minimum temperature. Positive correlation was observed for all the natural enemies with minimum temperature except *chrysopids*.
- Positive correlation was observed with grasshopper for all the natural enemies. *Spodoptera* also showed positive

correlation (*chrysopids*, *syrrhid* and *spide*). Similarly aphid was positively correlated with all the natural enemies except *chrysopids*.

- Among the different alternative cropping systems tried from the station paired row of hybrid cotton +chilli + french bean (3 rows) recorded highest net returns followed by hybrid cotton + chilli + groundnut (3 rows). No single crop cultivation can equate the income generated by tobacco.

VEDASANDUR

- Drip irrigation with 100% RDN soil application or through fertigation and planting the seedlings during October 1st fortnight increased the first grade leaf yield, total cured leaf yield and net returns of chewing tobacco hybrid.

AINPT Group Meeting

The Annual VIII Group Meeting of All India Network Project on Tobacco was held at ICAR-CTRI, Rajahmundry from 27th to 28th September, 2014. The Chief Guest, Dr. N. Gopalakrishnan, ADG (Commercial Crops), ICAR, New Delhi inaugurated the Group Meeting and delivered the inaugural address. Dr. D. Damodar Reddy, Director, ICAR-CTRI & Co-ordinator, AINPT addressed the gathering and presented the timeline and importance of AINPT along with salient research achievements. All the scientists from various AINPT centres and other delegates from all over India participated and presented the research results of 2013-14 and finalized the Technical Programme for 2015-16.



Four pipeline varieties viz., JS-117, TBST-2, NBD-209 and BSR-1 were identified for release during the Group Meeting.



Empowerment of Women in Agriculture

A 15 days duration off campus training programme on coir 2-ply yarn making over automatic machinery was conducted for six women beneficiaries of S.T.Rajapuram village during 04-04-2014 to 19-04-2014.

Three week duration training programme on DTP & E-Commerce was conducted from 24-04-2014 to 16-05-2014 for 20 rural youth of Rajanagaram, Gadarada, Yerrampalem and Kalavacharla villages in Collaboration with CTRI - ARIS cell.



DTP & E-Commerce training

A 12 days duration on campus training programme on banana fibre extraction and products making was conducted for 13 rural women of Rajampeta village of Kadapa District during 11-05-2014 to 22-05-2014.

Forty five days duration training programme on 'Coir doormat making' was conducted during 23.06.2014 to 01.08.2014 to 20 rural women of Vilasavilli village, Uppalaguptam Mandal in collaboration with Balaram farmers club.

Ten days duration on-campus training programme on 'Coir pith compost making by PVC method and heap method was conducted' to 10 rural women of Kalavacharla at KVK, Kalavacharla from 01.07.2014 to 11.07.2014.

Two months duration off-campus training programme on Garment making was conducted during 03-11-2014 to 02-01-2015 to 30 rural women of Narasapuram village.

Two months duration on campus training programme on Garment making was conducted

to 30 rural women of Kalavacharla village from 07-11-2014 to 06-01-2015.

Ten days duration on campus training programme on Handicrafts making with weeds was conducted' to 15 rural youth master trainers of Kalavacharla from 12.12.2014 to 22.12.2014 at KVK, Kalavacharla in collaboration with CAPRE Foundation, Allahabad.



Handicrafts with weeds

Ten days duration on campus training programme on 'Coir door mat making was conducted' to 10 rural women of Gadarada village at KVK, Kalavacharla during 15.12.2014 to 24.12.2014.

A 15 days duration off campus training programme on banana fibre extraction and products making was conducted' during 19.01.2015 to 04.02.2015 to 20 rural women of Kochur, PAL Dist of Maharashtra in collaboration with KVK, PAL.

A 15 days duration off campus training programme on banana fibre extraction and products making was conducted' to 20 rural women of Kirodha, PAL Dist of Maharashtra in collaboration with KVK, PAL during 06.02.2015 to 20.02.2015.

An externally funded project entitled 'Nutritional Security in Tribal Areas of East Godavari District through community based Approaches' with an outlay of Rs33.98 lakhs was sanctioned by the Department of Biotechnology, New Delhi for a period of three years (2012-15). A total of 30 training programmes, 10 demonstrations, 2 exposure visits, 1 nutrition work shop, 2 mass awareness programmes and

2 capacity building programmes were organized to empower the tribal women

Soya based food products unit: Established for providing employment for SHGs among tribal women at Maredumilli Mandal. Milk extraction unit is established at Ashram Schools for preparation of flavoured soya milk, paneer and other milk based products after conducting skill training. The soya milk is provided as supplementary diet for 400 Ashram school children @100 ml per day and SHGs in turn were



Training on soya based food products

benefitted by marketing the milk to the hostels. One SHG group consisting of 5 members is getting an additional income of Rs.10,000 per month by working for 2-3 hours per day.

Solar dried food products unit: Solar dried food products viz., desiccated coconut powder,



Training on Solar dried food products

vegetables chips, fruit jellies, aamchur, herbal powder, etc., were prepared by SHGs with the help of solar driers. SHGs were benefitted by marketing these products. One SHG consisting of 5 members is getting an additional income of Rs. 10,000 per month by working during leisure time during sunny days.

Millet based baked food products unit: Millet based products viz., 3G (green, gram & grain) ragi biscuits, jowar biscuits, toddy biscuits, cakes and buns, etc., were prepared with the help of baking ovens. The SHGs were benefitted by marketing these products locally through Girijan Co-operative Corporation (GCC) and Anganvadi centers. One SHG group consisting of 5 members is getting an additional income of Rs. 12,000/- per month by working for 4-5 hours per day.

Adda leaf plate & cup making units: This is proposed for providing employment for SHGs among tribal women at Maredumilli Mandal. Adda leaf cups & plates, bamboo sheath cups, teak leaf cups etc., are being prepared with the help of this unit. One SHG consisting of 5 members is getting an additional income of Rs. 15,000 per month by working for 5-6 hours per day.



Training on Adda leaf plate and cup making



List of publications

- Chandrasekhararao, C., K. Siva Raju, M. Anuradha, H. Ravisankar and S. Kasturi Krishna. 2014. Effect of nitrogen levels and leaf position on carbohydrate and nitrogen metabolism in FCV tobacco (*Nicotiana tabacum* L). Indian J. Pl. Physiol. 19(3): 244-9.
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- Papers accepted in 2013 and published in 2014**
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Popular articles

Mahadevaswamy, M. and S. Ramakrishnan. 2014. Efficient crop planning for sustainable crop

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Naidu, V.S.G.R. and J.V.R. Satyavani. 2015. Cashew - Grafting Methods. KVK, CTRI, Rajahmundry.

Technical bulletins

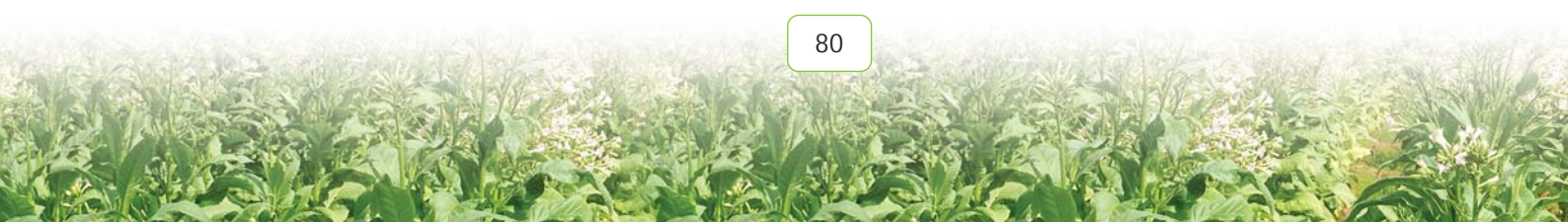
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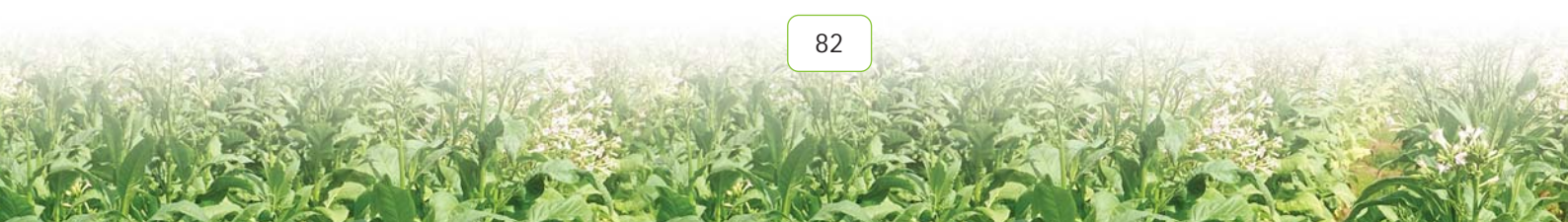
List of Approved On-going Projects

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP IMPROVEMENT		
1.	G.S.1	Germplasm acquisition maintenance, multiplication, evaluation and utilization T.G.K. Murthy
2.	Br.6.1.4(a)	Incorporation of disease resistance for tobacco mosaic virus (TMV) P.V. Venugopala Rao and S.K. Dam
3.	Br.2	Evolving superior varieties of FCV tobacco through hybridization P.V. Venugopala Rao
4.	Cy.2.1 (f)	Incorporation of aphid resistance from <i>N. gossei</i> , <i>N. repanda</i> , <i>N x umbratica-nesophila</i> and <i>N x benthamiana -repanda</i> T.G.K. Murthy, U. Sreedhar and K. Siva Raju
5.	Br.7	Developing hybrid FCV tobacco suitable for traditional black soil area of Andhra Pradesh T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala
6.	MB-9	Evaluation of advanced breeding lines for yield and quality K. Sarala, T.G.K. Murthy, P.V. Venugopala Rao and S.K. Dam
7.	Biotech-6	Molecular Mapping of tobacco traits: Tobacco specific nitrosamines in burley K. Sarala, K. Prabhakara Rao, T.G.K. Murthy, K. Siva Raju and P.V. Venugopala Rao
8.	Biotech 9	Transcript profiling and identification of candidate genes resistant to Damping-off in tobacco K. Prabhakara Rao, K. Sarala, T.G.K. Murthy, S.K. Dam and K. Siva Raju
9.	Br-8	Developing tobacco cultivars for high seed yield, oil content, high biomass and other phyto chemicals A.V.S.R Swamy, T.G.K. Murthy, S. Kasturi Krishna and K. Siva Raju
10.	Biotch-10	Molecular characterization and cataloguing of genus <i>Nicotiana</i> using DNA bar-coding K. Prabhakara Rao, T.G.K. Murthy and K. Sarala
CROP PRODUCTION		
1.	A-83	Chemical management of <i>Orobanche</i> in FCV tobacco S. Kasturi Krishna, S.V. Krishna Reddy and V.S.G.R. Naidu
2.	A-84	Studies on false maturity and its mitigation strategies in FCV tobacco growing regions of Andhra Pradesh S.V. Krishna Reddy, M. Anuradha, S. Kasturi Krishna and P. Venkateswarlu





Sl. No	Institute Code	Title of the project and Investigator(s)
3.	A-85	Leaf biomass improvement in Advanced breeding lines for alternative uses S. Kasturi Krishna, T.G.K. Murthy, K. Siva Raju and S.V. Krishna Reddy
AGRL. EXTENSION		
1.	Ag. Extn-50	On-farm evaluation of identified ABLs in NLS area of Andhra Pradesh Y. Subbaiah, T.G.K. Murthy and K. Sarala
2.	Ag Extn-51	On farm demonstration and Front line demonstration Y. Subbaiah
3.	Ag Extn-52	Impact analysis of CTRI Technologies Y. Subbaiah
AKMU		
1.	ARIS-15	Tobacco Agridaksh: An online expert system
CROP CHEMISTRY AND SOIL SCIENCE		
1.	OC-24	Studies on chemical constituents responsible for smoke flavour in FCV tobacco grown under different agro climatic zones K. Siva Raju, T.G.K. Murthy and D. Damodar Reddy
2.	SS-31	Evaluation of crop residue and wood ashes effects on soil fertility and potassium nutrition of tobacco D.damodar Reddy, S. Kasturi Krishna, M. M. Swamy, L.K. Prasad, K. Nageswara Rao and Jana Poorna Bindu
3.	Phy-77	Secondary nutrient deficiency effects on tobacco nutrition M. Anuradha, D. Damodar Reddy and K. Siva Raju
4.	SSMB-12	Tobacco (<i>Nicotiana tabacum</i>) leaf and stem assisted green synthesis of silver nanoparticles and evaluation of its antimicrobial activity against agricultural plant pathogens D.V. Subhashini
CROP PROTECTION		
1.	E-81	Bio efficacy and field evaluation of new pesticides against tobacco pests U. Sreedhar, S. Gunneswara Rao and S.K. Dam
2.	E.83	Management of ground beetle, <i>Mesomorpha villigera</i> in FCV tobacco U. Sreedhar, J.V. Prasad and G. Raghupathi Rao
3.	E-85	Bio-ecology and management of <i>Helicoverpa armigera</i> in tobacco as seed crop S. Gunneswara Rao and U. Sreedhar

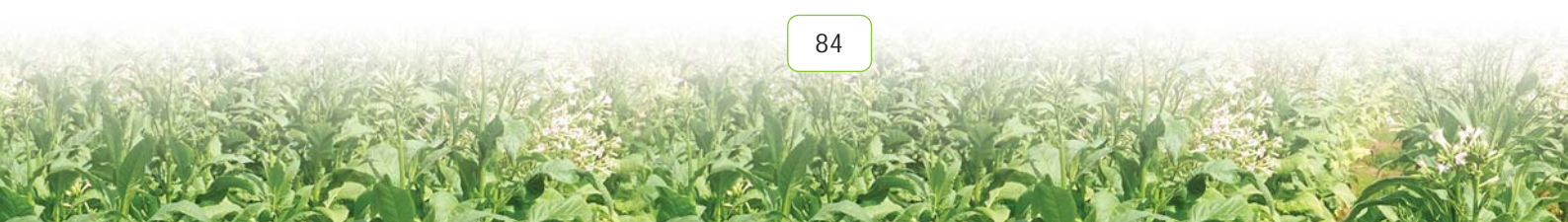


Sl. No	Institute Code	Title of the project and Investigator(s)
CTRI RESEARCH STATION: JEELUGUMILLI		
1.	JL. Br.2.1	Evolving flue cured tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh T.G.K. Murthy
2.	JLN-2	Developing new varieties of irrigated Natu tobacco for A.P. T.G.K. Murthy
3.	JL Br.3	Developing hybrid FCV tobacco suitable for northern light soils (NLS) of Andhra Pradesh T.G.K. Murthy, P.V. Venugopala Rao and K. Sarala
4.	JLA-37	Effect of drip irrigation and tray seedlings on the productivity of NLS tobacco S.V. Krishna Reddy, C. C.S. Rao and S. Kasturi Krishna
5.	E-82	Evaluation of insecticide application technology for the effective spray coverage on FCV tobacco in NLS G. Raghupathi Rao, U. Sreedhar and K. Nageswara Rao
6.	SS-32	Evaluation of organic and inorganic soil amendments to minimize nutrient leaching losses and enhance nutrient use efficiency under NLS tobacco production system J. Poorna Bindu and D. Domodar Reddy
BTRC, Kalavacharla		
1.	By.Br.1	Evaluation of advanced burley breeding lines for productivity and quality P.V. Venugopala Rao and. T.G.K. Murthy
2.	AB-30	Set row planting in burley tobacco C. Chandrasekhararao
3.	AB 31	Effect of fertilizer sources of nutrients on yield and quality of burley tobacco grown in uplands S. Kasturi Krishna, S.V. Krishna Reddy and K. Siva Raju
CTRI RESEARCH STATION: GUNTUR		
1.	Br.14	Development of FCV tobacco varieties suitable for cultivation in SBS of AP P. Venkateswarlu
2.	Br-15	Development of high yielding FCV varieties with good leaf quality suitable for cultivation in SBS and CBS area of Andhra Pradesh P. Venkateswarlu
3.	EG.14	Validation of IPM module against tobacco aphid, <i>Myzusnicotianae</i> under CBS conditions P. Venkateswarlu





Sl. No	Institute Code	Title of the project and Investigator(s)
4.	EG.15	Survey for assessment of insect pest incidence in tobacco and tobacco based cropping systems of CBS and SBS P. Venkateswarlu
CTRI RESEARCH STATION : KANDUKUR		
1.	K.Br.6	Breeding FCV tobacco variety for yield and quality under SLS conditions A.R. Panda, K.C. Chenchiah, P.V. Venugopala Rao, T.G.K. Murthy and A.V.S.R. Swamy
2.	K.Br-9	Evaluation of FCV Tobacco lines for yield and quality under SLS conditions A.R. Panda
3.	SSK-2	Assessment of leaf quality of FCV tobacco using hyper-spectral radiometric remote sensing techniques L.K. Prasad, M. Anuradha, M. Prabhakar (CRIDA) and D. Damodar Reddy
CTRI RESEARCH STATION: HUNSUR		
1.	BR.12	Germplasm maintenance of <i>Nicotiana tabacum</i> varieties/lines C. Nanda and S.S. Srinivas
2.	P.3.2	Screening of tobacco germplasm against root knot nematode S. Ramakrishnan and S.S. Srinivas
3.	N 1.1	Survey for plant parasitic nematodes infecting tobacco S. Ramakrishnan and P. Nagesh
4.	BR-19	Development and evaluation of F1 hybrids of FCV tobacco suitable to Karnataka Light Soil region C. Nanda, M.M. Swamy, S. Ramakrishnan and S.S. Srinivas
5.	A.38	Feasibility of producing organic tobacco under KLS situation M. Mahadeva Swamy and S. Ramakrishnan
6.	N-20	Integrated management of root- knot nematodes and soil borne fungal diseases in FCV tobacco nurseries S. Ramakrishnan and P. Nagesh
7.	N-21	Evaluation of bio-agents enriched tray seedlings against root-knot nematode - <i>Fusarium</i> wilt disease complex in FCV tobacco field crop S. Ramakrishnan
8.	A-40	Potassium nutrition Management strategies for productivity and quality enhancement in FCV tobacco grown under rainfed environment in KLS M. Mahadevaswamy
9.	A-41	Studies on climate Risk Management practices for FCV tobacco based cropping system in STZ of Karnataka M. Mahadevaswamy



List of Approved On-going Projects

Sl. No	Institute Code	Title of the project and Investigator(s)
CTRI RESEARCH STATION: VEDASANDUR		
1.	G.S.1	Evaluation and maintenance of germplasm A.V.S.R. Swamy and M. Mohan
2.	B.50	Breeding for high seed and oil yield in tobacco A.V.S.R. Swamy and R.K. Ghosh
3.	A 102	Crop productivity, soil quality and economic returns under chewing tobacco + Annual Moringa intercropping system in response to nutrient management M. Kumaresan and D. Damodar Reddy
CTRI RESEARCH STATION: DINHATA		
1.	A-10	Permanent manurial experiment with Motihari tobacco Sunil Mandi
Externally funded projects		
1.	DBT Project	Nutritional security and in tribal areas of East Godavari district of Andhra Pradesh through community based approaches K. Suman Kalyani





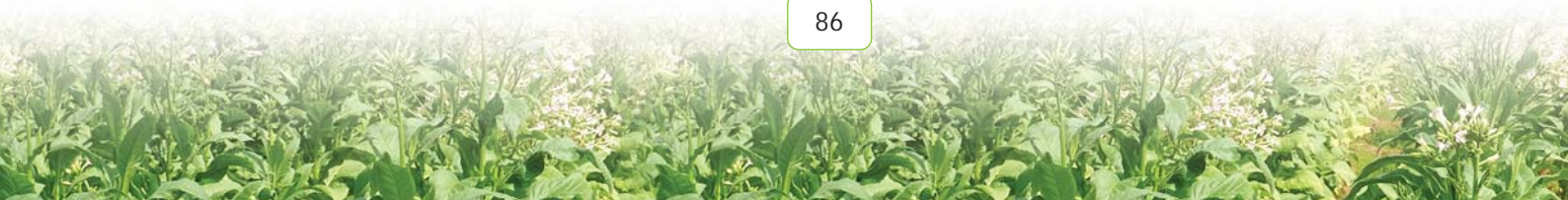
RAC, QRT, IRC and IMC Meetings

RESEARCH ADVISORY COMMITTEE



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

The third meeting of the Research Advisory Committee (RAC) meeting of CTRI was held during 22-23 May, 2014 at CTRI, Rajahmundry under the Chairmanship of Dr. P. Murugesha Boopathi, Former Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore.



QUINQUENNIAL REVIEW TEAM

Dr. R.R. Hanchinal, CHAIRMAN
Chairperson,
Protection of Plant Varieties and Farmers
Right Authority,
Govt. of India, Min. of Agriculture,
Dept. of Agriculture and Co-operation,
NASC Complex, DPS Marg,
New Dehi -110 012.

Dr. R.K. Samanta MEMBER
Retd. Principal Scientist, NAARM,
1-11-12, Bhavani Colony, Rajendranagar Post
Hyderabad-30

Dr. Satyendra Chandra Sarker, MEMBER
Professor, Agricultural Economics,
Dept. of Agricultural Economics,
UBKV, Cooch Behar-736165. W.B.

Dr. B.N. Bhat, MEMBER
Ex- Associate Director of Research
Agril. Research Station, P.B. No. 25,
Nipani-591237, Karnataka

Dr. C. Chandrasekhara Rao, MEMBER-
SECRETARY
Head, Crop Chem. & Soil Sci.,
CTRI, Rajahmundry

Dr. R. Lakshminarayana, MEMBER
Retd. Principal Scientist & Head and
Former Project Co-ordinator,
D. No. 23-11-12/1, Ramakrishna Rao Peta,
RAJAHMUNDY - 533105.

QRT VISITS

Date	Place
02.07.2014	CTRI, Rajahmundry
18.09.2014	CTRI RS, Hunsur
19.09.2014	AINPT Centre, Shimoga
05.02.2015	CTRI, Rajahmundry, KVK
06.02.2015	CTRI RS, Jeelugumilli
07.02.2015	CTRI RS, Kandukur
08.02.2015	CTRI RS, Guntur

Dr. T. Ramesh Babu, MEMBER
Dean,
ANGRAU,
Rajedranagar,
Hyderabad-500030



INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

The Institute Research Committee (IRC) Meetings of Central Tobacco Research Institute were held during 3-5 September, 2014 at Rajahmundry. Scientists of CTRI, its Research Stations, Tobacco Board officials and representatives of tobacco trade and industry

participated in the meetings. The progress of research work carried out during the year 2013-14 was reviewed and the technical programme for the crop season 2014-15 was discussed and finalized during the deliberations.



INSTITUTE MANAGEMENT COMMITTEE

Dr. D. Damodar Reddy
Director & Chairman

Asst. Director General (CC) Indian Council of Agricultural Research, Krishi Bhawan, Dr. Rajendra Prasad Road, New Delhi	Member	Dr. Y.G. Prasad Pr. Scientist CRIDA, Hyderabad	Member
Dr. K. Siva Raju Pr. Scientist CTRI, Rajahmundry	Member	Dr. K. Anitha Pr. Scientist NBPGR Regional Station, Hyderabad	Member
Dr. R.K. Mathur Pr. Scientist DOPR, Pedavagi	Member	Sri S.L.V. Prasad Sr. Administrative Officer CTRI, Rajahmundry	Member-Secretary

Participation of Scientists in Conferences, Meetings, Workshops and Symposia

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. S. Ramakrishnan	National Workshop on Emergence of nematode diseases of Karnataka	7.4.2014 at UAS, Shimoga, Karnataka
2.	Dr. T.G.K. Murthy	78th Meeting of registration committee for growers and others	11.04.2015 at Tobacco Board, Guntur
3.	Dr. P. Venkateswarlu	DPC meeting	15.04.2014 at Tobacco Board, Guntur
4.	Dr. P. Venkateswarlu	ZREAC meeting of Krishna zone	24.04.2014 at RARS, Lam, Guntur
5.	Dr. P. Venkateswarlu	Meeting on "Physical analysis of the redried threshed lamina of tobacco"	25.04.2014 at Tobacco Board, Guntur
6.	Dr. T.G.K. Murthy	Interactive Conference of the Vice Chancellors of Aus and Directors' of ICAR Institute	28.04.2014 at New Delhi
7.	Dr. U. Sreedhar	Interactive Meet on tobacco fumigation	28.04.2014 at Guntur
8.	Dr. S. Ramakrishnan	Brain Storming Session on "Emergence of nematode diseases of Karnataka with special reference to Rice Root Knot nematode"	28-30 April, 2014 at UAHS, Shimoga
9.	Dr.M.Kumaresan	XX IV Meeting of the Regional Committee No.VIII of ICAR	1 - 3 rd May-2014 at CTCRI, Trivandrum
10.	Dr. A.R. Panda	Review meeting of Krishi Vigyan Kendra of Andhra Pradesh for the year 2014-15&State level technical programme of KVK	13.05.2014 at Hyderabad
11.	Dr. S. Ramakrishnan	XXIV meeting of the Regional Committee meeting of ICAR (Zone VIII)	2-3 May, 2014 at CTCRI, Trivandrum
12.	Sunil Mandi	XXII meeting of ICAR Regional Committee-II	30-31 May, 2014 at CIFRI, Barrackpure
13.	Dr. T.G.K. Murthy	Foundation Day Lecture of National Academy of Agricultural Sciences	05.06.2014 at New Delhi



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Sl. No.	Participant (s)	Programme attended	Date and place
14.	Dr. T.G.K. Murthy	NAIP-IFPRI Two day workshop on "Impact of capacity building programmes under NAIP"	6-7 June, 2014 at New Delhi
15.	Dr. C.C.S. Rao	Fourth meeting of the Committee to study the environmental impact of FCV tobacco curing	18.06.2014 at Tobacco Board, Guntur
16.	Dr. C.C.S. Rao	PME-IFPRI Workshop	27.06.2014 at New Delhi
17.	Sunil Mandi	ICAR Regional Committee II meeting	27-28 th June, 2014 at CIFRI, Barrackpure
18.	Dr. T.G.K. Murthy	Meeting on Soil conversion from black soil to light soil	18.6.2014 at Tobacco Board, Guntur
19.	Dr. C.C.S. Rao	Meeting to assess the environmental impact of FCV tobacco curing in India	18.6.2014 at Tobacco Board, Guntur
20.	Dr.S.Ramakirishnan Dr.M. Mahadevaswamy	Workshop on "Sustainable Agricultural practices in tobacco farming" organized by ITC, Mysore	14-15 th July, 2014 at Pala, Hunsur
21.	Dr. H. Ravisankar	"DST National Conference on Recent Trends in Data Mining & Bioinformatics" and deliver a lecture on 'Data Mining' in the conference	15.07.2014 at Grandhi Varalakshmi Venkatarao Institute of Technology, Bhimavaram
22.	Dr. T.G.K. Murthy	51 st meeting of the Executive Committee/ Meeting of 79 th Registration Committee for Growers and Others	23.07.2014 at Tobacco Board, Guntur
23.	Dr. T.G.K. Murthy	86 Foundation Day, Award Ceremony-2014 of ICAR and Directors' Conference	29-30 July, 2014 at New Delhi
24.	Dr. T.G.K. Murthy	138 th Meeting of the Tobacco Board	25.7.2014 at Hyderabad
25.	Dr. S. Ramakrishnan Dr. M. Mahadevaswamy	Scientific Advisory Committee meeting of KVK, Suttur	25.07.2014 at KVK, Suttur
26.	Sunil Mandi	International Conference on Natural Fibers	01.08.2014 at NIRJAF, Kolkata
27.	Dr. P. Venkateswarlu	80 th Meeting of the Registration Committee for Growers and Others	08.08.2014 at Tobacco Board, Guntur

Sl. No.	Participant (s)	Programme attended	Date and place
28.	Dr. P. Venkateswarlu	DPC meeting	11.08.2014 at Tobacco Board, Guntur
29.	Dr. K. Siva Raju	Meeting on "Network Project on high value compounds/ phytochemicals"	12.08.2014 at IISR, Calicut
30.	Md. Elias	9 th Convention Planner - 2014 'Capacity building in Library and informatics services'	25-27 Sep., 2014 at Dibrugarh University, Dibrugah
31.	Dr. T.G.K. Murthy	ICAR Meeting in connection with the visit of Dr. Jorse Graziano da Silva, DG, FAOL	08.09.2014 at New Delhi
32.	Dr. K. Sarala Dr.H. Ravisankar	International Conference on "Biosciences : State of the art advancements"	11-12 Sept., 2014 at Kumarakom, Kerala
33.	Dr. L.K. Prasad Dr. V.S.G.R. Naidu	Annual Zonal Workshop (Zone V) of KVK	29.9.14 to 1.10.14 at KVK, Barapani
34.	Dr. D. Damodar Reddy	TII Award Function organized by TII	11.10.2014 at Guntur
35.	Dr. D. Damodar Reddy Dr. T.G.K. Murthy	12 th Meeting of the tobacco and tobacco products sectional committee (TSO-126)	20.10.2014 at M/s VST Industries, Hyderabad
36.	Dr. M. Kumaresan S. Mandi	National Symposium on Agricultural Diversification for Sustainable livelihood and Environmental Security	18-20 Nov., 2014 at Punjab Agricultural University, Ludhiana
37.	Dr. U. Sreedhar Dr. G. Raghupathi Rao	International Conference on "Changing Scenario of pest problems in Agri-Horti Ecosystem and their management	27-29 Nov., 2014 at Maharana Pratap University of Agri. & Tech. Udaipur
38.	Dr. M. Anuradha Dr. K. Siva Raju	National Conference of Plant Physiology (NCPP -2014) on "Frontiers of Plant Physiology Research - Food Security and Environmental Challenges"	22-25 Nov., 2014 at Orissa University of Agriculture & Technology, Bhubaneswar
39.	Dr. K.Sarala	'Brain-storming meeting for pre-testing of ASTI survey forms	17.11.2014 at NAARM, Hyderabad.
40.	Dr. K. Suman Kalyani	22 nd National Children's Science Congress -2014	05.11.2014 at Rajahmundry



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Sl. No.	Participant (s)	Programme attended	Date and place
41.	Dr. K.Siva Raju	Meeting to suggest measures to "Reduce imports of tobacco/ tobacco products into the country including Contraband/ illegal imports	11.11.2014 at Tobacco Board, Guntur
42.	Dr. S. Ramakrishnan	Meeting on FCV tobacco crop situation in KLS	26.11.2014 at Directorate of Agriculture, Bangalore
43.	Ms. J. Poorna Bindu	National Seminar on Developments in Soil science during 79 th Annual convention of ISSS	27-29 Nov., 2014 at PJSTAU, Hyderabad
44.	Dr. D. Damodar Reddy	Tobacco Board's Foundation Day	09.01.2015 at Tobacco Board, Guntur
45.	Dr. U. Sreedhar Dr. G. Raghupathi Rao	International Conference on "Innovative Insect Management Approaches for Sustainable Agro Eco-System (IIMASAE)	27-30 Jan., 2015 at TNAU, Madurai
46.	Dr. L.K.Prasad,	Meeting at ZC-IV	24.01.2015 at Hyderabad
47.	Dr. Y. Subbaiah	XII Agricultural Science Congress 2015	3-6 Feb., 2015 at NDRI, Karnaal
48.	Dr. D. Damodar Reddy	81st Meeting of registration committee for growers and others	18.02.2015 at Tobacco Board, Guntur
49.	Dr. D. Damodar Reddy	13th Meeting of tobacco and tobacco products sectional committee, FAD-4	20.03.2015 at Hyderabad
50.	Dr. D. Damodar Reddy	20th Meeting of FADC	24.03.2015 at New Delhi
51.	Dr. K. Siva Raju	SAB International symposium "New perspectives in Modern biotechnology"	23-25 Mar., 2015 at Puducherry



Trainings and Capacity Building



Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. K. Siva Raju	Training programme on "ISO/IEC17025 Assessors' conducted by national Accreditation Board for Testing & Calibration Laboratories" Dept. of Science & Technology	26-30 May, 2014 at Hyderabad
2.	Dr. V.S.G.R. Naidu	Training on 'Technology Management for KVK Professionals' under NAIP	9-11 June, 2014 at NAARM, Hyderabad
3.	Y. Prabhakar	Training Course on Pensions and other retirement benefits	12.06.2014 at ISTM, New Delhi
4.	K. Ganesh Babu	Training programme on Fixation of Pay	30.06.2014 to 2.7.2014 at ISTM, New Delhi
5.	V. Bhagyalakshmi	Training programme on Fixation of Pay	11-13 Aug., 2014 at ISTM, New Delhi
6.	Dr. K. Suman Kalyani	International Course on Lost harvest and wasted food held	15-26 Sept., 2014 at CDI, Wageningen, The Netherlands
7.	Dr. K. Suman Kalyani Dr. K. Prabhakar	Workshop for Liaison Officers for SC/ST/OBC	20-21 Oct., 2014 at ISTM, New Delhi
8.	Dr. P.V.V.Siva Rao	Model training course on "Good Dairy Farming Practices: A way forward for organic farming"	29.10.14 to 5.11.14 at NDRI, Karnal
9.	Dr. Y. Subbaiah	Management Development programme on "Leadership Development (a pre-RMP Programme)"	1-12 Dec., 2014 at NAARM, Hyderabad
10.	Dr. D. Damodar Reddy	Executive Development Programme on Leadership Development	19-23 Jan., 2015 at NAARM, Hyderabad
11.	Md. Elias	Training & awareness workshop on J-Gate@CeRA for Southern region	23.01.2015 at PJTSAU, Hyderabad
12.	C.V.K. Reddy	DST sponsored training programme conducted by IIPA, New Delhi on '6th Capacity Building Programme for Technical Personnel'	2-13 Feb., 2015 at New Delhi



Workshops, Seminars and Farmers' Days organised by the Institute



- ▲ The 86th Foundation Day of ICAR was conducted at Central Tobacco Research Institute, Rajahmundry on 16.07.2014. Farmers, faculty and students from Agricultural College, Rajahmundry, (ANGRAU), Scientists, representatives of tobacco industry, retired scientists of CTRI and other stake holders participated in the function.



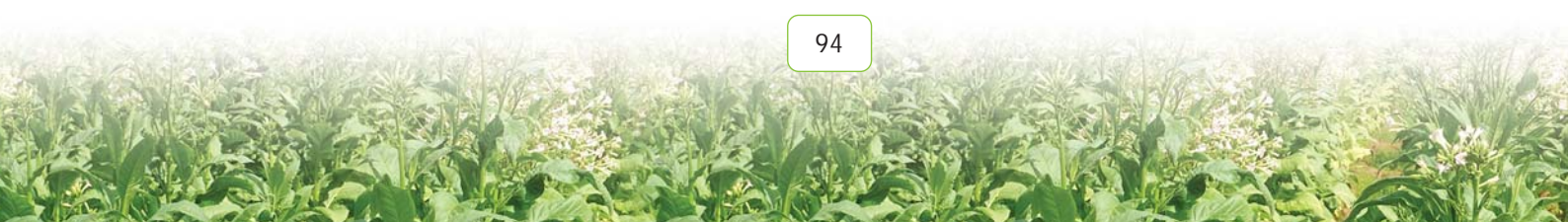
- ▲ Model Project Area Scheme in NLS, Growers Awareness Program was organized by CTRI RS, Jeelugumilli and Tobacco Board Guntur on 18.12.2014 at CTRI RS, Jeelugumilli
- ▲ As per the ICAR directives, National Science Day was celebrated on 28.02.2015 at this Institute.
- ▲ Field IRC was conducted at ICAR- CTRI RS, Jeelugumilli on 06.02.2015 to monitor the approved Institute/ AINPT experiments.
- ▲ 'Hindi Pakwada Samaroh' was celebrated from 15.09.2014 to 29.09.2014 at CTRI, Rajahmundry. Dr. D. Damodar Reddy, Director, CTRI has presided over the function and graced the occasion. On the eve of this, various competitions in Hindi were conducted. All the staff members of CTRI participated in the celebrations.



- ▲ International Women's day was celebrated at CTRI, Rajahmundry on 07.03.2015. Dr. D. Damodar Reddy, Director, CTRI addressed the staff of CTRI and graced the occasion. Dr. K. Sitaramaiah, Principal, Agricultural College, Rajahmundry was the chief guest of the day and all the students of Agricultural College and staff of CTRI participated in the celebration.



- ▲ An interaction meeting on "FCV Tobacco-Crop Developmental Activities" was organized at CTRI, Rajahmundry on 07.08.2014 in collaboration with Tobacco Board, Guntur. Dr. K. Gopal, Chairman of Tobacco Board, Ministry of Commerce & Industry, Govt. of India, Managers & Officers of Tobacco Board, Trade and Progressive tobacco farmers from NLS region participated in the programme.
- ▲ During 2014-15 as a sequel to the Swachh Bharat Abhiyan by Govt. of India, the Institute has taken up several activities including cleaning of the premises, office buildings, laboratories and also conducted sensitisation programmes.



Distinguished visitors

S.No.	Date	Visitors
CTRI, Rajahmundry		
1.	03.04.2014	Sri T. Ramakrishnaiah Senior Manager, Ruchi Soya Industries Ltd.,
2.	16.10.2014	Dr. Ch. Srinivasa Rao Director, CRIDA, Hyderabad
3.	28.01.2015	Dr. Susan Dinbin, Dr. Dahua Garwe Dr. Frank Magama Scientists of Tobacco Research Board, Harare, Zimbabwe
4.	28.02.2015	Dr. S.M. Patil Asst. prof. (Horticulture) from MPKV, Rahuri, Maharashtra
5.	03.03.2015	Dr. A. Padmaraju Vice Chancellor , ANGRAU, Rajendranagar, Hyderabad
6.	17.03.2015	Twenty farmers of ATMA programme Chhattisgarh
CTRI RS, Hunsur		
7.	15.07.2014	Dr. K. Gopal, Chairman Tobacco Board, Guntur
8.	09.10.2014	Ten delegates from Tobacco Industry and Marketing board, Govt. Of Zimbabwe
9.	July/Aug, 2014	300 FCV tobacco growers from different auction platforms of KLS
CTRI RS, Kandukur		
10.	22-01-2015	Dr. A.R. Reddy Principal Scientist, ZC, Hyd. visited KVK, Kandukur
11.	23-08-2014	Dr. K. Gopal Chairman, Tobacco Board, Guntur



Personnel (As on 31.03.2015)

Dr. D. Damodar Reddy, Director

DIVISION OF CROP IMPROVEMENT

Dr. T.G.K. Murthy, Principal Scientist & Head i/c
Dr. A.V.S.R. Swamy, Principal Scientist
Dr. K. Sarala, Principal Scientist
Dr. P.V. Venugopala Rao, Sr. Scientist & SPO
Dr. K. Prabhakara Rao, Scientist
K. Santhinandivelu, Sr. Technical Officer
B.S.N. Reddy, Sr. Technical Officer
J. Siva Sai, Sr. Technical Officer
B. Raja Rao, Technical Officer
M.M. Ali, Technical Assistant
M. Srinivas, Sr. Technician
S. Ramaraju, Technician
Y.N.V.V.S.N. Murthy, SSS

DIVISION OF CROP PRODUCTION

Dr. S. Kasturi Krishna, Head of the Division
Dr. S.V. Krishna Reddy, Principal Scientist
Dr. Y. Subbaiah, Principal Scientist
Dr. K. Suman Kalyani, Principal Scientist
Dr. H. Ravisankar, Senior Scientist
N. Aruna Kumari, Chief Techl. Officer
Dr. M. Nageswara Rao, Asst. Chief Techl. Officer
I. Jagadish Chandra, Sr. Techl. Officer
P.E. Jemmy, Technical Officer
P. Girija Sankar, Techl. Asst.
P.S.S. Prakasa Rao, Sr. Techl. Asst.
Ch. Sudhakara Babu, Techl. Assistant
D.S.R. Sastry, Sr. Technician
K. Pushpa, SSS
Y. Jaya Lakshmi, SSS
K.V.S.S. Bhaskara Rao, SSS
G. Sarveswara Rao, SSS
Y.V. Narayana, SSS
Ch. Satyanarayana, SSS

DIVISION OF CROP PROTECTION

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Dr. G. Raghupathi Rao, Sr. Scientist
K. Sessa Sai, Asst. Chief Technical Officer

Dr. S.K. Dam, Sr. Technical Officer
N. Veerraju, Technical Officer
V. Narasimha Murthy, Sr. Techl. Asst.
V.V. Ramana, Technical Assistant
A. Nageswara Rao, SSS
V.V.P.L. Acharyulu, SSS
B. Koteswara Rao, SSS

DIVISION OF CROP CHEMISTRY & SOIL SCIENCE

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E. Radhakrishna, SSS
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K. Satyanarayana, SSS

PME CELL

C.V.K. Reddy, Asst. Chief Techl. Officer
Ch. Lakshminarayani, Personal Assistant
Y. Subrahmanyam, SSS
N. Srinivasa Rao, SSS



ITMU

A. Aruna Kumari, Research Associate
Ch.V. Srihari, Research Associate

LIBRARY

Md. Elias, Sr. Technical Assistant
P.N.M. Swamy, Technician

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V. Madhava Rao, Technical Officer
G.H. Mohanacharyulu, Sr. Techl. Assistant
K. Bhyravaswamy, Sr. Technician
Y.V. Subrahmanayam, Sr. Technician
K.V. Ramana, Sr. Technician
D. Sreeramamurthy, Assistant
D.V. Rama Rao, SSS
B. Nageswara Rao, SSS
D. Balarama Reddy, SSS
A. Srinivas, SSS
N. Kakanandam, SSS

AINPT

B. Krishna Kumari, Sr. Technical Officer
R. Satyanarayana, Technician

SEED PRODUCTION

G. Adinarayana, Asst. Chief Techl. Officer
Garaga S.N. Murthy, Sr. Technical Assistant
B.V. Srinivas, Sr. Technical Assistant
M.S. Ashokan, Techl. Assistant
N. Endayya, Sr. Technician
G. Prasada Rao, SSS

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N. Gopinath, Techl. Officer
V.V. Sivaram, Technical Officer
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Y. Yesu, Sr. Technical Assistant
M. Yesuratnam, Technical Assistant

P.Ch.S.N. Murthy, Technical Assistant
S. Ramakrishna, Technical Assistant
G.S.N. Murthy, Technical Assistant
K.V.V. Satanarayana, Techl. Asst.
N.V.V. Satyyanaaryana, Sr. Technician
G. Kaleswara Rao, SSS
Y. Nirmala Kumari, SSS
P.V.V.R. Srinivasa Rao, SSS
Ch. Papa, SSS

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V. Bhagyalakshmi, Asst. Administrative Officer
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K.T.R. Singh, Private Secretary
N. Sambasiva Rao, Technical Officer
V. Narayanacharyulu, Assistant
P. Venkataratnam, Assistant
V.S.R.C. Murthy, Assistant
G.V.V.S. Rambabu, Assistant
P. Mariyamma, Assistant
M. Rambabu, Assistant
A. Sridhar, Assistant
P.V. Satyanarayana, Assistant
N. Suryanarayana, Assistant
S.V. Ramana, Assistant
K. Savithri, Assistant
P. Devanagaraju, Assistant
N. Veerabhadra Rao, Assistant
Lokanath Senapathi, Assistant
A.Veera Venkata Ramana, Assistant
V. Narasimha Rao, UDC
P.V.V.V. Prasad, UDC
Ch. Jayaram, UDC
P.J.F. Moses, UDC
S. Pradeep Kumar, UDC
P. Suchitra, UDC
G.M.B. Sujatha, UDC
J. Suseela Devi, UDC
Y. Subba Lakshmi, LDC
B. Rama Rao, LDC
G. Vasudeva Murthy, SSS
J. Veerraju, SSS
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K. Sankurudu, SSS
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P.K.V. Satyanarayana, SSS
N. Nirmala Kumar, SSS
Y.S.V. Subba Rao, SSS
Pragada Krishna, SSS
P.V. Ramana, SSS
P. Kotababu, SSS
G.V. Ramana, SSS
K. Vijaya Raju, SSS

BTRC, KALAVACHARLA

S. Rajeswara Rao, Sr. Technical Assistant
Ch.V.R. Rangacharyulu, SSS
Y.V. Subba Rao, SSS
P. Janakiramayya, SSS
Ch. Chinnayamma, SSS

CTRI RESEARCH STATION, GUNTUR

Dr. P. Venkateswarlu, Pr. Scientist & Head i/c
B. Krishnakumar, Sr. Technical Officer
M.V. Jayakrishna, Sr. Techl. Assistant
Shaik Ameer Ali, Techl. Assistant
K.N. Subbaiah, Technical Assistant
A. Suresh Babu, Technical Assistant
T. Nagamani, Sr. Technician
V. Subba Rao, Sr. Technician
B. Yesu, Technician
E. Veerabhadra Rao, Technician
S. Sambasiva Rao, Technician
T.S.N. Murthy, Asst. Fin. & A/cs. Officer
M.H. Uma, Assistant
V.V.K. Acharyulu, UDC
S. Siva Veeraiah, LDC
T. Sambrajyam, SSS
Alla Lakshmi Devi, SSS
M. Bhagyam, SSS
S. Anasuya, SSS
Pasupuleti Raju, SSS
A. Gangadhara Rao, SSS
S.K. Moulali, SSS
P. Purnachandra Rao, SSS
Manchala Prasad, SSS
D.V. Rama Rao, SSS
Manchala Raju, SSS

Pathella Srinivasa Rao, SSS
T. Sankara Rao, SSS
Bandi Subbulu, SSS
P. Babi Sarojini, SSS
Kondaveeti Subbulu, SSS
Setti Subbulu, SSS
Ch. Sarojini, SSS
S. Rajalu, SSS
M. Venkayamma, SSS
Mandadi Anjaneyulu, SSS
Avala Sambrajyam, SSS
Kanuganti Yesu, SSS
D. Sreenivasa Rao, SSS

CTRI RESEARCH STATION, KANDUKUR

Dr. L.K. Prasad, Principal Scientist & Head i/c
Dr. A.R. Panda, Principal Scientist
Dr. K.C. Chenchiah, Principal Scientist
T. Venkata Rao, Sr. Techl. Assistant
M. Mathaiah, Technical Assistant
K. Malakondaiah, Sr. Technician
A. Mutyam, Sr. Technician
K. Sudhakar, Technician
Ch. Lakshmana Rao, Technician
M. Mohana Rao, Technician
K. Venkateswarlu, Technician
K. Krishna Murthy, Asst. Admn. Officer
U.R.K. Murthy, UDC
V. Jayamma, SSS
K. Narasimham, SSS
Kallagunta Kondaiah, SSS
Divi Kesavulu, SSS
O. Rathamma, SSS
K. Mallikharjuna, SSS
Dama Singaiah, SSS
D. Prabhakara Rao, SSS
Divi Koteswara Rao, SSS
Orupalli Annapurnamma, SSS
Mannem Vijayamma, SSS
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Vankayalapati Mukundam, SSS
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Tanikonda Chinamma, SSS
G. Lakshamma, SSS
Divi Malakondaiah, SSS
Oruganti Lakshamma, SSS

CTRI RESEARCH STATION, JEELUGUMILLI

Dr. K. Nageswara Rao, Principal Sci. & Head i/c
T. Lakshmana Rao, Sr. Technical Assistant
T. Srinivasa Rao, Technical Assistant
Y. Venkateswara Rao, Technical Assistant
D.V. Prasad, Technical Assistant
J. Hanumantha Rao, Technical Assistant
A.L.N. Murthy, Sr. Technician
B. Durga Rao, Sr. Technician
G. Govinda Raju, Sr. Technician
D. Yesuratnam, Technician
P.V. Ramana, Technician
P. Kumar, Technician
K. Ganesh Babu, Asst. Admn. Officer
Anapakam Prabhu, Assistant
P.Y. Narasimha Rao, SSS

CTRI RESEARCH STATION, HUNSUR

Dr. S. Ramakrishnan, Principal Sci. & Head i/c
Dr. M. Mahadevaswamy, Principal Scientist
Dr. (Mrs.) C. Nanda, Scientist
S. Ramesh, Chief Technical Officer
C. Mahadeva, Chief Technical Officer
Dr. P. Nagesh, Asst. Chief Technical Officer
Dr. S.S. Srinivas, Asst. Chief Technical Officer
N.D. Suresh, Sr. Technical Officer
T. Venkatesh, Sr. Technical Officer
Sambu Gowda, Sr. Technical Assistant
Chikkanna Setti, Sr. Technical Assistant
Sanna Swamy, Sr. Technical Assistant
D.K. Eswara, Sr. Technical Assistant
Gopala Rao, Technical Assistant
B. Suresh Kumar, Technical Assistant
C. Puttamallaiah, Technical Assistant
A.V.G.K. Murthy, Asst. Admn. Officer
P. Prabhakara Murthy, Assistant
Rohini, Assistant
Devamma, SSS
Chikkabhagya, SSS
Jayamma, SSS
Byre Gowda, SSS

CTRI RESEARCH STATION, VEDASANDUR

Dr. M. Kumaresan, Principal Sci. & Head i/c
M. Mohan, Chief Technical Officer
R. Rajendran, Sr. Technical Officer

C. Muruganandam, Sr. Technical Officer
V. Annadurai, Sr. Technical Officer
S. Soundararajan, Technical Officer
R. Indrani, Technician
N. Manjula, Assistant
C. Nehru, Assistant
P. Malliasamy, SSS
R. Vellaiammal, SSS
N. Rosammal Punnus, SSS
M. Pitchaiammal, SSS
R. Kennedy Balasubramanian, SSS

CTRI RESEARCH STATION, DINHATA

Sunil Mandi, Scientist & Head i/c
B.K. Champramari, Technical Officer
J.K. Roy Barman, Technician
S.K. Sarkar, Personal Assistant
B.N. Ghosh, Assistant
M. Mumtaz Begum, UDC
Gowtham Ghosh, LDC
N.R. Barman, SSS
A.K. Chisim, SSS
Uttam Das, SSS
Gauranga Sarkar, SSS
Bharathi Ghosh, SSS
Naresh Biswas, SSS
Bijoy Das, SSS

KVK, KALAVACHARLA

Dr. V.S.G.R. Naidu, Programme Coordinator
V.V. Lakshmikumari, Chief Technical Officer
Dr. B. John Babu, Chief Technical Officer
R. Sudhakar, Chief Technical Officer
J.V.R. Satyavani, Chief Technical Officer
E. Vijaya Prasad, Chief Technical Officer
Dr. P.V.V.S. Siva Rao, Asst. Chief Tech. Officer
D. Balakrishna, Sr. Technical Assistant
P. Eswara Rao, Technical Assistant
Y. Udayakumar, Sr. Technician
M. Ramamohana Rao, Asst. Admn. Officer
T. Syamala Devi, Assistant
G. Chinna Rao, SSS
G. Sasi Rani, SSS
G.P.D. Varma, SSS
M. Veeraveni, SSS
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G. Ramakrishna Raju, SSS



Appendix - 1

Results-Framework Document) for ICAR-Central Tobacco Research Institute (2013-2014)



R F D
(Results-Framework Document)
for
Central Tobacco Research Institute
(2013-2014)

Section 1:
Vision, Mission, Objectives and Functions

Vision

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

Mission

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

Objectives

1. Germplasm enhancement and development of improved cultivars
2. Development and identification of appropriate technologies
3. Technology dissemination and capacity building

Functions

1. 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
2. To conduct research on economically viable and sustainable cropping systems alternative to tobacco
3. To conduct research on diversified uses of tobacco and development of value-added products viz. phyto-chemicals
4. To produce and distribute quality seeds of released varieties of tobacco
5. 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.

**Section 2:
Inter se Priorities among Key Objectives, Success Indicators and Targets**

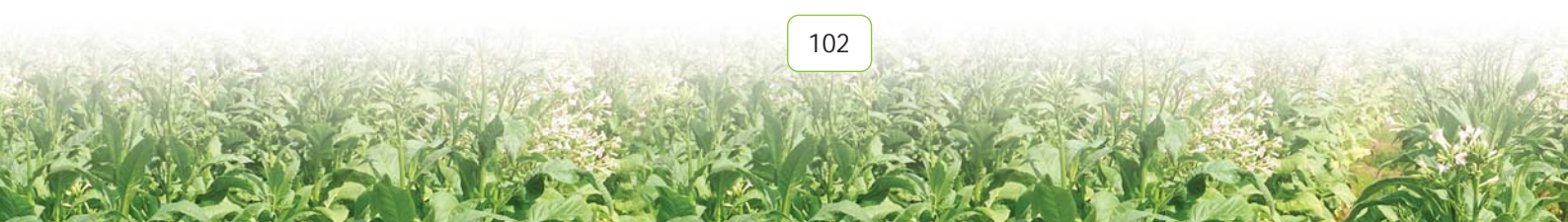
S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Excellent	Target/Criteria Value			
								Very Good	Good	Fair	
							100%	80%	70%	60%	
1.	Germplasm enhancement and development of improved cultivars	40	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	15	110	100	90	80	70
				Lines identified for unique traits	Number	3	2	1	0	0	0
			Development of improved cultivars	Entries tested in AINRP(T) multi-location trials	Number	8	22	20	18	16	14
				Varieties identified for release	Number	4	2	1	0	0	0
			Seed production programme	Foundation seed produced	Weight MT	10	19.5	18.5	16.5	14.5	12.5
2.	Development and identification of appropriate technologies	30	Development of new technologies	New technologies tested/developed	Number	30	5	4	3	2	1
3.	Technology dissemination and capacity building	19	Demonstrations conducted	Demonstrations/FLDs conducted	Number	10	10	9	8	7	6
			Training programmes organized for farmers/Extension officials	Trainings organized	Number	9	13	12	11	10	9
	* Efficient Functioning of the RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2.00	15/05/13	16/05/13	17/05/13	20/05/13	21/05/13





S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Excellent	Target/Criteria Value			
								Very Good	Good	Poor	
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1.00	100%	90%	80%	70%	60%
	* Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% Implementation	%	2.00	100	95	90	85	80
			Prepare an action plan for Innovation	On-time submission	Date	2.00	30/07/13	10/08/13	20/08/13	30/08/13	10/09/13
	* Improving internal efficiency/ responsiveness/ service delivery of Ministry/ Department	4	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2.00	100	95	90	85	80
				Independent Audit of implementation of public grievance redressal system	%	2.00	100	95	90	85	80

* Mandatory objective(s)



Section 3: Trend values of the success indicators

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual Value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
1.	Germplasm enhancement and development of improved cultivars	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	95	98	100	110	115
			Lines identified for unique traits	Number	1	1	1	1	1
		Development of improved cultivars	Entries tested in AINRP(T) multi-location trials	Number	16	15	20	22	23
			Varieties identified for release	Number	1	3	1	2	2
		Seed production programme	Foundation seed produced	Weight MT	18.2	19	18.5	19	19.5
2.	Development and identification of appropriate technologies	Development of new technologies	New technologies tested/developed	Number	4	4	4	5	5
3.	Technology dissemination and capacity building	Demonstrations conducted	Demonstrations / FLDs conducted	Number	12	9	9	10	10
		Training programmes organized for farmers/ Extension officials	Trainings organized	Number	11	11	12	12	13

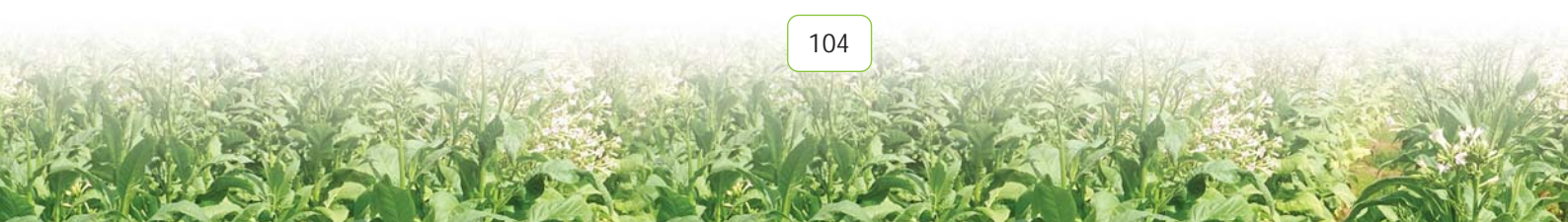




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Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual Value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
	* Efficient Functioning of the RFD System	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	-	-	16/05/13	-	-
		Timely submission of Results for RFD (2012-13)	On-time submission	Date	-	-	02/05/2013	-	-
	* Administrative Reforms	Implement ISO 9001 as per the approved action plan	% Implementation	%	-	-	95	-	-
		Prepare an action plan for Innovation	On-time submission	Date	-	-	10/08/13	-	-
	* Improving internal efficiency / responsiveness / service delivery of Ministry / Department	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	-	-	95	-	-
			Independent Audit of implementation of public grievance redressal system	%	-	-	95	-	-

* Mandatory objective(s)



Acronyms Section 4:

Sl.No.	Acronym	Description
1	AINRP(T)	All India Network Research Project on Tobacco
2	FLD	Front Line Demonstration
3	FCV	Flue-cured Virginia

Section 4:

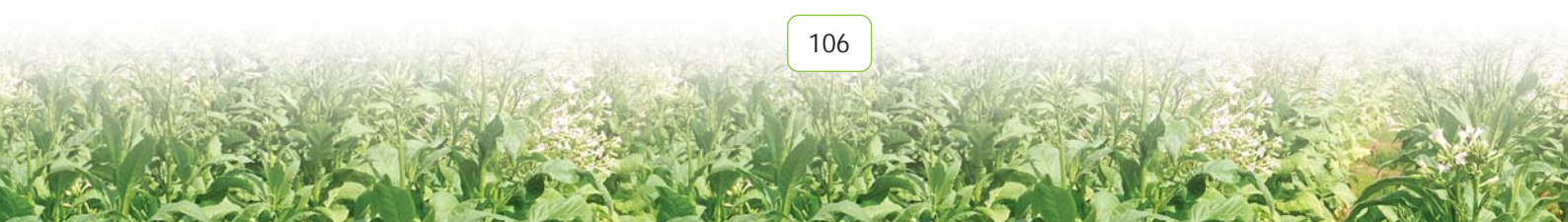
Description and Definition of Success Indicators and Proposed Measurement Methodology

Sl. No.	Success Indicator	Description	Definition	Measurement	General comments
1	Breeding and germplasm lines evaluated	Source material for the improved varieties to be evaluated	Material generated from the basic germplasm	Number of breeding lines evaluated	
2	Lines identified for unique traits	Germplasm lines having unique traits	Germplasm line or material generated from basic germplasm	Number of lines identified	
3	Entries tested in AINRP(T) multi-location trials	Improved lines developed in breeding programmes	Advanced breeding lines having higher yield and quality/resistance/tolerance to biotic and abiotic stresses	Number of entries tested	
4	Varieties identified for release	Breeding lines tested along with checks in multi-location trials through AINRP(T) and the best performing entries compared to checks are identified as new improved varieties for release	Best performing entries identified as a new variety for release during Institute Research Committee meeting or AINRPT group meeting/ workshop	Number of varieties identified	Identification of varieties depend upon the availability of superior material with respect to yield biotic and abiotic resistance/ tolerance over the existing varieties





Sl. No.	Success Indicator	Description	Definition	Measurement	General comments
5	Foundation seed produced	Production of breeder or foundation seed produced under the strict supervision of Scientists	Foundation seed in tobacco is the starting point in the seed chain which is multiplied for distribution among farmers	Quantity produced (Quintals)	Quantity may vary as per the indent from Tobacco Board/ farmer requirement
6	New technologies tested/developed	Technologies developed are aimed to increase yield and quality and to reduce the cost of cultivation and pesticide residues	Technology refers to new or modified practice which can be used as one of the Good Agriculture Practice	Number	This will increase the productivity and profitability
7	Demonstrations / FLDs conducted	Trials and demonstrations conducted for technology testing and proving the technology production potential	Demonstrating the production potential of the technology under real farm situation and to receive feed back from the stake holders	Number of demonstrations/ FLDs conducted	FLDs will be proposed based on the available innovations
8	Trainings organized	The knowledge and skills of the primary and secondary stake holders shall be enhanced by organizing trainings to the concerned	Training is the learning process through which knowledge is improved, attitudes are changed and skills are sharpened for enhancing the performance of clientele (farmers, extension functionaries etc.)	Number of trainings organized	Need based on/off campus training programmes will be organized



Section 5:
Specific Performance Requirements from other Departments

Location type	State	Organization Type	Organization Name	Relevant Success Indicator	What is your requirement from this organization	Justification for this requirement	Please quantity your requirement from this Organisation	What happens if your requirement is not met
Central Government		Board	Tobacco Board	Foundation seed produced	Indent for quantity of tobacco seed for distribution	Tobacco board fixes the crop size every year for FCV tobacco. FCV seed indent vary based on the area fixed	Quantity of foundation seed required	Quantity of foundation seed produced may fluctuate

Section 6
Outcome/ Impact of activities of organization

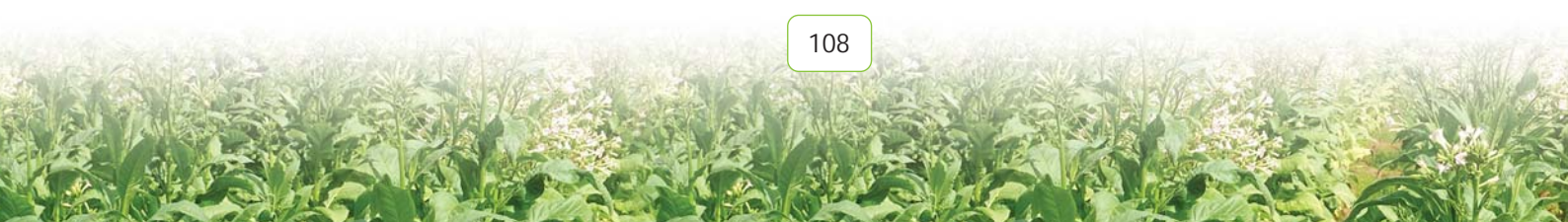
S. No.	Outcome/Impact of organization	Jointly responsible for influencing this outcome/impact with the following departments/ ministry(ies)	Success Indicator (\$)	Unit	2011-12	2012-13	2013-14	2014-15	2015-16
1.	Enhancement in farm production & production efficiency	Tobacco Board, Ministry of Commerce and tobacco Industry	Increased farm production Increase in farm income	M. kg Rupees (Million)	9 350	9.5 360	10 370	10 375	10 380





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S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				Achievements	Performance Raw core	Percent achievements against Target values of 90% Col	Reasons for shortfalls or excessive achievements, if applicable	
							Excellent	Very Good	Good	Fair					Poor
1.	Germplasm enhancement and development of improved cultivars	40	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	15	100	90	80	70	113	100	15.0	113	Number of entries evaluated increased due to the availability of entries with desirable characters selected at CTRI & its Research Stations.
				Lines identified for unique traits	Number	3	2	1	0	0	1	90	2.7	100	—
			Development of improved cultivars	Entries tested in AINRP(T) multi-location trials	Number	8	22	20	16	14	27	100	8.0	135	Number of entries tested increased due to entry of more number of entries having higher yield with desirable characters by AINPT Centres
				Varieties identified for release	Number	4	2	1	0	0	3	100	4.0	300	One variety was identified by AINPT committee and other two more were finally identified after considering the modifications suggested during previous meeting



S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				Achievements	Performance Raw core	Weighted Score	Percent achievements against Target values of 90% Col	Reasons for shortfalls or excessive achievements, if applicable	
							Excellent	Very Good	Good	Fair						Poor
							100%	90%	80%	70%	60%					
							19.5	18.5	16.5	14.5	12.5	18.5	90	9.0	100	—
							5	4	3	2	1	5	100	30.0	125	The achievement is 100% of the criteria only
2.	Development and identification of appropriate technologies	30	Development of new technologies	New technologies tested/developed	Number	30	5	4	3	2	1	5	100	30.0	125	The achievement is 100% of the criteria only
3.	Technology dissemination and capacity building	19	Demonstrations conducted	Demonstrations/FLDs conducted	Number	10	10	9	8	7	6	9	90	9.0	100	-
							13	12	11	10	9	12	90	8.1	100	-
							15/05/13	16/05/13	17/05/13	20/05/13	21/05/13	14/05/13	100	2.0		
							01/05/13	02/05/13	05/05/13	06/05/13	07/05/13	29/04/13	100	1.0		
							01/05/13	02/05/13	05/05/13	06/05/13	07/05/13	29/04/13	100	1.0		
							01/05/13	02/05/13	05/05/13	06/05/13	07/05/13	29/04/13	100	1.0		

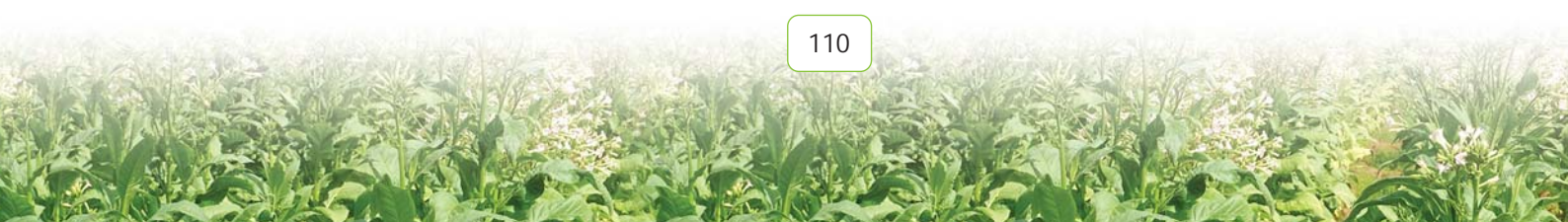




S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				Achievements	Performance Raw core	Weighted Score	Percent achievements against Target values of 90% Col	Reasons for shortfalls or excessive achievements, if applicable
							Excellent	Very Good	Good	Fair					
				100%			90%	80%	70%	60%					
		2.00	%	100		2.00	95	90	85	80	0	0	0		
* Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% Implementation												
		2.00	Date	30/07/13		2.00	10/08/13	20/08/13	30/08/13	10/09/13	27/07/13	100	2.0		
			On-time submission for Innovation												
* Improving internal efficiency/responsiveness/service delivery of Ministry/Department	4	Implementation of Sevottam	% Independent Audit of Implementation of Citizen's Charter			2.00	95	90	85	80	100	100	2.0		
			Independent Audit of implementation of public grievance redressal system			2.00	95	90	85	80	100	100	2.0		

Total Composite Score: 94.8%

Rating : Very good





ICAR - Central Tobacco Research Institute

Rajahmundry - 533 105, Andhra Pradesh, India
Phone: 0883 - 2449871-4, Fax: 0883 - 2448341, 2410555
e-mail : ctri-ap@nic.in; Website : www.ctri.org.in