भाकृअनुप
ICAR

ICAR - CTRI वार्षिक प्रतिवेदन Annual Report 2015-16

भाकृअनुप – केन्द्रीय तम्बाकू अनुसंधान संस्थान
राजमन्द्री - 533 105, आन्ध्र प्रदेश
ICAR - CENTRAL TOBACCO RESEARCH INSTITUTE
RAJAHMUNDRY - 533 105, ANDHRA PRADESH, INDIA

ICAR - CTRI

वार्षिक प्रतिवेदन

ANNUAL REPORT

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Annual Report

2015-16

Published by

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Contents

Preface

The year 2015-16 has been most invigorating in the annals of ICAR-Central Tobacco Research Institute as it witnessed the institute being granted the prestigious **ISO 9001:2008 certificate** for successful implementation of the quality management system with regard to basic, strategic and applied research on tobacco crop. The **Vision-2050** document of the Institute was also prepared during the year. This document articulates the Institute's long-term vision in terms of ***providing vibrant research back-up for Indian tobacco to be less harmful, remunerative and globally competitive in the changing milieu of national and international policy regimes***.

It is indeed an honour for me to present before you the Annual Report of the ICAR – CTRI for the year 2015-16. The institute has always been in the forefront to provide research services to the tobacco farming community by evolving varieties of different tobacco types for high yield potential coupled with quality and other desirable traits, and by developing suitable agro-techniques for effective management of resources, pesticide residues and a multitude of biotic and abiotic stresses.

During the year 2015-16, the institute facilitated the quinquennial review of its research programmes for the period from 2009-10 to 2013-14 by the ICAR appointed QRT team headed by Dr. R. R. Hanchinal, Chairperson, PPV&FRA, New Delhi. The institute's Research Advisory Committee with Dr. A. Padma Raju, Vice-Chancellor, ANGRAU as its Chairman also reviewed the institute's research and made its recommendations for strengthening and fine tuning the ongoing research and initiating new programmes to address the emerging issues relevant to tobacco sector.

The most significant research accomplishments made during the year 2015-16 include: Release of three FCV tobacco varieties (Lt Kanchan, CH1 and N 98) and one *bidi* tobacco variety (Nandyal Pogaku-1) for tobacco growing areas of Andhra Pradesh; Enriching and maintenance of tobacco germplasm; Development of DUS descriptors for characterising tobacco varieties; Use of bio-mass ashes as sources for nutrient supplementation; Management intervention for *orobanche* control; Evaluation and identification of effective pesticide molecules; Development of IPM strategies and pesticide application techniques and identification of neutral volatile aroma compounds in tobacco. The two Krishi Vigyan Kendras at Kalavacharla and Kandukur have made significant contribution in terms of technology assessment, front-line demonstrations, women empowerment, income generation activities and trainings for skill sharpening and capacity development for the benefit of farming community of their respective operational domains. The other significant services provided by the institute to the farming community during the year include: supply of about 6000 kgs of tobacco seed to farmers, and issuing of more than 600 nos. of **Soil Health Cards** to the farmers of A.P. and Karnataka on the eve of World Soil Day. A National Seminar on **Crop Diversification,** sponsored by DAC&FW, MoA & FW, GoI was conducted on 18-1-2016 and discussed the myriad issues relating to crop diversification. Under Tribal Sub-plan:2015-16, a Tribal Agri Action Plan covering important inputs and management intervention was prepared and implemented at Manchulavarigudem and Sugalimetta in A.P. Lastly, it is heartening to note that some Scientists have brought laurels to the institute by way of bagging prestigious honours and awards in recognition of their outstanding research contributions.

I express my gratitude to Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR, and Dr. S. Ayyappan, the Former Secretary, DARE & DG, ICAR for their inspirational leadership and guidance. I place on record my sincere thanks to Dr. J.S. Sandhu, DDG (Crop Science), Dr. R.K.Singh, ADG (CC) & Dr. P.K.Chakraborty, Former i/c ADG (CC) for their motivation and support extended from time to time. The encouragement and guidance given by the Dr. R.R. Hanchinal, Chairman, QRT and Dr. A. Padma Raju, Chairman, RAC are gratefully acknowledged. I appreciate the sincere efforts made by the editorial committee, PME cell and LDS in bringing out the annual report in time. Finally, I thank all the Heads of the Divisions/Research Stations, scientists and technical & administrative staff for their help and cooperation in running the institute smoothly and effectively.

15th June, 2016
Rajahmundry

(D. DAMODAR REDDY)
Director

कार्यकारी सारांश

तम्बाकू किस्मों का विकास

रिलीज किए गए किस्में

- व्यवसायिक खेती के लिए चार तम्बाकू किस्मों को रिलीज किया गया नामतः फ्लेवरयुक्त एफसीवी तम्बाकू संकर सीएच–1, एफसीवी तम्बााकू किस्में एलटी कंचन (कम टार वाला किस्म) एवं एन–98 तथा बीड़ी तम्बाकू किस्म नंदीयाला पोगाकू–1। चारों किस्मों में उच्च उपज क्षमता और बेहतर गुणवत्ता है।

किस्मों में सुधार

- काली मष्दा – उन्नत प्रजनन वंषक्रम वी–5057, आरएस–27 तथा आरएस–29 में सामान्य किस्म सिरी की तुलना में उपचारित पत्ती उपज, सुवर्ण पत्ती उपज तथा श्रेणी सूचकांक उल्लेखनीय रूप से अधिक पायी गयी। सिरी की तुलना में इन वंषक्रमों की उपज में औसतन उपचारित पत्ती में 19%, सुवर्ण पत्ती में 23% और श्रेणी सूचकांक में 20% की वषद्धि हुई।
- उत्तरी हल्की मष्दा – सोमाक्लोन्स, एनएलसीआर –1–9–2–13 एवं एनएलसीआर–7–11–1–4, उन्नत प्रजनन वंषक्रम आरटी3–1 एवं आरटी4–3 में कंचन की तुलना में अधिक उपज पायी गयी जिससे उपचारित पत्ती उपज में 20–41% और श्रेणी सूचकांक में 41–65% वषद्धि हुई।
- कर्नाटक हल्की मष्दा – उन्नत प्रजनन वंषक्रम एफसीएच 239 तथा एफसीएच 242 में अधिकतम उपचारित पत्ती (2600 तथा 2579 कि.ग्रा.), सुवर्ण पत्ती (1443 तथा 1716 कि.ग्रा.) और टीजीई (क्रमषः 1409 तथा 1708) दर्ज की गई।
- सिंचित नाटू तम्बाकू – उन्नत प्रजनन वंषक्रम एनएफ 3–5–1 तथा एनएफ 3–6–2 में सामान्य किस्म कोम्मूगूडेम की उपज की तुलना में उपचारित पत्ती उपज (19–59%) उल्लेखनीय रूप से अधिक दर्ज की गई।
- चर्वण तम्बाकू – सामान्य किस्मों में बेहतर किस्म अबिरामी की तुलना में चयन एचवी 2011–2 में उल्लेखनीय रूप से पत्ती उपज अधिक (11.0% की वषद्धि) पायी गयी।
- संकर तम्बाकू – सामान्य किस्म सिरी की तुलना में 10 सीएमएस संकरों में महत्वपूर्ण मानक भिन्नाश्रय (हेटेरोसिस) देखा गया। उपचारित पत्ती के संदर्भ में भिन्नाश्रय 18–34, सुवर्ण पत्ती के संदर्भ में 14–35 तथा श्रेणी सूचकांक के संदर्भ 17–36 दर्ज किया गया।
- रोग प्रतिरोधिता – रिलीज किए गए किस्मों नामतः सिरी, एन–98 तथा सीवाई–142 में ब्लैक षेंक प्रतिरोधिाता गुण सम्मिलित किया गया। दो सौ तैंतीस संततियों में ब्लैक षेंक प्रतिरोधिता दर्ज की गई।

जननद्रव्य संसाधन प्रबंधन

- भाकृअनुप–केन्द्रीय तम्बाकू अनुसंधान संस्थान में उपलब्ध आनुवंषिक संसाधनों की कुल संख्या 3369 वंषक्रम है।
- वन्यय निकोटियाना प्रजातियां – 56 वन्य निकोटियाना प्रजातियों तथा 2 उपप्रजातियों के कुल 210 वंषक्रम, 9 विदेषी संकर, 5 लोकल इन्टर स्पेसिफिक हाइब्रिड्स तथा 4 एम्पली डिप्लासयड्स का रखरखाव किया गया। कृत्रिम परिवेष में मैक्रोप्रोपागेषन के माध्यम से 11 फूल न खिलने वाले वंषक्रमों को बचाया गया।
- डीयूएस चित्रीकरण – तीन जीनप्ररूपों नामतः सिरी, टीबीएसटी–2 तथा विषिश्ट जननद्रव्य 324सी की भिन्नता, समानता और स्थिरता (डीयूएस) के 53 गुणों के लिए गुणचित्रण किया गया।

तम्बाकू सुधार हेतु जैवप्रौद्योगिकी

- टीएसएनए, निकोटीन तथा सोलानेसॉल गुणों के लिए 11 एसएसआर मार्कर नामतः टीएम51534, टीएम10606, टीएम10891, टीएम50469, टीएम1111062, टीएम50868, पीटी61653, पीटी10375, पीटी50065, पीटी60723 तथा पीटी53345 बहुरूपी पाए गए।
- चार डिफेंस रेसपान्स जींस नामतः एनटीएमईके2, पीआर1ए, पीएएल1 के ट्रांसक्रिप्ट विश्लेषण से सहविनियमन स्पष्ट हुआ है और इनका संबंध तम्बाकू में सीलन रोग सहिष्णुता से है।
- एम्प्लीकॉन की लम्बाई और अनुक्रमण के संदर्भ में

निकोटियाना वंशक्रमों मे तीव्र गति से उद्विकसित लोसी trnH-psbA (इन्टरजेनिक स्पेसर रीजन) बहुरूपी पाया गया।

कृशि–प्रौद्योगिकियों का विकास

एफसीवी तम्बाकू

- उत्तरी हल्की मष्दाओं में सामान्य सीडलिंग्स में रोपण के पष्चात मष्दा में 10, 25–30 तथा 40–45 दिनों पर उर्वरक+फर्रो इरीगेषन की तुलना में ट्रे सीडलिंग्स पर रोपण के पष्चात 3, 20–25 तथा 40–45 दिनों पर टपक सिंचाई करने पर उपचारित पत्ती उपज (16.67%) और श्रेणी सूचकांक (23.44%) में वष्द्धि देखी गयी।
- उत्तरी हल्की मष्दाओं में बेसल खुराक के रूप में यूरिया/अमोनियम सल्फेट (एएस) तत्पष्चात यूरिया या एएस या यूरिया+एएस या यूरिया+एएस+पोटैषियम नाइट्रेट या यूरिया+एएस+कैल्षियम नाइट्रेट टॉप ड्रेसिंग के रूप में देने पर उपचारित पत्ती उपज और श्रेणी सूचकांक एक समान ही रहा है।
- गोबर की खाद+एनपीके या गोबर की खाद+अत्यंधिक नाइट्रोजन+पीके देने पर अविष्वासी परिपक्वता के बिना उत्पादकता में वष्द्धि देखी गयी।
- नर्सरी में 25 या 50 कि.ग्रा./हे. की तुलना में पोटैषियम आक्साइड 100 कि.ग्रा./हे. की दर से चार भागों में (रोपण के दौरान तथा रोपण के 25, 35 और 45 दिनों बाद) देने पर सूखे पदार्थ का उच्च उत्पादन तथा प्रति युनिट क्षेत्र से प्रतिरोपण योग्य नवोदभिद पौधों की अधिक संख्या पायी गयी।
- कर्नाटक की हल्की मष्दाओं में वर्शा के दिन अधिक होने पर एफसीवी तम्बाकू उत्पादकता में वष्द्धि तथा फसल अवधि के दौरान धूप के घंटों से सहसंबंध है।
- तम्बाकू की जैविक खेती में सुवर्ण श्रेणी उत्पादन में 6–7% की वष्द्धि, जैविक तम्बाकू में मुरझान रोग प्रकोप तथा जड़ गांठ रोग में कमी हुई है।
- काली मष्दा में उगाए गए तम्बाकू में रोपण से पूर्व पेंडीमेथालिन @ 325 g a.i तथा अलाक्लार @ 1000 g a i/ ha देने पर उपज हाथों से ओरोबंचे निकालने के समान ही रहा है।
- वर्टीसोल में गोबर की खाद+एनपीके देने तथा ओरोबंचे निकालने पर अविष्वासी परिपक्वता के बिना उच्च उपचारित पत्ती उपज और श्रेणी सूचकांक प्राप्त हुई। टीबीएसटी–2 की तुलना में वीटी–1158 किस्म का निश्पादन अविष्वासी परिपक्वता के बिना बेहतर पाया गया।

गैर–एफसीवी तम्बाकू

- सामान्य किस्म में गोबर की खाद 10 टन/हे. की तुलना में मोतीहारी तम्बाकू में 112 कि.ग्रा. नाइट्रोजन+112 कि.ग्रा. फास्फोरस पेंटाक्साइड देने पर उच्च उपचारित पत्ती उपज (2331 कि.ग्रा./हे) दर्ज की गई।
- बर्ली तम्बाकू में 100% आरडीएफ के साथ सेट रो प्लांटिंग (एसआरपी) करने पर उल्लेखनीय रूप से उच्च उपचारित पत्ती उपज तथा एन, पी, के का उद्ग्रहण देखा गया। एसआरपी में 50% या 75% आरडीएफ देने पर 100% आरडीएफ के साथ परम्पररागत रोपण जैसा ही रहा है।
- प्रचलित अबिरामी की अपेक्षा उन्नत चर्वण तम्बाकू वंषक्रम एचवी 2009–3 में प्रथम श्रेणी पत्ती उपज में 10.6% तथा कुल उपचारित कुल पत्ती उपज में 13% की उल्लेखनीय वष्द्धि हुई।
- तमिलनाडु में चर्वण तम्बाकू पालन में वर्शिक मोरिंगा को उपयुक्त अंतर–फसल के रूप में पहचान की गई।

उत्पादन क्षमता और उत्पाद गुणवत्ता के लिए संसाधन अवरोधों का प्रबंधन

- फसल अवषेशों को जलाने से उत्पन्न बायोमास राख या तम्बाकू उपचार खलिहानों के लकड़ी के राख का उपयोग लाइमिंग मैटिरियल के रूप में किया जा सकता है और इससे मष्दा की पोटैषियम उर्वरता में सुधार होता है जो बायोमास डाली गई मष्दा में उपलब्ध पोटैषियम स्तर से प्रमाणित होता है।
- फसल अवषेशों/लकड़ी की राख को अकेले या एसओपी के साथ (50%+50%) 100 कि.ग्रा. पोटैषियम के समान आधार पर उपयोग से उपचारित पत्ती उपज तथा पत्ती की गुणवत्ता को प्रभावित किए बिना पोटैषियम उद्ग्रहण में उल्लेखनीय वष्द्धि देखी गई।

विभिन्न बायोमास राख उपचारों में तम्बा्कू की सापेक्ष उपज का स्तर हंसूर में 88 से 98% तथा जीलगूमिल्ली में 98 से 105% पाया गया।

- तम्बाकू डंठलों से बायोचार का उच्च मात्रा में टीओसी (80%), नाइट्रोजन (1.23), फास्फोरस (0.78%), पोटैषियम (3.48) तथा अल्कालीन पीएच (9.42) से गुणचित्रण किया गया। तम्बाकू डंठल बायोचार और सिंथेटिक जियोलाइट की धनायन विनिमय क्षमता (केषन एक्सचेंज कैपासिटी) क्रमषः 30 और 270 Cmol (p+) प्रति कि.ग्रा. पाया गया।
- एन. टबाकम से संष्लेशित सिल्वर नैनोपार्टीकल्स का आकार गोलाकार से अनियमित तथा पार्टीकल आमाप 10853.3 एनएम और पीडीआई मान 1.884 पाया गया।
- प्राथमिक पोशक तत्वों (एन, पी और के) की पर्याप्त आपूर्ति की स्थिति में ही गौण पोशक तत्व पौधे की वषद्धि, चयापचय और पोशक तत्वों के उद्ग्रहण में महत्वपूर्ण भूमिका निभाते हैं।
- बीड़ी तम्बाकू के नौ किस्मों में से एमआरजीटीएच1 में अधिकतम वाश्पषील सुगंध यौगिक पाया गया। लेनोलिनेट बीड़ी तम्बाकू में मौजूद प्रमुख असंतष्त वसीय अम्ल (अनसैचूरेटेड फैटी एसिड) है।
- पत्ती के लिए तम्बाकू फसल कैनोपी का स्पेक्ट्रल रिफ्लेक्टेंस में संवेदनषील बैंड की पहचान पोटैषियम मान 747–862 एनएम, निकोटिन 539–541 एनएम तथा 710 एनएम, घटती षर्करा 631–692 तथा 1901–1970 एनएम और पत्ती में कुल नाइट्रोजन 350–365 एनएम किया गया।

जैविक स्ट्रैस का समेकित प्रबंधन

- मध्य एवं दक्षिणी काली मष्दाओं में तम्बाकू नर्सरी और रोपित फसल में पत्ती मुडन और तम्बांकू सूंडीयां प्रमुख कीट पीड़क हैं।
- कर्नाटक हल्की मष्दाओं में तम्बाकू से जुड़े पांच प्रमुख परजीवीय सूत्रकृमियां पायी गयीं नामतः मेलोयडोजाइन उपप्रजाति, रोटीलेनचुलसरेनीफार्मिस, हेलकोटीलेंचस उपप्रजाति, प्राटीलेंचस उपप्रजाति तथा टाइलेंचस उपप्रजाति।
- नर्सरियों एवं रोपित फसलों में स्पोडोपटेरा लिटूरा के प्रति क्लारफ्लाजूरॉन 5.4 ईसी 0.03% प्रभावी पाया गया। एफसीवी तम्बाकू में तम्बाकू एफिड माइजस निकोटियाने के प्रति फ्लोनिकामिड 50 डब्ल्यूजी और पाइमेट्रोजाइन 50 डब्ल्यूजी 0.02% की दर से प्रभावी पाया गया। एफसीवी तम्बाकू में तम्बाकू व्हाइट फ्लाई *बेमिसिया टाबाकी* (गेन्ना डियस) पर पाइमेट्रोजाइन 50 डब्ल्यूजी 0.02% की दर से, फ्लोनिकामिड 50 डब्ल्यूजी 0.02% की दर से तथा स्पैरोमेसिफेन 240 एससी 0.02% की दर से उपयोग करने पर प्रभावी पाया गया। फ्लोनिकामिड 50 डब्ल्यूजी 0.02% तथा पाइमेट्रोजाइन 50 डब्ल्यूजी 0.02% छिड़काव वाले एफसीवी तम्बाकू में छिड़काव के 15 दिनों बाद 1 मि.ग्रा./कि.ग्रा. से भी कम अवषेश पाए गए।
- प्रतिरोपण गड्डे में नवोदभिद पौधे के जड़ को इमिडाक्लोप्रिड 70 एएफ 0.14: की दर पर डुबोने या इमिडाक्लोरप्रिड 200 एसएल 0.005% की दर से देने पर ग्राउंड बीटल *मेसोमॉरफस विल्लीगर ब्लानकार्ड* का प्रबंधन हो सकता है।
- सोकोस्पोरा निकोटियाने से होने वाले रोग फ्रॉग आई स्पॉट रोग के प्रति पैराक्लोसट्रोबिन. मेटीराम 0.2% या कार्बेंडाजिम 0.05% का छिड़काव रोग प्रकोप के तुरन्त बाद और 10–15 दिनों के बाद दूसरा छिड़काव प्रभावी पाया गया।
- तम्बाकू नर्सरियों में पत्ती मुरझान रोग प्रबंधन के लिए मेटालक्साइल 8% मैंकोजेब 64% की अपेक्षा फनामिडॉन 10% मैंकोजेब 50% बेहतर विकल्प है।
- रोपण के पष्चाात 50 दिनों तक हाई टेक स्प्रोयर बेहतर पाया गया और इसके बाद एचपीकेएस छिड़काव द्रव्यप और समय के संदर्भ में बेहतर है।
- तम्बाकू एफिड के नियंत्रण में बायो–इन्सेंटिव आईपीएम मॉड्यूल प्रभावी पाया गया जिसमें सीमा फसल के रूप में मक्का की दो पंक्तियां, रोपण के पष्चात वर्टीसिलियमलेसानी का 3X1012 सीएफयू/हे. की दर से एक छिड़काव तथा रोपण के 60 दिनों के पष्चात ईमिडाक्लोप्रिड का 50 ग्रा. ए.आई/हे. का छिड़काव सम्मिलित है।
- उद्भासित नर्सरी क्यारियों में सूत्रकृमियों के प्रकोप,

अवमन्दन तथा मुरझान रोग प्रकोप के प्रभावकारी नियंत्रण के लिए समेकित मॉडयूल का विकास किया गया जिसमें ट्राइकोडर्मा विराडे एवं पेसिलोमाइसेस लिलासीनस, ट्राइकोडर्मा विराडे एवं पोचानिया केलिमडोसपोरिया के संयोजन का रिडोमिल और फ्यूराडॉन के साथ उपयोग किया गया।

- टी. विराडे (30 ग्रा.)+ पी. लिलासीनस (30 ग्रा.)+ पी. क्लाकमीडिस्पो रिया (30 ग्रा.) से समष्द्ध ट्रे–सीडलिंग्स में सामान्य किस्म की तुलना में उपचारित पत्ती उपज में 10.5 प्रतिषत वषद्धि तथा मुरझान रोग में 51% की कमी देखी गई।

तम्बाकू के वैकल्पिक उपयोग का दोहन

- वंषक्रम आरटी 51–1 का 60 x 40 से.मी. की दूरी पर रोपण तथा एनपीके 150:75:75 कि.ग्रा./हे. की दर से देने पर निकोटीन की उपज अधिक दर्ज की गई। एचडीबीआरजी का 70 x 40 से.मी. की दूरी पर रोपण तथा एनपीके 150:75:75 कि.ग्रा./हे. की दर से देने पर सोलानेसोल (55.10 कि.ग्रा./हे.) तथा प्रोटीन उपज (925.7 कि.ग्रा./हे.) अधिक पायी गयी।

कृशि विज्ञान केन्द्र, कलवाचर्ला

वर्श 2015–16 के दौरान कृशि, बागवानी, पषु पालन, आय प्राप्त करने की गतिविधियों से संबंधित 6 खेत परीक्षण तथा 10 अग्रपांक्ति निरूपण, 4 वोकेषनल ट्रेनिंग तथा 14 प्रषिक्षण कार्यक्रमों का आयोजन किया गया।

- स्थानीय रूप से खेती वाले किस्म की अपेक्षा ऊतक संवर्धित कोकिनिया से उपज में 4.5 टन/हे. की वषद्धि हुई।
- कृशि प्रौद्योगिकी प्रबंधन अभिकरण के माध्यम से पूर्व गोदावरी जिले में किसानों को 11 ब्लैक बंगाल बकरियां दे कर इन्हें लोकप्रिय बनाया गया।
- गुड़ के घोल़ +डिक्लोरोवास़+गेहूं के आटे का प्रलोभन दे कर घोंघों का समेकित प्रबंधन प्रभावी रहा और मष्त्यु दर 23% रही।
- आय उत्पत्ति वाली गतिविधियों जैसे परिधान बनाना, पलमिराह पत्तियों से दस्तकारी, मग्गम इमब्राइडरी, पलमिराह रेषा निकालना, खरपतवारों से दस्तकारी और सस्योत्तर मूल्य संवर्धन जैसे फलों और सब्जियों में मूल्या संवर्धन, दूध के साथ साथ मछली/झींगों तथा मांस में मूल्य संवर्धन कार्यक्रमों का आयोजन किया गया ताकि पारिवारिक आय बढ़ सके।
- पूर्व गोदावरी जिले के कृशि प्रौद्योगिकी प्रबंधन अभिकरण के सहयोग से कृशि विज्ञान केन्द्र ने दिनांक 09.11.2015 को केवीके, कलवाचर्ला में 'किसान मेला' का आयेजन किया। इस कार्यक्रम में पूर्व गोदावरी जिले के 300 किसानों ने भाग लिया।

कृशि विज्ञान केन्द्र, कंदूकूर

- नई पहचान की गई एफसीवी तम्बाकू वंषक्रम टीबीएसटी–2 पर दो अग्रपंक्ति निरूपणों और मिल्की मुषरूम उत्पादन का भी निरूपण किया गया।
- प्रकाषम जिले में चारा उत्पादन को बढ़ावा देने हेतु किसानों को सीओ–4 के चारा कटिंग्स की आपूर्ति की गई।
- दो दिनों तक 50 किसानों को मिल्की मुषरूम उत्पादन में प्रषिक्षित किया गया।

अन्य उपलब्धियां

आईएसओ 9001:2008

''तम्बाकू फसल पर मौलिक, सामरिक एवं व्यवहारिक अनुसंधान'' के संदर्भ में गुणवत्ता प्रबंधन प्रणाली के कार्यान्वयन के लिए आईसीएआर–सीटीआरआई को आईएसओ 9001:2008 प्रमाण पत्र दिनांक 25.01.2016 को दिया गया।

फसल विविधिकरण पर राश्ट्रीय सेमिनार

आईसीएआर–सीटीआरआई ने डीएसी एवं एफडब्ल्यू द्वारा प्रायोजित ''फसल विविधिकरण'' विशय पर दिनांक 18.01.2016 को राश्ट्रीय सेमिनार का आयोजन किया। सेमिनार में वैज्ञानिक, किसान और उद्योग जगत के प्रतिनिधियों ने भाग लिया और तम्बाकू उगाने वाले क्षेत्रों में फसल विविधिकरण से संबंधित अनगिनत पहलुओं पर चर्चा की। कुल मिलाकर सेमिनार के माध्यम से तम्बाकू उगाने वाले क्षेत्रों में फसल विविधिकरण से संबंधित विभिन्न पहलुओं पर सूचनाओं और अनुभवों के आदान–प्रदान हेतु एक मंच उपलब्ध कराया गया।

जनजातीय उप–योजना

- वर्श 2015–16 के दौरान आन्ध्र प्रदेष के पष्चिम गोदावरी जिले के सीतप्पागूडेम ग्राम पंचायत के

जनजातीय गांव मंचुलावारीगूडेम में आईसीएआर–सीटीआरआई के जनजातीय उप–योजना का कार्यान्वनयन किया गया। पांच हस्तक्षेप नामतः उच्च उपज वाले मक्का संकर (डीएच–117) का फाउनडेषन सीड की आपूर्ति, उर्वरक, प्रक्षेत्र उपकरण (तौलन उपकरण, उन्नंत छिड़काव यंत्र), स्थायी खाद्यान्न भंडारण गोदामों का निर्माण आदि कार्य 38 प्रक्षेत्र परिवारों के लिए किया गया।

- एआईएनपी का जनजातीय उप–योजना का कार्यान्वयन आचार्य एन. जी. रंगा कृशि विष्वविद्यालय के आरएआरएस, नंदीयाल ने किया। उत्पादकता में सुधार हेतु संवेदनषील निवेषों (उर्वरक, कीटनाषक और उन्नत किस्में) की आपूर्ति, मोटे अनाज और दलहनों में उत्पादकता की वषद्धि हेतु प्रषिक्षण कार्यक्रम तथा संबंधित साहित्य की आपूर्ति सहित अनेक प्रकार के हस्तक्षेपों का कार्यान्वयन आन्ध्र प्रदेष के अनंतपुर जिले के पंयम मंडल के सुगलीमेट्टा गांव के 40 जनजातीय किसानों के लिए किया गया।
- आन्ध्र प्रदेष प्रौद्योगिकी विकास और प्रोन्नति केन्द्र (एपी–टीडीसी), हैदराबाद ने आईसीएआर–सीटीआरआई के प्रौद्योगिकी सहयोग से राजमंड्री में दिनांक 05.06.2015 से 07.06.2015 के दौरान कृशि प्रदर्षनी (एपी–टेक 2015) का आयोजन किया।

मेरा गांव मेरा गौरव

- आईसीएआर–सीटीआरआई, राजमंड्री में नवम्बर, 2015 के दौरान मेरा गांव मेरा गौरव कार्यक्रम प्रारम्भ किया गया। वैज्ञानिकों ने गांवों को अपनाया और गांवों के बेस लाइन सर्वे कार्य पूर्ण कर लिया गया। नियमित रूप से किसानों के लिए समय समय पर सलाहकार सेवाएं दी जा रहीं हैं।

विष्व मष्दा दिवस

- सीटीआरआई के प्रादेषिक केन्द्र, हंसूर, कर्नाटक, सीटीआरआई–केवीके, कलवाचर्ला (पूर्व गोदावरी जिला), आन्ध्र प्रदेष तथा सीटीआरआई–केवीके, कंदूकूर (प्रकाषम जिला), आन्ध्र प्रदेष में दिनांक 05.12.2015 को विष्व मष्दा दिवस मनाया गया। इस अवसर पर आन्ध्र प्रदेष और कर्नाटक के किसानों को 606 मष्दा स्वास्थ्य कार्ड जारी किया गया।

जय किसान जय विज्ञान सप्ताह

आईसीएआर–सीटीआरआई, राजमंड्री में दिनांक 23–29 दिसम्बसर, 2015 के दौरान किसानों के हित में विज्ञान को बढ़ावा देने हेतु जय किसान जय विज्ञान सप्ताह का आयोजन किया गया। कृशि और संबद्ध क्षेत्रों में योगदान के लिए नवोन्मेशी किसानों और कृशक महिलाओं को सम्मानित किया गया।

स्वच्छ भारत कार्यक्रम

प्राकृतिक संसाधन प्रबंधन (जल, मष्दा और ऊर्जा) के संरक्षण पर ध्यान केन्द्रित करते हुए स्वच्छ भारत कार्यक्रम को कार्यान्वित किया गया।

पुरस्कार एवं सम्मान

- डॉ. डी. दामोदर रेड्डी, निदेषक, आईसीएआर–सीटीआरआई, डॉ. के. सुमन कल्याणी, प्रधान वैज्ञानिक, डॉ. एच. रविषंकर को विज्ञान और प्रौद्योगिकी में उत्कष्ष्ट योगदान के लिए प्रतिश्टित पुरस्कार और सम्माान दिया गया।

Executive Summary

Tobacco Cultivar Development

Varieties released:

- Four tobacco varieties *viz.* flavourful FCV tobacco hybrid CH-1, FCV tobacco varieties LT Kanchan (low Tar) and N-98, and *bidi* tobacco variety Nandyala Pogaku-1 were released for commercial cultivation. All the four varieties are having high yield potential with superior quality.

Cultivar improvement:

- **Black soils:** Advanced breeding lines *viz.*, V-5057, RS-27 and RS-29 recorded significantly higher cured leaf yield, bright leaf yield and grade index over the control Siri. The average yield increase in these lines over Siri was 19% in cured leaf, 23% in bright leaf and 20% in grade index.

- **Northern light soils:** Somaclones, NLCR-1-9-2-13 and NLCR-7-11-1-4, advance breeding lines, RT3-1 and RT4-3, recorded significantly higher yields over Kanchan with an increase of 20-41 % cured leaf yield and 41-65% grade index.

- **Karnataka Light Soils:** Advanced breeding lines, FCH 239 and FCH 242 recorded highest cured leaf (2600 and 2579 kg), bright leaf (1443 kg and 1716 kg) and TGE (1409 and 1708 respectively).

- **Irrigated natu tobacco:** Advanced breeding lines, NF3-5-1 and NF3-6-2 recorded significantly higher cured leaf (19-59%) than check, Kommugudem.

- **Chewing tobacco:** Selection HV.2011-2 was significantly superior to the best check Abirami in leaf yield with 4144 kg/ha (an increase of 11.0%).

- **Hybrid tobacco:** Ten CMS hybrids showed significant standard heterosis over check Siri. The heterosis varied from 18-34% for cured leaf, 14-35% for bright leaf and 17-36% for grade index.

- **Disease resistance:** Black shank resistance was incorporated into released varieties *viz.*, Siri, N-98 and Cy-142. Two hundred and thirty three progenies recorded resistance for Black shank.

Germplasm resource management:

- The total available genetic resources at ICAR- CTRI stand at 3369 accessions.

- **Wild Nicotiana species:** A total 210 accessions of 56 wild *Nicotiana* species and two subspecies, 9 exotic hybrids, 5 local interspecific hybrids and 4 amphidiploids were maintained. Eleven non-flowering accessions were rescued through in-vitro micro propagation.

- **DUS Characterisation:** Three genotypes *viz.*, Siri, TBST-2 and unique germplasm 324C were characterized for 53 Distinctness, Uniformity and Stability (DUS) characteristics.

Biotechnology for tobacco improvement:

- Eleven SSR markers viz., TM51534, TM10606, TM10891, TM50469, TM1111062, TM50868, PT61653, PT10375, PT50065, PT60723 and PT53345 were found to be polymorphic for TSNA, nicotine and solanesol traits.

- Transcript analysis revealed the co regulation of four defense response genes namely NtMEK2, PR1a, PAL1 and are implied to be associated with the damping off disease tolerance mechanism in Tobacco.

- The rapid evolving loci trnH–psbA (intergenic spacer region) is found to be polymorphic among the *Nicotiana* accessions with respect to amplicon length and sequence.

Development of Agro-Technologies

FCV tobacco

- Tray seedlings coupled with drip fertigation at 3, 20-25 and 40-45 DAP showed increased cured leaf yield (16.67%) and grade index

(23.44%) over the practice of normal seedlings + soil application of fertilizers at 10, 25-30 and 40-45 DAP + furrow irrigatoion in Northern Light Soils.

- Application of urea/ ammonium sulphate (AS) as a basal dose followed by urea or AS or urea+ AS or urea + AS+ potassium nitrate or urea + AS + calcium nitrate as top dressing were at par in cured leaf yield and grade index under the conditions of NLS.

- Application of FYM + NPK or FYM + Excess N + PK, resulted in enhanced productivity without false maturity.

- Application of 100 kg K_2O/ha to nursery in 4 splits (at sowing, 25 DAS, 35 DAS and 45 DAS) recorded significantly higher dry matter production and higher number of transplantable seedlings per unit area compared to 25 or 50 kg/ha.

- On Karnataka Light Soils, FCV tobacco productivity tends to increase with increased number of rainy days and significantly correlated with the sun shine hours during the crop season.

- Organic tobacco cultivation increased the bright grade production by 6-7%, reduced incidence of wilt disease as well as root knot incidence by 40-45% in organic tobacco.

- Pre plant application of Pendimethalin @ 325 g a.i and Alachlor @ 1000 g ai/ ha recorded on par yields with that of hand removal of orobanche in black soil grown tobacco.

- In Vertisols, application of FYM + NPK and removal of *orobanche* produced higher cured leaf yield and grade index without any false maturity. cv. VT-1158 performed better than TBST-2 without any false maturity.

Non-FCV tobacco

- Application of 112 kg N + 112 Kg P_2O_5 + 112 Kg K_2O/ha recorded significantly higher cured leaf (2331 kg/ ha) yield in Motihari tobacco as compared to control, FYM @10t/ ha.

- In burley tobacco, Set Row Plating (SRP) with 100% RDF showed significantly higher cured leaf yield and N, P, K uptake. Application of 50% or 75% RDF in SRP was as good as conventional planting with 100% RDF.

- Advanced chewing tobacco breeding line Hv.2009-3 significantly increased the first grade leaf yield by 10.6% and total cured leaf yield by 13% over the ruling variety Abirami.

- Annual moringa was identified as suitable intercrop in chewing tobacco in Tamil Nadu.

Management of resource constraints for production efficiency and product quality

- Biomass ashes resulting from crop residue burning or wood ash from tobacco curing barns can serve as potential liming material and improves K-fertility of soil as evidenced from increased levels of K availability in biomass amended soils.

- Application of crop residue/wood ashes either alone or in combination with SOP (50% + 50%) on 100 kg K ha^{-1} equivalent basis caused a significant increase in tobacco cured leaf yield and K uptake without affecting the leaf quality. The relative yield of tobacco with different biomass ash treatments ranged from 88 to 98% at Hunsur and from 98 to 105% at Jeelugumilli.

- Biochar from tobacco stems is characterized by high content of TOC (80%), N (1.23%), P (0.78%), K (3.48%) and alkaline pH (9.42). The cation exchange capacity of tobacco stem biochar and synthetic zeolite were 30 and 270 Cmol (p+) kg^{-1}, respectively.

- Silver nanoparticles synthesized from N. tabacum leaf are spherical to irregular in shape with a particle size of 10853.3 nm and a PDI value of 1.884.

- Secondary nutrients play important role on

plant growth, metabolism and nutrient uptake under sufficient supply condition of primary nutrients (N, P and K) only.

- Among the nine bidi tobacco varieties, MRGTH1 showed maximum neutral volatile aroma compound. Lenolenate was the major unsaturated fatty acid present in *bidi* tobacco.
- Identified the sensitive bands in tobacco crop canopy spectral reflectance for leaf potassium at 747 – 862 nm, nicotine at 539-541 nm and 710 nm, reducing sugars at 631-692 nm and 1901-1970 nm and for leaf total nitrogen at 350-365 nm.

Integrated Management of Biotic stresses

- In Central and Southern black soils, Leaf curl and tobacco caterpillar, were the main insect pests in tobacco nursery and planted crop.
- Under Karnataka light soils condtions, five major plant parasitic nematodes were found associated with tobacco *viz., Meloidogyne* spp, *Rotylenchulusreniformis*, *Helcotylenchus* spp, *Pratylenchus* spp and *Tylenchus* spp.
- Chlorfluazuron 5.4 EC 0.03% was found highly effective against Spodoptera *litura Fabricius* in nurseries as well as in planted crop of FCV tobacco. Flonicamid 50 WG and pymetrozine 50 WG @ 0.02% were found promising against tobacco aphid, *Myzus nicotianae* Blackman in FCV tobacco. Pymetrozine 50 WG @ 0.02%, flonicamid 50 WG @ 0.02% and spiromesifen 240 SC @ 0.02% were promising against tobacco whitefly *Bemisia tabaci* (Gennadius) in FCV tobacco. The residues in FCV tobacco sprayed with flonicamid 50 WG @ 0.02% and Pymetrozine 50 WG @ 0.02% were less than 1 mg/kg after 15 days of spray.
- Ground beetle, *Mesomorphus villiger* Blanchard could be managed by seedling root dip with Imidacloprid 70 AF @ 0.14% or applying imidacloprid 200 SL @ 0.005% in transplant hole.
- Spraying of either pyraclostrobin + metiram @ 0.2% or carbendazim @ 0.05% immediately after disease incidence followed by another spray after 10-15 days found effective against Frog eye spot disease in tobacco caused by *cercospora nicotianae.*
- Application of fenamidone 10% + mancozeb 50% @ 0.3% is a promising alternative to metalaxyl 8% + mancozeb 64% for the management of leaf blight disease in tobacco nurseries.
- Use of Hi tech sprayer was superior till 50 DAP and thereafter HPKS in terms of saving spray fluid and time.
- The bio-intensive IPM module with two rows of maize border as barrier crop, one spray of Verticilliumlecanii @ 3X1012 CFU/ha at 50 DAP and one spray of imidacloprid @ 50g a.i./ha at 60 DAP effectively controlled the tobacco aphid
- An Integrated module comprising of of *Trichoderma viride & Paecilomyces lilacinus*, Trichoderma *viride & Pochania chlalymdosporia* used in conjunction with ridomil and furadon in solarised nursery beds was developed for effective control of nematode incidence, damping off and blight diseases incidence.
- Tray seedlings enriched with *T. viride* (30 g) + *P. lilacinus (30 g)* + *P. chlamydosporia (30 g*) increased the cured leaf yield by 10.5 per cent and decreased the wilt disease by 51% over the check.

Exploiting tobacco for alternative uses

- Line RT 51-1 with 60 x 40 cm spacing and 150:75:75 NPK kg/ha recorded higher nicotine yields. HDBRG with 70 x 40 cm spacing and 150:75:75 NPK kg/ha recorded higher solanesol (55.10 kg/ha) and protein yield (925.7 kg/ha).

Krishi Vigyan Kendra, Kalavacharla

- A total number of 6 On-Farm testings (OFTs) and 10 Front-line Demonstrations (FLDs), 4 vocational trainings and 14 trainig programmes were conducted during 2015-16 in agriculture, horticulture, animal husbandry and income eneration activities.

- Tissue culture *Coccinia* increased the yields by 4.5 tonnes/ha compared to local cultivated variety.

- Popularized Black Bengal goats in the East Godavari district by supplying 11 units to the farmers through ATMA

- Integrated management of snails with bait formulation of jaggery slurry + Dichlorovas + wheat flour was effective with a mortality of 23%.

- Vocational trainings on income generation activities viz.,Garment making, handicrafts with palmyrah leaves, maggam embrodery and palmyrah fibre extraction, Handicrafts with weeds and post harvest value addition viz.,value addition to fruits and vegetables, fish/prawn and meat'value added products with milk, were conducted for enhancement of family income.

- In collaboration with ATMA-East Godavari district, KVK organised 'Kisan Mela' on 09.11.2015 at KVK, Kalavacharla. A total number of 300 farmers from East Godavari district participated in the programme.

Krishi Vigyan Kendra, Kandukur

- Two front line demonstrations were conducted on newly identified FCV tobacco line, TBST-2 and also on milky mushroom production.

- Fodder cuttings of CO - 4 grass were supplied to the farmers for promoting fodder production in Prakasam district.

- Fifty farmers were trained on milky mushroom production for two days.

OTHER ACHIEVEMENTS

ISO 9001:2008

- ICAR-CTRI, Rajahmundry has been granted ISO 9001:2008 certificate for the successful implementation of its quality management system with regard to "Basic, Strategic and Applied Research on Tobacco Crop" on 25.01.2016.

National Seminar on Crop Diversification

- The ICAR –CTRI has organised DAC&FW sponsored National Seminar on "Crop Diversification" at Rajahmundry on 18.01.2016. Scientists, Farmers and Industry representatives participated in the seminar and deliberated on a myriad issues relating to crop diversification in tobacco growing areas. On the whole the National Seminar served as a platform for exchange of information and experiences on various issues relating to crop diversification in tobacco growing regions.

Tribal Sub-Plan:

- Tribal Sub-Plan ofICAR-CTRI was implemented in Manchulavarigudem, a tribal hamlet of Seethappagudem gram panchayat, West Godavari district, Andhra Pradesh during 2015-16. Five interventions *viz.,* Supply of foundation seed of high yielding maize hybrid (DH-117), fertilizers, farm equipment (weighing balances, Improved sprayers), construction of permanent grain storage bins were implemented for a total number of 38 farm families.

- Tribal Sub-Plan of AINP on Tobacco was implemented by AINPT Centre at RARS, ANGRAU, Nandyal. Interventions including supply of critical inputs (fertilizers, pesticides and improved varieties) for productivity improvement, training programme for increasing productivity in millets and pulses and supply of relevant literature were implemented for 40 tribal farmers of Sugalimetta village of Panyam Mandal in Anantapur, Andhra Pradesh.

AP-TECH 2015

- Andhra Pradesh Technology Development and Promotion Centre (AP-TDC), Hyderabad with the technical collaboration of ICAR-CTRI organised an Agri-Exhibition (AP-TEC 2015) at Rajahmundry from 05.06.2015 to 07.06.2015.

Mera Gaon Mera Gaurav

- Mera Gaon Mera Gaurav (My Village My Pride) was initiated at ICAR-CTRI,

Rajahmundry in the month of November, 2015. The scientists have adopted villages and completed the base line survey of the village. The regular farmers' advisory services are being provided from time to time.

World Soil Day

- World Soil Day was celebrated on 05.12.2015 at CTRI Research Station, Hunsur, Karnataka, CTRI-KVK, Kalavcharla (East Godavari dt.), A.P and CTRI-KVK, Kandukur (Prakasam dt), A.P. In this occasion, 606 Soil Health Cards were issued to farmers of Andhra Pradesh and Karnataka.

Jai Kisan Jai Vigyan Week

- Jai Kisan Jai Vigyan week was implemented by ICAR-CTRI at Rajahmundry from 23-29 December, 2015 for promoting the use of science for the welfare of farmers. Innovative farmers and farm women were felicitated in recognition of their contribution to agriculture and allied sectors.

Swachh Bharat Programme

- Swachh Bharat Programmes were implemented with a focus on conservation of natural resource management (water, soil and energy).

Awards & Recognitions

- Dr. D. Damodar Reddy, Director, ICAR-CTRI, Dr. K. Suman Kalyani, Principal Scientist, Dr. H. Ravisankar have been honoroured with prestigious awards/ recognitions for their outstanding contribution in Science & Technology.

Introduction

The Central Tobacco Research Institute (CTRI), established in 1947, is a constituent Institute of the Indian Council of Agricultural Research, New Delhi and has the exclusive mandate to undertake basic, strategic and applied research on various types of tobacco grown in India with special emphasis on exportable types of tobacco. Six regional stations situated at Guntur, Kandukur and Jeelugumilli in Andhra Pradesh; Vedasandur in Tamil Nadu; Hunsur in Karnataka; and Dinhata in West Bengal and a Research Centre at Kalavacharla in Andhra Pradesh are catering to the requirements of tobacco farmers in different agroclimatic zones by developing improved varieties and site specific 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, energy saving and alternate sources of energy 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.

Vision

Provide vibrant research back-up for Indian tobacco to be less harmful, remunerative and globally competitive in the changing milieu of national and international policy regimes.

Mission

Developing environmentally sustainable agro-technologies for production efficiency, product quality and diversified uses of tobacco.

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.

Quality policy:

ICAR-CTRI shall I focus on:

The ICAR- CTRI shall strive to provide vibrant research back-up for Indian tobacco to be less harmful, remunerative and globally competitive in the changing milieu of national and International policy regimes.

WITH FOCUS ON

- Ensuring production of “quality tobacco” with reduced levels harmful constituents
- Enhancing farm returns through innovative interventions for sustainable resource use and production efficiency
- Exploiting and effective use of green energy sources for FCV tobacco curing

- Exploiting tobacco for diversified uses (Phytochemicals and Value addition)
- Effective technology transfer/consultancy services to address the stakeholders needs.

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

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

(C) Post-harvest product management (PHPM)

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

(E) Technology outreach activities

(F) 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 andproduct 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 31.03.2016

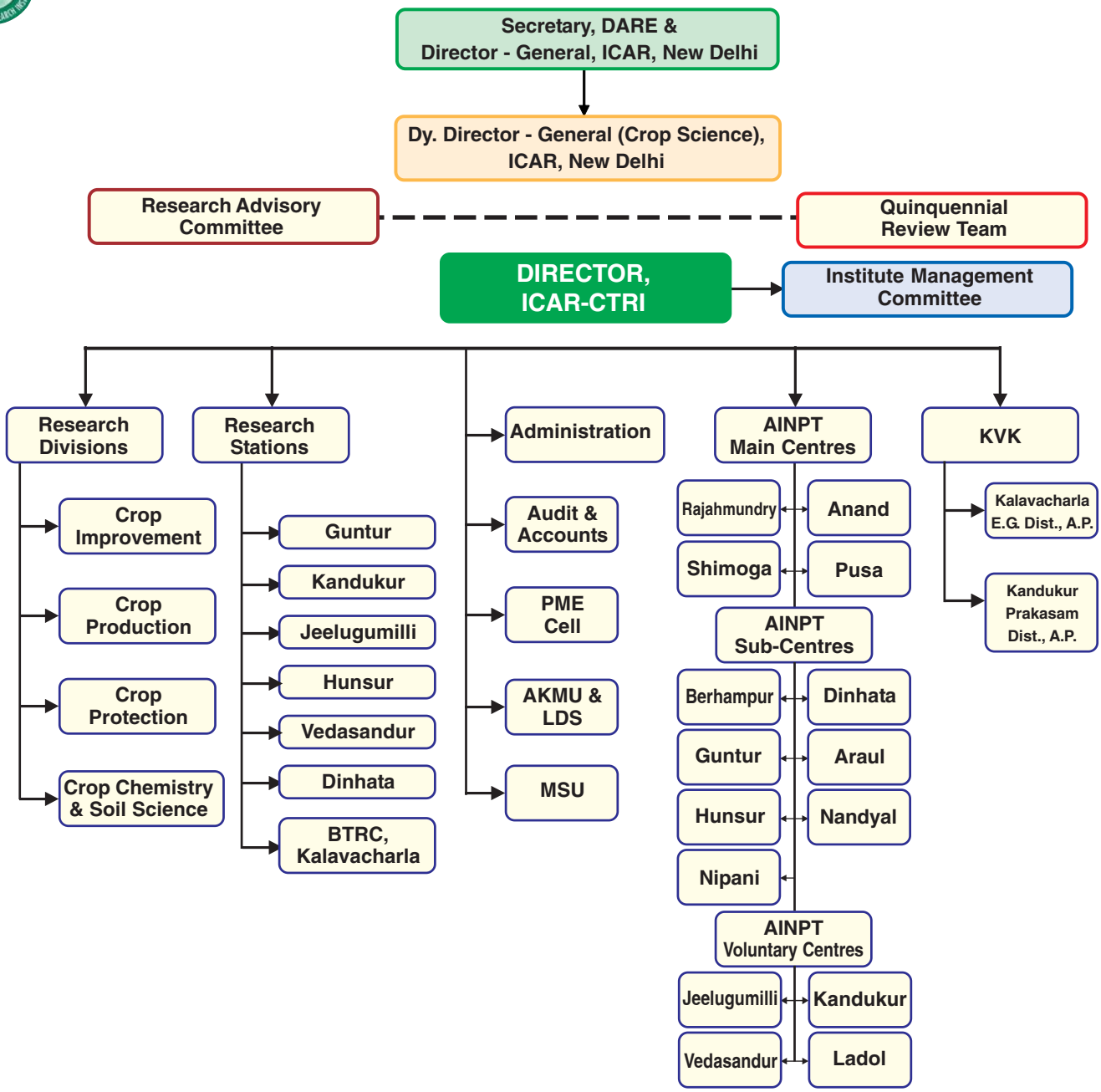
Sl. No.	Category	Sanctioned Strength	In Position	Vacancies
1.	Scientific	56+1*	26+1*	30
2.	Technical	158	107	51
3.	Administration	71	45	26
4.	Skilled Supporting Staff	160	119	41

* RMP position

FINANCIAL STATEMENT FOR THE YEAR 2015-16

Head of Accounts	Rupees in lakhs	
	Budget Grant	Expenditure
Non-Plan	2147.70	2147.62
Plan	192.00	192.00
KVK, Kalavacharla	146.00	136.49
KVK, Kandukur	8.39	8.34
AINPT	392.00	392.00
Pension & Retirement Benefits	1500.00	1500.02
Personal Loans & Advances	15.00	15.00
Recurring deposits Schemes	19.97	20.35
Revolving Fund Scheme	82.67	43.86
Internal Resource Generation	47.44	4.64
Revenue Receipts	165.36	

ORGANOGRAM


Secretary, DARE &
Director - General, ICAR, New Delhi
Dy. Director - General (Crop Science),
ICAR, New Delhi
Research Advisory Committee
Quinquennial Review Team
DIRECTOR, ICAR-CTRI
Institute Management Committee
Research Divisions
Crop Improvement
Crop Production
Crop Protection
Crop Chemistry & Soil Science
Research Stations
Guntur
Kandukur
Jeelugumilli
Hunsur
Vedasandur
Dinhata
BTRC, Kalavacharla
Administration
Audit & Accounts
PME Cell
AKMU & LDS
MSU
AINPT Main Centres
Rajahmundry
Anand
Shimoga
Pusa
AINPT Sub-Centres
Berhampur
Dinhata
Guntur
Araul
Hunsur
Nandyal
Nipani
AINPT Voluntary Centres
Jeelugumilli
Kandukur
Vedasandur
Ladol
KVK
Kalavacharla E.G. Dist., A.P.
Kandukur Prakasam Dist., A.P.

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

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-5057 recorded significantly superior green leaf yield (14453 kg/ha) by 10 %, cured leaf yield (2170 kg/ha) by 12%, bright leaf yield (1374 kg/ha) by 12 % and grade index (1808) by 15 % over Siri (13077, 1936, 1231 and 1568, respectively).

Chemical quality parameters

The nicotine (%) ranged from 1.37 to 3.20 and reducing sugars (%) ranged from 9.81 to 19.84 in the entries.

Based on the performance during 2013-14, V-5057 is only better performer among the entries evaluated with 10 per cent improvement in green leaf, 12 per cent improvement in cured leaf and bright leaf and 15 per cent improvement in grade index compared to the better check Siri.

Preliminary evaluation of advanced breeding lines:

Advanced breeding lines V-5083 to V-5126 (43) were evaluated in a row trial along with the control Siri and VT-1158. Ten selections viz., V-5083, V-5089, V-5096, V-5100,V-5111, V-5113, V-5119,V-5120, V-5121 and V-5124 a made based on the higher yield over Siri during 2014-15. These selections will be evaluated in a replicated trial along with Siri and VT-1158 during 2015-16. Another set of 58 selections were raised and sixty selections were made for evaluating in a row trial during the ensuing season. From a F_2 population of 1380 plants 82 selections were made for further study.

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 second year along with two controls, VT 1158 and Siri

Significant differences were observed among the tested lines for green leaf, cured leaf and bright leaf. Lines RS 27 and RS 29 recorded significantly higher green (17500 & 18090 kg/ha) and cured leaf yields (2800 & 2780 kg/ha) and bright leaf (1286 &1298kg/ha), and higher grade index (2086 & 2126 kg/ha) than the better control, Siri. The range of yield increase in these lines over Siri(c) is 17% in green leaf, 19% in cured leaf, 23% in bright leaf and 20% in grade index).

Chemical quality characteristics of breeding lines viz. nicotine range from 1.11% in RS-26, 2.64% in Rs-32 and reducing sugars from 8.67% in RS-29 and 15.99% in RS-22

Screening of breeding lines in row trial

Out of 90 breeding lines assessed for yield under row trial, 37 lines found to have desirable morphology and yield. One hundred and fifty advanced breeding lines were raised and seed collected for maintenance. One hundred and twenty four lines including breeding lines, germplasm lines and F_2s were screened for TMV resistance and resistant plants selfed and selfed seed collected.

Twenty promising Kanchan and 12 VT-1158 somaclones were inoculated with black shank under artificial conditions and seed collected from resistant plants.

Evaluation of breeding lines (CTRI RS, Jeelugumilli)

Twelve somaclones and two breeding lines were tested for third year in a replicated trial along with Kanchan(C). NLCR-1-9-2-13, NLCR-7-11-1-4, NLCM-1-5(a)-2, NLCR-BT1-P2, NLCR-BT2-P9, VLCR-12-15-14-5, NLCR-9-2 and Pasidi Kanchan P2 recorded significantly higher yields than Kanchan. The green leaf yield in these lines ranged from 16653 to 20111 kg/ha, cured leaf yield from 2894 to 3406 kg/ha and grade index from 2107to 2463 kg/ha; an increase of 22-48%, 20-41 % and 41- 65%, respectively, over control, Kanchan. Entry, NLCR-8-15-9 and NLCR-10-7-2-1 recorded significant cured leaf yields (2821 and 2892 kg/ha, respectively)

Pooled analysis was done for leaf yields, Leaf yields found to be significant among the lines. Clones, NLCR-1-9-2-13, NLCR-7-11-1-4, NLCR-BT2-P9 and NLCR-9-2 lines recorded 10-27% increase in green leaf yield, 8-26% in cured leaf yield and 15-37% in grade index than Kanchan.

Entry / Line	Cured leaf	Grade index
NLCR-1-9-2-13	3406	2463
NLCR-7-11-1-4	2894	2180
NLCM-1-5(a)-2	3092	2374
NLCR-BT1-P2	3265	2087
NLCR-BT2-P9	3172	2274
VLCR-12-15-14-5	3334	2015
NLCR-9-2	3172	2286
Pasidi Kanchan P2	3376	2107
Kanchan(C)	2410	1497

Seasons and seasons x entries interaction were significant for yield parameters. NLCR-1-9-2-13 & NLCR -9-2 recorded significantly higher yields of all types than kanchan in all the seasons.

Based on the overall performance, entries, NLCR-1-9-2-13, NLCR-7-11-1-4, NLCR-BT1-P2, NLCR-BT2-P9, VLCR-12-15-14-5, NLCR-9-2 and Pasidi Kanchan P2 are to be advanced for multilocation testing under AINPT.

Nicotine at 'X' position found to be in range from 1.23-3.18% and 'L' position from 1.15-3.33%. Reducing sugars at 'X' position found to be in range from 11.42 to 20.64% and 'L' position from 4.91-16.16%.

Six entries were tested in a bulk trial along with Kanchan. All the entries viz., NLCR (Tobios-6), NLCR-7(k) (Tobios-2), NLCR-4 (Tobios-7), NLCR-7 (FCJ -3), NLCR-10(Tobios-3) and NM (FCJ-

4) recorded higher leaf yields than Kanchan. The increase in cured leaf yields in these lines ranged from 15-73% and grade index from 17-87%.

Chemical quality characteristics viz. Nicotine at 'X' position ranged from 1.60-3.01% and 'L' position from 2.21-3.22%. Reducing sugars at 'X' position ranged from 11.17 to 17.57% and 'L' position from 9.07-18.34%.

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_8 progenies of crosses involving Kanchan as one of the parents were raised and 26 of the lines were found to be 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 146 advanced breeding lines along with the check variety Kanchan to identify selections suitable to NLS area. The lines varied for important morphological and agronomical traits. Fifteen lines with high yield potential (CLY 3300-4500 kg/ha against 2590 kg in Kanchan) and desirable leaf quality were identified. Seven of the lines were identified as uniformly resistant to TMV on artificial inoculation. Single plant selections showing good plant type and leaf characteristics suitable for NLS besides high yield potential, were advanced for further evaluation.

In addition to high yielding selections, four semi-dwarf selections with compact plant type and very short internodes, suitable for close spacing were also identified and advanced for further study.

III. Replicated yield trials

1. Trial RYT-15 (3rd year)

A set of 13 green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality traits in a RBD with three replications for the third year in succession. Lines RT9-1 and RT29-1 showed resistance to TMV also.

Seven lines (RT3-1, RT4-3, RT9-1, RT29-1, RT29-2 and RT33-1& RT49-1) showed significantly higher cured leaf yield and grade index than check, Kanchan. The increase was 13-47% for cured leaf yield and 20-42% for grade index. Cured leaf colour, size and body in the test entries *viz.*, RT Nos.9-1, 10-1, 33-1, 48-1, and 49-1 were comparable with that of Kanchan.

Combined statistical analysis of the yield data over last three seasons for identifying promising lines revealed that seven lines (RT3-1, RT4-3, RT9-1, RT10-1, RT29-1, RT29-2 and RT33-1) showed significantly higher cured leaf yield and grade index than check, Kanchan. The increase in these lines was 11 to 45% for cured leaf yield and 9 to 16 % for grade index, respectively over Kanchan.

Seasonal differences were significant and yield levels during 2014-15 were higher than the other two seasons. Season x entry interaction was also significant for all the four yield traits.

Chemical quality of leaf: The nicotine and reducing sugars in the lines were within acceptable limits.

Based on overall performance seven lines RT3-1, RT4-3, RT9-1, RT10-1, RT29-1, RT29-2, and RT33-1 are proposed for further studies.

RT 3-1

2. Trial RYT-16 (3rd year)

In another replicated trial, 13 medium/ green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality in a RBD with three replications. 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 RT91-1, RT92-1 and RT96-1 and RT108-1 showed resistance to TMV.

Five lines (RT66-1, RT91-1, RT92-1, RT96-1 and RT108-1) showed significantly higher cured leaf yield and grade index than check, Kanchan. The increase was 22-47% for cured leaf yield and 18-49% for grade index.

Cured leaf colour, size and body in the test entries RT Nos. 55-1, 57-1, 91-1, 92-1, 94-1, 104-1 and 108-1 were comparable with that of Kanchan. Nicotine and reducing sugars were within admissible limits.

Combined statistical analysis of the yield data over three seasons (2012-15) for identifying promising lines revealed that six advanced cross derivatives viz., RT66-1, RT91-1, RT92-1, RT94-1, RT96-1 and RT108-1exhibited significantly superior performance over best check, Kanchan for all the four yield traits. The increase in these lines was 13 to 44% for green leaf yield, 17 to 46% for cured leaf yield, and 20 to 51% for grade index, respectively over Kanchan.

Seasonal differences were significant and yield levels during 2014-15 were higher than the other two seasons. Based on overall performance the entries RT66-1, RT91-1, RT92-1, RT94-1, RT96-1 and RT108-1 are proposed for further studies.

3. Trial RYT-17 (2nd year)

The third replicated yield trial was conducted for the second year in succession with 13 green cast advanced breeding lines along with check Kanchan for leaf yield and quality in a RBD with three replications. Plant and leaf types were good in all the test entries like Kanchan.

Resistance to TMV was observed in the entries RT110-2, 113-2 and 114-3 while six others showed segregation for the trait.

Eight lines (RT54-1, RT55-1, RT56-1, 109-1, RT113-2, RT114-3, RT121-1 and RT123-1) showed significantly higher cured leaf yield and grade index than check, Kanchan. The increase was 16 to 45% for green leaf yield, 17-46% for cured leaf and 20-66% grade index.

Cured leaf colour, size and body in the all test entries were comparable with that of Kanchan. Nicotine and reducing sugars were within admissible limits.

4. Trial RYT-18 (2nd year)

In the 4th replicated trial conducted, medium/ green cast advanced breeding lines were evaluated for the second year along with check Kanchan for leaf yield and quality in a RBD with three replications. Plant and leaf types were good in all the test entries, like Kanchan.

Analysis of data indicated significant differences for cured leaf yields and grade index among entries. Four lines *viz.*, RT 121-1,129-3, 132-1 and RT135-1 showed significantly higher cured leaf yield and grade index than Kanchan. The increase was 11 to 31% for cured leaf yield

and 17 to 46% for grade index, respectively in the two promising lines.

Cured leaf colour, size and body in the test entries were good and comparable with Kanchan. Nicotine and reducing sugars were within admissible limits.

5. Trial RYT-19 (1st year)

In a new replicated trial with 11 medium/ green cast advanced breeding lines were evaluated along with check Kanchan for leaf yield and quality in RBD. Plant and leaf types were good in all the test entries, like Kanchan and initial vigour was observed in the entries RT Nos. 94-1, 108-2 and 118-1. Resistance to TMV was observed under artificial inoculation in two entries, RT93-1 and RT94-1.

Analysis of data indicated significant differences for cured leaf yields and grade index among entries. Four lines RT Nos. 126-1, 128-1, 135-1 and RT137-2 showed significantly higher leaf yield and grade index than Kanchan. The increase was 18 to 39 % for green leaf yield, 14 to 40% for cured leaf yield and 15 to 36% for grade index, respectively. Cured leaf colour, size and body in all the test entries were comparable with Kanchan.

IV. Bulk assessment trial and on-farm trials:

Bulk trial: One bulk assessment trial was conducted with 8 entries *viz.*, FCJ-1, FCJ-4, NLST-2, NLST-3, NLST-4, NLST-5, NLST-6 and Kanchan (check). All the lines were superior to Kanchan in Station and AINPT multilocation trials.

NLST-4

On-farm trial: Lines NLST-3, NLST-4 and NLST-5 were evaluated in on-farm testing at Nutiramannapalem village in NLS for obtaining farmer's acceptance during the year. Line NLST-4 (2104 kg/ha CLY) showed 9.5% improvement over Kanchan (1922 kg) and was opined as suitable for further testing.

Developing new varieties of irrigated natu tobacco for Andhra Pradesh

T.G.K. Murthy

1. Bulk evaluation

Nine 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, 45-90 recorded about 16% higher total cured leaf yield than Kommugudem.

2. Evaluation of promising lines in row trial

Thirteen advanced breeding lines derived from two crosses *viz.*, Singarajupalem x Kommugudem and Kommugudem x 45-90 were evaluated along with check variety, Kommugudem for leaf yield potential and physical leaf quality in a progeny row trial. All the lines showed desirable "Katta" characters suitable for cultivation as irrigated *Natu*. Most of the lines showed higher leaf yield potential than check, Kommugudem

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

Fifteen green cast *Natu* advanced breeding lines with high yield potential were evaluated in a RBD along with check Kommugudem for leaf yield and quality. Plant type and leaf colour, body and size were good in all the entries.

Analysis of data indicated significant differences for cured leaf yields among entries. Three test entries viz., NF4-16, NF4-22 & NF4- showed significantly higher (18 to 36%) cured leaf yield than Kommugudem.

4. Evaluation of promising lines in replicated trial - I (3rd year):

Fifteen green cast *Natu* type advanced breeding lines with high yield potential and /

or TMV resistance, were evaluated in RBD along with check Kommugudem for leaf yield and quality. Plant type and leaf colour, body and size were good in most of the test entries.

Analysis of data indicated significant differences for cured leaf yields among entries. Entries NF3-5-1, NF3-6-2,NF3-8-1, NF3-10-2, NF3-11-1, NF3-12-1, NF3-12-2, NF3-15-1, NF3-20-2, NF3-15-2 and PVM14-1 recorded significantly higher cured leaf (19-59%) than check, Kommugudem (2026 kg/ha).

Based on aroma, colour, leaf size, leaf aroma and flavour, leaf blemish and weight, the lines *viz.*, NF3-5-1, NF3-6-2, NF3-12-2 and NF3-15-1 are found suitable for irrigated conditions.

NF 3-5-1

4. Generation advancement and selection: F_6 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 inter node length, dark green foliage and more leaf number were selected for further studies.

5. TMV resistant irrigated *Natu* tobacco

Also, 8 *Natu* type derivatives (F_9) of cross Pyruvithanam x JMR 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

Fifty one selections made during 2013-14 were planted along with control BA1 and 95 selections were made based on the plant characters and these selections will be evaluated further during 2015-16.

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 BC9 crosses involving the male sterile hybrids BRK-1, BRK-2, TN-97, NCBH-127 and NC-3 were raised and back crossed with the respective male fertile recurrent parent *viz.,* Banket A1, Burley-21, VA-510, Banket-127 and seed collected.

Evaluation of advanced breeding lines

Ten selections made *viz.,* YB-26 to YB-35 were evaluated for first year along with checks BanketA1(C), Burley-21(C), Swetha(C) and YB-4 in a replicated trial during 2014-15. The line YB-27 showed 34 % increase in the yield (2217 kg/ha) over control Banket A1 (1649 kg/ha) and the improvement was 34 per cent followed by YB-33 (1916 kg/ha) with an improvement of 16% over control Banket A1. Nicotine in the entries tested ranged from 0.72 to 2.49 % and reducing sugars ranged from 0.08 to 1.68 % .

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

T.G.K.Murthy and P. Venkateswarulu

Eight FCV tobacco lines were evaluated for assessing their performance in respect of yield, quality and disease resistance. Compared to check Siri, significant difference in all the yield parameters was observed in three lines, *viz.,* RT 42-1, RT 44-1 and RT 130-1. A cured leaf yield of 2,559 kg and bright leaf of 1,791 kg/ha was recorded in RT 42-1 followed by RT 44-1 with 17,175, 2,532 and 1,799 kg/ha of green, cured and bright leaf, respectively. RT 42-1 and RT 44-1 showed 26 and 25% increase in the cured leaf yield over the standard check, Siri.

T-61

T-30

In all the entries tested, nicotine, reducing sugars and chlorides were in acceptable limits.

Pest incidence was also recorded in all the varieties. Tobacco aphid was not noticed in any of the varieties. Leaf curl (whitefly) incidence was above threshold level and varies from 5.33 to 9.66%. TMV incidence was low and varies from 0 to 2.66%.

Another replicated trial conducted with 6 advanced lines and three checks to evaluate their yield potential. Only two varieties, *viz.*, T-61 and T-63 were significantly superior to all three checks. Among all the treatments, line T-61 was superior with cured leaf of 2,540 kg, bright leaf of 1,905 kg and grade index of 2,175 kg/ha followed by T-63 with 16,791, 2,472, 1,730 and 2.080 kg/ha. In case of cured leaf, an increase of 20 and 17% was recorded in T-61 and T-63, respectively over the standard check, Siri.

Chemical analysis of cured leaf indicated that nicotine, reducing sugars and chlorides were at permissible limits.

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.

A. Five single plants selections from the F_4 single plant progeny rows of Siri X 15-2 (2) and Siri X 10-1 (3) crosses with aphid resistant lines were made.

B. Five single plants selections from the F_4 single plant progeny rows of Siri X 155-2 (3) and Siri X 113-1 (2) crosses with caterpillar resistant lines were made.

C. F_2 generation of Siri X 47-1 (10), Siri X 62-2 (10) and Siri X 151-2 (5) were grown and 25 single plants were selected.

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

C. Nanda, M. Mahadevaswamy, S. Ramakrishnan

Eight advanced breeding lines developed from the crosses involving Kanchan and Rathna with Coker 371G and NC 89 were evaluated in replicated trial in RBD along with the checks. Analysis of data indicated that none of the entries showed any statistically significant superiority over check Kanchan. The entry FCH 239 recorded highest green leaf yield (18693kg), cured leaf (2600kg), bright leaf (1443 kg) and TGE (1716) followed by FCH 242 (18655 kg green leaf, 2579 kg cured leaf, 1409 kg bright leaf and 1708 TGE) . The RKI of the entries was 2.1 – 3.1.The leaf chemical quality parameters of the lines assessed are in acceptable range.

Seed production of KLSH10 and its parents was carried out for further evaluation of the hybrid in current season.

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

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

M.Kumaresan

Out of ten F_8 populations of promising selections evaluated in a replicated yield trial along with Bhagyalakshmi and Abirami as controls, the selections HV.2011-2, HV.2011-9 and HV.2011-7 were significantly superior to the control Bhagyalakshmi recording 3086 (25.0%), 2963 (20.0%) and 2914 (18.0%) kg/ha whole leaf yield and 3901(19.2%), 3741(14.2%) and 3679(12.4%) kg/ha total leaf, respectively. None of the selections were significantly superior to the best check Abirami.

HV-2011-2

Based on pooled analysis for last three years, only the selection HV.2011-2 was significantly superior to the best check Abirami in total leaf yield recording 4144 kg/ha an increase of 11.0% percent and the same was promoted to the pre-release bulk evaluation in farmers' field along with the control Abirami in the coming season.

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 grown in pre-release bulk trial at CTRI Research Station, Vedasandur farm as well as in four out station centres showed that both the broad based selections performed well at CTRI-Research Station farm, Vedasandur recording cured leaf yield of 3634 and 3585 kg/ha respectively an increase of 13.3 and 11.5 % increase over the control Abirami (3214 kg/ha). At out station centres also, the broad based selections HV.2009-3 and HV.2009-5 performed well recording mean cured leaf yield of 3930 and 3755 kg/ha an increase of 9.7 and 4.8 % respectively over the control Abirami.

The overall mean performance of last three years of broad based selections (HV.2009-3 and HV.2009-5) at CTRI-Research Station, Vedasandur also revealed that both the selections were superior to the control Abirami recording 3473 and 3337 kg /ha cured leaf yield respectively an increase of 11.5 and 7.1 percent. At out station centres also they exhibited superior performance registering 4121 and 3781 kg/ha cured leaf yield respectively an increase of 12.1 and 2.8 percent over Abirami.

The chemical analysis data of broad based selections HV.2009-3 and HV.2009-5 were in the acceptable range.

Based on overall performance, it is proposed to submit variety release proposal for the broad based selection HV.2009-3 for its identification in the IRC meetings.

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 CMShybrids

Trial Br 7.13:

Twelve CMS hybrids were produced by crossing CMS and male parents that were identified as better combiners.The 12 CMS hybrids were evaluated for leaf yield potential and leaf quality along with checks Siri and VT 1158 in a RBD. In general, initial vigour and plant growth was more in the CMS hybrids.

Sl. No.	Entry	Cured leaf	Grade Index
1.	CMSH-134	2800	2307
2.	CMSH-135	2679	2188
3.	CMSH-137	2517	2031
4.	CMSH-143	2736	2188
5.	CMSH-144	2641	2197
6.	SIRI(c)	2088	1687
7.	VT 1158(c)	2071	1701

Superior CMS Hybrids

Significant differences for all the yield characteristics among entries are observed.Ten of the 12 hybrids showed significant standard heterosis over variety Siri. The heterosis varied

from 17-35% for green leaf yield, 18-34% for cured leaf, 14-35% for bright leaf and 17-36% for grade index, among the hybrids.

Colour of the cured leaf in all the hybrids was better than or comparable with checks, Siri and VT 1158. Leaf size was more in the hybrid CMSH-144, while leaf body was very good in hybrids CMSH nos. 133, 134, 136, 139, 140, 141, 143 and 144.

The nicotine and reducing sugar levels were within the admissible limits in the identified better performing hybrids (nicotine 0.90 – 1.60%, reducing sugars 16.52 – 21.10%).

2. Maintenance of CMS lines: A total of 67 CMS lines with varying cytoplasm sources were maintained.

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

Three CMS lines were shared with AINPT centre at Shimoga.

Four crosses viz., MS-58 x HDBRG, MS-58 x VT-1158, MS-58 x A-145 and MS58 x TI-163 (all in BC8) were made to develop CMS parental lines with high biomass potential.

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

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

1. Maintenance of CMS lines

Sixteen CMS lines in genetic background of ruling variety, Kanchan and other improved lines were maintained and back crossed to recurrent parent. Fifteen lines are stabilized and leaf levels were recorded in all the CMS parents along with check cultivar, Kanchan. Leaf yield and quality in four lines viz., CMS-1, CMS-2, CMS-4, CMS-8 & CMS-13 were comparable or higher than parent Kanchan.

2. Replicated yield trial with CMS hybrids:

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

Two hybrids, MSH-4 & MSH-5 showed significant standard heterosis for all the three yield traits over check, Kanchan with 34 & 43 % increase in green leaf yield, 31 & 37% in cured leaf and 28 & 27% increase in grade index.

Exploitation of heterosis and hybrid vigour for improving tobacco yield and quality

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

A.R. Panda

Three breeding lines, 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 along with seven advance breeding lines were evaluated for the second year, to test their superiority over the check varieties.

Interspecific hybridisation 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 73 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 for preliminary evaluation of leaf quality and yield potential. This includes 10 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. Fifteen lines were identified as TMV resistant on artificial inoculation. In general, aphid infestation was less during the season.

Details of inter specific cross derivatives maintained.

Sl. No.	Initial cross
1.	(N. gossei x cv. CM-12)
2.	cv. HR 62-9 x N. gossei
3.	[(N. x gossei-excelsior) x CM-12]
4.	(N. x benthamiana-repanda) x cv. CM-12
5.	Delcrestx[N. gosseixN. glutinosa)xCM-12]
6.	Delcrest x [N. gossei x N. glutinosa) x [cv.HR 62-9 x N. gossei) x Bhavya]
7.	N. umbratica x N. tabacum

2. Preliminary evaluation for leaf yield potential:

Twenty two light cast derivatives with high cured leaf yield potential (CLY 2600 – 3450 kg/ha) as compared to check variety, Siri (CLY- 1825 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 promising uniform lines were retained for further evaluation in replicated yield trials.

3. Evaluation of advanced lines in RYTs:

Six replicated yield trials were conducted during the season with 72 advanced stabilized interspecific cross derivatives.

i) Trial TBL-10 (3rd 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. Nine of the derivatives were reported as resistant to TMV under artificial screening.

Differences among entries were significant for all the four yield traits. Seven lines *viz.*, TBST 88, TBST 90, TBST 91, TBST 92, TBST 93, TBST 98 and TBST 99 showed significant improvement over best check, Siri. The increase varied from 17-34% for green leaf yield, 16-31% for cured leaf, 15-31% for bright leaf and 15-31% for grade index.

Ten lines *viz.*, TBST90 - 99 showed similar or better colour, body as well as size of cured leaf than Siri. The nicotine and reducing sugar levels were within the admissible limits.

In the combined analysis of the last three years yield data , seven advanced cross derivatives viz., TBST Nos. 88, 91, 92, 93, 94, 98 & 99) exhibited significantly superior performance over best check, Siri for all the four yield traits while TBST 89 & 90 showed significant superiority for cured and bright leaf yield and grade index. The superior lines exhibited 15 to 25% increase in green leaf yield, 10 to 25% in cured leaf, 6 to 16% in bright leaf and 7 to 17% for grade index, respectively over the best check, Siri.

The entries showing significant improvement for all the traits over checks during all the 3 seasons were: TBST Nos. 92, 93, 94, 98 & 99; four other lines *viz.*, TBST Nos. 88, 90, 91 & 96 showed significant improvement over checks during 2 seasons.

Seasonal differences were significant among yield traits. Season x entry interaction was also significant for all the four yield traits. Yield performance of the entries evaluated in the experiment during individual seasons.

Based on overall performance the entries viz., TBST Nos. 99, 88, 90, 91, 92, 93, 96 & 98 were selected for further studies.

ii) Trial TBL-11 (3rd 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 in a RBD with 3 replications for evaluation of yield potential and leaf quality. All the breeding lines were light cast in nature.

Ten of the derivatives (TBST100-105, 107, 108, 110 & 111) were identified as resistant to TMV also. Nine lines viz., TBST-100, TBST-101, TBST 102, TBST-104, TBST 105, TBST 107, TBST-109, TBST 110 and TBST-111 showed good colour,

body as well as the size of cured leaf, as compared to check varieties.

Differences among entries were significant for all the four yield traits. Eight lines, viz., TBST Nos., 100, 101, 105, 106, 107, 108, 109 and 111 showed significant improvement over the best check, Siri for all the four leaf yield traits.The increase was 23 to 34% for green leaf yield, 22 to 34% for cured leaf yield, 25 to 41% for bright leaf yield and 25 to 39% for grade index, respectively, over Siri. The nicotine and reducing sugar levels were within the admissible limits, as observed from the results of previous studies.

In the combined analysis, ten advanced cross derivatives viz., TBST-100, TBST-101, TBST-104, TBST 105, TBST 106, TBST 107, TBST 108, TBST-109, TBST 110 and TBST-111 exhibited significantly superior performance over best check, Siri for all the four yield traits during all the 3 seasons. The superior lines exhibited 12 to 33% increase in green leaf yield, 11 to 32% in cured leaf, 14 to 19% in bright leaf and 15 to 35% for grade index, respectively over the best check, Siri.

Based on overall performance the entries *viz.*, TBST-100, TBST-101, TBST-104, TBST 105, TBST 106, TBST 107, TBST 108, TBST-109, TBST 110 and TBST-111 were selected for further studies.

iii) Trial TBL-12 (2nd year)

A replicated yield trial was conducted for the second year 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, 113, 115, 116 & 117) are resistant to TMV also. All the entries along with checks showed good colour, body as well as the size of cured leaf.

Differences among entries were significant for all the four yield traits. Only one line, TBST-115 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 16% for green leaf yield, 16% for cured leaf yield, 24% for bright leaf yield and 21% for grade index, respectively. Nicotine and reducing sugars in cured leaf were in desirable limits in all the advanced interspecific cross derivatives during the season.

iv) Trial TBL-13 (2nd year)

Another replicated yield trial was conducted for the second year 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.

Differences among entries were significant for all the four yield traits. Five lines, viz., TBST Nos., 121, 122, 125, 126 and 127 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase in these lines was 13 to 26% for green leaf yield, 13 to 23% for cured leaf yield, 12 to 27% for bright leaf yield and 14 to 26% for grade index, respectively. Nicotine Content and reducing sugars in cured leaf were in desirable limits in all the advanced interspecific cross derivatives during the season.

v) Trial TBL-14 (2nd year)

Another set of eight morphologically stable, aphid resistant/ tolerant advanced cross derivatives (TBST 128 to TBST 135) were evaluated along with two checks, Siri and VT 1158 in a RBD for yield potential and leaf quality. Four of the derivatives, TBST 129 – 132 were identified as resistant to TMV

Differences among entries were significant for all the four yield traits. Fivelines, viz., TBST Nos., 128, 129, 130, 132 and 133 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase was 20 to 24% for green leaf yield, 17 to 22% for cured leaf yield, 21 to 26% for bright leaf yield and 21 to 25% for grade index, respectively.

vi) Trial TBL-15 (1st year)

A new replicated yield trial was conducted with a set of twelve morphologically stable,

aphid resistant/ tolerant advanced cross derivatives (TBST 136 to TBST 147) along with two checks, Siri and VT 1158 in RBD for evaluation of yield potential and leaf quality.

All the breeding lines were light cast in nature. Nine of the lines *viz.,* TBST 136, 137, 139-141, and 144-147 were resistant to TMV also under artificial inoculation.

Differences among entries were significant for all the four yield traits. Four lines, viz., TBST Nos., 136, 140, 144 and 147 showed significant improvement over the best check, Siri for all the four leaf yield traits. The increase over Siri was 13 to 35% for green leaf yield, 13 to 37% for cured leaf yield, 15 to 33% for bright leaf yield and 11 to 33% 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 of TBST 2 (CLY 2634 kg/ha) was higher than Siri (CLY 2113 kg/ha)

The line TBST-2 was also given for on-farm demonstration in SBS (4 farmers), SLS (7 farmers) and NBS (1 farmer) in collaboration with Tobacco Board and Trade. 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 than Siri in addition to having resistance to TMV, tolerance to aphid and leaf blight (in nursery). The higher (13.3 – 16.8%) yield potential (3140 kg/ha in NBS, 2440 kg in SBS and 1677 kg in SLS) and high BC ratio (1.36 in NBS, 1.32 in SBS & 1.11 in SLS) in addition to resistance traits and slow maturity and desirable leaf chemistry were preferred by the farmers.

Location specific evaluation of cross derivatives

Promising derivatives having resistance to tobacco aphid, caterpillar and those tolerant to leaf curl, identified under the project and were contributed to NLS (11) and KLS (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.

During 2014-15, 524 progenies were evaluated under artificial inoculation with the pathogen. Out of 524 progenies, 233 progenies recorded resistance in all the plants.

Maintenance of the TMV resistant lines

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

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

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

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

Two sets consisting of 28 F_1 hybrids along with 8 parents in each are evaluated in replicated yield trail. The first set is assessed for seed yield and oil content while the second set is evaluated for green leaf, total biomass and phyto chemicals *viz.*, nicotine, solanesol and protein content. In first set (RYT-I) crosses TI-163 x GT-7 and GT-7 x GT-8 exhibited higher number of primary branches (3.58 and 3.50) and

the differences are significant. The crosses TI-1112 X GT-7 and GT-7 X A-119 (7.13 & 6.33) exhibited higher number of secondary branches and the differences are significant. The crosses GT-7 X NP-19 (300 mg), A-145 X NP-19 (280 mg) and TI-163 X GT-7 (280 mg) recorded high weight of single capsule and the differences are significant. EC.554900 X A-145 (930 kgs), EC.554900 X A-119 (736 kgs) and parent A-145 (770 kgs) exhibited higher total seed weight with significant differences.

A119 X Abirami

In the second set of crosses (RYT-II) evaluated ABHIRAMI X A-119 (2.49), A-119 X GT-8 (2.45) and Parents A-119 (3.27) and GT-6 (3.02) exhibited higher nicotine. For solanesol, leaf crosses Abirami X NP-19 (1.97) and HDBRG X VDH-3 (1.85) exhibited higher content and the differences among the entries are not significant. For protein percent A-119 X NP-19 (26.09), GT-8 X NP-19 (24.96), and parent Abirami (31.71) showed higher values. The crosses NP-19 X VDH-3 (17076 kgs), GT-7 X GT-8 (16299 kgs) and GT-7 X Abirami (16188 kgs) exhibited higher green leaf per ha and the differences were significant among each other. The crosses NP-19 X VDH-3 (24351 kgs) HDBRG X Abirami (24220 kgs) and HDBRG X VDH-3 (24099 kgs) exhibited higher total biomass per ha., and the differences were significant.

In the second set of crosses (RYT-II) evaluated GT-7 X HDBRG (43.59), Abirami X VDH-3 (45.23) and Parents A-119 (46.10) and GT-7 (45.94) exhibited higher total nicotine per ha and the differences are not significant. For total solanesol per ha crosses Abirami X NP-19 (33.98), HDBRG X Abirami (30.41) and GT-7 X HDBRG (30.39) exhibited higher content and the differences among the entries are not significant. For total protein per ha GT-7 X VDH-3 (458.70), HDBRG X GT-8 (258.22), and parent Abirami (453.45) showed higher values.

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

From the forty F_5 populations of five promising crosses grown under 75cm x 60cm spacing for high seed yield, 10 selections which recorded seed yield ranging from 1500 – 1950 kg/ ha were retained for replicated yield evaluation for seed and oil yield in the coming season.

I. (C) Production and distribution of pure 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. About 6000 kg of truthfully labelled seed of seven different varieties was sold to farmers through CTRI, Rajahmundry and its Research Stations and Tobacco Board.

(D) Germplasm resource management

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

A. Acquisition

Seventy five *bidi* and 5 exotic FCV lines were added to the germplasm bank.

B. Maintenance

(i) Cultivated germplasm: The total available genetic resources at CTRI are 3369. A total of 2056 cultivated germplasm lines including FCV, non-FCV and elite lines were maintained.The elite lines included released varieties; lines with high seed bearing, low nicotine, insect pest resistance, disease resistance, root knot resistance, CMS and high yield potential etc.

After thorough examination for purity and uniformity, all the lines were selfed and seed collected.

(ii) Wild *Nicotiana* species: A total of 210 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* micro propagation.

C. Enhancement of variability: 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 (BC_2S_3) 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 in deep freezers at -10ºC. Also a sample of each line is 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. Also, three hundred Rustica germplasm lines and 140 wild *Nicotiana* species accessions have been processed to deposit at NBPGR.

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. **Barcode markers for *Nicotiana* species:** For the purpose of Cataloguing and development of reference database for genus *Nicotiana* based on DNA barcoding, leaf samples from 160 *Nicotiana* accessions raised in the season were collected and the digital images of the respective accessions were also captured. Total Genomic DNA was isolated from all the accession.

Preliminary analysis confirmed polymorphic nature of the intergenic spacer trnH-psbA with respect to the amplicon length in the test species accessions which was tested by Sanger Sequencing Method. The study is to continue with more bar code primers.

b. DUS characterization: During the year three genotypes *viz.*, ruling variety Siri, promising advanced interspecific cross derivative TBST-2 and unique germplasm line, 324C were characterized for 53 Distinctness, Uniformity and stability (DUS) characteristics.

G. Evaluation

Evaluation for seed yield:

In a preliminary row trial, 11 previously identified germplasm lines and advanced cross derivatives were evaluated along with three check varieties *viz.,* HDBRG, A-145 and GT-7, for seed yield potential. Advanced derivatives of crosses *viz.,* GT7 x TI163, A145 x GT-7 and GCMS12-3 along with check GT-7 and A-145 were promising.

Seed yield under different planting densities

In another preliminary trial, 7 previously identified lines comprising germplasm lines and advanced cross derivatives were evaluated along with check variety A-145 for seed yield under four panting densities *viz*., 0.8 x 0.6 m, 0.8 x 0.3 m, 0.8 x 0.2 m and 0.8 x 0.15 m.

Analysis indicated differential response of the genotypes to varying densities .Advanced derivatives of crosses *viz.,* GT7 x TI163, A145 x GT-7 and GCMS12-3 along with check GT-7 and A-145 were promising.

Seed samples of 96 released tobacco varieties besides seed samples of 126 wild *Nicotiana* species accessions have been collected, processed for estimation of oil content and fatty acid composition for documentation purpose.

H. Copyright: A copyright (SW-8169/2014 dt.12.11.2014) was granted by the Copyright Office of the Ministry of Human Resources, Govt. of India to the *Nicotiana* species information system database.Obtaining of another copyright on *Natu* germplasm is in progress.

Germplasm maintenanace of Nicotiana tabacum/lines(CTRI RS, Hunsur)

C. Nanda and S.S.Srinivas

Active stock of around 635 germplasm accessions are maintained. Under the periodical seed multiplication programme, 170 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 and FCH 222 was carried out.

Evaluation and maintenance of Chewing, Cheroot and Cigar germplasm (CTRI-Vedasandur)

Dr.M.Kumaresan and M.Mohan

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.

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

Molecular mapping of important tobacco (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

Twenty two SSR markers were screened to identify the polymorphism between the parents of RIL population developed for the mapping of TSNA, nicotine and solanesol traits. Eleven SSR markers viz., TM51534, TM10606, TM10891, TM50469, TM1111062, TM50868, PT61653, PT10375, PT50065, PT60723 and PT53345 were found to be polymorphic.

Solanesol content was estimated in the air cured leaf samples collected from the solanesol molecular mapping population and its parents. One of the parents HDBRG recorded higher solanesol (2.50%) and other parent By-53 lower (1.40%). Solanesol in the mapping population found to be in the range of 0.5-4.90. This indicates that transgressive segregation for solanesol in the mapping population. Out of 257entries analyzed in the mapping population highest population found to be in the range of 2.0-2.5% and 2.5-3.0%.

Range of solanesol content in a solanesol molecular mapping population and its parents (Air-cured samples) (2014-15)

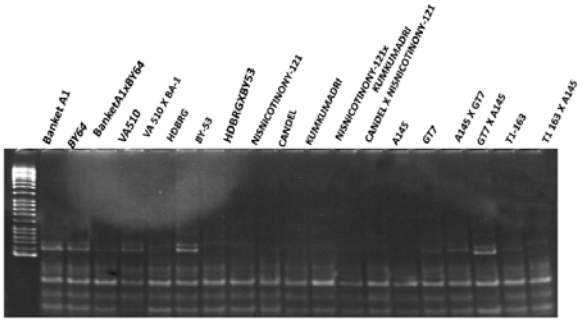
S.No.	Solanesol (%) range	Population frequency
1	0-0.5	1
2	0.5-1.0	10
3	1.0-1.5	26
4	1.5-2.0	41
5	2.0-2.5	60
6	2.5-3.0	66
7	3.0-3.5	37
8	3.5-4.0	11
9	4.0-4.5	4
10	4.5-5.0	1
Total		257

Nicotine content was estimated in the air cured leaf samples collected from the nicotine

molecular mapping population and its parents. Among the parents, Candel recorded higher nicotine (2.71%) and Nisnicotinony-121 lower (0.90%). Nicotine in the mapping population found to be in the range of 0.34-4.94. This indicates that wide variation is created in the mapping population. 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%.

Development of mapping populations

For the development of mapping populations i.e. Recombinant Inbred Lines (RILs), 9 F_1s and11 mapping populations *viz.,* BY 64 x Banket A1, VA 510 x Banket A1, HDBRG x BY 53, HDBRG x GT-7, TI 163 x A-145, Candel x Nisnicotinony 121, Kumkumathri x Nisnicotinony 121, Nisnicotinony 121 x Kumkumathri, A 145 x GT 7, GT 7 xA 145 and A 145 x Jayalakshmi-WS (a total of around 2200 plants) were raised and selfed seed collected. Thirteen dihaploid lines were developed from five crosses were maintained.



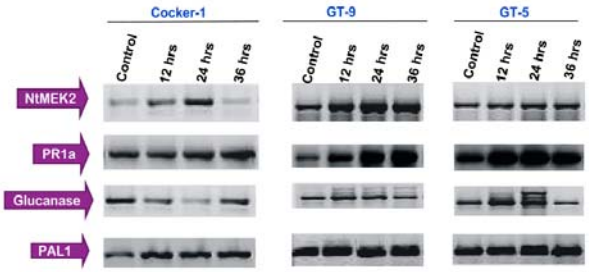
Polymorphism among the parents of RIL populations of nicotine and solanesol with SSR primer, PT50469

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

The ITS (Internally Transcribed Sequence) regions of the 21 fungal isolates collected from different regions of damping off effected tobacco nurseries were sequenced and identified as *Pythium* isolates by BLAST (Basic Local Search Alignment Tool) analysis. Four week old seedlings of tobacco genotypes Coker1, GT9 and GT5 were infected with *Pythium aphanidermatum* and samples were collected between 12 to 36 hrs after infection at different time intervals. Total RNA was isolated from the infected and control seedlings and cDNA was synthesized using reverse transciptase PCR. The integrity and quality of the cDNA was analysed using housekeeping genes, Ribulosebisphosphate carboxylase small subunit (Rbcs) and Elongation factor 1α (EF-1α).

In the expression analysis of defense related genes mitogen-activated protein kinase 2 (NtMEK2), other effector protein genes pathogenesis-related protein (PR1a), Phenylalanine Ammonia-Lyase 1 (PAL1) and Beta-1, 3-glucanase gene (Glunse) has shown prominent increase in their transcript levels in



Expression of defense related genes in tobacco genotypes under *Pythium* infection

tolerant genotypes. It implies the association of these genes with the disease tolerance mechanism.

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

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

Leaf samples from 160 *Nicotiana* accessions raised in the season were collected and the digital images of the respective accessions were also captured. Total Genomic DNA was isolated from all the accessions and screening was carried out in selective *Nicotiana* accessions with trnH–psbA (intergenic spacer region) which is a rapid evolving loci in a loci specific Polymerase Chain Reaction (PCR) and the amplicons were analyzed by Poly Acrylamide Gel Electrophoresis (PAGE). The results revealed that the trnH –psbA loci is continued to be

polymorphic with respect to amplicon length in the selected *Nicotiana* accessions. These amplicons were sequenced by Sanger sequencing which further confirmed the length and sequence variation of the loci in the selective accessions.

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 BanketA1, 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.

VARIETIES RELEASED BY ICAR-CTRI (2015-16)

- **LT KANCHAN :** A low Tar flue-cured Virginia tobacco variety with high yield potential of 2,500 kg/ha is suitable for commercial cultivation in the Northern light soil region covering West Godavari district of Andhra Pradesh. Low tar content (less by 10%) in cured leaf biomass is the special trait associated with this variety.
- **CH-1:** A CMS based flue-cured Virginia tobacco hybrid is released for commercial cultivation in the Northern light soil region of AP. This hybrid is known for its high yield potential (2900 kg/ha) as well as its superior leaf quality in terms of smoke flavor resulting from relatively higher concentration of neutral volatile compounds.
- **N-98:** A high yielding (2,200 kg/ha) FCV tobacco variety is suitable for commercial cultivation in Southern Light Soils region of Andhra Pradesh. It is the most prefered tobacco variety in the recommended area.
- **Nandyala Pogaku-1:** It is the first *bidi* tobacco variety released for commercial cultivation in Nandyal region of Andhra Pradesh and has yield potential of around 2200 kg/ha. It performs well in the drought conditions.

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

II(A): Optimisation of Water& Nutrient Use for Productivity Enhancement of Differeent Tobacco Ttyes

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

S. V. Krishna Reddy, C. Chandrasekhara Rao and S. Kasturi Krishna

The field experiment was conducted during *rabi,* at ICAR-CTRI RS, Jeelugumilli, with FCV tobacco (*Nicotiana tabacum* L.) cv.Kanchan in irrigated Alfisols (northern light soils) of Andhra Pradesh. The experiment consisted of 9 treatments replicated five times in RBD with different combinations of drip irrigation, Furrow irrigation, tray seedlings, normal seedlings, drip fertigation and soil application of fertilizers at 3rd, 25-30, 40-45 days after planting or at 10, 25-30, 40-45 days after planting. Results revealed that significant differences between the treatments with regard to the yield 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 3, 20-25 and 40-45 DAP increased green leaf yield by 3,556 kg (23.87%), cured leaf yield by 415 kg (16.67%) and grade index by 450 kg (23.44%) when compared with furrow irrigation, normal seedlings, soil application of fertilizers at 10, 25-30 and 40-45 DAP. Among all the treatments, furrow irrigation, normal seedlings and soil application of fertilizers recorded the lower yields. The tobacco yields are significantly higher during 2014-15 crop season due to favourable weather conditions.

Quality: The differences among treatments were also marked in quality parameters. In general, nicotine levels increased from P to T position and reducing sugars increased from P to L position and decreased from L to T position. Among the treatments drip irrigation, tray seedlings, drip fertigation at 3, 20-25 and 40-45 DAP and drip irrigation, tray seedlings, drip fertigation at 10, 25-30 and 40-45 DAP recorded higher levels of nicotine and lower levels of reducing sugars as compared to furrow irrigation, normal seedlings and soil application of fertilizers (T9) i.e. The treatment T9 recorded the lower levels of nicotine and higher levels reducing sugars. The chloride levels are well within the acceptable limits of good quality (< 1.5%).

Table II-1.Effect of drip irrigation and tray seedlings on the Productivity (kg/ha) in NLS tobacco

Treatment	Cured leaf	Grade index
T1	2904	2370
T2	2832	2332
T3	2489	1920
CD @5%	104	88

T1 : Drip irrigation, tray seedlings, drip fertigation at 3, 20-25 and 40-45 DAP

T2 : Drip irrigation, tray seedlings, drip fertigation at 10, 20-25 and 40-45 DAP

T3 : Furrow irrigation, normal seedlings, soil application of fertilizers at 10, 25-30 and 40-45 DAP

Alternative and Cheaper Source of Nitrogen to FCV tobacco in Northern Light Soils of Andhra Pradesh (CTRI, Rajahmundry)

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

Ten treatment combinations of urea, AS, KNO_3 and CN in three splits were compared with DAP + CAN + SOP (Recommended Dose), and 20-20-0, SSP, Urea, Ammonium Sulphate and SOP combinations (Interim Fertiliser schedule recommended). Application of urea/ AS as a basal dose followed by urea or AS or Urea+ AS or Urea + AS+ KNO_3 or Urea + AS + CN did not

show significant differences in green leaf yield or cured leaf yield or grade index.

Nicotine content in lamina was low and reducing sugars were high. Nicotine in lamina increased and reducing sugars decreased with increase in plant position. Different treatment combinations did not show any significant differences in nicotine, reducing sugars and nitrate nitrogen. Nitrogen content in lamina did not show any significant difference due to nitrogen sources. In general, the nitrogen concentration in different treatments was low especially in L and T positions. The concentration of P and K was also not significantly differed among the treatments. In general potassium concentration was low.

Effect of Fertiliser Source of Nutrients on Yield and Quality of Burley Tobacco Grown in Upland s (CTRI, Rajahmundry)

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

Sources of fertilizer affected the yield and quality of burley tobacco significantly. Application of CAN/Ammonium sulphate in 1st dose along with DAP and CAN in 2nd dose gave higher green and cured leaf yields. A/S + SSP in 1st dose with A/S in second dose and 28:28 :0 in 1st dose with A/S in second dose are the next best treatments. In case of non availability of CAN, either A/S or 28:28:0 may be used in burley tobacco production.

Nicotine and reducing sugars are within in the desirable limits. Significant differences were observed for the above parameters. However, higher values of Nicotine were observed when A/S was applied in both the doses. Differences were not observed in the treatments for reducing sugars.

Table II-2: Effect of different nitrogen sources on yield (kg/ha) Parameters

Treatments	Cured Leaf yield	Grade index
Urea+ Urea + AS	2111	1689
Urea + Urea + AS + AS	1932	1507
Urea + AS + AS	2002	1550
Urea + Urea + AS + KNO_3 + AS	2177	1745
Urea + Urea + AS + CN + AS	2119	1665
AS+ Urea + AS	1875	1458
AS + Urea + AS + AS	2005	1554
AS + AS + AS	1772	1382
AS + Urea + AS + KNO_3 + AS	1981	1580
AS + Urea + AS + CN + AS	1871	1389
DAP + CAN + CAN	2036	1557
20-20-0 + Urea + AS	2076	1625
CD at 5%	NS	NS

Feasibility of Producing Organic Tobacco in KLS (CTRI RS, Hunsur)

M. Mahadevaswamy and S. Ramakrishnan

The studies on the feasibility of producing organic tobacco using various organics (FYM @ 12 t/ha, use of bio-fertilizers @ 10 kg/ha, green manuring in rabi season with sunnhemp, use of neem based organics and bio-pesticides etc.,) was conducted for the fourth consecutive crop season during 2014-15 (for the second cycle) in Hunsur farm. The results of the 4th year indicated that the reduction in the productivity of the organic tobacco was 28.5% compared to the reduction of cured leaf to an extent of 50%, 42.7% and 33.0% observed in the first, second and third crop season respectively. The INM treatments involving organic and inorganic at 75:25 and 50: 50 ratios resulted in reduction in the yield comparatively (16.5 and 8.5 % respectively). Similarly the total top grade leaf production reduced by 22.5% in the organic treatment while the same in the INM treatments (75:25 and 50: 50) resulted in 11.7 and 6.4% reduction respectively. However, the bright grade production was higher by 6-7% in the organic treatment.

With respect to the cured leaf quality characteristics, the nicotine in the X position was lower (0.68%) in the organic treatment when compared to the inorganic treatment (1.23%). The L position leaf also showed similar trends with recommended NPK treatment recording the higher nicotine value of 2.17% compared to 1.47% in the organic treatment. With regard to the disease incidence, there was reduction in the root knot incidence by about 40.7% and reduction in the wilt incidence by 38.5% in the fully organic treatment.

Table II-3:Yield parameters (Kg/ha) as influenced by organic & INM treatments

Treatments	Cured leaf yield	Top grade equivalent
Fully organic	912	730
75% organic + 25% inorganic	1071	831
50% organic + 50% inorganic	1164	881
Recd. NPK	1272	942

Recommended NPK 60:40:120 kg/ha

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.Chandrashekar Rao

Under this project, the experiment with varied K levels and split/time of applications was conducted both in nursery and main field.

Nursery trial: The nursery experiment showed positive response in terms of seedling vigor, seedling root and shoot length and seedling dry matter production up to 100 kg K_2O/ha. Application of 100 kg K_2O/ha in 4 splits (at sowing, 25, 35 and 45 DAP) recorded significantly maximum seedling growth parameters, dry matter production and higher number of transplantable seedlings per unit area compared to 25 kg or 50 kg/ha. The incidence of RKI was also considerably reduced under higher level of K applications with more split doses.

Main felid trial: In the second phase of the experiment, the best performed nursery treatment was selected for planting in the main field and evaluated with various combinations of K_2O levels with varied split application methods to meet the K requirement of the tobacco crop for optimizing the productivity and enhancing quality.

The effect of K levels and their split applications on the plant growth parameters reveal that all the treatments with more than one split application of K showed increased leaf area of 9th ,12th and 15th leaf at 60 days compared to only single application. Eventhough the increase in the leaf area was not statistically significant, the split applications of K in 3-4 splits increased the leaf area by 4.0-11.7 % in the 9th leaf, 5.0 – 11.1% in the 12th leaf and by 2.0-14.5% in the 15th leaf. There were no significant differences in the growth parameters between 90 kg and 120 kg K_2O/ha.

All the treatments with various split applications of K were significantly superior compared to no K application with respect to cured leaf yield. The increase in cured leaf was maximum at 120 kg K_2O/ha applied in 4 splits with an increase of 23% compared to no K application and 10.3% compared to K application only as basal dose. Treatment with 120 kg K_2O/ha applied in 4 splits at (10, 25, 40 & 55 DAT) recorded the maximum TGE and was significantly superior to the same dose at one split or 2 splits. The increase in the productivity of TGE due to 3-4 split application of potassium was in the range of 15.6 to 20.7% indicating the usefulness of potash applications in more than 2 splits.

Table II-4: Effect of potassium levels and split applications on yield parameters

Treatments	CLY Kg/ha	TGE Kg/ha
60:40:**120**kg NPK/ha (10)	958	676
60:40:**120**kg NPK/ha (10 & 25)	1013	713
60:40:**120**kg NPK/ha ((10, 25 & 40)	1046	782
60:40:**90** kg NPK/ha (10, 25 & 40)	1038	802
60:40:**120** kg/ha (10, 25, 40 & 55)	1057	816
60:40:**90** kg/ha (10, 25, 40 & 55)	1043	792
60:40:**0** (No K) control	857	545
C.D. at 5%	116.6	95.9

Permanent Manurial Trial on *Motihari* Tobacco (CTRI RS, DINHATA)

S. Mandi & D.Damodar Reddy

Results of the permanent manurial trial showed that the application of 112 kg N + 112 Kg P^2O_5 + 112 Kg k_2O ha^{-1}recorded significantly higher green leaf (15875.32kg ha^{-1}) and cured leaf (2331.7 kg ha^{-1}) yields of *Motihari* tobacco as compared to control with only FYM @10q ha^{-}

[1]. First grade leaf yield was significantly higher in treatment 112 kg N + 112 kg P_2O_5 ha^{-1}(954.7kg ha^{-1}) than control FYM @10 q ha^{-1}. Application of phosphorus and potassium alone or in combination with each other and only 25 or 50 t F Y M applied plots gave lower green, cured and first grade leaf yield and quality as compared to the application of nitrogen alone or in combination of phosphorus and potassium.

Application of 112 kg N ha^{-1} + 112 kg P_2O_5 ha^{-1} + 112 kg K_2O ha^{-1} recorded highest gross returns (₹ 1,04,940 ha^{-1}) followed by 112 kg N ha^{-1} +112 K_2O ha^{-1} (₹ 1,01,835 ha^{-1}) and 112 kg N ha^{-1}+ 112 kg P_2O_5 ha^{-1}(₹ 1.00,485 ha^{-1}). However, net returns were higher in treatment 112 kg N ha^{-1} +112 K_2O ha^{-1} (₹ 2,24,24 ha^{-1}) followed by treatments 112 kg N ha^{-1} + 112 kg P_2O_5 ha^{-1} + 112 kg K_2O ha^{-1}(₹ 19999 ha^{-1}) and 112 kg N ha^{-1}+ 112 kg P_2O_5 ha^{-1}(₹ 18643 ha^{-1}).

Optimisation Dose of N, P, K with Spacing in Pipe Line Variety of Jati Tobacco in North Bengal (CTRI RS, DINHATA)

S. Mandi and S.Kasturi Krishna

The experiment comprised of three spacings (75X75cm, 75X90cm and 90X90cm) and three Nitrogen levels (100 N ha^{-1}, 125 N ha^{-1} and 150 kg N ha^{-1}) with three replications in FRBD. Spacing 90 X 75 cm was recorded highest green (7469.09 Kg ha^{-1}) and cured leaf yield (1298.45 Kg ha^{-1}) and first grade leaf yield (929.68 Kg ha^{-1}) followed by treatment 75 X 75 cm. However higher quality out-turn was recorded in 75 X 75 cm (73.81 %) than the rest of two treatments. Nitrogen dose 150 Kg ha^{-1} was recorded highest green leaf yield (7218.49 Kg ha^{-1}), cured leaf yield (1249.47 Kg ha^{-1}) and first grade leaf yield (990.13 Kg ha^{-1}).

Treatment 90 X 75 cm spacing in combination with application of 100 Kg ha^{-1} nitrogen recorded maximum gross returns (₹ / ha 79,500.00), net return (₹ /ha 5, 689.00) and B: C ratio (1:1.078) followed by spacing 90 X 75 cm combination with application of 150 Kg ha^{-1} nitrogen was recorded Rs/ha 75,840, Rs/ha 4,593 and Rs/ha 1:1.062 gross returns, net returns and B: C ratio respectively. Treatment 90 X 90 cm and 75 X 75 cm spacing with combination 100,125 and 150 Kg ha^{-1} nitrogen recorded low returns due to low market price this year.

Inference: Spacing of 90cm X 75 cm and Nitrogen dose 150 Kg ha^{-1} recorded highest green, cured and first grade leaves, treatment combination 90 X 75cm with 100 Kg ha^{-1} was more economical.

Table II-5: Yield of *Jati tobacco (kg/ha)* as influenced by different spacing and Nitrogen

Treatments	Cured leaf yield	First grade leaf yield
Spacings	**Main lots**	
75 X 75 cm	1230	908
90 X 75 cm	1298	929
90 X 90 cm	1085	783
CD at 5%	100	85
N Dose	**Sub plots**	
100 N Kg ha^{-1}	1192	823
125 N Kg ha^{-1}	1172	808
150 N Kg ha^{-1}	1249	990
CD at 5%	89	74

II B. Evolving Site-specific Cultural Management Practices in Different Agro-Ecological Sub Regions

Chemical Management of *Orbanche* in FCV tobacco (CTRI, Rajahmundry)

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

Yield: Field experiment was conducted during 2014-15 season at CTRI farm Katheru. Results revealed that significant differences were observed with regard to leaf yield of tobaccodue to chemical method of *Orobanche* control. Significantly higher green and cured leaf yield was recorded by PPI of Alachlor, followed by hand removal of *orobanche,* neem cake, A/S spray, neem oil spray, soybean oil spray, PPI of pendimethalin and lower yields in post emergence application of glyphosate & imazethapyr and in control when compared to hand removal of *orobanche.* In general, the grade out-turn is very low due to pot water given for o*robanche* emergence in tobacco. Post emergence application of glyphosate & imazethapyr reduced the quality drastically.

Weight of *Orobanche*: In general the *Orobanche* emergence was lower in the experimental plot. Orobanche emergence was not observed in the plots where glyphosate and imazethapyr were applied as post emergence spray at 50 and 70 days after planting. Application of chemicals viz.

neemcake, A/S spray, neem oil, soybean oil, pre emergence application of Alachlor and Pendimethalin reduced the *orobanche* weight when compared to control.

Leaf Quality: Leaf quality in terms of nicotine and reducing sugars are affected by chemical control of *orobanche* and are within the desirable limits. Significantly lower reducing sugars were observed in PPI of alachlor and in the control i.e. without removal of *orobanche* and in PEA of Glyphosate plots. Higher sugars were observed in neem cake applied plots. No significant differences were found between treatments for nicotine content.

Orobanche infestation was reduced and yield improvement was observed when glyphosate was applied @ 50 g ai/ha when compared to 200 g ai/ha application in the previous season. No phyto-toxicity was observed. PPI of pendimethalin@ 325 g ai and alachlor 1000 g ai/ ha recorded on par yields with that of hand removal of *orobanche.* Post emergence application of imazethapyr @ 50g ai /ha caused deformation in tobacco leaf shape and suckers were emerged from the stems, though the control of orobanche was reported in many cases.

Table II-6: Yield of FCV tobacco (kg/ha) and *Orobanche* weight as affected by chemical method of *Orobanche* control

Treatment	Cured leaf yield	*Orobanche* Fresh wt g/ 100 plants
PPI of Alachlor	2157	213
PPI of Pendimethalin	2069	278
Neemcake application @10 g/plant	2097	354
PEA of Glyphosate at 50 DAP	1663	-
PEA of Imazethapyr at 50 DAP	1652	-
PEA of Neem oil to *Orobanche*	2082	378
Hand removal of *Orobanche*	2114	562
Control	1774	636
CD at 5%	271	155

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

Among the INM treatments, organic manure (FYM) + balanced NPK plot performed better and produced higher green leaf yield, cured leaf yield and grade index and has balanced chemistry and higher chlorophyll content followed by FYM + Excess N+ recommended PK plot. These two treatments did not express any false ripening symptoms. Only N without FYM and PK plot recorded lower yields and showed false ripening. The FYM+ balanced NPK treatment recorded increased cured leaf yield by 180 kg/ha (7.17%) and grade index by 117 kg/ha (10.66%) as compared to the treatment, only N without FYM and PK. Among the varieties the cv.VT-1158 performed better followed by TBST-2 without false maturity. Though the cv. Siri recorded higher yields compared to TBST-2, false maturity was observed in cv. Siri. Higher chlorophyll content was recorded in VT-1158.

Among the inter-culture treatments, regular inter-culture with complete weeding and Orobanche (broomrape) removal recorded higher GLY, CLY, GI, GI/CL (%), balanced chemistry and higher chlorophyll content in leaf lamina. In reduced inter-cultivation and weed control through chemicals with no inter-cultivation, the cured leaf yields are slightly less than regular inter-cultivation treatment but grade index is reduced to a considerable extent. These two treatments showed lower chlorophyll content and false ripening. The regular inter-culture with complete weeding and orobanche (broomrape) removal treatment recorded increased cured leaf yield by 64 kg/ha (2.46%) and grade index by 112 kg/ha (9.47%) as compared to the treatment, only N without FYM and PK. Among the varieties the cv.VT-1158 performed better followed by TBST-2 without false maturity. Though the cv. Siri recorded higher yields and nicotine content compared to TBST-2, false maturity was observed in cv. Siri. Higher chlorophyll content was recorded in TBST-2.

Among the INM treatments, FYM + balanced NPK (reco.) and FYM + (excess N) rec.PK plots performed better and recorded higher GLY, CLY,

GI, GI/CL(%) and also recorded higher chlorophyll and nicotine content. These plots showed healthy growth all through the crop season and false maturity was not recoded. Balanced NPK and (excess N) + reco. PK plots recorded lower yields and lower chlorophyll content and reduced nicotine content. False maturity was recorded in these two plots.

Among topping/sucker control plots, decanol (2%) + pendimethalin (0.3%) performed better and showed healthy crop growth throughout the season followed by decanol (4%) and pendimethalin (0.6%) as is also indicated by higher chlorophyll and nicotine contents. Excess pendimethalin (1%), no topping and manual de-suckering produced lower yields and showed false maturity. No topping recorded lower yields compared to all other treatments.

Among irrigation water management plots excess irrigation during grand growth period, irrigation as per schedule showed healthy growth without false maturity and recorded higher GLY, CLY, GI, GI/CL (%) and chlorophyll content as compared to deficit irrigation during grand growth period. The deficit irrigation during grand growth period treatment showed false maturity and slightly higher nicotine content. This might be due to lower yield and concentration effect.

Among weed control / intercultural treatments, regular inter-culture plot performed better and recorded higher GLY, CLY, GI and chlorophyll content and maintained healthy crop growth all through the crop season. The plots of reduced inter culture with post emergence spray of quizalofop ethyl and PPI of pendimethalin recorded lower leaf yields and also showed false maturity.

Studies on Climate Risk Management in FCV Tobacco Based Cropping Systems in STZ of Karnataka (CTRI RS, HUNSUR)

M. Mahadevaswamy, and C. Chandrashekar Rao

During the period under report, the correlation of the 30 years data (1984-2014) between the climatic factors like temperature, relative humidity, sunshine hours Vs productivity and quality of FCV tobacco in KLS were studied. The effect of pre-monsoon rainfall as well as the rainfall during the crop season on FCV tobacco productivity pattern and quality of tobacco also was studied. The productivity was found to increase with increase in the rainfall and the number of rainy days during the crop growing season. There was no significant correlation between the various climatic factors like temperature, relative humidity, sunshine hours and the productivity or quality of FCV tobacco. Increase in temperatures during July/ August months slightly increased the nicotine. Sunshine hours even-though did not show significant correlation, sun shine hours during July/August months showed positive trend with the productivity. There was a decreasing trend in the nicotine content with the increase in the rainfall during crop growing season. The chloride content had a negative correlation with rainfall amount during the growing season.

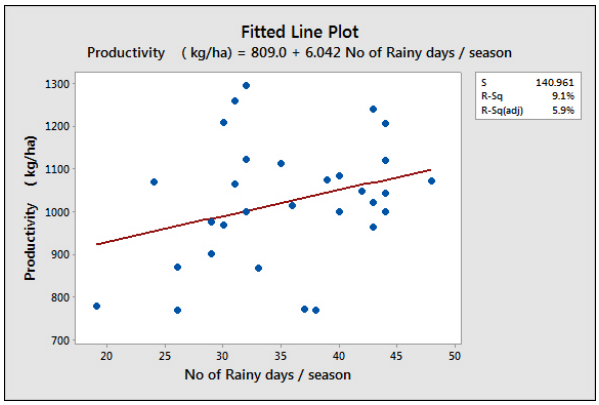


Fig. II-1: Correlation of the rainfall data with the cured leaf productivity

Identification of Critical Stages of Weather for FCV Tobacco Productivity and Quality:

Based on the meteorological standard weeks, weekly rainfall (RF), weekly potential evapotranspiration (PET) and ratio of RF/PET for each of the standard weeks, data was subjected for analyzing the length of growing period, and the probable dry spells and wet spells that could occur in the tobacco growing season for a period of 20 years (1995-2014).

During the growing season the standard, 23rd week as well as 26th week (June 2nd week and 4th week) which are called dry spells (where the RF/PET is less than 0.50) seems to be critical during which the PET exceeds the rainfall by

more than twice during which judicious drought management practices need to be adopted as this stage coincides with the active vegetative growth. Similarly during the Std weeks 32nd - 33rd (Aug 2nd and 3rd week), the crop is also likely to suffer from slight moisture deficiency during which moisture conservation techniques are needed for optimum productivity. However standard weeks (34-44th week) are called as wet weeks or wet spells (Aug 3rd onwards to October last week) where amount of rainfall is more than the evapo-transpiration(RF/PET ratio is more than 1.00) which requires separate excess water management practices for productive tobacco farming. The study indicates that the climatic risks are more during the later harvesting stages of the crop due to wet spells which is affecting the quality of the crop apart from decreasing the productivity in KLS Zone.

Evaluation of Set Row Planting in Burley Tobacco for Efficient Resource Conservation and Utilisation (CTRI, Rajahmundry)

C. Chandra Sekhara Rao, D. Damodar Reddy and S. Kasturi Krishna

Progressive increase in fertilizer doses in SRP increased green leaf yield and cured leaf yield. SRP 100% RDF showed significantly higher GLY over other treatments. SRP with 75% RDF, 50% RDF and CP with 100% RDF being at par showed significantly higher green leaf yield over SRP with 25% RDF and SRP with no fertilisers. SRP with 100% RDF showed significantly higher cured leaf yield over other treatments. SRP 75%, RDF is at a par with CP with 100% RDF showed significantly higher yields over SRP with 25% RDF and SRP with no fertilizers.

SRP with different doses of fertilisers and CP with RDF being at par showed significantly higher nicotine compared to SRP with no fertilizers. Increase in dose of fertilizers in SRP showed increase in leaf nicotine. Reducing sugars were significantly higher in SRP with no fertilisers compared to SRP with fertilizer doses and conventional planting with RDF

Nutrient uptake showed progressive increase with fertilizer doses in SRP. SRP with 100% RDF showed significantly higher N uptake over other treatments. SRP with 75% RDF and CP with 100% RDF being at par showed significantly higher 'N' uptake over SRP with 0 and 25 % SRP. SRP with 100% RDF showed significantly higher 'P' uptake and was at par with 75% RDF. SRP with 75% RDF at par with CP 100% RDF. SRP with 100% RDF showed significantly higher potassium uptake compared to other treatments. SRP with 75% RDF being at par with 50% RDF and CP with 100% RDF showed significantly higher K uptake over 25% RDF and SRP with no fertilizers

Soil properties: 0-5 cm: Increase in fertilizer doses in SRP increased the soil available nitrogen, phosphorus and potassium. Continuous application of fertilizers without disturbing the soil increased the soil available P significantly in SRP 75% and 100% RDF compared to conventional planting. Available potassium in SRP with 100% RDF was significantly higher than SRP with 25% RDF and no fertilizers. Available nitrogen also increased with increase in fertilizers in SRP. SRP with 100% RDF showed significantly higher N compared to other treatments.

5-15 cm: Available P in SRP 100% RDF showed significantly higher P compared to CP with 100% RDF and SRP 0, 25, 50 and 75 % RDF. Increase in fertilizer doses increased the phosphorus and potassium build up in set row planting.

15-30 cm: SRP treatments were not significantly differed with respect to pH and chlorides but showed significantly less pH and higher chlorides compared to CP with 100% RDF. Increase in fertilizer doses in SRP showed increase in available P. SRP with 100% RDF showed significantly higher P compared to CP with 100% RDF. Set row planting with 100% RDF showed increase in available K over conventional planting.

Agronomic Evaluation of Advanced Breeding Line HV.2009-3 (CTRI RS VEDASANDUR)

M. Kumeresan

The advanced breeding line Hv.2009-3 significantly increased the FGLY and TCLY over the check, Abirami. The FGLY and TCLY increased was 10.6 and 13% respectively with HV.2009-3 over Abirami.HV.2009-3, HV.2009-5 recorded a comparable FGLY and TCLY .The spacing 90x 75cm significantly increased the FGLY and TCLY

.The FGLY and TCLY increased with 90cm x75cm spacing was 7.8 and 8.66% respectively. Nitrogen at different levels did not influence the FGLY or TCLY. Higher gross return, net return and B.C ratio were recorded at HV.2009-3 at 90cmx75cm and Nitrogen at 75 kg/ha.

II C. Analysis of Socio-Economics for Stratification and to Formulate Appropriate Strategies

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 to study the impact assessment. The following technologies were identified pertaining to KLS and NBS areas.

KLS: 1. Variety FCH-222 2. Application of Propiconazole @ 0.05 to 0.10% against *Rhizoctonia solani* 3. Bio-intensive management of soil borne diseases and root knot nematodes by *Trichoderma viridi* and *Pseudomonas florescence* in nurseries and main field.

NBS: 1.Variety Siri 2. Hand removal of *Orabanche* shoots before flowering, 2-3 years of crop rotation and insitu green manuring 3. NPK fertilization 4. Recommended intercultures and 5. Insect control measures.

During 2014-15 season, adoption of recommended measures for the control of soreshine disease and bio-intensive management of soil borne diseases in disease prone nurseries improved the income of nursery growers by Rs.26,400/- per ha. Further adoption of cv.FCH-22 and bio-intensive management of soil borne diseases in F.wilt endemic main fields improved the farmers income by Rs.31,520/-, per ha in KLS area. With regard to NBS area, the results revealed that the adoption of cv: Siri improved the farmers' income by Rs.16,560/- per ha. Adoption of technology module consisting of NPK fertilization, timely inter-cultures, management of broomrape, insect control measures improved the farmers' income by Rs.32,018/- per ha.

The average value of assets like barn, tractor, bulking shed, implements etc., in different FCV tobacco growing areas of Andhra Pradesh which was found to be Rs. 11,28,720/- in NLS, Rs. 7,61,975/- in BS and Rs.3,95,592/- in SLS.

Nutritional Security in Tribal Areas of East Godavari District through Community Based Approaches (DBT funded Project: CTRI, Rajahmundry)

K SUMAN KALYANI & TGK MURTHY

The major objective of the project is to enhance the livelihood security of tribal farm families by introducing nutrition related location specific technologies and income generation and entrepreneurship programmes in tribal area.

Technologies Generated

1. Solar drying Technology: Production, preservation, processing, packaging methods and quality parameters were standardized for solar drying of fruit based food products viz., Amla powder, amla candy, amla ginger, amla supari, tooty fruity, copra powder and mango jelly.

2. Soya Milk Extraction: Production and processing technology of soya milk by using simple boiler method was developed in the project. By use of heat inactivation of lipoxidase and by removing the flavour compounds by evaporation (deodorization), masking the bitterness and off-flavour by sweetening and flavouring agents (chocolate and rose milk flavour), the milk can be readily consumed. The time and labour saving technology of preparation of Soya milk and milk based products (Tofu, granules, nuggets, meal maker) were popularized among ashram schools. The technology was introduced in tribal Ashram schools and this is being consumed by the tribal children as protein substitute as the availability of cattle milk is difficult in this hilly area.

3. Millet based Products : Production technology was standardized for millet based products (biscuits, cakes and curry puffs)with variety of combinations by using cereals, pulses and oil seeds. These low cost supplements are popularized in tribal area for benefitting rural and tribal children below five years.

4. Herbal Powders: Production and processing

technology by using solar drying method was standardized for making triphala powder, neem leaf powder, neem seed kernel powder, rita nut powder, mint leaf powder, curry leaf powder and henna powder. Varieties of mixtures were popularized by taking these products as base material for consumption and commercial purposes.

5. **Weaning Mixtures**: Production technology was standardized for three varieties of supplementary weaning mixtures with variety of combinations by using cereals (*ragi, sama and korra*), pulses and oil seeds. These low cost diets were developed by using the millets available in tribal hamlets. They are popularized in rural and tribal areas for the benefit of children below five years.

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

Crop productivity, soil quality and economic returns under intercropping system (chewing tobacco +Annual moringa) in response to nutrient management.

M. Kumaresan and D. Damodar reddy (CTRI RS, VEDASANDUR)

Annual moringa at different populations viz., 1,00,75 and 50% was inter crop with chewing tobacco under 100% population with 3 levels of fertilizers (75,100and 125% RDF) . The experiment was conducted in a split plot design.

The results of the 3rd year revealed that the different annual moringa population inter cropped in chewing tobacco did not affect the first grade leaf yield (FGLY) or total cured leaf yield (TCLY) of chewing tobacco. The fertilizer levels viz., 75% 100% and 125 % RDF showed a significant between the treatments. The FGLY and TCLY with 100% and 125% RDF are comparable. The gross returns, net returns and B:C ratio were also not affected by the different levels of annual moringa planted in chewing tobacco. The different levels of fertilizers significantly influenced the gross returns, net returns and B:C ratio of chewing tobacco . The gross returns, net returns and B:C ratio with respective 100% and 125% RDF were comparable.

Soil residual fertility status after tobacco (2013-14)

The population of annual moringa and nutrient management in tobacco + annual moringa inter-cropping did not influence the OC % at different depths. The OC % at 0 to 22.5 cm ranged between 0.40 to 0.47% and at 22.5 to 45 cm depth the OC% ranged between 0.27 to 0.31%. The available P_2O_5 significantly influenced annual moringa population. Annual moringa at 50% population inter-cropped with chewing tobacco significantly increased the available P_2O_5 at both the depths. Different levels of RDF also influenced the available P_2O_5 status of the soil in both the depths. The available K_2O was influenced by the annual moringa population at different fertility levels at both the depths 0 to 22.5 and 22.5 to 45cm. The recommended dose of RDF at 125 % significantly increased the available K status over the 75% RDF. The available K_2O ranged between 346-394 in the 1st depth and in the 2nd depth the K_2O ranged between 351-403 kg/ha.

Tobacco+Moringa

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

Advanced 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) and two fertiliser levels (100:50:50and 150:75:75 kg NPK/ha) were tested in split plot design with three replications. Observations taken during crop growth stage showed significant treatment variations with regard to plant height and no.of leaves Line RT 51-1 recorded significantly higher plant height and no. of leaves followed by HDBRG for plant height and RT 46-1 for leaf number. Regarding spacing, though significant differences were not observed between treatments 80x40 cm recorded higher plant height and 70x40 recorded more no. of leaves. Significant differences were not observed for fertiliser doses.

Leaf Biomass: Regarding leaf yield HDBRG produced significantly higher yield due to more no.of leaves and HI. Line RT 51-1 though recorded higher plant height, more no.of leaves; lower leaf length, width and HI resulted in lower yields. Spacing 70x40 cm gave higher yields though no significant differences were observed (Table 1&2). Fertiliser dose of 150:75:75 NPK kg/ha recorded higher leaf yield than lower dose. Interaction table showed that HDBRG with 80 x40 spacing and 150:75:75 NPK kg/ha recorded higher leaf yields of 410.32 q/ha followed by 70 x40 spacing and 100:50:50 NPK kg/ha line with an yield of 403.73 q/ha compared to other lines.

Nicotine Yield: Significant differences were observed in nicotine yield due to lines, spacing and fertiliser levels. Line RT 51-1 followed by TI-163 X A-145 line recorded significantly higher nicotine. Wider spacing 80X 40cm recorded higher nicotine content of 54.34 kg/ha followed by 70x40cm and 60x40 cm spacing. Fertiliser dose of 150:75:75 NPK kg/ha recorded higher nicotine than lower dose. Interaction table shows that Line RT 51-1 with a of 60 x40 spacing and 150:75:75 NPK kg/ha recorded higher nicotine yields followed by TI-163 X A-145 line with 80 x40 spacing and 150:75:75 NPK kg/ha.

Solanesol Yield: Significantly higher solanesol was recorded by HDBRG of (39.07) than other lines; Wider spacing of 80X 40 recorded higher solanesol followed by 70x40cm; Fertiliser dose of 150:75:75 NPK kg/ha recorded higher solanesol yield than lower dose. Interaction table shows that HDBRG with a of 70 x40 spacing and 150:75:75 NPK kg/ha recorded higher solanesol yield of 55.10 kg/ha followed by same line at 60x40 spacing with 100:50:50 NPK kg/ha.

Protein Yield: Significantly higher protein was observed in HDBRG (715.88kg/ha) than other lines; spacing of 70X 40 cm recorded higher protein; Fertiliser dose of 150:75:75 NPK kg/ha recorded higher protein yield than lower dose.Interaction table shows that HDBREG with 70x40 spacing and 150:75:75 NPK kg/ha recorded higher protein yield of 925.7 kg/ha followed by same line at 60 x40 spacing with 100:50:50 NPK kg/ha which was on par with line RT 46—1 at 60 x40 spacing with NPK kg/ha 150:75:75 .

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

Identification of constraints and their management for effective utilisation of natural resources is of paramount importance for optimizing resource use in an agro-ecosystem. 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

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

Canopy and leaf spectral reflectance values of FCV tobacco were compared and correlated with N, P and K contents and growth parameters which showed prominent response with increasing levels of nitrogen (120, 180, and 240 kg/ha) and potassium levels (120 and 240 kg/ha).

Quality constituents of leaf: Leaf nitrogen (0.87-5.65 %) showed good positive correlation with canopy spectral reflectance. Linear regression showed that leaf nitrogen content of cured leaf had significant relationship with leaf nicotine content (0.59 to 1.91 %, R = 0.903, Rsqr = 0.816) indicating role of nitrogen in synthesis of nicotine. Leaf potassium content varied form 1.12-4.43 % at different nitrogen and potassium levels. Reducing sugars ranged between 7.81 - 26.3 %. Nicotine content increased with nitrogen up to 180 kg but such linear response was not noticed.

Sensitivity analysis of Hyper Spectral variations in leaf and canopy spectrums: Responses to N and K variation in spectral bands are significant. Sensitive bands were delineated for important quality parameters. Canopy reflectance of % total chlorophyll and % leaf nitrogen at bud initiation stage had significant correlation at wavelength bands 724-729 nm and 350-365 nm (R=-0.62&0.64-0.65), respectively.

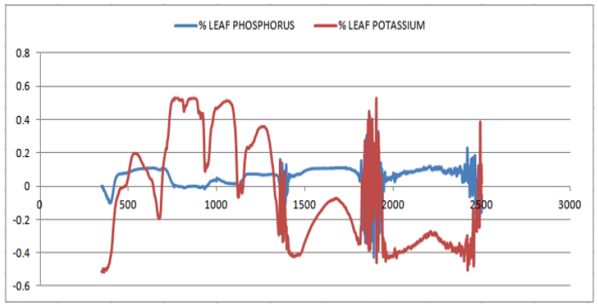


Fig.IV-1.Canopy reflectance with % leaf potassium.

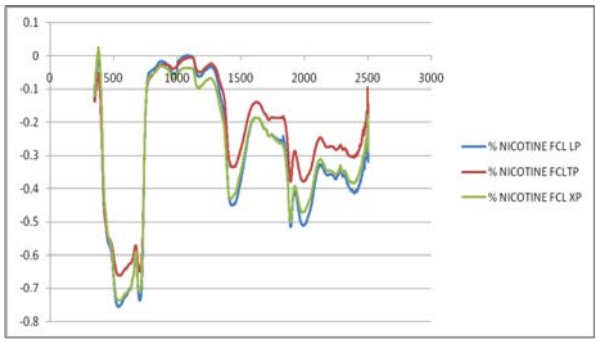


Fig.IV-2. Leaf spectral reflectance with % nicotine in cured leaf

Sensitive bands for canopy spectral reflectance for leaf potassium were observed between 747–862 nm with a positive correlation co-efficient value of 0.53 (Fig.IV-1). Sensitive analysis of the leaf reflectance in relation to nicotine and reducing sugars showed a significant correlation (Nicotine: R= - 0.75; Reducing sugars: R= 0.42).Identified sensitive bands for nicotine were 539-541 nm and 710 nm and for reducing sugars were 631-692 nm and 1901-1970 nm (Fig.IV-2).

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 ash addition effects on soil pH and K-fertility: The dynamics of soil pH and K-fertility of an Alfisol (Jeelugumilli) amended

with crop residue and wood ashes were assessed in a 90-day incubation experiment. The treatments for incubation experiment included four ashes viz., cotton stem ash (CSA), barn wood ash (BWA), tobacco stem ash (TSA) and maize rind ash (MRA), and $CaCO_3$ at three rates of addition (0.05, 0.10 and 0.15% on w/w basis) and a control (no biomass ash). Sub-samples of soils were drawn 6 times at pre-decided intervals (7, 15, 30, 45, 60 and 90 days) during the course of incubation and analyzed for soil pH and available K. Addition of biomass ashes caused a marked increase in soil pH over the no-ash control and thereby indicated the potential of biomass ashes as liming material for acid soils. For all the biomass ashes and at all the application rates, soil pH tended to decrease with the progress of incubation time. The magnitude of soil pH rise was larger with the increase in ash application rate. The increment in soil pH also differed between different biomass ashes and followed the order: CSA > BWA > TSA > MRA (**Fig IV-3)**. The addition of biomass ashes brought out a distinct change in soil K fertility. All treatments with biomass ashes enhanced the K availability in soil as compared to the no-ash control throughout the incubation period. 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 directly related to biomass ash K concentration and hence the amount of K added through ashes. Among the biomass ashes, the increase in K availability followed the order: TSA > MRA > CSA > BWA **($_{Fig IV-2}$)**.

Biomass ashes effect on phosphorus adsorption of an acid Alfisol: The increase in soil pH as a result of biomass ash addition might also have indirect influence on behaviour of nutrients like phosphorus. A laboratory experiment was, therefore, conducted to study the phosphorus sorption behaviour of an acid Alfisol amended with different biomass ashes (Tobacco stem ash, TSA; Cotton stem ash, CSA; Pigeon pea stem ash, PSA; Coffee husk ash, CHA; and Maize rind ash, MRA) at the rate of 0.1 % (on w/w basis). Phosphorus adsorption isotherms were prepared for soil samples that were treated with different biomass ashes and incubated for 30 days. In general, all the soils receiving biomass ashes as amendments showed a marked increase in the P adsorption as compared with the soil amended with no ash control. Highest phosphorus adsorption was recorded for soil amended with pigeon pea stem ash (PSA). The greater phosphorous adsorption observed for PSA amended soil could be attributed to the formation of calcium phosphate complexes favoured by higher Ca content and large rise in soil pH resulting from this ash.

Efficiency of biomass ashes as sources of K supply for flue cured tobacco on Alfisols: Two field experiments, one at CTRI-RS, Hunsur in KLS region under rainfed conditions (*kharif* 2014) and another at CTRI-RS, Jeelugumilli in NLS region under irrigated conditions (*rabi* 2014-15), were conducted to evaluate different biomass ashes alone or enriched with SOP as sources of K for flue- cured tobacco (Kanchan) grown on Alfisols. The treatments included 4 biomass ashes alone (TSA, CSA, PSA and EWA at Hunsur and CSA BWA, TSA, and MRA at Jeelugumilli) and their 4 combinations with SOP (50:50 wt. basis), SOP alone and a no-ash control. The 10 treatments in all for each field experiment were tested in a RBD with 4 replications. The results indicate that tobacco responds well to K application (100 kg K ha^{-1}) on the K deficient Alfisols in both KLS and NLS conditions. Application of biomass 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. Tobacco cured leaf yields obtained with different biomass ashes alone or their mixtures with SOP were at a par with the yields recorded with standard SOP fertilizer. The relative yield of biomass ash treatments indicating that the biomass ashes can serve as potential sources for K supplementation for FC tobacco on light textured Alfisols (Table 1). All the treatments receiving K also resulted enhanced K concentration in leaf and increased K uptake over the control, with the effect being more conspicuous for KLS than for NLS. The quality parameters *viz.,* nicotine and reducing sugars for both X and L position leaves were not affected by the biomass ashes alone or in combination with SOP.

Table 1: Yield efficiency parameters

Parameter	Hunsur	Jeelugumilli
Yield Response (%)	16.13-31.64	16.01-25.21
Agronomic Efficiency(kg CL/ kg K)	1.56-3.06	2.87-4.52
Relative Yield (%)	88-96	98-105

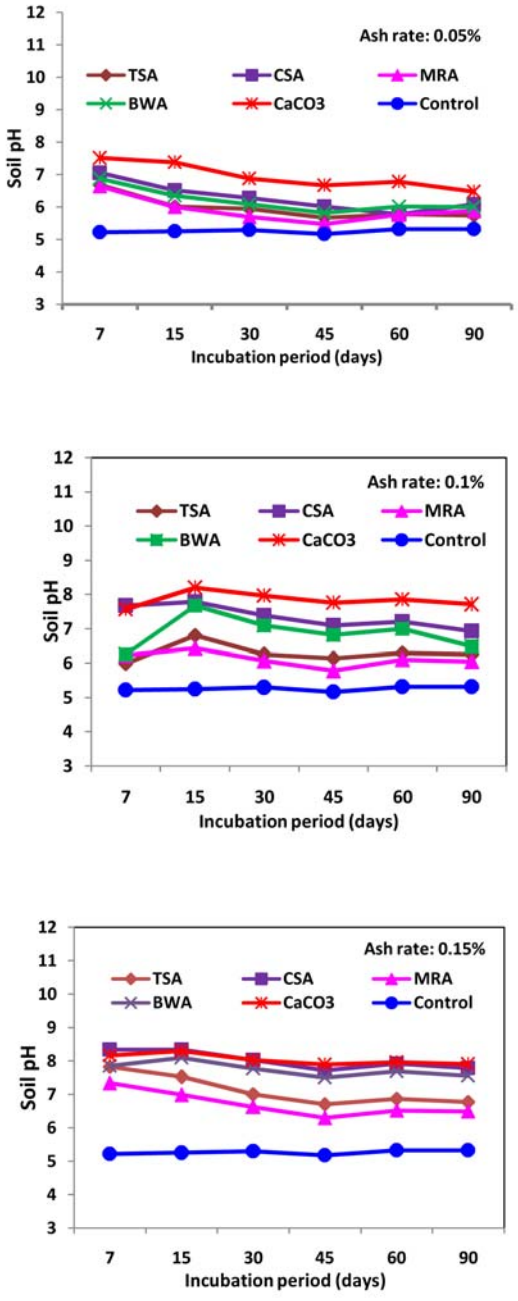


Fig. IV-3: Changes in soil pH as induced by different biomass ashes at varying rates of application

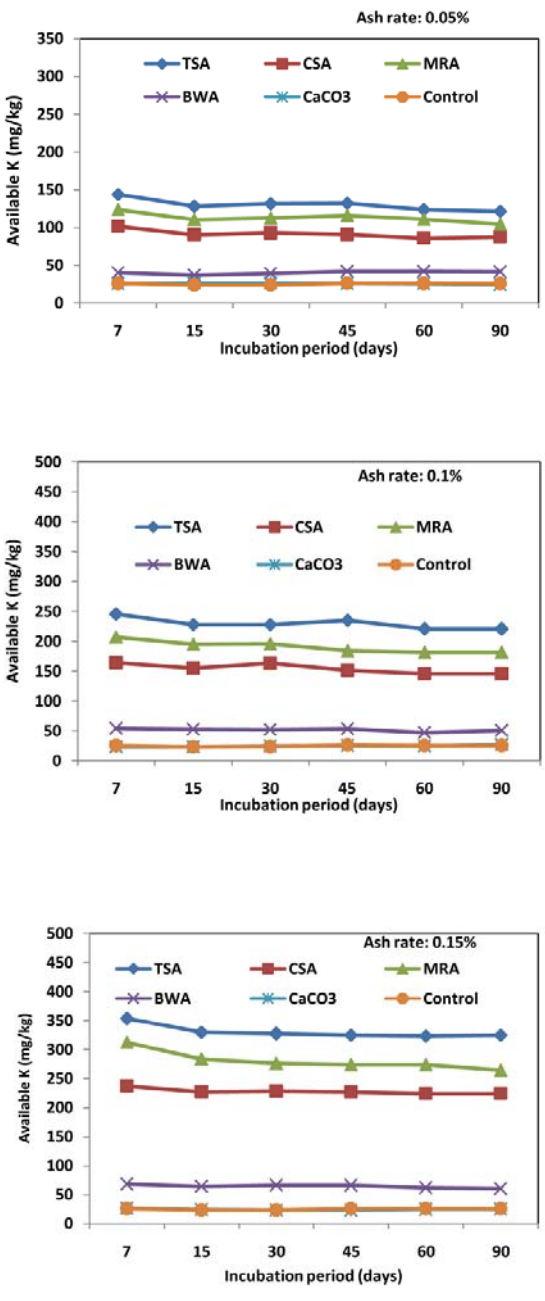


Fig. IV-4: Changes in soil K availability as induced by different biomass ashes at varying rates of application

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

Secondary nutrient deficiency effects on potassium nutrition:

Sand culture experiments were conducted to study the effect of single and multiple secondary nutrient deficiencies under sufficient and deficient conditions of phosphorus on plant growth, development and nutrient uptake. Uniform tobacco seedlings of variety Kanchan were planted in washed sand which is supplied with different nutrient combination treatments using Hoagland solution. The main treatments were with and without phosphorus. In each treatment all combinations of secondary nutrient stresses (Ca, Mg, S, Ca & Mg, Ca & S, Mg & S and Ca, Mg & S) were imposed. Results revealed that single and multiple nutrient secondary nutrient deficiencies reduced growth characters, net photosynthetic rate and nutrient uptake. Total chlorophyll content was reduced due to Mg, S deficiency and their combination treatments.

Under nutrient stress the concentration of anti-oxidative enzymes increased to counteract the adverse effects of stress. The increase in super-oxide dismutase activity is high under S deficiency and its combination treatments. Under no phosphorus condition the plant growth is less and omission of secondary nutrients further reduced the growth and uptake of nutrients and showed visual deficiency symptoms.

Evaluation of organic and inorganic soil amendments to minimize nutrient leaching losses and enhance nutrient use efficiency under NLS tobacco production system [CTRI, Rajahmundry]
J. Poorna Bindu and D. Damodar Reddy [CTRI, Rajahmundry]

System operating conditions for tobacco stems were optimized and the conditions were of 500 ^{0}C for 90 minutes with the recovery of 40%.Biochar from tobacco stems is characterized by high content of total organic carbon (80%), N (1.23%), P (0.78%), K (3.48%) and alkaline pH of 9.42.The cation exchange capacity of tobacco stem biochar and synthetic zeolite were 30 and 270 ^{0}C mol (p+) kg^{-1} respectively.

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

Tobacco (*Nicotiana tabacum L.)* and stem assisted green synthesis of silver nanoparticles and evaluation of its antimicrobial activity against agricultural plant pathogens [CTRI, Rajahmundry]
D.V. Subhashini

Preparation of tobacco leaf extract

Fresh and young leaves (10g) of tobacco, collected from black soils of ICAR-CTRI Farm, Katheru, was washed thoroughly with distilled water and cut into fine pieces. Leaves were subsequently macerated slightly with the help of mortar and pestle and transferred into a 500 ml beaker containing 200ml double distilled water and boiled for 10 minutes at 60^{o}C. The solution was filtered using Whatmann No 1 filter paper.

Synthesis of silver nanoparticles

For synthesis of silver nanoparticles, 10 ml of freshly prepared plant extract was added to 190 ml of 1mM $AgNO_3$ solution at room temperature. The incubation of the mixture was carried out at 30^{o}C in dark condition for 72 hours. Characteristic red colour appeared after incubation of the mixture for 72 hrs, due to reduction of colloidal silver. UV-Vis spectroscopy showed absorption maxima of the color at 420 nm. The average particle size (z-average) was found to be 10853.3nm and a PDI value of 1.884 while zeta value was found to be -29.1mV with a peak area of 100% intensity. SEM analysis showed that the silver nanoparticles synthesized from *N. tabacum* leaf are spherical to irregular in shape.TEM study showed that the size varied from 26.8-36.8 nm (small sized nanoparticles) to 36.9-53.3 nm (large sized nanoparticles).

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, T.G.K. Murthy and D. Damodar Reddy

Nine varieties of *bidi* tobacco were obtained from *Bidi* tobacco research station, Anand. Sixty one neutral volatile aroma compounds (NVAC) were identified among the 9 varieties of *bidi* tobacco. The NVAC identified in different tobacco were grouped in different classes based on their structure. The compounds identified were the degradation products of carotenoids, thunberganoids, neophytadiene, terpenoids, phenylalanine metabolite compounds and Maillard reaction products.

Terpenoids: The total terpenoids content varied from 69.43 to 148.12 ppm among the varieties. The variety GT5 showed maximum content of terpenoids (148.12 ppm) but it was at a par with the varieties MRGTH-1 and GABT-11. The important compounds identified among the terpenoids based on relative abundance are caryophyllene oxide, sclareoloxide, isophytol, 3-hydroxy solavetivone, epiglobulol, farnesyl acetone, spathlenol, limonene dioxide, indole, geranyl acetone, linalool, nerolidol-epoxyacetate and 4-ketoisophorone. The variety MRGTH-1 showed maximum and significantly higher content of geranyl acetone (31.84 ppm) followed by variety GABT-11 (26.61 ppm). The Spathulenol content was maximum in the variety GT7 (10.807 ppm) followed by A119. The variety GABT-1 showed significantly higher levels of farnesyl acetate (30.74ppm) compared to other varieties. Linalool content was maximum in the variety GT4 (1.193 ppm) and was not detected in the varieties MRGTH-1 and ABT-10. Isophytol content varied from 0.657 to 1.347 ppm among the varieties. The variety MRGTH-1 showed maximum isophytol content (1.347ppm) and it was at a par with varieties GT4 and GT5.

Carotenoid related compounds (CRC): The carotenoid degradation compounds viz., demascone, damascenone, ionones, four isomers of megastigmatrienone, dihydroactinidiolide and 3-oxo-alpha-ionone, which are related to aroma were identified. The total CRC were maximum in the variety GABT-11 and significantly higher than other varieties. Megastigmatrienone content was significantly higher in the variety MRGTH-1(29.24 ppm) compared to other varieties. The varieties MRGTH1 and GABT-11 showed significantly higher levels of individual CRC compounds.

Thunberganoids and cembrenoids: Thunberganoids and cembrenoids content ranged from 20.147 to 80.97 ppm among the varieties. The variety GT4 showed significantly higher content of Thunberganoids and cembrenoids (80.97 ppm) followed by GT5 and MRGTH1. Among the Thunberganoids and cembrenoids, the individual compounds present in abundance are solanone, thunberganol, cembrene and duvatrienediol. Solanone content was significantly higher in the variety GT4 (61.04 ppm) followed by variety MRGTH-1. The thunbergol content varied from 1.38 to 25.76 ppm among the 8 varieties. Neophytadiene content varied from 20.17 to 75.99 ppm among the varieties . The variety MRGTH-1 showed significantly higher levels of neophytadiene (75.99 ppm).

Phenylalanine metabolite compounds (PMC): Phenylalanine metabolite compounds were maximum in the variety GABT-11(3.72 ppm) followed by MRGTH-1 (3.443 ppm) and they were at a par with variety GT4. Among the PMC, phenyl acetaldehyde and phenylethyl alcohol were the major compounds identified based on the quantity. Phenyl acetaldehyde content varied from 0.423 to 1.62 ppm among the varieties. The variety GT4 showed maximum content of phenyl acetaldehyde (1.62 ppm) and it was at a par with the variety GT5 and GABT-11.

Maillard reaction products (MRP): Maillard reaction products varied from 0.09 to 1.22 ppm among the varieties. The variety GT4 showed significantly higher content of MRP (0.567 ppm). Among the MRP, furfural was the major compound and it was significantly higher in the variety GT4 and was at a par with the variety MRGTH-1.

Fatty acid composition of *bidi* tobacco: Maximum of 9 fatty acids were recorded in all the varieties. Among the nine fatty acids, palmitate, linoleate, lenolenate and oleate were in maximum contents. The per cent composition among the fatty acids showed that the linolenate> palmitate> linoleate> oleate> heptadeconate> myristate> pentadeconate > laurate.

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

A survey was conducted for assessment of insect pest incidence in tobacco and tobacco based cropping systems of CBS and SBS area. Six tobacco Auction Platfarms viz., Vellampalli 1 & 2, Ongole 1 & 2, Tangutur and Kondepi were selected for this study. The major crops covered under this area are tobacco, cotton, chillies, pigeon pea and chickpea.

Tobacco

Nursery survey covering 19 villages (7 in CBS and 12 in SBS) and 57 nurseries was conducted and data were recorded. Out of them, 28.6% nurseries were infested by tobacco caterpillar, *Spodoptera litura* in CBS and 25.0% in SBS.

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, *Bemecia tabaci* were recorded in both areas. Incidence of other pests was negligible. The average infestations of these pests in the infested fields were 6.1, 6.5, 7.2 and 8.5% in CBS and 5.6, 5.4, 6.8 and 8.2% in SBS, respectively.

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

FCV tobacco growing areas in KLS region were surveyed by collecting soil and root samples randomly from fields in different *Taluks* viz., HD Kote, Hunsur, Periyapatna and Arkalgudu and were processed for enumeration of various nematode populations. Results revealed the presence of following plant parasitic nematodes viz., *Meloidogyne spp, Rotylenchulus reniformis, Helcotylenchus spp, Pratylenchus spp* and *Tylenchus sp,* associated with main field tobacco. Maximum mean population of root knot nematodes were found in Periyapatna region followed by Hunsur, Arkalgud and H.D.Kote. Reniform nematodes, though found in large numbers in soil samples, they are not pathogenic to tobacco as compared to root knot nematodes. Plants revealed the presence of heavy multiple galls with attached slimy egg mass in roots.

(B) Development of IPM technology

Bio-efficacy and field evaluation of new insecticides against tobacco pests (CTRI, Rajahmundry)
U.Sreedhar and S. Gunneswara Rao

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

An experiment was conducted to evaluate new insecticide chlorfluazuron 5.4 % EC for its field efficacy against tobacco caterpillar, *S.litura* in tobacco nurseries. The new insecticide chlorfluazuron 5.4 EC @ 0.0075%, 0.015% & 0.03% was evaluated along with novaluron 10 EC @ 0.01%, lufenuron 5 EC @ 0.006% and emamectin benzoate 5 SG @ 0.0025% and untreated control in a replicated trial. At 2 DAS emamectin benzoate 0.0025% recorded least (5.63%) seedling damage followed by chlorfluazuron 0.03% (7.64) and novoluron 0.01% (8.30). The seedling damage in the treatments of emamectin benzoate 0.025% and chlorfluazuron 0.03% was ona par with each other. At 4 and 8 DAS more or less similar trend was observed.

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

A bulk trial was conducted to evaluate Flonicamid 50 WG @ 0.02% and pymetrozine 50 WG @ 0.02% against tobacco aphid, *M.nicotianae* on FCV tobacco in comparison with untreated control. At 2 DAS flonicamid @ 0.02% recorded lowest aphid population (2.75/plant) followed by pymetrozine 0.02% (3.62/plant) compared to untreated control (34.81/plant). From 4 DAS cent per cent control of aphids was observed in

both the plots treated with flonicamid and pymetrozine upto 16 DAS. Where as in untreated control plot continuous build up of aphid population was recorded from 38.54/plant at 4 DAS to 62.53/plant at 16 DAS. The per cent plants infested in untreated control plots was 67.6% at the first priming. Highest cured leaf (3050 kg/ha), bright leaf (1196 kg/ha) and grade index (1650) was recorded in the plot treated with flonicamid 50 WG @ 0.02%, where as it was 2990 kg/ha, 1196 kg/ha and 1650 in the plot treated with pymetrozine 50 WG @ 0.02%. The untreated control plot recorded 2356 kg/ha of green leaf, 840 kg/ha of bright leaf and a grade index of 1260.

Table V-1: Evaluation of new insecticides against tobacco aphid *Myzus nicotiane* blackman in FCV tobacco

Treatment	Mean aphids /plant Days after spray			
	2	4	8	16
Pymetrozine 50 WG 0.02%	3.62 (12.1)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Flonicamid 50 WG 0.02%	2.8 (6.7)	1.00 (0.0)	1.00 (0.00)	1.00 (0.0)
Control	34.8 (1217)	38.5 (1485)	39.1 (1525)	62.5 (3908)
CD *(p=0.05)*	1.46	1.54	1.74	2.43

Figures in the parenthesis are retransformed means

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

A bulk trial was conducted to evaluate Insecticides viz., Flonicamid 50 WG @ 0.02%, spiromesifen 240 SC @ 0.02%, pymetrozine 50 WG @ 0.02% and diafenthiuron 50WP @ 0.05% against tobacco leaf curl virus vector *B.tabaci* on FCV tobacco. The insecticides were applied twice at 10 and 25 days after planting. Results indicated that among the treatments, diafenthiuron 50 WP @ 0.05% recorded least whitefly population at all the observations. At 7 days after I spray (DAIS) the population (0.74) in diafenthiuron was on par with pymetrozine (0.81) and significantly less than all other treatments. At 15 DAIIS the population in diafenthiuron (0.83) was least followed by pymetrozine (1.44) which remained on par with both flonicamid (1.48) and spiromesifen (1.55). The data on leaf curl infected plants showed that it was least in diafenthiuron (2.0%) followed by pymetrozine (2.4%), flonicamid (3.2%) and spiromesifen (3.6%), where as it was 12.4% in untreated control plot. Pymetrozine treated plot recorded highest cured leaf (3080 kg/ha), bright leaf (1200 kg/ha) and grade index (1726) followed by flonicamid 2986 kg, 1110 kg/ha and 1660 respectively.

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

(i) New insecticides, chlorfenapyr 10 SC @ 0.01% and metaflumizone 22 SC @ 0.04% were evaluated for their field efficacy in a bulk plot trial in comparison with untreated control. The results showed that chlorfenapyr 10 SC @ 0.01% was most effective in controlling the infestation of *S.litura* in FCV tobacco as shown by no damage both in terms of per cent plants infested, mean no of leaves damaged as well as leaf area damaged. The plot treated with metaflumizone 22 SC @ 0.04% recorded 4.4% plant infestation. The mean number of leaves damaged were 1.24, 1.28 and 1.35 at 2, 4 and 8 DAS, where as the leaf area damaged was 10.01, 10.98 and 11.30% as against mean no. of leaves damaged in untreated control plots (1.71, 3.82 & 2.79) and the per cent leaf area damaged (19.24, 23.50 and 26.99%) at 2, 4 and 8 DAS. In the untreated control plot the infestation was 25.6%.

(ii) Chlorfluazuron 5.4 EC @ 0.075%, 0.015% & 0.03% was evaluated along with novaluron 10 EC @ 0.01%, lufenuron5.4 EC @ 0.06% and emamectin benzoate 5SG @ 0.0025% along with untreated control against *S.litura* on field crop of FCV tobacco. Results indicated that emamectin benzoate @ 0.025% recorded least number leaves damaged (1.00) followed by chlorfluazuron 0.03% at all the observations and remained on par with each other. At 4 DAS emamectin benzoate 0.025% (1.00), chlorfluazuron 0.03% (1.09) remained on par with each other while novoluron (1.21) remained

on a par with lufenuron((1.23) as well as chlorfluazuron 0.03%. At 8 DAS emamectin benzoate, chlorfluazuron 0.03% (1.12) and novaluron 0.01% (1.24) remained on a par with each other while novoluron 0.01% remained on a par with lufenuron (1.32). At 15 DAS emamectin benzoate and chlorfluazuron 0.03% while remaining on a par with each other recorded less number of leaves damaged than all others.

Evaluation of insecticide application technology for effective spray coverage on FCV tobacco in NLS (CTRI- Research Station, Jeelugumilli)

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

1.Assessment of spray volume requirements applied through different sprayers on FCV tobacco at different growth stages

Spray fluid applied through high volume sprayers viz., compressed, knapsack and Hi-tech and two low volume sprayers viz., motorized knapsack (MKS) and high pressure knapsack sprayers (HPKS) were assessed at six stages of the crop growth commenced from 20 DAP and subsequent four stages at 15 days interval.

Spray fluid applied through knapsack and Hi -tech sprayer at 30 DAP was low of 125-120 l/ha respectively as against compression sprayer- farmers method (170 l/ha) followed by compression sprayer (145 1/ha) and it reduced the quantity of insecticide to an extent of 41 and 21 % over compression sprayer-farmers method, and compression, respectively. Further, Hi- tech sprayer reduced the operation time to an extent of 28 and 11 % over compression sprayer- farmers method and compression, respectively. Spray fluid applied through low volume sprayers viz, high pressure knapsack (HPKS) and motorized knapsack sprayer (MKS) was low of 100 and 110 l/ha, respectively as against Hi tech sprayer (120 l/ha) with saving of time to a tune of 55% over Hi tech sprayer.

At 50 DAP compression sprayer- farmers method showed higher spray fluid (195 l/ha) followed by compression and knapsack sprayer 175 and 150 l/ha, respectively as against Hi-tech sprayer (142 l/ha). Hi- tech sprayer reduced the operation time to an extent of 15 and 6% over compression sprayer- farmer method, and compression, respectively. It revealed that up to 50 DAP by considering plant canopy, quantity of spray fluid and insecticide requirement, application through Hi-tech sprayer was more economical over low volume sprayers HPKS and MKS.

At 65 DAP the spray fluid applied through low volume sprayers viz., HPKS and MKS was low of 120 and 130 l/ha as against 175 l/ha with Hi tech sprayer. Though the quantity of insecticide required through HPKS was high of 27 per cent over Hi -tech, it showed saving of application time to an extent of 54 % over Hi tech sprayer.

As the crop growth was not in accordance with age, the spray fluid requirements at different growth stages are found to be inappropriate and valid conclusions could not be drawn. Under such sub normal growth situations, by considering quantity of insecticide and operators time, low volume sprayers are not preferable.

Table V-2: Spray fluid requirement through different high volume sprayers

Age of the crop (DAP)	Spray fluid l/ha				% saving of insecticide by using Hi tech over		
	CS (Fm)	CS	KS	Hi	CS (Fm)	CS	KS
35	170	145	125	120	41	21	5
50	195	175	150	142	36	20	4
65	220	200	180	175	26	14	3

2.Spray characteristics as influenced by different sprayers at 35 and 65 days after planting

Due to sub normal growth and poor canopy, the droplets deposited on photographic paper strips on top, middle and bottom canopy were coalesced and formed bigger droplets. As the

strips were completely flooded, the spray characteristics could not be analysed. Similarly deposition of spray fluid on ground surface could not be determined.

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

Incidence of leaf eating caterpillar, *Spodoptera litura* at 50 DAP was significantly lower to an extent of 11.4 per cent over control (18.4) in the plots treated through Hi- tech sprayer. At 65 DAP the infestation was significantly low of 14.1 in the plots received initial two sprayings through Hi -tech and subsequent spray through HPKS and reduced the infestation to a tune of 35 per cent over control. At 80 DAP the infestation in different treatments ranged from 11.5 per cent in the plots received initial two sprayings through Hi tech and subsequent two sprayings through HPKS to 14.9 through compression sprayer.

Incidence of aphid, *Myzus nicotianae* at 50 DAP was significantly low of 12.8 in the plots treated through Hi-tech and rest of the treatments were at par. At 65 DAP, the infestation was significantly low of 12.4 in the treatments received initial two sprayings through Hi tech and rest two through HPKS Critical perusal of data indicated that the infestation was lowest of 13.1 in the plots received initial two sprayings through Hi tech and rest two through HPKS and superior over other treatments.Similarly Hi tech sprayer showed superior performance up to 50 DAP in suppressing i1Incidence of tobacco budworm, *Helicoverpa armigera* and there after HPKS was more effective in minimizing the pest incidence on tobacco crop.

Spray fluid requirement during vegetative stage of the tobacco in NLS (Feeler trial)

At 20 DAP the spray fluid requirement varied from 60 l/ha (nozzle discharge @ 250 ml/min) to 260 l/ha (nozzle discharge @ 1000 ml/min).It varied from 63 to 275 l/ha ,when the crop was 35 DAP. Similarly at 40 DAP it varied from 65 to 280 l/ha .. Further it is evident that the crop growth was not in accordance with the age, the spray fluid requirements at different growth stages are found to be in appropriate. Droplets deposited on photographic papers could not be analysed as the droplets coalesced and formed bigger droplets.

II - Influence of insecticide formulations, discharge rate and sprayers on the incidence of major insect pests on FCV tobacco (CTRI-Rajahmundry)

It was evident that pplication of imidacloprid 200 SL at a discharge rate of 450 ml/min through Hi tech sprayer was effective in minimizing the aphid infestation at 35 DAP.

Infestation due to , *S. litura* : At 45 DAP leaf eating caterpillar infestation was low of 16.8 in the plots treated with novaluron 8.8 SC at a discharge rate of 450 ml/min applied through Hi tech sprayer as against 22.7 in control.

Spray characteristics indicated that at 25 days after planting(DAP), imidacloprid 200 SL emitted through Hi- tech sprayer at a discharge rate of 450 ml/min, 40 PSI pressure with a walking speed of 3.6 -4 kmph was characterized by superior spray characteristics of higher droplet density (67 per sq.cm), lower uniform coefficient (1.51) and higher coverage (0.66) on plant canopy At 45 DAP spraying with novaluron 8.8 SC, 450 ml/min through Hi tech sprayer exhibited superior spray characteristics of higher droplet density (62), lower uniform coefficient (1.52) and high (0.65) coverage.

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

A replicated field trial was conducted with eight treatments viz., T1foliar 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 Imidaclorpid 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 with imidacloprid 200 SL @ 0.005% T9- Untreated Control. Observations on plant

mortality were recorded at 7,15&30 days after planting (DAP).

The results indicated that at 7 DAT least per cent plant mortality of seedlings was recorded in T2-Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting and T5- T2 + FS of Imidacloprid 200 SL 0.005% 5 DAT. However, T3 Imidaclorpid 200 SL 0.005% in transplant water (3.50) remained on par with these two treatments as shown by per cent 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 DAT recorded cent per cent protection and significantly superior to all other treatments. T2 Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting (7.00), T3 Imidaclorpid 200 SL 0.005% in transplant water were the next best treatments and significantly superior to the rest. At 30 DAP similar trend was observed, however, T3 also remained on par with T 8 (17.10) and T 7 (17.27%).

Data on yield parameters (83 b) showed that T5- T2 + FS of Imidacloprid 200 SL 0.005% 5 DAT recorded highest cured leaf yield (2890 kg/ha) followed by T2 Seedling rootdip- Imidacloprid 70 AF @ 0.14% before transplanting (2830kg) and T3 Imidaclorpid 200 SL 0.005% in transplant water (2796 kg/ha) which were on par with all the treatments except T1foliar spray (FS) of imidacloprid 200 SL @ 0.005% on the seed bed 1 day before transplanting and T4 Foliar spray of Imidaclorpid 200 SL 0.005% a day after transplanting (DAT) which recorded less cured leaf yield than other treatments. As regards bright leaf yield T5 recorded highest (1300 kg/ha) followed by T2 (1270) and T3 (1200). Similar trend was observed for grade index except that T8 remained ona par with the best treatments i.e., T5, T2 and T3.

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

Five fungicides were evaluated against frog-eye leaf spot disease and the results revealed that spraying with carbendazim @ 0.05 per cent immediately after appearance of the disease followed by another spray at 10-15 days interval recorded minimum per cent disease index (PDI) of 19.92 which was on par with pyraclostrobin + metiram @ 0.2% (19.94 PDI) followed by kresoxim methyl @ 0.1 per cent (21.03 PDI). Among the fungicides propiconazole @ 0.1 per cent (21.23 PDI) and azoxystrobin @ 0.1 per cent (21.24 PDI) did not perform better in checking the incidence of the disease. All were superior to untreated check with more than 36 per cent reduction of PDI over control. Maximum disease incidence was noticed in untreated control (31.36 PDI). There was no significant difference with respect to cured leaf yield among different treatments tested. However, application of pyraclostrobin + metiram recorded maximum grade index of 892 followed by carbendazim 826 and kresoxim methyl 778 when compared to control.

Table V-3: Efficacy of different fungiciedes on frog-eye leaf sport disease of FCV tobacco

Fungicides	PDI	% disease reduction over control
Azoxystrobin 23% SC @ 0.1%	21.24	33.09
Propiconazole 25% EC @ 0.1%	21.23	31.79
Kresoxim methyl 44.3% SC @ 0.1%	21.03	42.47
Pyraclostrobin+Metiram 60% WG @ 0.2%	19.94	55.56
Carbendazim 50% WP @ 0.05%	19.92	55.79
Untreated check	31.36	
CD at 5%	0.51	-

Efficacy of new fungicides for the management of leaf blight disease in tobacco nursery caused by Phytophthora parasitica f. sp. nicotianae (Breda de Haan) Tucker

U. Sreedhar and S. K. Dam

In vitro studies

A total of seven fungicides were evaluated *in vitro* against *Phytophthora parasitica* f. sp.

nicotianae causing leaf blight disease of nursery tobacco by poisoned food technique at four different concentrations of 100, 250, 500 and 1000 ppm. The results indicate thatout of seven fungicides evaluated against the test pathogen, fenamidone + mancozeb was most effective as it checked 100% growth of fungus even at 100 ppm followed by metalaxyl + mancozeb and pyraclostrobin + metiram at 1000 ppm concentrations, respectively.

Nursery experiment

Attempts were made to find out the effective fungicides for managing leaf blight disease in FCV tobacco nursery. Seven fungicides with two sprays (21st and 31st days after sowing) were tested along with untreated check replicated thrice on FCV tobacco nursery. Fenamidone + mancozeb followed by metalaxyl + mancozeb , pyraclostrobin + metiram showed minimum disease index. Whereas, fenamidone + mancozeb showed 100% disease reduction as compared to control followed by metalaxyl + mancozeb 65% (positive check). Higher numbers of transplantable seedlings were recorded in fenomidone + mancozeb (850/m^2) @ 0.3% spray followed by metalaxyl + mancozeb (796/m^2) @ 0.2%. The Fungicidesdoes notshow any phytotoxicity even at 3 days after spraying.

Table V-4: Efficacy of new fungicides on management of leaf blight disease in FCV tobacco nursery

Fungicides	Diseased seedlings/ m^2	% reduction of disease over control
Azoxystrobin 23% SC @ 0.1%	4.80	51.7
Trifloxystrobin + Tebuconazole 75% WG @ 0.1%	5.35	35.4
Pyraclostrobin + Metiram 60% WG @ 0.2%	3.29	60.3
Kresoxim methyl 44.3% SC @ 0.1%	4.98	39.9
Fenomidone + Mancozeb 60% WG @ 0.3%	0.00	100.0
Metalaxyl + Mancozeb 72% WP @ 0.2%	2.93	64.6
Copper oxychloride 50% WP @ 0.2%	3.60	56.5
Untreated check	8.28	-
CD at 5%	1.61	-

Compatibility of recommended fungicides and insecticides against *Phytophthora parasitica* f. sp. *nicotianae*

Four fungicides *viz.,* copper oxychloride 0.2%, metalaxyl + mancozeb 0.2%, fenamidone + mancozeb 0.3% and metalaxyl- m + mancozeb 0.2% alone and in combination with two recommended insecticides viz., emamectin benzoate 0.05% and imidacloprid 0.25% were tested *in vitro* against *Phytophthora parasitica* f. sp. *nicotianae* by poison food technique. Cent per cent mycelial growth inhibition was recorded in fenamidone + mancozeb alone and in combination with emamectin benzoate and imidacloprid, followed by (metalaxyl + mancozeb) + imidacloprid (96.0%) and showed high compatibility. This indicated the compatibility of all recommended fungicides against *Phytophthora parasitica* f. sp. *nicotianae* with the recommended insecticides.

Pythiumaphanidermatum

Five recommended fungicides in tobacco nurseries viz., copper oxychloride 0.2%, metalaxyl + mancozeb 0.2%, fenamidone + mancozeb 0.3%, metalaxyl- m + mancozeb 0.2% and azoxystrobin 0.1% alone and in combination with two recommended insecticides viz., emamectin benzoate 0.05%, imidacloprid 0.25% were tested *in vitro* against *Pythiumaphanidermatum* by poison food technique. Cent per cent mycelia growth inhibition was recorded in combination of the treatments i.e. (fenamidone + mancozeb) + emamectin benzoate, azoxystrobin + emamectin benzoate and (metalaxyl + mancozeb) + imidacloprid followed by (metalaxyl- m + mancozeb) + emamectin benzoate (93.33%). Other fungicides and insecticides combination were also found inhibitory at their respective recommended doses and were superior over control, thus indicated the compatibility of

recommended fungicides against *Pythium aphanidermatum* with insecticides.

Studies on Bio-ecology and management of *Helicoverpa armigera* Hub.in tobacco as oil seed crop

An experiment was conducted to evaluate three different modules viz., bio intensive IPM, chemical control and IPM in comparison with untreated control for management of *Helicoverpa armigera* Hub. in tobacco as oil seed crop. Bidi tobacco variety A119 was planted in bulk plots of 500 plants each. Pheromone traps were installed to monitor the activity of the pest. The components of BIPM module were NSKS spray at flowering when the moths were observed in the trap. Two sprays of Ha NPV when the 1st and 2nd instar larvae were observed on the inflorescence and the capsules. The chemical control module consisted of three sprays of flubendiamide 480 SC @ 0.012% and chlorantranaliprole 25 SC @ 0.0075% at flowering, capsule formatioin and seed filling stages. The components of IPM module were spray of NSKS and Ha NPV at flowering and capsule formation, and flubendiamide 480 SC @ 0.012% need based spray of novaluron 10 EC@ 0.01%.The capsule damage was least in chemical control module (4.50, 4.65, and 6.81%) at all the observations and was on a par with IPM module (5.02, 5.13& 6.13) both of which were significantly superior to BIPM module (12.67, 12.81& 17.72) at all the observations. The data on percent plants infested with the pest also showed similar trend. The activity of *N.tenuis* was highest in untreated control plot followed by BIPM and IPM plots. The highest seed yield of 560 kg/ha was recorded in chemical control plot followed by IPM plot (546 kg/ha).

Validation of IPM module against tobacco aphid, *Myzusnicotianae* under CBS conditions (CTRI RS, Guntur)
P. Venkateswarlu

Bulk trial evaluation of identified IPM module in one acre area was carried out during 2014-15 at CTRI Research Station, Guntur. The module consists of two rows of maize border as barrier crop with one spray of *Verticillium lecanii* @ $3X10^{12}$ CFU/ha at 50 DAP and one spray of imidacloprid @ 50g a.i./ha (0.03%) at 60 DAP. Chemical control plot (farmer practice) with one spray of imidacloprid at 50 DAP and one spray of thiomethaxam (0.02%) at 60 DAP was kept for comparison. An unsprayed plot with only border crop and another unsprayed plot without any border crop were kept as controls.

A. Aphid population

All three treatments/modules were significantly superior over untreated control in reducing aphid population at 10 days of second spray. IPM module exhibited 100% reduction of aphid population on top leaves which was on par with chemical control module (farmer practice). Border crop alone also reduced aphid population by 20.68% over untreated control.

B. Yield

As aphid infestation was low during the season, there was no much difference in yield among all experimental plots. However, maximum yields of 13,380, 1,948 and 1,416 kg/ha of green, cured and bright leaf was recorded in chemical control module followed by bio-intensive IPM module with 13,345, 1,925, 1,405 kg/ha and maize border plot with 13,317, 1,927 and 1,380 kg/ha, respectively. There was an increase of 0.68 to 1.88% total cured leaf was recorded in treatments over untreated control.

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

Experiments on integration of solarisation and chemicals with antagonistic organisms, *Trichodermaviride*, *Paecilomyceslilacinus* and *Pochaniachlamydosporia* singly and in rational combinations against root knot nematodes and soil borne fungal diseases revealed that, integrated application of *Trichodermaviride &Paecilomyceslilacinus, Trichoderma viride* and *Pochaniachlalmydosporia* along with ridomil and furadon in solarised nursery beds were on par with each other in recording 50.0 and 45.1 per cent increased healthy seedling count compared to check. Similarly both the effective treatments recorded decreased root knot index to the tune of 49.2 and 48.7 percent respectively and also decreased damping-off + blight disease

incidence in nursery beds to the tune of 57.14 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

The coco-peat media used for raising tray seedlings were fortified with bio-agents viz., *Trichodermaviride*, *Paecilomyceslilacinus* and *Pochaniachlamydosporia* singly and in rational combinations in scheduled dosage levels and were evaluated against root knot nematodes and *fusarium* wilt disease incidence on FCV tobacco crop raised in sick field conditions. Un-treated tray seedlings and tray seedlings treated with carbendazim and furadon were also used for comparison and un-treated conventional seedlings served as untreated check. Results revealed that, *T.viride* (50g) + *P.lilacinus* (50g) enriched tray seedlings, *T.viride* (50g) + *P. chlamydosporia* (50g) enriched tray seedlings and *T. viride* (30g) + *P.lilacinus* (30g) + *P. chlamydosporia* (30g) were on par with each other in increasing the cured leaf yield by 10.0, 9.5 and 10.5 per cent respectively over check. These effective treatments also decreased the root knot index by 46.0, 49.1 and 51.0 per cent respectively and decreased the wilt disease incidence by 46.1, 42.3 and 51.3 per cent respectively over check. Whereas, the chemical control schedule, fuiradon + carbendazim at the time of planting was found to be the best in decreasing the *Fusarium* wilt disease by 59.0 per cent over check under field conditions.

Treatments	Cured leaf yield (kg/ha)	RKI	% Wilt disease incidence
T1	1473	1.92	25.3
T2	1370	2.76	39.0
T3	1377	2.52	21.3
T4	1333		52.5
CD at 5%	39.30	0.20	8.15

T1 : *Trichoderma viride* @ 30g + *Pochania chlamydosporia* @ 30g + *Paecilomyces lilacinus* @ 30g / tray media
T2 : Un Treated tray seedlings
T3 : Conventional seedling + Carbofuran @ 1g / plant+ carbendazim 0.2%
T4 : Untreated check

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

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

S. Ramakrishnan

A total of 30 advanced breeding lines maintained at CTRI Research Station, Hunsur were subjected to intensive screening against root-knot nematodes under sick field conditions. The varieties Rathna and Kanchan were included as resistant susceptible checks. At maturity, the plants were uprooted and scored for Root-Knot Index (RKI) under 0-5 scale. The lines FCR28 and FCJ22 recorded RKI 1.0 and were found promising against root knot nematode under sick field conditions.

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 the production potential, farmers' acceptance and profitability of advanced breeding lines. On-farm trials were conducted to evaluate the performance of ABLs Tobios-2, 6 & 7; NLST-3, 4 & 5 with Kanchan as check in NLS area. Adopted all the good agricultural practices in both the experimental and control plots. Data were collected on incidence of pests and diseases, morphological characters, yield, quality, benefit-cost ratio and farmers' feedback.

Cured leaf yield: Higher cured leaf yield was recorded in Tobios-6 (2798 kg/ha) and Tobios-2 (2633 kg/ha) at Gowravaram village. The yield improvement over check Kanchan (2403 kg/ha) was 16.44% in Tobios-6 and 9.57% in Tobios-2. At Nuthiramanna palem village NLST-3, 4 & 5 were evaluated. NLST-4 (2104 kg/ha) has outscored the yield of check Kanchan (1922 kg/ha) by 9.47%. However, Tobios-7, NLST-3 & 5 have not shown improvement over check. Data on leaf quality parameters indicated that there are no perceptible variations in leaf quality parameters of ABLs and check cv., Kanchan.

From the **benefit-cost ratio**, it can be concluded that ABL, Tobios-6 and Tobios-2 recorded markedly higher BCR i.e. 1.47 & 1.42 over Kanchan (1.35) at Gowravaram village. At Nuthiramanna Palem village, ABL NLST-4 recorded superior BCR i.e. 1.23 over Kanchan (1.16). Farmers preferred ABLs Tobios-6 and NLST-4.

On Farm Demonstration and Frontline Demonstrations (CTRI, Rajamundry)

Y.Subbaiah

FLD on FCV tobacco variety TBST-2 in SLS, SBS & NBS areas

Selected the villages following the random sampling procedure and farmers were selected on purposive sampling basis covering SLS, SBS and NLS areas. Implemented FLDs through convergence approach and data were collected on technical and socio-economic parameters

Yield, Quality and Economics

Superior cured leaf yield was recorded for TBST-2 over check, Siri in all the three regions i.e. SLS (1677 kg/ha), SBS (2440 kg/ha) and NBS (3140 kg/ha). The yield improvement over the check Siri was 16.81%, 14.82% & 13.35% in SLS, SBS and NBS areas respectively maintaining the same quality characters.

The results of benefit cost ratio, revealed that ABL TBST-2 recorded markedly higher BCR in NBS (1.44), SBS (1.32) and SLS (1.11) as compared to Siri i.e. NBS (1.36), SBS (1.22) and SLS (1.00). BCR was calculated on excluding the imputed rental charges on land and barn. Good bodied leaf, required harvest intervals, TMV resistance and lower internodal length are the advantages of TBST-2 over the control cv: Siri as opined by the farmers.

ARIS-15: Tobacco Agridaksh : An online Expert System

H Ravi Sankar

1) Home page of 'Tobacco Agridaksh' was created and linked to IASRI – agridaksh url as: agridaksh.iasri.res.in.

2) Created a Knowledge model with attributes viz., basic information of CTRI, origin of the tobacco crop, package of practices, tobacco varieties, success stories, nursery management, production technology and crop protection. Hyperlinks were provided from home page of tobacco agridaksh to these attributes and related information was uploaded in IASRI server.

3) Created a knowledge acquisition module with various entities viz., crop varieties, diseases, insect – pests, weeds and the basic data.

4) Developed knowledge base system for tobacco diseases as a 1) retrieval systems 2) ontology based system for identification

of diseases useful for the researchers and extension agencies working on tobacco.

TRIBAL SUB PLAN

ICAR-CTRI : Manchulavarigudem, a tribal hamlet of Seethappagudem Gram panchayat, West Godavari district, Andhra Pradesh was selected for implementation of tribal sub-plan during 2015-16. The following interventions were implemented for a total number of 38 farm families.

- Supply of foundation seed of high yielding maize hybrid (DH-117) to improve the maize yields (16 no.)
- Supplied fertilisers for balanced fertilisation of maize (16 no.)
- Supplied one weighing balance for proper weighing of agriculture produce
- Grain storage bins were constructed (6 no.) to reduce the grain storage losses
- Improved sprayers (2 no.) were supplied for efficient pest and disease management
- Training programmes were conducted on good agricultural practices of major crops (Paddy, maize, cotton and tobacco)

AINPT Centre, Nandyal, Andhra Pradesh

- TSP programme (2015-16) was implemented by AINPT Centre at RARS, ANGRAU, Nandyal. For the programme, about 40 tribal farmers of Sugalimetta village of Panyam Mandal were selected. The following interventions were implemented
- Identified critical inputs *viz.,* Fertilizers, pesticides and improved varieties were distributed to the farmers in order to improve crop productivity.
- Training programme on suitable farming methods for increasing productivity levels in Millets and Pulses was also organized for the benefit of farmers.
- Relevant literature on the aspect was prepared and distributed.

Grain storage structures, TSP-CTRI

Improved sprayers, TSP-CTRI

Supply of critical inputs for maize, TSP-CTRI

TSP AINPT Centre, Nandyal

Education and Training

Different extension activities *viz..,* training programmes, scientist-farmer interface meetings, diagnostic visits, field days, kisan melas, exhibitions, workshops and group meetings. Added emphasis has been accorded for collaborative activities with Tobacco Board, Tobacco Industry and other relevant organizations to achieve enhanced productivity, quality and profitability. The following programmes were conducted during the period under report.

Training to farmers	8
Training to ARS scientist trainees	1
Field visits	4
Diagnostic visits	4
Interactive meetings	2
Farmer discussions	2
Field Day	1
Field Friends Programmes	39
Demonstrations	15
Scientist Farmer Interface meetings	4
Radio talk	1
Students visits	7
Visitor Services	6

- Training programme on GAP in tobacco was conducted for Tobacco Board Field Assistants at CTRI RS Hunsur on 16.03.2015.

- Training on tobacco nursery management was conducted to FCV tobacco growers in association with Krsihi Gyana Vigyana Vedike, Mysore on 18.03.2015 at Hunsur

- A Seminar on customized fertilizers for tobacco was organized by M/s ITC Ltd. and Nagarjuna fertilizers on 16.4.15 at ICAR-CTRI, Rajahmundry.

- One day training programme on GAP and PHPM was conducted to the contact farmers groups from different auction platform of KLS at CTRI research Station Hunsur on 16.6.2015

- One day training programme on GAP and PHPM was conducted to Tobacco Board Field Officers of KLS at CTRI research station Hunsur on 17.6.2015

- A training programme on Burley tobacco production technology was conducted for GPI trainees from 21.9.15 to 23.9.15 at ICAR-CTRI, Rajahmundry

- A training programme on "Good agricultural practices of FCV tobacco cultivation" was conducted for newly recruited /promoted 'Field Assistants' of Tobacco Board from 15-17 March, 2016 at CTRI, Rajahmundry.

Training on GAP to Tobacco Board officials

Krishi Unnati Mela: Participated and put up an exhibition stall in Krishi Unnati-National Agricultural Fair organized by Ministry of Agriculture and Farmers Welfare during 19th to 21st March, 2015 conducted at Mela Ground of the Indian Agricultural Research Institute, New Delhi.

Awareness on PPVFR Act 2001: Organized Training-cum-Awareness Programme on "Protection of Plant Varieties and Farmers' Rights Act" on 5th December 2015 at KVK, Kalavacharla and on 29th March 2016 at Krishi Bhavan, Kakinada. Progressive farmers, Agricultural officers, Horticultural officers, ATMA field staff (Block technology managers and SMSs), Multipurpose Extension officers, Faculty

and final year students of Agricultural College (ANGRAU), Rajahmundry, Scientists and technical staff of ICAR-CTRI, Representatives of NGOs (World Vision) participated in these programmes.

Training-cum-Awareness Programme on PPVFR

Fields friends programme

- The Scientists and Technical Officers of CTRI, Rajahmundry and Research Stations, Guntur, Kandukur were nominated in the Field Friends Teams as resource persons, being implemented by the Tobacco Board, Guntur during 2015-16 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 Good Agricultural Practices. The Field Friends programme was implemented in the different platforms *viz*., Devarapalli, Gopalapuram, Thorredu, Koyyalagudem, Jangareddygudem-I & II, Ongole-I&II, Vellampalli- I & II Tangutur I & II , Kondepi, Podili – I & II, Kandukur – I & II, Kaligiri and D.C. Palli of West Godavari, East Godavari, Prakasm & Nellore districts of Andhra Pradesh.

S.N.	Resource person	Training imparted	Date and place
1	S. Ramesh	FCV tobacco nursery management	21.05.2015 at M.M. Koppalu, KLS
2	S. Ramesh	FCV tobacco nursery management	22.05.2015 atThandre Ankanahalli, KLS
3	Scientists/ Technical officers	Fertilizer management in field crop/reduction of low grades	27.05.2015 at CTRI RS Hunsur in collaboration with Coromandel international Ltd,
5	S. Ramesh	Orientation on Good Agricultural Practices of tobacco cultivation for UG students of forestry college, Ponnampet	05.06.2015 at CTRI RS,Hunsur
6	Dr.M.Mahadevaswamy	Field crop management of FCV tobacco	08.06.2015 at HD Kote, KLS
7	S.Ramesh	Field crop management of FCV tobacco	09.06.2015 at Thattakere, KLS
8	Scientists/ Technical officers	Training to progressive farmers (120 numbers) on FCV crop production technologies	16.06.2015 at CTRI RS Hunsur
9	Scientists/ Technical officers	Training to field officers of Tobacco Board (29) on FCV crop production technology in KLS	17.06.2015 at CTRI RS,Hunsur
10	Dr.S.Ramakrishnan	Krishi mela organized by Department of Agriculture, Karnataka	19.06.2015 at CTRI RS, Hunsur
11	Dr. S.Ramakrishnan	Field crop management to the FCV tobacco growers	20.06.2015 at APF-06, KLS
12	Dr. S.Ramakrishnan	Field crop management to the FCV tobacco growers	23.06.2015 at APF- 64, KLS
13	Dr. M. Mahadevaswamy	Field crop management to FCV tobacco growers	24.06.2015 at APF – 6, KLS
14	Sri.S.Ramesh	Field crop management to FCV tobacco	29.06.2015 at Heggandur, KLS 30.06.2015 to Periyapatna, KLS

S.N.	Resource person	Training imparted	Date and place
15	Dr.S.Ramakrishnan	Field crop management to FCV tobacco growers	06.07.2015 at APF 3, KLS
16	Sri.S.Ramesh	Field crop management & crop protection agents	15.07.2015 at Periyapatna, KLS
17	Dr.M.Mahadevaswamy	Field Crop management & crop protection agents	16.07.2015 at HD Kote, KLS
18	Sri.S.Ramesh	Field Crop management & crop protection agents	16.07.2015 at BTM Koppalu, HD Kote, KLS
19	Dr.C.Mahadeva	Field crop management, PHPM and crop protection agents	17.07.2015 at Gangur. Mullur, KLS
20	Sri.S.Ramesh and Dr.S.Sreenivas	Field crop management, PHPM and crop protection agents	21.07.2015 at Hosaveedu, B.D.Pura, Naganahally, HD Kote, KLS
21	Dr.S.Ramakrishnan Dr.M.Mahadevaswamy	Workshop on Post harvest product management in FCV tobacco organized by Tobacco Board and trade	21.07.2015 at Periyapatna, KLS
22	Dr.M.Mahadevaswamy	Field crop management and Post harvest product management	25.07.2015 at Hagaranalli and Manti koppalu, KLS
23	Dr.C.Mahadeva	Field crop management and Post harvest product management	28.07.2015 at APF 07 and 64, KLS
24	Dr.C.Mahadeva	Field crop management and Post harvest product management	29.07.2015 at Agrahara, KLS
25	Sri.S.Ramesh	Field crop management and Post harvest product management	31.07.2015 at APF 07 and 64, KLS
26	Dr.S.Ramakrishnan Dr.M.Mahadevaswamy S.Ramesh	Workshop on Field crop management and PHPM organized under core committee	07.08.2015 at Chilkunda, Periyapatna, KLS

S.N.	Resource person	Training imparted	Date and place
27	Dr. S. Ramakrishnan, Dr. M. Mahadevaswamy	Field crop management and Post harvest product management	11.08.2015 at HD Kote, KLS
28	Sri I. Jagadish Chandra	Nursery management	4.9.2015 at Sangayagudem, NLS
	Dr. S.K. Dam	Tobacco nursery management	9.9.2015 at Koyyalagudem
29	Dr. S.K.Dam	Nursery management	10-09-2015 at Koyyalagudem, NLS
30	Sri I. Jagadish Chandra	Nursery management	11.9.2015 at Reddy Ganapavaram, NLS
31	Dr. S.K.Dam	Nursery management	14.09.2015 at Gopalpuram, NLS
	I. Jagadish Chandra	Tobacco nursery management, preparation of nursery buds, raising of tobacco seedlings in poly trays and pest and disease management	16.9.2015 at Thorredu
	I. Jagadish Chandra	Tobacco plantings and manurial applications	20.10.2015 at Devarapalli, Badapuram
32	Dr. S.V. Krishna Reddy	Main field preparation, fertiliser application, ridge formation, plantings, intercultivation, IPM and irrigation	28.10.2015 at Koyyalagudem, NLS
	N. Arunakumari	Main field preparation, plantings, fertilizer application, ridge formation etc.	29.10.2015 at Gopalapuram, Chinnayigudem
33	Sri I. Jagadish Chandra	Transplantations, fertiliser application, intercultivation, irrigations and IPM in tobacco cultivation	5.11.2015 at Devarapalli, NLS
34	Dr. S. Ramakrishnan Sri.S.Ramesh	Post harvest Product management	06.11.2015 at Kellur village, KLS
35	S.Ramesh	Post harvest Product management	13.11.2015 at Motta, KLS

S.N.	Resource person	Training imparted	Date and place
36	Dr. P. Venkateswarlu	Nursery management and field preparation in SBS	12.11.2015 at Nagabhiruvaripalem village
37	Dr. P. Venkateswarlu	Field day on VT-1158 variety (OFT plot)	09.02.2016 at Gundlapalli
38	Dr.P. Venkateswarlu	Field day on N-98 variety (OFT plot)	10.02.2016 at B.Nidamanuru
39	Dr. P. Venkateswarlu	Field day on TBST-2 variety (OFT plot)	16.02.2016 at Ongole
40	Dr. P. Venkateswarlu	Field day on TBST-2 variety (OFT plot)	18.02.2016 at Vemulapadu village
41	S.K. Dam	Growers awareness meeting on "Good Agricultural practices, crop protection agents and PHPM in tobacco cultivation"	10.03.2016 at ICAR- CTRI RS, Jeelugumilli
	Dr. K. Suman Kalyani	Topping, desuckering, orobanche management, brown spot disease management	11.01.2016 at
	Dr. K. Suman Kalyani	Post harvest product management, better curing techniques	20.01.2015 at
	Dr. K. Suman Kalyani	Grading and curing methods	29.02.2015 at

RADIO TALKS

Sl. No.	Name	Topic	Station; date of broadcasting
1.	Dr. B. John Babu	Potti mekala pempakam	14.04.2015, AIR, Vijayawada
2.	Dr. P.V.V. Siva Rao	Samvatsaram poduguna nanyamaina pasugrasala sagu	17.04.2015, AIR, Vijayawada
3.	Dr. P. Venkateswarlu	Plant protection equipment and precautions while using pesticides through	29.04. 2015, AIR, Vijayawada.
4.	Smt. J.V.R. Satyavani	Improved cultural practices and nutrients management in mango and cashew orchards during flowering and fruiting stage	04.05.2.15, AIR, Vijayawada
5.	Dr. A.V.S.R. Swamy	Dakshinadi telika nelalaku mariyu nalla regadi nelalaku anuvaina pogaku vangadalu	26.06.2015, AIR, Vijayawada
6.	Sri R. Sudhakar	*Uses of Banana Pseudostems*	03.07.2015, AIR, Vijayawada
7.	Dr.M.Kumaresan	Tobacco cultivation aspects	22.09.2015, AIR, Madurai
8.	Sri.R.Rajendran	Pest and Disease and their control measures in Tobacco	28.09.2015, AIR, Madurai
9.	Sri R. Sudhakar	*Uses of Banana Pseudostems*	23.10.2015, AIR, Visakhapatnam
10.	Smt. V.V. L. Kumari	Aarogya parirakshanalo chirudanyala pramukyatha viluva aadharitha padardhala tayari	22.10.2015, AIR, Visakhapatnam
11.	Smt. J.V.R. Satyavani	Jeedimamidi thotalalo adhika digubadulaku patinchavalasina yajamanya padhatulu – muduru thotallo punarudharana	14.11.2015, AIR, Visakhapatnam

Field visits

- Dr. S. Ramakrishnan and RM Tobacco Board visited the Sundavalu, R Thunga, CHP Halli areas of the Periyapatna Auction floor of KLS on 01.06.2015.
- Dr. S. Ramakrishnan Dr. M. Mahadevaswamy visited the tobacco growing areas in Periyapatna on 30.06.2015 in KLS.
- Dr. S.Sreenivas visited the tobacco growing areas of Hosaveedu, B.D.Pura, Naganahally, HD Kote areas of KLS on 21.07.2015.
- Dr. S. Ramakrishnan Dr.M. Mahadevaswamy visited the tobacco growing areas of Periyapatna along with Director of Auctions, Tobacco Board Bangalore on 04.08.2015.
- Dr. M Anuradha, Dr. K China Chenchaiah and Dr. PV Venugopala Rao visited the on farm varietal plots of TBST-2 at Chavatapalem – Kandukur-I plat form of SLS on 16.12.15.
- Dr. S. Kasturi Krishna, Dr. C. Chandra Shekar Rao, Dr. K. Suman Kalyani and Dr. G. Raghupathi Rao visited NLS area on 21.12.2015 and monitored the crops situation and advised the farmers about the measures to be taken for the control of prevailing pests and diseases.
- Dr. M. Kumaresan and Sri.R.Rajendran visited tobacco nursery growing areas in Tamil Nadu on 25.09.2015, 05.10.2015 and 16.10.2015 and on-farm varietal trial plots on 18.12.2015.
- A survey on *Orobanche* was conducted in Prakasam and Nellore Districts (14 Plat farms) by Scientists of CTRI, Managers and Auction Superintendants of Tobacco Board for 5 days i.e. 21st, 22nd, 27th, 28th and 29th January, 2016. The extent of damage varies from 5 to 10%, approximately. Farmers were educated about *Orobanche* infestation, its nature of damage, and management practices through field visits and meetings.
- Dr. K China Chenchaiah visited OFT plot of N-98 at Ponnaluru- Kandukur-I on 22.01.16

Krishi Vigyan Kendra

Kalavacharla

ACHIEVEMENTS

- A total number of 6 On-Farm Testings (OFTs) and 10 Front-line Demonstrations (FLDs) were conducted during the year 2015-16.
- Pre emergence application of Pendimethalin @ 2.5 l/ha at 3DAS and post emergence application of Quizalofop ethyl @1l/ha and Pyrithiobac sodium @625 ml/ha at 25-30 DAS effectively managed the weeds in cotton.
- Application of sulphate of potash @100 kg / ha in equal split doses one at 10 DAP and the second one at 25 DAP resulted a tobacco leaf yield of 20q/ha as against 16 q/ha in control
- Tissue culture *Coccinia* was introduced in virus prone *Coccinia* belt of East Godavari District. No incidence of virus observed in existing crop and 13 tonnes/ha yield was recorded compared to traditional variety (8.5 tonnes/ha).
- Introduced 'Maran' Ginger variety in irrigated areas which yielded 16.5 t/ha compared to local ginger of 12 t/ha.
- Bait formulation of Jaggery slurry (Jaggery 6 kg in 12 litres of water) + Dichlorovas 250 ml. + 1 kg wheat flour effectively cotrolled the (23% mortality of snails).
- Introduced 'Osmanabadi' goats in East Godavari District for both for meat and milk. Males grow upto 34 kg and females upto 32 kg.
- Popularized Black Bengal goats in the district and supplied 11 units (Each unit is of two females and one male) to the farmers through ATMA, (East Godavari) under FLD programme.
- Demonstrated Azolla, a cheap source of protein, as supplementary feed to poultry with saving of feed cost by Rs.2/- per kg.
- Ovosync plus technology was implemented in cattle for inducing conception and 40% conception rate was noticed.
- Demonstrated fodder cluster bean varieties Bundel Guar-1 and Bundel Guar-2.
- Promoted the establishment of two palmyrah fibre extraction units at Sirsinapalli and Tulasipakala villages of Chinthuru Mandal.
- Promoted the establishment of one banana fibre production at Mandapeta.
- Promoted the establishment of one unit of Cup and Plate making with Bamboo culm sheath at Sirsinapalli village of Chinthuru mandal.

Collaborative training Programmes

Demonstrations on Cashew Apple Utilization: Demonstrations on Cashew Apple Utilization were organised at KVK, Kalavacharla on 13th, 14th, 15th and 16th May, 2015, in collaboration with Directorate of Cashewnut and Cocoa Development (DCCD), Cochin.Four batches of tribal women and youth (100 nos.) from Rasthakuntuhai (Vizianagaram Dt.), Rajanagaram, Gandepalli, Murari, Punyakshetram and Kalavacharla villages (East Godavari Dt) were trained in preparation of various recipes of cashew apple *viz.*,cashew apple jam, juice, chutney, pickle and chips.

KisanMela: In collaboration with ATMA-East Godavari district, KVK organised 'KisanMela' on 9 November 2015 at KVK, Kalavacharla. Dr.D.Damodar Reddy, Director, CTRI, Rajahmundry presided over the function.

Distribution of Black Bengal goats to farmers

Hon'ble Sri PendurthiVenkatesh, MLA, (Rajanagaram, East Godavari District) graced the occasion as Chief Guest. A total no of 300 farmers from 10 blocks of the East Godavari district participated in the programme. **'Exhibition stalls'** were arranged displaying improved technologies in agriculture, horticulture and allied sectors. Black Bengal goats were distributed to farmers with the financial assistance from ATMA, East Godavari.

Kisan Sammelan: Organized Kisan sammelan/ goshti on Rabi Vegetable cultivation on 1st March 2016 at Madiki village of Alamuru mandal, East Godavari District.Organized Kisan sammelan/ goshtion Pulses Production on 30th March 2016 at CTRI, Rajahmundry.

Internship: Eighteen RAWEP students of Final year B. Sc (Ag) , Agrl College, Rajahmundry did their internship during 4-22 December 2015 at KVK as a part of RAWE Programme.

Krishi Vigyan Kendra, Kandukur

Front line demonstration of FCV tobacco variety TBST-2: Demonstration were conducted in farmer's field with FCV tobacco variety TBST 2, a newly identified FCV tobacco line for prakasam and Nellore districts of AP

Front line demonstration with TBST-2

Popularisation of Napier grass variety CO-4 cuttings to farmers: A fodder block (40 cents) area is maintained with CO - 4 grass and supplied the cuttings to needy farmers.

Front line demonstrations and Training programme on Milky Mushroom production: FLD's were conducted on Milky mushroom production at Oguru village. A Training programme was organised on Milky mushroom production for two days where in 50 members were participated.

Training and Front line demonstrations on Milky Mushroom production

1. **Participation in Rytu Sadbhavana Yatra**: Participated in Rythu Sadbhavana Yatra along with Scientists from Indian Institute of Rice Research and ICRISAT on 27th January, 2016

Rytu Sadbhavana Yatra

Crop Cafeteria: Different rainfed crops *viz.*, Sorghum, Bajra, Variga, Ragi, Korra, Blackgram, Green gram, Sunhemmp for seed, cowpea, horse gram, bengal gram, lentil, castor, lineseed, mustard, sesamum were grown to evaluate their performance and found that performance of bajra, sorghum, variga, horse gram, bengal gram found better compared to other crops.

Awards and Recognitions

- Dr. K. Suman Kalyani, Principal Scientist, ICAR- CTRI has been honoured with the prestigious 'Bio-Technology Social Development Award – 2015' by the Department of Bio- Technology, New Delhi on 05.02.2016 during the Global Biotechnology Summit-2016 held at Vigyan Bhawan, New Delhi for her outstanding extension work in the area of diversification of agriculture towards socio economic up-liftment of the grass root level rural and tribal farmers and farm women. The award consists of 3.00 lakh cash prize, citation, memento and a certificate. The award was presented by Hon'ble Minister of Science and Technology, Dr. Harsh Vardhan.

- H. Ravi Shankar Senior Scientist, ICAR-Central Tobacco Research Institute, Rajahmundry receivedOutstanding Scientist Award from Venus International Research Foundation Research Academy (VIFRA), 2015

- Dr. D. Damodar Reddy, Director, ICAR-Central Tobacco Research Institute, Rajahmundry received FELLOW OF ANDHRA PRADESH AKADEMI OF SCIENCES for his outstanding contributions to Science & Technology in the first induction ceremony of ANDHRA PRADESH AKADEMI OF SCIENCES held at Acharya Nagarjuna University, Guntur on 19th March, 2016. In this connection, he delivered a lecture on "Phosphorus use efficiency in Indian Agriculture – importance, impediments and improvement interventions" to the delegates.

Photo, Dr. D. Damodar Reddy

- Dr. H. Ravisankar, Senior Scientist, ICAR-Central Tobacco Research Institute, Rajahmundry received ASSOCIATE FELLOW OF ANDHRA PRADESH AKADEMI OF SCIENCES for his outstanding contributions to Science & Technology in the first induction ceremony of ANDHRA PRADESH AKADEMI OF SCIENCES held at Acharya Nagarjuna University, Guntur on 19th March, 2016.

Linkages and Collaborations

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

Sl. No.	Name of the Collaborating Agency	Activity
a) National Institutes/Agricultural Universities		
1	Tobacco Board, Guntur	On Farm trials, Front line demonstrations and training programmes and Diagnostic visits
2	Bureau of Indian Standards, New Delhi	Development of Indian standards for tobacco and tobacco products
3	Department of Biotechnology, New Delhi	Empowerment of tribal's through agro-ecological conservation and bio-technological approaches in East Godavari district of Andhra Pradesh
4	National Bureau of Plant Genetic Resources, New Delhi	National Active Germplasm Site (NAGS). Import of tobacco germpalsm and maintenance
5	Department of Agriculture in different states	Development of technologies related to different tobacco types and technology dissemination
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 for varietal release
8	Uttar Banga Krishi Vishwa-vidyalaya, Pundibari, Cooch Behar(W.B.)	Collaborative research programmes
9	TNAU, Coimbatore	PG Studies, Research and Development
10	Gujarat Agricultural University	Research and development
11	Acharya NG Ranga Agrl. University	Research and development
12	UAS, Dharwad	Research and development

Sl. No.	Name of the Collaborating Agency	Project title/Activity
13	Chandra Shekhar Azad University of Agriculture and Technology, Kanpur	Research and development
14	Odisha University of Agriculture and Technology	Research and development
15	University of Agriculture and Horticultural Sciences, Shimoga	Research and development
16	Nannaya University, Rajahmundry	PG Studies, Research
17	Andhra Univ., Visakhapatnam	PG Studies, Research
18	NIFTEM, New Delhi	Training of UG & PG students
19	Rallis India Limited	Contract Research
20	ICAR- National Bureau of Agricultural Insect Resources, Bangalore	Coordinated trials in Biological control
21	Indian Institute of Spices Research, Kokhikode, Kerala	Network Project on "Phytochemicals and High value compounds"
22	CSIR- Indian Institute of Chemical Technology, Hyderabad	Collaborative studies on Characterisation and refining of crude tobacco seed oil
23	National Institute of Nutrition, Hyderabad	Pre-clinical efficacy and safety evaluation of Refined tobacco seed oil
(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

- Three FCV tobacco varieties viz., N-98 (for NLS), CH-1 (CMS hybrid for NLS), LT Kanchan (low tar for NLS) and one *bidi* variety, Nandyal Pogaku-1 were released for commercial cultivation by the State Seed Sub-committee on Agricultural/ Horticultural Crops for the State of Andhra Pradesh.

Coordinated Varietal Trials

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

Table 1: Initial Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCR-24, FCR-26, FCJ-17 and FCJ-18
Kandukur	FCR-29, FCR-31 & FCR-32
Jeelugumilli	FCJ-16, FCJ-17, FCJ-18, FCJ-20, FCJ-21 and FCJ-22
Rajahmundry	FCR-28, FCR-32, FCR-29, FCR-31, FCR-30 and FCR-26
Shivamogga	FCR-29, FCR-32 and FCR-30
***Bidi* tobacco**	
Anand	ABD 152 and NBD 261
Nipani	ABD 131, NBD 257 , NBD 277 , NBD 276 and ABD 152
Nandyal	ABD 146, NyBD 56 and NBD 276
***Rustica* tobacco**	
Araul	ArR-45 and LR-80
Ladol	LR 78 and AR 126
Dinhata	AR-126, ArR-45, ArR-46, LR-78, LR-79 and LR-80

Table 2: Advanced Varietal Trials

Centre	Promising line(s)
FCV tobacco	
Guntur	FCR-17, FCR-18, FCR-10 and FCR-11
Kandukur	FCR-15 and FCR-10
Jeelugumilli	FCJ-11, FCJ-13, FCJ-15, FCJ-5, FCJ-6 and FCJ-7
Rajahmundry	FCR-12, FCR-17 and FCR-22
***Bidi* tobacco**	
Anand	ABD 129, ABD 138, ABD 163, ABD 164, ABD 167, ABD 168 andABD 169
Nandyal	ABD 132, ABD 131 and NBD 260
***Rustica* tobacco**	
Anand	LR 77, AR 111 , AR 118 and AR 121
Araul	ArR 29 and ArR-38
Ladol	LR 77

Table 3: Bulk Evaluation Trials

Centre	Promising line(s)
FCV tobacco	
Rajahmundry	FCR-12
Jeelugumilli	FCJ-5 and FCJ-6
***Bidi* tobacco**	
Nandyal	ABD 124 and ABD 119
Araul	ArBD-09

Recommendations to tobacco farmers

- Results of a three years study indicated that for the purpose of oil and nicotine yield, variety A 145 and GABT 11 are most suitable with higher dose of nitrogen (300 kg N/ha).
- The farmers of the middle Gujarat are advised to apply emamectin benzoate 5 WG @ 0.0025% (5g / 10 l water; 7.5 g a.i./ha) for effective and economic control of leaf

eating caterpillar infesting *bidi* tobacco nursery.

- Bidi tobacco growing farmers are advised to raise nursery during I to II week of July for realising high number of healthy seedlings with higher net returns.
- Foliar application of nitrogen and potassium @ 2.5% in two splits markedly enhanced the production of top grade equivalent up to 17-19% in KLS
- Minimum disease severity of brown spot (21.48 PDI) was recorded with two sprays of Hexaconazole (0.1%) and Difenconazole (0.1%) or Hexaconazole (5%) + Capton (0.2%) respectively at Nipani area in Karnataka.
- Azoxystrobin 23 SC (0.1%) followed by fenamidon + mancozeb (0.3%) is recommended for controlling damping off disease and higher number of healthy seedlings in the nursery.
- A new efficient system of heat conveyance inside the curing chamber developed at Shivamogga centre was found to save wood to the extent of 45% over the conventional system.

Centre-wise research achievements

ANAND

- Application of 180 kg N/ha required for realising optimum cured leaf yield in *bidi* tobacco at Anand, Gujarat.
- Application of 200 kg N/ha is required for realising optimum cured leaf yield in ruling *rustica* tobacco.
- Genotype ASO 13 recorded higher seed and oil yield as compared to variety A 145. The khakhari yield, nicotine content and nicotine yield potential as well as oil content of seed were high in genotype 103-9-101. Variety GABT 11 showed highest green leaf biomass while protein content was highest in line 22-9-4-6.
- Various natural enemies like spider, coccinellids, Nesidiocoris tenuis, and Rhinocoris sp were active and found on different crops raised under entomophage Biodiversity Park in tobacco based agro ecosystem. Predatory bug *N. tenuis* have negative significant correlation with MIN T and Mean T while, RH 2 showed positive significant correlation. *Rhinocoris* spp. have negative significant correlation with RH 2.
- Spray of emamectin benzoate significantly reduced seedlings damage by *Spodoptera litura* and recorded highest number of transplantable seedlings in *bidi* tobacco.
- At Anand, significantly higher number of transplantable and total seedlings were recorded in III week of July sowings as compared to those in I and III week of August. Root-knot index was reduced with delay in sowing.

ARAUL

- Entry ArBD-39 and ArBD-40 showed significant superiority in yield over the check A-119, and these entries are proposed for testing in IVT during *Kharif* 2015-16. Entry ArBD-25 proved significant superiority in yield over the check A-119 in AVT-I.

BERHAMPUR

- Among nine entries tested during *kharif* 2014, the entry 'NF-3-1' produced 15.35% higher cured leaf yield (1407 kg/ha) over check variety 'Gajapati' (1222 kg/ha).
- Brinjal, chilli, tomato and cabbage with tobacco cured leaf equivalent yield of 18.62, 17.67, 17.11, 16.75 q/ha respectively were at a par with tobacco (17.01 q/ha). But the highest net return of Rs 56,567/ha with B:C ratio 2.52 was achieved with tobacco. Hence, now no other crop is as profitable as pikka tobacco.

HUNSUR

- Integrated farming system developed at the station has been demonstrated to the farmers, state department and development officials for its sustainability
- The Coconut husks/fronds in combination with fuel wood could be effectively utilized as alternative source for curing.
- Tray nursery technology was further popularise in the KLS area, the technology being adopted by more than 75-80 % growers.

- Green tech nursery using poly house for raising tobacco seedlings was demonstrated to farmers.

JEELUGUMILLI

- Lines Tobios-6 and NLST-4 performed better in on-farm trials conducted in northern light soils of Andhra Pradesh.

NANDYAL

- Cured leaf yield was significantly superior (2266 kg/ha) with ridge planting compared to traditional method of planting (1840 kg/ha). Among four spacing's tried 60 cm x 75 cm spacing recorded significantly highest cured leaf yield (2211 kg/ha).
- Cured leaf yield was significantly superior (2320 kg/ha) with NBD -119. Among N doses significantly higher cured leaf (2123 kg/ha) was recorded with 150 kg N/ha treatment which is on par with 110 kg/ha (2098 kg/ha). Topping at 15 leaf recorded highest cured leaf yield (2243 kg/ha) which is on par with topping at 18 leaf (2214 kg/ha).
- Foliar nutrition of N and K with KNO_3 and Ammonium sulphate + SOP at 45 and 60 DAT recorded 11% increase yield in cured leaf of Bidi tobacco.

NIPANI

- Topping at 18 leaves was found to be suitable for realizing maximum cured leaf yield with *bidi* tobacco variety, NBD 209.

SHIVAMOGGA

- Genotype, NLST-2 x KST-28 II was significantly superior for all the three characters over the high yielding check, Thrupthi.
- Application of K @100 kg/ha showed higher cured leaf yield (820 kg/ha) over 80 kg/ha. The yield and quality of the leaves tobacco stem ash (100 kg/ha K) was on par with the superior.
- Among the fifteen lines studied for rooting pattern, physiological and biochemical parameters, Tobios-6 recorded moderate root volume, root length, with lowest membrane damage, followed by F-210, FCR-15, FCJ-13, Kanchan and Thrupthi. Lines, FCR-18, FCR-1 and Thrupthi showed high chlorophyll stability. The lines, FCR-16 and FCR-1 recorded higher biomass followed by Kanchan Tobios-6 & FCR-2 .
- IVT entries FCR-23 and FCR-15 recorded higher pollen and seed germination followed by FCJ-14, FCJ-12 and FCR-17 under high PEG concentration which indicates their drought tolerance capacity.
- IVT Lines, FCR-26 and FCJ-16 were found resistant/ tolerant to black shank under sick plot condition.
- Among five tested combi-fungicides evaluated sectin @ 0.3 % and Amistar @ 0.1 % were equally found effective to as that of recommended check ridomil gold (0.2 %) in reducing the damping-off disease in nursery.
- Among the 25 germplasm lines screened against root-knot nematode, ten entries *viz.,* FCR-18, FCR-19, FCK-4, FCJ-14, FCR-20, FCJ-11, Kanchan, FCR-23, FCJ-13 and FCR-21 recorded least root-knot index (1.0) indicating resistant reaction.
- Lowest RKI was observed with consortia of bioagents and combination of *Pseudomonas fluorescens* and *Acacia*.

VEDASANDUR

- Drip fertigation recorded significantly higher FGLY, TCLY and WUE over the furrow irrigation or alternate furrow irrigation. The WUE of drip fertigation and drip irrigation is comparable.
- Planting chewing tobacco hybrid VDH-3 during the 1st fortnight of October with drip fertigation at 100% RDN increased the yield and net returns.

Empowerment of Women in Agriculture

The following programmes have been taken up for the benefit of empowering tribal farm women in the tribal area of East Godavari District.

1. Health and Nutrition Education for Tribal women

About ten training programmes on health and nutrition education, safe drinking water programme, fruits and vegetable preservation methods, post harvest technology were conducted in the adopted villages viz., Devarapalli, Sunnam Padu, Kutravada, Musurumelli, Ramanna valasa I.Pola varam & Seetha Palli, for the benefit of tribal women during the year. The backyard kitchen gardening component (greens, vegetables, orchards), the supplementary diets with locally available foods and nutrition education have played a key role in reducing anaemia and malnutrition of women and children to an extent of 60% in the adopted tribal villages.

Training on value added food products

2. Addressing the Gender Specific Issues in Tribal Area

The tribal women were exposed towards multiple skills and capacity building programmes for improving their knowledge, skills, and abilities. About five training programs were conducted on up-gradation of vocational skills, technical & market tie up, management & decision making skills and individual counseling for increasing their self confidence, self-esteem and self efficacy. This has enriched the farm and home environment of tribal farm families and reduced the socio-economic problems in the tribal area.

Capacity building programme at Seethapalli tribal village

3. Drudgery reduction and improving the efficiency of farm labour

Drudgery reducing farm implements were introduced and popularized in order to improve the farm efficiency of tribal women. Improved agricultural implements viz., wind mill (paddy threshing), wheel hand- hoe (vegetables), improved krishi sprayers, leaf plate making machinery were popularized in Maredumilli, Sunnampadu, I.Polavaram and Pedageddada villages for saving time and drudgery and for improvement of farm efficiency among tribal women. After introduction of this simple machinery, the drudgery was reduced and efficiency of the farm work was improved. About six programmes were conducted on occupational health and drudgery deduction during the year.

Drudgery saving farm implements at Devarapalli

4. Crop Diversification of Farming Systems:

Subsidiary income generating programmes viz., kitchen gardening, poultry keeping, fodder production, grafting techniques and value addition to the minor forest produce were different training components added to tribal farm families to enhance the farming system during lean period which enhanced the family income in tribal area.

Turkey bird rearing at Geddada

5. Homestead Units and Entrepreneurial Activities:

Nutri-preneurial (diversified agricultural) homestead units viz., solar drying, soya processing, millet based bakery units, leaf plate making and value addition(Minor Forest Produce) units were established in tribal villages viz., Devarapalli, Irlapalli, Seethapalli, Kutravada, Ramanna Gudem and Sunnampadu. This has enhanced the annual family income of the tribal women up to an extent of Rs. 10,000. The women were also provided technical and marketing assistance along with skill up-gradation.

Homestead Units in Devarapalli supported by ICAR-CTRI

Thus, a total of 16 training programmes, 12 demonstrations, 2 exposure visits, one nutrition work shop and 5 long duration capacity building programmes, one international women's day, one women in agriculture day were conducted for the benefit of 500 tribal families of East Godavari District for brining awareness, improving knowledge and skills and for integrating the tribal women in the national mainstream.

Skill Development Programme on Food Processing:

KVK in association with NITEM (National Institute of Food Technology Entrepreneurship and Management), New Delhi organized Skill Development Programme on Food Processing during 22-26 September 2015 at KVK Kalavacharla. A total no of 52 rural women of different Self Help Groups from Kalavacharla, Gadarada, Narasapuram villages have participated in this programme.

- Vocational training programme on *'Garment making'* was conducted during 6 July-5 August 2015 at Narsapuram village of Korukonda mandal (E.G dist) for 30 rural women in association with World Vision NGO.
- Training programme on 'Value addition to millet" was conducted during 22-25 September 2015 at KVK, Kalavacharla for 20 rural women.
- Training programme on 'Milky mushroom production" was conducted during 26-29 September 2015 at Vemagiri village for 10 rural women.
- Training programme on 'Value addition to

Fruits and Vegetables" was conducted during 4-7 October 2015 at Pasarlapudilanka village of P. Gannavaram mandal) for 20 rural women.

- Awareness programme was conducted on 6 October 2015 on 'Artificial ripening of fruits and its ill effects' at Mukkamala village of Ambajipet mandal for 20 rural women and 28 girl students of final year B. Sc (Hort.), YSRHU.

- Training programme on 'Handicrafts with Palmyrah leaves' was conducted during 5-15 October 2015 at KVK, Kalavacharla for 10 rural women.

- Training programme on 'Coirpith composting' was conducted during 5-15 October 2015 at KVK, Kalavacharla for 10 rural women.

- Vocational training programme on '*Maggam Embrodery and Garment making'* was conducted during 1st Oct – 30th Nov 2015 at Palasarla village of Rajanagarm mandal (E.G dist) for 20 rural women.

- Training programme on 'Value added products with milk' was conducted during 3-7th November 2015 at Chollangipeta village of Tallarevu mandal (E.G. dist) for 15 fisher women in association with EGREE Foundation-NGO.

- Training programme on 'Value added products with coir' was conducted during 3-19 November 2015 at Babanagar village of Tallarevu mandal (E.G dist) for 15 fisher women in association with EGREE Foundation-NGO.

- Training programme on 'Palmyrah fibre extraction' was conducted during 24-29th November 2015 at Sirsinapalli and Tulasipaka villages of Chinturu mandal (E.G dist) for 10 tribal women in association with ASHA Foundation-NGO.

- Training programme on 'Friends of Coconut Tree (FoCT)' was conductedduring 20-25th January 2016 at KVK Kalavacharla, for 20 rural youth/farmers in association Coconut Development Board, Cochin and HRS, Ambajipet.

- Training programme on 'Protray vegetable seedling production' was conducted during 3-6th February 2016 at Mirthipadu village, Korukonda mandal.

- Training programme on 'Value addition to fish/prawn and meat' was conducted during 12-15th February 2016 at Ainavilli of Ainavilli mandal for 20 rural women.

- Training programme on 'Handicrafts with Weeds' was conducted during 14-24th March 2016 at KVK, Kalavacharla.

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- FCV Tobacco production technology and Good Agricultural Practices in KLS (in English).
- Soil health management in FCV tobacco growing soils of KLS (Technical folder)
- V.S.G.R. Naidu and E. Vijaya Prasad. 2015. **Zero Tillage Maize cultivation.**
- V.S.G.R. Naidu and J.V.R.Satyavani. 2015) **Toxic effects of artificial ripening of fruits.**
- V.S.G.R. Naidu and J.V.R.Satyavani. (2015 **Value added products with cashew apple.**
- V.S.G.R. Naidu and R. Sudhakar. 2015. **Coconut Coir pith compost making**,
- V.S.G.R. Naidu and V. V. Lakshmi Kumari. 2015. **Value added products with cocoa.**
- V.S.G.R. Naidu, B. John Babu, P. V. V. S. Siva Rao. 2015) **Rearing of Black Bengal goats**.

List of Approved On-going Projects

Sl. No	Institute Code	Title of the project and Investigator(s)
CROP IMPROVEMENT		
1	**Br.2.**	Evolving superior varieties of FCV tobacco through hybridization T G K Murthy, P V Venugopala Rao, K. Sarala, A V S R Swamy and K. Prabhakara Rao
2	**Biotech-6**	Molecular Mapping of Important Tobacco Traits K. Sarala and K. Prabhakara Rao
3	**Biotech-11**	Biogenesis and regulation of TSNA (Tobacco Specific Nitrosamines) in Tobacco K. Prabhakara Rao and K. Sarala
CROP PRODUCTION		
4	A-83	Chemical management of Orobanche in FCV tobacco S. Kasturi Krishna, S.V. Krishna Reddy and V.S.G.R. Naidu
5	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, P. Venkateswarlu and K. Cahnchaiah
6	Ag. Extn-50	Technology evaluation demonstration and impact analysis Y. Subbaiah, and K.Suman Kalyani
7	ARIS-15	Tobacco Agridaksh: An online expert system H. Ravisankar
8	OC-24	Studies on chemical constituents responsible for smoke flavour in FCV tobacco grown under different agro climatic zones K. Siva Raju, TGK Murthy and D. Damodar Reddy
9	SSMB-12	Tobacco (*Nicotiana tabacum*) leaf and stem assisted green synthesis of sliver nanoparticles and evaluation of its antimicrobial activity against agricultural plant pathogens D.V. Subhashini
10	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
11	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

Sl. No	Institute Code	Title of the project and Investigator(s)
12	SSK-2	Assessment of leaf quality of FCV tobacco using hyper-spectral radiometric remote sensing techniques Dr. L.K. Prasad, M. Anuradha, M. Prabhakar(CRIDA) and D. Damodar Reddy
CROP PROTECTION		
13	E-81	Bio efficacy and field evaluation of new pesticides against tobacco insect pests and diseases Dr U Sreedhar, G. Raghupathi Rao, S. Ramakrishnan and S.K. Dam
CTRI RESEARCH STATION: JEELUGUMILLI		
14	JL.Br.2.1	Evolving flue-cured tobacco varieties having high yield and better quality suitable for NLS area of Andhra Pradesh A V S R SwamyT G K Murthy, K. Sarala and K. Prabhakara Rao
15	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
16	E-82	Evaluation of insecticide application technology for the effective spray coverage on FCV tobacco in NLS Dr G. Raghupathi Rao, U. Sreedhar and K. Nageswara Rao
BTRC, KALAVACHERLA		
17	AB-30	Set row planting in burley tobacco C.C.S. Rao
CTRI RESEARCH STATION: GUNTUR		
18	EG.14	Validation of IPM module against tobacco aphid, *Myzusnicotianae* under CBS conditions P. Venkateswarlu
CTRI RESEARCH STATION: KANDUKURU		
19	K.Br.6	Breeding FCV Tobacco varieties for yield and quality under Southern Light Soil (SLS) conditions P V Venugopala Rao
20	Phy.K-1	Abiotic stress management interventions for climate resilient flue cured tobacco production in SLS Domain of A.P M. Anuradha
21	EK-19	Evaluation of IPM modules for the management of caterpillar and aphid in FCV tobacco under SLS conditions **K.C. Chanchaiah**

Sl. No	Institute Code	Title of the project and Investigator(s)
CTRI RESEARCH STATION: HUNSUR		
22	Br.19	Development and evaluation of F_1 hybrids of FCV tobacco suitable to Karnataka light soil region C. Nanda
23	N-20	Integrated management of root- knot nematodes in FCV tobacco S. Ramakrishnan and P.Nagesh
24	A-41	Studies on climate Risk Management practices for FCV tobacco based cropping system in STZ of Karnataka M. Mahadevaswamy and C. Chandrasekhara Rao
CTRI RESEARCH STATION: VEDASANDUR		
25	B.50	Breeding non FCV tobacco types for desirable traits A V S R Swamy and T G K Murthy
CTRI RESEARCH STATION: DINHATA		
26	A-10	Permanent manurial experiment with Motihari tobacco Sunil Mandi

RAC, QRT, IRC and IMC Meetings

RESEARCH ADVISORY COMMITTEE

Dr. A. Padma Raju, Vice-Chancellor, ANGRAU, Hyderabad	Chairman	Dr. T.V.K. Singh, Dean of Agriculture Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad	Member
Dr. V. S. Korikanthimath, Retd. Director, ICAR Research Complex, Goa	Member	Director, ICAR-CTRI, Rajahmundry	Member
Dr. J.L. Karihaloo, Coordinator, APCoAb, C/o ICRISAT, NASC Complex, Pusa, New Delhi – 110 012.	Member	ADG (CC), ICAR, New Delhi	Member
		IMC Member	Member
Dr. Ashok Kumar, Professor and Head, Department of Soil Science, College of Agriculture, SVBPUA&T, Meerut	Member	Dr. K. Sarala, Principal Scientist & Head ICAR-CTRI, Rajahmundry	Member-Secretary, RAC

The Research Advisory Committee (RAC) meeting of ICAR-CTRI was held on 2nd May, 2015 at ICAR-CTRI, Rajahmundry under the Chairmanship of Dr. A. Padma Raju, Vice-Chancellor, Acharya N.G.Ranga Agricultural University, Hyderabad. RAC members, Dr. V. S. Korikanthimath, Dr. T.V.K. Singh and Dr. Ashok Kumar attended the meeting. Dr. D. Damodar Reddy, Director, ICAR-CTRI, Dr. K. Sarala, Member-Secretary, RAC, Heads of Divisions, Heads of Research Stations, Scientists and Heads of administration of ICAR-CTRI participated in the meeting.The committee reviewed the research being conducted at CTRI & its Research Stations and advised few priority areas for initiating the research.

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,
New Dehi -110 012.

Dr. B.N. Bhat, Member
Ex- Associate Director of Research
Agril. Research Station,
Nipani-591237,
Karnataka

Dr. R. Lakshminarayana, Member
Retd. Principal Scientist & Head and
Former Project Co-ordinator,
Rajahmundry – 533105.

Dr. T. Ramesh Babu, Member
Dean, PG Studies,
ANGRAU, Rajendranagar,
Hyderabad – 500 030

Dr. R.K. Samanta Member
Former Vice-Chancellor,
BCKV, WB and Former Director,
NAARM and MANAGE, Hyderabad
Hyderabad – 500 030.

Prof. Satyendra Chandra Sarker, Member
Agricultural Economics,
Dept of Agricultural Economics,
UBKV, Cooch Behar-736165
West Bengal

Dr. C. Chandrasekhara Rao, Member-Secretary
Head, Division of Crop Chemistry and Soil Science
CTRI, Rajahmundry,
Andhra Pradesh

QRT team visited the CTRI RS, Dinhata on10.05.2015.,CTRI RS, Vedasandur on 16.05.2015 CTRI, Rajahmundry during 28.11.2015 to 30.11.2015.The drat QRT report was prepared.

INSTITUTE RESEARCH COMMITTEE (IRC) MEETINGS

The Institute Research Committee Meetings (IRC) were held during 24-26 August, 2015 at ICAR-CTRI, Rajahmundry for reviewing the research carried out during the year 2014-15 and finalizing technical programme for 2015-16. Dr. D. Damodar Reddy, Director, ICAR-CTRI, Rajahmundry, Dr. K. Gopal, IAS, Chairman, Tobacco Board, Guntur, Dr. K. Deo Singh, Former Director, ICAR-CTRI, trade representatives, Tobacco Board officials, farmers and scientists participated in the meetings. In this connection, a Scientist-Farmer-Trade-Board Interface was organized for the identification and prioritisations of researchable issues.

INSTITUTE MANAGEMENT COMMITTEE

Dr. D. Damodar Reddy Director, CTRI, Rajahmundry	Chairman	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	ADG (CC) ICAR, New Delhi	Member
		SAO CTRI, Rajahmundry	Member-Secretary

48th Institute Management Committee meeting was held on 09.06.2015 at ICAR-CTRI, Rajahmundry and discussed about various management issues related to the institute.

49th Institute Management Committee meeting was held on 20.11.2015 at ICAR-CTRI, Rajahmundry and discussed about various management issues related to the institute.

Participation of Scientists in Conferences, Meetings, Workshops and Symposia

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. M. Kumaresan,	22nd Scientific Advisory Committee meetings at KVK, Gandhigram Rural University	11.04.2015 at Gandhigram Rural University, Dindigul
2.	U. Sreedhar	4th Congress on Insect Science (CIS-4) – Entomology for Sustainable Agriculture	16-17th April, 2015 at Punjab Agricultural University, Ludhiana.
3.	Dr. D. Damodar Reddy	32nd meeting of ISO/TC 126 and its working bodies as part of Indian delegation in the Capacity of Chairman, FAD-4 of Bureau of Indian Standards	20-22 April, 2015 in Zurich, Switzerland.
4.	Dr P. Venkateswarlu	Member, DPC, for promotion of Managers of Tobacco Board, Guntur	7th May, 2015 at Tobacco Board, Guntur
5.	Dr.VSGR Naidu	Annual Action Plan and Review meetings of KVKs	11-12 May, 2015 at Dr.YRS Horticultural University, Venkataramannagudem
6.	Dr.VSGR Naidu, Dr.B.Johnbabu,	State-level Technical Programme (SLTP) of KVKs:	12-14 May, 2015 at Agricultural College, Tirupathi
7.	Dr P. Venkateswarlu	Biological Workshop	2-3 June, 2015 at TNAU, Coimbatore
8.	Dr. K. Siva Raju	Meeting of FAD 4	11-13 June, 2015 at BIS, New Delhi
9.	VSGR Naidu	Annual Zonal workshop of KVKs of Zone-V	26-28 June 2015 at Jalgaon, Maharashtra
10.	Dr. T.G.K. Murthy Dr. K. Sarala Dr. K. Prabhakara Rao	Meeting of AP State Seed Sub Committee for Varietal Release	29th June2015 at Hyderabad
11.	Sri Sunil Mandi	Advisory Committee meeting organized by KVK under UBKV, Pundibari.	2nd July, 2015
12.	Dr P. Venkateswarlu	Member, Review Committee, Tobacco Board, Guntur	3rd July, 2015 at Tobacco Board, Guntur

Sl. No.	Participant (s)	Programme attended	Date and place
13.	Dr. T.G.K. Murthy Dr. K. Sarala Dr. K. Prabhakara Rao	Meeting of AP State Seed Sub Committee for Varietal Release	10th July, 2015 at Hyderabad
14.	Sri Sunil Mandi	Advisory committee meeting organized ACMART (Farmers Cooperative Training Centre) a joint body by NABARD and West Bengal State Cooperative Ltd.	22nd July, 2015
15.	Dr. L.K. Prasad Dr. V.S.G.R. Naidu	9th National Conference of KVKs	25-26 July, 2015 at Patna, Bihar
16.	Dr. T.G.K. Murthy Dr. K. Sarala Dr. K. Prabhakara Rao	Meeting of AP State Seed Sub Committee for Varietal Release	03rd August, 2015 at Hyderabad
17.	Dr. H. Ravisankar	First Workshop of Nodal Officers of ICAR Research Data Repository for Knowledge Management	4-5th August, 2015 at NASC Complex, New Delhi
18.	Sri Sunil Mandi	Interaction meeting with ICAR Governing Body member	22nd August, 2015 at NIRJAFT, Kolkata
19.	Dr. Y. Subbaiah	Interviewing Committee for filling up the posts of Programme Coordinator and Subject Matter Specialist (Home Science) and Programme Assistant (Veterinary)	BCT-KVK to be held on 22nd August, 2015 at Haripuram.
20.	Dr. K. Siva Raju	Review meeting of Phytochemical project	7th September, 2015 at IISR, Kozhikode
21.	Sri Sunil Mandi	Midterm Review Committee meeting of ICAR Regional Committee – II	19-20 Sept., 2015 at CIFRI, Barrakpur
22.	Dr P. Venkateswarlu	Member, ACP for promotions of Auction Superintendents, SGOs & Field Assistants and Member MACP	28th September, 2015 at Tobacco Board, Guntur
23.	Scientists, CTRI	AINPT Workshop	30 Sep -1st October, 2015 at CTRI Research Station, Hunsur
24.	Dr. S. Kasturi Krishna Dr. V.S.G.R. Naidu	Silver Jubilee conference of Asian-Pacific Weed Science Society (APWSS)	13-16 October, 2015 at PJTSAU, Hyderabad

Sl. No.	Participant (s)	Programme attended	Date and place
25.	Sri Sunil Mandi	Advisory committee meeting organized ACMART (Farmers Cooperative Training Centre) a joint body by NABARD and West Bengal State Cooperative Ltd.	15th October, 2015
26.	Dr. S. Kasturi Krishna	Workshop on developing a road map for Technological support to farmers in Southern Plateau & Hill Region (Agro-climatic zone-X)	21st October, 2015 at Indian Institute of Oilseed Research (IIOR), Hyderabad
27.	Dr. K. Suman Kalyani	11th International Food Data Conference	3-5 November, 2015 at NIN, Hyderabad
28.	Ms. J. Poorna Bindu	80th Annual Convention of ISSS and National Seminar on "Developments in Soil Science-2015"	5-8 December, 2015 at GKVK, UAS, Bangalore
29.	Dr. D.V. Subhashini	56thAnnual Conference of Association of Microbiologists of India (AMI-2015) & International Symposium on "Emerging discoveries in Microbiology"	7-10 December, 2015 at Jawaharlal Nehru University, New Delhi
30.	Dr. M. Anuradha Dr. K. Siva Raju	3rd International Plant Physiology Conference on "Challenges and Strategies in Plant Biology Research"	11-14 December, 2015 at Jawaharlal Nehru University, New Delhi
31.	Dr. H. Ravisankar	8th CGRA International Conference on Innovative Digital Applications for Sustainable Development	5-7 January, 2016 at GKVK, Bangalore
32.	All Scientists of CTRI	National Seminar on "Crop Diversification"	18th January, 2015 at CTRI, Rajahmundry
33.	Dr. U. Sreedhar Dr. G.Raghupathi Rao	Conference on National Priorities in Plant Health Management	4-5 February, 2016 at S.V. Agricultural College, Tirupati
34.	Dr. U. Sreedhar	Indian Ecological Society International Conference – Natural Resources Management Ecological Perspectives	18-20 Feb., 2015 at SKUAST, Jammu
35.	Dr. S.K. Dam	National Symposium on Microbial Diversity and its impacts and their management"	18-19 February, 2016 at Kolkata, West Bengal

Sl. No.	Participant (s)	Programme attended	Date and place
36.	Dr AVSR Swamy	Attended Eastern Zone Regional Agricultural Fair	19 - 21 February, 2015 at CPR Station Patna, Bihar
37.	Dr. K. Siva Raju	Meeting of FAD 4	7-9 March, 2015 at BIS, New Delhi
38.	Sri Sunil Mandi	Advisory committee meeting organized ACMART (Farmers' Cooperative Training Centre) a joint body by NABARD and West Bengal State Cooperative Ltd.	15th March, 2016

Trainings and Capacity Building

Sl. No.	Participant (s)	Programme attended	Date and place
1.	Dr. C. Chandrasekhara Rao	Workshop on Right to Information Act, 2005	27-28 April, 2015 at ISTM, New Delhi
3.	Dr. K. Siva Raju	Training programme for Technical Committee members, BIS on the concept and process of formulating standards to increase their awareness on standard formulation work	20-21 July, 2015 at NITS, Noida
4.	K. Padmaja J. Vasanthi	7th Capacity Building Programme for Technical Personnel	28.09.2015 to 09.10.2015 at IIPA, New Delhi
5.	V.S.R.C. Murthy Ch. Jayaram	Training on Additional knowledge enhancement training on MIS/FMS	5-7 October, 2015 at IASRI, New Delhi
6.	B. Krishna Kumari	Training programme on "Agricultural Knowledge Communication"	5-9 October, 2015 at NAARM, Hyderabad
7.	Dr. C. Nanda	Winter School on "Advanced Breeding Strategies for Biotic and Abiotic Stress Tolerance in Vegetable Crops"	8-28 October, 2015 at IIHR, Bangalore
8.	P.V.S. Bharati	Management Development programme on public procurement	16-21 Nov., 2015 at NIFM, Faridabad
9.	E. Vijay Prasad	Workshop cum training on pulses	22-23rd December, 2015 at ATARI, Zone-V, Hyderabad
10.	V. Bhagyalakshmi K.T.R. Singh	Workshop on communication skills	2 days5-6 Jan., 2015 at ISTM, New Delhi
11.	E. Vijay Prasad	Training programme on IPM in Major crops	6-8th January, 2016 at ATARI, Zone-V, Hyderabad
12.	Dr. K. Suman Kalyani	Workshop on Competency Development programme for Nodal Officers of HRD	10-13 Feb., 2016 at NAARM, Hyderabad
13.	Dr. K. Siva Raju	Refresher course on "Processing and analytical methods of oils & fats"	16-18 March, 2016 at IICT, Hyderabad

Sl. No.	Participant (s)	Programme attended	Date and place
14.	T. Krishna Reddy K. Sesha Sai I.Jagadish Chandra Dr. S.K.Dam B. Raja Rao M.Trinadh P.S.S.Prakasa Rao V.Narasimha Murthy M.M. Ali V.V.Ramana B.V.Srinivas Ch.Sudhakara Babu D.S.R.Sastry M.Srinivas K.V.Ramana S.Ramaraju	Refresher cum skill upgradation training on "Field crop management"	16-19 March, 2016 at ICAR-CTRI, Rajahmundry
15.	B.Nageswara Rao D.Balarama Reddy A.Nageswara Rao A.Srinivas G. Prasada Rao KVSS.Bhaskara Rao VVPL Acharyulu Y.N.V.V.S.N.Murty B. Koteswara Rao Ch. Satyanarayana Y. Subrahmanyam P.Satyavathi M.Srilatha K.V.Narasimha Raju K. Satyanarayana B .S.S.Sai Ch.Subba Rao Evani Radhakrishna A. Daniel Raju P.Subbayamma Y.Jayalakshmi	Refresher cum skill upgradation training on "Field crop & lab management"	16-19 March, 2016 at ICAR-CTRI, Rajahmundry

Workshops, Seminars and Farmers' Days organised by the Institute

Tobacco Scientist-Farmer-Trade-Board Interface

Tobacco Scientist-Farmer-Trade-Board Interface was organized on 24.08.2015 at ICAR-CTRI. Chairman, Tobacco Board; Director and Scientists from CTRI, tobacco farmers from NLS, SLS and representatives of trade & industry participated.

AINPT Tobacco Workshop

The Biennial XXII Tobacco Workshop of All India Network Project on Tobacco was held at ICAR-CTRI-RS, Hunsur during 30th September & 1st October, 2015 to discuss the research results of 2014-15 and finalization of Technical Programme for 2015-16. The Workshop was inaugurated by the Chief Guest Shri Bipin Bihari Chowdary, Executive Director (FAC) & Director (Auctions), Tobacco Board, Bangalore. Dr. T.G.K. Murthy, Nodal Officer, AINPT presented the status of research work and issues to be discussed. Dr. D. Damodar Reddy, Director, ICAR-CTRI & Co-ordinator, AINPT addressed the gathering and presented the importance of tobacco in Indian economy along with AINPT salient research achievements.

AP- TEC 2015

Andhra Pradesh Technology Development and Promotion Centre (APTDC), Hyderabad organised an exhibition in technical collaboration with ICAR-CTRI from 05.06.2015 to 07.06.2015. About 10,000 progressive farmers of the district visited the stalls and got benefitted through this programme.

Mera Gaon Mera Gaurav

Mera Gaon Mera Gaurav (My Village My Pride) was initiated at ICAR-CTRI, Rajahmundry in the month of November, 2015. The scientists of ICAR-CTRI were divided into seven groups viz., **Godavari Group,Gowthami Group, Polavaram Group, Krishna Group, Pattiseema Group, Gundlakamma Group,Kaveri Group** for identification of villages in a cluster/ locality as per the convenience. The scientists have adopted villages and completed the base line survey of the village. The regular activities *viz.*, farmers' advisory services were carried out from time to time.

Jai Kisan Jai Vigyan week

Jai Kisan Jai Vigyan week was organised by ICAR-CTRI at Rajahmundry from 23-29 December, 2015 for promoting the use of science for the welfare of farmers. The week was inaugurated by the Chief Guest, Mr. Chiranjeevi Choudhary, IFS, Commissioner of Horticulture, Govt. of Andhra Pradesh on 23.12.2015. Dr. Damodar Reddy, Director, ICAR-CTRI has invited the students and upcoming youth to join the agricultural education in building the National Agricultural Research System (NARS).

Hindi Week

Hindi week was celebrated at the Institute and its research stations from 19-26 September, 2015 for the promotion of use of official language, Hindi. Sri A. Srinivasa Rao, ITS, General Manager, BSNL, Rajahmundry acted as Chief Guest for the Valedictory Function and gave away the prizes to the winners of various events/ competitions held during the week.

Aadhar Based Biometric Attendance System

Dr. D. Damodar Reddy, Director inaugurated the Aadhar Based Biometric Attendance System for registering the staff attendance on 15.08.2015.

National Seminar on Crop Diversification

The ICAR –CTRI has organised the National Seminar on Crop Diversification at Rajahmundry on 18.01.2016. The Seminar is sponsored by the DAC & FW, Ministry of Agriculture, Govt. of India. Department officials, Scientists from ICAR and ANGRAU, Hyderabad and YSR Horticulture University, Farmers and Industry Representatives participated in the Seminar and deliberated on a myriad issues relating to crop diversification in tobacco growing areas. The National Seminar served as a platform for exchange of information and experiences on various issues relating to crop diversification in tobacco growing regions.

World Soil Day

World Soil Day was celebrated on 05.12.2015 at CTRI Research Station, Hunsur, Karnataka, CTRI-KVK, Kalavcharla (East Godavari dt.), A.P and CTRI-KVK, Kandukur (Prakasam dt), A.P. The farmers were sensitized about the importance of the soil health and its management. In this connection, 606 Soil Health Cards were distributed to farmers of Andhra Pradesh and Karnataka.

Vigilance Awareness Week

Vigilance Awareness Week celebrated during 26-31 October, 2015. Dr. D. Damodar Reddy, Director, ICAR-CTRI, Mr. T. Rama Prasada Rao, Regional vigilance & Enforcement Officer, E. Godavari, Rajahmundry, chief guest and Dr. K. Sarala, Vigilance officer addressed the staff on issues relating to Preventive Vigilance as a tool of Good Governance.

Field IRC

Field IRC was conducted at CTRI Research Station, Jeelugumilli on 06.02.2016 to monitor CTRi and AINPT experiments as per the approved technical programme.

Field IRC was conducted at Black Soil Research Farm, Katheru on 25.02.2016 to monitor the experiments as per the approved technical programme.

IJSC Meeting

The 2nd meeting of XIII Institute Joint Staff Council held on 20.11.2015 examined various issues related to staff welfare including issue of health cards, updating of roster registers, providing facilities to IJSC members, timely filling up of posts, promotions etc.

Swachh Bharat Programmes

Swachh Bharat programmes were mainly aimed at awareness creation on natural resource management (water, soil and energy).The programmes were implemented on 'Prevention of wastage of fuel in Office Premises'. Swachch Bharat Programme on 'Leaf manure making' and 'Eco Friendly Ganesha' were the other activities implemented.

Growers awareness meet

Growers awareness meet for MPA (Model Projet Area) farmers on GAP, CPA and NTRM was arranged by Tobacco Board in collaboration with CTRI was held on 10.3.16 at CTRI RS Jeelugumilli.

Scientific Advisory Committee Meeting (07.04.2015)

KVK organized SAC 2015 at CTRI, Rajahmundry on 7th April, 2015 to review work done during 2014-15 and to finalise action plan for 2015-16.

ISO 9001:2008

ICAR-CTRI, Rajahmundry has been granted ISO 9001:2008 certificate for the successful implementation of its quality management system with regard to "Basic, Strategic and Applied Research on Tobacco Crop" on 25.01.2016.

Distinguished visitors

S.No.	Date	Visitors
CTRI, RAJAHMUNDRY		
1.	10.04.2015	Sri B.M.C. Reddy Vice Chancellor, DR. YSR H U, Venkataramanna Gudem
2.	10.04.2015	Sri K. Madhusudhan Rao IAS, Commissioner of Agrl. Govt. of Andhra Pradesh
3.	13.04.2015	Dr. K. Satyagopal IAS, Director General NIPHMRajendranagar, Hyderabad
4.	24.06.2015	Dr. Baleshi Ram Director, Sugarcane Breeding Institute,Coimbattore (TN)
5.	17.07.2015	Dr. S. Ayyappan Secretary, DARE & DG, ICAR
6.	21.08.2015	Sri P. Venkateswara Rao and Team, Associate Scientist for ITC – ABD – ILTD Research Department
7.	23.09.2015	Sri Chiranjeevi Chowdhary IFS,Commissioner of Horticulture, Govt. of Andhra Pradesh (AP)
8.	31.10.2015	Dr. S. Ravichandran Pr. Scientist, NAARM, Hyderabad
9.	04.01.2016	Dr. J. S. Chauhan ADG (Seed), ICAR, New Delhi
10.	04.01.2016	Dr. Padma Raju Dr. Rama Rao Vice Chancellor, ANGRAU Director, NAARM, Hyderabad
11.	07.01.2016	Sri C. Raghavachari VEVIL, BPI Pvt. Limited, ISO Auditor
12.	21.01.2016	Sri Ch. Srinivasa Rao Agrl. Officer, RARS, Lam Guntur
13.	03.02.2016	Dr. K. Manikya Kumari Head, Dept. of Botany & BiotechnologySt. Joseph's college for women (A) Visakhapatnam-530 004
CTRI RS, Hunsur		
15.	5-12.2015	Sri. Bipin Behari Choudahry Director (Auctions), Tobacco Board, Bangalore

S.No.	Date	Visitors
16.	30.10. 2015	Dr. Y.P. Singh Dr.A.N.Ganesh Murthy Principal Scientist (Agronomy), ICAR, New Delhi Head, Division of Soil Science & Agriculture Chemistry, ICAR- IIHR Bangalore
CTRI RS, Vedasandur		
17.	16.05.2015	Dr. Hanchinal, Dr. R. Lakshmi Narayana, Dr. T.Ramesh Babu, Dr. R. Samantha, Dr. B.N.Bhat QRT, team
18.	22.01.2016 and 23.01.2016.	Dr.K.Sarala Dr.U.Sreedhar Principal Scientist & Head Crop ImprovementPrincipal Scientist & Head Crop Protection
CTRI RS, Dinhata		
19.	01-07-2015	Sri Ashish Kr. Patra Deputy Director of Agriculture ,Cooch Behar
20.	21-12-2015	Sri YugeswaranandaAsstt. Secretary Ramkrishna Mission, Narendrapur, Kolkata

Personnel (As on 31.03.2016)

Dr. D. Damodar Reddy, Director

DIVISION OF CROP IMPROVEMENT

Dr. (Mrs.) K. Sarala,	Principal Scientist & HOD
Dr. T.G.K. Murthy,	Pr.Scientist & Nodal Officer, AINPT
Dr. A.V.S.R. Swamy,	Principal Scientist
Dr. K. Prabhakara Rao,	Scientist
K. Santhinandivelu,	Sr. Technical Officer
B. Raja Rao,	Technical Officer
M. Trinadh,	Sr. Technical Assistant
M.M. Ali,	Technical Assistant
M. Srinivas,	Sr. Technician
S. Ramaraju,	Technician
Y.N.V.V.S.N. Murthy,	SSS

DIVISION OF CROP PRODUCTION

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Dr. S.V. Krishna Reddy,	Principal Scientist
Dr. Y. Subbaiah,	Principal Scientist
Dr. (Mrs.) K. Suman Kalyani,	Principal Scientist
N. Aruna Kumari,	Chief Techl. Officer
T. Krishna Reddy,	Chief Techl. Officer
I. Jagadishchandra,	Sr. Techl. Officer
P.S.S Prakasa Rao,	Sr. Techl. Asst.
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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

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

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Dr.(Mrs.) D.V. Subhashini,	Principal Scientist
Dr. L.K. Prasad,	Principal Scientist
Jana Poorna Bindhu,	Scientist
D.V.L. Satyavathi,	ACTO
Y. Ramabai,	Sr. Technical Officer
K. Padmaja,	Sr. Technical Officer
J. Vasanthi,	Technical Officer
G. Srinivasa Rao,	Sr. Technical Assistant
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P. Satyavathi,	SSS
P. Subbayamma,	SSS
M. Srilatha,	SSS
K.V. Narasimha Raju,	SSS
B.S.S. Sai,	SSS
E. Radhakrishna,	SSS
Ch. Subba Rao,	SSS
A. Daniel Raju,	SSS
Sirikonda Krishna,	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
C.V.N. Srihari,	Research Associate

AKM UNIT

Dr. H. Ravisankar,	Senior Scientist
M.N.P. Kumar,	Sr. Techl. Officer
K. Satyanarayana,	SSS

LIBRARY

Md. Elias,	Sr. Technical Assistant

AINPT

B. Krishna Kumari,	Sr. Technical Officer
R. Satyanarayana,	Technician
Bathina Chinnari,	SSS

MAINTENANCE SERVICE UNIT

G. Nagesh Kanth Rao,	Sr. Technical Officer
N. Sreedhar,	Technical Officer
N. Gopinath,	Technical Officer
V.V. Sivaram,	Technical Officer
G.S.N. Murthy,	Technical Assistant
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N.V.V. Satyanarayana,	Sr. Technician
G. Kaleswara Rao,	SSS
Y. Nirmala Kumari,	SSS

TRANSPORT

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K. Bhyravaswamy,	Sr. Technical Assistant
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K.V. Ramana,	Sr. Technician
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Uppati Kalyanam,	SSS
Bagala Venkata Rama Rao,	SSS
Yerubandi Srinivas Durga Prasad,	SSS
Miriyala Subba Rao,	SSS
Polumati Sreenivasu,	SSS

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Ch. Chinnayamma,	SSS

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P.V. Satyanarayana,	AAO
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K.T.R. Singh,	Private Secretary
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P. Mariyamma,	Assistant
M. Rambabu,	Assistant
A. Sridhar,	Assistant
N. Suryanarayana,	Assistant
P. Devanagaraju,	Assistant
A.Veera Venkata Ramana,	Assistant
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P.V.V.V. Prasad,	UDC
Ch. Jayaram,	UDC
P.J.F. Moses,	UDC
S. Pradeep Kumar,	UDC
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G.M.B. Sujatha,	UDC
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S. Rajalu,	SSS
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Dama Singaiah,	SSS
Divi Koteswara Rao,	SSS
Orupalli Annapurnamma,	SSS
Mannem Vijayamma,	SSS
Divi Sheshamma,	SSS
Vankayalapati Mukundam,	SSS
Nalluri Subbayamma,	SSS
Divi Annamma,	SSS
Tanikonda Chinnamma,	SSS
G. Lakshmamma,	SSS
Orupalli Malakondaiah,	SSS
Oruganti Lakshmamma,	SSS
Vankayalapati Mariyamma,	SSS
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Gauranga Sarkar,	SSS
Naresh Biswas,	SSS

KVK, KALAVACHARLA

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Dr. B. John Babu,	Chief Technical Officer
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J.V.R. Satyavani,	Chief Technical Officer
E. Vijaya Prasad,	Chief Technical Officer
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Y. Udayakumar,	Sr. Technician (Tr. Driver)
G. Chinna Rao,	SSS
G. Sasi Rani,	SSS
G.P.D. Varma,	SSS
M. Veeraveni,	SSS
G. Ramakrishna Raju,	SSS
Kamidi Venkanna,	SSS
Penumakula Surya Kumari,	SSS
Challa Koteswara Rao,	SSS
Sadanala Nageswara Rao,	SSS

Appendix - 1

Results-Framework Document for ICAR-Central Tobacco Research Institute (2014-2015)

Address : Rajahmundry-533105, Andhra Pradesh

Website ID: www.ctri.org.in

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 such as phyto-chemicals, oil, biomass based products etc.

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	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100%	90%	80%	70%	60%
1.	Germplasm enhancement and development of improved cultivars	35	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	13	132	110	88	66	44
				Lines identified for unique traits	Date	3	1st week of Sept., 2014	1st week of Oct., 2014	1st week of Nov., 2014	1st week of Dec., 2014	1st week of Jan., 2015
			Development of improved cultivars	Entries tested in AINP(T) multi-location trials	Number	7	26	22	18	14	10
				Varieties identified for release	Number	4	3	2	1	0	0
			Seed production programme	Foundation seed produced	Weight MT	8	20	19	15	11	7
2.	Development and identification of appropriate technologies	27	Development of new technologies	New technologies tested/developed	Number	27	6	5	4	3	2
3.	Technology dissemination and capacity building	18	Demonstrations conducted	Demonstrations/ FLDs conducted	Number	9	12	10	8	6	4
			Training programmes organized for farmers/Extension officials	Trainings organized	Number	9	14	12	10	7	4
*	Publication/Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	3	6	5	4	3	2
			Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	2	30.06.2014	02.07.2014	04.07.2014	07.07.2014	09.07.2014
*	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90
*	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	2	May 15, 2014	May 16, 2014	May 19, 2014	May 20, 2014	May 21, 2014

Enhanced Transparency / Improved Service delivery of Ministry/Department	3	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80
		Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80
Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	Nov.1 2014	Nov.2 2014	Nov.3 2014	Nov.4 2014	Nov.5 2014
		Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC).	% of Implementation	%	1	100	90	80	70	60
		Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80
		Implementation of milestones of approved Innovation Action Plans (IAPs).	% of implementation	%	2	100	90	80	70	60

Section 3: Trend Values of the Success Indicators

S. No.	Objectives	Actions	Success Indicators	Unit	Actual Value for FY 12/13	Actual Value for FY 13/14	target Value for FY 14/15	Projected Value for FY 15/16	Projected Value for FY 16/17
1.	Germplasm enhancement and development of improved cultivars	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	98	100	110	112	115
			Lines identified for unique traits	Number	1st week of Sept., 2014	1st week of Sept., 2014	1st week of Oct., 2014	1st week of Oct., 2014	1st week of Oct., 2014
		Development of improved cultivars	Entries tested in AINRP(T) multi-location trials	Number	15	20	22	23	24
			Varieties identified for release	Number	3	1	2	3	4
		Seed production programme	Foundation seed produced	Weight MT	19	18.5	19	19.5	20
2.	Development and identification of appropriate technologies	Development of new technologies	New technologies tested/developed	Number	4	4	5	6	7
3.	Technology dissemination and capacity building	Demonstrations conducted	Demonstrations / FLDs conducted	Number	9	9	10	10	10
		Training programmes organized for farmers/Extension officials	Trainings organized	Number	11	12	12	13	14
*	Publication/Documentation	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	5	4	5	6	7
		Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date			02.07.2014		
*	Fiscal resource management	Utilization of released plan fund	Plan fund utilized	%	100	100	100	100	100
*	Efficient Functioning of the RFD System	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	-	-	May 16, 2014	-	-
		Timely submission of Results for 2013-2014	On-time submission	Date	-	-	May 2 2014	-	-

*	Enhanced Transparency / Improved Service delivery of Ministry/Department	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	-	-	95	-	-
		Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	-	-	95	-	-
*	Administrative Reforms	Update organizational strategy to align with revised priorities	Date	Date	-	-	Nov.2 2014	-	-
		Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of Implementation	%	-	-	90	-	-
		Implementation of agreed milestones for ISO 9001	% of implementation	%	-	-	95	-	-
		Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	-	-	90	-	-

Section 4 (a): Acronyms

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

Section 4 (b):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	Date of identification of line have unique traits	
3	Entries tested in AINP(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 AINP(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
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 stakeholders	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 stakeholders 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 that are critical for delivering agreed results

Location type	State	Organization Type	Organisation Name	Relevant Success Indicator	What is your requirement from this organization	Justification for this requirement	Please quantify 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 varies based on the area fixed	Quantity of foundation seed required	Quantity of foundation seed produced may fluctuate

Section 6 : Outcome/ Impact of activities of Department / Ministry

S.No.	Outcome/Impact of organization	Jointly responsible fo influencing this outcome/impact with the following organization(s) departments/ ministry(ies)	Success Indicator (s)	Unit	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1.	Enhancement in farm production & production efficiency	Tobacco Board, Ministry of Commerce and tobacco Industry	Increased farm production	M. kg	9.5	10	10	10	10
			Increase in farm income	Rupees (Million)	360	370	380	385	390
			Increased farm productivity	Kg/ha	33.32	34.3	34.67	35.28	35.44

Annual (April 1, 2014 to March 31, 2015) Performance Evaluation Report of RFD of RSCs i.e. Institutions for the year 2014-2015

S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value					Achievements	Performance		Percent achievements against Target values of 90% Col.	Reasons for shortfalls or excessive achievements, if applicable
							Excellent	Very Good	Good	Fair	Poor		Raw Score	Weighted Score		
							100%	90%	80%	70%	60%					
1.	Germplasm enhancement and development of improved cultivars	35	Evaluation of genetic material	Breeding and germplasm lines evaluated	Number	13	132	110	88	66	44	144	100	13	130.9	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	Date	3	2	1	1	1	1	3	100	3	300.0	The achievement is one higher than the 100% of the criteria only.
			Development of improve-ed cultivars	Entries tested in AINP(T) multi-location trials	Number	7	26	22	18	14	10	30	100	7	136.4	Number of entries tested increased due contribution of more number of entries having higher yield with desirable characters by AINPT Centres.
				Varieties identified for release	Number	4	3	2	1	0	0	4	100	4	200.0	The achievement is one more than 100% of the criteria only.
			Seed production programme	Foundation seed produced	Weight MT	8	20	19	18	17	16	16	60	4.8	84.2	The necessary seed requirement met with seed produced.
2.	Development and identification of appropriate technologies	27	Development of new technologies	New technologies tested/developed	Number	27	6	5	4	3	2	6	100	27	120.0	The achievement is 100% of the criteria only.
3.	Technology dissemination and capacity building	18	Demonstrations conducted	Demonstrations/ FLDs conducted	Number	9	12	10	8	6	4	12	100	9	120.0	The achievement is 100% of the criteria only.
			Training programmes organized for farmers/ Extension officials	Trainings organized	Number	9	14	12	10	8	6	14	100	9	116.7	The achievement is 100% of the criteria only.
*	Publication/ Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	3	6	5	4	3	2	6	100	3	120.0	The achievement is 100% of the criteria only.
			Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	2	30.06.2014	02. 07. 2014	04.07.14	07.07. 2014	09.07. 2014	15.06.2014	100	2		

*	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90	100	100	2		
*	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	2	May 15, 2014	May 16, 2014	May 19, 2014	May 20, 2014	May 21, 2014	May 28, 2014	0	0		
			Timely submission of Results for 2013-2014	On-time submission	Date	1	May 1 2014	May 2 2014	May 5 2014	May 6 2014	May 7 2014	April 25 2014	100	1		
*	Enhanced Transparency / Improved Service delivery of Ministry/Department	3	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80	100	100	2		
			Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80	100	100	1		
*	Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	Nov. 1 2014	Nov.2 2014	Nov.3 2014	Nov.4 2014	Nov. 5 2014	Oct, 31, 2014	100	2		
			Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC).	% of Implementation	%	1	100	90	80	70	60	100	100	1		
			Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80	--	--	0		
			Implementation of milestones of approved Innovation Action Plans (IAPs).	% of implementation	%	2	100	90	80	70	60	100	100	2		

Total Composite Score: 92.80%

Rating : Very good

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