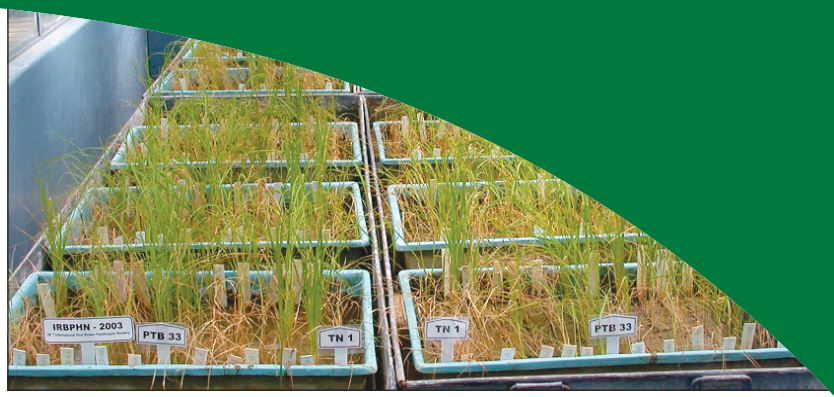

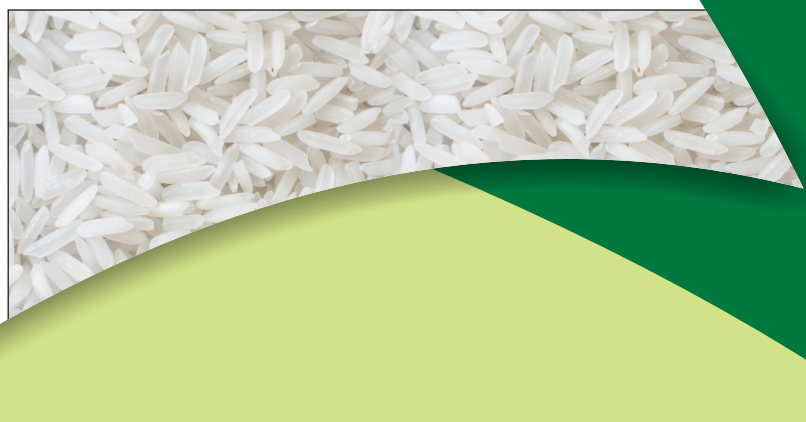

वार्षिक प्रतिवेदन
Annual Report
2013-2014

चावल अनुसंधान निदेशालय
Directorate of Rice Research
Rajendranagar, Hyderabad - 500 030

वार्षिक प्रतिवेदन

Annual Report

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भाकृअनुप
ICAR

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Directorate of Rice Research

DRR

Rajendranagar, Hyderabad - 500 030

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Preface

I am privileged to place before you the Annual Report of the Directorate of Rice Research for the period 2013-14 which is the ninth consecutive one and the last report of my eventful tenure as Project Director.

Timely arrival of south-west monsoon and its reasonable well distribution across the country notwithstanding three consecutive cyclones (*Phailin, Helen, Lehar*) in the eastern belt resulted in an estimated record rice production of 106.29 million tonnes. The progress of research during the period of report is quite encouraging with 8 hybrids and 15 varieties being released for cultivation. The Varietal Identification Committee identified two varieties *viz*., IET 22598 and IET 22729 developed by the Directorate. The breeder seed production was also satisfactory with 555 tonnes seed of 220 varieties being produced and distributed. It is also heartening to note that the Directorate is going to lead the Consortia research platform on 'Biofortification in selected crops for nutritional security' with a total budget of Rs. 130 crores during the XII Plan period. Several proven rice production technologies were demonstrated through 485 FLDs covering 15 states. The country has earned Rs. 33,858 crores in foreign exchange which is the highest ever through rice exports of 10.5 million tonnes.

On the research front, significant breakthroughs were achieved in identifying resistant genetic stocks against BPH and WBPH, promising lines under low phosphorous and pyramided basmati lines resistant to bacterial blight. The complete genome sequence of RTSV isolate from southern India was successfully deciphered and deposited in the NCBI database

The year is also significant in that the scientists of the Directorate were conferred with prestigious Hari Om Ashram award for team research as well as individual awards at national level in recognition of their commendable services to the nation. One scientist has been deputed abroad for advanced training. Six externally funded projects with a total outlay of 1.76 crores were sanctioned to the Directorate which will be celebrating its Golden Jubilee next year.

A summary of these activities is presented in this Annual Report.

(B.C. Viraktamath)
Project Director

Hyderabad

31st May 2014

Contents

कार्यकारी सारांश
Executive summary

अखिल भारतीय समन्वित चावल सुधार कार्यक्रम

आठ संकर यथा, 27पी52, 27पी63, के.पी.एच.-199, के.पी. एच.-371, यू.एस.-305, यू.एस.-314 और वी.एन.आर. 2375 और केंद्र के द्वारा अनुमोदित ए.आर.आर.एच. 7434 छत्तीसगढ़ से और 15 किस्मों (सेंट्रल-8, राज्य 7) विभिन्न पारिस्थितिकी के लिए जारी किए गए। सभी 12 किस्मों और संकर (8 संकर और 2 किस्मों) सिंचित पारिस्थितिकी के लिए जारी किए गए; एरोबिक और वर्षा आधारित अपलैंड के लिए 2 किस्मों; उथले और वर्षा आधारित तथा पहाड़ी और गहरे पानी पारिस्थितिकी के लिए एक किस्म, और 3 किस्मों बासमती समूह के लिए जारी किए गए।

फसल सुधार

- चालीस किस्मे परीक्षणों, एक स्क्रीनिंग नर्सरी और 5 संकर चावल परीक्षणों का आयोजन किया गया जिसमें 1116 प्रविष्टियों और 799 प्रयोगों को 120 स्थानों पर (46 वित्त पोषित और 74 स्वयं सेवक केन्द्रों) जिसमे 27 राज्यों और 2 केंद्र शाहित प्रदेशों सहित देश के सभी 5 क्षेत्रों को शामिल किया गया।
- अट्ठाईस उत्कृष्ट लाइनों की पहचान की गई।
- 12 आई.एन.जी.ई.आर. नर्सरी जिसमे 572 अभिजात वर्ग लाइनों को 100 केन्द्रों पर आयोजित की गई और 58 उत्कृष्ट लाइनों की पहचान की गई।
- पांच संकर चावल परीक्षण जिसमे एक बहू स्थानिय परीक्षण शामिल है देश के 37 अलग-अलग केन्द्रों पर आयोजित की गई जिसमे 116 परीक्षण संकर. 19 उत्कृष्ट संकर के रूप में पहचान की गई है ।
- 26 बासमती, 42 खुशबूदार लघू अनाज अभिजात वर्ग लाइनों को अखिल भारतीय समन्वित चावल सुधार कार्यक्रम परीक्षण में 15 भौतिक रासायनिक वर्ण के लिए परीक्षण किया गया। इनमें, पतला अनाज किस्मों में बांटा गया जैसे लंबे पतले (32), मध्यम पतले (20) और छोटे पतले (3). अड़तीस प्रविष्टियों में उच्च दर्ज की पूरा चावल पुर्नप्राप्ति है और 15 में मध्यम। वांछनीय और मध्यवर्ती एमयलोस 54 प्रविष्टियों में उच्च दर्ज की। 28 प्रविष्टियों में मुलायम जेल स्थिरता है, जबकि बीस प्रविष्टियों में मध्यम जेल स्थिरता है।
- तीन सौ तिरसठ गैर बासमती उत्कृष्ट प्रजाति 23 अग्रिम परीक्षणों में 14 भौतिक रासायनिक वर्ण के लिए मूल्यांकन किया गया । इनमें, लंबे पतले (127), मध्यम पतले (65) और बाकी छोटे पतले पाये गए। 250 प्रविष्टियों में उच्च दर्ज की पूर्ण चावल प्राप्ति है (>60%) और 85 में मध्यम (51-59%)। वांछनीय और मध्यवर्ती एमयलोस 54 प्रविष्टियों में उच्च दर्ज की। 28 प्रविष्टियों में मुलायम जेल स्थिरता है, जबकि बीस प्रविष्टियों में मध्यम जेल स्थिरता है। वांछनीय और मध्यवर्ती होनहार प्रविष्टियों के पहचान में 269 और 218 प्रविष्टियों में मध्यवर्ती एमयलोस और मुलायम जेल स्थिरता पायी गयी है।
- डी.ए.सी. आवेदोनों के अनुसार चावल की 220 किस्मों और 12 संकर के पैतृक लाइनों की प्रजनक बीज उत्पादन का आयोजन 38 क्षेत्रों में किया गया। 474 टन के लक्ष्य के मुकाबले प्रजनक बीज के 555 टन का कुल उत्पादन किया गया।

सस्य विज्ञान

- 54 सर्वोत्कृष्ट जीनोप्रकारों में 14 समूहों से संबंधित का अपनी नत्रजन उपयोग क्षमता के लिए परीक्षण किया गया और 31 आशाजनक संवर्धों की पहचान की गयी।
- वर्षाधारित उपरीली पारिस्थितिकी प्रणाली में पोषक अनुसूची जैविक खाद (5 टी. एफ.वाई.एम./2t वरमी कंपोस्ट) और 75% पोषक अनुसूची के लगाने में अनाज उपज को बढाने में और मृदा स्वास्थ्य को बढाने में आशाजनक पाया गया।
- वायुजीवी धान के लिए बोआई का इष्टतम तिथि 1 जून से 26 जून पखवाड़े. तक को आशाजनक पाया गया। किस्मों और संकर के परीक्षण जैसे एम.टी.यू. 1001, एम.टी.. यू. 1010, डी.आर.आर.एच. 3, पी.ए. 837, पी.ए. 6129, दांडी, पराग, वैश्य, पी.ए. 6444, अराईज तेज और एच.पी.आर. 2143 उत्कृष्ट के रूप में पहचान की गई है । संकर किस्मों ने सभी स्थानों पर उत्कृष्टता के रूप में पहचान की गई है
- धान की बोआई की अवस्था में ग्लाइफोसैट (बुआई के पूर्व) के साथ बेनसल्फरान मेथल + प्रिटिलाक्लोर (बुआई के उपरांत) के प्रयोग द्वारा व्यापक रूप में अपतृण नियंत्रण में उत्तम परिणाम दर्ज किये गये।
- बोआई की पारंपरिक विधि में अनाज उपज (43) की तुलना में चावल सघनीकरण प्रणाली (श्री) में उच्च उपज सूचक मूल्यों की पहचान की गयी। कृषिजोपजाति की तुलना में फसल की स्थापना प्रणाली का स्थान महत्वपूर्ण पाया गया।

मृदा विज्ञान

- धान में जैविक कृषि पर पाच्चीस साल के अध्ययन में जैविक कृषि के अधीन अनाज की उपज खरीफ में 5वीं फसल में और रबी में 10वीं फसल में अजैविक के तुलनात्मक स्तर तक पहुँच गयी। जैविक खादों के प्रयोग से मृदा के भौतिक, रासायनिक एवं जैविक गुणधर्मों में महत्वपूर्ण सुधार पाया गया। मृदा गुणवत्ता सूचकों यथा पोषक, माइक्रोबाइल और समग्र टिकाऊपन के सूचक प्रणाली के द्वारा जो प्रयोग के अंत में जैविकों से 1.63 थी जबकि उर्वरकों के प्रयोग के खेतों में 1.33 थी।
- टिटाबार और मारुटेरु की आप्लावित मृदाओं में मृदा प्राचलों में परिवर्तन, उपज की प्रवृत्ति के अनुरूप पाये गये जबकि मांड्या के वर्तमान अनुमोदित उर्वरकों की पुनरीक्षा की आवश्यकता महसूस की गयी।
- मांड्या, मारुटेरु और टिटाबार प्रांतों में कुछ चयनित किसानों के खेतों में एक अध्ययन किया गया, जहाँ मृदा पोषकता की आपूर्ति, धान की उत्पादकता, पोषक तत्वों की आवश्यकता, उपयोगिता की दक्षता और उर्वरकों की सिफारिश में स्थानों के अनुरूप परिवर्तन पाये गये। उपर्युक्त सिफारिशों का उपज लक्ष्य टिटाबार में 6.5 टन हे. 40:20:20 एन.के.पी./हे. के प्रयोग कि सिफारिश की गयी। मांड्या में 6.4 टन धान की उपज हे. लक्ष्य के लिए 100:50:50 एन.पी.के./ हे. की जगह 67-86 कि नत्रजन 28.48 कि फास्फेट और 42-88 कि हें तक परिवर्तित मात्रा के. पोटाश प्रयोग की सिफारिश की गयी। प्रचलित अनुमोदित उर्वरक मात्रा और कृषकों के द्वारा व्यवहार में लायी जाने वाली उर्वरक पद्धतियों की तुलना में स्थान विशिष्ट पोषक प्रबंध श्रेष्ठतर पाया गया।
- कानपुर की क्षारीय मृदाओं में पोषकता और धान गेहूँ फसल पद्धतियों में उत्पादकता पर सूक्ष्म पोषकों के प्रत्यक्ष, अवशिष्ट और संचित प्रभावों के अध्ययनों से पाया गया कि 100% तक जिप्सम प्रयोग से उपज और पोषक संचयन में महत्वपूर्ण सुधार हुआ। गोबर की खाद के साथ या उसके बिना पूरक के रूप में 50 कि.ग्रा. (हे. जिंक सल्फेट $ZnSO_4$ और लोहे) 30 कि.ग्रा. Fe-ई.डी.टी.ए.) के संयुक्त प्रयोग से धान उत्पादकता में एन.पी.के. की उपयोग क्षमता में सुधार हुआ।
- सामान्य तौर पर 11 स्थानों में उच्च जस्ता और लोहा की अंतर्वस्तु के लिए 185 कल्चर के परीक्षण से सामान्य रूप से भिन्न स्थानों और जीनोप्रकारों में चेक किस्मों की उत्पादकता तथा जस्ते और लोहे की अंर्तवस्तु में भिन्नता पायी गयी। जस्ता और लोहे की अर्तवस्तु और अनाज की उपज में कोई महत्वपूर्ण संबंध नहीं था। उच्च लोहे और जस्ता अंतर्वस्तु के लिए अनेक स्थान विशिष्ट आशाजनक संवर्ध की पहचान की गयी जिनमें मोनकंपू में नजवारा समूह, कराइकल में पथानी 23 और जोडुमनी, कानपुर में स्वर्ण सब 1, बंकुरा में मनी और फैजाबाद और खुदवानी में एन.डी.आर. क्रमश और सुगंधित संवर्ध थे।
- वायुजीवी धान प्रणाली में उपज हानि के बिना जल उत्पादकता (कि.ग्रा.धान/उपयोग किया गया मि.मी. जल) 3.9 से 4.8 कि.ग्रा. अनाज तक पाया गया और सिंचाई 100% संचित पटल वाष्पण (सी.पी.ई.) के बराबर इष्टतम पाया गया। प्रतिबंधित आपूर्ति के द्वारा क्रमश: लगभग 12-16 प्रतिशत सिंचित जल की बचत होगी।

पादप क्रिया विज्ञान

- सूचक पर एक अध्ययन में बोआई के दो विभिन्न तिथियों के कारण पुष्पण में आगुआई, सी.डी.डी.,सी.एन.पी., जैव पदार्थ और अनाज की उपज में कोई महत्वपूर्ण भिन्नता नहीं पायी गयी। 20 चावल प्रजातियाँ का प्रकाश ऊष्मीय अनुक्रमण और विकिरण का उपयोग दक्षता के लिए जल्दी और सामान्य बोया स्थितियों के तहत मूल्यांकन 9 स्थानों पर किया गया. आई.ई.टी. 20924, डी.आर.आर.एच. -3, आई.ई.टी. 22580, आई.ई.टी. 22569, आई.ई.टी. 22218 और एन. एस -5 बेहतर पायी गयी।
- संकर किस्मों में सिलिकॉन की उच्च खुराक की जरूरत उसके आंतरिक पत्ता में उच्च सिलिकॉन एसिड सामग्री से स्पष्ट है कटक, टीटाबर पट्टाम्बी (सैंडी दोमट मिट्टी) और कोयंबटूर पर सिलिकॉन घुलनशील के अनुप्रयोग से सामान्य फसल स्वास्थ्य में सुधार पाया गया।
- अनाज पैदावार, शुष्क पदार्थ, गर्मी संवेदनशीलता सूचकांक, अनाज वजन, गर्मी संवेदनशीलता सूचकांक और बाँझपन सत्यश्री, आई.ई.टी. 22116 और आई.ई.टी. 21404 पट्टाम्बी सेंटर में कम थे.
- 10 चावल प्रजातियाँ कई अजैव तनाव पर अंकुर प्रतिक्रिया के लिए मूल्यांकन किए गए और वायुवीय तनाव में गंभीर जड़ विकास निषेध पाया गया।

कीट विज्ञान

- देश भर में कीट सर्वेक्षण के द्वारा पता लगाया गया की स्थानीय क्षति में तना छेदक, भूरे फुदके कीड़ा, पत्ती मोडक ज्यादा नुकसन के दोषी पाये गए।

- खरीफ 2013 के दौरान 41 स्थानो पर 1765 प्रविष्टियों 210 वैध परीक्षण में 14 कीटों पर मूल्यांकन किए गए थे।
- गालमिड्ज पर विषाक्तता संघटन अध्ययन द्वारा सकोली और पट्टांबी में जी.एम. और जी.एम 11 जीनों के विरुद्ध 50% से अधिक जीव संख्या विषाक्त पायी गयी।
- तना छेदक, पत्ता मोडक, भूरा फुदका, सफेद पीठवाला फुदका और आर्मी वर्म के नियंत्रण में बुप्रोफेजिन 20% + एसिफेट 50% डब्ल्यू.पी. (आर.आई.एल 049/एफ 1) से अंतर्विष्ट एक नया सम्मिश्र उत्पाद को 1000 ग्रा/हे की दर से प्रयोग करने पर प्रभावी पाया गया और साथ-साथ अधिक अनाज उपज भी दर्ज हुआ।
- धान कृषि प्रणालियों पर कीट नाशक जीवों के प्रभाव (आई. आर.सी.पी) पर परीक्षणों से पाया गया कि तना छेदक और पत्ता मोडक से हानि धान की साधारण बोआई विधि की तुलना में सीधी रोपाई विधि में अधिक थी।
- नाशक जीव ग्रस्तता पर जैव खाद के प्रभाव (ई.ओ.एम.पी) पर अध्ययन ने दर्शाया कि अनुमोदित उर्वरक की मात्रा के उपचार के परिणाम स्वरूप अधिक नाशकजीव तनाव और हानि के बावजूद अधिकतम अनाज की उपज प्राप्त हुई।
- अनाज पैदावार और सफेद क्षति के बीच एक महत्वपूर्ण नकारात्मक सहसंबंध पाया गया।
- इक बूंद का प्रभाव जो की एक गैर ईओण गीला एजेंट है केवल सफेद पीठवाला फुदका और हरे फुदका पर पाया गया।
- धान कृषि प्रणालियों पर कीट नाशक जीवों के प्रभाव (आई. आर.सी.पी) पर परीक्षणों से पाया गया कि तना छेदक और पत्ता मोडक से हानि धान की साधारण बोआई विधि की तुलना में सीधी रोपाई विधि में अधिक थी।
- देश भर में पांच स्टेम बोरर प्रजातियों में प्रमुख प्रजाति के रूप में पीला स्टेम बोरर (वाई.एस.बी.) को पाया गया।

पादप रोग विज्ञान

- अखिल भारतीय समन्वित प्लांट पैथोलॉजी परीक्षण प्रमुख चावल रोगों, ब्लास्ट और बैक्टीरियल ब्लाइट रोगजनकों, रोग अवलोकन नर्सरी और रासायनिक नियंत्रण परीक्षणों के क्षेत्र की निगरानी पर 15 परीक्षण किए गए।
- 1135 परीक्षण प्रविष्टियों में से भारत भर में पांच अलग स्क्रीनिंग नर्सरी से मूल्यांकन में उत्कृष्ट प्रविष्टियों की संख्या 53 है लीफ़ ब्लास्ट के विरुध, 41 है ब्राउन स्पॉटके विरुध, 62 है शीथ ब्लायट के विरुध, 41 है ब्राउन स्पॉट के विरुध, 38 है शीथ रॉट के विरुध, 56 है बकटेरियल ब्लीटे के विरुध और 36 है टुंगरों राईस के विरुध।
- रोग प्रेक्षण संवर्धन-गृह के परिणामों ने दर्शाया कि खरीफ मौसम में, झोंका, भूरे धब्बे और पत्ता गलन जैसे विभिन्न रोगों की तीव्रता पिछेती बोआई फसलों में अधिक थी जबकि पत्ता अंगमारी ग्रस्तता अगेती बोआई फसलों में थोडी अधिक थी।
- अधिकतम स्थानों में पत्ता अंगमारी, भूरे धब्बे और पत्ता गलन की तीव्रता को कम करने में दो नये सूत्र याने हेक्साकोनाजोल 75 डब्ल्यू.जी. (आर.आई.एल-012 एफ1) और क्रेसेक्जिम मेथिल 40% + हेक्साकोनाजोल 8% डब्ल्यू.जी. (आर.आई.एल-068/एफ 148 डब्ल्यू.जी.) बडे प्रभावी थे। गला झोंका, कूटकलिका और पत्ता जला के प्रति क्रेसेक्जिम मिथिल 40% + हेक्साकोनाजोल 8% डब्ल्यू.जी. (आर.आई.एल-068/एफ 148 डब्ल्यू.जी.) के यौगिक पदार्थ बडा प्रभावी पाया गया।

प्रौद्योगिकी स्थानांतरण

- देश के 15 राज्यों और पाँच धान पारिस्थितिकियों को सम्मिलित करते हुए विभिन्न धान उत्पादन प्रौद्योकियों को मूल्यांकित करने और प्रदर्शित करने के लिए 485 एफ.एल. डी. का आयोजन किया गया।

अग्रणी अनुसंधान

फसल सुधार

पौध प्रजनन

- आई.ई.टी. 22598 (आर.पी.5213-69-13-3-4-1-2-बी) जो सहभागी धान, क्षेत्रीय चेक और स्थानीय चेक के ऊपर 11.38%, 16.81% और 11.61% की मात्रा में अधिक उपज लाभ दर्ज की गई, को क़िस्म पहचान समिति द्वारा हरियाणा और झारखंड में जारी करने के लिए पहचान की गई ।
- आई.ई.टी. 22836 (आर.पी. 5208-3- आई.आर. 87707 -445-बी- बी - बी) को सूखा सहिष्णु प्रविष्टि के रूप में पहचान की गई जिसमे दो उपज क्यू.टी.एल. पाये गए। इस प्रविष्टि ने मध्यम सूखा तनाव अवस्था में आई.आर.64 से 30-69% अधिक उपज दर्ज की और इसे मध्य प्रदेश, छत्तीसगढ़ और तमिलनाडु जैसे राज्यों में जारी करने के लिए पहचान की गई।
- पाँच अधिक उपज देने वाली किस्मों के साथ अट्ठाईस नए चावल लाइनों यथा जया, एन.डी.आर. 359, स्वर्णा, आई.आर. 64 और धनराशी का स्टेशन परीक्षण में मूल्यांकन किया गया। 0910022-23, 0910022-3, 0910024-8, 0910021-23, 0910023-2, 0910023-3, 0910022-56 और 0910022-24 की उपज उच्चतम उपज के बनिस्पत काफी बेहतर पाये गए, और धनराशि और स्वर्ण के ऊपर 15-22% अधिक उपज दर्ज की।
- आण्विक जीव विज्ञान तकनीक के माध्यम और जीन और क्यू.टी.एल. एकीकरण बी.पी.टी. 5204 में हो ताकि सुधार लाये जाएँ जलमग्नता के विरुध (*sub1*), सूखा सहिष्णुता (qDTY2.1+ qDTY3.1), बी.एल.बी. के लिए प्रतिरोध (*Xa21 + xa13*), ब्लास्ट (*Pi54 + Pi2*) और बी.पी. एच (*Bph20 + Bph21*) के विरुध पाया गया।
- आर.एन.आर. 2809/तेल्ला हम्सा से विकसित उत्कृष्ट किस्म आई.वी.टी. बोरो में 2013-14 के दौरान परीक्षण किया गया।
- कम स्फुर की मात्रा के लिए सहिष्णु जीनोटाइप निम्न हैं जी.एस.आर. 330, जी.एस.आर. 323, एस.एम. 686, जी.एस.आर. 111, एस.एम. 363, जी.एस.आर. 333, जी.एस.आर. 336, के.आर.एच.2, एन.डी.आर. 359, आर.टी.एस. 14, बी.जे.1, ई.एम.ए.टी.ए. ए. 16-34, मुदगो, योदान्या, आई.आर. 64-21, आई.आर.-74 पी.यू. पी.1-ए., आई.आर.-74 पी.यू.पी.1-बी., आई.आर.-74 पी.यू.पी.1-सी., आई.आर.-74 पी.यू.पी.1-ई., आई.आर. -64- पी.यू.पी.1-एफ.।
- आई.ई.टी.22729 (आर.पी. 5311-पी.आर. 26703-3बी-पी.जे.7) एरोबिक स्थिति में सभी चेकों यथा आई.आर. 64 (एन.सी.), एम.ए.एस. 946 (आर.सी.) और लोकल चेकों पर बेहतर प्रदर्शन कर उपज श्रेष्ठता दर्ज किया गया।
- सात देशी जातियों यथा गमधान, वाजूहो फेक, मेघालया लेफेरा, चंग चकाओं, कुंडा, गोनोलशा और शथारिया महा में पादप-गृह परीक्षण के दौरान शीथ ब्लाईट के विरुध सहिष्णुता पायी गई।
- आई.ई.टी. 22787 (आर.पी. 4594-121-148-24-11) पारंपरिक बासमती प्रदेशों जैसे पश्चिमी उत्तर प्रदेश और पंजाब के उत्पादक क्षेत्रों में उत्कृष्ट पायी गई। इसने पूसा बासमति 1, पूसा बासमति 1121 और तरोरी बासमति के ऊपर 15%, 38% और 67% अधिक उपज दर्ज की और गुणवत्ता तरोरी बासमति के जैसी ही है। यह 102 दिनों की फूलने की अवधि के साथ के कद (115 सेमी) है और जी.एम. बायोटाईप 4, नेक ब्लास्ट और ब्राउन स्पॉट के विरुध माध्यम प्रतिरोध रखती हैं।
- पावर कोरे सॉफ्टवेर की मदद से 78 खुशबूदार लाइंस का एक कोर सेट पहली बार विकसित की गई जो 73 मार्केर्स के बाइनरी डेटा का 12 क्रोमोसोमस पर उपयोग कर पहली बार विकसित किया गया।
- आर.पी. 4691-326-1-1-2-2-1-1-1, आर.पी. 4700-35-1-2-2-1-1-1-1 3 जीन्स के साथ (*Xa21, xa13, xa5*); आर.पी.4700-30-1-1-3-1-1-1-1, आर.पी. 4693-35-2-1-1-1-1, आर.पी.4693 40-2-2-2-1-1 2 जीन्स के साथ (*Xa 21, xa5*) और आर.पी.4700-41-2-2-4-1-1, आर.पी. 4700-42-2-1-1-1-1, आर.पी. 4693-44-5-2-2-2-2-1-1 2 जीन्स के साथ (*Xa21, xa13*) का परीक्षण किया गया।
- आई.ई.टी. 23830, आई.ई.टी. 23831, आई.ई.टी. 23832 कई स्थानों में उच्च जस्ता और उच्च उपज के साथ उत्कृष्ट पाए गए।

- एक नए उत्पाद राइस रिची क्रीम का विकास किया गया जो "सूखे और टूटी एड़ी और बहुत शुष्क और निर्जलित त्वचा के लिए बहुउपयोगी पाया गया।
- चावल आधारित फ़ेस क्रीम जो की चावल की भूसी का तेल और चावल के आटे की सामग्री के साथ मिलाकर विकसित किया गया है, त्वचा के लिए काफी उपयोगी सिद्ध हुआ है।

संकर चावल

- छः सौ पच्चीस प्रविष्टियों, स्रोत नर्सरी में उगाए गए और 270 क्रॉसिंग की गयी। इस मूल्यांकन में 60 रेस्टोरेर्स, 40 मेंटेनर्स और 20 उत्कृष्ट संयोजक की पहचान की गई।
- स्टेशन परीक्षण में 26 संकर संयोजकों का मूल्यांकन किया गया और 8 यथा आई.आर.79156ए/बी.के. 49-78, आई.आर. 58025 ए/बी.के. 64-116, आई.आर. 79156 ए/बी.के.49-43, आई.आर. 58025 ए/बी.के. 49-43, आई.आर. 58025 ए/बी.के. 39-179, ए.पी.एम.एस.-6 ए/बी.के. 49-77, आई.आर. 58025 ए/बी.के. 49-77, आई.आर. 79156ए/के.सी.डी.-1 कों उत्कृष्ट पाया गया।
- 26 उत्कृष्ट जनन द्रव्यों की पहचान उपलब्ध प्रजनन सामग्री से की गयी।
- 5 नए संकर यथा डी.आर.आर.एच.-88, डी.आर. आर.एच.-89, डी.आर.आर.एच.-90, डी.आर.आर.एच. -91 और डी.आर.आर.एच.-92 कों अखिल भारतीय समन्वित चावल सुधार कार्यक्रम परिक्षण के लिए नामित किया गया और 2 संकर जैसे डी.आर.आर.एच.-85 और डी.आर.आर.एच.-92 कों अग्रिम परिक्षण के लिए नामित किया गया।
- नई संकर संयोजको का एरोबिक स्थितियों के लिए पहचान की गयी (आई.आर. 58025ए / 3005; आई.आर. 58025ए / एल 2182) और उनको आई.वी.टी. एरोबिक 2013 परिक्षण के लिए पहचान की गयी। इसी तरह से 1 संकर आई.आर.79156ए/363-5 को सी.एस.टी.वी.टी. परिक्षण के लिए नामित किया गया।
- पचास डी.आर.आर. किस्मों की उर्वरता रेस्टोरेर्स जीन *Rf4* और *Rf3* उपस्थिति के लिए जांच की गई।
- 1600 सेलेक्शन का विकास अजैव तनाव के विरुध के लिए किए गए और उनके रेस्टोरेर्स और मेंटेनर्स अब एफ.3 पीढ़ी चरण में और एफ.4 पीढ़ी चरण में हैं।
- डी.आर.आर.एच.-2 के नाभिक बीज के पैतृक लाइनों यथा, आई.आर. 68897ए (100 कि.ग्रा.), आई.आर.68897बी. (150 कि.ग्रा.), डी.आर. 714-1-2 आर. (100 कि.ग्रा.), डी.आर.आर.एच.-3 जैसे कि ए.पी.एम.एस.-6ए (70 कि.ग्रा.), ए.पी.एम.एस.-6बी. (100 कि.ग्रा.) एवं आर.पी. एच.आर.-1005 (125 कि.ग्रा.) का उत्पादन किया गया।

जैव प्रौद्योगिकि

- आठ बी.टी. ट्रांसजेनिक चावल लाइनों की पहचान आई.आर. 64 से जिसमे क्राय 1 ए.सी. (*Cry1Ac*) जीन्स हैं येल्लो स्टेम बोरेर प्रतिरोध के लिए की गयी।
- पानी तनाव स्क्रीनिंग के आधार पर समयुग्मक सूखा सहिष्णु (डी.टी) ट्रांसजेनिक चावल लाइनों बी.पी.टी. 5204 की पहचान की गई।
- उपज घटकों के लिए आठ क्लोन जीनों में से यथा अनाज संख्या (जी.एच.डी.7, जी.एच.डी.8 और साईटोकिनिन ऑक्सीडेज (Cytokinin oxidase); अनाज उपज (Dep1 और Dep3); सीधे विकास, अनाज संख्या, अनाज उपज पी.आर.ओ.जी. (PROG1); आदर्श पौधा स्थापत्य और उपज (OsSPL14) के लिए मार्कर्स जी.एच.डी.8, OsSPL14 और पी.आर.ओ.जी.1 (PROG1) जीन्स के साथ इंडिका, ट्रॉपिकल जपोनिका और ओराईज़ा ग्लाबेरिमा में जुड़ा होना पाया गया है डबल्यू.ए –सी.एम.एस.लाइंस में तीन के एक सेट और 17 रेस्टोरेर्स की क्रॉसेसिंग एल. x टी. से की गयी और संकर विकसित की गयी।
- फेनोटिपिंग और आण्विक लक्षण वर्णन चावल ट्रांसजेनिक लाइनों की आर.एन.ए.आई. तकनीक से की गयी।
- गोलाकार चावल टुंग्रों वायरस की एक दक्षिण भारतीय आइसोलेट्स का पूरा जीनोम की पहचान की गयी और एन.सी.बी.आई. डेटाबेस में जमा किया गया (एक्सेशन संख्या: के.सी.794785)।

फसल उत्पादन

सस्य विज्ञान

- श्री विधि उपयोगी पायी गयी जिससे की कार्बनिक और अकार्बनिक पोषक तत्व प्रबंधन के द्वारा उच्च कृषि दक्षता दर्ज की गयी। एस.आर.आई. पर ई पाठ्यक्रम विकसित किया गया।
- संतृप्ति विधि द्वारा पानी की बचत मात्रा 260 एम.एम./हे. (32% जल का) है।
- 75% सिफारिश नाइट्रोजन (120 किग्रा / हेक्टेयर) और पोटेशियम की 50% की सिफारिश की खुराक के शीर्ष ड्रेसिंग के अनुप्रयोग से प्रत्यक्ष चावल उत्पादन विधि में पुष्पगुच्छ काल में पौधों का गिरना कम हो गया है।

- देरी से बुवाई (सितम्बर), गीला चावल की खेती प्रतिरोपित चावल से आशाजनक साबित होता है।
- वायुजीवी धान के लिए 100-125% नत्रजन का प्रयोग + आविर्भाव के पूर्व शाकनाशी का प्रयोग + धान ढैंचा (1:1) + बुआई के 60 दिनों को बाद हाथ से निराई या बुआई के 25-30 दिनों के बाद 2,4 डी-एन.ए. का प्रयोग आशाजनक पाया गया।
- वायुजीवी धान में नत्रजन का प्रयोग 3 बराबर भागो में अगर 10-12 दिन उद्भव के बाद, अधिकतम बाली निकालने के समय और पुष्पगुच्छ चरण में की जाए तथा एक सप्ताह बाद फेर्रस सल्फ़ेट की छिड़काव @ 1.5% करने से नत्रजन दक्षता बढ़ती है।
- गीली चावल की खेती में ब्राउन खाद (डैंचा का समावेश) द्वारा खरपतवार की गिनती और घास बायोमास की मात्रा कम हो जाता है।

मृदा विज्ञान

- नाइट्रोजन की कई उपयोग दक्षता के आधार पर , जीनोटाइप को निम्न तरीके से बांटा गया है – रासि, विकास और वंदना (शीघ्र समूह), डी.आर.आर.एच. 82 & डी.आर.आर. धान 39 (मध्यम अवधि) और धनराशि, मांड्या विजय एवं स्वर्णा (लंबी अवधि) खरीफ और रबी के मौसम में दोनों आशाजनक साबित हुये है।
- नाइट्रीकरण निषेधक के आवेदन से जैसे की नीम कोटेड यूरिया और डाइसिनामएड़े ने धान के खेत से नत्रजन ऑक्साईड (N_2O) उत्सर्जन यूरिया की तुलना में काफी कम कर दिया है। कुल N_2O–N उत्सर्जन (नीम कोटेड यूरिया और डाइसिनामएड़े) 0.05% के सीमा में पाये गए और 0.06% (अकेले यूरिया) के बनिस्पत। सबसे ऊँचा दर N_2O–N उत्सर्जन का (41%) निषेदक में तब पाये गयी जब यूरिया और डाइसिनामएड़े का प्रयोग किया गया।
- एक नये तकनीक के जाँच में यह पाया गया की मुर्गी खाद और वरमी खाद जिसे 10% और 20% नत्रजन और स्फुर से संबर्धन की गयी और धान की खेती में काफी उत्साहजनक पाये गयी जिससे की 30% उपज उत्पादन का लाभ और नाइट्रोजन और स्पूर की कई उपयोग दक्षता में वृद्धि हुई है।
- मृदा जाँच कीट का विकास और अलग मिट्टी और स्थितियों के लिए इसके प्रयोग किया गया। एक द्विभाषी मृदा जाँच कार्ड का निर्माण और किसानो के बीच में वितरण किया गया।
- सीरशिया मरसेसेनसे बैक्टीरिया जो की चावल की रिज़ोस्फेरे से अलग की गयी है उसमे कई लाभकारी लक्षण पाया गया है। यह विशेषकर मिट्टी पोषक तत्वों को जुटाना और जैव नियंत्रण में लाभदायक है।

पादप क्रिया विज्ञान

- प्रकाश प्रेरित श्वसन (LIR) 1.64 µ mol. min^{-1} से 0.737 µ mol. min^{-1} के बीच में पायी गयी। जंगली प्रजाति ओ. लॉंगीस्टेमिनेटा और ओ. रूफिपोगॉन में यह संकर प्रजाति के बनिस्पत ज्यादा पायी गयी।
- 115 प्रविष्टियों (43 लोकप्रिय किस्मों, विविध चावल जीनोटाइप, ट्रोपीकल जपोनिका (2), जंगली चावल अंर्तगमन लाइनों,(2), 20 ग्रीन सुपर राइस और 52 स्वर्णा x ओरायजा निवारा अंतर्गमन लाइनों खेतों में पत्ती संश्लेषक लक्षण में बदलाव के लिए मूल्यांकन किया गया। पत्ती संश्लेषक लक्षण (Pn) में खाफी विभिन्नता पायी गयी: 9.07 (78-के.) से 21.54 (3-1के.) तक और औसतन 14.08 20µmol (CO_2) $m^{-2}s^{-1}$): विविध चावल जीनोटाइप: 14.3 (ललाट) से 27.3 µmol (CO_2) $m^{-2}s^{-1}$ तक और औसतन 20.2) और ग्रीन सुपर राइस: 21.28 (जी.एस.आर.112) से 26.6 (जी.एस.आर.125) तक और औसतन 24.05 µmol (CO_2)$m^{-2}s^{-1}$. जी.एस.आर.125, जी.एस.आर.122 और जी.एस.आर.138 प्रविष्टियों में पत्ती संश्लेषक लक्षण पी.एन. >26 µmol (CO_2)$m^{-2}s^{-1}$. पाये गए।

फसल सुरक्षा

कीट विज्ञान

- 7 प्रविष्टियों में, आई.ई.टी. 22989, आई.ई.टी. 23894, आई.ई.टी. 21944, आई.ई.टी. 23705, आई.सी. संख्या. 578151, वी.पी.बी. 231 एवं वी.पी.बी. 232 दोनों फुदका कीट प्रतिरोधी थे।
- दोनों फुदका कीट की प्रतिस्पर्धी क्षमता पर ग्रीन हाउस अध्ययन में पाया गया की जब दोनों को साथ में जारी की गयी तब भूरा फुदका की उर्वरता कम हो गयी।
- दो नए जर्मप्लाज्म नामकरण यथा आई.सी.462402 और आई.सी. 577036 गालमिड्ज बायो टाइप-1 के लिए प्रतिरोधी के रूप में पहचान की गई ।
- वास्तविक समय सत्यापन अध्ययन से पुष्टि हुई कि एन.बी. एस.-एल.आर.आर. जो *Gm4* अभया में और प्रोलिने रिच

प्रोटीन 3 *Gm8* अगहनि में कंडीडटेस जीन्स के रूप में विद्यमान हैं।

- इक बूंद, एक गीला एजेंट का कीटनाशकों की प्रभावकारिता पर और उनके प्रभाव पर फील्ड परीक्षण में पाया गया की तना छेदक हानि काफी कम थे रेनाक्सीपायर में और एक बूंद के साथ संयोजन में आसिफट उपचार बनिस्पत की जब उन्हे अकेले में उपयोग की गयी हो।
- चार वाणिज्यिक योगों और दो बोटानिकल्स अर्क का खेत की स्थिति के तहत मूल्यांकन किया गया जिसमे मल्टीनीम 300 ppm, नीम बन 300 ppm को काफी उपयोगी पायी गयी स्टेम बोरर और पत्ता मोड़क कीटों पर।
- पर्यावरण इंजीनियरिंग फूल वाले पौधों के साथ में पाया गया की मेड़ पर एक सीमा के रूप में गेंदे के रोपण से ओलिगोसिटा (Oligosita) सपा द्वारा हॉपर अंडे की परजीवी बढ़ जाती है।
- आई.आई.सी.टी., हैदराबाद और सी.पी.सी.आर.आई. कासरगोड के साथ आध्यन में, गुलाबी स्टेम बोरर का सेक्स फेरोमोन के घटक की पहचान सेसामिया इनफरेंस (Sesamia inferens) की अंक असीटेट अणु के रूप में पहचान की गयी है।
- धान मूलगांठ गोलकृमि एम. ग्रामिनिकोला की संख्या असंतृप्त अवस्था में ज्यादा पायी गयी बनिस्पत की संतृप्त अवस्था में, यह दोनों (40-45^{0}C) तापमान परिवेश में देखी गयी।
- मिट्टी निमेटोड आबादी के विश्लेषण से पता चलता है की परजीवी नेमाटोड की संख्या एसआरआई भूखंडों में कम था।

पौध रोग विज्ञान

- 6962 प्रविष्टियों में, जिनमे निल्स,रिल्स भिन्नता, प्रजनन सामग्री, अंर्तगमन लाइनों और आई.आर.बी.एन. प्रविष्टियों शामिल हैं, 803 प्रविष्टियों में झोंका के प्रति प्रतिरोधिता है। नौ अंर्तगमन लाइनों यथा पी.ए.यू. # 547, 549, 550, 695, 747, 848, 1061, 1077 और 1195 Xoo इसोलाटेस के खिलाफ व्यापक प्रतिरोध पाया गया है।
- छः बैकक्रास जन्मजात लाइनों (बिल) का परीक्षण 120 में से यथा, बी.आई.एल. (BILs) # 4बी., 5बी., 6बी., 24बी., 25बी. और 84बी. राइस टुंगरों वाइरस के खिलाफ प्रतिरोधिता दर्शायी।
- नश्तरिकरन की कई विधियों की जाँच में, सुई नश्तरिकरन जब बूटिंग चरण हो और फिर सापेक्ष आर्द्रता 80-90% तथा 24^{0}C पर पौधों को सात दिन तक रखने से स्मट बाल्स का निर्माण होता है।
- कई बार के स्क्रीनिंग पर यह पाया गया की, 2 मुटाण्ट प्रविष्टि, 14 अंर्तगमन लाइनों , 2 संब्रहन्त लाइंस, 1 बी. लाइन और 7 ट्रोपिकल जपोनिका शीथ ब्लाईट पर बडा प्रभावी पाया गया।
- 260 Xoo इसोलाटेस के फेनो टिपिंग को भारत के विभिन्न चावल उत्पादक क्षेत्रों से एकत्र की है और 22 पेथोटाइप्स में उन्हें वर्गीकृत. किया।
- आर.टी.वी. के प्रभाव प्रतिरोधी किस्म विक्रमार्या और टी.के.एम. 6, मामूली प्रतिरोधी किस्म आई.आर. 20 और आई.आर. 67406-6-3-2-3 के पौधे की ऊंचाई पर प्रमुख नहीं था टी.एन.1 जैसे अतिसंवेदनशील किस्मों की तुलना में।
- आंध्र प्रदेश के नलगोंडा जिले में सर्वेक्षण से पाया गया की फाल्स स्मट चावल किस्म बी.पी.टी. 5204 प्रभावित क्षेत्र में गंभीर रूप से प्रभावित था।

प्रौद्योगिकि हस्तांतरण

- तमिलनाडु के चयनित गांवों में धान की खेती में लिंग आधारित भागीदारी में पायी गयी की , पुरुष कृषक भूमि की तैयारी, सिंचाई प्रबंधन और विपणन में भाग लेते हैं और महिला कृषक रोपाई, निराई और कटाई में शामिल थे। बिहार में महिलाओं ने ज्यादातर निराई और कटाई में शामिल थे. सामान्य रोपाई (58%) की तुलना में श्री पद्धति को अत्यधिक कुशल और कठिन परिश्रम वाला (73%) खेती माना गया।
- स्थिर खेती अध्ययन बिहार के सहरसा जिले के पारंपरिक बोरो चावल उगाने वाले क्षेत्रों में किए गए। इससे पता चला की खेती में बड़ी बाधा फसल नर्सरी स्तर में ठंड के चोट से नुकसान देखा गया और फूल चरण में गर्म मौसम थी।
- 120 चावल किसानो से आँकड़े लेकर उपज भिन्नता अध्ययन बिहार के मुजफ्फरपुर, समस्तीपुर और बेगूसराई जिलों में की गयी। उपज भिन्नता 27% मापी गयी। बीज उपलब्ध न होना एक बड़ी समस्या मानी गयी। स्टेम बोरर की समस्या आम देखी गयी। चूहों का प्रकोप देखा गया। ज़िंक की कमी और बैक्टेरियल ब्लाईट की कठिनाई महसूस की गयी। तमिल नाडु चावल किसानो से आँकड़े लेकर उपज भिन्नता अध्ययन कोयंबतूर और इरोड जिलों में की गयी। उपज भिन्नता 19% मापी गयी। मजदूर की कमी

और स्टेम बोरर की समस्या, ज़िंक की कमी और बैक्टेरियल ब्लाईट की कठिनाई महसूस की गयी।

- ✧ वर्ष 2013-14 के लिए, आर.के.एम.पी. में प्रमुख ध्यान केंद्रित जागरूकता की गतिविधियों पर था। इन गतिविधियों के साथ साथ, विभिन्न आवश्यकता के आधार पर अतिरिक्त सुविधाओं पोर्टल के लिए जोड़ा गया था।
- ✧ 2013-14 में, चार प्रशिक्षण कार्यक्रम की योजना बनाई, संगठित और चावल के उत्पादन प्रौद्योगिकी के विभिन्न पहलुओं पर मूल्यांकन किया गया. 70 व्यक्तियों ने इन प्रशिक्षणों के माध्यम से प्रशिक्षित किया गया ।
- ✧ देश के 15 राज्यों और पाँच धान पारिस्थितिकियों को सम्मिलित करते हुए विभिन्न धान उत्पादन प्रौद्योकियों को मूल्यांकित करने और प्रदर्शित करने के लिए 485 एफ.एल. डी. का आयोजन किया गया।
- ✧ जनजातीय उपयोजना गतिविधियों आंध्र प्रदेश के महबूब नगर जिले में अमर्बाद और रेगडी मंडल में और नलगोंडा जिले के कोरा ठंडा मंडल के आदिवासी गांवों की आजीविका बढ़ाने के लिए किए गए।
- ✧ आंध्रा प्रदेश के कृषि विज्ञान केन्द्र गड्डीपल्ली, उंडी, कल्वाचेर्ला, बनगनपल्ली, गुंटुर, विजयवाडा में बेहतर सांबा महसूरी के बीज को भेजा गया।
- ✧ चावल अनुसंधान निदेशलाय ने कुल मिलाकर पांच कृषि मेलों और प्रदर्शनियों में भाग लिया और 2013 में एक किसान दिवस का आयोजन किया।

हिन्दी गतिविधियाँ

- ✧ तिमाही बैठकों का आयोजन: हिन्दी में कार्यकलापों का जायजा लेने के लिए विगत वर्ष में तीन बैठकों का आयोजन किया गया जिसकी अध्यक्षता परियोजना निदेशक महोदय ने किया। इन बैठकों में चावल अनुसंधान निदेशालय की राजभाषा कार्यान्वयन समिति के सभी सदस्य सम्मिलित हुए।
- ✧ हिन्दी कार्यशालाओं का आयोजन: निदेशालय के कर्मचारियों में हिन्दी के ज्यादा से ज्यादा उपयोग करने के लिए हिन्दी कार्यशालाओं का आयोजन किया गया।
- ✧ डी आर आर समाचार का हिन्दी में प्रकाशन : निदेशालय के समाचार पत्रों का हिन्दी अंक प्रकाशित किया गया ।
- ✧ हिन्दी सप्ताह का आयोजन: चावल अनुसंधान निदेशालय में हिन्दी सप्ताह का आयोजन 14 से 21 सितंबर, 2013 तक हुआ। चावल अनुसंधान निदेशालय के सभी वैज्ञानिक,अधिकारी और कर्मचारियों ने कार्यक्रम के दौरान सभी प्रतियोगिताओं में भाग लिया । निदेशालय के 27 से भी ज्यादा वैज्ञानिक, अधिकारी और कर्मचारियों ने पुरस्कार प्राप्त किए हैं।
- ✧ आर एम महेंद्र कुमार ने पर्णहरित पटल (लीफ़ कलर चार्ट) को हिन्दी में मुद्रित करके किसानो के लिए जारी किया है और यह प्रयास से किसानो को उनकी भाषा में यूरिया के उपयोग ज्ञान को आसान करने का एक परिवर्तनात्महक प्रयास है ।

All India Coordinated Rice Improvement Programme (AICRIP)

Eight hybrids and 15 varieties were released during 2013. Central Sub Committee on Crop Standards, Notification and Release of Varieties (CSCCSN &RV) released 7 hybrids and 8 varieties which include 27P52, 27P 63, KPH-199, KPH 371, US 305, US314, VNR 2375 Plus (hybrids), CR Dhan 201, CR Dhan 202, CR Dhan 304, CR Dhan 305, CR Dhan 407, CR Dhan 505 and Pusa Basmati 1509 (varieties) and Pusa 6. State release committees released 1 hybrid, ARRH 7434 in Chhattisgarh and 7 varieties *viz*., GAR 1 in Gujarat, Palam Lal Dhan 1 in Himachal Pradesh, Birsa Vikas Dhan 11A, Birsa Vikas Dhan 203, Birsa Vikas Sugandh 1 in Jharkhand, PDKV Kisan in Maharashtra and TPS 5 in Tamil Nadu.

Crop Improvement

- Forty varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted involving 1116 entries and 799 experiments at 120 locations (46 funded and 74 voluntary centres) in 27 states and 2 Union territories covering all the 5 regions of the country. Twenty nine promising cultures including two hybrids from 16 Centres were identified.
- Twenty eight promising lines were identified.
- Twelve INGER nurseries comprising of 572 elite lines were conducted at 100 centres and 58 promising lines were identified.
- Five hybrid rice trials including one Multilocation trial were conducted in 37 different locations across the country involving 116 test hybrids. 19 hybrids have been identified as promising.
- Twenty six basmati, 42 aromatic short grain elite test lines in AICRIP were evaluated for 15 physico-chemical characters. Among these, slender grain varieties are grouped into long slender (32), medium slender (20) and short slender (3). Thirty eight entries recorded high head rice while 15 exhibited moderate head rice. Desirable and intermediate amylose content recorded in 54 entries. Twenty three lines possess medium gel consistency while 28 showed soft gel consistency.
- Three hundred sixty three non-basmati elite cultures in 23 advance trials in AICRIP were assessed for 14 physico-chemical characters. Of these, 127 are long slender, 65 are medium slender and the remaining entries are short or long bold. As many as 250 entries recorded high (>60%) while 85 entries showed moderate (51-59%) HRR. Promising entries identified for desirable and intermediate AC and medium to soft gel consistency include 269 and 218 respectively.
- Breeder seed production of rice varieties and parental lines of hybrids as per the DAC indents was organized at 38 centres across the country, involving 220 varieties and parental lines of 12 rice hybrids. A total of 555 tonnes of breeder seed was produced against a target of 474 tonnes.

Agronomy

- Evaluation of 54 elite genotypes for their response to nitrogen led to the identification of 31 cultures belonging to 14 different groups based on the Grain Yield Efficiency Index values.
- Rainfed rice yields can be increased with integration of organic manures (5 t FYM/2 t vermicompost) with 75% recommended dose of fertilizers (RDF) or 20 kg S with RDF and intercropping of rice with Uradbean/ Soybean in 4:2 ratio.
- In aerobic rice situation, optimum date of sowing for higher yield varied with location from 1st fortnight of June to 26th June. Among the varieties and hybrids tested, MTU 1001, MTU 1010, DRRH 3, PA 837, PA 6129, Dandi, Parag, Avish, Prabhava, PA 6444, Arize Tej and HPR 2143 are promising. The hybrids outyielded the varieties at all the locations.
- Integrated Weed management in aerobic rice was possible with Pendimethalin @ 1 kg a.i./

ha or Butachlor @ 1.5 kg a.i/ha at 3-4 DAS with Bispyribac Sodium 35 g at 15-20 DAS or Chlorimuron + Metsulfuron methyl 40 g a.i./ha at 25-30 DAS which reduced weed menace and thus helped in realizing higher grain yields in aerobic situation.

- ✧ SRI method recorded higher grain yield (16%) over direct seeded rice with SRI principles (DSRI). Slightly modified SRI and DSRI proved as productive as manual transplanted rice and reduced drudgery and transplanting costs significantly.
- ✧ Weed management trials in transplanted rice indicated that the application of combination herbicides, flucetosulfuron @ 25 g a.i/ha followed by Bispyribac sodium @ 20 or 25 g a.i/ha was effective. For direct seeded rice, flucetosulfuron @ 20 or 25 g a.i./ha or sequential application of flucetosulfuron @ 20 or 25 g a.i./ha followed by Bispyribac sodium @ 25 g a.i/ha was found effective depending on the weed intensity, emergence, soil type and duration of the variety.
- ✧ In rice-based systems, soil application of organic manure + NPK + micronutrients recorded higher grain yields as compared to NPK alone suggesting judicious application of organic manures.

Soil Science

- ✧ 25 years of study on "Long term soil fertility management in RBCS", indicated the consistent superiority of conjunctive use of 100% RDF + 5t FYM/ha compared to inorganic fertilizers alone. Linear trends of rice productivity over 25 years indicated near stable to slightly negative growth rate at Maruteru; improved growth at Titabar and a negative growth rate at Mandya with current RDF and a positive growth of about 100 kg/ha/year at all locations with a supplementary dose of 5 t FYM along with RDF.
- ✧ On the basis of realistic assessment of soil fertility and its variability for realizing site specific yield targets, rice productivity with recommended fertilizer practice was higher at Titabar (4.4 –5.6 t/ha) and Mandya (2.94 – 6.81 t/ha) compared to farmers' fertilizer practices. Validation of previous year's SSNM recommendations increased the yields over farmers' fertilizer practices and indicating the importance of location and site specific input management for sustaining soil and crop productivity.
- ✧ Gypsum application increased grain yields by 11.3% while organic fertilization in combination with recommended fertilizers (macronutrient and micronutrient) increased grain yields by 19.6% over control in sodic soils of Kanpur. In acid soils of Ranchi, supplementation of NPK and micronutrients along with organic manure like FYM resulted in marginal increase in rice yields.
- ✧ Screening of about 160 cultures including 21 common entries at 10 locations revealed strong interaction effects of genotypes and locations for both Fe and Zn content. Cultures Aghonibora and Vasumati were found consistently promising for accumulation of both Fe and Zn at different locations.
- ✧ Productivity of water ranged from 2.0-3.0 and 0.9-1.6 kg grain/ha mm water at Kanpur and Mandya, respectively. Irrigation equivalent to 75% of CPE appeared to be optimum for aerobic rice system saving about 26% irrigation water at Kanpur and 30% at Mandya over 150% CPE.
- ✧ To assess rice productivity and nutrient use efficiency due to changing crop calendar, higher productivity was recorded with early planting while delayed planting resulted in yield reduction by about 13-40% at all the centres.
- ✧ Evaluation of genotypes for tolerance to soil acidity revealed location and genotype specific response to liming and fertilizer regimes. IET 22218 (NP218), Varadhan and 27P-63 at Moncompu; Jarava, RP-Bio-226 and Dhanrasi at Ranchi; Prafulla, Aghonibora and SS-3 at Titabar were identified as promising cultures.
- ✧ Combined use of organics, micronutrients and cytokinin recorded maximum Zn and

Fe concentration and uptake in both grain and straw. The major portion of the absorbed micronutrients remained in straw with only 26-46% being translocated to grain.

✧ Transplanted rice recorded maximum rice productivity at Jagtial showing its superiority over direct seeded rice and aerobic rice by 68 and 180%, respectively whereas, at Mandya, transplanted and direct seeded rice were at par and superior to aerobic rice by 52 and 21%, respectively.

Plant Physiology

✧ 20 rice cultures were evaluated for photothermic indexing and Radiation Use Efficiency under early and normal sown situations at 9 locations. IET 20924, DRRH-3, IET 22580, IET 22569, IET 22218 and NS-5 had requisite regimes of cumulative nycto period and cumulative degree days with superior RUE.

✧ Hybrids need higher dose of silicon as compared to the varieties is evident from the internal leaf silicilic acid content. Application of silicon solubilizers at Cuttack, Titabar (sandy or silty clay soils), Pattambi (sandy loam soil) and Coimbatore (clay soil) was found to improve general crop health.

✧ Grain yield, Dry matter heat susceptibility index, Grain weight heat susceptibility index and spikelet sterility reductions were lower in Sasyasree, IET 22116 and IET 21404 cultures under heat stress (>7°C) at Pattambi centre.

✧ 10 rice cultures evaluated for seedling response to multiple abiotic stresses revealed severe root growth inhibition under anaerobic stress. The severity of the stress were in the following order from severe inhibition of germination, root and shoot lengths and seed vigour for Anaerobic, Cold, NaCl and water stresses respectively.

Entomology

✧ Pest surveys across the country reported localized damage by hispa, case worm, leaffolder, brown planthopper, stem borer and swarming caterpillar.

✧ During *kharif* 2013, 1765 entries were evaluated against 14 insect pests in 210 valid tests (52 greenhouse reactions +158 field reactions) at 41 locations. 64 entries were identified as promising against major insect pests of which five entries were under retesting.

✧ PTB 33 and RP 2068-18-3-5 were promising against BPH in all the seven greenhouse tests.

✧ Resistance conferred by *Gm1*, *Gm8* and *gm3* genes was effective against most of the gall midge populations.

✧ The impact of Ek boond, a non ionic wetting agent was evident only in case of acephate treatment against white- backed planthopper and green leafhopper. Dinotefuran with Ek boond yielded the highest and was on par with rynaxypyr with and without Ek boond.

✧ No adverse effect on the efficacy of either the combination product of flubendamide plus buprofezin or sutathion when applied with either hexaconazole or tricyclazole or *vice versa* was observed, confirming the compatibility of the tested insecticides and fungicides when used as tank mix in the field.

✧ Significantly low dead heart damage and BPH incidence and high leaffolder damage was observed in direct seeded rice as compared to normal transplanted rice. Drum seeding treatment had lower BPH population as compared to other methods of planting. Early planting of rice had more white ear damage and late planting had more number of gundhi bug.

✧ Five stem borer species were reported across the country with yellow stem borer (YSB) as the dominant species. The natural egg mass parasitisation of YSB ranged from 20.83 to 100% while the egg parasitisation varied from 9.13 to 100 %. A mixed population of BPH and WBPH was observed at all the locations.

✧ Adoption of various interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering plants on bunds as components of Ecological engineering for planthopper

management increased the natural enemy populations and hopper egg parasitisation.

- A significant negative correlation between grain yield and white ear damage was observed.
- Integrated Pest Management conducted in a farmer participatory mode reduced the insect pest incidence, area under disease progress curve of major diseases and weed biomass with higher grain yields as compared to farmers practice.
- Population monitoring of major insect pests through light trap catches recorded yellow stem borer, brown planthopper, gall midge and GLH as the main insects.

Plant Pathology

- All India coordinated Plant Pathology trials consisted of 15 trials on host plant resistance against major rice diseases, monitoring of field virulences of blast and bacterial blight pathogens, disease observation nursery and chemical control trials.
- Out of 1135 test entries evaluated from five different screening nurseries across India, the number of promising entries were 53 for leaf blast, 59 for neck blast, 62 for sheath blight, 41 for brown spot, 38 for sheath rot, 56 for bacterial blight and 35 for rice tungro virus.
- Out of 400 germplasm evaluated, the number of promising entries were 12 each for blast and rice tungro, 6 each for sheath blight and brown spot and 13 for bacterial blight.
- Monitoring of field virulences of blast and bacterial blight pathogen revealed that there was shift in virulence of blast pathogen in some of the locations like Upper Shillong, CRRI, Lonavala and Mugad and bacterial blight pathogen in Raipur, Maruteru, Chiplima and Kaul.
- The data of disease observation nursery revealed that early sowing increased sheath blight severity and delayed planting favoured leaf blast, neck blast, brown spot, sheath rot and bacterial leaf blight.
- Trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l was the best in reducing the disease severity of leaf blast, neck blast, node blast, brown spot, sheath rot, leaf scald and glume discoloration across the locations, while azoxystrobin 25 SC @ 1 ml/l was best in reducing the disease severity and incidence of sheath blight.
- Trifloxystrobin 25% + tebuconazole 50% @ 0.4g/l or propiconazole @ 1 ml/l either at 50% or 100% panicle emergence stage was most effective in reducing the false smut.
- The data on Integrated disease management trial revealed, cultivation of resistant variety alone or any other variety with need based fungicide spray significantly reduced fungal diseases. In case of bacterial blight, cultivation of resistant variety alone or any other variety with suitable fertilizer management strategy can reduce the disease intensity.
- The data on special IPM trial indicated that adoption of IPM practices reduced the progress of leaf blast, neck blast, sheath blight and bacterial leaf blight compared to farmers' practices.
- The trial on false smut screening revealed that in northern India (Kaul and Ludhiana) early sowing resulted in high disease incidence whereas at southern India (Maruteru), the disease incidence was more in late sown crop.
- Production oriented survey was conducted by 25 AICRIP centres. A total of 111 scientific staff and 53 officials from the different States Department of Agriculture surveyed 125 districts in 18 States. A large number of rice hybrids are being grown in different states like Maharashtra, Madhya Pradesh, Jharkhand, Uttar Pradesh, Haryana, parts of Gujarat and Himachal Pradesh. Some of the emerging diseases are bakanae and neck blast while BPH, sheath blight and false smut were wide spread.

Transfer of Technology

- In all, 485 FLDs of one ha each were demonstrated on various rice production technologies covering 15 states and five rice ecosystems across the country.

Lead Research

Crop Improvement

Plant Breeding

- IET 22598 (RP5213-69-13-3-4-1-2-B) with 11.38%, 16.81% and 11.61% yield advantage over Sahabagidhan, regional check and local check, respectively was identified for release in Haryana and Jharkhand by Varietal Identification Committee.
- IET 22836 (RP5208-3-IR87707-445-B-B-B) was identified as drought tolerant entry having 2 yield QTLs. This entry recorded 30-69% higher yield than IR64 under moderate drought stress and identified for release in the states of Madhya Pradesh, Chhattisgarh and Tamil Nadu.
- Twenty eight new designed rice lines along with five high yielding varieties *viz*. Jaya, NDR 359, Swarna, IR 64 and Dhanrasi were evaluated in station trial. 0910022-23, 0910022-3, 0910024-8, 0910021-23, 0910023-2, 0910023-3 0910022-56 and 0910022-24 yielded significantly superior to highest yielding checks with yield of 7.0 t/ha with yield advantage of 15-22% over Dhanrasi and Swarna.
- Effort are in progress to introgress genes and QTLs through MABB in improving BPT 5204 for submergence (sub1), drought tolerance (qDTY2.1+ qDTY3.1), resistance to BLB (*Xa21+xa13*), blast (*Pi54+Pi2*) and BPH (*Bph20+Bph21*).
- An elite culture developed from RNR 2809/ Tella Hamsa has been under test in IVT Boro 2013-14.
- RILs of TN1/Ptb33 and TN1/Sinnasivappu resistant against both hoppers during seedling stage in green house as well as reproductive stage in field of crop growth can be utilized as potential dual genetic stock for resistance to planthoppers.
- Tolerant genotypes to low P include GSR 330, GSR 323, SM 686, GSR 111, SM 363, GSR 333, GSR 336, KRH2, NDR 359, RTS 14, BJ1, EMATA A 16-34, Mudgo, Yodanya, IR-64-21, IR-74 PUP1-A, IR-74 PUP1-B, IR-74 PUP1-C, IR-74 PUP1-E, IR-64-PUP1-F.
- The NILs not only gave better yield under low P but also responded well to P application and recorded a mean grain yield increase of 148.6% followed by 123.5% in GSR & varieties and only 90.3% in donors at 60 kg/ha.
- IET 22729 (RP 5311 -PR 26703-3B-PJ7) tested under aerobic situation outperformed all the checks by registering yield superiority of 38.96%, 34.58% and 28.01% over IR 64 (NC), MAS 946 (RC) and local check on overall basis, respectively. It has high HRR-71.50% and intermediate ASV (5.0), amylose content (22.74%) and GC (43 mm). It is identified for release in Bihar and Karnataka by VIC.
- Seven land races *viz*., Gumdhan, Wazuho Phek, Meghalaya Lefara, Chng Chakhao, Kunda, Ngonolasha and Shitharia Maha recorded tolerance to sheath blight under repeated testing under glasshouse conditions.
- IET 22787 (RP 4594-121-148-24-11) was promising in the traditional basmati growing areas of Western Uttar Pradesh and Punjab. It recorded 15%, 38% and 67% yield superiority over Pusa Basmati 1, Pusa Basmati 1121 and Taroari Basmati respectively in region 3 with quality characters similar to Taroari Basmati. It has semi tall plant stature (115 cm) with 102 days flowering duration and consistently exhibited moderate resistance to GM biotype 4, neck blast and brown spot.
- A core set of 78 aromatic accessions was developed for the first time using the binary data of 73 markers from 12 chromosomes along with data of 15 important DUS characters with the help of power core software.
- The core set was analysed with BADEX7-5, the functional marker to score the presence of 8 bp deletion of betaine aldehyde dehydrogenase (*badh*) gene responsible for accumulation of

aroma compound, 2 acetyl-1 pyrroline (2AP). 19 accessions were without this deletion indicating the presence of novel alleles of *badh-2*.

- RP 4691-326-1-1-1-1-1-1-1, RP 4700-35-1-2-2-1-1-1 with 3 genes (*Xa21, xa13, xa5*); RP 4702-40-2-2-2-1-1 with 2 genes (*Xa 21, Xa5*) and RP 4693-44-5-2-2-2-2-1-1, RP 4693-101-2-1-1-1-1-1-1, RP 4703-41-2-2-5-1-1, RP 4703-42-2-1-1-1-1 with 2 genes (*Xa21, Xa13)* in Basmati 386 and Taroari Basmati background recorded high degree of resistance to BB pathogen along with good quality parameters.
- IET 23830, IET 23831, IET 23832 were found promising with high zinc and high yield across the locations. Five lines are identified for nomination to IVT- Bio-fortification during *Kharif* 2014.
- Iron and zinc values obtained with ICPAES are higher than that of XRF. Significant correlation was observed for zinc from lab to lab and machine to machine in both brown and polished rice. For iron significant correlation was observed among the 3 XRF machines while correlation was non- significant between XRF and ICPAES.
- One line with high zinc (>20 ppm) with short slender grains and >3.0 t/ha grain yield developed at DRR through conventional breeding is submitted for registration to NBPGR and another line with medium slender grains and >6.0 t/ha grain yield and >20 ppm zinc in polished grain with good quality is identified for nomination to bio-fortification trial.
- Twenty popular varieties with different amylose content were analysed for glycemic index content and of these Lalat and Samba Mahsuri recorded low GI of 53.17% and 51.41% respectively.
- A new product "Rice Riche Cream for Dry and Cracked heel" suitable for very dry and dehydrated skin was developed.
- Rice based face scrub with ingradients of rice bran oil and rice flour was developed. Its regular use keeps skin smooth, soft and moist.
- Two hundred and eight aromatic short grain (ASG) land races based on 49 characters (18 morphological, 9 agronomic, 6 insect pests and disease resistance, 16 physico-chemical quality parameters) and 27 polymorphic SSR marker data was considered for core set identification using Power core. Core set identified 45 genotypes representing the allele richness.
- Based on phenotype, field tolerance to stem borer and quality, 26 advance elite lines were identified as promising in a cross of Swarna/ RAU 3041.
- Variation was observed among 104 RILs in a cross of *japonica* and *indica* for all quality traits studied. The head rice recovery ranged from 23.2% to 62.8%; alkali spreading value varied from 3 to 7; gel consistency ranged from hard (22 mm) to soft (92.5mm); amylose varied from 12.92% to 32.91%. The differential expression of chalk towards complete opaqueness to complete translucence could be due to the cumulative effect of minor genes controlling in the final manifestation of grain quality.
- Soft rice Aghonibora was completely cooked at 78^{0}C in 45 minutes time. In contrast, Samba Mahsuri and Swarna were completely cooked in 45 minutes and 30 minutes at 84 and 88^{0}C respectively.

Hybrid Rice

- Six hundred and twenty five entries were grown in source nursery and 270 test crosses were made. Of 270 test crosses evaluated 60 restorers, 40 maintainers and 20 promising combinations were identified.
- In Station Trial, 26 hybrid combinations were evaluated and eight *viz*., IR 79156A/BK 49-78, IR 58025A/BK 64-116, IR 79156 A/BK 49-43, IR 58025A/BK 49-43, IR 58025A/BK 39-179, APMS-6A/BK 49-77, IR 58025A/BK 49-77, IR 79156A/KCD-1 were promising.
- Twenty six promising genotypes were identified from the available breeding material and crosses were attempted between the promising

lines. Around 270 test crosses, 100 paired crosses and 30 varietal crosses were attempted. 20 promising test crosses were identified for further evaluation.

- Five new hybrids DRRH-88, DRRH-89, DRRH-90, DRRH-91 and DRRH-92 were nominated in AICRIP trials for their evaluation and two hybrids DRRH-85 and DRRH-92 were promoted for further evaluation.

- New hybrid combinations identified for aerobic conditions (IR 58025A/3005; IR 58025A/L2182) were nominated in IVT Aerobic 2013 trial, the latter was promising and promoted. Similarly one hybrid *viz.*, IR 79156A/363-5 was nominated in CSTVT Trial.

- For stigma exsertion trait improvement in maintainer lines 17 crosses were attempted between low and high stigma exsertion parents. F_1's were phenotyped and two F_2 populations *viz*., APMS-6B x BF-16B and IR 68897B x BF 16B having 370 and 339 plants respectively were phenotyped and three BC_2 F_1 and six BC_1F_1 were developed.

- Polymorphic survey using reported markers for stigma exsertion trait have not shown polymorphism, hence 453 HRM and RM markers were used for polymorphic survey covering all 12 chromosomes. More than 110 polymorphic markers were identified for each cross combination. For APMS-6B x BF-16B cross genotyping is under progress using above 110 polymorphic markers.

- Fifty DRR released varieties were screened for the presence of fertility restorer genes *Rf4* and *Rf3*. The varieties namely Shanti, Akshayadhan and Varadhan identified as restorers based on molecular screening and test crossing.

- Around 1600 single plant selections made for the development of abiotic stress restorers and maintainers are now in F3 and F4 generation stage.

- The nucleus seed of parental lines of DRRH-2 *viz*., IR 68897A (100 kg), IR 68897B (150 kg), DR 714-1-2R (100 kg), DRRH-3 *viz*., APMS-6A (70 kg), APMS-6B (100 kg) and RPHR-1005 (125 kg) were produced.

Biotechnology

- Eight Bt transgenic rice lines of IR64 with Cry1Ac were stringently screened for YSB resistance and selected for final Event Selection and Biosafety Research Level-1 trials.

- Based on the physiological and water stress screening of homozygous drought tolerant (DT) transgenic rice lines of BPT5204, about 5-10 lines were short listed for confined event selection trials and Biosafety Research Level-1 trials.

- Out of eight reported cloned genes for yield components *viz*., grain number (*Ghd7*, *Ghd8* and *Cytokinin oxidase*); grain yield (*Dep1* and *Dep3*); erect growth, increased grain number and yield (*PROG1*); ideal plant architecture and yield (*OsSPL14*) and strong culm (*SCM2*), markers of *Ghd8*, *OsSPL14* and *PROG1* genes have been found to be associated with spikelet and filled grains across panicle in the germplasm comprising *indica*, tropical *japonica* and *O. glaberrima* accessions using association mapping analysis.

- A set of three WA-CMS lines and 17 restorer lines have been crossed using L X T design and hybrids have been developed from these crosses. They were then analyzed with a set of 40 hyper-variable SSR markers to analyze the polymorphism, which was then correlated with heterosis. A moderate positive correlation of 0.37 was recorded.

- Through an analysis of the mitochondrial genome, few cleaved amplicon length polymorphism and amplicon length polymorphism markers capable of distinguishing WA-CMS lines from their maintainers have been identified and validated. Expression profile of putative candidate genes/ ORFs associated with WA-CMS trait revealed that ORF126 and WA352 are the candidate genes.

- A major and stable large effect QTL for gelatinization temperature (GT) (qGT-6) was identified and fine mapped on chromosome-6 in the marker interval of RM217- RM 19562 which spans around 1.1 Mb region and identified as Sucrose Synthase and unknown expressed protein as candidate genes for this QTL.
- Phenotyping and molecular characterization of rice transgenic lines transformed with RNAi inducing binary vector construct based on RTSV-CP gene done. Transgenic plants showing no or less symptoms were evaluated for the presence of RTBV and RTSV using viral genome specific primers. Complete immunity, recovery phenotype and susceptible phenotype were recorded with respect to RTSV presence.
- The Complete genome of a south Indian isolate of Rice tungro spherical virus (RTSV) from Andhra Pradesh (AP) was deciphered and deposited in the NCBI database (accession number: KC794785).

Crop Production

Agronomy

- SRI method of rice cultivation was found promising with higher agronomic efficiency by the application of organic and inorganic nutrient management. E-learning course on SRI has been developed and trained 1500 resource poor farmers for spreading the technology.
- The amount of water saved by saturation method is to the tune of 260 mm/ha (32% of water) as compared to normal transplanting.
- Application of 75% recommended nitrogen (120 kg/ha) and top dressing of 50% recommended dose of potassium in direct wet seeded rice (DWSR) at panicle initiation stage has reduced lodging. Potassium top dressed DWSR has significantly improved rice yield over its entire basal application, however RDN and 75% RDN recorded yields at par.
- For delayed sowing (September), wet seeded rice cultivation proved promising than transplanted rice.
- Effective weed management in Aerobic rice involves sequential application of Pendimenthalin 30% EC @ 1.5 kg a.i./ha within 3 days of sowing and Bispyribac sodium 10% SC @ 30 g a.i./ha or chlorimuron + metsulfuron methyl 20% WP @ 4 g a.i./ha at 2-5 leaf stage of weeds resulted in lower weed population, weed biomass and increased grain yields.
- In aerobic rice 25% of recommended nitrogen and phosphorus can be substituted by basal application of Azospirillum + PSB @ 5 kg/ha mixed with 100 kg organic manure.
- Nitrogen application in 3 equal splits at 10-12 days after emergence, at maximum tillering and panicle initiation stage followed by spraying of ferrous sulphate @ 1.5% after one week enhanced the nitrogen use efficiency and rectified the iron deficiency in aerobic rice.
- Brown manuring (incorporation of dhaincha) has reduced the weed count and weed biomass of wet seeded rice by 17.4% and 40.8% respectively as compared to control. The cumulative effects of reduced weed infestations and better N nutrition of BM plots resulted in 3% increase in grain yield.

Soil Science

- Based on several NUE indices, the genotypes - Rasi, Vikas & Vandana (early group), DRRH 82 & DRR Dhan 39 (medium duration) and Dhanrasi, Mandya Vijaya & Swarna (long duration) proved promising in both *kharif* and *rabi* seasons.
- Application of nitrification inhibitors *viz*., neem coated urea and dicyandiamide reduced N_2O emission significantly from the paddy field as compared to urea. Total N_2O–N emissions were in the range of 0.05% (with urea + DCD) to 0.06% (with urea alone) of the total nitrogen applied. The highest inhibition of total N_2O emission (41%) was recorded from plots treated with urea + DCD followed by NCU (26%).
- In the field fortification trial, poultry manure and vermi compost were fortified with 10

and 20% of total nitrogen and phosphorus requirement with urea and superphosphate. Over 30% grain yield advantage was recorded in all the fortified treatments over control. Soil quality index was very good (>0.7) for manure fortified samples and was poor for control soil samples (<0.2).

- ✧ Soil health kit developed was validated for different soils and conditions. Methods of assay are being remodeled based on feedbacks. A bilingual (English and Telugu) soil health card was designed and developed and is now being widely used for distribution among farming community.
- ✧ A *Serratia marcescens* strain (SSB-1) isolated from the rhizosphere of rice was found to possess multiple plant beneficial traits that lead to phytostimulation, soil nutrient mobilization and biocontrol. The isolate also exhibited solubilization of silicates and unavailable forms of phosphorus (Tricalcium phosphate) and zinc (zinc oxide).
- ✧ Seed bacterization of rice variety Swarna with the rhizobacterial isolate was found to increase the germination percentage under 15% and 20% PEG 6000 induced water stress when compared to control under *in vitro* conditions. The rhizobacteria enhanced the root length, root volume and root diameter of inoculated seedlings.

Plant Physiology

- ✧ The light induced respiration (LIR) ranged between 1.64 µ mol. min^{-1} to 0.737 µ $mol.min^{-1}$. Wild spp., *O. longistaminata* and *O. rufipogon* have higher LIR compared to hybrids and other wild spp., *O. eichengeri* and *O. nivara.*
- ✧ A total of 115 (43 diverse rice genotypes consisting of popular varieties, tropical japonica (2 No.), wild rice introgressed lines (2 No.), 20 Green Super Rice (GSR entries) and 52 Swarna x *Oryza nivara* introgressed lines (ILs) were assessed for variation in leaf photosynthetic traits under field condition. Photosynthetic efficiency (Pn) varied widely in these groups, ILS: from 9.07 (78-K) to 21.54 (3-1K) with a mean of 14.08 20 µmol (CO_2) m^{-2} s^{-1}. Diverse genotypes: 14.3 (Lalat) to 27.3 µmol (CO_2) m^{-2} s^{-1} with a mean value of 20.2) and GSR lines: minimum of 21.28 (GSR112) to a maximum of 26.6 (GSR125) with a mean of 24.05 µmol (CO_2)$m^{-2}s^{-1}$. GSR125, GSR122 and GSR138 are the other entries which showed Pn >26 µmol (CO_2)$m^{-2}s^{-1}$. Correlation between different photosynthetic traits, TDM and grain yield indicated that the Pn is positively associated with stomatal conductance and carboxylation efficiency (A/Ci ratio). The association between Pn TDM and grain yield though positive, was non-significant.
- ✧ Physiological Studies for Improving Ideotype Breeding in Rice - 82 diverse genotypes comprising introgression lines, restorer lines, germplasm accessions, advance breeding lines, tropical japonicas, high yielding varieties and hybrids were evaluated for different plant type characters based on physiological parameters for using them as donors in ideotype breeding. Leaf area index (LAI), leaf photosynthetic characters, leaf angle, chlorophyll content and phenols were measured. LAI varied from 4 to 10, leaf angle varied from 30 to 55 degrees, chlorophyll content 20 to 44, Phenols were high in ILS followed by hybrids/HYVs and germplasm.

Crop Protection

Entomology

- ✧ Seven entries *viz.*, IET 22989, IET 23894, IET 21944, IET 23705, IC NO 578151, VPB 231 and VPB 232 were resistant to both the planthoppers.
- ✧ Greenhouse study on the competitive ability of both WBPH and BPH indicated that when released together, the fecundity of BPH was reduced.
- ✧ Infestation by BPH and WBPH reduce the total number of panicles and grain yield.
- ✧ Two new germplasm accessions *viz.*, IC 462402 and IC 577036 were identified as resistant to gall midge biotype 1.

- Real time validation studies confirmed that NBS-LRR for *Gm4* in Abhaya and Proline Rich Protein 3 for *Gm8* in Aganni are the candidate genes.
- Field evaluation of the back cross inbred lines derived from IR64 X *O. glaberimma* followed a normal distribution for white ear damage by yellow stem borer. Cut stem assay with neonate larvae in these lines revealed antibiosis as one of the mechanisms.
- The leaf area damaged by a single third instar leaffolder larva in 48 h in TN1/W1263 RILs followed a normal distribution when screened under field conditions. Variation in leaf width and larval development was observed in both the parents.
- Field trial on the effect of Ek Boond, a wetting agent, on the efficacy of insecticides revealed that stem borer damage was significantly lower in rynaxypyr and acephate treatments in combination with Ek boond compared to the same insecticides when applied alone.
- Among four commercial formulations and two extracts of botanicals evaluated under field conditions, Multineem 300 ppm (containing 90.57% neem oil) was found effective in reducing yellow stem borer and leaffolder damage followed by Neem Ban 300 ppm when compared to control. Among the seed powder extracts tested, Neem and Annona caused mortality of BPH. Argemone and Annona extracts decreased feeding by leaffolder.
- Ecological engineering with flowering plants showed that planting of marigold as a border plant on field bunds increased the parasitization of hopper eggs by *Oligosita* sp. as compared to gaillardia and bhendi.
- Laboratory studies indicated that honey and flowers of *Eclipta* as food source increased the longevity of *Tetrastichus schoenobii*, a predominant egg parasitoid of yellow stem borer.
- Studies on the predatory potential of the coccinellids revealed that adult *Harmonia octomaculata* consumed more BPH nymphs than *Menochilus sexmaculatus*.
- In association with IICT, Hyderabad and CPCRI, Kasaragod identified the component of sex pheromone of pink stem borer, *Sesamia inferens* as an acetate molecule.
- A binary blend consisting of two acetate molecules when tested against rice leaf folder, *Cnaphalocrocis medinalis* resulted in marginally good pheromone trap catches.
- Among the five Entomopathogenic Nematodes evaluated against yellow stem borer in small scale field experiments, maximum reduction (38.2%) in white ears over untreated control was observed in case of nematode *Metarhabditis amsactae* isolate (DRR-Ma2).
- Rice root-knot nematode *Meloidogyne graminicola* damage (root galling) was significantly higher (41-61%) in un-flooded condition compared to the flooded condition at both ambient and elevated (40-45^{0}C) temperatures. Further, the nematode damage was observed to be more at ambient temperature compared to that at elevated temperature.
- Analyses of soil nematode populations revealed that the relative abundance of plant parasitic nematodes was low in SRI plots compared to the conventional system but the total nematode abundance was higher in SRI plots compared to the conventional system across different nutrient management systems.

Plant Pathology

- Out of 6962 lines which included parents, NILs, RILs, differentials, breeding materials, introgression lines and IRBN entries from IRRI, 803 entries were found to be resistant to blast disease.
- Nine introgression lines *viz*., PAU # 547, 549, 550, 695, 747, 848, 1061, 1077 and 1195 were found to have broad spectrum resistance against multiple *Xoo* isolates. Out of these, PAU 1061 did not have any of the known major

BB resistance genes and may provide a novel source of resistance to bacterial blight.

- Six backcrossed inbred lines (BILs) out of 120 tested *viz*., BILs # 4B, 5B, 6B, 24B, 25B and 84B were found to exhibit high level of resistance to rice tungro virus.
- Among the different methods of inoculation tested, injection inoculation with conidial suspension at the booting stage and then keeping the inoculated plants under 80-90% RH and 24 ^{0}C for 7 days resulted in maximum infection and production of smut balls.
- On repeated screening, 2 mutant lines, 14 introgression lines, 2 elite lines, 1 B line and 7 tropical japonicas were found promising to sheath blight disease. In addition 7 land races and one accession of green super rice (GSR 106) were found promising to sheath blight.
- Six cultures developed through MAS having resistance to blast or blast and bacterial blight *viz*., IET #24164, 24165, 24166, 241 67, 24168 and 24169 were nominated for in All India Coordinated Trials and out of which three cultures *viz*., IET #24164, 24166 and 24167 were promoted to AVT 2 NIL trial.
- Phenotyping of 260 isolates of *Xoo* collected from different rice growing regions of India and categorized them into 22 pathotypes.
- The effect of RTV on plant height was not prominent on resistant variety Vikramarya and TKM 6 and moderately resistant variety IR 20 and IR67406-6-3-2-3 compared to susceptible varieties like TN1 and Tapaswini when inoculated at 50 DAS. Reduction in number of panicles per plant was also found less in Vikramarya. Virus inoculated TN1 and Tapaswini were the most affected in terms of reduction in total number of grains per panicle.
- Roving survey in false smut affected area in Nalgonda district of Andhra Pradesh revealed that the rice variety BPT 5204 was severely affected with false smut.
- Toxic secondary metabolites from the culture filtrate of *Ustilaginoidea virens* (false smut pathogen) was partially purified and assayed with test organism *Candida albicans*.
- A combination product of trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l was most effective in reducing the blast and sheath blight disease severity and simultaneously increasing the yields. In another study, a combination product of mancozeb 68% + tricyclazole 18% was found very effective in checking the blast disease.
- Two combination products *viz*., tetraconazole 7.46%+azoxystrobin 9.32% (3.0 ml/l of water) and mancozeb 68%+hexaconazole 4% WG (2-3 ml/l) were found very effective in reducing the sheath blight severity.
- Three vitamins *viz*., thiamine hydrochloride, pyridoxine hydrochloride and nicotinic acid individually at 50 mM concentration and combination three vitamins at 10 mM concentrations significantly reduced the bacterial blight disease severity under field condition.

Transfer of Technology

- Gender based participation in rice cultivation in selected villages of Tamil Nadu indicated that land preparation, irrigation management and marketing were undertaken by farmers and farm women were involved in pulling out seedlings, transplanting, weeding and harvesting. In Bihar, women were involved mostly in weeding and harvesting. SRI method was rated as highly skilful and drudgery prone (73.00%) compared to normal transplanting (58.00%). The livelihood options were wage work as agriculture labour and MGNREGA activities.
- Sustainability study carried out in the traditional boro rice growing areas of Saharsa district of Bihar revealed that the major constraint was cold injury in the nursery stage and hot weather in the flowering stage of the crop. Varieties suitable to both the stress are required. The top soil removed from the boro rice fields to

manufacture bricks is a major constraint to sustain the rice production. Farmers need subsidy linked credit to install the shallow bore well using the bamboo poles.

- Research survey on maximizing the impact of rice technologies though ICT applications. In case of Andhra Pradesh, out of 45 information needs 12 (26%) were found to be unfelt information needs. In case of Karnataka, both information and technology needs about hybrids, aerobic rice and mechanised transplanting were felt by the farmers in FLD villages. About 63% of the respondents from non-FLD villages were not aware of aerobic rice cultivation.
- The yield gaps in irrigated rice ecologies of 3 districts of Bihar was found to be 27%.
- The study on partnerships examined the developments in the basmati rice sector. Majority of farmers (about 80%) were aware of contract farming processes, respondents were willing to enter contract farming with written agreement.
- For the year 2013-14, in RKMP the major focus was on awareness and various need based additional features were added to the portal.
- In 2013-14, four training programs were planned, organized and evaluated on various aspects of Rice Production Technologies. 70 persons were trained through these trainings.
- As part of DRR on farm evaluation programs, DRR technologies like DRRH3 Dhan 39, Improved Samba Mahsuri, drum seeder, mechanical transplanter, leaf colour chart were demonstrated in the farmers fields of Andhra Pradesh and Tamil Nadu.
- 485 FLDs of 1 ha each were demonstrated during the year 2013-14 in 15 states.
- Tribal sub-plan activities were undertaken to enhance the livelihood of the tribal farmers from the tribal villages of Amarabad mandal and Regadi Mylarum Mandals in Mahabbobnagar district and the Korra Thanda of Nalgonda district in Andhra Pradesh.
- Seeds of Improved Samba Mahsuri were sent to the KVKs – Gaddipalle, Undi, Kalvacherla, Banaganapalli, Guntur, Vijayawada in Andhra Pradesh. Overall 1500 demonstrations were conducted in the BLB endemic areas of AP and Tamil Nadu.
- Overall DRR participated in five agricultural fairs and exhibitions and organized a Farmer's Day in 2013.

Introduction

Mandate

Significant Achievements

Organization

Infrastructure

Budget Allocation and Staff

Weather and Crop Season

All India Coordinated Rice Improvement Project (AICRIP) was established in 1965 by the Indian Council of Agricultural Research (ICAR) to organize national level multi-location testing of varieties and other crop management technologies across all rice growing ecologies of the country. In order to meet the objective of the technology development and evaluation, the AICRIP was elevated as the Directorate of Rice Research (DRR) in August 1975 with the added mandate of pursuing research on irrigated rice for strengthening and stabilizing rice production in the country. The Directorate has evolved into an efficient and successful program of partnership in rice research bringing together more than 300 rice researchers from 47 funded and over 100 voluntary research centers across the country.

The Mandate

- To organize, coordinate and monitor multi-location testing at national level to identify appropriate varietal and management technologies for all the rice ecosystems.
- To conduct basic, strategic, applied and anticipatory research in the major thrust areas of irrigated rice aimed at enhancement of production, productivity and profitability while preserving environmental quality.
- To initiate, organize, coordinate and monitor research networks relating to problems of national and regional importance.
- To serve as major centre for exchange of research material and information.
- To accelerate the pace of technology transfer through development and adoption of innovative extension training models, self learning modules, organizing formal training courses, frontline demonstrations, exhibitions, farmers' day etc.
- To develop linkages with national, international and private organizations for collaborative research programmes.
- To provide consultancy services and undertake contractual research.

Since 1968, more than 1011 rice varieties including 68 hybrids have been released through multilocation testing for various agro- ecological systems prevalent across the country. 46% of these varieties are meant for irrigated areas, 18% for rainfed shallow lands, 12% for rainfed uplands, 4% for irrigated areas in hills, 4% for deep and semi-deep water, 4% irrigated saline/alkaline soils, 6% for scented rice and rest for the other rice ecologies. More than 60 varieties have been developed by the Directorate of which 40 are central releases and the rest are released in different states. Globally 19 varieties released through AICRIP are being cultivated in 25 other rice growing countries.

Significant Achievements

- Eight hybrids and 15 varieties were released during 2013. Central Sub Committee on Crop Standards, Notification and Release of Varieties (CSCCSN&RV) released 7 hybrids and 8 varieties, while the State release committees released 1 hybrid and 7 varieties in six states.
- 40 varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted as 799 experiments at 120 locations (46 funded, 74 voluntary centers) in 27 states and 2 Union Territories in all the 5 regions of the country. Two hybrids and 27 elite breeding lines developed at 16 Centres and tested for 3 years in AICRIP were found promising for various ecosystems.
- Breeder seed production of 220 rice varieties and parental lines of 12 hybrids as per the DAC indents was organized at 38 centres. A total production of 555 tonnes of breeder seed was achieved against a target of 474 tonnes.
- Among the 42 advanced basmati pyramided lines (BPLs) 6 lines in the background of Taroari Basmati and 19 lines in the background of Basmati 386 were most promising showing resistance to bacterial blight.
- Marker data generated from DRR, IARI, TNAU, PAU, along with DUS data was used to identify a core set of aromatic germplasm consisting of 78 accessions for the first time in aromatic rices.
- Identified 3 resistant genetic stocks namely RP 5448 derived from TN1/PTB 33 (BPH resistance), RP 5435 from Samba Mahsuri/MO1

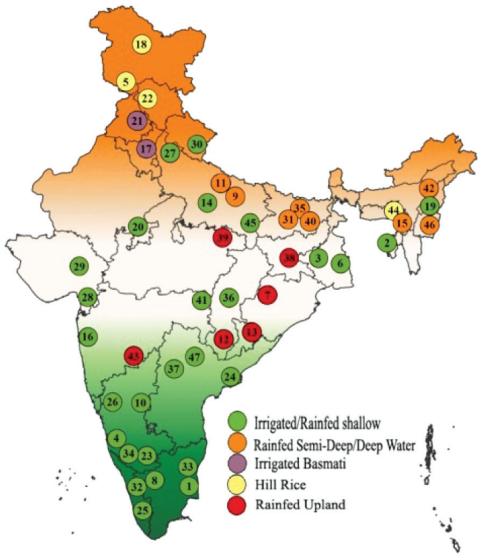
(WBPH resistance) and RP 5449 from TN1/ Sinna sivappu (both BPH and WBPH)

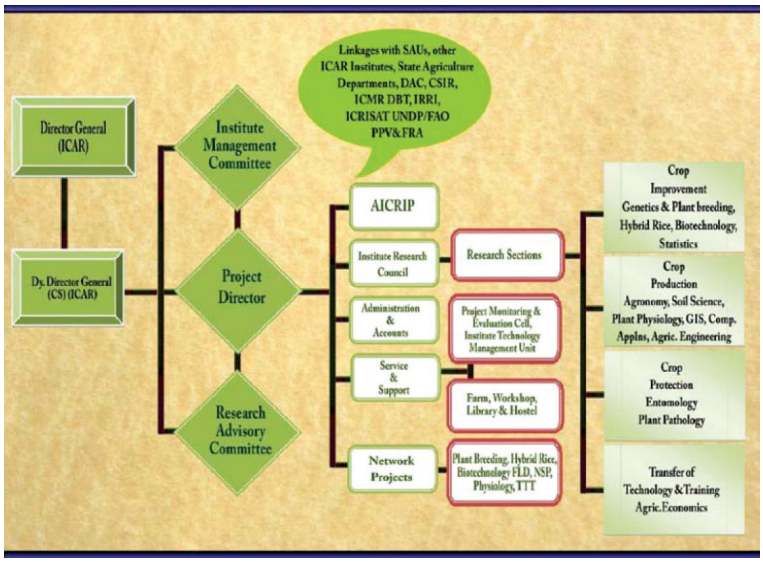
- Genotypes *viz*., GSR 307, GSR 323, GSR 332 and SM 363 were promising under very low phosphorus (1.5 to 2.0 ppm) wherein majority of the genotypes failed to survive.
- Fe and Zn content were analyzed for the first time with XRF machine at DRR and IETs 23825, 22624, 23830, 23824, 23833, 23834, 23831, 23829, 23832 were found promising for zinc.
- Five new hybrids DRRH-88, DRRH-89, DRRH-90, DRRH-91, DRRH-92 were nominated in AICRIP trials. BB resistance gene *Xa21* and blast gene *Pi54* were introgressed into IR 58025B following MABB.
- 13 novel micro RNAs were analysed for their expression and 2 novel miRNAs (miR172e and miR157) reported in shoot and root of N22 cultivar in control and heat stress conditions.
- Introgression line derived from *O. glumaepatula* possesses a major QTL on Chr. 3 for leaf and neck blast resistance.
- Evaluation of 54 elite genotypes for their response to nitrogen led to the identification of 31 cultures based on the Grain Yield Efficiency Index values.
- 25 years of study on "Long term soil fertility management in RBCS", indicated the consistent superiority of conjunctive use of 100% RDF + 5 t FYM/ha compared to inorganic fertilizers alone.
- Combined use of organics, micronutrients and cytokinins recorded maximum Zn and Fe concentration and uptake in both grain and straw. The major portion of the absorbed micronutrients remained in straw with only 26-46% being translocated to grain.
- Developmental studies of YSB at constant temperature (25±1°C) indicated that the highest mortality (47%) of YSB larvae occurred in the first instars.
- Complete genome sequence of RTSV isolate from southern India (Andhra Pradesh, AP) was deciphered and deposited in the NCBI database (accession number: KC794785).
- Three promising wild rice accessions with high photosynthetic efficiency and tolerant to high temperatures were submitted for registration.
- Developmental duration decreased with increase in temperature from 15-30°C for each stage of BPH, but increased at 32°C indicating a nonlinear response at this threshold temperature.
- The phenotyping and genotyping of >250 isolates of *Xoo* collected from different rice growing regions of India was completed and categorized them into 22 pathotypes.
- Vitamins (Thiamine hydrochloride, Pyridoxine hydrochloride and Nicotinic acid) tested singly at 50 mM concentration and combinations of three vitamins (at 10 mM each) were highly promising in reducing the bacterial blight lesion length.
- A cafeteria of rice technologies were demonstrated in 485 hectares covering 15 states under four major rice ecosystems of the country. In total 33 promising technologies have been identified from 15 states.
- In 2013-2014, four -training programs were planned, organized and evaluated on various aspects of Rice Production Technologies through which 70 subject matter specialists and extension officers were trained.

Organization

DRR is an important constituent institute of ICAR under direct supervision of the Deputy Director General for Crop Sciences. The detailed organizational setup of the Directorate is provided in its organogram. For fulfilling its mandate effectively, DRR is organized into four sections and ten units along with centralized service wings and administration. AICRIP activities are integrated into the mandate with senior most scientists of each discipline acting as the PIs of the programme. There are 47 funded (see figure and table) and more than 105 voluntary centers

involved in rice research activities. Research and institutional activities are planned and guided by Research Advisory Committee and Institute Management Committee while the progress is critically evaluated once in five years by the Quinquennial Review Committee.





S. No.	Center
1	Aduthurai
2	Agarthala
3	Bankura
4	Brahmavar
5	Chatha
6	Chinsurah
7	Chiplima
8	Coimbatore
9	Faizabad
10	Gangavati
11	Ghaghraghat
12	Jagdalpur
13	Jeypore
14	Kanpur
15	Karimganj
16	Karjat
17	Kaul
18	Khudwani
19	Kohima
20	Kota
21	Ludhiana
22	Malan
23	Mandya
24	Maruteru

S. No.	Center
25	Moncompu
26	Mugad
27	Nagina
28	Navasari
29	Nawagam
30	Pantnagar
31	Patna
32	Pattambi
33	Pondicherry
34	Ponnampet
35	Pusa
36	Raipur
37	Rajendranagar
38	Ranchi
39	Rewa
40	Sabour
41	Sakoli
42	Titabar
43	Tuljapur
44	Upper shillong
45	Varanasi
46	Wangbal
47	Warangal

Infrastructure

The Directorate is equipped with state of the art facilities such as fully equipped laboratories for all departments, temperature controlled greenhouses, net-houses, growth chambers, screening nursery beds, containment transgenic poly-houses and heat tunnels. Field facilities include a well laid out experimental farms at Rajendranagar (20 ha)

and Ramachandrapuram (40 ha) with a wild rice garden and pollination chambers.

A centrally air conditioned auditorium with 350 seating capacity, seminar halls, guest house and hostel facilities for imparting training and to

disseminate information using latest multi-media and ICT tools. The Central library of the institute is a fully digitized with over 4,654 books, 6,500 bound volumes and subscribes to 55 Indian and

13 foreign journals. The significant achievements of the directorate are exhibited through a state of the art museum.

Weather and Crop Season

The Indian meteorological department (IMD) reported that the rainfall for the season (June-September, 2013) was 106 % of its long period average (LPA). Seasonal rainfall was 109% of its LPA over Northwest, 123% over Central, 115% over southern Peninsula and 72% of its LPA over Northeast (NE) India. Out of the total 36 meteorological subdivisions, 14 subdivisions constituting 48% of the total area of the country received excess seasonal rainfall, 16 subdivisions (38% of the total area of the country) received normal seasonal rainfall and the remaining 6 subdivisions (14% of the total area of the country) received deficient rainfall. Monthly rainfall over the country as a whole was 132% of LPA in June, 106% of LPA in July, 98% of LPA in August and 86% of LPA in September. Out of the total of 641 districts, 100 were affected by moderate meteorological drought (seasonal rainfall deficiency of 26% to 50%), while 39 were affected by severe meteorological drought (seasonal rainfall deficiency of 51% to 99%).

Budget Allocation

(Rupees in lakhs)

Item	2013-14 (Plan)		2013-14 (Non-Plan)	
	Outlay	Expen-diture	Outlay	Expendi-ture
DRR, Hyderabad	390.00	384.98	2182.30	2122.80
AICRIP	2595.00	2276.56	-	-
Total	2985.00	2661.54	2182.30	2122.80

The Staff

Cadre	Sanctioned	Filled	Vacant
Scientific	71	54	17
Technical	53	43	10
Administrative	32	27	5
Supporting	17	17	-
Total	174	142	32

Research Achievements-AICRIP

Coordinated Research

Crop Improvement

New Varieties and Hybrids released

Crop Production

Agronomy

Soil Science

Plant Physiology

Crop Protection

Entomology

Pathology

Transfer of Technology

All India Coordinated Rice Improvement Programme (AICRIP)

Crop Improvement

New Varieties and Hybrids released.

Eight hybrids and 15 varieties were released during 2013. Central Sub Committee on Crop Standards, Notification and Release of Varieties (CSCCSN &RV) released 7 hybrids and 8 varieties which include 27P52, 27P 63, KPH-199, KPH 371, US 305, US314, VNR 2375 Plus (hybrids), CR Dhan 201, CR Dhan 202, CR Dhan 304, CR Dhan 305, CR Dhan 407, CR Dhan 505 and Pusa Basmati 1509 (varieties) and Pusa 6. State release committees released 1 hybrid, ARRH 7434 in Chhattisgarh and 7 varieties *viz*., GAR 1 in Gujarat, Palam Lal Dhan 1 in Himachal Pradesh, Birsa Vikas Dhan 11A, Birsa Vikas Dhan 203, Birsa Vikas Sugandh 1 in Jharkhand, PDKV Kisan in Maharashtra and TPS 5 in Tamil Nadu. These HYVs were recommended for rainfed upland (4), shallow land (1), deep water (1), irrigated (10), aerobic (2), basmati areas (2), aromatic short grain growing areas (2), irrigated hilly areas (2). Many of these releases are resistant/ moderately resistant to biotic stresses.


Pusa 1509

S. No	Variety Name	IET No.	Designation	Cross Combination	FD (days)	Eco Sys.	Grain Type	Yield (kg/ha)	Reaction to pests
Central Releases									
1.	27P52	21433	--	R 871F/R 860	105	IRM	MS	5700	--
2.	27P 63	21832	--	R 909F/R 915	103	IRM	MS	5700	
3.	KPH-199	21825		KCMS-1017A/ KPGOS-516	98	IRME	MS	6700	MR- Bl
4.	KPH 371	21794		KCMS 1090A/ KPGOS 503	96	IRME	MS	6300	MR-Bl.
5.	US 305	21827		F 3 2 7 4 - 4 A / M4582R	100	IRM	MS	6500	--
6.	US314	21777		F11/M4318	89	IRE	MS	5000	
7.	VNR 2375 Plus	21423	VNR 203	VNR-F02/ VNR –RB 244	103	IRM	MS	5800	
8.	CR Dhan 201	21294	CR2721-81-3	IR 72022-46-2-3-2/IRRI 105	85	ARB	LS	3800	
9.	CR Dhan 202	21917	CR 2715-13-IR 84899	IRRI 148 / IR 78877-208-B-1-1	85	ARB	SB	3800	
10.	CR Dhan 304	22117	CR 2644-2-6-4-3-2	Tapaswini / IET 16611	100	IRME	SB	4800	R-GM
11.	CR Dhan 305	21287	CR 2706	IR 770-B-34-3 / IRRI 123	95	RUP	LS	4800	MR- WBPH, BPH, Bl ,
12.	CR Dhan 407	21974	CR 2459-12-8	Swarna / IR 64	120	RSL	LB	5200	
13.	CR Dhan 505	21719	CR 2682-4-2-2-2-1	CRLC 899 / AC.38606	136	DW	MS	3500	
14.	Pusa Bas 1509	21960	Pusa 1509-03-3-9-5	Pusa 1301 / Pusa Bas 1121	93	SCR	ELS	4250	R-Bl
15.	Pusa Bas 1612	22290	Pusa 1612-07-6-5	PS 5/C 101A51 // PS 5*2/ PS 5 / Tetep// PS5*2	96	SCR	ELS	5000	R-Bl

S. No	Variety Name	IET No.	Designation	Cross Combination	FD (days)	Eco Sys.	Grain Type	Yield (kg/ha)	Reaction to pests
States Releases									
Gujarat									
16	GAR-1	21276	NWGR 3108	Narmada // IET 14708 / 18-1-5-1-4-3	103	SCR	MS	3550	
Chhattisgarh									
17	ARRH 7434	20734	Ankur 7434	OS/CA-3 x DR-70023R	99	IRM	LS	6500	
Himachal Pradesh									
18	Palam Lal Dhan 1 (Improved Begmi)	22286	HPR 2720	Pure line selection from IC 455333	98	HRIR	MS	4000	R-Bl
Jharkhand									
19	Birsa Vikas Dhan 111	19848	BAU GVT 434-06	Azuchena/ Kalinga111/ / Kalinga 111	65	RUP	LS	2000-2500	MR-BL, BS, SB
20	Birsa Vikas Dhan 203	19896	BAU GVT 406-99	IR 64 / Kalinga 3	90	RUP	LS	4000-4500	MR- BL, BLB, BS, SB
21	Birsa Vikas Sugandh 1	18941	Sugandh 1	Irradiation in PB 1	95	SCR	LS	4000-4500	MR-BL, BS, SB
Maharashtra									
22	PDKV Kisan	20880	SKL-22-39-31-25-31-34	SKL 6-1-23 / SYE 3-17	100-105	IRE	MS	4349	MR- BL, BLB,GM
Tamil Nadu									
23	TPS 5	22808	TP 08010	ASD 16/ADT 37	88	RUP	SB	6300	MR- BL, GLH, SB

Coordinated varietal testing

During this year 40 varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted as 799 experiments at 120 locations (46 funded, 74 voluntary centers) in 27 states and 2 Union Territories in all the 5 regions of the country. Hybrid rice experiments were also conducted by 14 private seed companies. The 45 trials were constituted with 1116 entries including 156 checks and 104 experimental hybrids. In addition, 12 INGER nurseries involving 572 entries were tested at 100 centers. Two hybrids and 27 elite breeding lines developed at 16 Centres and tested for 3 years in AICRIP were found promising for various ecosystems (Appendix 1) like direct seeded upland situation, transplanted irrigated conditions, coastal saline soils, traditional basmati growing areas, irrigated and upland hilly areas and aerobic situation.

INGER Observational Nurseries

In order to disseminate elite breeding lines and varieties developed in different countries, provide opportunities for free exchange of diverse rice germplasm and also to strengthen effective linkages among various national and international rice improvement programmes; 12 IRRI coordinated INGER Observational Nurseries were evaluated during 2013. A total of 572 elite rice lines of different nurseries were evaluated at 93 locations. Based on yield, resistance/tolerance to biotic stresses, maturity duration and overall phenotypic acceptability under respective situations promising lines were identified in different trials.

National Seed Project and Breeder Seed Production

Breeder seed production of rice varieties and parental lines of rice hybrids as per the DAC indents was organized at 38 centres across the country, involving 220 varieties and parental lines of 12 rice hybrids. A total production of 5552.00 quintals of breeder seed was achieved against a target of 4744.00 quintals. At DRR centre, 12 varieties and parental lines of DRRH-2 and DRRH-3 were included in breeder seed production with a total production of 190.00 quintals against the target of 100.50 quintals (Appendix 2). The nucleus seed of 26 DRR varieties was also multiplied.

KPH 199

	Nursery	Promising lines
1	International Irrigated Rice Observational Nurseries (IIRON)	Module-1: IR 06A181, IR 07A234, IR 07A253, IR 10A134, IR 10N237 Module -2: IR 05N304, IR 09N142, IR 09N247, IR 10F290, MRQ 50
2	International Rainfed Lowland Rice Observational Nursery (IRLON)	08FAN2, IRRI 163, IR 09L261, IR 10L357, IR 11F190
3	International Upland Rice Observational Nursery (IURON)	IR 10L240, IR 08L152, IR 10L398, IR 09L179, UPL RI-7
4	International Temperate Rice Observational Nursery (IRTON)	Milyang 23, IRRI 102, GZ 8450-19-6-5-3
5	Green Super Rice (GSR)	GSR-IRLL: HHZ 8-SAL9-DT2-Y2, HHZ 5-DT20-DT3-Y2, SACG 4, Huanghuazhan, Weed Tolerant Rice 1 GSR-RFLL: HHZ 5-Y4-SAL1-Y1, HHZ 8-SAL12-Y2-DT1, IRRI 119, HHZ 11-Y10-DT3-Y3, D4098
6	International Rice Soil Stress Tolerance Nurseries (IRSSTN)	Module-1: IR 85920-11-2-1-AJY1-3-B, IR 87938-1-1-2-1-B, IR 88320-B-AJY1-B, 011 IR 87938-1-1-1-3-B and IR 55179-3B-11-3 Module-2: IR 66946-3R-178-1-1(FL 478), IR 84107-2-B-AJY1-1-3-AJY1-2-B, IR 11T182
7	International Rice Blast Nursery (IRBN)	IR 77186-148-3-4-3, IR 06A145, IR 06A148, IR 10A121, IR 10A231
8	International Rice Bacterial Blight Nursery (IRBBN)	IR-BB58, IR-BB59, IR-BB64, IR-BB65, IR-BB66
9	International Rice Brown Plant Hopper Nursery (IRBPHN)	PTB 33, Rathu Heenati (ACC 11730), IR 78119-24-1-2-2-2, IR 13540-56-3-2-1, Sinna Sivappu (ACC 15444)

Crop Production

Agronomy

During the year 2013, a total of 251 experiments were conducted at 55 locations under AICRIP Agronomy Programme during both *Kharif* and *Rabi* seasons. Salient findings of these experiments include:

Response of Rice Cultures to Nitrogen

Evaluation of 54 elite genotypes for their response to nitrogen led to the identification of 31 cultures based on the Grain Yield Efficiency Index values (GYEI values higher than 1) belonging to 14 different groups which are promising, stable and efficient genotypes. The 4 efficient genotypes were identified based on the mean per cent yield reduction in 50% RDN and also cultures recording higher grain yield over the mean of the cultures at N 50. Identified 4 nitrogen efficient genotypes *viz*., IET 22283 (MH-Irrigated), IET 22763 and IET 22764 (E-TP), IET 22704 (Aerobic-dry seeded) which were promising and performed well under reduced 'N' application.

Cultural Management

Rainfed rice yields can be increased with integration of organic manures (5 t FYM / 2 t vermicompost) with 75% RDF (Parbani and Jagdalpur) or 20 kg S to RDF (Hazaribagh) and Uradbean intercropped rice in 4:2 ratio (Parbani, Jagadalpur and Tuljapur) or soybean intercropped rice 4:2 ratio at Ranchi.

In aerobic rice situation, optimum date of sowing for higher yield varied with location from 1st fortnight of June (Rajendranagar -7 June to Ranchi -26 June). Among the varieties tested, MTU 1001 and MTU 1010 (Rajendranagar), DRRH 3 and PA 837 (Ghaghraghat), PA-837 (Kota, Chatha and Hazaribagh), Savanah and PA-6129 (Ludhiana), Dandi (Nawagam), Parag, Avish and Prabhava (Parbhani), PA 6444 (Pusa), Arize Tej and DRRH 3 (Ranchi), MY1001, DRRH 3 and PAC 837 (Sabour) and HPR 2143 (Malan) are promising. Further, optimum seed rate for aerobic rice for higher productivity varied from 15 kg/ha (Bankura and Varanasi) to 35 kg/ha (Gaghraghat, Kota, Vadgaon and Hazaribagh). Among the varieties tested, hybrids out yielded the varieties at all the locations.

In SRI, use of 10-day old seedlings and optimum spacing were found effective in increasing grain yield. SRI method recorded higher grain yield (16%) over direct seeded rice with SRI principles (DSRI) and traditional transplanted rice. Slightly modified SRI (SMSRI) and DSRI proving as productive as manual transplanted rice and reducing drudgery and transplanting costs significantly.

Weed Management

Integrated Weed management in aerobic rice was possible with Pendimethalin @ 1 kg a.i./ ha or Butachlor @ 1.5 kg a.i/ha at 3-4 DAS with Bispyribac Sodium 35 g at 15-20 DAS or Chlorimuron + Metsulfuronmethyl 40 g a.i./ha at 25-30 DAS which reduced weed menace and thus helped in realizing higher grain yields in aerobic situation.

Weed management trials in transplanted rice indicated the application of combination herbicides, flucetosulfuron @ 25 g a.i/ha followed by Bispyribac sodium @ 20 or 25 g a.i /ha were effective. For direct seeded rice, flucetosulfuron @ 20 or 25 g a.i. /ha or sequential application of flucetosulfuron @ 20 or 25 g a.i. /ha followed by Bispyribac sodium @ 25 g a.i/ha found effective depending on the weed intensity, emergence, soil type and duration of the variety. IPM significantly reduced the weed biomass and enhanced the grain yield in transplanted rice at various locations (a collaborative trial).

Rice based Cropping Systems

In rice-based systems, soil application of organic manure + NPK + micro-nutrients recorded higher grain yields as compared to NPK alone suggesting judicious application of organic manure (in conjunction with NPK and micro-nutrients) in system approach. Impacts of conservation agriculture on rice based cropping systems revealed that at most of the locations, rice crop yield was

reduced with adoption of Zero tillage (ZT). Rice hybrids produced higher yield than varieties.

Soil Science

The soil science coordinated program 10 trials were conducted during *Kharif* and *Rabi* 2013 in 15 locations representing typical soil and crop systems of important rice growing regions. Salient findings of these trials were summarized hereunder:

Long term soil fertility management in rice based cropping systems

25 years of study on "Long term soil fertility management in RBCS", indicated the consistent superiority of conjunctive use of 100% RDF + 5t FYM/ha compared to inorganic fertilizers alone, INM/complete organics at Mandya, Maruteru and Titabar. Linear trends of rice productivity over 25 years indicated near stable to slightly negative growth rate at Maruteru; improved growth at Titabar and a negative growth rate at Mandya with current RDF and a positive growth of about 100 kg/ ha/year at all locations with a supplementary dose of 5 t FYM/PM along with RDF.

Yield gap assessment and bridging the gap through site specific integrated nutrient management in rice in farmers' fields.

On the basis of realistic assessment of soil fertility and its variability for realizing site specific yield targets, rice productivity with recommended fertilizer practice was higher at Titabar (4.4 –5.6 t/ ha) and Mandya (2.94 – 6.81 t/ha) compared to farmers' fertilizer practices. Validation of previous year's SSNM recommendations increased the yields over farmers' fertilizer practices and also the existing RDF, indicating the importance of location and site specific input management for sustaining soil and crop productivity.

Management of micronutrients in rice based cropping system in sodic, acid and neutral soils.

Gypsum application increased grain yields by 11.3% while organic fertilization in combination with recommended fertilizers (macronutrient and micronutrient) increased grain yields by 19.6% over control in sodic soils of Kanpur. In acid soils of Ranchi, supplementation of NPK and micronutrients along with organic manure like FYM resulted in marginal increases in rice yields.

Screening of rice germplasm for high iron and zinc contents

Screening of about 160 cultures including 21 common entries at 10 locations revealed strong interaction effects of genotypes and locations for both Fe and Zn content. Cultures Aghonibora and Vasumati were found consistently promising for accumulation of both Fe and Zn at different locations.

Nutrient and water requirement for aerobic rice cultivation

Productivity of water ranged from 2.0-3.0 and 0.9-1.6 kg grain/ha mm water at Kanpur and Mandya, respectively. The per cent saving in water requirement with 100 and 75% Cumulative pan evaporation (CPE) irrigation ranged from 27.7 to 54.1 at Kanpur and 29.9 to 57.2 at Mandya over 150% CPE. Irrigation equivalent to 75% of CPE appeared to be optimum for aerobic rice system saving about 26% irrigation water at Kanpur and 30% at Mandya over 150% CPE.

Nutrient use efficiency and soil productivity in early and late sown rice

To assess rice productivity and nutrient use efficiency due to changing crop calendar, higher productivity was recorded with early planting over optimum planting time at Karaikal, Khudwani and Maruteru by 24, 10 and 9%, respectively and delayed planting resulted in yield reduction by about 13-40% at all the centres.

Screening of genotypes suitable for acid soils and related nutritional constraints

Evaluation of genotypes for tolerance to soil acidity revealed location and genotype specific response to liming and fertilizer regimes. IET 22218 (NP 218), Varadhan and 27P-63 at Moncompu, Jarava, RP-Bio-226 and Dhanrasi at Ranchi, Prafulla,

Aghonibora and SS-3 at Titabar were identified as promising cultures.

Nutrient requirement of recently released varieties and hybrids of different duration groups

Study on nutrient requirement of recently released varieties and hybrids indicated that the test genotypes accumulated nutrients differentially reflecting broadly the influence of environment. Nutrient requirement in general varied from 12.7 – 34.7 kg N, 3.51-17.56 kg P_2O_5 and 11.1 – 28.7 kg K_2O per ton of grain production. Nutrient requirement for hybrids was less compared to HYVs at Maruteru and was more at DRR, Chinsurah and Faizabad.

Studies on partitioning of zinc and iron in rice and prospects of enrichment

Combined use of organics, micronutrients and cytokinin recorded maximum Zn and Fe concentration and uptake in both grain and straw. The major portion of the absorbed micronutrients remained in straw with only 26-46% being translocated to grain.

Sustaining soil and crop productivity under different rice production systems.

Transplanted rice recorded maximum rice productivity at Jagtial showing its superiority over direct seeded rice and aerobic rice by 68 and 180%, respectively. Whereas, at Mandya, transplanted and direct seeded rice were at par and superior to aerobic rice by 52 and 21%, respectively. Among the nutrient sources, maximum uptake was recorded with 100 % RDF+ 50 % organics followed by 100 % RDF. Though nutrient uptake was comparatively less in direct sown and aerobic rice than transplanted rice, the nutrient use efficiency was better in case of direct sown and aerobic rice.

Plant Physiology

Photothermic indexing and Radiation use efficiency of genotypes.

20 rice cultures were evaluated for photothermic indexing and RUE (Radiation Use Efficiency) under early and normal sown situations at 9 locations. IET 20924, DRRH-3, IET 22580, IET 22569, IET 22218 and NS-5 had requisite regimes of cumulative nycto period and cumulative degree days with superior RUE.

Hybrids need higher dose of silicon as compared to the varieties is evident from the internal leaf silicilic acid content. Application of silicon solubilizers at Cuttack, Titabar (sandy or silty clay soils), Pattambi (sandy loam soil) and Coimbatore (clay soil) was found to improve general crop health.

Grain yield, Dry matter heat susceptibility index (DMHSI), Grain weight heat susceptibility index (GWHSI) and spikelet sterility reductions were lower in Sasyasree, IET 22116 and IET 21404 cultures under heat stress (>7°C) at Pattambi centre.

10 rice cultures evaluated for seedling response to multiple abiotic stresses revealed severe root growth inhibition under anaerobic stress. The severity of the stress were in the following order from severe inhibition of germination, root and shoot lengths and seed vigour for Anaerobic, Cold, NaCl and water stresses respectively.

Crop Protection

Entomology

All India Coordinated Entomology Programme 2013 comprised of 369 experiments under 7 major trials which were conducted at 41 locations (34 funded + 7 voluntary) in 22 states and one Union territory. Significant findings of these studies are given below:

Host plant resistance

Host plant resistance studies comprised of even screening experiments involving 1765 entries which included 1070 pre-breeding lines & varieties, 117 hybrids, 440 germplasm accessions, 59 donors and 79 checks. These entries were evaluated against 14 insect pests in 210 valid tests (52 greenhouse reactions +158 field reactions). These reactions identified 64 entries (3.6% of the tested) as promising against various insect pests. Of these promising materials, 5 entries were under retesting.

Insect biotype studies:

Under *Gall Midge Biotype Trial* (GMBT), reaction of 17 differentials carrying 11 known genes and those with unknown genes and checks were tested against 6 designated biotypes and 3 populations of gall midge. The study indicated that *Gm1, Gm8* and *Gm3* are the effective genes across the tested biotypes and populations of gall midge, except at Pattambi. Variation in the virulence composition of gall midge populations monitored in *Gall Midge Population Monitoring* trial (GMPM) trial highlighted the development of virulence against *Gm8, Gm4 and gm3 genes* at Pattambi and *Gm11* gene *at* Ragolu. A set of 16 differentials evaluated across 7 locations under *Planthopper Special Screening trial* (PHSS) revealed that PTB 33 and RP 2068-18-3-5 were promising in all the seven tests against BPH.

Promising entries identified against each insect pest in screening trials

Pest	Trial	Promising entries
Plant hoppers	PHS, GEMP, MRST, NSN	CR 3006-8-2, IR 65482-7-216-1-2-B, RP Bio 4919-501, CR 2711-149, KAUM 179-1, KAUM 179-2, KAUM 182-1, IET Nos 23118, 22486, 23073, 23110, 23083, 23101, 23132, 23130, IET Nos 23887, 23888, 23919, 23921, 23939, 23612, 23613, 23175, 23874, 23875, IET 24158, *KAUM 166-2,* RP Bio 4918-236, RP Bio 4918-221 (S), RP Bio 4918-228(S), IC Nos 463924, 578140, 578142, 578916, 578920, IC 577285, 464186, 578151 & Dhanrasi
Gall midge	GMS, GMSS, MRST, NSN	CORG 24, JGL 19618, CORG 15, KNM 113, KNM 563, SKL-3-22-19-31-55-11, NP 3113-7, KNM 134, KNM 489, KNM 539,KNM 557, KNM 637, IC 462402, IC 577036, CB-07-540, SB143, SB 319, DRR H2, RP Bio 4918-236, RP BIO 4918-221(S), PTB 33, IET No.s 23185, 23411, 23421,22764, 23459, 23464, 23383, 23913, 23972, 23525, 24159
Stem borer	GEMP, MRST, NSN	IC Nos 463445, 577293, 577566, 578116, 578672 , 463175, 466430, 578996, KAUM 166-2, RP Bio 4918-142, RP Bio 4918-24K, 4918-228(S), RP Bio 4919-50-13, IET No.s 23004, 23009, 23185, 23308, 22894, 22568, 23431, 23440, 22752, 22763, 22777, 22289, 23459, 23081, 23088, 23118, 23073, 23919, 23600, 23604, 23574, 23589, 23839, 24007, 23961, 21936, 23923, 23935, 23003, 24083, 24114 & Jalmagna at one or more tested locations.
Leaf folder	LFST, GEMP, MRST, NSN	W 1263, LF 293, Anjali, RP 4645-688, LF 270, TKM 6, SB 436, IC 114978 & CSR 23, IC Nos 462271, 578136, 578912, 578942, 578943 & 579029, IET No. 23604, 24062, 24071, 24114, NSN-H-03, NSN-H-05, NSN-H-06, NSN-H-08, NSN-H-43, NSN-H-47
Multiple pests	GEMP	IC 463924, 462407, 463445, 578116, 578148, 578406,
	MRST	RP Bio 4918-236, RP Bio 4918-228(S) & DRRH-2
	NSN -1	IET No.s 23185, 23118, 23073, 22989, 23081, 23440, 22752, 22486, 23009, 22565, 23083, 23132, 23078, 23004, Jalmagna (NC), Salivahana
	NSN-2	IET No.s 23919, 23939, 23620
	NSN H	HPR 2143, IET No.s 22281, 22283, 22974, 23536, 23537, 23524, 23525, 23526
	NHSN	IET No.s24111, 24159, 24131, 24149, 24151

Chemical control studies

Insecticide Evaluation Trial (IET) was carried out at 35 locations revealed that the impact of Ek boond, a non ionic wetting agent was evident only in case of acephate treatment against white backed planthopper and green leafhopper. Dinotefuran with Ek boond yielded the highest and was on par with rynaxypyr with and without Ek boond. Rynaxypyr treatment was effective against stem borer and leaf folder. Dinotefuran was effective against planthoppers and leafhoppers. Pesticide Compatibility Trial (PCT) was carried out with the objective of evaluating the compatibility of newer insecticide and fungicide formulations at 22 centres revealed that there was no adverse effect on the efficacy of either the combination product of flubendamide plus buprofezin or sutathion when applied with either hexaconazole or tricyclazole or *vice versa*, confirming the compatibility of the chemicals when used as tank mix in the field.

Ecological studies

Influence of Rice Cultivation methods on insect Pest incidence (IRCP) trial conducted at 5 locations revealed significantly low dead heart damage and BPH incidence in direct seeded rice as compared to normal method. Leaf folder damage was significantly high in direct seeded rice while hispa, whorl maggot and gundhi bug damage was high in normal method of planting . In the trial on selective mechanization for enhancing productivity and profitability of rice cultivation, BPH incidence was above ETL in all the four methods of rice cultivation. BPH incidence was significantly low in drum seeding as compared to other methods. Effect of planting dates on insect pest incidence (EPDP) trial conducted at 18 locations indicated higher white ear incidence in early planting and more gundhi bug numbers in late planting. BPH and GLH population was more in normal planting.

Biocontrol and biodiversity studies

Monitoring of Pest species and Natural Enemies (MPNE) revealed the presence of five species of stem borer distributed over 15 locations with YSB being dominant in 12 locations. The YSB egg mass parasitisation ranged from 20.8% to 100% while the egg parasitisation varied from 9.13 to 100 % at various locations. Mixed populations of BPH and WBPH were found across locations. Ecological Engineering for Planthopper Management (EEPM) was taken up in six locations with a combination of non pesticidal interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering plants on bunds to increase the fitness of natural biological control agents. Such interventions increased the natural enemy populations like mirids, spiders and coccinellids and increased egg parasitisation of planthoppers across the locations.

Integrated pest management studies

Yield Loss Estimation Trial (YLET) was conducted at seven locations for two target pests *viz*., stem borer and leaf folder. Regression analysis revealed a significant negative relation between white ears and grain yield at five locations in augmented plots and two locations in natural infestation plots. A significant positive relation was observed at Aduthurai (r^2 = 0.7449). Integrated Pest Management special trial (IPMs) was conducted at 10 locations in a farmer participatory mode for a holistic management of insects pests, diseases and weeds. The insect pest incidence, disease progress curve (AUDPC) of leaf blast, neck blast, bacterial blight and sheath blight and weed population and weed biomass was low across locations in IPM plots with higher yields as compared to farmers practice with a favourable B:C ratio. Population dynamics of major insect pests assessed through light trap catches was reported from 27 centres across the country. YSB, BPH, WBPH, gall midge, leaffolder and GLH were reported from more than 15 centres in addition to other minor pests and few natural enemies.

Plant Pathology

All India coordinated Plant Pathology trials consisted of 15 trials consisting of host plant resistance against major rice diseases, monitoring of field virulences of blast and bacterial blight pathogens, disease observation nursery and

chemical control trials. The trials were conducted in 51 hot spot locations across the country. The trials on host plant resistance consisted of five nurseries comprising of 1135 entries. In addition, 400 germplasm accessions were evaluated for major rice diseases in different hot spot locations.

Host plant resistance against major rice diseases

A total of 1135 test entries from five different screening nurseries *viz*., NSN1 (185 entries), NSN2 (600 entries), NSN-Hills (66 entries), NHSN (125 entries) and DSN (159 entries) were evaluated for major rice diseases *viz*., blast, neck blast, brown spot, sheath blight, sheath rot, bacterial blight and rice tungro diseases at different hot spot locations across India. The total number of promising entries in different nurseries was 53 for leaf blast, 59 for neck blast, 62 for sheath blight, 41 for brown spot, 38 for sheath rot, 56 for bacterial blight and 35 for rice tungro virus. Out of 400 germplasm evaluated, the number of promising entries were 12 each for blast and rice tungro, 6 each for sheath blight and brown spot and 13 for bacterial blight. Some of the highly promising entries are presented in the following table.

Promising entries in Germplasm Screening Nursery

Disease	Promising entries
Leaf Blast	IC # 577329, 464126, 463845, 466619, 577482 and 466603
Sheath Blight	IC # 466619, 578035, 579011 and 577755
Brown Spot	IC # 462250, 578726, 578963 and 579036
BB	IC # 463162, 577483 and 463221

Monitoring of field virulences: *Pyricularia grisea*

The trial was conducted at 25 hot spot locations across India on a set of differentials. Cluster analysis of data from these locations categorized the blast pathogens into 6 major groups. The isolates from Upper Shillong, CRRI, Lonavla and Mugad were found to exhibit MS reaction on IR 64 indicating a shift in virulence of the pathogen at these locations. The isolates from Gangavathi, Ranchi, Pattambi and Rajendranagar formed different cluster.

Monitoring of field virulences: *Xanthomonas oryzae pv. oryzae*

The trial was conducted at 22 different hot spot locations across the country using 25 host

Highly promising entries against different diseases

Disease	Promising entries
Leaf Blast	IET # 22876, 23345, 23270, 23324, 23333 and 23446 in NSN 1; 23040, 23908, 23646, 24003 and 23826 in NSN 2; 22984, 23519, 22960 and 23523 in NSN-Hills; 24141, 24163 and 24150 in NHSN; IET 22243, DRR-BL-31-1, GSR 225, RP-Bio patho-3 and GSR 216 in DSN
Neck blast	IET # 23101, 23088, 23270, 22913 and 21261 in NSN 1; 23922, 23139, 23919 and 23619 in NSN 2; 23528, 23529 and 22978 in NSN-Hills; 24151, 24111, 24150 and 24130 in NHSN; DRR -BL-155-1, DRR-BL-295-2, RP-Patho -10, RP-Patho -11, DRR-BL-155-2, DRR-BL-257-1 and IET 22168 in DSN
Sheath Blight	IET # 22302, 22769, 23010, 22986 and 22994 in NSN 1; 23932, 23050, 23614 and 22664 in NSN 2; 22281, 22296, 23518 and 22955 in NSN-Hills; 24145 and 24127 in NHSN; RP-Patho -11 and IET 20884 in DSN
Brown Spot	IET # 22764, 22768, 22752, 23471 and 22568 in NSN 1; 23658, 23049 and 23856 in NSN 2; 23533 and 23532 in NSN-Hills; 24116, 24110 and 24109 in NHSN; VL 31630 and VL 31545 in DSN
Sheath Rot	IET # 23009, 23231, 23270 and 23088 in NSN 1; 23582, 23585 and 23737 in NSN 2; 24109, 24074 and 24081 in NHSN; IET 22128 and RP-Patho-8 in DSN
BB	IET # 23083, 23235, 23224 and 22878 in NSN 1; 23718, 23774, 23772 and 23957 in NSN 2; 23535, 23533 and 22291 in NSN-Hills; 24118, 24104 and 24082 in NHSN; IET 22226, IET 22486, IET 21009 and CB09 127 in DSN
RTV	IET # 23480, 23275 and 23110 in NSN 1; 23241, 23897, 23659 and 23698 in NSN 2; 24088 and 24145 in NHSN; CB 06 -124 RTD and IET 22715 in DSN

differentials. Most of the single genes were found susceptible at most of the locations. Isolates from Raipur, Maruteru, Chiplima and Kaul were able to produce susceptible reaction on IRBB 55 having the combination of *xa13* and *Xa21*. These data indicate a major shift of pathogen virulence profile at these locations. All the less virulent strains grouped together while the virulent and highly virulent once grouped together.

Disease Observation Nursery

The trial was conducted at 13 locations across India. Observations were recorded on leaf blast, neck blast, brown spot, sheath blight, sheath rot, narrow brown leaf spot, false smut and bacterial leaf blight disease. Across the locations, early sowing increased sheath blight severity and delayed planting favoured the diseases *viz*., leaf blast, neck blast, brown spot, sheath rot, bacterial leaf blight.

Evaluation of fungicides against location specific diseases

The trial was conducted at 34 locations across the country with an objective to evaluate some new and commercially available fungicides against locally important fungal diseases of rice. Six formulations *viz*., trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l, kresoxim methyl @ 1 ml/l, azoxystrobin 25 SC @ 1 ml/l, tricyclazole 75 WP @ 0.6 g/l, carbendazim 50 WP (Bavistin) @ 1 g/l, propiconazole 25 EC @ 1 ml/l were evaluated against location specific diseases like leaf blast, neck blast, node blast, sheath blight, brown spot, sheath rot, leaf scald and glume discoloration. Among the formulations tested, Nativo 75 WG (0.4 g/l) was the best in reducing the disease severity of leaf blast, neck blast, node blast, brown spot, sheath rot, leaf scald and glume discoloration across the locations with simultaneous increase in yield. Among the treatments, Amistar @ 1.0 ml was best in reducing the disease severity and incidence of sheath blight.

Evaluation of fungicides against false smut disease

The trial was conducted at 14 locations. Three chemicals *viz*., trifloxystrobin 25%+ tebuconazole 50% (Nativo 75WG @ 0.4g/l), kresoxim methyl (Ergon 44.3 SC @ 1ml/l) and propiconazole 25 EC (Tilt or Result @ 1ml/l)) were evaluated against false smut disease at different stage of the crop. The data revealed that application of Nativo 75WG @ 0.4g/l or Tilt/Result @ 1ml/l either at 50 % or 100% panicle emergence stage was most effective in reducing the number of infected panicles/m^2 and infected spikelets/panicles and increasing the yield when compared to control.

Integrated disease management

This trial was conducted at 8 locations. Trial was formulated with three varieties *viz*., susceptible, moderately resistant, and locally grown hybrid with and without different management practices. In case of fungal diseases, cultivation of resistant variety alone or any other variety with need based fungicide spray significantly reduced the disease. In case of bacterial blight, cultivation of resistant variety alone or any other variety with suitable fertilizer management strategy can reduce the disease intensity.

Special integrated pest management trial

The trial was formulated to validate IPM practices for the management of pests in a holistic way (including insects, diseases and weeds). The treatment includes two types of practices *viz*., IPM and farmers practices. The trial was proposed at 12 locations. With respect to diseases, data was received from Gangavathi, Chinsurah, Jagdalpur, Ludhiana and Maruteru. Adoption of IPM practices which includes seed treatment, application of recommended dose of fertilizer, proper plant spacing and timely application of specific fungicides reduced the progress of the disease *viz*., leaf blast, neck blast, sheath blight and bacterial leaf blight compared to farmer's practices.

Special screening trial on false smut

The trial was conducted at 7 locations. Ten entries (varieties/hybrids) were sown at 15 days interval and disease incidence was recorded. Among the three sowing dates, false smut disease was high on second sown crop at Aduthurai, Gangavathi, DRR, Pantnagar and Ranchi. At Kaul and Ludhiana, early sown crop recorded high disease incidence whereas at Maruteru the disease incidence was high in the third crop.

Production Oriented Survey

Production oriented survey (POS) was conducted during crop season of 2013 by 25 AICRIP centres in 18 states. A total of 111 scientific staff and 53 officials from the different States Department of Agriculture surveyed 125 Districts in 18 States. Timely arrival of the South-West Monsoon and its reasonably well distribution across the country encouraged the farmers to bring more area under rice. For the country as a whole, the rainfall for the season (June-September, 2013) was 106 % of its long period average (LPA). Out of the total 36 meteorological subdivisions, 14 subdivisions constituting 48% of the total area of the country received excess seasonal rainfall, 16 subdivisions (38% of the total area of the country) received normal season rainfall and the remaining 6 subdivisions (14% of the total area of the country) received deficient rainfall. However, during October, heavy torrential rains and tropical cyclones in the eastern belts posed a major problem to rice production. Since October, three consecutive cyclones (Phiallin, Helen and Lehar) caused significant damage to the maturing rice crop in the coastal belts of Andhra Pradesh and Odisha. Among these, Cyclone *Phailin* was the strongest which lashed on the coastal districts of Odisha and Andhra Pradesh during 10-12th October, 2013 causing severe damage to standing rice crop and human life.

A large number of rice hybrids are being grown in different states like Maharashtra, Madhya Pradesh, Jharkhand, Uttar Pradesh, Haryana, parts of Gujarat and Himachal Pradesh. The diseases like neck blast and false smut have spread throughout the country in last few years. Bakanae has become a major problem in Punjab and Haryana especially on basmati varieties. Sheath blight was recorded in moderate to severe intensity in many fields in Andhra Pradesh, Haryana, Maharashtra, Uttar Pradesh, Uttarakhand and West Bengal. Similarly, neck blast was recorded in severe form in Uttarakhand and West Bengal. False smut was recorded in moderate to severe intensity in many states like Bihar, Jharkhand, Madhya Pradesh and Uttar Pradesh. Among the insect pests, BPH was severe in many places of Punjab, Haryana, Andhra Pradesh, Kerala, Uttarakhand and West Bengal.

Technology Transfer

During the year, a cafeteria of rice technologies were demonstrated in 485 hectare area covering 15 states and four major rice ecosystems of the country. FLDs organized during this year have been effective in creating the awareness about the potential of new rice varieties, hybrids and other management technologies. In majority of the cases the yield advantages recorded by the FLD technologies were significant.

Research Achievements

Lead Research

GEY - Genetic enhancement of yield and stress tolerance
GEQ - Genetic enhancement of quality for domestic & export purpose
ABR - Application of biotechnology tools for rice improvement
RUE - Enhancing resource and input use efficiency
SSP - Sustaining rice system productivity
CCR - Assessing and managing crop response to climate change
HRI - Host-plant resistance against insect pests and its management
HRP - Host-plant resistance against pathogens and its management
IPM - Integrated pest management
TTI - Training, transfer of technology and impact analysis

GEY - Genetic Enhancement of Yield and Stress Tolerance

GEY/CI/BR/12

Redesigning the indica rice plant type by introgressing the traits for higher yield potential and disease and pest resistance from tropical japonica and wild rices (T. Ram)

IET 22598 (RP 5213-69-13-3-4-1-2-B) with 11.38%, 16.81% and 11.61% yield advantage over Sahbhagidhan, regional check and local check, respectively was identified for release in Haryana and Jharkhand by Varietal Identification Committee.

IET 22836 (RP 5208-3-IR87707-445-B-B-B) was identified as drought tolerant entry having 2 yield QTLs. This entry recorded more than 30-69% higher yield than IR64 under moderate drought stress and identified for release in the states of Tami Nadu, Madhya Pradesh and Chattisgarh.

Twenty eight new designed rice lines along with five high yielding varieties *viz*. Jaya, NDR 359, Swarna, IR 64 and Dhanrasi were evaluated in station trial. 0910022-23, 0910022-3, 0910024-8, 0910021-23, 0910023-2, 0910023-3 0910022-56 and 0910022-24 yielded significantly superior to highest yielding checks with yield of 7.0 t/ha with yield advantage of 15-22% over the best check, Dhanrasi. Forty six BC_1F_2 populations derived from *indica* and tropical japonica derived lines with bacterial leaf blight, blast and brown planthopper resistant genes were evaluated for selection of superior plant type and 1207 single plant selections (SPS) were selected while in F_3 generation 1086 SPS were selected from 114 crosses. Further, 1893 SPS in 170 crosses of F_4 and F_5 generations, 825 progenies from 2523 in F_6 generation were selected. Thirty two BC_1F_5 progenies having the genes *Bph17* (6), *Bph20 & Bph21* (12), *Bph22* (5) and *Bph23* (9) were evaluated and superior plants for yield were selected.

Of twenty two lines from Swarna/*O. longistaminata* and 230 lines from IR64/*O. glaberrima* screened under repeated tests, sixteen lines showed <10% dead heart damage. Nine hundred and forty lines in BC_3F_7 generation derived from Swarna/*O. longistaminata* and Swarna/*O. rufipogon* were screened for blast resistance; 39 lines from the former showed immune reaction while 213 lines from the latter showed resistance to blast. Seven hundred BC_3F_2 lines derived from Swarna/*O. nivara* were screened for blast and the segregation pattern suggested that a major resistant gene is introgressed. Twenty two of the BC_2F_4 introgression lines derived from Swarna/*O. rufipogon* and 103 BC_3F_6 lines from IR64/*O. glaberrima* showed resistance reaction to BLB. Effort are in progress to introgress genes and QTL through MAB in improving BPT 5204 for submergence (sub1), drought tolerance (qDTY2.1+ qDTY3.1), and resistance to BLB (*Xa21+xa13*), blast (*Pi54+Pi2*) and BPH (*Bph20+Bph21*).

Two hundred forty BILs of SR27/RP Bio226// RP Bio226 in BC_1F_6 generations were validated for the salt tolerance involving QTLs (Qksm 1.1, qNa/KSH 1.1, qSSISFH8.1). The genotypic and phenotypic data indicated that these QTLs are the alternatives to the saltol 1.

GEY/CI/BR/9

Breeding varieties for boro areas (L.V. Subba Rao)

During 2013-14, forty crosses were effected involving HYVs, farmers varieties and land races collected from the boro areas. 12 F_1 crosses and 8 F_6 populations were advanced. 156 progenies in F_4 were raised in two row pedigree nursery and 286 SPS were made based mainly on plants showing good seedling growth at low temperatures and simultaneously recording low sterility at high temperatures. Four hundred germplasm accessions/land races/farmers' varieties belonging to early group were also evaluated. One elite culture from RNR 2809/Tella Hamsa developed under the project was nominated to IVT Boro 2013-14.

GEY/CI/ BR/16

Breeding high yielding rice varieties for resistance to planthoppers (G. Padmavathi)

A set of 60 resistant RILs developed from four crosses *viz*., TN1 / Ptb 33, TN1 /Sinna sivappu,

Samba Mahsuri /MO1 and NDR 359 /MO1 were screened for third and fourth season during *kharif*, 2013 and *rabi*, 2014 against mixed population of planthoppers under field conditions at Maruteru, a hot spot location. Planthopper outbreaks were noticed when some of the RILs are in flowering and maturity stage. The susceptible check (TN1) as well as susceptible RILs showed severe hopper-burn symptoms of complete drying and mortality. The insect counts of planthoppers were recorded on 20 seedlings in each test line. It revealed the prevalence of BPH infestation over WBPH *i.e.*, 350 to 515 BPH insects and 80-130 WBPH insects during *Kharif*, 2013. Again during *rabi*, 2014, BPH was abundant compared to WBPH throughout the crop growth with an average BPH population of 500-600 and 5-10 WBPH insects. Thirty of 60 RILs evaluated were found to be resistant to planthoppers in both seasons. They survived and were rated as resistant with a mean score of 3.2 to 5.3 on 0-9 scale. Their growth was normal and could set seed under field situation. The same 30 resistant RILs identified in field were evaluated for seedling stage resistance under controlled conditions in green house for BPH and WBPH separately at DRR, Hyderabad. The experiment was replicated thrice adopting standard seed box method. TN1 was used as a susceptible check whereas PTB 33 and MO1 were the resistant checks for BPH and WBPH respectively.

In green house, 4 RILs of the cross TN1/PTB 33 and one RIL of the cross TN1/Sinnasivappu showed resistance with more are less similar scoring against both hoppers individually and combined. However, the 10 resistant RILs obtained from two crosses namely Samba Mahsuri/MO1 and NDR 359 /MO1 against combined hopper population in field indicated susceptible reaction to both hoppers in green house. The differential insect reaction of few RILs exhibited in field and green house can be attributed mainly to the possibility of expression of different sets of resistant genes during seedling and reproductive stages in those specific lines. However, the common resistant RILs for both hoppers found during seedling stage (green house) as well as reproductive stage (field) of crop growth derived from the crosses, TN1/ Ptb33 and TN1/Sinnasivappu can be utilized as potential dual

GEY/CI/ BR/14

Breeding rice for enhanced phosphorus use efficiency (V.P. Bhadana)

Ninety diverse genotypes consisting 36 entries of Green Super Rice (GSR), 28 mutants of N 22, 11 *Pup1* NILs in the background of IR 64 and IR74 including recurrent parents and 15 Pup donor genotypes were screened under graded level of Phosphorus (0, 20, 40, and 60 kg/ha) during *Kharif* 2013 in order to assess their tolerance to low P conditions and response to its application. Different groups of genotypes responded differently under different gradients of phosphorus. Under 0-P situation

Screening of recombinant inbred lines against planthoppers at Maruteru and DRR

Cross	Number of resistant RILs	Score in field at Maruteru (BPH+WBPH)	Score in green house at DRR	
			BPH	WBPH
TN1 / PTB 33	8	3.9 (R)	4 (R)	4.3 (R)
TN1 / Sinna sivappu	7	4.5 (R)	2.9 (R)	3.2 (R)
Samba Mahsuri / MO1	8	3.8 (R)	8 (S)	6 (S)
NDR 359 / MO1	7	4.3 (R)	8.3 (S)	7.9 (S)
Checks				
TN1 (S)		9 (S)	9	9
MTU 1001 (R to BPH)		3 (R)	-	-
Ptb 33 (R to BPH)			3	-
MO 1 (R to WBPH)			-	3

Pup1 NILS have recorded the highest yield (1910 kg/ha) followed by donors (1760 kg/ha) and GSR & varieties (1412 kg/ha). The NILs not only gave better yield under low P but also responded well to P application at 60 kg/ha and recorded a mean grain yield increase of 148.6% followed by 123.5% in GSR & varieties and only 90.3% in donors. Grain weight/hill at 0-P was maximum (9.0 g/hill) in KRH 2 and RTS 14, while minimum in GSR-309 (1.0 g). At 60 kg/ha P application RTS-14 could give only 11 g/plant whereas IR 64-*Pup1*-F recorded yield of 17.8 g/plant against the 15.0 g/plant in IR 64 indicating that IR 64 retained high yielding attributes even after acquiring *Pup1* QTL. Twenty genotypes as listed below performed well under very low P.

Involving Swarna and Rasi as donor for low P tolerance, 1643 progenies of 10 crosses in F_4 were raised under sub-optimal level of phosphorus during *kharif* 2013. Based on comparative growth and other agronomic attributes including grain type more than 1500 SPS were made. 500 plants each of four F_4 bulks were grown under low P condition and seeds were collected from vigorous plants. In addition, F_4 generation of 4 crosses was advanced by collecting single seed from each plant for developing RILs. 36 BC_1F_1s or three way F_1s were developed; 35 new crosses involving donors from northeast germplasm and Kasalath were successfully attempted.

Tolerant genotypes with > 7 productive tillers and 6 g /plant)
HHZ 5-SAL 10-DT 2-DT 1, IR 83142-B-61-B, SM 686, SACG 4, SM 363, IET 22081, YJ20, KRH2, NDR 359, RTS 14, BJ1, Emata A 16-34, Mudgo, Yodanya, IR-64-21, IR-74 PUP1-A, IR-74 PUP1-B, IR-74 PUP1-C, IR-74 PUP1-E, IR-64-PUP1-F

GEY/CI/ BR/19

Germplasm screening and identification of genes for developing resistance to sheath blight in rice (Jyothi Badri)

Seven land races Gumdhan, Wazuho Phek, Meghalaya Lefara, Chng Chakhao, Kunda, Ngonolasha and Shitharia Maha have shown resistance consecutively for the third time under glass house conditions. Nine hundred forty accessions comprising of introgression lines, land races, A, B, R lines, wild rices and tropical japonicas (TJPs) were screened during *Kharif* 2013 and among these 106 germplasm lines were found promising for sheath blight resistance. Of these 2 mutants, 14 introgresed lines (IL), 2 elite lines, 1 B line and 7 TJPs were found promising for the second time. Three gall midge biotype lines *viz*., ARC 6605, MR 1523, RP 2068-18-3-5 have shown moderate resistance. Of 82 Green Super Rice (GSR) lines, GSR 106 showed resistance and three lines *viz*., GSR-133, GSR-304 and GSR-311 showed moderate resistance to sheath blight disease.

Earlier reports indicate that days to flowering and plant height are correlated to sheath blight resistance. In the present study, 80% of the germplasm lines showing promising reaction to the disease are late in flowering or taller or both. 9 ILs, 9 TJPs and 4 LRs are early flowering types and with plant height less than 120 cm. These lines may possess true resistance to sheath blight and can be used in breeding programmes. Tetep, Teqing, Jasmine 85 and 7 land races reported as promising against sheath blight disease were crossed with Samba Mahsuri, MTU 1010 and Improved Samba Mahsuri. F_1s have been generated in various combinations.

GEY/CI/HY-1

Development and evaluation of three line hybrids with better grain quality and resistance to major pests and diseases (B.C. Viraktamath)

S.No.	Promising hybrid
1.	IR 79156A/BK 49-78
2.	IR 79156 A/BK 49-43
3.	IR 79156A/KCD-1
4.	APMS-6A/BK 49-77
5.	IR 58025A/BK 64-116
6.	IR 58025A/BK 49-43
7.	IR 58025A/BK 39-179
8.	IR 58025A/BK 49-77

During *Kharif* 2013, five hybrids developed at DRR *viz*., DRRH-88 (IHRT-ME), DRRH-89 (IHRT-ME),

DRRH-90 (IHRT-M), DRRH-91 (IHRT-M) and DRRH-92 (IHRT-MS) were tested in AICRIP trials. In a station trial, of the 26 hybrid combinations evaluated, eight promising ones were identified and listed below.

GEY/CI/HY-7

Exploitation of inter sub-specific heterosis in rice (*Oryza sativa* L.) (A. S. Hari Prasad)

Twenty six promising genotypes were identified from the available breeding materials and ten crosses were attempted between the promising lines. Two hundred sixty single plant selections were made from the breeding materials in various segregating generations. Of 300 test crosses evaluated, 60 restorers, 40 maintainer and 20 promising combination were identified.

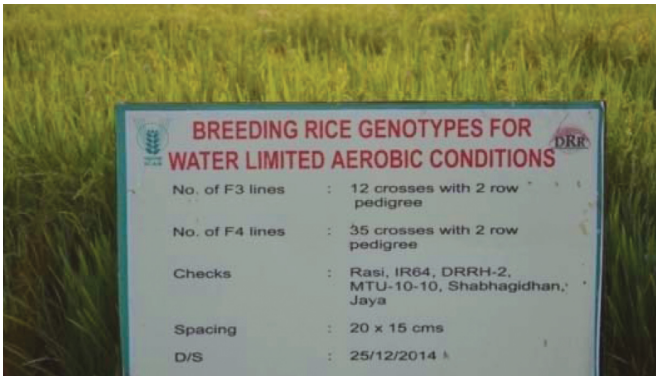
GEY/CI/HY-8.

Development of Parental lines and hybrids with tolerance to salinity and suitability to aerobic situations. (P. Senguttuvel)

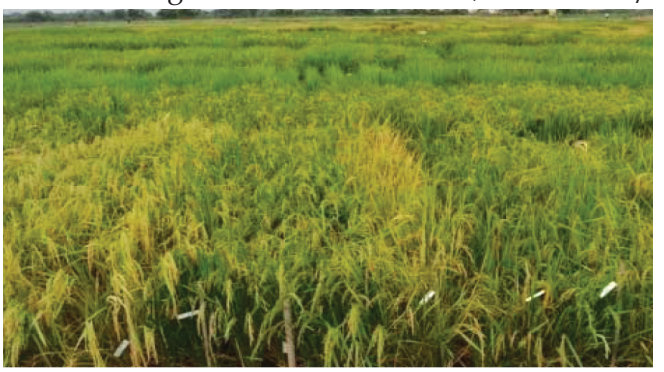
For the improvement of hybrid rice parental lines through Marker Assisted Backcross Breeding (MABB) for abiotic stresses, F1s were produced utilizing DR714-2-1R,RPHR 1096 restorer lines and also maintainer lines with donors of qDTY 12.1 (yield under drought), *Pup* 1 and SalTol.

For parental line improvement for abiotic stresses through conventional breeding, the segregating populations of 47 cross combinations were evaluated under direct seeded aerobic and irrigated conditions. More than 1600 single panicle/plant selections were made based on their seedling vigor, good plant type, grain type and also yield and are in F3 & F4 generations. 37 new crosses were made involving diverse donor parents for abiotic stresses with hybrid rice parental lines.

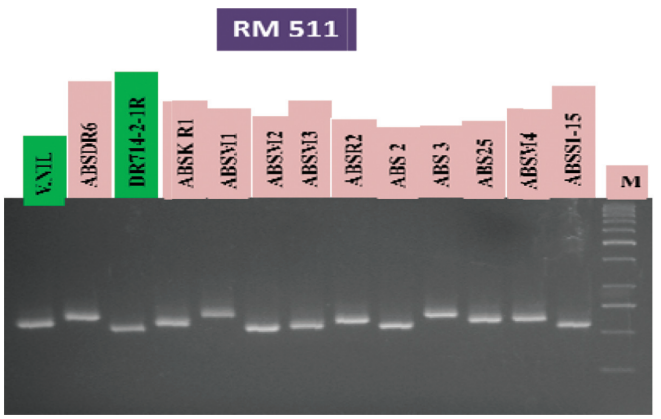
265 F1s were obtained involving 455 breeding lines for abiotic stresses resulted 16 restorers and 4 maintainers, which will be retested for confirmation. Developed new hybrid combinations for aerobic conditions (IR 58025A/3005; IR 58025A/L2182) and

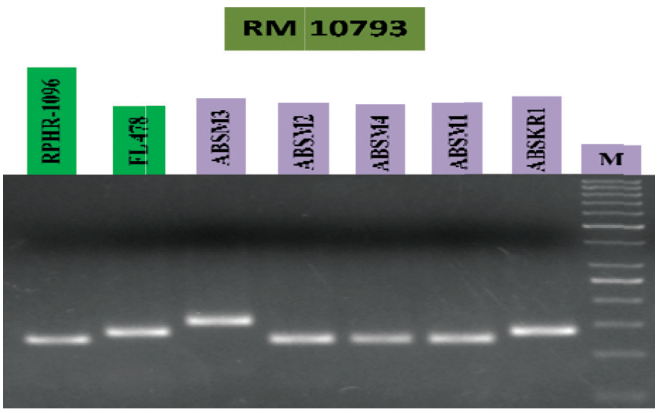


nominated in IVT Aerobic 2013 trial, similarly one hybrid *viz.*, IR 79156A/363-5 nominated in CSTVT Trial. Among the three nominated, IR 58025A/



L2182 is promoted for AVT 1 aerobic for further testing. Another best restorer for aerobic condition was identified for nomination in IVT Aerobic trial-





2014 are IR58025A/AYT 21 and IR68897A/ SV-315-80R. New hybrid combinations namely, IR 68897A/ABU-10-82R and IR 79156A/50-13 and APMS 6A/10246 are in yield trial testing. Best restorers were identified and included in station trials *viz.,* ABU-11-37R and SV-31-080.

GEY/C1/HY/6

Genetic improvement of maintainers and development of CMS lines (K.B. Kemparaju)

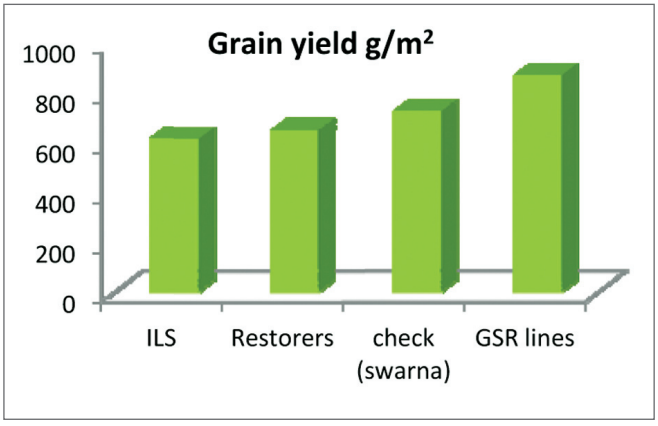
S. No.	Cross Combination	Stage of development
1	APMS 6A X Tukad UNDA	BC4 generation
2	IR 79156A X OM 6377 X	BC4 generation
3	Pusa 5A X CR 2652-14	BC3 generation
4	Pusa 5A X CNR-12	BC3 generation
5	IR 68897A X CN-1223-5-4-3-2	BC3 generation
6	IR 68897A X C 047	BC3 generation

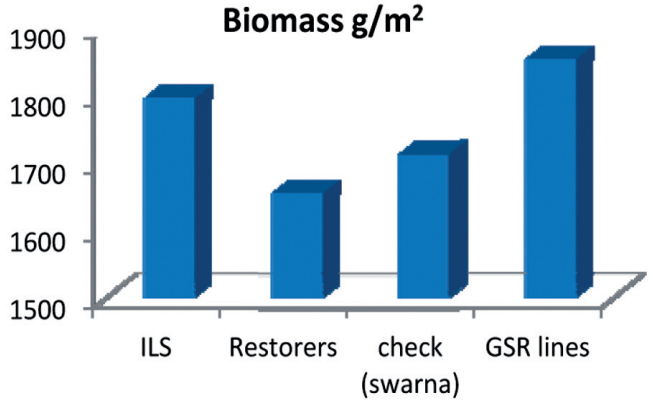
650 entries were evaluated in source nursery and promising entries were used for effecting test cross using different CMS lines. Of 250 test cross evaluated there were 20 promising maintainers were identified in test cross nursery. The identified important ones are being used for the CMS line development by recurrent back cross. The list shows the entries were in the back cross nurseries as follows. There were 16 F1's were produced for the genetic improvement of maintainers using promising ones. F1's were back crossed to respective recurrent parents in order to improve stigma exsertion.

GEY/CP/PP/12

Physiological approaches for Ideotype breeding in rice (P. Raghuveer Rao)

Divergent rice groups from introgressed lines for yield QTLs, restorers in hybrid rice programme and GSR lines were screened for identifying physiological characters for using them as donors in Ideotype breeding. 30 lines from various groups with Swarna as check were laid out in RBD design and observations were recorded at tillering, flowering and maturity stages. GSR lines had mean values of 105-120 cm plant height with thick dark green leaves and high chlorophyll content, leaf angle varied from 40-55 degrees with high photosynthetic rate and tiller number varied from 300-350 per m^2, leaf area index 6-7, biomass of 1850-2500 g/m^2, harvest index more than 45%, panicle number 300-350 m^2, grain number 100-150 grains per panicle, 1000 grain weight of more than 25 grams and grain yield varied from 700-1000 g/m^2. Among the groups studied GSR lines were superior for various yield components such as biomass, grain yield, harvest index and thousand grain weight except panicle number when compared with Swarna. Among ILS 248-s was superior and in case of restorers RPHR-1005 (Restorer of DRRH3 hybrid) was superior as compared to Swarna.





GEQ - Genetic Enhancement of Quality for Domestic and Export purpose

GEQ/CI/BR/11

Genetic enhancement of quality rice varieties through conventional and molecular breeding approaches (N. Shobha Rani)

Promising Basmati elite line

After 3 years of testing from 2011-2013 in Basmati trials, IET 22787 (RP 4594-121-148-24-11) was promising in the traditional basmati growing areas of Western Uttar Pradesh and Punjab. It recorded 15%, 38% and 67% yield superiority over Pusa Basmati 1, Pusa Basmati 1121 and Taroari Basmati respectively in region 3. It has semi tall plant stature (115 cm) with 102 days flowering duration and consistently exhibited moderate resistance to GM biotype 4, neck blast and brown spot. Quality wise, IET 22787 possesses aromatic extra long slender grains (7.76 mm), moderate HRR (50.3%), good kernel elongation on cooking (KLAC) (13.5 mm), intermediate ASV (4.0) and intermediate amylose content (24.10%) which are most desirable cooking quality traits. In the panel test, IET 22787 recorded good appearance on cooking with well elongated grains, tenderness on touching and chewing, very good taste, optimum aroma and good overall acceptability as compared to Pusa Basmati 1 and Taroari Basmati.

Evaluation of breeding material

A pedigree nursery of 2,420 lines (F4 ~ F8 generations) from 39 crosses were evaluated during *Kharif* 2013. All lines were also assessed for aroma, kernel length and kernel elongation on cooking in quality laboratory. 172 lines were best with excellent KLAC (18.1 ~ 20 mm) with long to extra long slender aromatic grains. Some of the most promising crosses include RP 5237 (Vasumati / IET 18004), RP 5268 (Pusa Basmati 1121 / IET 18990), RP 5238 (Vasumati / IET 19492), RP 5240 (Sugandhamati / IET 18990), RP 5242 (Sugandhamati / IET 19492) and RP 5249 (IET 18033 / IET 18004). In addition, 544 lines from 14 crosses also possessed aromatic, long to extra long slender grains with very good KLAC (16.1 ~ 18 mm). A total of 1,330 SPS were made based on semi-dwarf plant stature, flowering duration and good phenotypic acceptability.

Under the objective morphological and molecular characterisation of an exclusive set of 556 basmati and other aromatic rice germplasm, a core set of 78 accessions was developed for the first time using

Promising crosses in F5 generation with high kernel elongation on cooking and aroma, *Kharif* 2013

RP No	Cross Combination	12-13	13.1-14	14.1-15	15.1-16	16.1-17	17.1-18	18.1-19	19.1-20	20.1-21	21.1-22	Total
RP5237	Vasumati / IET 18004	1	2	10	19	14	72	36	15	-	-	298
RP5238	Vasumati / IET 19492	-	3	-	41	40	10	7	7	-	-	110
RP5240	Sugandhamati / IET 18990	-	-	-	62	45	4	-	-	-	-	111
RP5241	Sugandhamati / IET 18004	-	-	-	24	24	-	4	-	-	-	52
RP5242	Sugandhamati / IET 19492	-	-	-	22	27	12	7	-	-	-	68
RP5249	IET 18033 / IET 18004	-	-	14	7	20	19	22	-	-	-	89
RP5250	IET 18033 / IET 19492	7	19	33	22	31	3	-	-	-	-	136
RP5268	Pusa Basmati 1121 / IET 18990	-	-	-	12	15	18	40	32	9	7	140

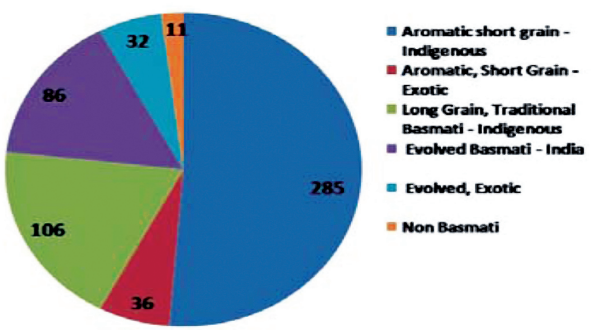
the binary data of 73 markers from 12 chromosomes along with data of 15 important DUS characters with the help of power core software. SSR markers were selected based on universal core genetic map (UCGM) (Julie Orjulea *et al*, 2009). Using this map, for every anchor 1 or 2 SSR markers were chosen for initial polymorphism survey. As a collaborative activity with IARI, PAU, TNAU, we used about 150 markers for the development of core set. The analysis gave the core set an efficiency index of 0.85. Traits like days to 50% flowering (0.983), panicle threshability (0.969) showed high diversity and contributed more to the core set formation. Among molecular markers, RM 27172 (0.966) and RM 27318 (0.898) of chromosome 11 contributed highest. Diversity index of morphological traits and molecular markers was almost similar in the core as well as in the entire collection. The core set was analysed with BADEX7-5, the functional marker to score the presence of 8 bp deletion of betaine aldehyde dehydrogenase (*badh*) gene responsible for accumulation of 2 acetyl-1 pyrroline (2AP), the principle aroma compound in aromatic varieties. 19 accessions were without this deletion indicating the presence of novel alleles of *badh-2*.

Introgression of Bacterial blight resistance into basmati genetic background

Many backcross derived lines developed earlier by crossing two traditional Basmati varieties (Taroari Basmati and Basmati 386) and an evolved Basmati (Vasumati) with Improved Samba Mahsuri which is a MAS derived product resistant to bacterial leaf blight (BB), to transfer the three major BB resistant genes *viz.*, *Xa21*+ *xa13* + *xa5* into the genetic background of the aforementioned Basmati cultivars. Based on repeated phenotyping and genotyping, a total of 42 Basmati pyramided lines (BPLs) were selected. The presence of the three major BB resistant genes was done using candidate gene specific markers *viz.*, for *Xa2 1*(pTA248), *xa13* (xa13-prom) and for *xa5* (xa5-FM). During *Kharif* 2013, 42 BPLs were tested in station trial and were inoculated with BB inoculum to thoroughly assess the BB reaction in the field conditions. On genotyping, it was found that there are 25 valuable BPLs of which six lines are in the background of Taroari Basmati and 19 in the background Basmati 386 having the BB resistant genes either singly or in combination and on phenotyping showed high degree of resistance to BB both in the field and glass house inoculated conditions. This simultaneous field and glass house phenotyping and accurate genotyping clearly confirmed the presence of the target resistance genes and unequivocally demonstrated their resistance against bacterial blight. The single-gene, two-gene and three-gene pyramid lines, being near-isogenic lines (NILs) of Taroari Basmati and Basmati 386, with few variations for agromorphological traits which are similar to IRBB lines (NILs of IR 24 possessing different single and multiple genes conferring resistance against bacterial blight and developed by IRRI, Philippines). These BB resistant BPLs are the materials developed first of its kind in basmati

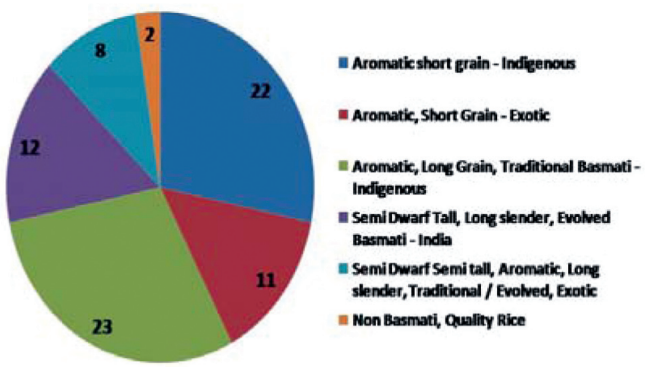
Total aromatic accessions and core accessions, *Kharif* **2013**

Distribution of Aromatic accesions in ANP, *Kharif* 2012



Total Collection: 556

Distribution of Aromatic accessions in CANP, *Kharif* 2013



Core Collection: 78

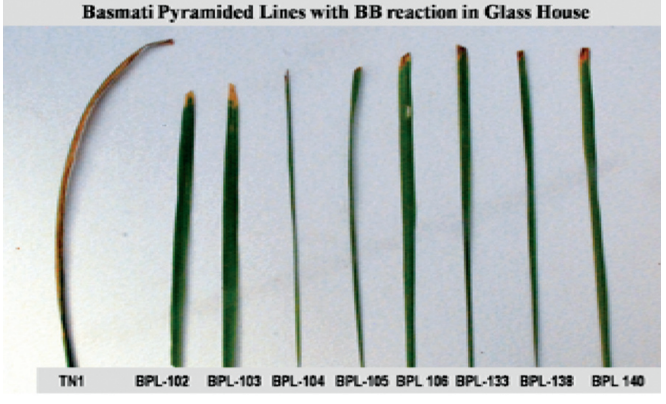
background through this study which can be deployed as varieties and also as elite donor lines for resistance breeding programmes. The salient features of some of BB resistant lines are given below.

There are four outstanding BPLs *viz.*, BPL 104 (RP 4691-326-1-1-1-1-1-1-1), BPL 105 (RP 4691-326-1-1-2-1-1-1-1), BPL 106 (RP 4691-326-1-1-2-2-1-1-1), and BPL 123 (RP 4700-35-1-2-2-1-1-1-1), which are three-gene pyramids possessing *Xa21* + *xa13* + *xa5*. Among these, mention may be made of BPL 123 which has a constellation of long slender grains and BPL 106 which has medium slender aromatic grains both with excellent cooking characteristics.

There are 4 BPLs which have a combination of 2 genes *xa13* + *xa5* with long slender aromatic grains with good cooking quality and elongation on cooking. These lines include BPL 120 (RP 4700-30-1-1-3-1-1-1-1), BPL 121 (RP 4700-30-1-1-3-2-1), BPL 122 (RP 4700-30-1-1-4-1-1) and BPL 127 (RP 4693-35-2-1-1-1-1).

Details of basmati pyramided lines with introgression of BB resistant genes

Genes combinations	Back ground Cross	Pedigree details
Xa21 *xa13* *xa5*	Basmati 386 (4 BPLs)	BPL 104 (RP 4691-326-1-1-1-1-1-1-1), BPL 105 (RP 4691-326-1-1-2-1-1-1-1), BPL 106 (RP 4691-326-1-1-2-2-1-1-1), BPL 123 (RP 4700-35-1-2-2-1-1-1-1)
xa13 *xa5*	Basmati 386 (3 BPLs)	BPL 120 (RP 4700-30-1-1-3-1-1-1-1), BPL 121 (RP 4700-30-1-1-3-2-1), BPL 122 (RP 4700-30-1-1-4-1-1)
	Taraori Basmati (1 BPL)	BPL 127 (RP 4693-35-2-1-1-1-1)
Xa21 *xa5*	Taraori Basmati (1 BPL)	BPL 131 (RP 4693-40-2-2-2-1-1)
Xa21 *xa13*	Taraori Basmati (3 BPLs)	BPL 101 (RP 4693-44-5-2-2-2-2-1-1), BPL 103 (RP 4693-101-2-1-1-1-1-1-1), BPL 128 (RP 4693-38-1-1-2-1-1)
	Basmati 386 (5BPLs)	BPL 134 (RP 4700-41-2-2-4-1-1), BPL 135 (RP 4700-41-2-2-5-1-1), BPL 137 (RP 4700-42-2-1-1-1-1), BPL 139 (RP 4700-42-2-1-3-1-1), BPL 140 (RP 4700-45-1-2-4-1-1)
xa13	Basmati 386 (7 BPLs)	BPL 108 (RP 4694-193-3-1-1-3-1-1-1), BPL 109 (RP 4694-193-3-1-1-3-2-1-1), BPL 110 (RP 4694-193-3-1-1-3-1-2-1-1), BPL 111 (RP 4694-193-3-1-1-3-2-2 1-1, BPL 133 (RP 4700-41-2-2-1-1-1), BPL 141 (RP 4694-130-1-1-1-1-1-1-1), BPL 142 (RP 4694-130-1-1-1-1-1-2-1)
	Taraori Basmati (1 BPL)	BPL 124 (RP 4693-28-2-1-1-1-1)



Basmati Pyramided lines exhibiting resistant BB in glass house

BPL 131 (RP 4693-40-2-2-2-1-1), is exclusive in possessing a dominant and a recessive gene combination (*Xa21* + *xa5*) , with BB resistance and desirable Basmati grain quality traits.

Eight BPL lines could be identified with the gene introgression being a combination of *Xa21* + xa13. They include BPL 101, BPL 103, BPL 128, BPL 134, BPL 135, BPL 137, BPL 139 and BPL 140. Although, all these lines were highly resistant to bacterial blight, BPL 134 (RP 4700-41-2-2-4-1-1), BPL 137 (RP 4700-42-2-1-1-1-1) were immune under repeated phenotyping. These 8 two-gene pyramids have excellent basmati grain quality traits. Special mention may be also be made of BPL 135 (RP 4700-41-2-2-5-1-1), BPL 101 (RP 4693-44-5-2-2-2-2-1-1) and BPL 103 (RP 4693-101-2-1-1-1-1-1-1) in this category.

Eight BPL lines have the single recessive gene *xa13*. These include BPL 108, BPL 109, BPL 110, BPL 111, BPL 124, BPL 133, BPL 141 and BPL 142. Among these, five lines have extra long slender aromatic grains, good elongation and preferred range of ASV and AC. While all the lines recorded high degree of resistance to bacterial blight, BPL 133 (RP 4700-41-2-2-1-1-1) is a unique genetic stock which was observed to be consistently immune in repeated glass house tests. Few other valuable lines with *xa13* gene include BPL 108 (RP 4694-193-3-1-1-3-1-1-1), BPL 109 (RP 4694-193-3-1-1-3-2-1-1), BPL 124 (RP 4693-28-2-1-1-1-1) and BPL 142 (RP 4694-130-1-1-1-1-1-2-1).

Efforts are being made to nominate some of elite bacterial blight resistant basmati lines into AICRIP trials and also to identify unique lines of potential academic, scientific value for registration with NBPGR, New Delhi as they will be a valuable resource for use in basmati improvement programmes.

BPL No	Phenotypic screening data					Quality data 2013								
	FD days	PH (cm)	NET/P	Field score	Glass House score	Mill (%)	KL (mm)	L/B ratio	GT	KLAC (mm)	ER	ASV	AC (%)	Aro-ma
Xa21+xa13+xa5														
104	116	118	35	1	1	66.0	4.98	2.89	MS	8.8	1.76	4.0	20.84	MS
105	119	98	13	1	1	63.7	4.85	2.77	MS	10.5	2.16	4.0	20.09	SS
106	116	105	12	1	1	68.7	4.98	2.76	MS	12.5	2.51	4.0	22.37	SS
123	116	120	12	1	1	66.2	7.48	4.22	LS	13.6	1.81	4.0	23.00	SS
xa13+xa5														
120	113	140	11	1	1	66.0	7.08	4.06	LS	14.8	2.09	5.0	20.61	SS
121	103			1	1	66.0	7.76	4.33	LS	15.4	1.98	5.0	20.75	SS
122	109	138	13	3	3	63.5	7.64	4.19	LS	14.5	1.89	5.0	21.15	SS
127	98	105	12	3	3	62.6	8.13	4.61	LS	14.8	1.82	3.0	20.70	SS
Xa21+xa5														
131	96	118	11	3	3	64.4	7.36	4.08	LS	15.7	2.13	4.0	19.26	SS
Xa21 +xa13														
101	99	118	35	1	1	68.0	7.41	4.11	LS	14.3	1.92	4.0	21.17	SS
103	102	107	12	1	1	65.0	7.19	3.80	LS	15.2	2.11	4.0	21.34	SS
128	100	117	11	1	1	60.3	7.63	4.36	LS	15.5	2.03	3.0	19.40	SS
134	98	118	11	1	1	63.9	7.77	4.11	LS	15.1	1.94	3.0	20.03	SS
135	98	76	14	3	1	64.9	7.91	4.32	LS	16.5	2.08	4.0	20.66	SS
137	97	111	17	1	1	60.7	7.77	4.36	LS	16.2	2.08	3.0	22.06	SS
139	99	118	16	3	3	62.1	7.69	4.13	LS	16.2	2.10	3.0	19.33	SS

BPL No	Phenotypic screening data					Quality data 2013								
	FD days	PH (cm)	NET/P	Field score	Glass House score	Mill (%)	KL (mm)	L/B ratio	GT	KLAC (mm)	ER	ASV	AC (%)	Aro-ma
140	98	112	10	1	1	64.6	7.87	4.37	LS	17.5	2.22	3.0	19.60	SS
xa13														
108	104	87	16	3	3	68.2	7.99	4.64	LS	13.7	1.71	4.0	21.78	SS
109	111	85	13	3	3	69.6	7.36	4.20	LS	14.4	1.95	4.0	20.79	SS
110	109	82	11	3	3	65.3	7.22	4.12	LS	14.3	1.98	4.0	20.68	SS
111	107	91	18	3	3	71.1	7.86	4.44	LS	15.4	1.95	4.0	22.10	SS
124	96	118	11	3	3	62.1	7.85	4.31	LS	14.3	1.82	4.0	21.98	SS
133	99	113	11	3	1	60.2	7.91	4.37	LS	15.9	2.01	4.0	20.05	SS
141	111	86	13	3	3	65.0	7.51	4.36	LS	14.1	1.87	4.0	23.27	SS
142	112	90	12	3	3	69.2	7.73	4.27	LS	14.4	1.86	4.0	20.75	SS
Checks														
143	112	104	10	9	9	68.9	7.68	4.77	LS	15.4	2.00	4.0	24.32	SS
144	105	95	14	9	9	61.4	7.25	3.96	LS	13.9	1.91	4.0	19.35	SS
145	105	92	12	9	9	65.6	7.33	3.89	LS	13.8	1.88	4.0	20.66	SS
146	120	109	13	1	1	69.9	4.82	2.70	MS	9.2	1.90	4.0	21.47	NS
147	105	113	10	9	9	66.5	7.45	4.40	LS	13.9	1.86	4.0	22.25	SS

BPL 143-Vasumati; BPL 144 -Taraori Basmati -BPL 145- Basmati 386; BPL 146-RPBIO 226, BPL 147-Pusa Basmati 1 FD: Flowering duration; PH-Plant height; NET-No of effective tillers/plant, GT-Grain type

GEQ/CI/BR/8

Enhancing nutritional quality of rice through bio-fortification (V. Ravindra Babu)

During *kharif* 2013 about 100 lines each in F_4 and F_5 generations were selected for high zinc content and another 10 fixed lines in F_8 generation of PR 116/ Kalanamak, PR116/ R. Basmati, Samba Mahsuri/R. Basmati, Samba Mahsuri/Kalanamak were selected on the basis of phenotype acceptability, high yield and with high zinc content. Four elite lines were nominated to AICRIP testing during *Kharif* 2013 and of these three entries RP HP 1-IR 68144-2B-2-2-3-10120 (IET 23830), RP HP 2-IR 68144-2B-2-2-3-1-127 (IET 23831), RP HP 3-IR 80463-B 39-3/IR 81421-B-B-66 (IET 23832) were found promising on the basis of high zinc and higher yield across 17 locations. Five lines are identified for nomination to IVT Biofortification during *Kharif* 2014. About 150 and 200 SPS were made from F_3 segregating populations bred for high protein and bran oil respectively.

200 germplasm lines form Coimbatore and 40 lines from hill region i.e., from Malan are analyzed for Fe & Zn contents in grains and identified 5 lines with high zinc content.

An attempt was made to calibrate X ray fluorescence spectrometry (XRF) readings of Fe and Zn with atomic absorption spectrometry (AAS) and inductively coupled plasma atomic emission spectrophotometer (ICPAES). About 293 brown and polished rice samples from DRR were

analyzed on XRF at DRR; ICRISAT, Hyderabad; MSSRF, Chennai; AAS, Raipur; ICPAES, Ludhiana. Results indicate that iron and zinc values obtained with ICPAES are higher than that of XRF. At 0.05 probability, significant correlation was observed for zinc from lab to lab and machine to machine in both brown and polished rice; for iron significant correlation was observed among the 3 XRF machines. Correlation was non significant between XRF and ICPAES.

First time, IVT-bio-fortification trial with 26 nominations was organised at 17 locations under AICRIP and on the basis of yield, quality and high zinc content six genotypes are promoted to AVT-1. IET 23191 (Samba Mahsuri/Chittimutyalu) having high zinc of >20 ppm, with short slender grains and >3.0 t/ha grain yield developed at DRR through conventional breeding is submitted for registration to NBPGR and another line from the same cross with medium slender grains and >6.0 t/ha grain yield and >20 ppm zinc in polished grain with good quality possessing 61% HRR, 23.67% AC, 22 mm GC is identified for nomination to bio-fortification trial.

Twenty popular varieties with different amylose content were analysed for glycemic index and of these Lalat and Samba Mahsuri recorded low GI of 53.17% and 51.41% respectively.

GEQ/C1/BR/20

Development of value added rice based products for different uses (M.M. Azam)

After several modifications in the composition a new product "Rice Riche Cream for Dry and Cracked heel" was developed. The product in present form was obtained containing 30-40% rice bran oil and 10-20% brown rice extract and other key ingredients of the product include water and glycerol. The product also contains oryzanol, vitamins and other nutrients and antioxidants like tocopherols, tocotrienols, phytosterols. The product is suitable for very dry and dehydrated skin and is also very effective against cracked heels. Its regular application makes skin smooth, soft and supple.

The product face scrub contains rice bran oil (20-35%) and rice flour (10-20%) as key ingredients. Although the product is oil based, it can easily be washed with water. Skin after use becomes smooth, soft and moist.

Experiments for iron fortification of rice from four different varieties (Swarna, Jaya, MTU 1010 and RP Bio 226) were conducted using three different concentration of iron (1000 ppm, 500 ppm, 250 ppm). With decrease of iron concentration, absorption of iron in grain also decreased. At 1000 ppm, maximum absorption in polished rice grain was observed in Jaya variety. At 250 ppm concentration, maximum absorption was observed in RP Bio 226 (38.5 ppm) followed by MTU 1010 (30.7 ppm), Jaya (23.9 ppm) and Swarna (16.1ppm).

GEQ/ BR/13

Genetic enhancement of aromatic short and medium grain rices (G.S. Varaprasad)

Identification of core set

Two hundred and eight aromatic short grain (ASG) land races based on 18 morphological, 9 agronomic, 6 biotic stresses, 16 physico-chemical quality parameters and 27 polymorphic SSR marker data was considered for core set identification using Power core. (http://genebank.rda.go.kr/powercore/). In the present study, the core set identified comprises of 45 genotypes. The diversity existed for the characters in the entire collection is represented in the core set. The allele richness present in the entire collection is also retained in the core collection as evidenced by the coincidence rate of 96.93% and polymorphic information content of 0.99.

Core set in aromatic short grain rices

Asg_0001	Shukla Phool	Asg_0076	Atmashital
Asg_0003	Kubri Mohar	Asg_0077	Amritbhog
Asg_0004	Bhatta Phool	Asg_0083	RAU 3079
Asg_0006	Bans patri	Asg_0084	RAU 3030
Asg_0008	Chini Kapoor	Asg_0086	RAU 3043
Asg_0009	Barang	Asg_0093	Pim-pudibasa

Asg_0013	Moongphali B	Asg_0097	IGSR 3-1-5
Asg_0014	Shyam Jira	Asg_0098	IGSR 3-1-40
Asg_0015	Dindli	Asg_0101	Neelabati
Asg_0029	RAU 724-48-33	Asg_0109	Malaysia
Asg_0031	Magura-phulla	Asg_0116	ASGPC19
Asg_0032	Deulabhog	Asg_0121	Bikoni
Asg_0041	Ganjeikalli	Asg_0126	Dudaga
Asg_0044	Jaiphulla	Asg_0151	RD 1008 Sel from Dubraj
Asg_0046	Magura	Asg_0157	RC 781 Chinnor
Asg_0048	Nagri Dubraj	Asg_0159	RB 287 Dubraj Bandi
Asg_0055	Jhilipanjari	Asg_0166	Kanak Jeer
Asg_0061	Muhulakuchi	Asg_0170	Champaran Basmati 1
Asg_0062	Thakurabhog	Asg_0190	Khorika Joha
Asg_0064	Kalikati	Asg_0201	Kapoor Chini
Asg_0067	Kesar	Asg_0205	Kala Namak (Nichlaul)
Asg_0072	Juhibengal A	Asg_0207	Jeerakasala
		Asg_0208	Narendra Lalmati

Development of high yielding ASGs

Eight hundred ninety one families from 24 crosses were evaluated in 2 row pedigree nursery. Of these 885 families showed moderate resistance to resistance to bacterial leaf blight and 51 to leaf blast. From these, 453 progenies were selected for further testing. Promising crosses were RP 4926 (Swarna/RAU 3041), RP 5277 (Sona / Malaysia //Swarna/Sonachoor), RP 5101(Swarna/KB 13//Swarna/ RAU 3041), RP 5096 (Swarna/KB 13). 736 single plants were selected in 7 F2 populations. From 168 entries of Swarna/RAU 3041 in 4 row elite nursery, 98 entries exhibited strong aroma; 49 mild aroma and 136 entries showed desirable and intermediate amylose content (20.1 to 25%). Based on phenotypic acceptability, field tolerance to stem borer and quality, 26 families were promoted to station yield trial while 66 entries were selected for further testing.

Elite aromatic shot grain rice in station yield trial, ***rabi*** 2014

GEQ/CI/BR/21

Breeding for quality improvement of rice through conventional and molecular approaches (K. Suneetha)

The variation in grain quality was assessed among RILs developed by crossing tropical *japonica* and *indica*. Physico-chemical quality including hulling, milling, head rice recovery, grain dimensions, alkali spreading value (ASV), gel consistency (GC), amylose content (AC) and degree of chalkiness were analyzed among 104 RILS including parents. There was considerable variation among lines for all traits studied. The hulling percent varied from 63.4% and 84.2% with mean of 76.1%, while, milling varied from 56.5% to 78.0% with mean of 65.3%. The head rice recovery ranged a great deal from 23.2% to 62.8% with an average of 46.9%. The broken percent varied from 4.7% to 36.7% with average

of 18.4%. Differences in the head rice recovery and broken percent might be associated with the degree of chalkiness and amylose content which in turn is related to packing of starch granules indicating the genotypic differences. However, the influence of environment during grain filling and chalkiness and post harvest processing are important which needs testing across seasons, environments along with standardized post production practices. The ASV varied from 3 to 7, while GC ranged from hard (22 mm) to soft (92.5 mm). It is interesting to note that the AC varied from 12.92% to 32.91% with differential expression of chalk from complete opaqueness to translucency. Further studies would help in identifying suitable donors for chalkiness and would unravel the influence of grain chalk on milling, starch and cooking qualities.

GEQ/CI/BR/18

Investigation into starch properties and chalkiness on rice cooking quality (D. Sanjeeva Rao)

Standard solutions of potato and maize amylopectin samples were prepared and their spectra were observed in spectrophotometer. Absorbance values in the spectra indicate large interference of amylose in amylopectin estimation and therefore direct estimation of amylopectin with iodine method is not possible. However it can be determined by removing amylose and simple sugars from total carbohydrate content.

Significant changes were not observed in the polished grain of Aghoni Bora upto 63˚C whereas grain was partially cooked at temperature of 68 and 73˚C. The grain appeared as completely cooked at 75, 76 and 77˚C temperatures, however, few uncooked starch grains were noticed when the cooked grain was pressed. At 78^0C in 45 minutes, Aghoni Bora was completely cooked. The minimum cooking time at 78^0C was noticed as 28 and 30 minutes with and without ten minutes soaking in water prior to incubation in water bath. Brown rice of all the varieties was semi-cooked when incubated in boiling water (100^0C) for twenty minutes. Aghoni Bora grain was completely cooked at all polishing times except 30 seconds while Swarna and Samba Mahsuri were completely cooked after 90 seconds polishing time. However, complete cooking of all the varieties was observed at or after 10% polishing. In contrast, Samba Mahsuri and Swarna were completely cooked in 45 minutes and 30 minutes at 84 and 88^0C respectively.

ABR - Application of Biotechnology tools for Rice improvement

ABR/CI/BT9

Improvement of rice against biotic and abiotic stresses through transgenic approach (S.M. Balachandran)

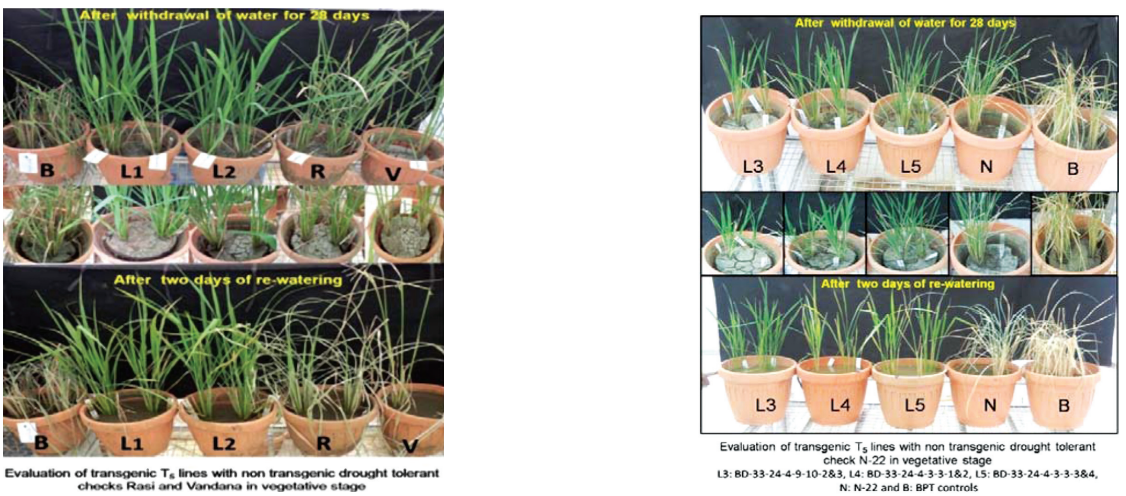
Evaluation of homozygous Bt transgenic rice of IR64 with cry1Ac gene resistant to yellow stem borer Advancement of Bt rice lines/seed multiplication:

During the last year about 8 homozygous lines (T6 lines) of Bt transgenic rice with Cry1Ac in the background of IR64 were selected for advancing to further generation and also for seed increase (Fig.1). The selected lines *viz*., AIC-3-5-27-6-2-2-34; AIC-3-5-27-6-2-17-4; AIC-3-5-27-6-2-2-60;IC-5-4-20-2-10-6-54; IC-5-4-20-2-13-3-26; IC-5-4-20-2-13-3-55; AIC-3-2-8-1-14-20-12 and AIC-3-2-8-1-14-20-46 were grown in Biosafety net house and seeds were harvested. A small event selection experiment is planned for the year 2014.

Evaluation of homozygous transgenic rice of BPT 5204 with DREB1A gene for drought tolerance

Based on the drought stress screening, last year we selected best 12 homozygous lines which were advanced T6 generation. The progenies raised from the above lines along with non-transgenic control BPT5204 were grown and in the biosafety screen house and subjected to drought stress by withdrawing water for 3-4 weeks. Most of these lines were healthy and there was neither wilting nor leaf rolling observed under natural screening conditions. Most of the transgenic lines showed greater tolerance up to three weeks where as DT controls, Rasi and Vandana could not survive beyond a week due to rapid wilting and ultimately drying.

IR64 Bt transgenic rice plants in Biosafety screen house



Screening of transgenic (T5) lines along with controls under severe drought stress

In another experiment, selected T5 transgenic lines, BD-33-24-4-3-3, BD-33-24-4-3-9, BD-33-24-4-3-10 and, BD-33-24-4-3-11 were subjected to additional physiological traits related to drought stress such as improved water relations, enhanced osmolyte accumulation, increased cell membrane stability, maintenance of chlorophyll greenness, efficient photosynthesis, better regulatory transpiration mechanisms, water use efficiency and higher potentiality of PSII photosystem. The study clearly confirmed that the above physiological parameters highly correlated with the transgenic rice lines confirming the efficient mechanism of water stress tolerance. Based on various physiological traits related to drought stress, we short listed about 120 transgenic lines with varying days of tolerance to drought. A few selected lines will be nominated for RCGM trials.

ABR/CI/BT/6

Identification of genes for grain filling in rice (*Oryza sativa L.*)(C.N. Neeraja)

The markers for eight reported cloned genes for yield components *viz*., grain number (*Ghd7*, *Ghd8* and *Cytokinin oxidase*); grain yield (*Dep1* and *Dep3*), erect growth, increased grain number and yield (*PROG1*), ideal plant architecture and yield (*OsSPL14*) and strong culm (*SCM2*), polymorphism were surveyed in the germplasm comprising *indica*, tropical *japonica* and *O. glaberrima* accessions. Polymorphism was observed for *Ghd8*, *OsSPL14*, and *PROG1* genes Association mapping using TASSEL) and two-way ANOVA analysis using Mapdisto has shown linked markers associated with spikelet and filled grains across panicle. The markers for *OsSPL14* were validated in F_2 mapping population of Rasi and IC114927.

ABR/CI/BT10

Genomic studies on grain yield heterosis and WA-CMS trait in rice (R.M. Sundaram)

Grain yield heterosis:

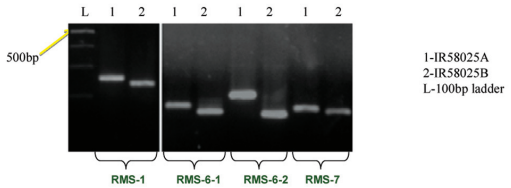
A set of 5 WA-CMS lines and 17 restorer lines have been crossed using L X T design and hybrids have been developed from these crosses. These were evaluated in *Kharif* 2013 for their grain yield along with standard checks. The parental lines of hybrids were then analyzed with a set of 40 hyper-variable SSR markers to analyze the polymorphism and an index called coefficient of marker polymorphism (CMP) was calculated for each hybrid. The values of CMP were then correlated with heterosis values of the hybrids. A moderate positive correlation of 0.49 was recorded.

A set of PCR primers pairs (for both conventional and RT-PCR) have been designed targeting key candidate genes associated with yield (*Gn1a, OsSPL14* and SPIKE) for validation in hybrids and correlation with heterosis.

WA-CMS trait

Rice Mitochondrial genome (~ 490 Kb) was downloaded from Oryzabase (database) and

A set of co-dominant PCR based markers which can distinguish WA-CMS mitochondria from fertile mitochondria developed based on sequence polymorphisms



These markers can clearly distinguish WA-CMS lines from their cognate isonuclear maintainer lines and hence can be used for assessment of purity of seed-lots of WA-CMS lines

Linked markers with cloned candidate genes for yield components	Associated traits
PROG1	Spikelets on primary branches of upper portion of the panicle
	Total spikelets on primary and secondary branches of panicle
	Grains on primary branches of panicle
Ghd8	Spikelets on primary branches of the panicle
OsSPL14	Grains on primary branches of upper portion of panicle

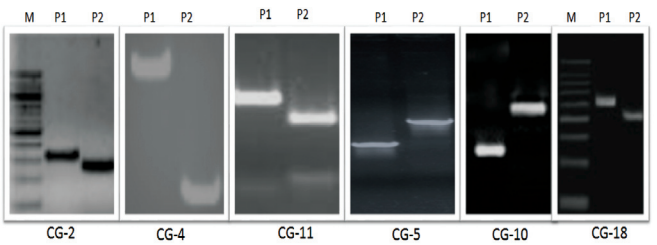
NCBI and analyzed for the key genes in the region of interest (150-210 kb), where markers have been developed in earlier studies. A set of primer pairs were designed for amplification of the region and the amplicons were analyzed for amplicon length polymorphism (ALP) and cleaved amplified polymorphic sequences (CAPS). Few CAPS markers and many ALPs were identified.

Three genes have been so far identified by different research groups to be putatively associated with WA-CMS trait in rice. They are ORFB, ORF126 and WA352. In order to validate these candidate genes, a reverse-transcriptase analysis of the anthers collected from WA-CMS lines, maintainer lines and restorer lines and hybrids was carried out using gene-specific primer pairs. The analysis revealed that ORF126 and WA352 are most possibly the candidate genes for WA-CMS trait.

ABR/CI/BT 8

Development of molecular markers for important quality traits in rice (Sheshu Madhav)

Twenty five STS markers were designed targeting 12 candidate genes, there were designated as CG1..G25. Out of 25 markers, 3 ILP (Intron length Polymorphic markers) namely CG-2, CG-4 and CG-11 which are targeting BLH-Transcription factor, Penta trico peptide domain containing protein and Sucrose synthase showed polymorphism among parents. Another three STS markers namely CG-5, CG-10. CG-18 targeting Zn finger protein, Sucrose Synthase and unknown expressed protein were also showed polymorphism among parents. Among 6 markers, CG-11 targeting Sucrose synthase and CG-18 targeting unknown expressed protein showed good segregation with minimum number of recombinants.



P1: RB2816 ; P2: Pusa 1401-97-7-1-5

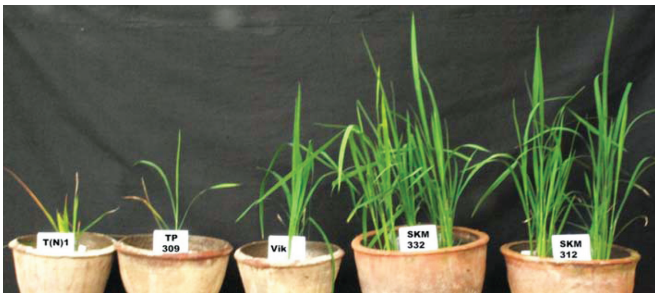
Parental polymorphic candidate gene-specific markers for qGT6

ABR/CPT/PATH/16

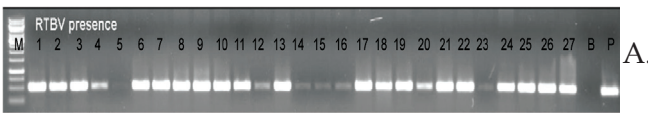
Suppression of Rice tungro virus through RNA interference (Satendra K Mangrauthia)

Phenotyping and molecular characterization of rice transgenic lines transformed with RNAi inducing binary vector construct based on RTSV-CP gene:

220 plants representing 18 T1 putative transgenic lines were inoculated using GLH to phenotype for RTSV resistance. The phenotyping was done along with susceptible (TN1) and tolerant (Vikramarya and Nidhi) cultivars of rice. Transgenic plants showing no/less symptoms were further evaluated for the presence of RTBV and RTSV using viral gnome specific primers developed in earlier study. All plants showed presence of RTBV suggesting successful inoculation of tungro virus. However, variable reaction was recorded for the presence of RTSV. Complete immunity, recovery phenotype and susceptible phenotype were recorded with respect to RTSV presence.Phenotyping of transgenic plants at 25dpi. T(N)1- susceptible



control, TP-Taipei-309 (non-transgenic), Vik- Vikramarya (Tolerant control), SKM 312 and 332 (Taipei 309 transgenic lines).



A. Diagnostic of RTBV using primers designed from RTBV genome. M- 1Kb ladder, 1 to 27- transgenic plants, B- negative control, P- positive control.

B.

Diagnostic of RTSV using primers designed from RTSV genome. M- 1Kb ladder, 1 to 24- transgenic plants, B- negative control, P- positive control.

The complete genome sequencing of AP isolate of Rice tungro spherical virus

Complete genome of a south Indian isolate of Rice tungro spherical virus (RTSV) from Andhra Pradesh (AP) was sequenced, and the predicted amino acid sequence was analyzed (accession number: KC794785). The RTSV RNA genome consists of 12,171 nt without the poly(A) tail, encoding a putative typical polyprotein of 3,470 amino acids. Multiple alignment with other RTSV isolates showed a nucleotide sequence identity of 95% to East Indian isolates and 90 % to Philippines isolates. A phylogenetic tree based on complete genome sequence showed that Indian isolates clustered together, while Vt6 and PhilA isolates of Philippines formed two separate clusters. Twelve recombination events were detected in RNA genome of RTSV using the Recombination Detection Program version 3. Recombination analysis suggested significant role of 5′ end and central region of genome in virus evolution. Further, AP and Odisha isolates appeared as important RTSV isolates involved in diversification of this virus in India through recombination phenomenon.

ABR/CI/BR/11

Mapping quantitative trait loci (QTLs) for yield and related traits using backcross inbred lines (BILs) from elite x wild crosses of rice (*Oryza sativa* L.) (Divya Balakrishnan)

14 BILs (Swarna x *O. nivara*): 14 S, 14-3 S, 148 S, 166 S, 166-1, 166-2, 24 K, 248 S, 250 K, 3-1 K, 65 S, 7 K, 70 S, 75 S along with high yielding checks *viz.*, IR 64, Jaya, MTU 1010, MTU 1081, NLR 34449, Sahbhagidhan, Swarna, Tellahamsa, Tulasi were raised at DRR farm in randomized block design with three replications in Kharif 2013 and Rabi 2014. Introgression lines 166s and 148s were selected as best lines with most of the desirable yield traits compared with checks.166s showed high single plant yield, bulk yield, total dry matter, per day dry matter production. Derived lines from 166s *ie.*, 166-1 and 166-2 had highest grain number, filled grains and panicle weight. 148s had highest per day productivity, panicle length, high spikelet fertility percentage and 1000 grain weight. Physiology data showed that among the BILs 166s has highest photosynthetic rate, stomatal conductance, high transpiration rate, highest concentration of chlorophyll pigments, chlorophyll A, chlorophyll B, carotenoids and its derived line 166-2 had highest intrinsic water use efficiency and carboxylation efficiency. The checks showed higher single plant yield than BILs, but Swarna/ *O.nivara* BILs were better in photosynthetic related traits compared to checks and recurrent parent Swarna. The BILs were surveyed for reported genes/ QTLs for yield traits. 166s had part of *yldp1.4* QTL in heterozygous state.

RUE – Enhancing Resource and Input Use Efficiency

RUE/CP/AG/10

System of Rice intensification (SRI) - Potential and Sustainability (R. Mahender Kumar)

Studies were made to assess the productivity and water saving potential of SRI in comparison to manual and mechanical transplanted rice under 3 irrigation schedules (I_1: Flooding 5 - 7.5 cm depth of standing water up to dough stage; I_2: Irrigating to keep the soil at saturation till dough stage and I_3: Irrigation at 5 days interval to bring the soil to field capacity (AWD) in clay soils of DRR. The data (Table 1) reveals that grain yield in SRI gave 20.7% higher than manually planted rice (4.03 t/ha). Among irrigation schedules, AWD (I_3) gave highest grain yield than other two irrigation schedules. The water input to rice crop was 43.3-53.8% and 31.7- 44.7% lower in saturation (I_2) and AWD (I_3) treatments as compared to conventional flooding. Irrigation schedule of keeping soil at saturation moisture recorded highest values of water productivity whereas flooding recorded the lowest values.

RUE/CP/AG/13

Agro techniques for improving the productivity of aerobic rice (B. Sreedevi)

Studies on aerobic rice grown under three recommended dose of fertilizer (RDF) i.e. 50, 75 and 100 % RDF with a RDF of 100:50:50 N:P:K integrated with four biofertilizer inoculation (*Azospirillum*, Phosphorus solubilizing bacteria (PSB), *Azospirillum* + PSB and control) indicated greater aerobic rice yield enhancements due to *Azospirillum* inoculation as compared with PSB at

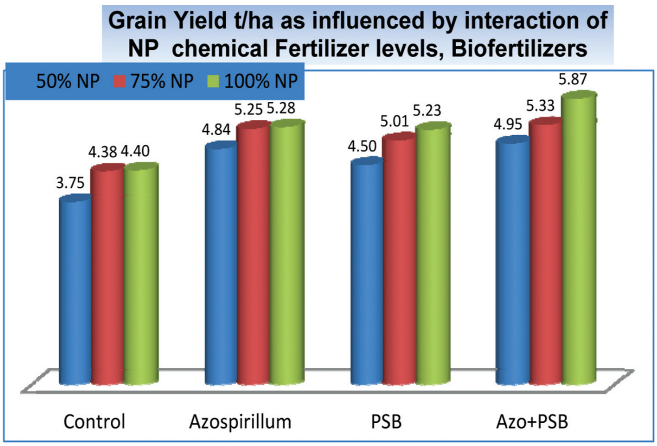
Rice productivity and water use indices as influenced establishment methods and irrigation schedules

Treatment		Total water applied (x10^6 litre/ha)	Yield (t/ha)	Water use (liter)/kg grain produced	% of Water saving over flooding	Water productivity (kg m^{-3})
SRI	I_1	1525.0	4.28	3564.9	-	0.28
	I_2	867.9	5.27	1648.2	53.8	0.60
	I_3	1218.1	5.70	2140.3	40.0	0.47
Manual planting	I_1	1636.2	3.43	4775.8	-	0.21
	I_2	1000.1	4.04	2473.5	48.2	0.40
	I_3	1218.1	4.69	2641.7	44.7	0.38
Mechanical planting	I_1	1636.2	3.90	4187.3	-	0.24
	I_2	1000.1	4.20	2375.6	43.3	0.42
	I_3	1218.1	4.35	2859.9	31.7	0.36

Overall view of SRI and comparison of AWD and flood

50 and 75% RDF. However, combined inoculation of *Azospirillum* + PSB with RDF gave markedly higher yields than all other treatments. Lab studies indicated that P solubilisation rate was higher in PSB, *Azospirillum* + PSB treatments in bulk as well as rhizosphere soils.

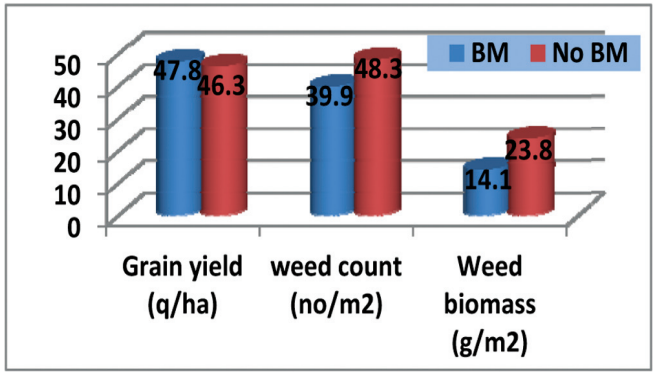
Impact of four seed priming treatments (4% KH_2PO_4 priming; hardening i.e. soaking seeds in water for 3 hours and redrying in shade for 3 hours back to initial moisture content and cycle was repeated 4 times; hydro priming i.e. soaking seeds in water for 48 hours and redrying to original moisture content, and unprimed control) under weed free and weedy conditions. The study showed that seed priming can enhance the seedling vigor and seedling growth which in turn improves the weed suppressing ability of rice, and consequently reducing the risks of poor stand establishment and crop losses due to weeds. Seed priming with 4% KH_2PO_4 and seed hardening were found promising for improving crop performance.



RUE/CP/AG/14

Resource conservation studies in rice cultivation (B. Gangaiah)

A study was made to assess contributions of dhaincha brown manuring (BM) to nitrogen nutrition and weed suppression effects in wet seeded rice (WSR) for during *kharif* 2013 season under four levels of recommended N dose (RDN, i.e. 120 kg/ha) *i.e.*, 0, 50, 75 and 100% RDN. In WSR



crop sown @ 80 seeds/m^2, dhaincha seeds were broadcast sown @ 30/m^2 and was knocked down by spraying 2, 4-D @ 0.60 kg a.i/ha on 30 day after seeding. The results revealed that BM has reduced the weed count and weed biomass (recorded on 30 day after seeding) of WSR crop by 17.4 and 40.8% as compared to control. The cumulative effects of reduced weed infestations and better N nutrition of BM plots resulted in 3% increases in grain yield of WSR than no BM plot (4.78 t/ha). Weed biomass was lowest in no N applied plot and increased significantly with application of 75% RDN only. Interaction effect of BM and N fertilization showed that BM improved WSR crop yields equivalent to 16.9 kg N fertilization in no N applied crop and its effects gradually disappeared as N dose increased beyond 50% RDN. Effect of brown manuring on weed indices and grain yield of WSR

SSP- Sustaining Rice System Productivity

SSP/CP/SS/9

Assessment of soil quality for improved rice productivity (Brajendra)

The field experiment was done to assess the impacts of fortified poultry as well as vermi manure with 10 and 20% of total N and P requirement to be met with urea and superphosphate applications on two rice varieties (KRH2 and Krishnahamsa) for eight seasons. Field results have shown that native fertility treatment yield ranged from 1.5 - 2.5 t/ha. Fortified poultry manure and vermicompost with 10 and 20 % urea and SSP out yielded RDF treatment and the yield ranged from 4-6 t/ha. There is no yield penalty even without addition of potash. Significant residual effects were seen in poultry and vermi manure fortified treatments over RDF.

Soil health kit developed was validated for different soils and conditions and methods of assay are being remodelled based on feedbacks. A bilingual (English and Telugu) soil health card was designed and developed and is now being widely used for distribution among farming community. An online e-soil health card generation system has been developed and hosted at www.rkmp.co.in that will enable farmers to generate soil health card based on inherent soil fertility status of the region.

SSP/CP/SS/11

Assessment of genotypic variability and improving nitrogen use efficiency in irrigated rice (K. Surekha)

The field experiment initiated in 2010 with two N levels (0 and 100 kg/ha) as main and 15 genotypes as sub-plot treatments in a split plot design with 3 replications to evaluate the N use efficiency (NUE) and to identify efficient rice genotypes for their responsiveness and use of soil and applied N continued during *kharif* and *rabi* seasons of 2012. The data reveal that grain yield was increased by 27 and 51% during *kharif* and *rabi* seasons. Genotypes Suraksha, RP-5212-41-4-

Grain yield (t/ha) of genotypes at two N levels

Variety	*Kharif*			*Rabi*		
	N0	N 100	Yield diff. (t/ha)	N0	N 100	Yield diff. (t/ha)
Rasi	3.18	6.05	2.87	3.89	5.37	1.48
Vandana	3.28	4.75	1.47	3.39	4.70	1.31
Suraksha	3.80	4.94	1.14	3.43	4.29	0.86
IET 21665	3.18	4.30	1.12	3.59	4.44	0.85
DRR Dhan 39	3.16	4.84	1.68	3.80	4.69	0.89
RP-5212-41-4-3-1-1-1B	4.06	5.01	0.95	3.57	4.65	1.08
Vikas	3.16	6.26	t3.10	4.24	4.97	0.73
Improved chittimutyalu	2.63	4.46	1.83	2.45	3.50	1.05
Dhanrasi	3.81	5.96	2.15	4.47	5.68	1.21
DRRH 79	3.67	5.43	1.76	3.35	4.67	1.32
DRRH 82	4.76	7.54	2.78	3.70	5.08	1.38
NDR 359	3.50	4.75	1.25	4.50	5.17	0.67
Swarna	3.72	5.16	1.44	4.63	5.46	0.83
Mandya vijaya	4.06	6.02	1.96	3.75	4.99	1.24
IET 21044	2.59	3.93	1.34	3.89	4.35	0.46
Mean	3.50	5.30		3.78	4.80	
CD (0.05) –Main-0.36, sub-0.57, M in S – 0.79,S in M -0.80			CD (0.05) –Main-0.221, sub-0.721,MxS-NS			

3-1-1-1B, DRRH-79, DRRH-82, Dhanrasi, Swarna, NDR-359 and Mandyavijaya (*kharif*) and Rasi, IET21665, DRRdhan-39, RP-5212-41-4-3-1-1-1B, Vikas, Dhanrasi, DRRH-82, NDR-359, Swarna and Mandyavijaya (*rabi*) performed well without N fertilization. With N fertilization, Dhanrasi, DRRH-82, Vikas and Mandyavijaya were found promisng in *kharif*. Grain yield difference between N_0 and N_{100} varied from a minimum of 0.95 t/ha in case of RP-5212-41-4-3-1-1-1B to 3.10 t/ha in case of Vikas in *kharif* and from 0.67 t/ha in case of NDR-359 to 1.48 t/ha in case of Rasi during *rabi*.

With regard to NUE indices (agronomic, physiological, recovery and internal efficiencies, per day productivity, N uptake rate per day, harvest index, internal efficiency, partial factor productivity etc.), no single genotype possessed all efficiency indicators in the maximum range and different genotypes exhibited different values. Based on the number of efficiency parameters that a genotype had expressed maximum values, and as per the mean values of the rank, Rasi, Vikas & Vandana (early group), DRRH 82 & DRR Dhan39 (medium duration) and Dhanrasi, Mandyavijaya & Swarna (long duration) proved promising in both the seasons.

SSP/CP/SS/13

Utilization of plant growth promoting micro-organisms for improving nitrogen and water use efficiency in rice (P.C. Latha)

A *Serratia marcescens* strain (SSB-1) isolated from the rhizosphere of rice was found to possess multiple plant beneficial traits that lead to phytostimulation, soil nutrient mobilization and biocontrol. The rhizobacteria produces indole acetic acid (2.89 µg IAA/µg protein), a plant growth hormone and ACC deamainase (1-aminocylcopropane -1-carboxylic acid) deaminase activity (2.2 µmol ketogutarate/µg protein/h) which reduce the production of stress ethylene in plants. The isolate also exhibited solubilization of unavailable forms of phosphorus and zinc like tricalcium phosphate and zinc oxide. In addition, the isolate possessed the unique feature of silicate solubilization.

Laboratory experiments involving incubation of the bacteria with insoluble silicate sources resulted in significant increase in release of silica into the culture supernatant. The insoluble silicate sources used were magnesium trisilicate, aluminium silicate, potassium aluminium silicate, diatomaceous earth, siliceous earth, straw and husk. Silicate mobilization as measured by silica concentration in the culture supernatant indicated that though Si release was highest with magnesium trisilicate (4.01 µg silica/µg protein), followed by aluminium silicate (3.75 µg silica/µg protein) and diatomaceous earth (3.49 µg silica/µg protein), the highest growth of Serratia was observed in the presence of siliceous earth, rice straw, potassium aluminium silicate and magnesium trisilicate. The isolate also tested positive siderophore production and protease activity.

Seed bacterization of rice variety Swarna with the rhizobacterial isolate was found to increase the germination percentage under 15% and 20% PEG 6000 induced water stress when compared to uninoculated control under *in vitro* conditions.

Effect of inoculation on germination and root characteristics of rice seedlings

Treatment	Germination (%)	Root length (cm)	Root diameter (mm)	Root volume (cm^3)
Inoculation with S. *marcescens*				
15% PEG	90	7.0	0.42	0.021
20% PEG	85	8.3	0.39	0.018
Uninoculated Control				
15% PEG	50	4.2	0.41	0.016
20% PEG	70	5.1	0.34	0.014

(Values are average of 3 replications containing 10 seedlings)

A comparison of the root traits which play an important role in water stress tolerance established that the rhizobacteria also enhanced the root length, root volume and root diameter of inoculated seedlings. Further evaluation of the strain in soil plant systems is in progress to uncover the efficiency and the possibility of using this isolate as microbial inoculant for alleviating the effect of water stress on rice plants.

CP/ENG/6

Selective mechanization in rice cultivation (T. Vidhan Singh)

Chinese 8-row transplanter planted the seedlings at a depth of 3-4 cm hence there were more number of productive tillers compared to other methods. Also in mechanical transplanted paddy, the yield was 15% more as compared to drum seeder/ farmers' practice. In case of SMSRI, the yield was 5% more as compared to traditional drum seeder which may be because of the distance in planting. In SMSRI, mechanical weeder was used to destroy the weeds. Performance of mechanical weeder is excellent and the average area covered is 2 acres/ day. The newly developed SRI drum seeder was modified by providing pegs so that the seeds get better anchorage and there is less damage by birds as the seeds are buried at a depth of one cm. In view of increasing demand for drum seeder and to cover more area in short time a mechanical riding type drum seeder is under fabrication. In *Rabi* 2014 studies are being undertaken to study the effect of soaking time for better germination in drum seeder and is in progress. Developed drum seeder to suit SRI Cultivation: The modified drum seeder with row to row spacing of 25 cm x 25 cm was developed and used for sowing pre germinated seed. This drum seeder can be modified to suit SMSRI sowing by removing nuts from holes which are closed using nuts and bolts. Under FLD 25 acres was transplanted using Chinese and Korean transplanter in East and West Godavari district of AP.

TTI/CP/CA/3

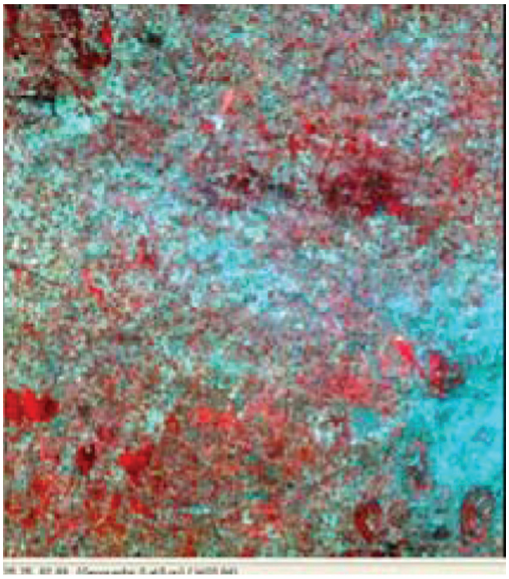
Computer Applications: Delineation of rice growing ecologies by using spatial technologies and crop models (B. Sailaja)

LISS III images of Varanasi and Mirzapur districts were classified using combination method of NDVI and unsupervised classification. Varanasi and Mirzapur districts of UP were selected as study areas. GPS coordinates were collected for rainfed rice fields in Tandia block of Varanasi district and Villages on the way to South Campus of BHU in Mirzapur district and interacted with many farmers and gathered information about the crops being grown. Other Ground truth points required for land use classification like rocky areas, forest areas, households etc were collected.

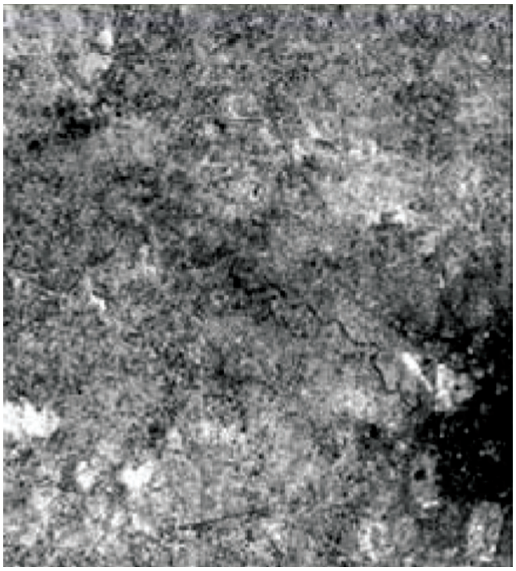
Mechanical Transplanter in operation in farmers' field in East Godavari district of AP.

IRS P6 LISS3 image was geo-referenced and a model was developed to zero features other than vegetation in the master image. NDVI threshold value was fixed at 2.0 for identifying rainfed rice areas. This image was further classified using unsupervised classification and validated with ground truth points.

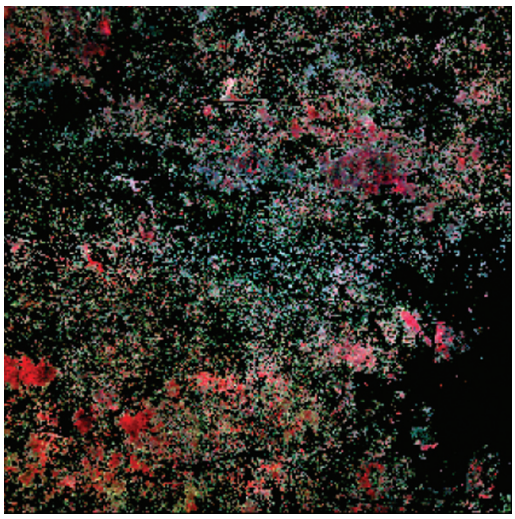
Infocrop model was validated with nitrogen use efficiency experimental data of 2006. Genetic coefficients were calculated for varieties Ajaya and BPT 5204. Crop growing dates and management data were entered into InfoCrop model and model was executed at 0,100 and 200 (kg/ha) nitrogen levels. Grain Yields estimated from Infocrop model were compared with estimated values of Oryza2000, DSSAT and observed values. At 200N, 3 models performed well as percentage differences with observed values were below 10. At 100 and no nitrogen application level the percentage difference is high in Oryza2000 and InfoCrop compared to DSSAT.



IRS P6 LISS3 image



NDVI of LISS3 image



Model output

Unsupervised classification
-Red colour pixels represent rainfed rice area

CCR – Assessing and managing Crop Response to Climate Change

CCR/CP/PP/9

Physiological studies on heat tolerance due to ambient and elevated carbon dioxide in rice) (S.R.Voleti)

Quantification of photosynthetic efficiency, dark respiration, light induced respiration and compensation points using leaf disc oxygen electrode in selected accessions of wild rice species confirmed the results of the photosynthesis rate values obtained using LI-6400.

Based on the performance of different rice genotypes, five genotypes were selected and submitted to NBPGR for registration and all the five genotypes were analyzed for physiological and biochemical responses at 5.0°C high temperature to that of ambient temperature inside high temperature tunnel.

Under elevated temperature Somaly2, Vandana, IR55178, GQ-25, SG26-120 and IR82310 were found to maintain relatively higher photosynthetic efficiency at elevated temperature (lower reduction)

Photosynthesis (A), Potential photosynthesis (POA), Light induced respiration (LIR), dark respiration (Rd) and light respiration (LR) rates in wild and cultivated rices

Genotype	A µmol.min^{-1}	POA µmol.min^{-1}	CO_2 compensation time (min)	LIR µmol.min^{-1}	Rd µmol.min^{-1}	LR µmol.min^{-1}
Akshayadhan	0.748^{cdefg}±0.12	0.856 ^{b}±0.02	-2.220^{b}±1.40	0.920^{c}±0.21	0.118^{b}±0.04	0.801 ^{b}±0.25
Varadhan	0.669^{defg}±0.06	0.832 ^{b}±0.18	-1.960^{b}±1.31	0.941^{c}±0.60	0.182^{b}±0.11	0.759 ^{b}±0.48
DRRH 3	0.676^{cdefg}±0.04	1.307 ^{ab}±0.11	-7.670^{ab}±2.44	0.611^{c}±0.13	0.133^{b}±0.10	0.477 ^{b}±0.04
PA6444	0.660^{efg}±0.14	0.855 ^{b}±0.33	-2.780^{b}±0.68	0.863^{c}±0.19	0.256^{ab}±0.15	0.607 ^{b}±0.33
O. glaberrima (IR 101800)	0.775^{cdef}±0.01	0.834 ^{b}±0.03	-1.900^{b}±0.18	0.834^{c}±0.07	0.079^{b}±0.03	0.754 ^{b}±0.05
O. glaberrima (IR 100983)	0.769^{cdef}±0.06	1.135 ^{ab}±0.15	-3.720^{b}±1.36	0.905^{c}±0.02	0.056^{b}±0.00	0.849 ^{b}±0.01
O. glaberrima (IR 102445)	0.752^{cdef}±0.00	0.952 ^{b}±0.00	-3.050^{b}±0.00	0.802^{c}±0.00	0.120^{b}±0.00	0.682 ^{b}±0.00
O. glaberrima (IR 104020)	0.478^{g}±0.02	1.131 ^{ab}±0.08	-13.950^{a}±1.37	0.629^{c}±0.07	0.144^{b}±0.00	0.485 ^{b}±0.08
O. nivara (CR 100097)	0.746^{cdefg}±0.09	1.148 ^{ab}±0.16	-4.030^{b}±2.49	0.704^{c}±0.11	0.160^{b}±0.03	0.544 ^{b}±0.07
O. nivara (CR 100008)	0.944^{bc}±0.01	0.980 ^{b}±0.03	-0.858^{b}±0.20	0.725^{c}±0.04	0.067^{b}±0.01	0.658 ^{b}±0.06
O. nivara (IR 104650)	0.706^{cdefg}±0.03	0.995 ^{b}±0.69	-5.480^{b}±5.63	0.949^{c}±0.10	0.993^{ab}±1.20	0.779 ^{b}±0.06
O. rufipogon (IR 103404)	0.939^{bcd}±0.05	1.044 ^{b}±0.06	-1.424^{b}±0.04	0.870^{c}±0.00	0.077^{b}±0.02	0.780 ^{b}±0.00
O. rufipogon (CR 100309)	1.109^{ab}±0.00	1.143 ^{ab}±0.00	-0.810^{b}±0.00	2.106^{ab}±0.00	1.440^{b}±0.00	0.666 ^{b}±0.00
O. rufipogon (CR 100018)	1.160^{ab}±0.17	1.327 ^{ab}±0.22	-1.673^{b}±0.76	1.140^{bc}±0.01	0.180^{b}±0.17	0.960 ^{b}±0.16
O. longistaminata (IR 104301)	0.822^{cdef}±0.02	0.945 ^{b}±0.02	-1.760^{b}±0.25	0.846^{c}±0.12	0.085^{b}±0.01	0.760 ^{b}±0.13
O. longistaminata (IR 105262)	1.241^{a}±0.03	1.358 ^{ab}±0.05	-1.463^{b}±0.97	2.432^{a}±0.88	0.265^{ab}±0.26	2.167 ^{a}±0.62
O. eichengeri (IR 100881)	0.619 ^{fg}±0.08	1.913 ^{a}±0.02	-15.332^{a}±2.90	0.747^{c}±0.06	0.099^{b}±0.00	0.648 ^{b}±0.07
O. glumaepatula (IR 104387)	0.904^{bcde}±0.00	1.200 ^{ab}±0.00	-3.067^{b}±0.00	0.915^{c}±0.00	0.113^{b}±0.00	0.802 ^{b}±0.00
Overall Mean	0.820	1.094	-3.857	1.008	0.257	0.797

Temperature gradient tunnel facility developed at DRR farm (A) Crop growing inside the temperature gradient tunnel. (B) Software interface of the temperature gradient tunnel facility.

than N22, a known temperature tolerant cultivar. Respiration and photorespiration were also found to be lower in these entries under elevated temperature compared to ambient temperature. Loss of Nitrogen as ammonia was estimated. Vandana and N22 had lost ammonia in the range of 80 -100 µmoles/ plant. Ammonia loss was within 50 µmoles in selected genotypes under the both N levels, except IR82310 under recommended fertilizer N. Under elevated temperature also similar observations were recorded. The parameters of photosynthesis, associated with N loss under elevated temperature in these selections should help to select breeding rice lines suitable or climate change.

CCR/CP/PP/11

Evaluation of genotypic variability in leaf photosynthetic efficiency and its associatedfactors in rice (D. Subrahmanyam)

Photosynthetic characteristics were measured in 43 diverse rice genotypes consisting of popular varieties, tropical japonica (2) and wild rice introgressed lines (2) under field condition. Leaf photosynthetic traits were measured with LI-6400 photosynthesis measuring system with artificial light source. Photosynthetic efficiency (PN) varied from 14.3 (Lalat) to 27.3 µmol (CO_2) m^{-2} s^{-1} with a mean value of 20.2. Similarly, significant variation was observed among the tested entries for stomatal conductance (gs). Varadhan, ADT-43, Sugandha Samba, Rasi along with many land races showed PN >20 µmol (CO_2) $m^{-2}s^{-1}$.The gs varied between 0.212 (BPT-5204) and 0.480 (Tella Hamsa) with a mean of 0.345 mol (H_2O) $m^{-2}s^{-1}$. Rasi, MTU-1001, Jaya, RPHR-517 and Khudaridhan are the other entries in which the g_s was >400 mol (H_2O) $m^{-2}s^{-1}$. A significant correlation (*P<0.005)* between leaf photosynthesis rate (P_N) and stomatal conductance and carboxylation efficiency (P_N/C_i) ratio indicate that the P_N is dependent on both stomatal (gs) and non-stomatal (carboxylation) factors. Hence it is important to select genotypes with high photosynthesis and stomatal conductance along with high

Genotypic variation in important leaf photosynthetic traits amongst divergent rice genotypes.

S.No	Parameter	Df	MSError	F-Value	Mean	HSD	Range	CV(%)
1.	P_N	42	4.591	7.87**	20.24	7.12	14.34 — 27.34	10.59
2.	g_s	42	0.00305	3.591**	0.346	0.183	0.212 — 0.484	15.97
3.	E	42	1.2112	4.93**	9.699	3.65	7.02 — 12.75	6.66
4.	C_i	42	293.74	2.91*	257.3	56.94	221.9 — 294.1	6.66
5.	P_N/E	42	0.336	4.759**	2.096	0.609	1.563 — 2.533	8.75
6.	P_N/gs	42	98.216	1.40(ns)	59.84	32.86	43.19 — 74.57	16.59
7.	P_N/C_i	42	0.000153	3.842**	0.0793	0.0411	0.057 — 0.108	8.74
8.	T_{leaf}-T_{air}	42	0.0416	3.808**	-0.917	0.633	-0.418 — -1.429	22.0
9.	C_i/C_a ratio	42	0.00216	1.35(ns)	0.694	0.154	0.616 — 0.760	6.70

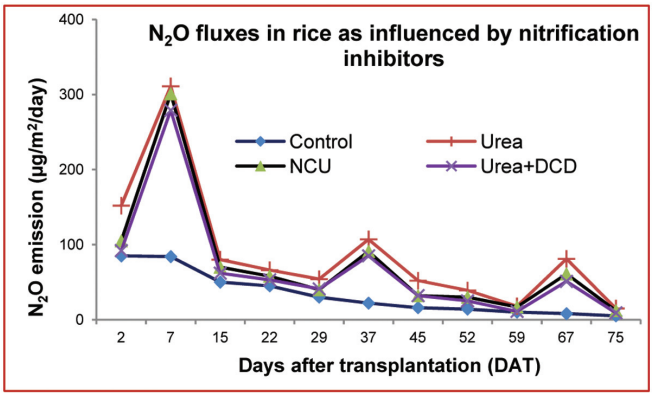
P_N / C_i ratio. The leaf photosynthetic efficiency showed positive association with the TDM. The association between grain yield and PN was non-significant.

Physiological characterization of 20 Green Super Rice (GSR) entries indicate that photosynthetic efficiency varied between a maximum of 26.6 (GSR125) to a minimum of 21.28 (GSR112) µmol (CO_2) m^{-2} s^{-1} with a mean of 24.05 µmol (CO_2) m^{-2} s^{-1}. GSR125, GSR122 and GSR138 are the other entries which showed PN >26 µmol (CO_2) m^{-2} s^{-1}, Significant variation was observed among the entries for stomatal conductance, inter cellular CO_2 concentration and transpiration rate. Correlation between different photosynthetic traits, TDM and grain yield indicated that the P_N is positively associated with stomatal conductance and carboxylation efficiency (A/Ci ratio). The association between P_N TDM and grain yield was not significant. From an on-going trial 52 Swarna x *Oryza nivara* introgressed lines (ILs) were evaluated for leaf photosynthetic traits. Significant variation was noticed between the entries for photosynthesis rate, transpiration rate and inter cellular CO_2 content. The P_N varied between 9.07 (78-K) to 21.54 (3-1K) with a mean of 14.08 µmol (CO_2) m^{-2} s^{-1}. P_N was positively associated with gs, total chlorophyll, Chl. a content and P_N / C_i ratio representing the carboxylation efficiency. P_N was positively associated with leaf thickness. However, the association is statistically non-significant. A positive association was observed between rate of photosynthesis (P_N), grain yield and TDM.

CCR/CP/SS/10

Impact of changing temperatures on nitrogen dynamics and use efficiency in rice (M.B.B. Prasad Babu)

The impact of nitrification inhibitors *viz*., Neem Coated Urea (NCU) and Dicyandiamide (DCD) on N_2O emissions, nitrogen use efficiency (NUE) and grain yield of rice was studied. Application of DCD and neem coated urea reduced N_2O emission



significantly from the rice field as compared with urea. The N_2O flux during the study period was higher with untreated urea as compared to urea with inhibitors, indicating the inhibitory role of the nitrification inhibitors on N_2O emission. Total N_2O–N emissions were highest with urea (64 g/ha) followed by NCU (54 g/ha) and urea + DCD (49 g/ha) and were least in control with no nitrogen (23 g/ha). The highest inhibition of total N_2O emission (36%) was recorded from plots treated with urea + DCD followed by NCU (24%).

Maximum N uptake of 110.08 kg/ha was recorded with DCD + Urea followed by NCU (93.81 kg/ha) and Urea (81.61 kg/ha) while it was the lowest (38.83 kg/ha) in unfertilized Control. Application of N significantly increased grain yield as compared to absolute control where N was not applied. Recommended dose of nitrogen (RDN, 120 kg/ha) has doubled the grain yield (6311 kg/ha) by over unfertilized control (3083 kg/ha). The highest grain yield of 6992 kg/ha was recorded by the application of dicyandiamide (DCD) + Urea applied at RDN. The yield increase by the application of DCD + Urea and NCU was 14% and 7% respectively over urea. Application of 75% RDN (90 kg/ha) either through NCU or DCD + Urea yielded at par with RDN applied as PU. The nitrogen use efficiency (kg grain/kg N applied) was highest with DCD + Urea (70 kg grain/kg N applied) followed by NCU (66 kg grain/kg N applied). Reduction of N dose by 25 and 50% resulted in 11 and 24% loss in grain yield, respectively over RDN.

HRI - Host Plant Resistance against Insect Pests and its Management

HRI/CPT/ENT/11

Assessment of host plant resistance to brown planthopper (BPH) and whitebackedplanthopper (WBPH) and their management (V. Jhansi Lakshmi)

Of the 2900 entries consisting of breeding lines and germplasm accessions evaluated against BPH and WBPH through mass screening test in the greenhouse, 16 entries for BPH and 7 entries for WBPH were found promising (damage score <3.0). Seven entries *viz*., IET 22989, IET 23894, IET 21944, IET 23705, IC NO 578151 VPB 231 and VPB 232 were resistant to both the planthoppers. The mechanisms of resistance in the resistant sources were identified as non-preference for feeding and antibiosis for nymphal survival.

Greenhouse studies on the interspecific competition between BPH and WBPH revealed that the fecundity of WBPH was more when released in combination with BPH as compared to the fecundity when released alone. But, the fecundity of BPH was high when released alone.

Population dynamics of planthoppers and their predators

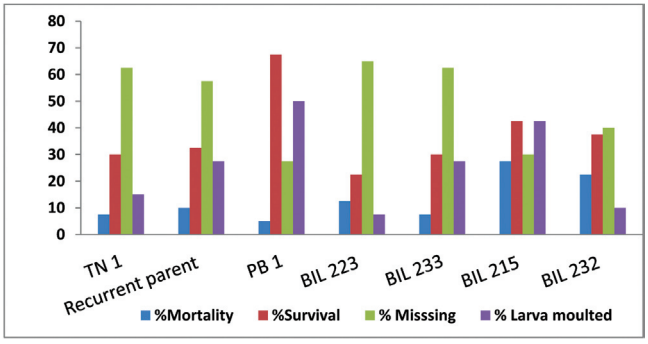
During *kharif* 2013, BPH and WBPH (1000 insects) were released individually in an area demarcated by mylar sheets and their effect on grain yield and on yield components was studied at harvest. The planthoppers and predators multiplied well and mirid bugs outnumbered the hoppers at the end of the crop season. There was considerable yield loss in the case of BPH and WBPH infested cages, the per cent unfilled grains was more and the number of panicles/hill was less in infested cages compared to uninfested cages.

HRI/CPT/ ENT/23

Insect-plant Interactions with Special Reference to Rice Pests – Yellow stem borer and Gall midge (A.P. Padmakumari)

Yellow stem borer:

Backcross inbred lines (BIL) derived from IR64 X *O. glaberrima* were evaluated in field as two row material for yellow stem borer damage. The mean damage by stem borer in the population was 12.7% WE with a maximum damage of 50 % WE in some of the lines. The damage in the donor parent was 15.4% WE and in the recurrent parent was 26.3 % WE. The damage followed a normal distribution. Cut stem assay of the introgressed lines revealed that larval mortality was high in BIL215 and BIL232. Low larval survival was recorded in IL223 and IL233. Larval moulting was affected in BIL232 and BIL 223.



Effect of backcross inbred lines on neonate larvae of yellow stem borer

Gall midge:

JGL 19618 (JGL 11609/Abhaya) was identified as resistant to gall midge biotypes 1, 3, 4 and Jagdalpur population. Two new germplasm accessions *viz*., IC 462402 and IC 577036 were identified as resistant to gall midge biotype 1. IET Nos 21841, 22096, 23074, 23194, 23234, 23247, 23262, 22144, 22698 INRC 15888 and germplasm accessions *viz*., IC 462402, 462447, IC463987, IC577588, ACC503, COGR1,COGR2, INRC17837 and IC450029 had nil damage against gall midge biotype 1 in the second year of testing .

Under map based approach, two gall midge resistance genes NBS-LRR for *Gm4* and Proline Rich Protein 3 for *Gm8* were short listed for Real Time validation. They were found to be upregulated (≥ 2 fold) in respective resistant parents compared

to other resistant and susceptible genotypes when challenged with biotype 1. These results confirmed the putative candidate genes for *Gm4* in Abhaya and *Gm8* in Aganni.

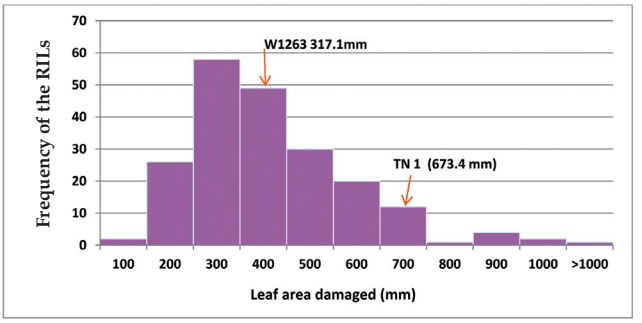
HRI/CPT/ENT/19

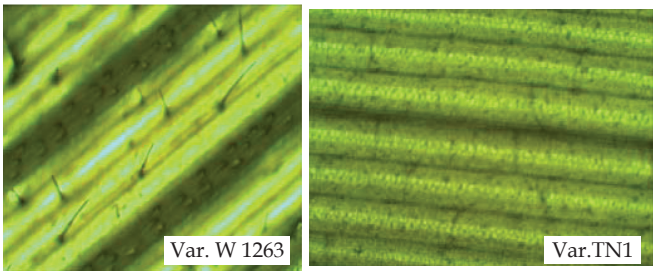
Host plant resistance for Leaffolder in Rice (Ch. Padmavathi)

In order to understand the basis of tolerance to leaffolder, field screening of 204 RILs of TN1/ W1263 was carried out during *Kharif* 2013. Each RIL was grown in a line of 20 hills and 3 hills were screened in each line. Special method was devised for screening wherein the leaves (10-15) of the RIL were covered with a nylon mesh bag and tied at the bottom. A single 3rd instar larva was released on to the leaves from the top of the bag by opening the thread and allowed to feed for 48 hrs. After 48 hrs, larva was collected and the number of damaged leaves were counted, collected and preserved in a book for the measurement of damaged leaf area. Damaged leaves were scanned with Cannon MF 4320-4350 scanner at colour mode with 300dpi image quality. Leaf area fed was measured by using image software. Each time both the parents were also screened along with the RILs. It took about 2 weeks for complete screening of 204 RILs along with parents.

The data on frequency of leaf area damaged revealed a normal distribution curve with values between 78.1 mm to 1675.8 mm. Among the 204 RILs evaluated, less than 100 mm leaf area was damaged in only 2 RILs (No.114 & 144) while in one RIL (No.240), more than 1000 mm. leaf area was fed in 48 hrs. The leaf area fed in TN 1 was almost double the area fed in W 1263. Leaf parameters like leaf length and leaf width of second leaf from top were also measured in these 204 RIls. Both Parents differed significantly in parameters like leaf width, percent development of the eggs and also in the presence of trichomes. Developmental studies revealed that 91% eggs developed into adults on TN 1 whereas only 44% eggs developed into adults on W 1263. Among the two parents, trichomes were observed only on abaxial surface of W1263 leaves while they were absent on both surfaces of TN1 leaves.

Frequency distribution of leaf area damaged by rice leaffolder in RILs of TN1/ W1263





Variation in trichomes on the abaxial leaf surface of the parents

IPM- Integrated Pest Management

IPM/CPT/ENT/3)

Chemical control as a component of rice IPM (G. Katti)

A replicated field trial was carried out to evaluate the effect of non ionic wetting agent, Ek boond on the efficacy of three insecticides against stem borer in rice during *kharif* 2013 at DRR Farm, Rajendranagar.

The trial included eight treatments replicated thrice in a randomized block design (RBD). The treatments consisted of three insecticides, rynaxypyr @ 30 g a.i./ha, acephate 95 SG @ 500 g a.i./ha and dinotefuran @ 40 g a.i./ha each applied with Ek boond (200 ml/ha) and alone (without Ek boond). Ek boond alone and an untreated control treatment without any pesticide application served as controls.

Stem borer incidence ranged from 4.5% to 11.5% DH in insecticide treatments and 8.2 to 13.2% DH in Ek boond alone and control during 32 to 74 DAT. The white ear incidence varied between 11.2% and 14.8% in insecticide treatments compared to 15.1% in Ek boond alone and 16.1% control. Rynaxypyr and acephate treatments with Ek boond had significantly lower dead heart damage at 32 DAT and white ear damage. The yield in rynaxypyr with Ek boond was significantly high (3347 kg/ha) followed by acephate with (2944 kg/ha) and without Ek boond which were at par.

IPM/CPT/ENT/13

Invertebrate biodiversity of irrigated rice ecosystems and its functional significance. (Chitra Shanker)

Ecological engineering for enhancing natural enemy fitness

Field studies on ecological engineering with marigold, gaillardia and bhendi as border plants for enhancing parasitisation of hopper eggs were taken up at DRR farm during *Kharif* 2013 and Gaillardia and cowpea in *rabi* 2013-14. Fields with border of marigold resulted in 40 per cent increase in parasitisation of hopper eggs by *Oligosita* sp. In the laboratory, the longevity of adults of *Tetratsichus schoenobii* was studied by providing honey, flowers of marigold, *Eclipta* and *Tridax* as food source. The longevity of the parasitoid was highest when provided with honey (22.75±0.75) as food source and lowest when they were not provided with any food (3.40±0.42). Among the flower sources, the longevity (days) was highest on *Eclipta* (7.11±1.45) followed by marigold (6.83±1.40) and *Tridax* (6.35±1.37).

Effect of Ek boond on the efficacy of insecticides against rice stem borer, *kharif* 2013

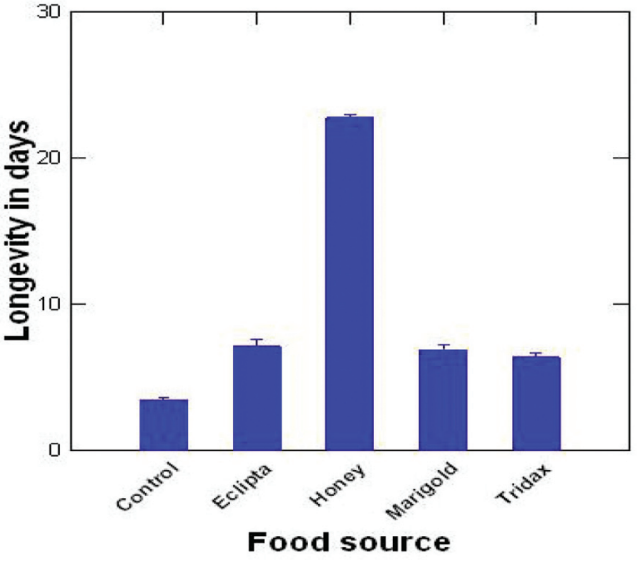
Trade Name	Dead hearts (%)				% WE	Yield (kg/ha)
	32 DAT	45 DAT	63 DAT	74 DAT		
Rynaxypyr + Ek Boond	7.9a	4.9a	5.2a	7.9a	11.2a	3347a
Acephate + Ek Boond	8.7a	5.6a	5.1a	9.4ab	11.3a	2944b
Dinotefuran + Ek Boond	10.1b	5.7a	7.9b	9.5ab	14.8b	2806bc
Rynaxypyr alone	11.5b	6.1a	8.1b	9.3ab	14.2b	2903b
Acephate alone	10.6b	4.5a	8.4b	10.5b	13.0ab	2972b
Dinotefuran alone	10.9b	5.0a	7.8b	10.3b	14.2b	2792bc
Water + Ek Boond	12.0b	8.2b	8.7b	10.4b	15.1b	2602c
Untreated control	13.2b	9.2b	9.0b	11.1b	16.1b	2569

Values in the columns followed by different letters are significantly different at p=0.05

Mass rearing of predators for augmentation biocontrol

Predatory potential of two coccinellid beetles on brown planthopper was assessed. The coccinellid, *Harmonia octomaculata* consumed a mean of 7.53 nymphs per day during adult stage while *Menochilus sexmaculatus* consumed 4.66 nymphs per day. The pentatomid predator *Andralles spinidens* completed its life cycle in 45- 57 days on *Corcyra* larvae and offers scope for biocontrol against earhead bugs and lepidopteran pests.

Flowering plants for enhancing natural enemies

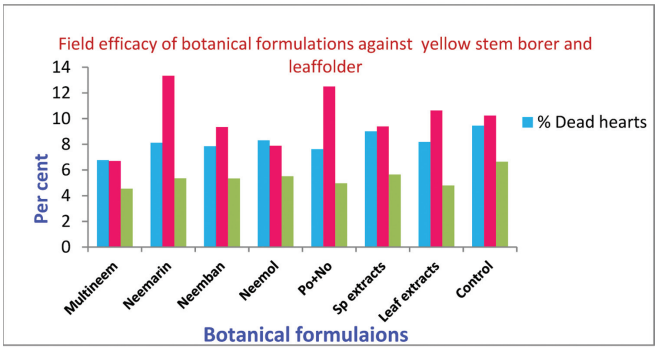


Longevity of *Tetrastichus schoenobii* in relation to food source

IPM/CPT/ENT/21

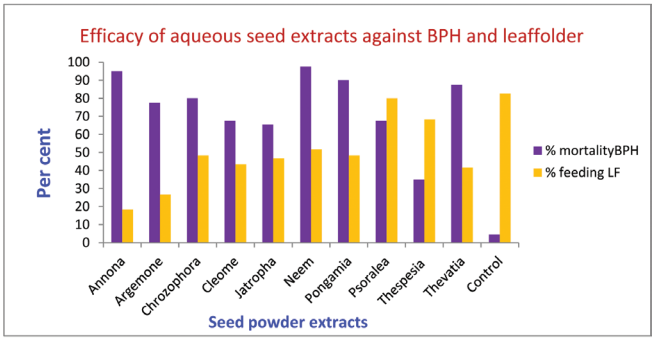
Botanicals for sustainable management of major pests of rice (B. Jhansi Rani)

A field experiment was conducted to evaluate the efficacy of commercial botanical formulations and three plant extracts in a randomized block design with 3 replications during *Kharif*, 2013. Of



8 treatments tested, a neem oil based formulation-Multineem (containing 300 ppm azadirachtin) at 2ml/l was found effective in reducing yellow stem borer, *Scirpophaga incertulas* damage with 6.76% of dead hearts followed by Neem Ban (300 ppm azadirachtin) with 7.84% when compared to 9.44% in control. Multineem was also effective in controlling white ears with 6.7% damage as against 10.22% in control and leaffolder damage of 4.54% DL as compared to 6.64 % DL in control. Highest yield of 9.32 kg/34.5 $m^2$was recorded in Neem Ban, followed by Multineem with 9.15 kg/34.5 m^2 as compared to 8.50 kg/34.5 m^2 in control.

Field efficacy of botanical formulations against yellow stem borer and leaf folder



Efficacy of aqueous seed extracts against BPH and leaffolder

A laboratory test was carried out to assess the efficacy of water extracts from seed powders of various plant species at 5% against BPH, *Nilaparvata lugens* nymphs. Among ten extracts tested, neem, *Azadirachta indica* extract caused highest mortality of 97.5% followed by *Annona squamosa* with 95.0 % when compared to 4.5 % in control. When the same extracts were tested for their antifeedant efficacy against leaffolder, *C. medinalis* at 5%, *A. squamosa* extract recorded lowest feeding of 18.3% followed by *Argemone mexicana* with 26.6% as compared to 73.3% in control.

IPM/CPT/ENT/20

Semiochemical approaches to manage insect pests of rice with special emphasis on sex pheromones (M. Sampath Kumar)

In association with IICT, Hyderabad and CPCRI, Kasaragod the sex pheromone component of pink stem borer, *Sesamia inferens* was confirmed as an acetate molecule Field evaluation of the identified pheromone component resulted in marginally good trap catches when tested at two different locations *viz*., DMR Hyderabad and PAU, Ludhiana.

Developed a binary blend consisting of two acetate molecules against rice leaffolder, *Cnaphalocrocis medinalis* Guenee which resulted in good trap catches upto a maximum of 23 males/tarp on a single day at DRR farm, Hyderabad.

Leaffolder catches in the pheromone trap

IPM/CPT/ENT/22

Investigations on Nematodes of Importance to Rice Cultivation (N. Somasekhar)

Biological control potential of five entomopathogenic nematodes (*Metarhabditis amsactae* isolates DRR-Ma1 & DRR-Ma2, *Heterorhabditis indica*, *Steinernema glaseri* and *S. asiaticum*) against rice yellow stem borer *Scirpophaga incertulas* was evaluated in small scale field experiments. Observations on white ear damage caused by the yellow stem borer revealed that the incidence of white ears was low in nematode treated plots as compared to the untreated control. Maximum reduction (38.2%) in white ears over untreated control was observed in case of nematode *Metarhabditis amsactae* isolate DRR-Ma2.

Studies on influence of different temperature and moisture regimes on root-knot nematode damage in rice revealed that the number of galls caused by the nematode was significantly higher (41-61%) in un-flooded condition compared to the flooded condition at both ambient and elevated temperatures (40-45^{0}C). Further, the number of galls caused by the nematode was more at ambient temperature compared to that observed at elevated temperature under un-flooded condition.

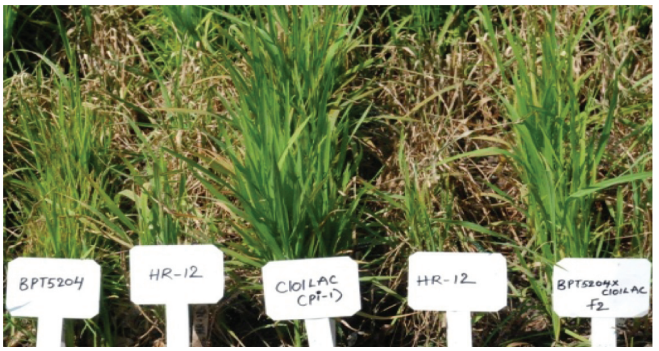
Analyses of soil Nematode populations revealed that the total nematode abundance was higher in SRI plots compared to the conventional system across different nutrient management systems. In general, relative abundance of plant parasitic nematodes was low in SRI plots compared to the conventional system. Population of rice root nematode, *Hirshmanniella spp.* was less in SRI plots compared to the conventional system.

HRP - Host-plant Resistance against Pathogens and its Management

HRP/CPT/PATH/15

Assessment of host plant resistance to rice blast disease and its management (M. Srinivas Prasad)

Host Plant Resistance: A total of 6962 rice lines which includes parents, near isogenic lines



(NILs), RILs, blast differentials, advanced lines from aromatic short grain variety improvement programme, IRBN lines from IRRI and various introgression lines were evaluated for their resistance to blast in uniform blast nursery under heavy disease pressure. The lines generated in functional genomics project were also evaluated for resistance against rice blast. Of these 6962 lines, 803 lines were found to be resistant against blast disease.

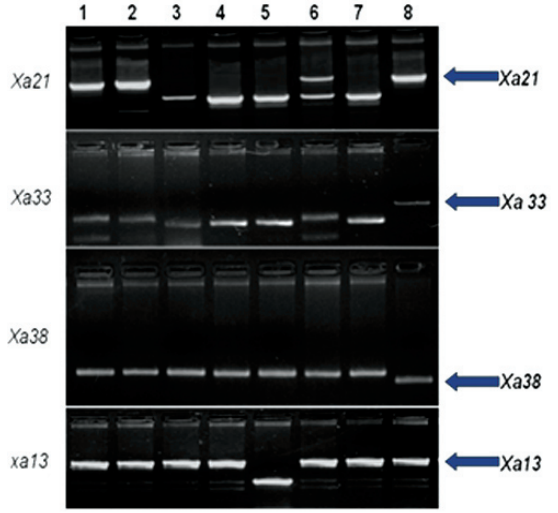
Some of the materials developed through MAS were nominated for All India Coordinated trials. These included IET # 24164 (RP Patho-1-2-15) and 24165 (RP Patho-1-6-5) which had blast resistance gene Pi1 in the background of BPT 5204, IET # 24166 (RP Patho-3-56-11) and 24167 (RP Patho 3-73-6) which had blast resistance gene Pi54 in the background of BPT 5204 and IET # 24168 (Rp Bio Patho-2 -18-5) and 24169 (RP Bio Patho -2 -16-4) which had Pi54 in the background of Imrpved Samba Mahsuri. Among these, IET # 24164, 24166 and 24167 were promoted to AVT-2-NIL.

Management of Blast disease: A trial was conducted involving newer and existing fungicides for the management of blast disease. All the fungicidal treatment significantly reduced sheath blight severity. The formulations like trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l, kresoxim methyl @ 1 ml/l, azoxystrobin 25 SC @ 1 ml/l, tricyclazole 75 WP @ 0.6 g/l, carbendazim 50 WP @ 1 g/l, propiconazole 25 EC @ 1 ml/l were evaluated. Among the treatments, trifloxystrobin 25% + tebuconazole 50% @ 0.4 g/l was most effective in reducing the blast disease severity and simultaneously increasing the yields. In another study, a combination product of mancozeb 68% + tricyclazole 18% was found very effective in checking the blast disease. In a separate study, a new product pyraclostrobin @ 4 ml/l was also found effective against blast.

HRP/CPT/PATH/13

Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice (G. S. Laha)

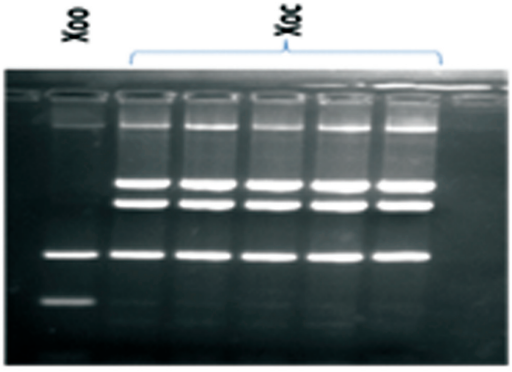
Host Plant Resistance: Out of selected 49 introgression lines (ILs) tested against 6 different Xoo isolates, nine ILs *viz*., PAU # 547, 549, 550, 695, 747, 848, 1061, 1077 and 1195 were found to have broad spectrum resistance against all the BB isolates used. PCR analysis for the presence of selected known major BB resistance genes in some



Detection of Major BB R genes (Lanes 1-7: PAU # 547, 549, 695, 747, 1061, 1077 and 1195; 8: Imp. Samba Mahsuri for *Xa21* & *xa13*; FBR 1-15 for *Xa33*; PAU-3554 for *Xa38*)

of these promising ILs with gene specific markers indicated that IL PAU 1061 did not have any of the known major BB resistance genes tested. Thus IL PAU 1061 may provide novel source of resistance to bacterial blight in India

Collection and characterization of Xoo: Ninety six new isolates of *Xanthomonas oryzae* pv. *oryzae* were established from infected samples collected from different rice growing regions of India during 2013. There was severe outbreak of bacterial blight in Guntur district of Andhra Pradesh during September-October, 2013 and in Thanjavur district of Tamil Nadu. Till now we have completed the phenotyping and genotyping of 260 isolates of *Xoo* collected from different rice growing regions of India and categorized them into 22 pathotypes. Few strains of Xanthomonas oryzae pv. oryzicola (Xoc) from Tamil Nadu and Assam were also isolated. Many times both Xoo and Xoc will occur together. As the colonies of these two bacteria cannot be differentiated visually, we studied the effectiveness of a multiplex PCR reported by Prof. Jan Leach. The marker system consisted of 4 primer pairs *viz*., 2 primer pairs specific for Xoc, one primer pair specific for Xoo and one primer pair for both Xoo and Xoc. The multiplex PCR clearly distinguished the strains of Xoo and Xoc.



Multiplex PCR for distinguishing strains of Xoo and Xoc

We tested the efficacy of three vitamins {Thiamine hydrochloride (TH) Pyridoxine hydrochloride (PH) and Nicotinic acid (NA)} and their combination on bacterial leaf blight of rice. All the vitamins significantly reduced the lesion length compared to control. Among the vitamins tested, combination of three vitamins at 10 mM concentrations and Thiamine hydrochloride at 50 mM were the best in reducing the lesion length.

Effect of some vitamins and their combination on the disease severity of bacterial blight of rice

			Yield (kg/ha)	
Treatments	1st Observation	2nd Observation	(Vitamins + BB)	Vitamins only
TH (50 mM)	5.71	13.04	3860.00	5413.33
PH (50 mM)	5.62	15.50	4270.00	5570.00
NA (50 mM)	5.34	15.77	5853.33	5186.67
Mix of 3 vitamins (3 mM each)	7.79	15.37	4583.33	5703.33
Mix of 3 vitamins (10 mM each)	5.44	13.47	4336.67	6383.33
Control	10.47	23.94	4426.67	5706.67
CV (%)	23.98	14.65	14.76	11.1
LSD (5%)	2.9339	4.3135	1223	1143.4

HRP/CPT/PATH/14

Assessment of host plant resistance and Development of Diagnostic tools to rice tungro virus disease (D. Krishnaveni)

Host plant resistance: One hundred and twenty introgression lines from a cross of BPT 5204 x *O. rufipogon* along with TN1 (Susceptible check) and Vikramarya (resistant check) were evaluated for their reaction to RTV in glasshouse. Of these, 6 lines (BILs # 4B, 5B, 6B, 24B, 25B and 84B) exhibited resistant reaction with a score of 3, 30 lines showed moderately resistant reaction (score 5) while rest were susceptible. The resistant lines showing a score of 3 in 1-9 scale were on par with the resistant check Vikramarya. The allelic variability of the putative candidate gene identified though fine mapping of qRTV7 was screened in the resistant and susceptible ones and found the association of the identified candidate genes in the selected resistant lines. In another study, 338 BC_2F_2 populations from IR64/Utri Rajapan cross were phenotyped to study the functional analysis of RTV resistant genes and identified 120 lines with score1 and 78 lines with score 3.

Assessment of yield losses at different stages of tungro infection: Six rice genotypes comprising of two susceptible (TN1 and Tapaswini), two moderately resistant (IR 20 and IR67406-6-3-2-3) and two resistant (TKM-6 and Vikramarya) were selected for yield loss studies. The results revealed that the resistant cv. Vikramarya was less affected in terms of plant height when inoculated with RTV at 60 DAS with 0.4% increase and 0.9% reduction in plant height at 50 DAS. Moderately resistant IR 20 and IR674066-3-2-3 also showed less reduction in terms of plant height as compared to susceptible rice cvs. TN1 and Tapaswini. Reduction in number of panicles per plant was also found less in Vikramarya. A significant decrease in grain number per panicle (15.5%) was observed in Vikramarya when inoculated with RTV at 20 DAS while in TKM-6 it was 16.3 per cent. However, when TKM-6 and Vikramarya were inoculated with RTV at 60 DAS, it had no significant effect on grain number per panicle. Virus inoculated TN1 and Tapaswini were the most affected in terms of reduction in total number of grains per panicle. Rice variety TN1 was most affected in terms of 1000-grain weight when inoculated at 20 DAS as the inoculated plants could not reach the flowering stage to produce panicles.

HRP/CPT/PATH/17

Biology of false smut disease of rice (D. Ladha Lakshmi)

Host Plant Resistance: Different methods of inoculation were tried *viz.*, dusting of chlamydospore, spraying of conidia during anthesis, swabbing of conidial suspension, injection of conidial suspension at booting stage. The inoculated plants were kept under 80-90% RH at 24^0C for one week followed by incubation under room temperature. Among these methods tried, injection of conidial suspension during booting stage produced considerable number of smut balls (ranging between1-11). The percentage of infected tillers varied from 60-100%. The inoculation technique was repeated and reproducible results were obtained. Plants injected with one week old

Figure 4: Artificially inoculated TN 1 at late stage of booting plants showing false smut infected grains under controlled conditions

conidial suspension of *U. virens* during the early stage showed typical smut balls in the emerging panicles. The secondary metabolite of *U. virens* was partially extracted from the 30 days old grown culture filterate and the chloroform layer showed inhibitory action against *Candida albicans.*

Roving survey was conducted during the first week of December 2013 at Nalgonda district of Andhra Pradesh to assess the incidence of false smut. Eleven villages (Chityal, Veliminedu, Cherughat, Vemulapallee, Tummadam, Mukundapuram, Narasihula gudam, Kampasagr, Thripuraram,

Survey on the incidence of false smut of rice in Nalgonda district of Andhra Pradesh

Name of the village	*% of infected tillers	*% of infected spikelets/ panicle	*Total no. of smut balls/50 panicles	Range of smut ball observed per panicle
Chityal	15.42	2.47	271	1-22
Cherughat	19.07	2.50	269	1-26
Kampasagar – 1	15.35	2.23	160	1-17
Kampasagar -2	44.08	3.61	509	1-57
Thipuraram -1	59.49	4.13	883	3-64
Thipuraram -2	35.54	3.12	425	2-24
Mukundapuram	22.15	2.43	239	1-19
Tummadam	39.40	3.05	443	1-54
Narashihula gudam	45.15	3.95	590	1-45
Miryalguda	15.13	1.92	173	1-16
Vemulapallee -1	19.24	2.04	244	1-21
Vemulapallee -2	20.12	2.69	281	1-22
Velimineduu	33.52	3.25	401	1-42

** At random 50 panicles were observed*

Chrlapalle and Miryalguda) from 8 mandals were surveyed. The percentage of infected tillers/ hill varied between 15.13% to 59.49%. Very high percentage of infected tillers was recorded in the fields at Thripuraram (59.49). Among the varieties, BPT 5204 recorded severe incidence of false smut both in terms of infected panicles/hill (100%) and number of smut balls/ panicle (64).

HRP/CPT/PATH/18

Characterization and management of *Rhizoctonia solani* causing sheath blight of rice (V. Prakasam)

Host Plant Resistance: Nine hundred and forty germplasm comprising of introgression lines (ILs), land races, A, B, R lines, wild rice accessions and tropical japonicas (TJPs) were evaluated during *Kharif*-2013. Out 106 germplasm found promising in the initial screening, 2 mutant lines, 14 ILs, 2 elite lines, 1 B line and 7 TJPs were found promising in the repeated screening. Seven land races like Gumdhan, Wazuho Phek, Meghalaya Lefara, Chng Chakhao, Kunda, Ngonolasha, Shitaria Maha have shown promising results consecutively for the third time. Among the Green Super Rice (GSR) lines evaluated, one line called GSR 106 showed resistance and three others *viz*., GSR-133, GSR-304 and GSR-311 showed moderate resistance to sheath blight disease. Fifteen land races out of selected 55 germplasm lines were found promising for sheath blight resistance for the second time.

Management of sheath blight disease: A trial was conducted involving newer and existing fungicides for the management of sheath blight disease of rice under field condition. All the fungicidal treatment significantly reduced sheath blight severity. The combination fungicide trifloxystrobin 25% + tebuconazole 50% and azoxystrobin 25 SC were best in reducing the sheath blight severity and were on par with check fungicide (propiconazole). Highest yield was recorded in the plots where azoxystrobin 25 SC sprayed (3173 Kg/ha).

In another trial, bio-efficacy of a new combination fungicide, tetraconazole 7.46% + azoxystrobin 9.32% was tested against sheath blight of rice. The formulation was tested at 4 different dosages (1, 1.5, 2 and 3 ml/l). Among different treatments, tetraconazole 7.46% + azoxystrobin 9.32% (3.0 ml/liter of water) was best in reducing the sheath blight severity and was better than check Nativo 75 WG. The test chemical tetraconazole 7.46% + azoxystrobin 9.32% did not show any symptoms of phytotoxicity. In another experiment, combination product mancozeb 68% + hexaconazole 4% WG (at 2-3 ml/l) was found effective against sheath blight disease.

Evaluation of new and commercially available fungicides on sheath blight disease, *Kharif,* **2013**

Treatments	Dose	Disease severity	Yield (Kg/ha)
Trifloxystrobin 25% + tebuconazole 50%	0.4 g	3.1(1.7)	2930
Kresoxim methyl	1.0 ml	3.2 (1.8)	2393
Azoxystrobin 25 SC	1.0 ml	3.1 (1.8)	3173
Tricyclazole 75 WP	0.6 g	3.2 (1.8)	2730
Carbendazim 50 WP	1.0 g	3.2 (1.8)	3090
Propiconazole 25 EC	1.0 ml	3.1 (1.7)	2560
Check	-	6.9 (2.6)	1890
General Mean	-	-	2689
CV(%)	-	7.94	6.89
CD at 5%	-	0.26	329
Transformation	-	ST	

(Figures in parenthesis indicate transformed means; ST-Square root transformation)

TTI – Training, Transfer of Technology and Impact analysis

TTT/EXT/8

Sustainable Rice production Practices: problems and prospects (P. Muthuraman)

Sustainability study was carried out in the traditional boro rice growing area of Bihar. A total of 120 farm households in three villages in Saharsa district were interviewed. Results of this study revealed that the maximum labour use pattern in boro rice is observed in the operation of sowing and transplanting (28%), followed by land preparation (19%), harvesting and threshing (18%), irrigation (17%), intercultural operation (15%) and manuring and fertilizer application (3%). The prominent rice varieties adopted by the farmers are Pusa 2-21, Pusa 33, Saket 4, Jaya, Sujatha, Gautam, Saroj, Prabhat, IR 64, Vishnu Prasad, Jyothi Prasad and Richharia, Chinsura Hybrid -3 .

The major information sources to the farmers about the know –how of boro rice are from the fellow farmers (30.8%) followed by Agricultural Research station and KVK (24.2%), input dealers (19.2%) line department (15.0%), print and electronic media (9.2%) and civil society organizations (1.6%).

Sustainable Rice production in the study area is at stake due to the following reasons

Major Reasons for Low Sustainability in Boro Areas of Bihar

S. No	Major Reason	Percentage	Rank
1	Maize and vegetables are replacing boro rice	79 %	1
2	Imbalanced use of inorganic fertilizers	72 %	2
3	No scientific water management practices	70 %	3
4	Inadequate attention to problem soils	66 %	4
5	No standard IPM and INM practices	61 %	5
6	Poor seed replacement	60 %	6
7	Dependency of hired labour	59 %	7
8	Tenant farming	55 %	8
9	Lack of information Reliancy	49 %	9

TTT/EXT/10

Gender dimensions in Rice Sector: An Exploratory study on labor migration and livelihoods (Amtul Waris)

Gender based participation in rice cultivation in selected villages of Tamil Nadu indicated that land preparation, irrigation management and marketing were undertaken by farmers and farm women were involved in pulling out seedlings,

transplanting, weeding and harvesting. An inter district variation in participation of women in rice cultivation was observed in Bihar and women

SWOT Analysis of Sustainable Boro Rice Production in Bihar

Strength	Weaknesses
• Higher productivity • suitable for deep water eco system • Boro rice serves as an insurance for food to the farmers • Transforming the resource poor environment into a more agro economically viable domain. • Increased employment opportunities for agricultural labors • Encouragement by the government	• The extended crop duration • Increased expenditure on crop management • Delayed harvest further interfere with *Kharif* rice • Non availability of suitable varieties with both cold and heat tolerance • Very poor seed replacement
Opportunities	**Threats**
• Boro rice is helping household food security and enhance livelihood • It provides better lowland use opportunity • It can promote rice-fish culture in suitable places • It provides lot of employment opportunity • More incentives are coming through BRIGREA, NFSM etc	• Low Temperature during winter • High rate of seedling mortality • Penetration of new crops in the traditional boro areas • Prevalence of Brickclin industries • Lack of credit facilities to install shallow borewell

were involved mostly in weeding and harvesting. Women have limited access to and control over resources. The comparative drudgery rating by farm women between traditional and SRI method indicated that line sowing in SRI method was rated as highly skilful and drudgery prone (73%) compared to normal transplanting (58%). The livelihood options were wage work as agriculture labor and MGNREGA activities. During peak transplanting activity in the villages, the women labor preferred it over MGNREGA activities as the wages were Rs. 200/day for transplanting higher than wage for MGNREGA Rs.130/day.

TTT/EXT/12

Maximizing the Impact of Rice Technologies through ICT applications (Shaik N. Meera)

During the year 2013-14, a small action research and surveys were conducted in two major rice growing states in India (Andhra Pradesh and Karnataka) involving 180 rice farmers and 45 extension professionals. The study focused on demand analysis for knowledge products and rice technologies, mapping of knowledge and technology sources, delivery channels, ICT tools, impact, factorial contribution of non-negotiable adoption points to farm productivity etc.,

The per cent respondents receiving information from different ICT tools were found to be; Seeds & Varietal Selection (45%), Land Preparation (8.33%), Nursery Management (8.8%), Crop Establishment Methods (13.88%), Nutrient Management (24.44%), Water Management (4.44%), Plant Protection (56.11%), Weed Management (28.33%), Harvest Management (12.22%), Market and supply chain (23.33%), Government related (41.66%), Weather related (26.66%). Further analysis of the components (except for latter three components) was also done for factorial contribution.

In both these provinces, impact of knowledge interventions was found to be significant when blended with field demonstrations. Factorial contribution of knowledge interventions (using ICTs and non-ICTs) adoption levels on productivity and income levels were studied. About 89% of respondents (107) have accessibility to ICT tools such as Mobile phone, Internet, Video etc. Out of 32 non-negotiable adoption points, 15 (46%) Information needs were met from these tools. Changes in practices due to ICT interventions were found to be in the range of 11-12% of total adoption points. Majority of the farmers opined that productivity increase was realised to the tune of 30% (both information and technology impact). About 20% of the farmers benefitted either by reduced cost of cultivation or other advantages. Impact of different factors, knowledge and technology interventions on rice productivity were calculated. Age (-0.387*), Education (0.283*), Use ICT tools for rice knowledge (0.204), Changes in practices (0.227*), Reduced cost of cultivation (0.318*), Adequacy of information (0.259*) were significantly correlated with the field productivity.

The non-negotiable adoption points under the categories of Land Preparation (0.241*), Seeds & Varietal Selection (0.376**), Nursery Management (0.027), Crop Establishment Methods (0.404*), Nutrient Management (-0.295*), Water Management (0.271*), Plant Protection (0.383**), Weed Management (0.296*), Harvest Management (0.490*) were found to be associated with the productivity of rice in farmers fields. There is a significant correlation between the extension professionals and farmers about the perceived and actual benefits accrued by the ICTs.

TTT/EXT/9

An Exploratory Study on Partnerships: Impact and Implications for the Rice Sector (S. Arun Kumar)

The partnership formation cycle of basmati rice sector, stakeholder's perceptions and willingness in the various partnership processes were studied. The data was collected from the scientists from ICAR institutes, SAUs, KVK, Private sector and farmers from the Punjab region. Majority of farmers (about 80%) were aware of contract farming processes, respondents were willing to enter contract farming with written agreement. Few farmers preferred group activities like seed

production under contract farming. Study revealed that positive organizational environment with clear vision on partnership with leadership support as one of the favorable factor for creating effective partnerships.The contractual agreement processes like selection of farmers, agreement, input supply, technical support and procurement pattern of Kohinoor Foods Ltd and Pepsi Foods Ltd were analysed. Extension efforts of the private sector (Pepsi) in popularizing Direct Seeded Rice in the Punjab region under its "Positive Water Balance Agenda" were documented. The study suggests having more emphasis towards partnerships of MNCs (under CSR strategy) in technology dissemination and adoption processes

TTT/ECON/1

Yield gaps and constraints in rice production- An econometric analysis (B. Nirmala)

The yield gaps in irrigated rice ecologies of Muzaffarpur, Samastipur and Begusarai districts of Bihar were studied during the year 2013. The data on economics of rice cultivation and yield realized were collected from 120 rice farmers. Yield gap I which is the difference between the potential yield (experimental station yield) and the potential farm yield (demonstration yield) was 12%. Yield gap II which is the difference between the potential farm yield (demonstration yield) and actual yield (average yield realized by the sample farmers) is 18 percent. The index of the yield gap has been found to be 27%. Index of realized potential yield which is defined as the ratio of actual yield to potential yield, expressed in percentage has been found to be 72.6%. Index of realized potential farm yield which is defined as the ratio of actual yield to potential farm yield, expressed in percentage has been found to be 82.4% in Bihar. The major problems in cultivation of rice as opined by the farmers in sample districts of Bihar were quantified by using the Garrett's ranking technique. The non-availability of seed in time, incidence of pests and diseases like gundhi bug, stem borer and leaf folder, brown spot, false smut and BLB were the major constraints in realizing the potential yield in the study area. Labor shortage and high marketing charges were the other constraints as perceived by the sample farmers. Thus, it can be inferred that, if production constraints experienced by farmers

in this region are addressed, productivity can be increased to the tune of 27%.

The yield gaps in irrigated rice ecologies of Tamil Nadu were studied. Coimbatore and Erode districts of Tamil Nadu were selected as the study area with a sample size of 100 rice farmers. In Tamil Nadu, Yield gap I and Yield gap II were found to be 6 percent and 13 percent respectively. The index of yield gap has been found to be 19%. Index of realized potential yield has been found to be 80.9%. Index of realized potential farm yield has been found to be 86.2%. The major constraints in realizing the potential yield in Tamil Nadu have been shortage of labor during the peak operation periods, incidence of pests and diseases like stem borer, BPH and leaf folder and BLB and Blast, nutrient deficient soils and lack of remunerative price. Weed infestation was another problem reported by the sample farmers. Apart from these problems, imbalanced fertilization is found to be a common problem prevalent among the sample farmers. This can be overcome by application of optimum doses of fertilizers after soil testing and creation of awareness among the farmers regarding the judicious use of fertilizers. The constraints identified in the study area if addressed, could help in bridging the yield gap and realizing the potential yield by the sample farmers.

Institutional Activities

Technologies assessed and transferred
Licensing and Commercialization of Technologies
Awards/recognitions Revenue generation
Linkages and collaborations
Significant events
Personnel
Publications
RFD
Appendices

Technologies Assessed and Transferred

Training and Extension

During the year 2013-2014, four training programs were planned, organized and evaluated on various aspects of Rice Production Technologies through which 70 persons were trained. Out of four training programs, two training programs on Model Training programmes were conducted on various aspects of Rice Production Technologies for Human Resource Development on National Level. Two model training courses viz. System of Rice Intensification (SRI) and Hybrid Rice Production Technologies (HRPT) were sponsored by Directorate of Extension, New Delhi while one each sponsored by the private companies (agro input agencies) and the PPRVFRV. Through these 4 training programmes 70 participants were trained including Scientists, Senior Level Extension Functionaries, Subject Matter Specialists from various Departments of Agriculture, State Agricultural Universities. For all the training programs information brochures were designed and prepared including background information, course content, training methodology etc and sent to various State Department of Agriculture SAU's, Public Private Sector for nominations. Besides these four programs six Short Duration courses were also organized for farmers, Extension Officials and students from all over India through which 185 persons were trained.

Tribal Sub Plan

As part of Tribal sub-plan activates were undertaken to enhance the livelihood of the tribal farmers (Chenchus and Lambadas) from the tribal villages of Amarabad mandal and Regadi Mylarum Mandals in Mahabbobnagar district and the Korra Thanda of Nalgonda district in Andhra Pradesh. Total number of tribal settlements covered under TSP is 15.

Overall 200 tribal families were given the technologies like Improved samba Mahsuri,, Krishna Hamsa, MTU 1010, drum seeder, Zinc sulphate, fungicides and other critical inputs. Various constraints in rice cultivation were identified and the technologies given to them helped to break the yield barriers. The tribal farmers were shown the waste management (recycling the waste) through vermi compost and this was demonstrated in the tribal hamlets of Nalgonda district. The importance of choosing appropriate varieties, seed selection, good agronomic practices and adoption of INM practices was stressed for improving production and productivity of rice crop.

A home based remedy for control of diarrhoea by using pre-cooked rice powder along with medical advice was demonstrated in the training program. The members of farm women's group

Ecosystem	Total FLDs (ha)	Mean FLD Yield (t/ha)	Mean Check Yield (t/ha)	Mean % Yield Advantage
Irrigated	315	5.54	4.54	24.25
Upland	80	4.12	3.30	31.34
Shallow	75	4.48	3.41	33.16
Hills	15	4.50	3.40	36.54
Total or Mean	485	4.66	3.66	31.32

were trained in setting up vermin compost units for eco-entrepreneurship development.

Frontline Demonstrations on Rice

During the year through this programme, a cafeteria of rice technologies were demonstrated in 485 hectare area covering 15 states and four major rice ecosystems of the country. FLDs organized during this year have been effective in creating the awareness about the potential of new rice varieties, hybrids and other management technologies. In majority of the cases the yield advantages recorded by the FLD technologies were significant.

About 65% of the total FLDs were conducted in irrigated ecosystems, 16% in rainfed uplands, 15 % in shallow lowlands and 3% of the FLDs were covered under Hill Ecosystems. FLD technologies demonstrated in irrigated ecosystems have recorded mean yield of 5.54 t/ha where as in Shallow lowlands FLD technologies have recorded an average yield of 4.48 t/ha. Average demonstration yields in rainfed uplands was 4.12 t/ha.

The analysis of yield advantages obtained in various ecosystems revealed that across the ecosystems, FLD technologies have recorded impressive yield advantages. In case of irrigated ecosystems, the mean yield advantage was 24%, in uplands the mean yield advantage was 31% and in shallow lowlands, the mean yield advantage was 33%. This shows the attainable yield potential in the farmers' fields, which needs to be considered for planning the extension programs in these regions. The range of yield advantages explains

that there are few promising technologies, if properly adopted by the farmers may result in enhancing the farm level productivity. In total 33 promising technologies have been identified from 15 states. The criteria adopted to identify these technologies are relative yield advantages over the existing technologies and the kind local problem the technology tried to address. This is not an exhaustive list, but only indicative list giving those technologies that could be tried in these states. These technologies will help either in withstanding abiotic stresses (such as submergence – Amara, Swarna sub-1), improving the field productivity (Indira Sona, KRH-4, Palam basmati, Ajaya, HUR-105 under INM, Shiats Dhan -1), solving

the local problems (Problem soil management), labour scarcity (mechanical transplanting, drum seeding), early harvest for facilitating rabi crops (Abhishek), consumer preferences (RC Maniphou-10), replacing the local varieties in tribal areas (CO (R) 50) etc., But a viable strategy should be in

place before these promising technologies making a difference in the livelihoods of farmers.

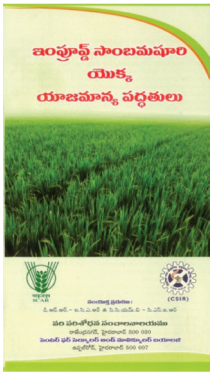
During this year, monitoring was done across the country in select locations involving a team of DRR scientists. The monitoring teams have visited FLD sites and interacted with the farmers. Various components such as field boards, list of farmers, performance of technologies, input supply details were verified during these visits.

The new varieties and technologies demonstrated need to be popularized in an extensive way, so as to enhance the productivity and production on a location specific basis. The effectiveness of the FLDs can be enhanced much more through proper planning, expeditious administrative approval, timely release of funds and critical monitoring. The fruits of FLDs can be harnessed on large scale, if proper follow up activities are taken up by the state departments of agriculture.

DRR is continuing with the efforts to critically analyze the data of FLDs to generate data on factors contributing to higher crop yields and constraints of production under various farming situations to aid in policy decisions. As a part of this initiative a comprehensive database is being developed on FLDs conducted in last two decades and is made available at http://www.fld.rkmp.co.in.

Blightout Program

Seeds of Improved Samba Mahsuri were sent to the KVKs – Gaddipalle, Undi, kalvacherla, Banaganapalli, Guntur, Vijayawada in Andhra Pradesh. In case of Tamil Nadu the state department of agriculture were roped to popularize this variety. Thanjavur and Villuppuram districts were chosen to demonstrate this variety. Overall 1500 demonstrations were conducted in the BLB endemic areas of both the states. The extension information were provided in the form of video films and information brochure in both Tamil and Telugu languages.



Farmers' Day

DRR Farmers Day Organized on Oct.20th 2013 at DRR experimental fields , Rajendranagar. Dr.

Padma Raju, Vice Chancellor, ANGRAU was the Chief guest and Shri. J. Dharma Naik, Addl. Director of Agriculture, Govt. of AP was the guest of honour.More than 600 farmers attended the farmers day and visited various stalls set up by ANGRAU, DOR, DSR, M/S Bayer and other

organisations. The technologies developed by DRR were displayed and explained to the farmers. At the end question answere session was organized in which pressing issues of the farmers with respect to rice cultivation were addressed. Few selective progressive farmers were also felicitated in the meeting.

Participation in Farmers' fair / Exhibition

1. DRR took active part in the Farmer's day organized by CRIDA on 13th September 2013. An exhibition stall on rice production Technology was installed in the Hayatnagar farm. DRR subject matter specialists participated in the question answer session and the Kisan gosthi.

2. DRR participated in the World Agricultural Forum congress from 4-7th Nov. 2013 at the Hitex international convention Central Hyderabad. Installed an exhibition stall on Rice Production Technology.

3. DRR participated in the Global Consultation on Millets Promotion from Health & Nutritional Security December 18 - 20, 2013 organized by project directorate on sorghum Research. DRR installed an exhibition stall and sold seeds and its scientific and farmers friendly publications.

4. RKMP Private Sector workshop on Sep 29th 2013.

5. DRR Farmers Day Organized on Oct.20th 2013 at DRR experimental fields , Rajendranagar.

6. Krishi Vasant 2014: In the 100th birth centenary of Late Shri Vasant Rao Naik, Former Chief Minister of Maharashtra this great visionary, *Krishi Vasant* was organized as the biggest ever *Kisan Mela* and exhibition in the country. Shri Pranab Mukherjee, Hon'ble President of India inaugurated the Krishi Vasant-2014. ICAR displayed its innovations, technologies and best practices through a especially created pavilion on the theme, Era of Resurgence in Agriculture. DRR installed a stall and exhibited all the latest techniques in irrigated rice. Approximately 10.0 lakhs farmers from all over India visited DRR stall and benefited.

The health products of DRR and sample seeds were distributed along with relevant rice related extension literature. Director, DRR and his team of scientists participated in the Farmers' conferences and farmer-scientist interaction sessions.

Visitors Services

During the year 2013-14, about 4800 visitors comprising students, farmers, extension officials, executives from private input agencies, foreigners, policy makers, scientists visited DRR and acquainted with the ongoing activities and achievement of DRR.

Media Coordination and Kisan Call centre

Approximately 20 scientific talks on various aspects of rice production Technologies were delivered by the resource faculty of DRR and broadcasted by AIR, Hyderabad Kendra. DRR is part o f Kisan Call centre program and the question related to rice from the farmers through toll free non 1551 were answered. Five of the Scientists delivered rice related program in the private televisions' (Telugu) Channel.

Intellectual Property Management and Transfer / Commercialization of agricultural technology Scheme

S.No	Licensee	Date of MoA signed
DRRH-2		
1	Namdhari Seeds Pvt Ltd	19/06/2013
2	Siri Seeds (India) Private Limited	19/06/2013
3	Krishidhan Seeds Private Limited	26/06/2013
4	RJ Biotech Ltd	12/12/2013
5	Super Agri Seeds Private Limited	13/05/2014
DRRH-3		
1	Krishidhan Seeds Private Limited	26/06/2013

DRR entered MoAs with private seed companies on non- exclusive basis for commercialization, production and marketing of DRR varieties / hybrids. The agreement is valid for 5 years initially and renewable on mutually agreed terms and conditions. During 2013-14, 4 MoAs for DRRH-2 and 1 MoA for DRRH-3 signed and earned Rs. 20 lakhs. 114 entries of seed was provided to various institutes and private companies through MTA. Several applications for germplasm registration were screened and certified by ITMU members for soft registration with NBPGR, New Delhi. As an authorized institute, DRR received 40 import permit applications which were scrutinized and forwarded to NBPGR for processing.

Awards and Recognitions

✧ Hari Om Ashram Award to Dr. B.C. Viraktamath, Team Leader and his associates Dr. M.S. Ramesha, Dr. R.M. Sundaram and Dr. A.S. Hari Prasad during the 85th Foundation Day Ceremony of ICAR on 16th July, 2013.

✧ Lal Bahadur Shastri Outstanding Young Scientist Award to Dr. M. Sheshu Madhav, Senior Scientist, Biotechnology.

✧ Dr. Shaik N.Meera, Senior Scientist bagged prestigious 'Young Scientist Leadership Award' in agriculture during the Agriculture Leadership Summit-2013 organized by the leading national agriculture magazine 'Agriculture Today' at New Delhi on 19th September 2013.

✧ Dr. Shaik N.Meera Sr. Scientist received Young Extension Professional Award of International Society of Extension Education (INSEE) for the year 2013 for his outstanding contribution in the field of Extension Research. He received the award from Dr. S. Ayyappan, Director General ICAR and Secretary DA RE during the International Conference on 'Extension Educational Strategies for Sustainable Agricultural Development- A Global Perspective' held on 5-8 December 2013 at Bengaluru.

- Dr. S. R. Voleti, Principal Scientist (Plant Physiology) was conferred with Prof G. V. Joshi memorial award of Indian society of Plant Physiology, New Delhi for the year 2013, at the National Conference of Plant Physiology organized by DGR, Junagadh (Gujarat) during December, 2013.

- Dr. V. Ravindra Babu, Principal Scientist (Plant Breeding) has received "Spandana Best Scientist for 2013" award for his contribution to the rice research in general and developing high zinc genotypes in par ticular on 30.12.2013 at Sri Prakash Educational Institutions, Payakaraopet, Tuni, A.P

- Society for Scientific Development in Agriculture and Technology, Meerut, UP, India, conferred 'Distinguished Scientist Award' in the field of Soil Science and Plant Breeding to Dr. Brajendra and Dr. V P Bhadana, Senior Scientists, DRR, respectively during the 'National Conference on Emerging Problems and Recent Advances in Applied Sciences: Basic to Molecular Approaches' during 8-9th February, 2014 at CCS, University, Meerut

- Dr. Divya Balakrishnan, Scientist, ICAR National Professor Project, received a Commendation Certificate from Directorate of Sorghum Research, Hyderabad for her outstanding performance in the Winter School training on 'Molecular breeding approaches for the genetic enhancement of millet crops' sponsored by the Division of HRD, ICAR during January 06 - 26, 2014

- Dr. Jyothi Badri, Scientist received Sri. Vaddadi Narasimha Swamy Memorial Gold medal at the 44th Annual convocation of ANGRAU, Rajendranagar held on 20th March 2014 for securing highest OGPA in Ph.D

Revenue Generation

An amount of ₹ 1,25,20,000 was received through contractual services for the evaluation of breeding lines for quality, diseases, insects and also assessing the efficacy of new molecules/chemicals. A sum of ₹ 2,00,000 was generated as course fee for M.Sc research project students.

Testing Fees

Through testing of varieties and hybrids an amount of ₹ 1,64,00,00 was generated.

Revolving Fund

DRR is actively involved in production of quality seed in research farms and farmers fields and supplying it to Pvt. Seed companies, Govt. seed agencies and also to farmers earning huge revenue. The receipts have generated an amount of ₹ 25,18,122 for the financial year with a closing balance of ₹ 28, 45,125.

Linkages and collaboration in India and abroad

DRR signed MOU with IGKV, Raipur for collaborative research work and academic exchange of students for award of Ph.D degree.

Collaboration with International Rice Research Institute (IRRI) is also active with "Stress tolerant rice for poor farmers in Africa and South Asia" STRASA project.

AICRIP centres

List of funded AICRIP centres with staff positions during 2013-14 is given in Appendix 4.

Externally funded projects

Six externally funded projects have been sanctioned during 2013-14 (Appendix 6) with a budget outlay of 176 lakhs. A total of 45 externally funded projects are currently being handled at DRR (Appendix 7) with a sanctioned budget of Rs. 38 crores.

Significant Events

Research Advisory Committee Meeting

The second meeting of the new Research Advisory Committee (constituted in 2012) was held at DRR from 2-3 May, 2013 under the chairmanship of Prof. E. A. Siddiq, Former DDG (CS}, ICAR. The members were Dr. Ramesh V. Sonti, Chief Scientist CCMB, Hyderabad; Dr. Madan Mohan, Professor, Biotechnology, Delhi University; Dr. R. P. Singh, Former Project Director, Project Directorate on Cropping System Research, Modipuram; Dr. R. K

Samanta, Ex-Vice Chancellor, BCKVV. (WB), Dr. s. N. Sinha, Ex Head, IARI Regional Station, Karnal; Dr. T. Mohapatra, Director, Central Rice Research Institute, Cuttack and Dr. GururaJ Katti, Member Secretary, RAC, DRR. At the outset, Dr. N. Shobha Rani, ProJect Director I/C welcomed the chairman and all the members and presented an overview of DRR research activities and accomplishments covering crop Improvement, crop production, crop protection and social sciences division. Dr. G. Katti presented the proceedings of RAC-2012 and action taken report. This was followed by detailed presentation of research accomplishments of each discipline by respective PI/Head. A special lecture on Indian Agriculture scenario was presented by Dr. R. P. Singh, member RAC.

Institute Research Council Meeting

Institute Research Council Meeting (IRC) was organized from May 6-9, 2013 under the chairmanship of Dr. B. C. Viraktamath, Project Director, DRR. All the scientific staffs of DRR participated in the meeting. At the outset, Dr. V. Jhansi Lakshmi, Principal Scientist, Entomology and secretary, IRC welcomed the Chairman and all other members of IRC. The chairman in his introductory remarks

emphasized the importance of the meeting. This was followed by presentation of the work done during 2012-13 by individual scientists of each discipline. Each presentation was thoroughly discussed by the members. As many as 6 new projects were approved by the chairman. The chairman in his concluding remarks mentioned about excellent work done during the last year. He also urged to put new and Innovative Ideas In research and suggested to incorporate the suggestions given in Divisional JRC meeting by the external experts and also by the Research Advisory Committee (RAC). This was followed by the presentation of Results Framework Document (RFD) by Dr. M. B. B. Prasad Babu, Sr. Scientist, Soil Science and EFC draft by Dr. K. V. Rao, Principal Scientist and Head, Soil Science. The meeting ended with vote of thanks by Dr. B. Sreedevi, Principal Scientist, Agronomy and Joint Sceretary, IRC.

Review Meeting on Bio-fortification.

One-day meet on Review of Rice Bio-fortification program was organized by ICRISAT-HarvestPlus (HP) team in association with ICAR, DRR and DBT on 12th April 2013 at SKUAST, Srinagar. Dr. S.K. Datta, DDG (CS) underscored the mission of bio-fortification for the development and release of nutritionally enriched food crops for the needy with the support from DBT project and international dimensions provided by HarvestPlus.

He mentioned about ICAR's Bio-fortification Platform and the recent concept of 'Nutri-Farms' and complementation of both programs. The progress of two phases of the DBT Bio-fortification project was outlined by Dr. K.S. Charak.Advisor, DBT. Detailed presentations were made by eight centers: DRR-Hyderabad, JGKV-Raipur, CRRJ-Cuttack. RRS-Chinsurah, TNAU-Colmbatore, UAS-Bengaluru, MSSRF-Chennal and University of Calcutta. The deliberations were concluded with general discussion on rice biofortification coordinated trials 2013, germplasm exchange among centers and proficiency test across XRF and ICP laboratories.

Lecture on Green Super Rice

Dr. Jauhar All, Plant Breeder and Coordinator of Green Super Rice (GSR) Project, International Rice Research Institute, Philippines delivered a talk on the GSR Project on 22nd April 2013 at DRR.

Release of DRR Publication "DUS Characterization of Rice Varieties"

During 5th Genome Saviour Community Recognition awards ceremony held at NASC complex, New Delhi, organized by PPV&FR Authority on 22nd May, 2013, Honorable Minister of state for Agriculture and Food Processing Industries, Shri Tariq Anwarji released the publication "DUS Characterization of Rice Varieties".

Meeting on IRRI-India Collaboration Organized

A meeting on strengthening the collaboration between IRRI and India was organized at DRR on 19th July, 2013. Dr. K. K. Jena, Principal Scientist and team leader of GRiSP's (Global Rice Science Partnership) biotic stress breeding program, P B G B Division, IRRI, Philippines visited DRR and had a detailed discussion on component 8 (biotic stresses) and component 11 (increasing yield potential) of GRiSP with Dr. B. C. Viraktamath, Project Director, DRR. The meeting was also attended by scientists of Crop Improvement and Crop Protection Division, DRR. Again on 24th July, Dr. Nese Srinivasulu visited DRR to discuss about IRRI-India collaborative project-18 (on slower digestive rice varieties) under GRiSP product line titled "High quality rice and innovative rice based food products" with the scientists involved in quality and nutrition of Crop Improvement Division.

Indian Rice Check Programme Planning

Under Global Rice Science Partnership (GRiSP Theme 6) and RKMP outreach program, DRR is planning to initiate a pilot project on innovative concept known as Rice Check in Andhra Pradesh in collaboration with Andhra Pradesh Rice Research Institute (APPRI, Maruteru, ANGRAU). The Planning meetings were conducted during 17-20 September 2013 in West Godavari District of Andhra Pradesh. Dr. John Lacy, Consultant IRRI participated in the meetings along with selected scientists from DRR and ANGRAU.

Independence Day Celebrated

Independence day was celebrated with great enthusiasm on 15th August, 2013 both at DRR and ICRISAT campus. All the DRR staffs participated in the function. At DRR, the national flag was hoisted by Dr. K. V. Rao, Project Director I/C and at ICRISAT farm campus, by Dr. V. Rabindra Babu, Principal Scientist, Plant Breeding. Project Director (I/C) in his message narrated the salient DRR achievements and thanked all the DRR staff for the good work done during the last year. He also emphasized that the entire DRR community should strive for further excellence of the institute and for increasing the rice productivity and production.

DRR Observes *'Parthenium* Awareness Week'

Directorate of Rice Research observed Parthenium Awareness week from 16th-22nd August, 2013. Dr. N. T. Yaduraju, Former Director, National Research Centre for Weed Science (NRCWS), Jabalpur and Principal Scientist, ICT4D, KSI, ICRISAT delivered a lecture on "Parthenium story-Have we learnt the lesion" at DRR Seminar Hall-1 on 16th August, 2013. He presented details the biology and management of this notorious weed on the eve of "Parthenium Week".

Dr. N. Shobha Rani (Project Director I/C) briefed all the staffs regarding importance of this dangerous weed. All the staffs of DRR including farm labours removed all the Parhenium plants from DRR campus (on 17th August) and from DRR fields at Rajendranagar (on 19th August). A token gift was given to the staffs for this collective activity. The event ended with vote of thanks by Dr. R. Mahendra Kumar, PS and Head, Agronomy.

Hindi Week Celebrated

Hindi Week was celebrated with great enthusiasm from 14-21st September, 2013. All scientists, technical and administrative personnel of the directorate participated in various competitions like Hindi quiz (16th September), Extempore (17th September) and memory test (19th September). Ms. Sujataji who is a Hindi teacher in Central School, NPA Rajendranagar wa the chief guest at the closing ceremony. The chief guest emphasized the importance of hindi as official language. On this occasion the hindi version of leaf colour chart was released.

RKMP- Private Sector Workshop

One day workshop was organized at DRR on 24th September, 2013 to encourage private sector involvement in Rice Knowledge Management Portal (www.rkmp.co.in). A total of 50 private sector rice Stakeholders participated in this workshop. The main objective of this workshop is to create awareness about RKMP, provide the hands-on experience for various features of the RKMP and to get the private sector perspective and involving them for information/data contribution.

Inauguration of Heat tunnel facility at DRR farm

Temperature gradient facility for conducting high temperature studies in relation to impact of climate change on rice cultivation was inaugurated on 23rd September, 2013 by Dr. Y. P. Abrol, FNASc, Former Head, Plant Physiology, IARI in presence of Dr. B. Venkateshwarlu, Director, CRIDA, Dr. N. Shobha Rani (Project Director I/c, DRR) and Dr. S. R. Voleti, PI, NICRA, DRR.

One Day Workshop on Climate Change Organized at DRR

One day workshop/brain storming was held at DRR in relation to N-use efficiency on 23rd September, 2013 in rice in Project Director's committee room. The meeting was attended by Dr. Y. P. Abrol, Former Head, Plant Physiology, IARI, Dr. B. Venkateshwarlu, Director, CRIDA, Dr. M. Maheswari, Head, Crop Sciences, CRIDA, Dr. Altaf Ahmed, Dr. Raghuram, Dr. Jagadish Rane, Dr. Padmini Swain, Dr. Sangeeta Mohanty, Dr. S. R. Voleti and other DRR NICRA Staffs along with RAs and SRFs.

Vigilance week observed

DRR observed vigilance week from October 28-November 2,2013. The observance of Vigilance Awareness Week commenced with the pledge on 28th October, 2013 at 11.00 A.M. The English version of the oath was read by Dr. N. Shobha Rani, In-charge Director and the Hindi version was read by Dr. N. Sarla, National Professor, DRR. All the DRR staff took the oath. This year theme of observing Vigilance Awareness Week was "Promoting Good Governance-Positive Contribution of Vigilance".

Prof. G. Harogopal, former Dean, School of Social Sciences, University of Hyderabad delivered a lecture on "Providing good governance: positive contribution of vigilance" on 2nd November, 2013 during the vigilance week.

Cyclone 'Phalin', 'Helen' and 'Lehar' hit coast of Andhra Pradesh

The Cyclone Phailin lashed on the coastal districts of Odisha and Andhra Pradesh during 10th -12th October, 2013 causing severe damage to standing rice crop and human life. A team of scientists from DRR viz., Dr.V. Ravindrababu, D. Subrahmanyam, M. S. Prasad and B. Gangaiah along with the staffs from ARS, Ragolu and State Department of Agriculture surveyed the affected areas in Srikakulam district of AP. There were heavy winds (1 00-150 kmph) and intense rain fall (107-190 mm) on the day the cyclone crossed the coast line near Gopalpur, Odisha on 12th October. There was heavy damage to the rice crop due to water stagnation in the low lying areas (3-6 days) and crop lodging due to heavy winds. The state department of agriculture had estimated that rice crop was damaged approximately in 41 00 ha due to inundation and in 1400 ha due to lodging of crop. In some of the villages near the sea coast, the saline sea water intruded into the rice fields which resulted in yellowing of the leaves and burning of the leaf tips. The team also made some suggestions for the immediate actions to be taken to save the crop as much as possible.

Cyclone Helen lashed on the coast of Andhra Pradesh on 22 November, 2013. Though its intensity was not very high, it resulted in heavy rains and caused extensive damage to the maturing rice crop in the coastal districts of Andhra Pradesh. Even before coastal Andhra Pradesh fully recovered from the effects of Cyclone Helen, another cyclone called Lehar hit between Machillipatnam and Kalingapatnam near Kakinada on 28th November, 2013. However, the cyclone was weak and did not cause much damage to crops and human life.

International symposium on bacterial blight of rice organized

Fourth International Conference on bacterial blight of rice was jointly organized by Centre for Cellular and Molecular Biology, Hyderabad (CSIR), Directorate of Rice Research, Hyderabad (ICAR) and Society for Advancement of Rice Research, Hyderabad from December 2-4, 2013. The inaugural meeting was attended by Prof. Swapan K. Datta, DDG (Crops), ICAR, Prof. Mohan Rao, Director CCMB, Prof. E. A. Siddiq, Honorary Professor, ANGRAU, Dr. B. C. Viraktamath, Director, DRR, Dr. T. Mohapatra, Director, CRRI, Prof. Adam Bogdanove, Professor, Cornell Univeristy and Dr. Ramesh V. Sonti, Chief Scientist, CCMB. Inaugural lectures were delivered by Prof. Jan Leach from Colorado State University and Prof. Adam Bogdanove from Cornel Univeristy. Many leading scientists from different parts of World participated in the meeting and discussed the latest advancements made.

DRR organizes free medical camp

A free medical camp was organized at DRR on 6th December, 2013 by the DRR Staff Recreation club. Three CGHS and ICAR recognized hospitals situated at Hyderabad viz., Deccan Hospitals, Somajiguda, Olive Hospitals, Mehdipatnam and Dr. Agarwal's eye Hospital, Panjagutta took part in the camp. About 150 DRR staffs and their family members got the benefit from the free medical camp.

DRR organizes IPM day

An IPM day was organized by DRR in collaboration with KVK, Kampasagar, ANGRAU on 25th November 2013, to create awareness about the management of pests (weeds, insects & diseases) from nursery to harvest. Around 50 farmers and 25 scientists from DRR, KVK and state government officials attended the meeting. The IPM practicing farmers shared their experiences and operations taken for the management of different pests. "IPM card" was distributed to farmers along with leaf colour chart.

Mutant day organized

A mutant day was organized at village Kakonoor (Kesampeta mandai) where about 1 0,500 M2 lines of popular rice variety Samba Mahsuri are being grown in farmer's fields (a CCMB-DRR project: PLOMICS). The main objective of the meeting was to involve scientific staffs from different disciplines of Directorate of Rice Research in selecting novel mutants. Dr. N. Shobha Rani (Project Director I/c) inaugurated the meeting and about 30 scientific staffs participated in the meeting and selected many unique mutants.

One day workshop on sustainability in Agriculture

One day workshop on Ag Balance-A method to measure sustainability in agriculture was organized at DRR jointly by BASF and DRR on 9th December, 2013. The meeting was inaugurated by Dr. N. Shobha Rani, Project Director (I/c). All DRR scientific staffs and different BASF officials viz., Mr. Ashok Koshy, Mr. M. K. Reddy, Dr. Martijn Gipmans and Mr. Jagmeet Bal participated in the meeting.

Training program of plant variety protection

One day Awareness cum Training Programme on Plant Variety Protection and Registration of Plant

Varieties was held at DRR on 21st December, 2013 for the benefit of the Agricultural Officers/ Assistant Professors from SAUs/ NGOs.

AICRIP Hill Trials Review Meeting

The first ever AICRIP Group meeting for Hill region (a satellite rice workshop) was held at CSKHPKVV, Palampur on February 25, 2014. The meeting was organized mainly to overcome to problem of late receipt of the seed to the hill locations and also to review the progress of work of these locations during the normal rice workshop. Dr. K.K. Katoch, Honorable Vice Chancellor and Dr. S.P. Sharma, Director of Research, CSKHPKV graced the Inaugural function and complimented DRR, Hyderabad for conceptualizing the satellite workshop for hill trials and hoped that this will lead to development and identification of promising genotypes for Hill ecology at a faster rate and will eventually contribute to the increased rice production and productivity in the Hill region. The DRR team for this meeting was led by Dr. BC Viraktamath, Project Director, and a team of seven DRR scientists par ticipated in the deliberations.

Brain storming session on Pre-breeding and Resistance gene resourcing

A special meeting was organized on 18.3.2014 at DRR to discuss about research strategies on Pre-breeding and resistance gene resourcing. DRR scientists (Crop Improvement Section, Crop Protection Section) led by the Project Director Dr. B.C. Viraktamath and a team of four CRRI scientists led by the Director, CRRI, Dr. T. Mohapatra par ticipated in this brain storming session and discussed in detail about the ongoing pre-breeding activities at both the institutes and decided to fur ther strengthen the activities by proposing a Network Project on Pre-breeding involving wild species., land races, mutants etc. The status of resistance sources against major biotic stresses were also discussed in detail, resistant genes for different rice growing regions were identified and special committees were formed to monitor the pests' virulence across the country.

New Year Celebrations

All employees of the institute celebrated New Year, 2014 on 1st January 2014. Project Director Dr. B.C. Viraktamath congratulated all DRR staff for significant achievements of the institute and emphasized to continue the sincere effor ts and take DRR to new heights. Project Director felicitated various award winners on this occasion.

DRR Foundation Day

DRR Foundation Day was celebrated on 4th January, 2014 in a joyous atmosphere. About 250 members (DRR staff and their family members) enthusiastically participated in the cultural evening. A plethora of cultural activities like songs, skits, games were organized which kept all the children and adults hooked to their seats. The Project Director appreciated the splendid efforts of the Recreation Club in bringing out the latent talent of the DRR and the project staff in making the DRR family having a memorable evening. On

this occasion, he felicitated the Best employees in different categories.

Commercial Launch of Rice Healthcare Products

On the occasion of DRR Foundation Day, two herbal health care products namely 'Rice Riche Moisturizing Lotion' and 'Rice Riche Pain Relieving Gel' developed by Dr. M. M. Azam, Senior Sceintist, CIS, DRR, have been launched for sale. Moisturizing Lotion is a skin care product made from rice bran oil and aqueous brown rice extract as key ingredients and is suitable for normal and oily skin.The product has also anti-aging property on account of oryzanol. The Pain Relieving Gel contains rice bran oil as a carrier and is highly effective for relieving minor aches and pains of muscles and joints associated with simple strains, bruises and sprain. It also contains analgesic ingredients like camphor, menthol, methyl salicylate and eucalyptus oil.

Motivational address by ICAR Women Scientist Awardee

Dr. Radha Prasanna, Principal Scientist, Division of Microbiology, IARI, New Delhi and recipient of the ICAR Panjab Rao Deshmukh Outstanding Woman Agricultural Scientist Award interacted and motivated the women scientists of all ICAR Institutes at Rajendranagar on 6th February, 2014.

Sports and Games

Dr. P. Revathi, Scientist (Hybrid Rice), has secured two Gold Medals in Women's High Jump and Long Jump events at ICAR Inter Zonal Spor ts Meet-2013, organized by NAARM during December 17-20th 2013. 2013. DRR staff is proud of her achievement.

49th Annual Rice Group Meetings

The 49th Annual Rice Group Meetings was held in the auditorium of DRR, Hyderabad during 6th – 8th April, 2014. The Inaugural session started with ICAR song followed by the lighting of Lamp by the dignitaries. Dr. B.C Viraktamath, Project Director, welcomed all the delegates and briefed on the progress of research under the AICRIP and lead research at DRR. The Chief Guest was Dr A. Padma Raju, Vice Chancellor, ANGRAU, Hyderabad. The guest of honour were Padma Shri Prof. E A Siddiq, Honorary Professor, Biotechnology, ANGRAU and Dr. Mathew Morrell, Deputy Director General (Research), IRRI, Phillipines. The following recommendations were made:

Varietal Improvement

The Varietal Identification Committee recommended the 3 hybrids and 16 varieties.

Agronomy

- Sowing of hybrids during June month at a seed rate of 25- 35 kg/ha seed with four splits of nitrogen application is recommended for higher productivity of aerobic rice.
- New combination herbicide, Flucetosulfuron @ 25 g a.iat 2-3 DAS or Flucetosulfuron @ 25 g a.iat 2-3 DAS + Bispyribac Sodium at 15-20 DAS (both applied @ 25 g a.i/ha) is recommended effective weed management in both transplanted and direct wet seeded rice crop.

- Four nitrogen efficient genotypes 'IET 22283' (MH, irrigated), 'IET 22763' and 'IET 22764' (E-TP), 'IET 22704' (Aerobic dry seeded) performing best even at 50% recommended nitrogen dose have been identified for registration
- Under limited water conditions SRI/ SMSRI method is recommended as it recorded 16% higher grain yield over direct seeded and transplanted rice.

Soil Science

- In the long term fertilizer experiment, FYM alone recorded superior yields over RDF for the first time after 25 years at Mandya during *kharif* and on par yields at Titabar during *rabi*.
- Aghonibora and Vasumathi proved their consistent superiority by recording higher Fe and Zn contents at several locations over the years.
- Irrigation equivalent to 75% CPE appeared to be optimum by saving water input by 10 and 23% over 100% CPE in aerobic rice at Kanpur and Mandya, respectively.
- Early planting and INM were found promising for mitigating yield loss due to changing climatic conditions and shifts in rainfall.
- Genotypes IET 22218, 27P-63, 27P-31, Sampada, Jarava, RPbio-226, Dhanrasi, Praffulla, Aghonibora and VNR 203 were found promising under acid soil conditions of MCP, Ranchi & TTB.

Plant Physiology

- IET-20924 was submitted for registration for photothemic indexing. Two new entries IET 22580, IET 22569 were found to be promising for PTI and RUE.
- Application of silicon solubilizer had improved the silicilic acid content and photosynthesis in leaf tissues. CTK, TTB (sandy or silty clay soils), PTB(sandy loam soils), CBT(clay soils) silicon application was found to improve general crop health and grain yield. Internal silicilic acid content in hybrids was lower compared to varieties.
- Based on the grain yield, DMHSI, GWHSI and spikelet sterility Sasyasree, IET 22116 and IET 21404 could be identified as relatively heat tolerant.
- IET 24064 was found to be superior under both irrigated and rainfed treatments. Based on DSI, DMSI and YS IET 24063, IET 23383 and IET 22744 are relatively tolerant to water stress.
- Among the different stresses anerobic stress had strong influence on the root growth followed by salinity and water stress. AC-39416A and SM-686 were found to be having multiple abiotic stress tolerant.

Entomology

- Three cultures given below have been identified as promising and are recommended for registration with NBPGR
    - CR 3006-8-2 (Pusa 44/ Salkathi) for planthoppers
    - JGL 19618 (JGL11609/ Abhaya) for gallmidge
    - RPBIO 4918-228 (S) (Swarna/ *O. nivara*) for multiple pest resistance
- Two new germplasm accessions IC 462402 and IC 577036 were identified as promising for gallmidge.
- The combination product of flubendiamide + Buprofezin (1.75 ml/l) when tank mixed with either hexaconazole (2ml/l) or tricyclazole (0.6 ml/l) did not have any adverse impact on the efficacy of the combination product, confirming the compatibility of these chemicals for field use.

Plant Pathology

- Multiple disease resistance lines GSR 225, CB08 702, CB09 126 & CR 2916-15, CB09 127,

DRR-BL-155-1, DRR-BL-295-2, DRR-BL-31-1, IET 22168 & RP-Patho-1, IET 22610, RP-Bio-Patho-2, RP-Patho-12, VL 3145 and VL 31630 identified for more than two diseases may be used in breeding programmes.

- Combination fungicide trifloxystrobin 25% + tebuconazole 50% (0.4 g/l) can be used against leaf blast, brown spot, sheath rot and grain discolouration.

Important Visitors

- Dr. AchimDobermann, Deputy Director General (Research), IRRI visited DRR on 19th April, 2013.
- Dr. N. Nadarajan, Director, Indian Institute of Pulses Research, Kanpur visited DRR on 12th June, 2013.
- Shri Arvind Kaushik, Additional Secretary (DARE) and Secretary (ICAR), visited DRR on 29th June, 2013.
- Dr.M.V.Rao, Former A.P. MLC visited DRR and interacted with DRR Scientists on recent technologies/developments in rice on 4th July, 2013.
- A lecture was delivered by Dr. N.T. Yaduraju, Principal Scientist – ICT4D, ICRISAT, on 16th August 2013 on the occasion of inaugural session of 'Parthenium Awareness Week' observed during 16-22 August, 2013 at DRR.
- Dr R.S. Paroda, Former DG, ICAR delivered 'Dr. M.V. Rao lecture' organized by Indian Society of Oilseeds Research, in DRR Auditoriumon 24th August, 2013. Project Director and all the scientists of DRR attended this lecture.
- Professor G. Haragopal, Former Dean, HCU visited DRR on 2nd November, 2013 to deliver a lecture on closing day of Vigilance Awareness Week.
- Dr. K.K. Jena, Senior Scientist, IRRI visited DRR and interacted with scientists of Crop Improvement section of DRR on 19th July and 5th December, 2013.

Project Completion Reports

Rice Knowledge Management Portal

Vision 2025 document of DRR envisages bridging the yield gap by improving the access to the rice knowledge amongst the rice stakeholders. Accordingly a flagship initiative is undertaken in under Rice Knowledge Management Portal-RKMP (funded by NAIP). Successfully completed this innovative project that was implemented for last five years.

For the year 2013-14, major focus was on awareness activities. Along with these activities, various need based additional features were added to the portal. They are as follows;

Instant content upload service provided on the homepage and the main purpose is to provide an easy opportunity for the users to upload the content in a single click. Here the uploader can upload any content related to rice which will be validated under the supervision of experts before getting published on the portal.

Contingency plans added to the Extension Domain that helps in providing the contingency plans to the farmers in case of natural calamities, delay in monsoons, drought etc. This may help in reducing losses to the farmers by suggesting the alternative plans in times of crisis. This feature was developed to give right advice to the farmers at right time so that the farmers could avoid the losses.

To exploit the popularity of YouTube among various users, a feature for RKMP on YouTube was added to Extension Domain. This feature helps the users in directing to the RKMP YouTube account where videos on rice are posted

RKMP remains as one of the most effective information source online as evident from the day-to-day usage and Google analytics. RKMP project activities funded by NAIP are closed with effect from 31 March 2014 however the efforts are on to integrate into XII plan activities of DRR and AICRIP. During last year, attempts were made to build partnership with Private sector, Kisan call centres, CSCs, Annapurna project, Mahindra Samridhi, Mobile applications (in collaboration with IKSL). An exclusive workshop for Private Sector was conducted and RKMP was demonstrated during World Agricultural Forum, Krishi Vasant 2014, DRR Farmers' Day 2014.

Also, regular content in various features like extension domain, news and events are being uploaded. RKMP presentation was made in the final workshop of NAIP held at New Delhi during 6-7 March 2014. So far, 4,63,954 users have visited the rice portal from 3,44,747 public IPs with an average concurrent user number of 900. As of today, this is the one of most effective agricultural portal across the globe. Till date, about 2600 users have registered who can upload content in the portal.

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Publications

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P. Gopi, J.Karthik, Md. Ershad, M.G. Gayatri, M. Milton, B.Sunil, A.P. Padmakumari, G.S. Laha, M.S.Madhav, R.M. Sundaram, L. V. Subba Rao, M.R. Vishnu Priya, B.C. Viraktamath, R.V. Sonti (2013). "Development of a Mutagenized Population and Screening for Resistance Characteristics in the genetic background of elite rice cultivar, Samba Mahsuri" Poster presented at 4th International conference on Bacterial blight of rice, December 2nd to 4th 2013 at CCMB, Hyderabad.

C. Padma, Keerthana Ch, Lavanya K, Jayasree B, Chaitanya U, Chiranjeevi M, Surender R, Aruna Sri Yadav P, Radha Krishna K V, Neeraja C N and Subba Rao L V (2014). "Evaluation of Rice Genetic Resources for Tolerance to Heat Stress" presented at National Seminar on Climate Change – Crop Improvement and Management Strategies for Food Security on 25th March, 2014 at Agricultural College, Bapatla.

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Annual (April 1, 2013 to March 31, 2014) Performance Evaluation Report in respect of RFD 2013-2014 DRR

Objective	Wt.	Action	Success indicators	Unit	Wt.	Target/ Criteria value					Achieve-ments	Performance		Percent achieve-ments 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%					
Identification & validation of technologies for different ecologies under AICRIP	39	Development of improved varieties suited to diverse agro ecologies	Varieties/ hybrids identified for release	No.	16	15	12	10	8	6	15	100	16	125	Aggressive efforts of private sector resulted in release of more number of hybrids
		Organizing multi-disciplin-ary multi-location trials	Entries evaluated	No.	15	1100	1000	950	850	750	970	84	12.6	97	NA
			Management practices identi-fied	No.	8	10	8	6	4	2	8	90	7.2	100	NA
Genetic en-hancement for yield, quality and resistance for sustainable rice production	30	Evaluation of genetic mate-rial for crop improvement programmes	Breeding/germ-plasm lines and experimental hybrids evaluated	No.	15	500	400	300	200	100	380	88	13.2	95	NA
			Lines identified for unique traits	No.	11	8	6	4	3	2	6	90	9.9	100	NA
		Seed produc-tion programme to ensure quality seed availability	Breeders seed produced	MT	3	600	550	500	400	300	553	90.5	2.7	100.5	NA
			Truthfully labeled seed produced	MT	1	60	50	40	30	20	52	92	0.92	93.6	NA
Development and dissemi-nation of ap-propriate crop production & protection technologies for maximizing yield	20	Development of new tech-nologies	Production/pro-tection technolo-gies tested	No	14	17	15	13	10	7	15	90	12.6	100	NA
		Dissemination of technologies	Trainings orga-nized	No.	5	8	7	6	5	4	6	80	4.0	85.7	NA
			Demonstrations of technologies conducted	No.	1	600	500	400	300	200	510	92	0.92	102	NA

Objective	Wt.	Action	Success indicators	Unit	Wt.	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%					
Efficient Functioning of the RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013	10/05/2013	100	2	100	NA
		Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	01/05/2013	02/05/2013	05/05/2013	06/05/2013	07/05/2013	25/04/2013	100	1	100	NA
Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% Implementation	%	2	100	95	90	85	80	-	-	-	-	Consultant has been appointed
		Prepare an action plan for Innovation	On time submission	Date	2	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013	30/07/2013	100	2	100	NA
Improving Internal Efficiency / responsiveness / service delivery of Ministry / Department	4	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	85	80	100	100	2	105	NA
			Independent Audit of implementation of public grievance redressal system	%	2	100	95	90	85	80	100	100	2	105	NA

Total Composite Score: 89.04

Appendix 1

Promising entries in Varietal Trials, *Kharif* 2013

IET No / Designation	Source trial	Cross Combination	FD (Days)	Grain Type	Yield (kg/ha)	Remarks	Suitable for
22020 CRR451-1-B-2-1	AVT-VE(DS)	Vandana/ IR 64	83	LS	2173	-	Rainfed upland areas in Madhya Pradesh
22744 CRR 617-B-47-3	AVT-VE(DS)	Vandana/ UPLRi7	77	LS	2056	-	Rainfed upland areas in Madhya Pradesh and Chhattisgarh
22767 PAU 3832-79-4-3-1	AVT 2ETP	PR 116 // PAU 3075/ PR 106-P3	90	LS	5204	MR - BLB	Irrigated areas in Madhya Pradesh and Haryana
22764 NLR 400024	AVT 2ETP	WGL 14280-1/ NLR 30491	90	SB	5498	R-GM	Irrigated areas in Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Gujarat and Tamil Nadu
22752 Gontra Bidhan 3	AVT 2ETP	Selection from IET 17430	89	SB	5704	R-GM, MR-SB	Irrigated areas in Uttarakhand, Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Tamil Nadu, Kerala, Karnataka and Andhra Pradesh
22763 RP 5219-9-6-7-3-2-1-1	AVT 2ETP	IR 7887-208-B-1-1/IRRI 1132	91	LS	5133	R-GM, MR-SB	Irrigated areas in Haryana, Madhya Pradesh, Gujarat and Kerala
22565 TM 07275	AVT 2 IME	WGL 32100/ Swarna	94	MS	5263	MR-SB	Irrigated areas in Rajasthan, Gujarat, Bihar and Madhya Pradesh.
22212 HKR 07-147	AVT 2 IME	PR 114 / HKR 96-89	92	LS	4998	--	Irrigated areas in Punjab and Haryana.
22592 HKR 08-62	AVT 2 IME	UPR 1230-9-2 / IET 16833	98	LS	5248	--	Irrigated areas in Bihar, Punjab and Uttarakhand.
22598 RP 5213-69-13-3-4-1-2-B	AVT 2 IME	IR64 / IR72176-140-1-2 / IRR123	93	LS	5213	--	Irrigated areas in Uttarakhand and Odisha
22379 *HRI 174 (Hybrid)*	AVT 2-IM	--	102	LB	5256	R-GM	Irrigated areas in Uttar Pradesh
22381 *HRI -178 (Hybrid)*	AVT 2-IM	--	104	LB	5206	--	Irrigated areas in Uttarakhand
22520 NDR 3325	AVT 2-IM	NDR 3025-1/ NDR 359	100	SB	4415	--	Irrigated areas in Maharashtra
21943 RP Bio 4919-50-13	CSTVT	KMR-3/*O. rufipogon*	95	SB	3566	MR-SB	Coastal Saline areas in West Bengal.
22778 Pusa 1609-09-9-4	AVT 1-BT	Pusa 1602 / Pusa 1603	95	LS	4676	-	Basmati growing areas of Delhi, Uttarakhand, Punjab and Uttar Pradesh

IET No / Designation	Source trial	Cross Combination	FD (Days)	Grain Type	Yield (kg/ha)	Remarks	Suitable for
22787 RP4594-121-148-24 11	AVT 1-BT	Basmati kota/IET 16313	92	LS	4147	MR-SB	Basmati growing areas of Uttar Pradesh, and Punjab
22777 Pusa1601-05-1-46-1-1	AVT 1-BT	PRR 78/ Pusa 1460//PRR 78 *2	96	LS	4051	MR-SB, MR-BLB	Basmati growing areas of Delhi, Uttarakhand, and Uttar Pradesh
22289 Pusa 1592-06-5-2	AVT 1-BT	Pusa Sugandh 5/Pusa 1460//Pusa Sugandh *2	96	LS	4325	-	Basmati growing areas of Punjab, New Delhi and Haryana
21850 CN 1268-5-7	AVT 2 ASG	Jaya / Pusa Basmati 1	111	SB	3853	-	Irrigated area in West Bengal, Uttar Pradesh, Maharashtra, Chinsurah, Assam
21842 R 1536-136-1-77-1	AVT 2 ASG	R 302-111 / Ganga Baru	106	SB	3570	-	Irrigated areas in Uttar Pradesh, West bengal, Chhattisgarh, Assam
22272 VL 31616	AVT 2- E (H)	VL 3861 / SR 1818BF-4-BI-2-1-2	91	SB	3059	MR-LBL, MR-ShB1	Irrigated areas in Uttarakhand under medium elevation
22291 VL 8204	AVT 2 U (H)	VR 539-2 / VLD 81	73	LB	1372	MR-BLB	Upland areas under medium hills in Uttarakhand
22294 HPR 2656	AVT 2 U (H)	RP 2421/VL 221	80	SB	1674	MR-ShB1	Upland areas under medium hills in Uttarakhand
22292 VL 8302	AVT 2 U (H)	VL 9588 / A-57	80	SB	1908	MR-ShB1	Upland areas under medium hills in Uttarakhand; Low hills of Meghalaya
22295 VL 8185	AVT 2 U (H)	VR 539-2 / IR 63872-93-2-37	80	LS	1774	MR-LBL, MR-NBL	Upland areas under medium hills in Uttarakhand
22729 RP 5311-PR26703-3B-PJ7	AVT-2 Aerobic	Nekken / BPIR110	91	LS	3225	--	Gujarat
22699 KMP 153	AVT-2 Aerobic	IR 64 / Rasi	85	LS	3706	--	Madhya Pradesh, Gujarat, Tamil Nadu, Karnataka
22731 CR 2996-1-14-29-3-1	AVT-2 Aerobic	Brahmannaki / NDR 9930077	89	SB	3334	--	Gujarat
22737 CR 3001-IR-86931-B-528-CR-5-5-2	AVT-2 Aerobic	N 22 / Swarna	82	SB	3638	--	Madhya Pradesh

Appendix 2

Variety wise Breeder Seed Production during *kharif* 2013 (*in Quintals*)

S. No	Hybrid/ Variety	Produced by	Quantity Alloted	Quantity Produced
1	Akshayadhan (IET 19367)	DRR	3.00	4.00
2	Abhishek (IET 17868) (RR-272-829)	CRURRS, Hazaribagh	3.50	7.00
3	ADT(R)-48 (AD 95128)	TNAU, Coimbatore	1.00	1.00
4	ADT-37	TNAU, Coimbatore	11.50	-
5	ADT-39	TNAU, Coimbatore	6.00	6.00
6	ADT-43 (IET-14878)	TNAU, Coimbatore	8.00	8.00
7	ADT-44	TNAU, Coimbatore	0.50	0.50
8	ADT-45	TNAU, Coimbatore	2.00	2.00
9	Amara (MTU-1064)	ANGRAU	7.00	8.00
10	Anjali (IET- 16430)	CRURRS, Hazaribagh	7.50	3.00
11	Annada	CRRI, Cuttack	8.60	3.00
12	Athira (PBT-51)	KAU, Pattambi	2.00	3.00
13	Bahadur (IET-13358)	RAS, Titabar	10.00	10.00
14	Bamleshwari (IET 14444)	IGAU, RAIPUR	39.00	42.00
15	Barani Deep (IET -13194)	NDUAT, Faizabad	2.00	13.00
16	Bhadra MO-4)	RRS, Moncompu	9.00	-
17	Bharani (NLR 30491)	ANGRAU	3.00	3.00
18	Bhogavati	ARS, Radhanagari	4.50	19.20
19	Bhrigu Dhan	RWRC, Malan	0.15	0.15
20	Birsa Dhan -108	BAU, Ranchi	1.00	-
21	Birsa Vikas Dhan-109	BAU, Ranchi	78.00	15.00
22	Birsa Vikas Dhan-110	BAU, Ranchi	10.00	11.00
23	Birsamati	BAU, Ranchi	8.00	9.50
24	BPT-3291 (Sonamasuri)	ANGRAU	40.00	40.00
25	BR-2655	UAS, Bangalore	2.00	72.00
26	Bsamati-386	PAU, Ludhiana	0.10	1.00
27	Chandrahasi-ni (IET-16800)	IGAU, RAIPUR	43.00	43.20
28	Chandrama	RRS, Gerua	0.50	BSP-IV not yet received
29	Cotton Dora Sannalu (MTU 1010)	ANGRAU; IGAU, RAIPUR; JNKVV, Jabalpur	485.00	505.00
30	CR Boro Dhan-2 (IET 17612), (Chandan)	CRRI, Cuttack	10.00	10.00
31	CR Dhan 500 (IET 20220)	CRRI, Cuttack	0.50	0.30
32	CR Dhan 501 (IET 19189)	CRRI, Cuttack	0.50	-
33	CR Dhan-10 (IET 18312)	CRRI, Cuttack	6.00	8.00
34	CR Dhan-70 (IET-11904)	CRRI, Cuttack	1.00	1.00
35	CR Sugandh Dhan-3 (IET 18395)	CRRI, Cuttack	0.50	1.00
36	CR-1014	CRRI, Cuttack	16.00	12.00
37	CSR 30 (IET -14720, Yamini)	CSSRI, KARNAL	19.00	42.00
38	CSR -36 (Naina) (IET-17340)	CSSRI, KARNAL	4.00	20.00
39	Danteshwari (IET 15450)	IGAU, RAIPUR	15.00	15.30
40	Dhanrasi (IET 15358)	DRR	8.50	0.50
41	Dharitri (IET-6272)	CRRI, Cuttack	1.00	1.50
42	Erramallelu (WGL-20471)	ANGRAU	12.50	15.00
43	Gajapati (IET-13251)	OUAT, BHU-BANESHWAR	0.50	0.75
44	Gayatri (IET- 8022)	OUAT, BHU-BANESHWAR	11.00	-
45	Geetanjali (IET-17276)	CRRI, Cuttack	4.50	3.50
46	Gontra Bidhan-1 (IET 17430)	BCKVV, Nadia	33.00	70.00
47	Govind	GBPUAT, PANTNAGAR	5.00	32.00
48	Gurjari	GAU, NAWAGAM	0.50	0.50

S. No	Hybrid/ Variety	Produced by	Quantity Alloted	Quantity Produced
49	Hazaridhan	CRURRS, Hazaribagh	1.50	1.50
50	HKR- 147	RRS KAUL	2.10	-
51	HKR-127 (HKR-95-222)	RRS KAUL	15.10	20.00
52	HKR-47	RRS KAUL	14.10	20.00
53	HPR 2143	RWRC, Malan	4.00	6.50
54	HPR-1068	RWRC, Malan	5.00	12.50
55	HPR-1156 (IET-16007)	RWRC, Malan	0.50	5.50
56	IET 7191	UAS, Bangalore	1.00	12.00
57	Improved Pusa Basmati-1 (IET-18990)	IARI Regional Station, Karnal; DSST, New Delhi	14.10	3.50
58	Improved Samba Mahsuri	DRR	27.00	100.00
59	Indira Barani Dhan-1	IGAU, RAIPUR	13.00	16.50
60	Indra (MTU- 1061)	ANGRAU	5.00	5.00
64	Indrayani (IET-12897)	ARS Vadgaon	27.00	40.00
62	Intan	ARS, Mugad	2.50	8.00
63	IR-36	JNKVV, Jabalpur; DSR, MAU	63.00	5.00
64	IR- 50	TNAU, Coimbatore	6.50	6.50
65	IR-64	DRR: IGAU, RAIPUR; DSR, MAU; JNKVV, Jabalpur	162.00	45.90
66	Jajati (IET- 7284)	OUAT, BHU-BANESHWAR	3.00	3.00
67	Jaldhubi (IET- 17153)	IGAU, RAIPUR	0.50	1.30
68	Jarava (IET -15420)	DRR	2.00	2.00
69	Jaya	DRR	32.00	42.00
70	JGL 11470 (Jagtial Mahsuri)	ANGRAU	3.00	5.00
71	JGL-1798	ANGRAU	14.00	15.00
72	Jogesh (OR-1519-2) (IET-15169)	OUAT, BHU-BANESHWAR	6.00	2.20
73	JR-503 (Richa) (IET - 16783)	JNKVV, Jabalpur	1.00	1.00
74	Jyothi	KAU, Pattambi	17.10	40.00
75	Karjat-184	RARS, Karjat	1.00	4.10
76	Karjat-2	RARS, Karjat	3.50	6.00
77	Karjat-3	RARS, Karjat	4.50	7.35
78	Karjat-5	RARS, Karjat	2.00	6.00
79	Karjat-7	RARS, Karjat	3.50	5.80
80	Karjat-8	RARS, Karjat	1.00	1.00
81	Karma Mahsuri (IET 19991)	IGAU, RAIPUR	58.00	60.00
82	Kasturi (IET-8580)	DRR	0.50	0.50
83	Ketekijoha (IET-18669)	CRRI, Cuttack	6.00	4.00
84	Khandagiri	OUAT, BHU-BANESHWAR	86.00	49.00
85	Khitish (IET-4094)	CRRI, Cuttack	16.50	17.00
86	KMD-2 (Abhilash)	ARS, Mugad	1.50	6.00
87	Konark (IET -12734)	OUAT, BHU-BANESHWAR	6.60	3.40
88	Kotha Mo-lagolukulu 74	ANGRAU	2.00	5.00
89	Kranti (R-2022)	JNKVV, Jabalpur	13.00	-
90	Krishna Hamsa	DRR	1.00	1.00
91	Lachit	RAS, Titabar	5.00	9.70
92	Lalat (IET-9947)	OUAT, BHU-BANESHWAR	101.00	101.00
93	Luit	RAS, Titabar	5.00	5.00
94	Lunasampad (IET 19470)	CRRI, Cuttack	0.50	1.50
95	Lunasuwarna (IET 18697)	CRRI, Cuttack	0.50	1.00
96	Lunishree	CRRI, Cuttack	8.50	6.00
97	Mahamaya (IET_10749)	IGAU, RAIPUR	67.00	78.90
98	Mahsuri	JNKVV, Jabalpur; RAS, Titabar	44.00	45.00
99	Malaviya Dhan- 2(HUR 3022)	BHU, Varanasi	1.00	10.00
100	Malaviya Sugandh -105 (HUR-105)	BHU, Varanasi	2.00	20.00
101	Malaviya Sugandh 4-3 (HUR-4-3)	BHU, Varanasi	3.00	40.00
102	Manaswini (IET 19005)	OUAT, BHU-BANESHWAR	5.50	4.80
103	Mandakini (OR 2077 -4)	OUAT, BHU-BANESHWAR	5.50	1.00
104	Manohar Sali	RAS, Titabar	10.00	14.50

S. No	Hybrid/ Variety	Produced by	Quantity Alloted	Quantity Produced
105	Maruteru Sannalu (MTU-1006, IET-14348)	ANGRAU	1.00	1.50
106	Moti (IET-9170)	CRRI, Cuttack	3.00	2.00
107	Mrunalini (OR 1898-18)	OUAT, BHU-BANESHWAR	1.00	1.00
108	MTU 1075 (IET 18482)	ANGRAU	7.50	8.00
109	MTU 7029 (SWARNA)	DSR, MAU; PRDF Gorakhpur; IGAU, RAIPUR; ANGRAU	444.00	475
110	MTU-1031 (Tholakuri)	ANGRAU	1.00	2.00
111	MTU-1032 (Godavari)	ANGRAU	1.00	1.50
112	Narendra – 8002 (IET-15848)	NDUAT, Faizabad	36.00	68.00
113	Narendra Usar Dhan -2008 (IET 18699)	NDUAT, Faizabad	90.00	135.00
114	Narendra Dhan 3112-1 Prakhar (IET 19335)	NDUAT, Faizabad	9.00	27.00
115	Narendra Dhan -359 (NDR-359)	NDUAT, Faizabad	5.00	150.00
116	Narendra Dhan-97	NDUAT, Faizabad	2.50	8.00
117	Narendra Jal Pushp (IET -17972)	NDUAT, Faizabad	18.00	-
118	Narendra Lalmati (IET 21051)	NDUAT, Faizabad	5.00	7.50
119	Narendra Mayank (NDR-9830144) (IET- 18055)	IARI Regional Station, New Delhi	18.00	-
120	Naveen (CR-749-20-2) (IET-14461)	CRRI, Cuttack; RRS, Gerua	75.00	70.00
121	NDR 2064 (IET 17475)	NDUAT, Faizabad	3.00	18.00
122	NDR 2065 (IET 17476)	NDUAT, Faizabad	3.50	-
123	Nellore Mahsuri (NLR-34449)	ANGRAU	11.00	10.00
124	NLR-145	ANGRAU	5.00	10.00
125	Nua Chinikamini (IET 18394) CR 2580)	CRRI, Cuttack	0.50	1.50
126	Nua Kalajeera (IET 18393)	CRRI, Cuttack	1.00	1.50
127	Onam	KAU, Pattambi	1.00	1.00
128	Padmini (IET-10561)	CRRI, Cuttack	3.50	6.00
129	Palam Dhan-957 (IET -13795)	RWRC, Malan	5.00	-
130	Pankaj	RAS, Titabar	2.00	-
131	Pant Dhan -10 (IET-8616)	GBPUAT, PANTNAGAR	1.00	9.00
132	Pant Dhan -11 (IET-9620)	GBPUAT, PANTNAGAR	4.10	8.00
133	Pant Dhan-12 (IET-10955)	GBPUAT, PANTNAGAR	4.00	4.00
134	Pant Dhan -16 (IET-14807)	GBPUAT, PANT-NAGAR	1.00	8.00
135	Pant Dhan -18 (IET 17920)	GBPUAT, PANT-NAGAR	0.50	14.00
136	Pant Dhan -19 (IET 17544)	GBPUAT, PANT-NAGAR	16.50	27.00
137	Pardhiva (NLR - 33892)	ANGRAU	3.00	4.00
138	Parijat (IET- 2684)	OUAT, BHU-BANESHWAR	13.50	14.00
139	PAU-201	PAU, Ludhiana	15.00	12.10
140	Phalguni (IET 18720)	CRRI, Cuttack	0.50	1.00
141	Phule Samrudhi	ARS Vadgaon	3.50	40.00
142	PKV HMT	ARS, Sindewahi	90.00	84.88
143	Pooja (IET-12241)	CRRI, Cuttack	103.00	95.00
144	Poornima (IET-12284, R-281-PP-31-1)	IGAU, RAIPUR	1.00	1.20
145	PR-111	PAU, Ludhiana	13.00	13.00
146	PR-113	PAU, Ludhiana	9.10	10.00
147	PR-114	PAU, Ludhiana	34.00	45.00
148	PR-115	PAU, Ludhiana	0.10	1.00
149	PR-116	PAU, Ludhiana	10.00	20.00
150	PR-118	PAU, Ludhiana	48.50	60.00
151	Prabhat	RAU, Pusa	36.00	40.00
152	Prathyasa (MO 21)	RRS, Moncompu	1.00	2.00

S. No	Hybrid/ Variety	Produced by	Quantity Alloted	Quantity Produced
153	Pratikshya-15191	OUAT, BHU-BANESHWAR	118.50	118.50
154	Pusa Basmati -6 (IET 18005)	IARI Regional Station, Karnal	25.00	28.00
155	PTB-58 (IET-17608)	KAU, Pattambi	1.00	2.00
156	PUNJAB Basmati-2	PAU, Ludhiana	0.30	1.10
157	Pusa Basmati – 1121 (Pusa Sugandh -4)	BEDF, New Delhi; DSST, New Delhi; IARI	118.50	112.00
158	Pusa Basmati -2 (IET- 16310)	IARI Regional Station, Karnal	5.00	5.00
159	Pusa Basmati -3(IET-16313)	IARI Regional Station, Karnal	48.00	20.00
160	Pusa Basmati -5 (IET-17021)	IARI Regional Station, Karnal	74.00	49.00
161	Pusa Basmati-1-(IET-10364)	IARI Regional Station, Karnal; DSST, New Delhi; BEDF	37.10	44.00
162	Pusa-44	IARI Regional Station, Karnal	74.10	80.00
163	Pusa-834	IARI Regional Station, Karnal	20.00	14.50
164	Rajendra Bhagvati	RAU, Pusa	11.00	11.00
165	Rajendra Kasturi	BAC,SABOUR; RAU, Pusa	17.50	12.59
166	Rajendra Mahsuri-1	BAC,SABOUR; RAU, Pusa	22.50	25.35
167	Rajendra Suwasini	BAC,SABOUR	5.50	12.77
168	Rajendra Sweta	BAC,SABOUR	11.00	20.37
169	Ramachandi (IET- 13354)	OUAT, BHU-BANESHWAR	1.00	1.50
170	Rani Dhan (IET - 19148)	OUAT, BHU-BANESHWAR	20.50	20.50
171	Ranjeet (IET-12554)	PAU, Ludhiana	45.00	53.60
172	Rashmi (JR-201)	JNKVV, Jabalpur	63.00	-
173	Rasi (IET- 1444)	DRR	2.50	10.00
174	Ratnagiri-1	RARS, Karjat	3.00	5.00
175	Ratnagiri-24-(IET-19812)	RARS, Karjat	4.00	6.00
176	Ratnagiri-4-(IET-20980)	RARS, Karjat	0.50	1.00
177	Reeta (IET 19969)	CRRI, Cuttack	0.50	0.50
178	RP-2421 (IET-11242)	RWRC, Malan	10.00	4.00
179	Sabhagi Dhan (IET 19576)	CRURRS, Hazaribagh	181.50	36.00
180	Sabita (IET-8970)	RRS, Chinsurah	2.00	6.20
181	Sadabahar	CRURRS, Hazaribagh	0.50	0.50
182	Samba Mahsuri (BPT-5204)	ANGRAU;PRDF Gorakhpur; TNAU, Coimbatore	124.00	251
183	Samleshwari (IET -17455)	IGAU, RAIPUR	22.00	23.10
184	Sampada (IET 19424)	DRR	11.50	12.00
185	Sarala CR-260-77 (IET-10279)	CRRI, Cuttack	20.50	15.00
186	Sarjoo-52	NDUAT, Faizabad; PRDF Gorakhpur	12.00	220
187	Satabadi (IET-4786)	RRS, Chinsurah; CRRI	40.00	38.80
188	Savitri (IET - 5897) (CR 1009)	CRRI, Cuttack	17.10	16.00
189	Shusk Samrat (NDR 1045-2) (IET -17458)	NDUAT, Faizabad	0.50	18.50
190	Sidhanta (ORS 102-4) (IET- 15296)	OUAT, Bhubaneshwar	5.10	10.40
191	Sita	BAC, Sabour	7.50	4.60
192	Somasila (NLR-33358)	ANGRAU	1.00	2.00
193	Srikakulam Sannalu	VIHA, Almora	20.00	25.00
194	Surendra (IET -12815)	OUAT, Bhubaneshwar	7.00	4.60
195	Swarna-Sub 1 (CR 2539-1) IET-20266	CRRI, Cuttack	136.00	75.00
196	SYE-75-(SINDEWAHI)	ARS, Sindewahi	5.00	22.60
197	Taraori Basmati (HBC-19)	RRS KAUL	3.00	9.10
198	Tejaswani (OR 1912-22)	OUAT, Bhubaneshwar	1.00	16.00
199	Tellahamsa	ANGRAU	7.50	50.00
200	Thanu	UAS, Bangalore	2.50	65.00
201	Tunga (IET-13901)	UAS, Bangalore	8.00	12.00
202	Turant Dhan	RAU, Pusa	20.00	7.50

S. No	Hybrid/ Variety	Produced by	Quantity Alloted	Quantity Produced
203	Uma (MO 16)	RRS, Moncompu	15.00	12.00
204	Upahar (IET 17318)	OUAT, BHU-BANESHWAR	2.50	1.40
205	Utkal Prava (OR-1030)	CRRI, Cuttack	7.50	4.50
206	Vallabh Basmati-22 (IET 19492) (MAUB-162)	SVBPU&T Meerut	2.00	
207	Vandana (Rr-167-982)	CRURRS, Hazaribagh	9.50	4.00
208	Vardhan (IET 18940)	DRR	3.50	6.00
209	Varshadhan (CRLC-899) (IET-15296)	CRRI, Cuttack	11.00	15.00
210	VI Dhan 209	VIHA, Almora	1.20	1.60
211	Vijetha (MTU-1001)	ANGRAU	194.00	200.00
212	Virender (IET-17901)	CRURRS, Hazaribagh	0.50	0.50
213	Vivek Dhan 154	VIHA, Almora	2.00	2.50
214	Vivek Dhan-62 (IET-14621)	VIHA, Almora	1.50	2.00
215	VL Dhan -208(VL-9632)	VIHA, Almora	1.20	1.20
216	VL Dhan 221	VIHA, Almora	0.10	0.25
217	VL Dhan 65	VIHA, Almora	0.30	1.25
218	VL Dhan 85(IET-16455)	VIHA, Almora	2.60	3.00
219	Warangal Samba (WGL-14)	ANGRAU	6.00	10.00
220	Warangal Sannalu	ANGRAU	70.00	75.00
Total Varieties			**4737.35**	**5475.31**
1	**HYBRIDS**			
1	**DRRH-2**			
	A Line	DRR, Hyderabad	0.05	0.05
	B Line	DRR, Hyderabad	0.05	0.05
	R Line	DRR, Hyderabad	0.05	0.05
	DRRH-3 (IET -19543)			
	A Line	DRR, Hyderabad	0.15	0.15
	B Line	DRR, Hyderabad	0.05	0.05
	R Line	DRR, Hyderabad	0.05	0.05
3	**KRH2**			
	IR 58025A	UAS, Bangalore	1.20	37.20
	IR 58025B	UAS, Bangalore	0.40	1.00
	KMR-3R	UAS, Bangalore	0.55	28.50
4	**Pant Shankardhan-1**			
	A Line	GBPUAT,	0.05	0.20
	B Line	GBPUAT,	0.05	0.60
	R Line	GBPUAT,	0.05	0.10
5	**SAHYADRI 1**			
	A Line	RARS, Karjat	0.50	0.50
	B Line	RARS, Karjat	0.15	0.15
	R Line	RARS, Karjat	0.15	0.15
6	**SAHYADRI 2**			
	A Line	RARS, Karjat	0.15	0.15
	B Line	RARS, Karjat	0.05	0.05
	R Line	RARS, Karjat	0.05	0.05
7	**SAHYADRI-3**			
	A Line	RARS, Karjat	0.10	0.10
	B Line	RARS, Karjat	0.05	0.05
	R Line	RARS, Karjat	0.05	0.05
8	**SAHYADRI-4**			
	A Line	RARS, Karjat	0.05	0.05
	B Line	RARS, Karjat	0.05	0.05
	R Line	RARS, Karjat	0.05	0.05
9	**Ajay (CRHR-7) (IET-18166)**			
	A Line	CRRI Cuttack, rissa	0.30	1.00
	B Line	CRRI Cuttack, rissa	0.10	1.50
	R Line	CRRI Cuttack, rissa	0.10	1.50
10	**RAJALAXMI (CRHR-5)**			
	A Line	CRRI Cuttack, rissa	0.40	0.80
	B Line	CRRI Cuttack, rissa	0.15	1.50
	R Line	CRRI Cuttack, rissa	0.15	1.50
11	**JRH-5**			
	A line	JNKVV, Jabalpur	0.50	-
	B line	JNKVV, Jabalpur	0.20	-
	C line	JNKVV, Jabalpur	0.20	-
12	**JRH-8**			
	A line	JNKVV, Jabalpur	0.50	-
	B line	JNKVV, Jabalpur	0.20	-
	C line	JNKVV, Jabalpur	0.20	-
Total Parental lines			**7.10**	**77.20**
Grand Total			**4744.45**	**5552.51**

Appendix 3

List of PPV & FRA Registration certificates of Extant varieties issued during 2013-14

S.No	Registration No.	Denomination
1	111/2013	SYE-2001
2	184/2013	Pant Dhan 16 (IET-14807)
3	185/2013	Surya (BPT 4358)
4	186/2013	PKV-SKL-3-11-25-30-36
5	187/2013	Cottondora Sunnalu (MTU-1010)
6	188/2013	VL Dhan 81 (IET-13792)
7	189/2013	Hema Vathi (DWR-4107
8	190/2013	CSR-23 (CSR-891 R-5) (IER 13769)
9	191/2013	GR-7
10	192/2013	HRK-46
11	193/2013	Vedagiri (NLR-33641)
12	194/2013	WGL 3962
13	195/2013	Gurjari
14	273/2013	TKM-11
15	294/2013	ADT (R) 45 (IET-15924)
16	298/2013	Vandana (RR-167-982)
17	36/2014	TRY 1
18	40/2014	TRY (R) 2

S.No	Registration No.	Denomination
19	142/2014	SKL-8(SKL-11-28-29-55)
20	147/2014	IGKVR-2 (IET 19795)
21	149/2014	IGKVR-1 (IET-19569)
22	151/2014	Akshayadhan (IET 19367)
23	162/2014	Ajay (CRHR-7) (IET-18166)
24	166/2014	Parvati (LMH 16-5)
25	171/2014	Narendea-8002 (IET-15848)
26	172/2014	CRMS31A
27	175/2014	Naveen (CR-749-2-2) (IET-14461)
28	177/2014	VL Dhan 208 (VL-9632)
29	179/2014	VL Dhan 207 (VL-97-9729)
30	180/2014	Sampada (IET 19424)
31	200/2014	Vasundhara (RGL-2538)
32	204/2014	Vardhan (IET 18940)
33	206/ 2014	Rajalaxmi (CRHR-5)

Appendix 4

Funded AICRIP centers with staff positions during 2013-14

S. No	State	Centre	Total
1	Andhra Pradesh	Maruteru	9
2	Andhra Pradesh	Rajendranagar	6
3	Andhra Pradesh	Warangal	4
4	Assam	Jorhat/ Titabar	7
5	Assam	Karimganj	1
6	Bihar	Patna	6
7	Bihar	Pusa	4
8	Bihar	Sabour	1
9	Chattisgarh	Jagdalpur	4
10	Chattisgarh	Raipur	5
11	Gujarat	Nawagam	6
12	Gujarat	Navasari	3
13	Haryana	Kaul	7
14	Himachal Pradesh	Palampur / Malan	6
15	Jammu & Kashmir	Khudwani	5
16	Jammu & Kashmir	R.S. Pura Chatha)	4
17	Jharkhand	Kanke / Ranchi	4
18	Karnataka	Mandya	5
19	Karnataka	Gangavati	5
20	Karnataka	Brahmavar	2
21	Karnataka	Mugad	2
22	Karnataka	Ponnampet	2
23	Kerala	Moncompu	4
24	Kerala	Pattambi	7
25	Madhya Pradesh	Rewa	5
26	Maharashtra	Karjat	7
27	Maharashtra	Sakoli	2
28	Maharashtra	Tuljapur	2
29	Manipur	Imphal (Wangbal)	4
30	Meghalaya	Upper Shillong	4
31	Nagaland	Kohima	2
32	Orissa	Chiplima / Sambulpur	6
33	Orissa	Jeypore	1
34	Puducherry	Puducherry	3
35	Punjab	Ludhiana	6
36	Rajasthan	Kota	2
37	Tamil Nadu	Aduthurai	4
38	Tamil Nadu	Coimbatore	7
39	Tripura	Arudhutinagar	3
40	Uttar Pradesh	Nagina	1
41	Uttar Pradesh	Kanpur	2
42	Uttar Pradesh	Ghaghraghat	4
43	Uttar Pradesh	Varanasi	4
44	Uttar Pradesh	Faizabad	5
45	West Bengal	Bankura	3
46	West Bengal	Chinsurah	6
47	Uttaranchal	Pantnagar	6

Appendix 5

On-going Institute Projects (2013-14)

P1 : GEY: Genetic enhancement of yield potential and stress resistance in rice for irrigated ecology.

Programme leader: BC Viraktamath

Code	Project Title	Project Leader & Associates
GEY / CI / BR / 12	Redesigning the indica rice plant type by introgressing the traits for higher yield potential and disease and pest resistance from tropical japonica and wild rices.	**T Ram,** G.S.Laha, V. Jhansi Lakshmi, A. P. Padmakumari, D. Krishnaveni, B.Sreedevi, Satendra Kumar Mangrauthia, Ladha Lakshmi
GEY/CI/ BR/9	Breeding varieties for Boro areas.	**LV Subba Rao,** V. Ravindra Babu, Ch. Padmavathi
GEY/CI/ BR/ 16	Breeding rice varieties for resistance to planthoppers	**G Padmavathi,** G.S.V. Prasad, V. Jhansi Lakshmi, P. V. Satyanarayana, K. Vasantha bhanu
GEY/CI/ BR/14	Breeding rice for enhanced phosphorous use efficiency	**VP Bhadana,** T. Ram, P.Brajendra, R. M. Sundaram, D. Subramanyam, R. M. Kumar
GEY / CI/ BR/ 19	Germplasm screening and identification of genes for developing resistance to sheath blight in rice	**Jyothi Badri,** N. Shobha Rani, VP Bhadana, Suneetha Kota, V Prakasam, M. Sheshu Madhav
GEY/CI/ HY/1	Development and evaluation of three line hybrids with better grain quality and resistance to major pests and diseases	**BC Viraktamath,** A.S. Hariprasad, P. Senguttuvel, K.B. Kemparaju, N. Shobha Rani, C.N. Neeraja
GEY/CI/ HY/7	Exploitation of inter sub-specific heterosis in rice (*Oryza sativa* L.)	**AS Hari Prasad,** P. Senguttuvel, K.B. Kemparaju, B.C. Viraktamath
GEY/CI/ HY/10	Development of parental lines and Hybrids with tolerance to salinity and suitability to aerobic situations	**P Senguttuvel,** A.S. Hariprasad, P. Revathi, K.B. Kemparaju, Suneetha Kota, G.Padmavathi, B.Sreedevi, D. Subbramanyam, N Somasekhar, B.C. Viraktamath
GEY/CI/ HY/6	Genetic improvement of maintainers and development of CMS lines	**K.B.Kemparaju,** B.C. Viraktamath, A. S. Hari Prasad, P. Senguttuvel, P. Revathi
GEY/CP/ PP/12	Physiological studies for improving ideotype breeding in rice	**P Raghuveer Rao,** A.S. Hariprasad, V.P. Bhadana
GEQ/CI/ BR/11	Genetic enhancement of quality rice varieties through conventional and molecular breeding approaches	**N Shobha Rani,** G.S.Varaprasad, L.V. Subba Rao, R.M. Sundaram, M.S. Madhav, M. Srinivas Prasad, V. Jhansi Lakshmi

P 2: GEQ/: Genetic enhancement of grain and nutritional quality for domestic and export purpose

Programme leader : N. Shobha Rani

GEQ/CI/ BR/8	Enhancing nutritional quality of rice through bio-fortification	**V Ravindra Babu,** N. Shobha Rani, L.V. Subba Rao, B. Sreedevi, K. Surekha, C.N. Neeraja, G. Padmavathi, D. Sanjeeva Rao, T. Longvah (NIN)
GEQ/CI/ BR/ 20	Development of value added rice based products for different uses	**M.M. Azam,** D. Sanjeeva Rao, Amtul Waris, Suneetha Kota
GEQ/CI/ BR/ 13	Genetic enhancement of aromatic short and medium grain rices	**GS Varaprasad,** N Shobha Rani, G Padmavathi, M.S. Prasad

GEQ/CI/BR/21	Breeding for Quality Improvement of Rice through Conventional and Molecular Approaches	**Suneetha Kota,** G.S.V. Prasad, V. Ravindra Babu, M. Mohibbe Azam, D. Sanjeev Rao, G.S. Laha,
***GEQ*/CI/ BR/ 18**	Investigation into starch properties and chalkiness on rice cooking quality	**D Sanjeeva Rao,** V.Ravindra Babu

P 3 : ABR/: Development and application of biotechnology tools for rice improvement.

Programme leader : SM Balachandran

***ABR*/CI/ BT/9**	Genetic improvement of rice against biotic and abiotic stresses through transgenic approach	**SM Balachandran,** A.P. Padmakumari, Ch. Padmavathi, D. Subrahmanyam, S.K. Mangrauthia
***ABR*/CI/ BT/6**	Identification of genes for grain filling in rice (*Oryza sativa* L.)	**CN Neeraja,** SR Voleti, LV Subba Rao, S.M. Balachandran
ABR/CI/ BT-10	Genomic studies on grain yield heterosis and WA-CMS **trait in rice**	R. M. Sumndaram, SM Balachandran, AS Hariprasad, P Revathi
***ABR*/CI/ BT/8**	Development of molecular markers for important quality traits in rice	**M.Sheshu Madhav,** R. Meenakshi Sundaram, G.S.V. Prasad, C.N. Neeraja
***ABR*/CPT/ PATH/16**	Suppression of Rice tungro virus through RNA interference	**SK Mangrauthia,** SM Balachandran, D Krishnaveni
***ABR*/CI/ HY/9**	Molecular breeding for fertility restoration, wide compatibility and disease resistance in rice	**P Revathi,** P. Senguttuvel, K. B. Kemparaju, B. C. Viraktamath
NP 2 (ABR/CI/ BR/10)	Mapping Quantitative Trait Loci (QTLs) for yield and related traits using backcross inbred lines (BILs) from elite x wild crosses of rice (*Oryza sativa* L.)	Divya Balakrishnan, **N Sarla,** G Padmavathi, Jyothi Badri

P 4: RUE: Enhancing resource and Input use efficiency

Programme leader: R. Mahendra Kumar

***RUE*/ CP/ AG/10**	Evaluation of the system of rice intensification (SRI) for its potential to save water and sustaining rice productivity	**R.Mahender Kumar,** B.Sreedevi, V.R.Babu, K. Surekha, Ch Padmavthi, P.C.Latha, M.Sreenivas Prasad, N.Somashekhar, P.Muthuraman, P.Raghuveer Rao, B.Nirmala, B.Shailaja, Vidhan Singh
RUE/CP/ AG/14	**Resource conservation studies in rice cultivation**	B Gangaiah, M B B Prasad Babu, T Vidhan Singh, P Raghuveer Rao
RUE/CP/ AG/13	Development of suitable agronomic management practices for improving the productivity of aerobic rice	B. Sreedevi, T.Ram, P.Brajendra, N.Somasekhar, K Suneetha

P 5: SSP: Sustaining rice system productivity

Programme leader: K. Surekha

SSP/CP/ SS/11	Assessment and improving nitrogen use efficiency in irrigated rice	**K.Surekha,** V.P. Bhadana, S.R. Voleti, R.M. Kumar C.N. Neeraja
***SSP*/CP/ SS/9**	Assessment of soil quality for improved rice productivity	**Brajendra**
SSP/CP/ SS/13	Utilization of plant growth promoting micro organisms for improving nitrogen and water use efficiency in rice	**PC Latha**

SSP/CP/ ENG/6	Selective mechanisation in rice cultivation	**T Vidhan Singh,** R.Mahender Kumar, B. Gangaiah, B.Nirmala

P6: CCR: Assessing and managing crop response to climate change

Programme leader: SR Voleti

***CCR*/CP/ SS/10**	Impact of changing temperatures on nitrogen dynamics and use efficiency in rice	**M.B.B. Prasad Babu,** P.C. Latha and B. Gangaiah
***CCR*/CP/ PP/9**	Physiological studies on Heat tolerance due to ambient and Elevated carbon dioxide in rice	**SR Voleti,** PR Rao, B Sailaja, N Somasekher, PC Latha, K Surekha, Chitrashanker, D.Krishnaveni
***CCR*/CP/ PP/11**	Evaluation of genotypic variation in leaf photosynthetic efficiency and its associated factors in rice	**D Subrahmanyam**, SR Voleti, VP Bhadana

P7: HRI Host plant resistance against insect pests and management.

Programme leader: G Katti

HRI/CPT/ ENT/11	Assessment of host plant resistance to rice planthoppers and their management	**V. Jhansi Lakshmi**, D Sanjeeva Rao, M Sampath Kuamr
HRI/CPT/ ENT/23	**Insect-plant interactions with special reference to rice pests – yellow stem borer and gall midge**	**AP Padmakumari,** S.R Voleti, T. Ram, C.N. Neeraja, K. Suneetha
HR1/CPT/ ENT/19	Host plant resistance for leaf folder in rice	**Ch Padmavathi,** LV Subba Rao, N Sarla

P8: HRP Host plant resistance against pathogens and management.

Programme leader: MS Prasad

HRP/CPT/ PATH/15	Assessment of host plant resistance to rice blast disease and management through botanicals	**MS Prasad,** SM Balachandran
***HRP*/CPT/ PATH/13**	Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice	**GS Laha,** D. Krishnaveni, D. Ladha Lakshmi, R. M. Sundaram, T. Ram, S. K. Mangrautia
***HRP*/CPT/ PATH/14**	Assessment of host plant resistance and strainal variation in rice tungro disease	**D Krishnaveni,** Chitra Shanker S.K Mangrauthia, D. Ladhalakshmi
***HRP*/CPT/ PATH/17**	Biology of false smut disease of rice	**D.Ladhalakshmi,** GS.Laha
HRP/ CPT/ PATH/18	Characterization and management of rhizoctonia solani causing sheath blight of rice	**V Prakasham,** M. Srinivasa Prasad, G.S. Laha, Joythi Badri

P9: IPM: Integrated Pest management

Programme leader: G Katti

***IPM/* CPT/ ENT/3**	Chemical control of rice insect pests as a component of rice IPM	**Gururaj Katti,** V Jhansi Lakshmi, A.P. Padmakumari, Chitra Shanker

IPM/CPT/ ENT/21	Botanicals for sustainable management of major pests of rice	**B Jhansi Rani,** Chitra Shankar, M.M. Azam, M. Srinivasa Prasad
IPM/CPT/ ENT/22	Investigations on Nematodes of Importance to Rice Cultivation	**N Somasekhar ,** A.P. Padmakumari, G. Katti, V. Prakasam, P.C. Latha and M. Sheshu Madhav
***IPM/* CPT/ ENT/13**	**Arthropod Biodiversity of irrigated rice ecosystem,its functional significance and use in Biological control**	**Chitra Shanker,** Gururaj Katti, B Jhansi Rani, M Sampath kumar
IPM/CPT/ ENT/20	Semiochemical approaches to manage rice pests with special emphasis on sex pheromones	**M Sampath Kumar,** G. Katti, Ch. Padmavathi, K. Subaharan

P10: Transfer of technology and training

Programme leader: P Muthuraman

TTT/EXT/8	Sustainable rice production practices: Problems and prospects	**P Muthuraman,** S.N.Meera, S. Arun Kumar
TTT/EXT/10	Gender Dimensions in Different Rice -Eco systems-An Exploratory Study in Andhra Pradesh	**Amtul Waris,** P.Muthuraman, S. N. Meera, Arun Kumar, R .Mahender Kumar
TTT/EXT/11	Maximising the impact of rice technologies through ICT applications	**SN Meera,** Arun Kumar S, Amtul Waris, B. Sailaja, Brajendra, P. Muthuraman,
TTT/EXT/9	An Exploratory study on public-private-partnerships: Impact and implications	**S Arun Kumar,** Shaik N. Meera
***TTT/* CP/ CA/2**	Delineation of rice growing ecologies using spatial technologies and crop models	**B Sailaja,** D. Subrahmanyam, K.V. Rao, Shaik N Meera, B.Nirmala
TTT/ ECON/1	Yield gaps and constraints in rice production- An econometric analysis	**B. Nirmala, P.** Muthuraman

Appendix 6

List of Externally funded projects sanctioned during 2013-14

S.No.	Title of the Project	PI	Funding Agency	Duration	Budget (In lakhs)
1	Molecular Marker assisted introgression of two major blast resistance genes and a major QTL for grain yield under drought stress in rice	Dr. M. Sheshu Madhav	DBT	2013-2016	18.76
2	Common basis of defense induction in rice & mustard against sucking & gall insect pests	Dr. J.S. Bentur	NFBS-FARA	2013-2016	55.94
3	Modeling network of gene responses to abiotic stress in rice	Dr. D. Subramanyam	NFBS-FARA	2013-2016	26.15
4	ICAR LBS Outstanding Young Scientist Award Challenge Project "Genomic and transcriptomic analysis of rice hybrids and their parental lines in relation to heterosis"	Dr. R.M. Sundaram	ICAR	2013-2016	30.00
5	Marker-assisted introgression of Pup1 into elite rice varieties	Dr. R.M. Sundaram	DBT	2013-2015	41.65
6	Effect of foliar and root application of silicate SiO_2 in rice	Dr. R. Mahender Kumar	Geolife Agritech Pvt. Ltd.,	2014-2015	3.59
Total Budget					**176.09**

Appendix 7

List of On going externally funded projects during 2013-14

S. No	Title of the Project/Schemes	Name of PI	Funding Agency
1	Seed Production and seed technology research in Rice (NSP)	Dr. LV. Subba Rao	ICAR
2	DUS Tests in Rice(PPV&FRA)	Dr. LV. Subba Rao	PPV&FRA
3	Generation, characterization and use of EMS induced mutants of Upland variety Nagina 22 for functional Genomics of Rice.	Dr. N. Sarla	DBT Project
4	ICAR Network Project for Transgenics in crops : Rice (Transgenic Component)	Dr. S.M. Balachandran	ICAR, GOI
5	Research into development of decision support systems for insect pests of major rice and cotton based cropping - CRIDAS main coordinating centre, DRR for rice along with five AICRIP centres (Maruteru, Ludhiana, Mohanpur, Cuttack, Coimbatore)	Dr. G. Katti	NAIP
6	ICAR Network Project for Transgenics in crops : Rice (Functional genomics Component- Iron and Zinc)	Dr. N. Sarla	ICAR
7	Development Of Indica Rice With Beta Carotene Rice Endosperm Through Marker Assisted Gene Introgression And Their Evaluation	Dr.R.M.Sundaram	DBT_IRRI Project
8	Gene and protein expression study in salt-tolerant and sensitive cultivars of indica rice	Dr. N. Sarla	DST
9	Development and maintenance of Rice Knowledge Management Portal Development	Dr. Shaik Meera	NAIP
10	Establishment of National Rice Resource Data base	Dr. L.V. Subba Rao	DBT
11	Functional Validation of Identified candidate gall midge resistance genes FGR Ph II 4A	Dr. J.S. Bentur	DBT
12	Identification and functional validation of BPH resistance genes FGR Ph II 5A	Dr. J.S. Bentur	DBT
13	Functional analysis of gene regulatory networks during flower and seed development in rice FGR Ph II 7	Dr. S.M. Balachandran	DBT
14	High resolution fine mapping, identification and functional analysis of rice tungro virus resistance genes FGR PH II 6	Dr. C.N. Neeraja	DBT
15	Identification and functional analysis of novel blast resistance genes in rice FGR Ph II 3B	Dr. M.S. Prasad	DBT
16	Fine mapping of yield enhancing QTLs from wild rice FGR Ph II 1A	Dr. N. Sarla	DBT
17	Development of Biotic stress resistant rice through marker assisted breeding sub project- I A&B (DBSRR - GCP)	Dr. B.C. Viraktamath	DBT
18	Functional Characterization of novel bacterial blight resistance genes from wild relative of Oryza spp FGR Ph II 2A	Dr. B.C. Viraktamath / Dr. R.M. Sundaram	DBT

S. No	Title of the Project/Schemes	Name of PI	Funding Agency
19	Multi locational evaluation of rice germplasm	Dr. L. V.Subba Rao	ICAR/NB-PGR
20	BMGF " Stress tolerant rice for poor farmers in Africa and South Asia " STRASA	Dr. T. Ram	IRRI
21	Marker assisted breedinbg of abiotic stress tolerant rice varieties with major QTLs for drought, submergence and slat tolerance	Dr. T. Ram	DBT
22	Seed Production in Agriculture (MEGA SEED)	Dr. LV. Subba Rao	ICAR
23	National Centre For Integrated Pest Management (NICRA) 2011-12	Dr. J.S. Bentur	ICAR-NCIPM
24	National Initiative on Climate resilient agriculture	Dr. S.R. Voleti	ICAR
25	Identification of candidate genes for enhanced water use efficiency in rice through activation tagging	Dr. S.M. Balachandran	DBT
26	"Rice bio-fortification with enhanced iron and zinc in high yielding non-basmati cultivars through marker assisted breeding and transgenic approaches- Phase II"	Dr. C. N. Neeraja	DBT
27	Conversion of Elite partial restorers of rice cultivars in to restorer by Marker-assisted introgression of major fertility restoer genes, Rf4 & Rf3	Dr. Revathi P	DBT
28	Marker assisted Recurrent Selection (MARS) for improvement biotic stress resistance in parental lines of hybrid rice	Dr. Revathi P	DST- women scientist
29	Investigations on System of Rice Intensification (SRI) for water saving and yield optimization in irrigated ecosystem	Dr. R. Mahender Kumar	Ministry of Water resources
30	Exploitation of RNAi technology for management of yellow stem borer in rice	Dr. Sheshu Madhav	DBT
31	Metabolic and molecular profiling of aromatic rice germplasm of India for gaining insights about aroma	Dr. N. Shobha Rani	DBT
32	Molecular and functional characterisation of yield enhancing QTL from wild ricce	Dr. N. Sarla	DBT
33	Identifiction and Molecular Mapping of a novel neck blast resistance gene (s) from local landrances and introgression lines of Oryza	Dr. Sheshu Madhav	DBT-BCIL
34	Molecular mapping and introgression of stigma exsertion trait in hybrid rice parental lines	Dr. B.C. Viraktamath/ Dr. A.S. Haripprasad	DBT
35	Enhancing scope of marker assisted selection using genomics technologies (En MAS)	Dr. Sheshu Madhav	CSIR
36	Marker assisted introgression of different traits to develop new generation climate adapted varieties	Dr.T.Ram	DBT
37	Evaluation of new herbicide molecules (Rice Co-Herbicide) for its efficiency in Transplanted Rice	Dr. B. Sreedevi	Rice-Co
38	Evaluation of new herbicide molecules (Rice Co-Herbicides) for its efficiency in Direct Seeded Rice	Dr. B. Sreedevi	Rice-Co
39	Evaluation of new fertilizer product "Geofert" An Agro-Nano Technology product in transplanted rice	Dr. R. Mahender Kumar	Geofert
40	Evaluation of "Metal Glyainates" in Paddy	Dr. R. Mahender Kumar	AMSRI Chemicals Ltd

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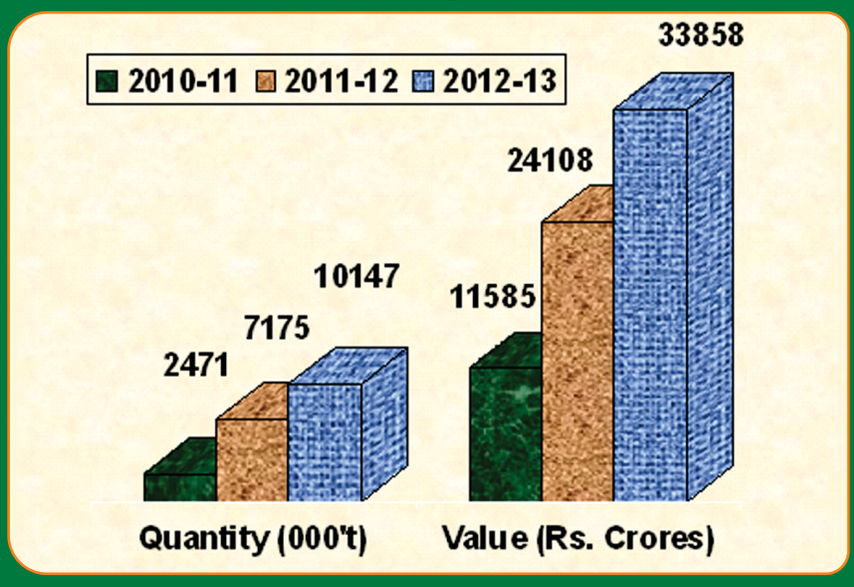

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