वार्षिक प्रतिवेदन

ANNUAL REPORT

2012 - 2013

भाकृअनुप
ICAR

चावल अनुसंधान निदेशालय

Directorate of Rice Research

Rajendranagar, Hyderabad - 500 030

DRR

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Preface

I am extremely happy to place before you the Annual Report 2012-13 of the Directorate of Rice Research. This is eighth report after I have taken over as the Project Director.

The year 2012-13 was a mixed bag of achievements and little despair on rice production front. The delayed monsoon had cast a gloomy shadow in the beginning of the season. But late rains during August and September buffered enough to post another 100 plus million tonnes of rice production during the second consecutive year. The season again ended with untimely rains during the first week of November that followed NILAM cyclone that affected badly the standing rice crop in few states, particularly Andhra Pradesh.

The year has also been a period of steady progress on research frontier with ten hybrids and two varieties being released for cultivation from the central agency. Over 11,000 quintals of breeder seeds of 233 varieties were produced and distributed. Two advanced breeding lines developed at DRR have been identified for possible release. Improved lines with high iron and zinc content in grain have been developed for multilocation evaluation. Several proven crop production and protection technologies along with potential of new varieties and hybrids were demonstrated on farmers' field in more than 570 FLDs. The year also witnessed the highest foreign exchange earning of Rs.18,000 crores through rice exports.

Eleven new externally funded projects were approved during the period with a total budget of Rs. 729.41 lakhs. Some of our scientists have been conferred with the prestigious awards. Six new scientists joined the Institute during the period and two scientists were deputed abroad for advanced training.

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

(B.C. Viraktamath)
Project Director

July 2013
Hyderabad

Contents

कार्यकारी सारांश

Executive Summary

अखिल भारतीय समन्वित चावल सुधार कार्यक्रम (अ.भा.स.भा.सु.का)

नई विमोचित किस्में

- विभिन्न पारिस्थिकिए स्थानों के लिए (सीएसीएसएन. आर. वी से यूएस ३८२, अरिज तेज, पीएन पीएस-२४, २७ पी३१, २७पी ६१, २५पी २५, आर एस, ५३१, जेकेआर एस ३३३३ और सीओ ४ नामक दश संकर और दो किस्में (एनडीजी आर २०१ और सी आर सुगंध धान ९०७) और ९ राज्यों में एसवी आरसी से एक संकर (आरिज धानी) और २० किस्मॉ का विमोचन किया गया।

फसल सुधार

- खरीफ २०१२ के दौरान सभी ५ क्षेत्रों में स्थित २७ राज्यों और २ संघ राज्यों में ११० स्थानों (४६ निधिक और ६४ केंद्रों) में उन्तीस उपजातीय परीक्षण, स्क्रीनिंग नर्सरी और चेक सहित १०९० प्रविष्टियों के साथ ५ संकर धान के ७७१ प्रयोग किये गये । इसके द्वारा आशाजनक प्रविष्टियों की पहचान की गयी।
- २०१२ के दौरान ७८ स्थानों में १४ विविध आईएनजीईआर पर्यवेक्षित संवर्धन स्थानों में सात सौ तिरासी उत्कृष्ट वंशक्रमों का मूल्यांकन किया गया।
- देश भर में ३९ केंद्रों में २३३ किस्मों के प्रजनक बीजों और संकर धानों के पैतृक वंशक्रमों का उत्पादन किया गया और ५,२६७.०५ क्विंटल डी एसी मांग को पूरा करने केलिए कुल ११,४३६.३१ क्विंटल प्रजनक बीज का उत्पादन किया गया।

सस्यविज्ञान

- नाइट्रोजन के प्रति प्रतिक्रिया की जांच के लिए १६ संवर्गों से संबंधित ७६ उत्कृष्ट जीनोएइपों का मूल्यांकन किया गया। इससे दाना उपज क्षमता सूचकांक मूल्य के आधार पर २२ उपयुक्त संवर्घों की पहचान की गयी । वर्षा-प्रधान धान की समग्र उत्पादकता बढाने में सोयाबीन लोबिया उडद (बदलाई अनुक्रम में ४:२) की अंतर फसल और पेंडीमेंथालिन ०.७५ कि.ग्रा सक्रिम घटक (उभरने के पहले) रोपाई के २५ दिनों के बाद हाथ से निराई के संघटित उपतृण प्रबंधन द्वारा खेती आशाजनक पायी गयी ।
- वायुजीवी धान की खेती में, अधिक उत्पादन प्रप्त करने के लिए ३०-३५ कि.ग्रा हे बीज की दर से सधन रोपाई (२० सें.भी) के साथ रोपाई का समुचित समय १० जून होगा। नाइट्रोजन की इस्टतम मात्रा १२० कि.ग्रा / हे का प्रयोग ३ विभाजनों में करने की तुलना में ४ विभाजनों में (की मात्रा) उभरने के १०-१२ दिनों (हीएई) पर, सक्रिय अंतर्भूस्तरी अवस्था पर बाली निर्माण आरंभ अवस्था पर पुष्पण की अवस्था पर) करने से २५ एन की बचत हुई।
- धान सधनीकरण प्रणाली (एसआरआई) में दाने की उपज को बढाने में १० दिने की पौधों का उपयोग और इष्टतभ अंतराल (२५२५ से.भी.) की रोपाई क्रांतिक और प्रभावी पाये गये।
- अपतृण प्रबंधन में वायुजीवी धान की सेती में रोपाई के, ३-४ दिन के बाद पेंडिमथालिन कि.ग्रा स.सं हे की दर से या बूटाक्लोर १.५ कि.ग्रा.स.संहे की दर से प्रयोग के साथ रोपाई के १५-२० दिनों के बाद बिस्पालिबैक सोहियम ३५ कि.ग्रा.स.सं या रोपाई के २५-३०दिनों के बाद क्लोरीमुरान मेथ्सुलपरोन मेथिल ४० ग्रा.स.सं.जैसे शाकनाशी प्रभावी पाए गये जबकि रोपित धान के लिए पेनोक्सुलम साइहालोफोपबुटिल १३५ ग्रा.स.सं.की दर से, सीधी बीज रोपाई अवस्था में वेटर के साथ फलुसटो सल्फरान २० या २५ ग्रा.स.सं हे या पेनो कसुलम साइहालोफोए - बुटिल १२० मा १३५ ग्रा. स.सं हे की दर से और बिस पारिबैकसोहियम मेटामिफोप ७० ग्रा. स.सं की दर से प्रयोग प्रभावी पाये गये।
- विविध धान आधारित फसल पध्दतियों में केवल एन.पी.के.के प्रयोग की तुलना में मिट्टी में जैविक खाद्य एन.पी.के सूक्ष्म- पोषक - तत्वों का प्रयोग आशाजनक पाया गया।

मृदा विज्ञान

- मारुटेरु और टिटाबार पर २४ वें वर्ष के अध्ययन से पाया गया कि सभी उपचारों में अनुमोदित उर्वरक मात्रा (१०० एन.पी.के.जेइएन.एस) के साथ साथ ५ टन / हे गोबर की खाद्य को पूरक के रुप में प्रोयोग करना श्रेष्ट पाया गया। इसके अतिरिक्त, समय के साथ सकारात्मक वृद्दि, पोषकतत्वों के संभयन में सापेक्ष रुप से बढोत्तरी, और मृदा पोषकों की स्थिति और जैव कार्बन में सुधार पाया गया। उपज के निर्धारित लक्षय प्राप्त करने के लिए टिटाबार, मांड्या, सिरसी और मारुटेरु के आसपास वर्तमान उर्वरक प्रयोग को
- मानकीकृत किया गया । अनुमोदित उर्वरक मात्रा (आर.डी.एफ) की तुलना में कृषकों द्वारा प्रयुक्त उर्वरकों से उपज में २६-१९४ की महत्वपूर्ण कमी पायी गयी। ६ टन / हे के निर्धारित लक्ष्य की उपज प्रप्त करने के लिए अनुमानित उर्वरक की मात्रा में स्थान और अनुमोदित उर्वरक मात्रा (आर.डी.एफ) के आधार पर भारी अंतर पाया गया है।

- आम्लीय और क्षारीय मृदाओं में, जैविक खाद्य के साथ अनुमोदित एन.पी.के.और सूक्षम पोषकतत्वों (जेउएन, एफई, एमएन, बी, एस आई) को पूरक के रुप में प्रयोग करने पर धान (के दानों) की उपज में वृध्दि हुई।
- भूरे चावल में सूक्ष्मपोषकतत्वों के अंश पर पर्यावरण के प्रभाव के बारे में अध्ययन करने के लिए २३० संवर्धों का स्क्रीनिंग किया गया । अनाज का उत्पादन खुदवानी में एफई अंश के साथ नकारात्मक रुप से सहसंबोधित है जब कि फैजाबाद, मांड्या और मोनकंपू में जेएएन के साथ नाकारात्म रुप के सहसंबंधित है । अधिक एफई और जेइएन अंश के लिए अनेक आशाजनक संवर्ध (अधोनिबोरा, यीन १०३९, डब्ल्यू जी एल १४३७७ और बोर्गतु) स्थान विशिष्ट हैं।
- वायुजीवी कृषि के अंतर्गत १०० संचभी पटल वाष्पण (सी पी ई) के समकक्ष कृषि में मांड् या में १० सिंचाई का जल और कानपुर में २० जल की बचत हुई पर उपज में कमी हुई । अनज के प्रतिटन उत्पादन के लिए एन.पी.के की आवश्यकता कानपुर और मांड्या में क्रमशह १७.८, ५.३ तथा २०.३ और १५.९, ४.७ तथा ८.४ किग्रा थी।
- खरीफ मौसम में विलंबित फसल की स्थापना के फलएवरुप फसल उत्पादकता में हानि हुई जिसे जैविक खाद्यों के संघटित पोषक प्रबंधन और सभी आवश्यक पोषकतत्वों के प्रयोग जाए दूर किया गया है।
- आम्लीय मृदाओं के लिए मोनकंपू में आईईटी २१०९ और आईटी २१५४२, रांची के लिए आईईटी २०८८४ और आईईटी २१५१०, सिरसी के लिए आईईटी २१४७७ और आईईटी २२०८१, टिटाबार के लिए अधोनिबोरा, प्रफुल्ला और आईईटी २०८८४ किस्में आशाजनक पायी गयी।
- किसानों के खेतों में धान की मृदा ओं की पोषक स्थिति में अत्यधिक असंतुलन पाया गया और फसल पोषक आवश्यकताओं से मेल नहीं खाती।
- हाल ही में विमोचित किस्मों और संकरों की पोषकतत्वों की आवश्यकताओं के अध्ययन से पाया गया कि संकरों और एचवाई.वी. द्वारा सर्वोय्य उपज प्राप्त करने के लिए देश के विभिन्न स्थानों के लिए अनुमानित पोषकतत्वों की आवश्यकता १४.३-३०.१ कि.ग्रा.एन, ०.६-३९.४ कि.ग्रा. पी२०५ और ६.७-६८.४ कि.ग्रा. के२० के बीच में पाया गया। सभी केंद्रों में एच.वाई.वी. की तुलना में संकर की उपज १४-२४% अधिक पायी गयी।
- चावल में जस्टा और लोहे के उपयोग पर अध्ययन ने दर्शीया कि लोहे और जस्त का अत्यधिक भाग पुआल में रहजाता है (७०-९०%) और केवल १०-३०% अनाज के दाने में स्थानंतरित होता है। सूक्ष्म पोषकतत्वों के साथ जैविक खाद्यों के प्रयोग से अनाज के दानों के पोषकतत्व और उपज में सुधार हुआ।

पादप क्रिया विज्ञान

- विभेदक प्रकाश अत्मीय कालावधियों के प्रभाव में पर हुए ७ भौगोलिक स्थानों में १५ दिनों की अगे तीरोपाई और साधारण रोपाई के साथ ३४ संवर्धों पर प्रकाश तापायनिक प्रयोग किये गये । आईईटी २०९२४ ने अपना सापेक्षिक प्रकाश संवेदनशील लक्षण को तीसरे क्रमिक वर्ष जारी रखा इसने, दाने भरने, बाली निर्माण आरंभ और ५०% पुष्पण अवस्थाओं में क्रमश रोपाई और क्रांतिक सीडीडी (१६००-१७००) तथा सीएन पी (८५०-१०००० और १०००-१२००) की अवधि में अपने संसर्ग के अनुप लक्षण की पुष्टि की।
- विकिरणन उपयोग क्षमता (आर.सू.ई) अध्ययनों से पहचान की गयी है कि विकिरणन उपयोग क्षमता (आर.यू.ई) समग्र शुल्क द्रव्य उत्पादन और प्रकाशसंवेदनशीलता के संबंध में आई.ई.टी. २०९२४, आई.ई.टी २२२१८, आई.ई.टी. २२५६९, आर.पी ४९१८-१६६३० और डी.आर.आर.एस-३ उत्कृष्ट पाये गये।
- बाली निर्माण आरंभ अवस्था में ताप तनाव आरोपण के द्वारा अंतिम ताप सध्यता के लिए मूल्यांकित २२ प्रतिष्टियों में से संकर पीए-६४४४, और संवर्ध आई.ई.टी-२२१११६, आई.ई.टी-२२२१८, आई.ई.टी-२१५७७, आई.ई.टी-२१४११ और लोकप्रिय किस्में एम.टी.यू-१०१०, आई.आर-६४ ने उत्तर-प्रफुल्लन उच्च तापमान के प्रति सहिष्णुता दर्शायी।
- जलाभाव सहिष्णुता के लिए मूल्यांकित ७२ धान संवर्धों में से आट प्रविष्टियों (आई.ई.टी २३३४४, आई.ई.टी-२२७६७, आई.ई.टी २२७४४, आईईटी २२०६१ आई.ई.टी २३३७७, आई.ई.टी. २३३८१, आई.ई.टी २३३४५ और आई.ई.टी २२७४७) को जलभाव इंडाइसेस (डी.एस.आई और वाई.एस) और अनाज के दानों की उपज के आधार पर उपशीली वर्षा - प्रधान खेती की आवस्था के लिए उपयुक्त पाया गया।

कीटविज्ञान

- ४३ स्थानों में ३८० परीक्षणों में १२ कीटनाशक जीवों के बारे में २२२९ प्रविष्टियों के समूह का मूल्यांकन किया गया । इन परीक्षणों द्वारा वैशकितक और बहुल नाशकजीवों के खिलाफ आशाजनक दाताओं और संवर्धों की पहचान की गयी। इनमें ८ प्रविष्टियाँ परीक्षणाधीन है। भूरे फुदके के प्रति, पीटीबी ३३ (बीपीएच२ बी पी एच अज्ञात कारक) सभी स्थानों में आशाजनक पाया गया जबकि आई.आर ६५४८२-७-२१६-१-२-बी (बीपीएच १८) और आई.आर ७१० ३३३-१२१-

१५ (बीपीएच २० बीपीएच २१) प्रत्येक दो-दो स्थानों पर आशाजनक पाये गये।

- अनेक गॉलमिज बायोटाइप और स्थानों में जीएमएल, जीएम३, जीएम८ जीनों द्वारा प्रदत्त प्रतिरोधिता प्रभावी पायी गयी।
- नये कीटनाशकों के मूल्यांकन से पताचला कि ट्रियाजोफोसे के एक नये सूत्रीकरण सुया-शिभान, तना उदर और गॉलमिज के प्रति प्रभावी था जबकि रिनाकिसपासर पत्ता। मोडक के प्रति प्रभावी था और अधिकतम अनाज की उपज प्राप्त की गयी। दो नये कीटनाशकों (बु प्रो फेजिन ए से फेट और सल्फोकसफ्लोर २४ एस.सी) का प्रयोग पृथक या फफूंदनाशी (हे कसाकोनाजोल और ट्राइसाकताजोल) के साथ संयुक्त रुप से करने पर उन के निष्पादन में कोई विपरीत प्रभाव नहीं दिखाई दिया जिस से उन रसायनों को खेत में रेक मिक्स के रुप में उपयोग करने पर उन की संगतता की पुष्टि होती है।
- साधारण फसल रोपाई की तुलना में सीधीबोआई के धान में तना त्वेदक, हिस्पा, पादप और पत्ता फुदकों का प्रभाव कम था जबकि पत्तामोइक का प्रभाव और अनाज की उपज अधिक था। अगेती और साधारण रोपाई की तुलना में धान की रोपाई के फलस्वसाय भूरे फुदक और सफेद पृष्टवाले फुदके के अलावा प्रमुख कीट नाशकजीवों का प्रभाव अधिक था।
- विभिन्न स्थानों में चार तना द्वेदक उपजातियाँ यानी सी.मेहिनलिस (८०) और मरास्भिया एसपी (२०) और मिश्रित भूरा फुदको और सफेद पृष्ठवाला फुदके की जनसंख्या का रिकार्ड किया गया। पुष्प विविधता को बढाने जैसे नाशीजीवमारक इतर पद्धतियों और पारिस्थिति की अभियांत्रि की के रुप में अण्डाणु भक्षी को बढाने के फल स्वरुप फुदके की जनसंख्या को कमकरने और प्राकृतिक शत्रु जनसंख्या को बढाने में सहायक हुआ।
- अनाज की उपज और व्हाइट इथर्स के प्रतिशत और (२) अनाज की उपज और पत्ता मोडक ढिंशकों की संख्या और क्षतिगत पत्तों में एक महत्वपूर्ण नकारात्मक सहसंबंध पाया गया। कृषकों द्वारा अपनाभी जानेवाली खेती की पद्धतियों की तुलना में एककृत पेस्ट प्रबंधन पध्दति को अपनाई के फलस्वरुप न्यून पेस्ट का प्रभाव, अधिक अनाज की उपज और अधिक लाभ लागत अनुपात पाया गया।
- प्रकाश फंदा संग्रहण द्वारा कीट नाशक जीव जनसंख्या के अनुवीक्षण से पीले तना गॉल मिज और और भूरे फुदके को प्रमुख कीटकों के रुप में दर्ज किया गया।

पादप रोगविज्ञान

- परपोषी पादप प्रतिरोधिता झोंका और जीवणुज अंगमारी रोगकारक जीवों के प्रभाव का खेतों पर अनुवीक्षण, रोग प्रेक्षण पौधशाला और रोग प्रबंधन पर ५२ स्थानों में कुल ५४८ परीक्षण आयोजित किये गये। विविध स्क्रीनिंग पौधशालाओं (एन एस एन-१, एन एस एन -२, एन एस एन-एस, एन एच एस एन और डी एस एन) में, अनेक जाँच प्रविष्टियों ने, दो से अधिक प्रमुख रोगों के प्रति प्रतिरोधिता दर्शायी। आशाजनक आई ई टी नंबर थीं- एन.एस.एन-१ में आई ई टी नंबर २२४८६, २२३७९, २२५३१, २१९५३, २२५९२, २२७५३ और २१४३१, एन एस एन -२ में आई टी नंबर २२४९४, २३००४, २३१४९, २३१४७, २२६३७, २३००१, २३०४९, २३१५५, २२४३७ और २३०७८, एन एस एन-एच में आई ई टी नंबर २१७४१, २१७५१, २२२७०, २२२८६, २२९५४, २२९५९, २२९६४, २२९७४, २२९७८, २२९८४ और २२९८५, एन एच एस एन में आई ई टी नंबर २२८७४, २२८७५, २२८९१४, २२८९८, २२९०२, २२९०५, २२९१०, २२९१७, २२९१९, और २२९२०, डी एस एन में अजया, बीएयू आई आर आर आई-४९७, सीबबी ०५-०३१, सीएच ४५, जी एस आर १०१, जी एस आर १४२, के ०१४, निधि, आर पी -बयोपैथो -३, आर पी-पैथो-१०, आरपी-पैथो-१२, आर पी -पैथो -२, आरपी -पैथो-६, आर पी-पैथो-७, आर पी-पैथो-८, आरपी-पैथो-९, टेटेप, वीएल-३१२८९, वीएल ३१५९८, वीएल-३१६११, वीएल-३१७१६ और वीएल ८६५४ थी। देश के ११ स्थोनों में ९१५ जननद्रव्य प्रविष्टियों के स्क्रीनिंग द्वारा छः रोगों यथा झोंका, पत्ता अंगभारी, जीवाणुज अंगभारी, भूरे धब्बे, पर्ण एलन और टुंग्रो, के प्रति आशाजनक प्रविष्टियों की पहचान की गयी। झोंके के प्रति : प्रविष्टि नंबर ४५०१६५, ४५९६३९, ४५९६५२, १७०८९, ४५०३८६, ४५०४६५, ४५०४००, ४६१८०८, ४५०५१६, ५४४८६८ और ४५००५२, पत्ता अंगमारी के प्रति : प्रविष्टि नंबर ४५० ३०५, ४६११६०, ४६१८१८, ४४९५५३, ४४९७९८ और ५४५४७०, भुरे धब्बे के प्रति : प्रविष्टि नंबर ३४६२०७, ४५०६३२ और ४५०१२३-आशाजनक प्रविष्टियाँ हैं।
- देश के विविध प्रांतों के २१ स्थानों में २५ संवर्धो के संबंध में पारिकुलेरिया ग्रेसिया (झों को) के प्रभाव को चार प्रमुख वर्गों में विभाजित किया जा सकता है। उसी प्रकार का अध्ययन विविध, जीवाणुज अंगमारी के प्रति प्रतिरोधी जीन निहित २१ लगभग आइसोजनिक वंशक्रम (आई आर बी बी वंशक्रम) और उनके संयोगों और विविध चेक के प्रभांव पर २० अधिक प्रयुग्ता वाले स्थानों में किया गया और पाया गया कि लगभग सभी स्थानों में एकल प्रतिरोधी जीन युक्त प्रविष्टियाँ सुग्राही हैं। बीबी प्रतिरोधी जीन एक्स ५१३ छः स्थानों में जबकि एत्सट २१ स्थानों में प्रमाबहीन पाया गया एक्स ए १३ एक्स ए

२१ का योग कौल, पटना, मारुटेरु और रायपुर में प्रभावहीन पाया गया।

- देश के विविध स्थानों में आयोजित रोग प्रेक्षण पौधशाला परीक्षणों से दर्ज हुआ कि रोपाई की अवस्था में पत्ता झोंका ग्रीक झोंका, भुरे धब्बे, पर्ण गलन, और जीवाणुज अंगमारी रोगों का प्रभाव बहुत अधिक था जबकि अदेती बो आई की फसलों में पत्ता झोंके के प्रभाव की तीव्रता थी। देश के विविध प्रांतो में फलो कसी स्ट्रोबिन २५ टेबुकोनाजोल ५० प्रयोग द्वारा मुनान झोंका, गीवा झोंका, नोड झोंका भुरे धब्बे, पत्ता स्कैल्ड, कूटकलिका और दाना विवर्ण रोगों की तीव्रता कम हुई और इसके साथ साथ उत्पादन में वृध्दि हुई।
- जैव नियंत्रण परीक्षण के संबंध में स्यूडोमोनस फ्लूरेसीन्स यूर्ण तथा द्रव सूत्रीकरणोंने एक समान प्रभाव प्रदर्शित किया और झोंका, पत्ता। अंगमारी, पर्णगलन और भूरे धब्बे रोगों की प्रमुख्ता को कम किया और साथ साथ अनाज उत्पादन में वृध्दि की।
- बाली के संबंध में कूटकलिका रोग संक्रमण में, नियंत्रण (२१-३०) की तुलना में, ५० बाली उभरने (पीई) की दशा में प्रोपिकोनाजोल २५ ईसी (टिल्ट १.० मिली लीटर की दर से) छिडकावव से कभी (९.९८) पायी गयी जो ५० बाली उभरने (पीई) की दशा में ट्रिफलोकिजस्ट्रोबिन २५ टुबोकोनाजोल (नेटिवो ७५ डब्ल्यू जी ०.४ ग्रा लीटर की दर से के बराबर (१०.६८) था भूस्टरियों के संक्रमण के संबंध में, नियंत्रण (११.०२) की तुलना में ५० बाली उभरने (पी ई) की दशा में ट्रिफ्लोकिजस्ट्रोबिन २५ टुबुकोनाजोल (नेटिवो ७५ डब्ल्यू जी ०.४ ग्रा लीटर की दर से) छिडकाव से संक्रमण में कभी (६.४८) पायी गयी जो बूटिंग में प्रोपिकानाजोल २५ ई सी (१.०मि.ली ली की दर से) छिडकाव के प्रभाव (६.५६) के बराबर पाया गाया।
- नत्रजन (आरडीएन) की अनुमोदित मात्रा के १०० प्रयोग के साथ स्थानीय प्रतिरोधी किस्मों की खेतीने पत्ता और गर्दन झोंके रोग की तीव्रता का कम किया और अनाज की उपज में वृध्दि की। जीवाणुज अंगभारी वे संबंध में, उपयुक्त उर्वरक प्रबंध प्रफली के साथ स्थानीय संकर या प्रतिरोधी किस्मों को अपनाने से रोग के प्रकोप को कम किया और अनाज की उपज बढाया।
- सोलह धान उपजाने वाले राज्यों में आयोजित उत्पादन अभिमुखीकृत सर्वेक्षण ने इस बात पर विशेष प्रकासडाला कि नवंबर प्रथम सप्ताह में संभवित निलम तूफान के प्रकोप से आंध्र प्रदेश राज्य में ४-५ लाख हेक्टर धान की फसल के लिए तीव्र क्षति पहुँची। देश के विविध रोज्यों में अंगमारी (पत्ता अंगमारी और गर्दन अंगमारी) भुरे धब्बे, पत्ता झोंका, पर्ण गलन, कूटकलिका, दाने का रंग विवर्ण और जीवाणुज अंगमारी जैसे रोगों का व्यापक रुप से प्रचलित हैं। पंजाब में विशेषता : बासमति धान की किस्मों में एक प्रमुख रोग (बैकाना) पाया गया है। कीटनाशकजीव जैसे मोडक और भूरा फुदका सफेद पृष्ठवाला फुदके के द्वारा मध्यम से तीव्र क्षति की रिपोर्ट दर्ज हुई। आंध्रप्रदेश और गुजरात के कुछ भागों में बाली पत्ते का माइट दर्ज हुआ।

प्रोद्योगिकी हस्तांतरण और प्रशिक्षण

- कुल मिलाकर, देश के १४ राज्यों और पाँच पारिस्थिति की प्रणालियों को सम्मिलित करते हुए विविध धान उत्पादन प्रौद्योगिकियों के मूल्याँकन और प्रदर्शन करने के लिए ५७२ एफ.एल.डी.का आयोजन किया गया।

अग्रिम अनुसंधान

फसल सुधार

- ४८वी कृषि अनुसंधान समूह बैठकों के अवसर पर उपजातीय पहचान समिति द्वारा संवर्ध आई ई टी २२०८० (आर पी ५१२५-५-९-१, आई आर ८३८७६-बी-एफ३ ढेर) जिसकी उपज २६.५२, ३८.४१ और १२.४९ है जिनकी क्रमश सहभागी धान, प्रांतीय चेक और स्थानीय चेकों की तुलना में उपज लाभ है की विमोयनार्थ पहचान तमिलनाडु, पांडुचेरी, केरल और कर्नाटक के लिए की गयी।
- उत्तराखंड, हरियाणा, बिहार और उडिसा राज्यों के लिए उपजातीय पहचान समिति द्वारा सहभागी धान, प्रांतीय चेक और स्थानीय चेक की तुलना में उपज लाभ वाले और एक प्रविष्टि आई ई टी २२०८ (आरपी ५१२७-९-३-आई आर ९३३७६-बीबी-१३०) जिसकी उपज लाभ २६.५२, ३८.४१ और १२.४९ है, की पहचान भी की गयी है।
- ट्रोपिकल जपोनिकास के विशेषक के प्रवेश करने के द्वारा विकसित १० नये पाइप टाइप संवर्धों यथा एफ.जी.आर २१-१७, एफ जी आर २१-२२, एफ जी आर २२-२७, एफ जी आर २१-२३, एफ जी आर २२-५६, एफ जी आर २२-४६, एफ जी आर २३-८२, एफ जी आर २३-११, एफ जी आर २४-८ और एफ जी आर २३-३ द्वारा लोकप्रिय उपजातीय चेक (जया, एन डी.आर ३५९, स्वर्णा, संपदा और धनराशि) की तुलना में २० उपज लाभ दर्ज हुआ।
- बोरो मौसम के लिए तीन उत्कृष्ट संवर्धो को आर.ए.यू, पूसा द्वारा नामित किया गया और आई वी.टी.बोरो २०१३ में पहलीबार उनका परीक्षण किया जा रहा है।
- भूरे फुदके के तीव्र प्रभाव में आनेवाले स्थानों (मारुटेरु) में भूरे फुदके के तीव्र संक्रमण (क्षति दर उसे अधिक है) द्वारा पूर्ण रुप से मर जानेवाले सुग्राइय चेकों के प्रति उच्च स्वरीय प्रतिरोधिता दर्शानेवाले विविध संकरों से ३० से अधिक आर.आई.एल की पहचान की गयी।

- जहाँ अल्प फासपेट वाली मृदाओं में अधिकतम जीनोटाइप जीवित नहीं हो पाये वहाँ छ जीनोटाइफ प्रतिरोधी पाये गये। वे हैं जी एस.आर-१०३, जी.एस.आर-१०९, जी एस आर -१११, जी.एस.आर-१२५, एस.एम-३६३ और एस.एस-६८६.
- सीधी बोआई अवस्था में मूल्यांकित ६०० से अधिक जीनो टाइपों में से सुगंधित छोटे दानों के समूह से संबंधित ए एस जी ७३ (५१०७ कि.ग्रा हे), ए.एस.जी.आई (४८९३ कि.ग्रा हे), ए.एस.जी २३५ (४८९३ कि. ग्रा हे), ए.एस.जी ३३ (४७८६ कि.ग्रा हे) और ए.एस.जी ३०(४७५० कि.ग्रा हे) ने उत्कृष्टता का प्रदर्शन किया और संरक्षण कृषि के लिए उपयुक्त जीनोटाइप विकसित करने के लिए दाताओं के रुप में उपयोग किये जा सकते हैं ।
- मुतान अंगमारी के प्रति परीक्षित विविध स्रोतों के ११०० जीनोटाइपी में से ३८ जीनोटाइपीने रोग स्कोर ३ दर्ज किये।
- कहोर परीक्षणों के अधीन तीन जीनों (एक्स ए२१, एक्स एल ३, एक्स ए५) से प्रवेशित तरौरी बासमति और बासमति ३८६ की पृष्ट भूमि में अठारह वंशक्रमों ने भूरे फुदक के प्रति ३२४ स्तरीय प्रतिरोधिता दर्शायी।
- एक पारंपरिक सुगंधित छोटे दानेवाले पैतृक के द्वारा विकसित संकरों से ३००० से अधिक विविध पीढियों के प्रथक संकरों का चयन किया गया। उनमें दानों की अधिक संख्या मजबूत डंठल के साथ अधिक भारयुक्त बाली और अर्ध-बौना पौधा जैसे अधिक उपज देनेवाले लक्षण निहित हैं।
- जैव पुष्टीकरण पर अखिल भारतीय समन्वित चांवल सुधार कार्यक्रम परीक्षणों में सम्मिलित करने के लिए बीपीटी ५२०४ चिट्टिमुत्यालू संकर से प्राप्त मध्यम महीन दानेवाले और अधिक उपज तथा अधिक लोहा और जस्त वाले एक स्थाई वंशक्रम की पहचान की गयी।
- ऐमाइलोस अंतर्वस्तु के आकलन की तुलना और मानकी करण की प्रक्रिया में यह पाया गया है कि एथानोल इसका एक आवश्यक अभिक्रमक नहीं है।
- पहली बार डी आर आर में राइस रिर्चमाइच्छराइजिंग लोशन और राइस रिर्च पेन रिलीविंग जल नामक दो चावल आधारित उत्पादन विकसित किये गये।

जैवप्रौद्योगिकी

- चेक की तुलना में ८५,६३ और २९उपज वृष्टि दर्शानेवाले प्रवेशित वंशक्रमों - आई.ई.टी. २२६२५ (स्वर्णा ओ.निवारा), आई.ई.टी २२६३२(के.एम.आर३ओ सफि पोगान) और आ.ई.ई.टी २२६२६ (के एस आर ३ ओ. सफिपोगान) को अखिल भारतीय समन्वित चावल सुधार कार्यक्रम (अ.भा.स.चा.सु.का) के ए एल एवं आई एस टीवीटी परीक्षणों के द्वितीय वर्ष के लिए प्रवर्दन किया गया।
- आई.आर ६४ की पृष्ठभूमि में काई। एसी के साथ बीटी ट्रान्सजेनिक धान के तीन ईवेटस (आई सी - ५, ए आई सी-ट और ए आई सी - ३) का प्रजनन किया गया और टी ६ पीढी के लिए प्रवर्तन किया गया और उनकी संतित को समयुग्म स्थिति में पाया गया। पीले तना छेदक के प्रति विस्तृत जैव-परीक्षण के उपरांत पहचान गये आट वंशक्रमों को जैव - सुरक्षा अनुसंधान स्तर परीक्षण - १ (बी आर एल - १) पर और अधिक परीक्षण किया जायेगा।
- बीपीटी ५२०४ की पृष्ठभूमि में एटी.डी.आर.ई.बी १५ (बीडी-३३, बीडी-३८ और बीडी-४५) जीन के साथ तीन पृथक ट्रान्सजेनिक राइस ईवेंट्स को विकसित किया और १२ उत्कृष्ट सूरवा सहय समयुग्म वंशक्रमों की पहचान की गयी जिनको टी ५ टी६ पीढी के लिए आगे प्रवर्तन किया गया। बहुत अधिक ट्रान्सजेनिक वंशक्रमों ने तीन सप्ताहों तक की उच्च स्तरीय सूखा सहायता दर्शायी।
- कुछ जीन ओ एस.एस.पी. एल १४ अपने आप में कुछ उच्च दाने उपज क्षमता से सम्मिलित पाये गये बल्कि किसी पृथक उपज घटकों के साथ सम्मिलित नहीं थी। इसके अतिरिक्त राशि और आई.सी.आई १४९२७ और ७० जननद्रव्य वंशक्रमों की मानचित्रण की जनसंख्या में इसजीन का मान्यकररण किया गया। वास्तविक समय पी.सी.आर अध्ययनों से पाया गया कि केवल उच्च उपज जीनोटाइपों की ओएस एसपीएल १४ बालियों में ही अधिक अभिव्यजना होती थी।
- जिलै टिनाइजेशन टेंपरेचर (जी टी) के लिए ३०.७ फेनोटाइप भिन्नता का योगदान देनेवाले एक प्रमुख क्यू.टी.एल. पहचान गया और आर.एम २१७ (४.२ एम.बी) - आर.एम १९५६२ चिहनकों के अंदर करीब। एम.बी.स्थान में उत्कृष्ट मानचित्रण किया गाया इस क्यू.टी.एल. के द्वारा अनेक जपोनिका जनसंख्या में दर्ज किये गये वाक्सी लोकस के समान अपने स्थान के संबंध में भिन्नता दर्शायी गयी।
- १४ प्रायोगिक संकरों में से सही ढंग से अनुमेय विषम युग्मन में सक्षम दस प्रधान सूचनात्मक ई.एस.टी-एस.एस.आर चिहनकों की पहचान और मान्यकरण किया गया। प्राथमिक स्तर पर पैतृक वंशक्रमों की छटाई के लिए जी.ए.टी.ए मूल मो.टि.फी को बहुत अच्छा माना गया।
- ए.टी.पी ६ के रिपीट प्रजेंट अपस्ट्रीम जीन को लक्ष्य बनाते हुए एक (ए.टी)६ डी.आर.आर.सी. एम.एस.नामक एस.एस.आर रिहनक का विकास किया गया जो धान के डब्लयू. ए-सी.एम.एस. वंशक्रमों को अपने अनुरक्षकों से विशिष्ट रुप से प्रभेदित करते है और इस चिहनक का उपयोग करते हुए डब्लुयू ए-सी.एम.एस वंशक्रमों के बीजों

की शुध्दता को शीघ्र और विश्वसनीय आकलन के लिए एक पारख अभिकल्प का विकास किया गया है।

- तेइपाय-३०९, आई.आर-६४ और बी.पी.टी. की पृथ्वी भूमि में आर.एन.ए.आई-आर.टी.एस.वी-सीपी कंस्ट्रकट के साथ रुपांतरण द्वारा तिरपन ट्रान्सजेनिक वंशक्रमों का विकास किया गया। कोट प्रोटीन विशिष्ट जीन प्राइमर्स का उपयोग करते हुए इन का पी.सी.आर पर विश्लेषण करने पर टी, के स्तर पर पाजिटिव के रुप में पुष्टि मिली।

फसल उत्पादन

सस्य विज्ञान

- अनेक अध्ययनों से पाया गया कि अनाज उपज के संवंध में पारंपरिक विधि की तुलना में चावल सधनीकरण प्रणाली (एस.आर.आई) अपने निष्पादन में उत्कृष्ट है। फसल की कालावधि कम होने के कारण चावल सधनीकरण प्रणाली (चा.स.प्र) की प्रति दिन की उपज अधिक है। अपनी अधिक अंत भूस्तरियों की क्षमता के कारण चा.स.प्र.में संकर धान अच्छा प्रदर्शन दिखाया दोनों मौसमों में बी.एम.पी. उपचार की तुलना में तथा सूक्ष्मजीव जैव-द्रव्यमान कार्बन (एम.बी.सी) भी बहुत अधिक मात्रा में चा.स.प्र-जैविकी में (क्रमश ११-१८ और ३४-३८) और चा.स.प्र. में (क्रमश १९-५० और ६-३४) उपलब्ध है।
- संसाधन संरक्षण प्रौद्योगिकी अध्ययन से पाया गया कि नमी से शराबोर प्रणाली अवस्था में घास पात से नहीं ढकने से धान फसल की उत्पादन में महत्वपूर्ण बढोत्तरी हुई। पारंपरिक जुताई (सी.टी) के लिए ५.२४ १०३ एम.जे.की शक्ति की आवश्यकता है जबकि आवर्तक जुताई (आर.टी) या शून्य जुताई (जड.टी) के लिए आवश्यक शक्ति को क्रमश ६२.५ और ८७.६ कम किया जासकता है फसल शायक समस्या को गीली बु आई धान (डब्ल्यू.एस.आर) की विधी की धैंचा खेती की प्रणाली द्वारा उत्पादकता में किसी प्रकार की कमी के बिना, हल किया जा सकता है।
- वायुजीवी धान की प्रणाली में पयोग किये जानेवाले मानकीकृत उर्वरक विभाजन प्रयोग की तुलना में अनुमोदित नत्रजन की मात्रा के ४ विभाजनों में प्रयोग किया जाय तो पर्याप्त होगा। वे विभाजन निम्नानुसार हो १४ भाग स्थापना के १०-१२ दिनों के बाद १४ सक्रिय अंतःभूस्तरियों के निकलने की अवस्था (ए.टी) पर १४ बाली निर्माण आरंभ (पी.आई) की अवस्था पर १४ पुष्पण की अवस्था पर या १४ जुताई की अवस्था पर सक्रिय अंतःभूस्तरियों के निकलने की अवस्था पर १४ बाली निर्माण आरंभ की अवस्था पर १४ पुष्पण की अवस्था पर हो।
- उन्नत वंशक्रमों (अगेती और और मध्यम अदेती अवधि के) के परीक्षण के द्वारा, वायुजीवी अवस्था में, अधिक उपज के संबंध में आशाजनक संवर्धो-आर.पी. ५२१३-६९-१३-७-४-१-२, एल.टी५०, आर.पी. ५२१४-३८-१४-९-५-२-१-बी, ५२१८-४९-१३-९-२१-१-बी, ए.आर.पी १, ए.आर.एस२, ए.आर.एच ५, ए.पी.आर२ और ए.आर.एच.४ की पहचान की गयी।
- शाकनाशी (बोआई के ३-४ दिनोंके १ कि.ग्रा सक्रिय तत्व हे की दर से) और उसके साथ बुआइ के १५ और ३० दिनों के उपरांत बिसपाइलिबैक-सोडियम ३५ ग्रा या बोआई के २५-३० दिनों के बाद क्लोरिमुरोन मेटसुलफरोन मेथिल ४० ग्रा.स.त हे, का प्रयोग उपतृण की सांद्रता को कम करने में प्रभावी पाया गया और अधिक उपज दर्ज हुआ।

मृदा विज्ञान

- पौदा की वृध्दि बो आई के धनत्व की विविधता और पोटैश के प्रयोगने फसल की वृध्दि और उत्पादकता को प्रभावित किया। जीनो राइप ने पौदशाला प्रबंधने के अनुरुप अपनी प्रतिक्रि या में भिन्नता दर्शायी-वरधान किस्म और संकर पी.ए६४४४ ने पोटैश के प्रयोग के साथ कम धनत्व की अवस्था में उच्च पौद-ऊजा दर्शायी।
- वर्मीकंपोस्ट (५टन हे), वास्तविक समय नत्रजन प्रयोग, पोटैश और कैल्शियम की अतिरिक मात्रा का प्रयोग और पुष्पण अवस्था पर बोरोन के छिडकाव द्वारा दाने की उपज में १५-२४ वृद्दि पायी गयी और पोषक तत्वों (एन.पी.के.) के संययन में १२-३८ वृध्दि हुई।
- फसल वर्धन नमूना द्वारा पूर्वानुमानित १८ किस्मों (९०-१५० दिनों की अवधि) की उपज सामर्थ्य (४.१-६.६ टन हे) और अनुमोदित उर्वरक प्रयोग के साथ वास्तविक उपज में उपज अंतर २.० ट हे से अधिक पाया गया।
- जीनोटाइप और नत्रजन प्रयोग के स्तरों के बीच महत्वपूर्ण अन्योन्य क्रिया प्रभावों के साथ साथ साधारण उपज २.७-४.४ ट / हे की तुलना में नत्रजन प्रयोग के प्रति धान के जीनोटाइप की औसत प्रतिक्रिया खरीफ मौसम में १.४-२.१ ट / हे और रबी में ३.१ ट / हे पाया गया।
- खरीफ और रबी दोनों मौसमों के दौरान अनेक एन.यू.ई सूचकों के अधीन परीक्षण जीनोटाइपों के प्रदर्शन के आधार पर, अगेती अवधि के लिए के.आरर.एच २, आर.पी.बयो-४९१८-२४८,आर.पी.बयो ४९१९-४५८ और अक्षय धान और लंबी अवधि के लिए स्वर्णा को
- नत्रजन उपयोग और अनुक्रियाशीलता के संबंध में बडा आशाजनक के रुप में मूल्यांकित किया गया।

- एन२ओ उत्सर्जनों पर नत्रजनीकरण प्रवरोधिके नीम के वावरण युक्त यूरिया (एन.सी.यू) और डाइसिंडियामिड (डी.सी.डी) के प्रभाव का अध्ययन किया गया । यूरिया डी.सी.डी. के साथ के प्रयोग से एन२.ओ.हनि (४१) का प्रवरोधिन दर्ज हुआ । जब आमोदित नत्रजन की मात्रा के लिए डाइसिया –नडियामिड (डी.सी.डी) यूरिया का प्रयोग किया गया तो अधिकतम अनाज की उपज (६.६ २ हे) प्राप्त हुई जो नियंत्रित यूरिया की तुलना में १ ६ अधिक है ।
- डिस्सिमिलेटोरी नाइट्रेट रिडकटेस एफिटविटी (डी.एन.आर.ए) को बढाने के द्वारा डीनाइट्रिफिकेशन हानि को कम करने और एन.यू.ई.के. बढाने के प्रयास में विविध मृदाओं से नाइट्रेट अम्मोनिफइंग जीवाणुज आइसोलेट को पृथक किया गया । इनको जैवरासायनिक लक्षणों के आधार पर इनटेरो बैकटीरिया परिवार से संबंधित पाया गया और एन.आर.एफ.ए. जीन का उपयोग करते हुए और इन की डी.एन.आर.ए. गतिविधि के और अम्मोनिफिकेशन गतिविधि का मूल्यांकन किया जा रहा है ।
- एत धान की किस्म स्वर्णा बीज के उपनिवेशन (निशेचन संचयन के लिए) लेवन (स्टेइन पी.ए.एल ५) उत्पादक एक प्रसिध्द अंतपादपीय जीवाणुज उपनिवेशक ग्लूको नसेटोबैक्टर डयाजोट्रोफिकस का टीका लआने पर जडों और शाखाओं की लंबाई को सात दिनों के बाद ३.८ और ६.४ अंकुरण परीक्षण में ५.२ ओज सूचकांक में बढोत्तरी हुई और अजैविक तनावों के प्रति सहयता प्रदान करने में सहायक ताजा निशेचन पादप पदार्थ के लगभग २०० यूजी ग्रा का संचयन हुआ ।

पादप क्रियाविज्ञान

- अल्प, मध्यम और लंबी अवधि के एच.वाई.वी. और संकरों में प्रत्येक के ३ पादपों पर सोर्स सिंक किया गया । यह अंदाज लगाया गया था कि ९ ट / हे अनाज प्राप्त करने के लिए लीफ एरिया इंडेक्स ७, प्रकाश संश्लेषज (ए) की दर २२-२५ (एम एम ओएल.एम२.सेकंड) प्रस्वेदन (टी) दर १०-१२ एम.एम.ओ.एल. एम२.सेकंड परिवेशी की तुलना में पत्र तापमान की भिन्नता - १ सी, ए टी अनुपात १.९ - २.०, कार्बोजिलेशन दक्षता ०.०९ और सी.जी.आर ५०-६० १११एम२ सप्ताह की आवश्यकता है ।
- १०७ विभिन्न धान जीनोटाइपों का पत्र प्रकाश संश्लेषण दक्षता का माप किया किया गया उनके प्रकाश संश्लेषण में १८.६ माध्यम (यू.एम.ओ.एल (सी ओ २) एम २ एस) के साथ ६.९८ (टी.ने.पी-२०) से ३२.४ (ई २७२९) ०.४४१ (एम ओएल (एी२ ओ) एम -२ एस -१) माध्यम के साथ जी एस १.० (जया) से ०.१३३(एस.ओ.एम.सी.ए.यू ७०ए) और ०.७४६ माध्यम के साथ सी आई सीए अनुपात ०.८६२ (यूएस-३८२) से ०.५९२ (टी.जे.पी-१९१) तक भिन्नता पायी गयी ।
- दो क्रिमक वर्षों में, चालीस अनुरक्षक वंशक्रमों, २ ए वंशक्रमों, ४ बी वंशक्रमों और ६ विमोचित संकर धानों का खेतों में अपने १८ लक्षणों के लिए मूल्यांकन किया गया ।
- तापमान और कार्बोनडाइआक्साइड के प्रति धान की प्रति क्रिया का अंदाज लगाने के लिए ओरिजा प्रणाली २००० का उपयोग करते हुए प्रयोग किया गया । यह अंदाज लगाया गया कि विविध भौगोलिक स्थानों पर ६० सें की वृध्दि होने पर धान की उपज में २७ से ५० तक कमी हुई जबकि कार्बोन डाइआक्साइड की वृध्दि के कारण धान की उपज में बढोत्तरी केवल १-३ हुई जिससे धान की फसल की भेधता का पता चलता है ।

हिन्दी गतिविधियाँ

- तिमाही बौठकों का आयोजन : हिन्दी में कार्यकलापोंका जायजा लेने के लिए विगत वर्ष में तीन बौठकों 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 उपयोग करने के लिए हिन्दी कार्यशालाओं (जुलाई, आगस्त माह) 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 : इस निदेशालय द्वारा १४ सितंबर, २०१२ से २१ सितंबर २०१२ तक हिन्दी सप्ताह का आयोजन किया गया जिसका उद्घाटन परियोजना निदेशक महोदय ने किया। इस सिलसिले में कई कार्यक्रमों का आयोजन किया गया ।

All India Coordinated Rice Improvement Programme (AICRIP)

Ten hybrids *viz.*, US382, Arize Tej, PNPH24, 27P31, 27P61, 25P25, RH1531, JKRH3333, NPH924-1 and CO4 and two varieties (NDGR201 and CR Sugandh Dhan907) by CSCSNRV and one hybrid (Arize Dhani) and 20 varieties in nine states for SVRCs were released for different ecologies.

Crop Improvement

- Thirty-six varietal trials, one screening nursery and five hybrid rice trials with 1090 entries including checks were conducted during *kharif* 2012 as 771 experiments at 110 locations (47 funded, ~90 voluntary centers) in 27 states and two Union Territories spanning over all the five regions of the country. Fifty promising entries were identified.
- Seven hundred eighty three elite lines belonging to 14 different INGER Observational Nurseries were evaluated at 78 locations and 60 promising lines were identified.
- Four hybrid rice trials, one multi-location trial with 105 hybrids were conducted at around 30 locations and 10 promising hybrid combinations were identified.
- Breeder seed production of 233 varieties and parental lines of 11 rice hybrids was organized at 39 centers across the country and a total of 11,436.31 quintals of breeder seed was produced against the DAC indent of 5,267.05 quintals.

Agronomy

- Evaluation of 76 elite genotypes belonging to 16 categories for their response to nitrogen led to the identification of 22 suitable cultures based on the Grain Yield Efficiency Index values.
- Intercropping with soybean / cowpea / urad bean (4:2 in replacement series) and integrated weed management through pendimethalin @ 0.75 kg a.i. / ha (pre-emergence) + hand weeding at 25 days after sowing proved promising for enhancing overall productivity of rainfed rice.
- In aerobic rice, optimum sowing time was noted as 10th June with seed rate of 30 - 35 kg/ha planted closely (20 cm) to realize higher yields. The optimum dose of nitrogen *i.e.*, 120 kg N/ha when applied in 4 splits (¼ 10-12 DAE + ¼ AT stage + ¼ at PI stage + ¼ at flowering) saved 25% N over 3 splits.
- Use of 10-day old seedlings and optimum spacing (25 x 25 cm) were found critical and effective in increasing grain yield in SRI method.
- Herbicides such as pendimethalin @ 1 kg a.i. /ha or butachlor @ 1.5 kg a.i. / ha at 3-4 DAS with Bispyribac Sodium 35g a.i. at 15-20 DAS or chlorimuron + metsulfuronmethyl 40g a.i. / ha at 25-30 DAS for aerobic rice situation, penoxsulam + cyhalofop-butyl @ 135g a.i. / ha and 25g a.i / ha for transplanted rice; flucetosulfuron @ 20 or 25g a.i. / ha or penoxsulam + cyhalofop-butyl @ 120 or 135g a.i. / ha, and bispyribacsodium + metamifop @ 70g a.i/ha along with wetter for direct seeded transplanted situation were found to be effective for weed management.
- Soil application of organic manure + NPK + micro-nutrients was promising as compared to application of NPK alone in different rice based cropping systems.

Soil Science

- The results of 24th year of study showed that supplementary application of 5 t/ha FYM along with recommended fertilizer dose (100% NPKZnS) was superior among all the treatments at Maruteru and Titabar with positive growth over time and with corresponding increase in nutrient accumulation and improvement in soil nutrient status and organic carbon.
- Current fertilizer practice was fine tuned for targeted yields in farmers' fields around Titabar, Mandya, Sirsi and Maruteru. Farmers' fertilizer practice produced significantly lower yields than with recommended dose of fertilizer (RDF) by 26 - 194%. The estimated fertilizer doses for yield targets of 6 t/ha varied substantially between the sites and from RDF.
- In acidic and sodic soils, complementing recommended NPK and micronutrients (Zn, Fe, Mn, B and Si) with organic manuring increased rice grain yields and nutrient uptake.
- About 230 cultures were screened to study the influence of environment on micronutrient content in brown rice. Grain yield was negatively correlated with Fe content at Khudwani, while it was negatively correlated with Zn content at Faizabad, Mandya and Moncompu. Several promising cultures for high Fe and Zn content (Aghonibora, China 1039, WGL 14377 and Borgathu) were found to be location specific.
- Irrigation equivalent to 100% of cumulative pan evaporation (CPE) saved about 10% irrigation water under aerobic cultivation at Mandya and 20% at Kanpur but with yield penalty. The NPK uptake requirement at Kanpur and Mandya was estimated to be 17.8, 5.3

and 20.3 and 15.9, 4.7 and 8.4 kg per tonne of grain production, respectively.

- Delayed crop establishment in *kharif* season resulted in loss in crop productivity which could be avoided by integrated nutrient management of organic manuring and application of all essential nutrients.
- Promising cultures for acidic soils *viz.*, IET 21009 and IET 21542 at Moncompu; IET 20884 and IET 21510 at Ranchi; IET 21477 and IET 22081 at Sirsi; Aghonibora, Prafulla and IET 20884 at Titabar were identified.
- Nutritional status of rice soil in farmers' fields was found to be highly imbalanced and did not match with the crop nutrient requirements.
- Study on nutrient requirement of recently released varieties and hybrids indicated that the estimated nutrient uptake requirements for the highest yields of hybrids and HYVs across the locations ranged from 14.3 – 30.1 kg N, 0.6-39.4 kg P_2O_5 and 6.7 – 68.4 kg K_2O. Hybrids yielded more than the HYVs by 14 - 24% in all the centers.
- Studies on partitioning of Zn and Fe in rice showed that most of the Fe and Zn taken up was retained in straw (70-90%) with only 10-30% translocated to grain. Application of organic manures along with micro nutrients improved grain nutrition and yield.

Plant Physiology

- Photothermic Indexing experiments were conducted at seven locations with 34 cultures with 15 days early sowing and normal sowing so as to expose the crop to differential photo thermal periods. IET 20924 maintained its relative photo sensitivity characteristic for the third consecutive year confirming its uniqueness of associating with sowing and critical photothermal period at grain filling, PI and 50% flowering stages, respectively.
- Radiation use efficiency (RUE) studies identified IET 20924, IET 22218, IET 22569, RP 4918-16630 and DRRH-3 to be superior with respect to RUE and total dry matter production.
- The hybrid PA6444; and cultures IET 221116, IET 22218, IET 21577, IET 21411 and popular varieties MTU1010, IR64 showed tolerance to post-anthesis high temperature, among the 22 entries evaluated for terminal heat tolerance with imposition of heat stress at panicle initiation stage.
- Of the 72 rice cultures assessed for drought tolerance, eight entries (IET 23344, IET 22767, IET 22744, IET 22061, IET 23377, IET 23381, IET 23345 and IET 22747) were found suitable for upland rainfed situations on the basis of drought indices (DSI and YS) and grain yields.

Entomology

- A set of 2229 entries was evaluated against 12 insect pests in 380 tests at 43 locations. Genotypes were identified as promising against individual and multiple pests of which eight entries were under retesting.
- Ptb33 (*bph2+Bph3*+unknown factors) was promising against BPH at all locations whereas IR65482-7-216-1-2-B (*Bph18)* and IR710333-121-15 (*Bph20+Bph21)* were promising at two locations each.
- Resistance conferred by *Gm1*, *gm3*, *Gm8* genes was effective against several of the gall midge biotypes.
- Evaluation of new insecticides revealed that sutathion, a new formulation of triazophos was effective against stem borer and gall midge whereas sulfoxaflor was effective against planthoppers.
- There was no adverse impact on the performance of the two newer insecticides (buprofezin + acephate and sulfoxaflor 24% SC) when applied alone or in combination with fungicides (hexaconazole and tricyclazole) confirming the compatibility of the chemicals when used as tank mix in the field.
- The incidence of stem borer, hispa, plant and leaf hoppers was low whereas leaf folder incidence and grain yield was high in direct seeded rice as compared to normal transplanted crop. Late planting of rice resulted in high incidence of major insect pests except BPH/WBPH as compared to early and normal plantings.
- Four stem borer species, two leaf folder species *viz.*, *C.medinalis* (80%) and *Marasmia* sp. (20%) and mixed populations of BPH and WBPH were recorded at different locations.
- Non-pesticidal methods such as increasing floral diversity and augmenting egg predators as components of ecological engineering resulted in reduction of planthopper populations and increased natural enemy populations.
- A significant negative correlation between i) grain yield and per cent white ears and ii) grain yield and number of leaf folder larvae and damaged leaves was observed.
- Integrated Pest Management resulted in lower pest incidence, higher grain yield and high benefit cost ratio compared to farmers' practice.

- Population monitoring of insect pests through light trap collections recorded yellow stem borer, gall midge and BPH as the main insects.

Plant Pathology

- In all 548 trials were conducted at 52 locations on host plant resistance, field monitoring of virulence of blast and bacterial blight pathogen, disease observation nursery and disease management.
- In various screening nurseries (NSN 1, NSN 2, NSN H, NHSN and DSN), many of the test entries were showing resistance against more than two major diseases. The promising IET Nos. were 22486, 22379, 22531, 21953, 22592, 22753 and 21341, in NSN 1; IET Nos. 22494, 23004, 23149, 23147, 22637, 23001, 23049, 23155, 22437 and 23078 in NSN 2; IET Nos. 21741, 21751, 22270, 22286, 22954, 22959, 22964, 22974, 22978, 22984 and 22985 in NSN H; IET Nos. 22874, 22875, 22894, 22898, 22902, 22905, 22910, 22917, 22919 and 22920 in NHSN; Ajaya, BAU / IRRI497, CB05 – 031, CH45, GSR101, GSR104, GSR105, GSR111, GSR112, GSR113, GSR126, GSR127, GSR130, GSR138, GSR140, GSR141, GSR142, K014, Nidhi, RP Biopatho3, RP Patho10, RP Patho12, RP Patho2, RP Patho6, RP Patho7, RP Patho8, RP Patho9, Tetep, VL31289, VL31598, VL31611, VL31716 and VL8654 in DSN.
- Screening of 915 germplasm accessions against six diseases (blast, sheath blight, bacterial blight, brown spot, sheath rot and tungro) at 11 locations in the country identified the promising accessions *viz.*, Acc. numbers 450165, 459639, 459652, 17089, 450386, 450465, 450400, 461808, 450516, 544868 and 450052 against sheath blight; Acc. nos 449829, 86009, 449948, 450296 and 449668 against blast disease; Acc. nos 450305, 461160, 461818, 449553, 449798 and 545470 against BLB and Acc. nos 346207, 450632 and 450123 against brown spot.
- Field monitoring of virulence in *Pyricularia grisea* (Blast) populations across 21 locations with 25 cultivars revealed that the pathogens collected from all these locations could be classified into four major groups. Similar virulence study on *Xanthomonas oryzae* pv. *oryzae* with 21 near isogenic lines (IRBB lines) carrying different bacterial blight resistance genes and their combinations and different checks at 20 hot spot locations across the country showed that entries having single resistance gene were found susceptible at most of the locations. BB resistance gene *xa13* was found ineffective at six locations, while *Xa21* was ineffective at 10 locations. The *xa13 + Xa21* combination was not effective at Kaul, Patna, Maruteru and Raipur.
- Disease observation nursery trial conducted at 10 locations recorded prevalence of leaf blast, neck blast, brown spot, sheath rot and bacterial blight disease across location with increased severity in delayed planting whereas sheath blight severity was high in the early sown crop.
- Application of trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) 0.4 g/l reduced the mean disease severity of leaf blast, neck blast, node blast, brown spot, leaf scald, false smut and grain discolouration across the locations and simultaneously increased the yield.
- With respect to bio-control trial both talc and liquid formulations of *Pseudomonas fluorescens* performed on par and reduced the disease severity of blast, sheath blight, sheath rot and brown spot.
- False smut disease infection was reduced by spraying of propiconazole 25 EC (Tilt @ 1.0ml/l) at 50% PE stage (9.98) which was on par with trifloxystrobin 25% + tebuconazole (Nativo 75WG @ 0.4g/l) at 50% PE stage (10.68) compared to control (21.30). In case of spikelet infection, spray of trifloxystrobin 25% + tebuconazole (Nativo 75WG @ 0.4g/l) at 50% PE stage reduced the infection (6.48) which was on par with the spray of propiconazole 25 EC (Tilt @ 1.0ml/l) at booting stage (6.56) compared to control (11.02).
- The Production Oriented Survey conducted in 16 rice growing states highlighted severe damage to rice crop on 4-5 lakh hectares in AP due to 'NILAM' cyclone in the first week of November. The diseases like blast (both leaf blast and neck blast), brown spot, sheath blight, sheath rot, false smut, grain discolouration and bacterial blight were widely prevalent across different states. Bakanae was a major problem in Punjab and Haryana especially on basmati varieties. Incidence and moderate to severe damage by insect pests like leaf folder and BPH/WBPH was reported. Panicle/leaf mite was recorded in Andhra Pradesh and many parts of Gujarat.

Transfer of Technology

- In all, 572 FLDs for evaluation and demonstration of various rice production technologies were conducted covering 14 states and five rice ecosystems of the country.

Lead Research

Crop Improvement

Plant Breeding

- The culture IET 22080 (RP 5125-5-9-1) (IR83876-B-F_3 Bulk) with 26.52, 38.41 and 12.49% yield advantage over Sahbhagi Dhan, regional check and local check, respectively, was identified for release in Tamil Nadu, Puducherri, Kerala and Karnataka by Varietal Identification committee during 48th ARGM.
- Another entry, IET 22081 (RP5127-9-3-IR93376-B-B-130) with 28.5, 34.2 and 20.2% yield advantage over Sahbhagidhan, regional check and local checks has also been identified for release in the states of Uttrakhand, Haryana, Bihar and Odisha by Varietal Identification Committee**.**
- Ten new plant type cultures developed by introgressing traits from tropical *japonicas viz.*, FGR21-17, FGR21-22, FGR22-27, FGR21-23, FGR22-56, FGR22-46, FGR23-82, FGR23-11, FGR24-8 and FGR23-3 recorded more than 20% yield advantage over the popular varietal checks (Jaya, NDR359, Swarna, Sampada and Dhanrasi).
- Three elite cultures developed for boro season have been nominated from RAU, Pusa and are being tested for the first time in IVT Boro 2013.
- More than 30 RILs from different crosses exhibiting high degree of resistance against BPH (damage score <3) under severe infestation leading to complete mortality of susceptible checks and test materials at hot spot location (Maruteru) were identified.
- Six genotypes: GSR103, GSR109, GSR111, GSR125, SM363 and SM686 were found tolerant to low P conditions wherein majority of the genotypes failed to survive.
- Out of 600 genotypes evaluated under direct seeded conditions, ASG73 (5107 kg/ha), ASG1 (4893 kg/ha), ASG235 (4893 kg/ha), ASG33 (4786 kg/ha) and ASG30 (4750 kg/ha) from aromatic short grain group exhibited superior performance and can be used as donors for developing genotypes suitable for conservation agriculture.
- Of the 1100 genotypes of diverse origin screened against sheath blight, 38 genotypes recorded disease score of 3.
- Eighteen lines in the background of Taraori Basmati and Basmati 386 introgressed with three BLB genes (*Xa21*, *xa13*, *xa5*) exhibited high level of resistance against BLB under stringent screening.
- From the crosses wherein one traditional aromatic short grain parent was involved, more than 3000 promising segregants of different generations possessing high yield attributes such as high grain number, more panicle weight with sturdy stem and semi-dwarf stature were selected.
- One fixed line derived from the cross BPT 5204/ Chittimutyalu with medium slender grain, high yield and high Fe and Zn (11.8 and 38.8 mg/kg) was identified for inclusion in AICRIP trial on biofortification.
- In the process of comparing and standardizing amylose content estimation protocols, it was found that ethanol is not a necessary reagent.
- Two rice based products with rice bran oil as ingredient namely 'Rice Riche Moisturizing lotion' and 'Rice Riche Pain Relieving gel' were developed for the first time in India at DRR.

Hybrid Rice

- In a station trial, of the 36 hybrid combinations evaluated, six promising ones were identified for seed production and evaluation. 100 paired crosses and 20 varietal crosses were made for further evaluation. Of the 650 test crosses evaluated, 15 promising test crosses were identified for further evaluation.
- Five promising TGMS lines were evaluated under different temperature regimes to find their fertility behaviour. Fifteen promising lines were identified and utilized in hybridization, 95 single plant selections were made from the breeding materials utilizing Tropical *japonicas* with restorers
- Out of 420 hybrids generated and evaluated for restoration ability, 20 restorers and 4 maintainers were identified for abiotic stress. Two hybrids found suitable for aerobic conditions *viz.*, IR58025A/ L2182, IR58025A/ ABHR65-R1207-SV25-4-1R (3005) and one for salinity *viz.*, IR58025A/363-12 were identified.
- 105 genotypes were screened for fertility restoration with *Rf* markers and restorers with resistance to biotic stress are being developed using donors for BLB (*Xa 21*, *Xa33*), Blast (*Pikh*), BPH (*Bph 18*, *20* and *21*) with RPHR1005, RPHR1096, RPHR1004 and IBL57. F_2 populations were genotyped for S_5 MMS. DRCP102 restorer and DRCP105 maintainer GMS population crossed with donors of biotic resistance and were in fourth cycle of recurrent selection.
- 650 entries in source nursery evaluated for test crossing, 28 maintainers were identified and subjected to BPH screening, one entry TCP 211 was found to be

moderately resistant. Ten crosses were attempted for maintainer improvement with low stigma exertion with high stigma exertion donors and also evaluated for parental polymorphism with HRM markers.

Biotechnology

- Intogression lines, IET 22625 (Swarna / *O. nivara*), IET 22632 (KMR3 / *O. rufipogon)* and IET 22626 (KMR3 / *O. rufipogon*) showing 85, 63 and 29% yield increase over best check were promoted to 2nd year of testing in AL&ISTVT trial of AICRIP.
- Three events (IC-5, AIC-2 and AIC-3) of Bt transgenic rice with *Cry1Ac* in the background of IR64 were generated and advanced to T6 generation and the progenies were observed to be in homozygous condition. Eight of the lines identified through extensive bioassay against yellow stem borer will be further subjected to Biosafety Research Level Trial – 1 (BRL-1).
- Three independent transgenic rice events with *AtDREB1A* gene (BD-33, BD-38 and BD-45) in the background of BPT5204 were developed and 12 best drought tolerant homozygous lines were identified which were advanced up to T5/T6 generation. Most of the transgenic lines showed high level of drought tolerance up to three weeks. Two or three lines will be promoted to Biosafety Research Level-1 (BRL-1) trials with the permission of RCGM/GEAC.
- Fifty three transgenic lines developed through transformation with RNAi-RTSV CP construct in the background of Taipei309, IR64 and BPT5204 were confirmed as positive at T1 based on PCR analysis using coat protein specific gene primers.
- In the germplasm screening, *OsSPL14* (SQUAMOSA PROMOTER BINDING PROTEIN LIKE) gene has been found to be associated with higher grain yield per se, but not with any individual yield component. Further, this gene was validated in a mapping population of Rasi and IC114927. Real time PCR studies showed over expression of OsSPL14 only in panicles of high yielding genotypes.
- A major QTL (*qGT-6*) which contributes 30.7% phenotypic variance for Gelatinization Temperature (GT) was identified and fine mapped to around 1Mb region within the markers RM217 (4.2 Mb) - RM19562. This QTL differed in its location from the reported QTL like Waxy locus, which was reported in many *japonica* populations.
- Ten 'key informative' EST-SSR markers capable of accurately predicting heterosis were identified and validated in a set of 14 experimental hybrids. Four EST markers targeting GATA motif were rated as very good for preliminary sorting of parental lines.
- A SSR marker named *drrcms* targeting (AT)6 repeat present in the upstream of *ATP6* gene was developed which is distinguishing WA-CMS lines of rice from their maintainers and using this marker, an assay has been designed for rapid and reliable estimation of purity of seeds of WA-CMS lines.

Crop Production

Agronomy

- More studies confirmed SRI performance to be better in terms of higher grain yield over conventional method across the cultivars. Per day productivity was higher in SRI due to reduced duration of the crop. Hybrids performed well under SRI due to their better tillering ability. Soil dehydrogenase and microbial biomass carbon (MBC) were also found significantly higher in SRI-organic (11−18% and 34−38%, respectively) and SRI-inorganic (9−50% and 6−34%, respectively) treatments over BMP in both seasons.
- Resource conservation technology studies indicated that mulching could significantly improve rice crop yield over no mulching under saturation moisture regime. Conventional tillage (CT) required 5.24 x 10^3 MJ energy which could be reduced by 62.5 and 87.6 % with rotary tillage (RT) or zero tillage (ZT), respectively. Crop lodging problem was reduced with dhaincha cultivation in alleys of wet seeded rice (WSR) without affecting productivity.
- Application of recommended nitrogen dose was found to be sufficient when applied in 4 splits (¼ at 10-12 days after establishment + ¼ at active tillering (AT) stage + ¼ at panicle initiation (PI) stage + ¼ at flowering or ¼ basal + ¼ at AT stage + ¼ at PI stage + ¼ at flowering stage as against standard split application in aerobic rice system.
- Screening of advanced lines (early and mid-early duration) identified promising cultures in terms of higher grain yield in aerobic situation: RP5213-69-13-7-4-1-2, LT50, RP5214-38-14-9-5-2-1-B, 5218-49-13-9-2-1-1-B, ARP1, ARH2, ARH5, APR2 and ARH4.
- Application of herbicides (pendimethalin @ 1 kg a.i. / ha within 3-4 DAS) with bispyribacsodium 35 g at 15 and 30 DAS or chlorimuron + metsulfuronmethyl 40 g a.i. / ha at 25-30 DAS was effective in reducing weed density and resulted in better yields.

Soil Science

- Seedling growth, manipulated by varying density of sowing and P application, influenced crop growth and productivity. Genotypes differed in their response to nursery management - variety Varadhan and hybrid PA 6444 showed higher seedling vigour at low density and with P application.

- Grain yield could be enhanced by application of vermicompost (5t/ha), real time N application, additional dose of P and K and spraying of boron at flowering stage by 15 – 24% and resulted in enhanced nutrient (NPK) accumulation by 12 – 38%.
- Potential yields of 18 varieties (90–150 days duration) predicted by crop growth model (4.1 – 6.6 t/ha) and actual grain yield with recommended fertilizer practice (2.6 – 11.0 t/ha) showed a yield gap of > 2.0 t/ha.
- Average response of rice genotypes to N application ranged from 1.4 – 2.1 t/ha over the base yield of 2.7-4.4 t/ha during *kharif* and 3.1 t/ha in *rabi* season with significant interaction effects between genotypes and N levels.
- Based on the performance of test genotypes under several NUE indices during both *kharif* and *rabi* seasons, Rasi and Tulasi in early duration; KRH2, RPbio4918-248, RPbio4919-458 and Akshayadhan in medium duration and Swarna in long duration group were rated as most promising in N utilization and responsiveness.
- Impact of nitrification inhibitors neem coated urea (NCU) and Dicyandiamide (DCD) on N_2O emissions showed highest inhibition of N_2O loss (41%) with urea + DCD. The application of DCD + Urea with recommended dose of N produced highest grain yield (6.6 t/ha) with 16% more over control urea.
- In an attempt to reduce denitrification loss and improve NUE through increasing dissimilatory nitrate reductase activity (DNRA), six isolates of nitrate ammonifying bacteria isolated from different soils were biochemically characterized as belonging to *enterobacteriaceae* family and are being evaluated for DNRA activity using *nrfA* gene and for ammonification activity.
- *Gluconacetobacter diazotrophicus*, a known endophytic bacterial colonizer producing levan (Strain PAL 5), when inoculated to colonize seed of Swarna variety (for fructan accumulation) improved root and shoot length by 3.8% and 6.4% and vigour index by 5.2% in the germination assays after 7 days and accumulated around 200 µg of fructans / g fresh plant material suggesting the prospects of imparting tolerance to abiotic stresses.

Plant Physiology

- Source–sink potential relationships were worked out in three of short, medium and long duration HYVs and hybrids. It was estimated that to achieve 9 tonne/ha grain yield, leaf area index needed was 7, rate of photosynthesis **(A)** at 22-25 (µmol/m^2/sec), Transpiration rate **(T)**10-12 m.mol /m^2/ sec, Ambient to leaf temperature difference -1oC, A/T ratio 1.9-2.0, carboxylation efficiency of 0.09 and crop growth rate 50-60 g/m^2/week.
- In order to identify better genotypes for improving biomass production, leaf photosynthetic traits were measured in 107 diverse rice genotypes. Photosynthetic efficiency varied from 6.98 (in TJP-20) to 32.4 (E-2729) with a mean of 18.6 [µmol (CO_2)/m^2/s], stomatal conductance (*gs*) 1.0 (Jaya) to 0.133 (SOMCAU 70 A) with a mean of 0.441[mol (H_2O) m-2s-1] and *Ci/Ca* (intra-cellular to ambient CO_2) ratio 0.862 (US-382) to 0.592 (TJP-191) with a mean of 0.746.
- For heat tolerance, forty restorer lines, two A lines, four B lines and six released hybrids were evaluated for 18 characters in field for two consecutive years. Hybrids and parents exhibited higher leaf rolling time with lower reduction in leaf area.
- Using Oryza model 2000 for prediction of temperature and carbon dioxide responses on rice, it was predicted that increased temperatures up to 6°C rice yields reduced by 27 to 50% across locations while the increase in rice yield due to carbon dioxide was 1-3% only, indicating the vulnerability of rice crop.

Crop Protection

Entomology

- New sources of gall midge resistance *viz.*, RCM10, IC466471, IC317651, RP4918-212(S), ADT39 mutant (CB07-540), HR-DRR01 and HR-DRR02 were identified.
- Of the 2200 entries evaluated, CR2689-3-2-1-2-1, CR3608-11-1-1-1, CR2815-2-4-2-1-1-1, Ptb33, KAUM166-2, IC Nos 17065, 86004 and Lalat were resistant to both planthoppers.
- The gene differentials, Ptb33 (*bph2*+*Bph3*+unknown factors), Rathuheenathi (*Bph3*+*Bph17*), RP2068-18-3-5 and RP Bio4918 (introgression line from *O.nivara*) had high level of resistance against BPH whereas two breeding lines IR65482-7-216-1-2-8 (*Bph 18*) and IR 71033-121-15 (*Bph 20 + BPh 21*) were susceptible.
- Two F_6 families of IR64*3 / *O.glaberrima* introgressed lines showed promising reaction against yellow stem borer with <13% white ear damage and good grain filling.
- Four entries *viz.*, Ptb12, W1263, LF293 and an introgressed line, 248(S) were promising against leaf folder with <7% damaged leaves.
- Rice cultivars *viz.*, Bala, N22, Ramakrishna, Annada, Aggani, INRC2489 and BG380-2 showed resistance reaction to rice root-knot nematode *Meloidogyne graminicola*.

- Field evaluation of insecticides against insect pests showed that rynaxypyr 20 SC was the best treatment against stem borer in terms of low pest damage and high yield followed by triazophos @ 500 g a.i. / ha.
- Fresh leaf extracts of wild lettuce and C*leome viscose;* seed oils *viz.*, pongamia and annona (0.2%) were effective against BPH nymphs causing 57-95% mortality whereas annona and pongamia seed oils were effective against leaf folder and recorded low feeding.
- Planting of flowering plants *viz.*, Cowpea, Lucerne, French marigold, African marigold, Bhendi and Gaillardia on the borders of rice fields increased parasitization of hopper eggs. The reduviid predator, *Rhynocoris fuscipes* was found to be effective against rice hoppers and lepidopteran insects.
- Field application of entomopathogenic nematodes (EPNs) reduced stem borer damage and brown planthopper population. EPNs were also found to infect rice hispa.
- GC-MS analysis of the pheromone glands of pink stem borer, *Sesamia inferens* revealed the presence of alcohol molecule as one of its active components.

Pathology

- Of 13,538 rice lines evaluated on uniform blast nursery beds against leaf blast, 817 lines were found to be resistant.
- Five hundred and eighty cultures from different sources were evaluated against bacterial blight and sixty two cultures showed resistance. Among the twenty four introgression lines (ILs) evaluated, eight entries were found to have a broad spectrum resistance to all the four isolates tested.
- Out of 68 N22 mutant lines screened for tungro virus disease, 15 lines *viz.*, 16, 86, 152-2, 219, 282, 360, 368, 406, 407, 418, 443-3, 444, 449, 685 and 756 showed moderate resistance reaction under the forced inoculation method. The major QTL *qRTV-7* is being introgressed into IR64 (BC_2F_2), BPT5204 (BC_2F_2), MTU1010 (BC_2F_2), ADT39 (BC_2F_2) and CR1009 (BC_1F_2).
- Application of trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) 0.4 g/l reduced the leaf blast disease severity compared to check and simultaneously increased the grain yield.
- Spraying of trifloxystrobin 25% + tebuconazole 50% (Native 75% WG) @ 0.4 g/l reduced the sheath blight disease severity (29%) compared to check (DS – 53.7%) which was followed by azoxystrobin 25 SC (@ 1ml/l.
- Studies on morphological variation in 28 isolates of the false smut causing fungus *Ustilaginoidea virens* showed that the isolates from Tamil Nadu, Haryana, Uttarakhand have higher growth rate. Toxin (Ustiloxin) production was confirmed by using *Candida albicans*. Sclerotia after collection and treatment with UV light for one hour produced yellow colour mycelium when incubated in the sterile sand with water at 28^0C.

Transfer of Technology

- Study on impact, awareness and constraints in adoption of IPM revealed that most of the farmers (60%) were aware about IPM and its impacts but not able to fully adopt the recommended packages as most of its components were not easily available to farmers.
- Gender analysis in paddy cultivation activities indicated that majority (68%) of the farm women had access to resources like land, labour and inputs but their control over the resources was limited. For the crop related decisions, older women were consulted in joint families whereas it was joint decision in nuclear families.
- Sustainability study carried out in the traditional rice growing areas of Kerala state revealed that the major constraints in *Kuttanad* and *Palakkad* region.
- For the project on Maximising Impact of Rice Technologies through ICT applications, methodology was developed that comprised of knowledge pathway analysis and personal interviews.
- The preliminary analysis of the partnership studies in Karnataka revealed that the farmers were not aware of any contract farming or partnership and majority of the farmers (70%) reported their willingness to join hands with the SAUs and local NGOs.
- Yield gap analysis in irrigated ecologies of Andhra Pradesh indicated that the difference between the potential yield and actual yield realized by the average sample farmers is 0.5 t/ha.
- Over 400 subject matter specialists and extension officers were trained through seven structured training programs and short training programmes on various aspects of rice production technologies like IPM, SRI, Water saving technologies, Hybrid rice seed production.
- On-farm trials were conducted on DRR varieties *viz.*, Improved Samba Mahsuri and IPM interventions in the states of Andhra Pradesh and Karnataka.
- DRR organized Farmers' day and more than four hundred and fifty farmers participated in this event.
- As a part of Tribal Sub-plan, activities were undertaken to improve the livelihoods of the tribal farmers from two tribal villages of Amarabad Mandal in Mahaboobnagar District of Andhra Pradesh.

Introduction

Significant achievements

Mandate

Organization and infrastructure

Budget allocation

Cadre strength

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. Currently 47 funded and over 90 voluntary centers operate under AICRIP which also forms a part of the mandate of DRR. In addition, DRR initiates network projects of national importance and coordinates these activities.

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 and anticipatory research in the major thrust areas of irrigated rice aimed at enhancement of production, productivity and profitability while preserving environmental quality.
- To develop, organize, coordinate and monitor research networks relating to problems of national and regional importance.
- To serve as major center 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 and through 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 consultant services and undertake contractual research.

Since 1968, more than 990 rice varieties for various agro-ecological systems prevalent across the country have been released through multilocation testing, out of which 60 varieties have been developed by the Directorate. About 27% of these varieties are meant for irrigated area in medium and early duration group, 17% for rainfed shallow lands, 14% for rainfed uplands, 4.6% for irrigated areas in hills, 3.9% for irrigated mid-early, 3.7% for semi-deep water, 2.9% irrigated saline/alkaline soils, 2.6% for scented rice, 2% for deep water and rest for the other rice ecologies. The releases also include 59 rice hybrids. Of the varieties released under AICRIP, 19 are being cultivated in 25 other rice growing countries worldwide.

Significant achievements

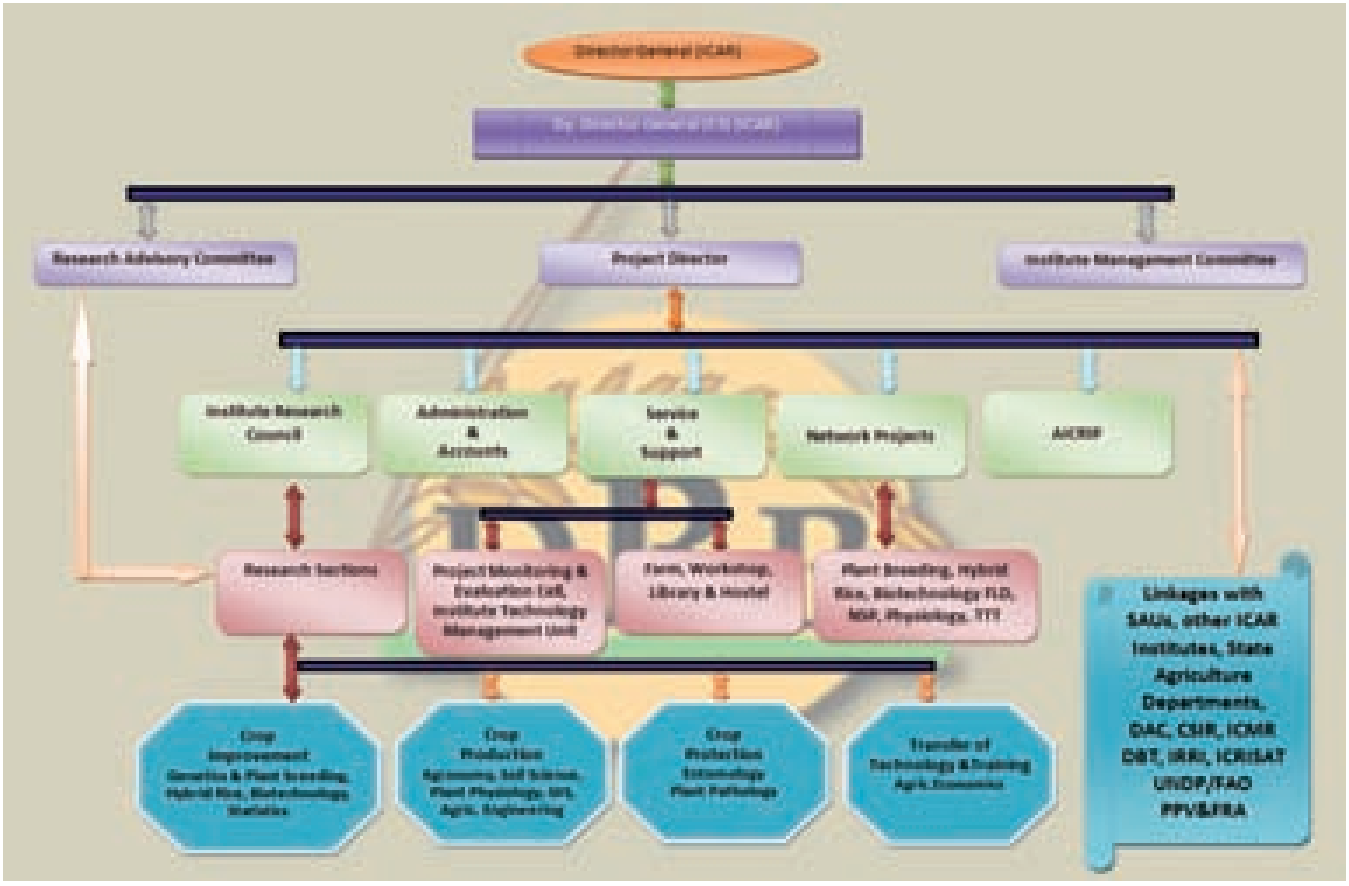
- Ten hybrids namely, US382, Arize Tej, PNPH24, NPH924-1, 27P31, 27P61, 25P25, RH1531, JKRH3333 and CO4 and two varieties (NDGR201 and CR Sugandh Dhan 907) from CSCSNRV and one hybrid (Arize Dhani) and 20 varieties in 9 states from SVRCs were released for different ecologies.
- Out of 1090 entries evaluated in 771 experiments at 110 locations, 50 promising entries were identified.
- Breeder seed production to the tune of 11,436.31 quintals of 233 varieties and parental lines of 11 rice hybrids was achieved at 39 centers across the country.
- Use of 10-day old seedlings and optimum spacing (25 x 25 cm) were found critical and effective in increasing grain yield in SRI method.
- In acidic and sodic soils, complementing recommended NPK and micronutrients (Zn, Fe, Mn, B, Si) with organic manuring increased rice grain yields and nutrient uptake.
- Delayed crop establishment in *kharif* season, resulted in loss in crop productivity which could be avoided by integrated nutrient management of organic manuring and application of all essential nutrients.
- Radiation use efficiency (RUE) studies identified IET20924, IET22218, IET22569, RP4918-16630 and DRRH-3 to be superior with respect to RUE and total dry matter production.
- Resistance conferred by *Gm1*, *gm3*, *Gm8* genes was effective against several of the gall midge biotypes across locations but resistance conferred by *Bph18*, *Bph20+21* was effective against BPH at only two locations.
- Resistance conferred by *xa13* + *Xa21* gene combination was not effective against BLB strains at Kaul, Patna, Maruteru and Raipur.
- Over 570 FLDs for evaluation and demonstration of various rice production technologies were conducted covering 14 states and five rice ecosystems of the country.

- Two cultures IET22080 and IET22081 with distinct yield advantage have been identified by VIC for submission of release proposal.
- Three events of Bt transgenic rice with *Cry1Ac* in the background of IR64 and three events with *AtDREB1A* gene in the background of BPT 5204 in advanced generation are ready for Biosafety Research Level Trial–1 (BRL-1).
- Screening of advanced lines identified nine promising aerobic cultures viz., RP5213-69-13-7-4-1-2, LT50, RP5214-38-14-9-5-2-1-B, RP5218-49-13-9-2-1-1-B, ARP1, ARH2, ARH5, APR2 and ARH4.
- Rasi and Tulasi in early duration; KRH2, RPbio 4918-248, RPbio4919-458 and Akshayadhan in medium duration and Swarna in long duration group were rated as most promising in N utilization and responsiveness.
- Two F6 families of IR64*3 / *O. glaberrima* introgressed lines showed promising reaction against yellow stem borer with < 13% white ear damage and good grain filling.
- Studies on morphology and biology of the false smut causing fungus *Ustilaginoidea virens* revealed strainal variation among isolates collected from Tamil Nadu, Haryana, Uttarakhand. Sclerotia after collection and treatment with UV light for 1 hr and incubated in the sterile sand with water at 28^0C produced yellow colour mycelium.
- Over 400 subject matter specialists and extension officers were trained through seven structured training programs and short training programmes on various aspects of Rice Production Technologies

Organization

DRR is one of the constituent institutes of the ICAR under direct supervision of the Deputy Director General for Crop Sciences. Following flow diagram provides the detailed organizational plan of the Directorate. 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. 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.

Organogram of DRR

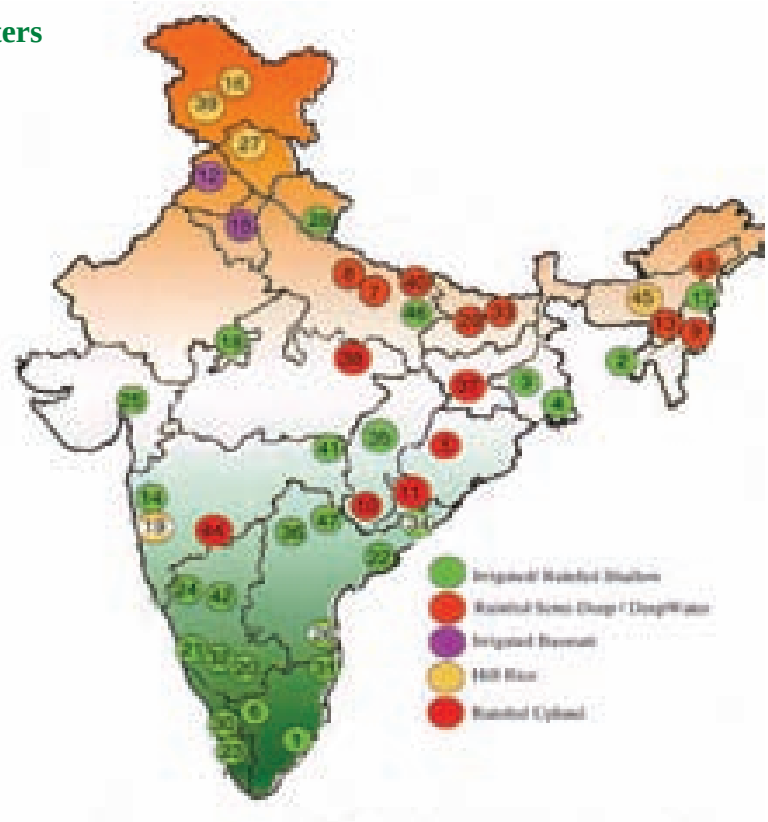


Infrastructure

The Directorate has well equipped laboratories with state of the art equipments, centrally air cooled greenhouses, bio-safe transgenic greenhouses, growth chambers, well laid out experimental farm and digital enabled library facilities.

DRR also coordinates rice research at 47 funded and over 90 voluntary centers under AICRIP.

AICRIP Funded Centers



AICRIP funded centres conducting rice research under DRR coordination.

AICRIP Funded Centers

Sl. No.	Center	Sl. No.	Center	Sl. No.	Center	Sl. No.	Center	Sl. No.	Center
1	Aduthurai	11	Ghaghraghat	21	Ludhiana	31	Patna	41	Sakoli
2	Agarthala	12	Jagdalpur	22	Malan	32	Pattambi	42	Titabar
3	Bankura	13	Jeypore	23	Mandya	33	Pondicherry	43	Tuljapur
4	Brahmavar	14	Kanpur	24	Maruteru	34	Ponnampet	44	Upper shillong
5	Chatha	15	Karimganj	25	Moncompu	35	Pusa	45	Varanasi
6	Chinsurah	16	Karjat	26	Mugad	36	Raipur	46	Wangbal
7	Chiplima	17	Kaul	27	Nagina	37	Rajendranagar	47	Warangal
8	Coimbatore	18	Khudwani	28	Navasari	38	Ranchi		
9	Faizabad	19	Kohima	29	Nawagam	39	Rewa		
10	Gangavati	20	Kota	30	Pantnagar	40	Sabour		

Budget allocation

Budget allocation with actual expenditure (2012-13)

(Rs. in lakhs)

Centre	Plan		Non-Plan	
	Amount sanctioned	Amount spent	Amount sanctioned	Amount spent
DRR Plan	388.00	383.44	1739.07	1722.49
AICRIP Rice	2500.00	2500.00	-	-
Total	**2888.00**	**2883.44**	**1739.07**	**1722.49**

Cadre strength of Scientists, Technical, Administration and SS grade staff

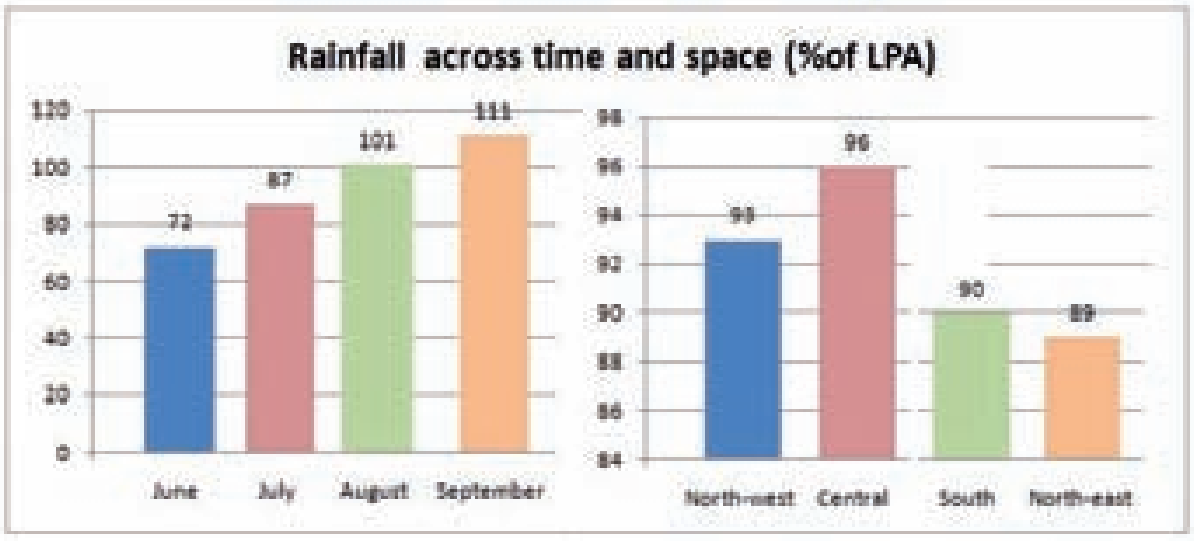
(as on 31-03-2013)

S.No.	Cadre	Sanctioned	Filled	Vacant
1	Scientists (Excluding Project Director)	71	57	14
2	Administration	32	27	05
3	Technical	53	42	11
4	Supporting	17	17	-

Weather and crop season

As per the Indian Meteorological Department (IMD), for the country as a whole, the seasonal rainfall from first June to 30th September, 2012 was 92% of its long period average (LPA). The temporal distribution of seasonal monsoon rainfall was 72% of LPA in June, 87% of LPA in July, 101% of LPA in August and 111% of LPA in September. The spatial distribution was 93% of its LPA over Northwest India, 96% of its LPA over Central India, 90% of its LPA over South India and 89% of its LPA over Northeast (NE) India. Out of the total 36 meteorological subdivisions, 23 subdivisions constituting 67.3% of the total area of the country received excess / normal season rainfall and the remaining 13 subdivisions (32.7% of the total area of the country) received deficient rainfall. Thus, during 2012, monsoon season rainfall activity was delayed and subnormal during June July but picked up and was normal during August and September.

The rice production in the country in 2012-13 has been estimated to be 101.80 million tonnes, according to second advance estimate by Ministry of Agriculture.



Research Achievements

Coordinated Research

Crop Improvement

- New varieties/hybrids released

Crop Production

- Agronomy
- Soil Science
- Plant Physiology

Crop Protection

- Entomology
- Plant Pathology

Transfer of Technology

All India Coordinated Rice Improvement Programme (AICRIP)

Crop Improvement

New varieties/hybrids released

A total of 33 releases including 11 hybrids and 22 varieties were made during 2012-13 for general cultivation. Central Sub-Committee on Crop Standards, Notification and Release of Varieties (CSCCSN & RV) released two varieties (NDGR 201 and CR Sugandh Dhan 907) and 10 hybrids [US382, Arize Tej, PNPH24, 27P31, 27P61, 25P25, RH1531 (Front line gold), JKRH3333 and CO4 (TNRH174)] for irrigated areas and one hybrid for Boro (NPH924-1). Nine states have released 20 varieties and one hybrid. These include 8 from **Andhra Pradesh**: Sheetal, Siddhi, Krishna, Anjana, Prathyumna, Pranahita, Nellore Sona and Swetha; 3 from **Odisha:** Luna Sankhi, Luna Barial, Arize Dhani (hybrid); 3 from **Manipur:** CAUR-3, CAUR-4 and RC Maniphou 12; 2 from **Maharashtra**: Karjat-8 and Phule RDN-6; one each from **Assam** (Kanakalata-Boro), **Bihar (**Sabour Surbhit) **Gujarat** (GNR 2-coastal salinity), **Uttar Pradesh** (CSR 43-inland salinity) and **Uttarakhand** (Pant Sugandh Dhan 21-Basmati). Among state releases, ten varieties including a hybrid were released for the irrigated ecology; 4 for salinity affected areas, 3 for rainfed shallow lowland and one each for semi-deep water, boro, salinity and Basmati.

Varieties released by Central and State variety release committees during 2012-13

Sl. No.	Variety Name	IET No.	Designation	Cross Combination	FD (Days)	Eco-System	Grain Type	Yield (kg/ha)	Reaction to pest / diseases
Central Releases									
1.	US382 (Hybrid)	20722	US 382	F1 / M4318	94	IRME	LB	6700	MR- BL
2.	Arize Tej (Hybrid)	21411	HRI 169	CO 02 / M012	94	IRME	LS	7000	MR- BL, BS
3.	PNPH24 (Hybrid)	21406	PNPH-24	PRN1A / PRN24R	97	IRME	LS	5500	MR- BL, BS
4.	NPH924-1 (Hybrid)	21255	NPH-924-1	NSPL2A / PAB52F	135 - 140	Boro	MS	6200 -6700	R- BL, BLB & MR- ShBl
5.	27P31 (Hybrid)	21415	27P31	R834F / R872	100	IRME	LB	6175	R- BL & MR- RTV, WBPH
6.	27P61 (Hybrid)	21447	27P61	R 822F / R872	102	IRM	MS	5761	MR- BL, BS
7.	25P25 (Hybrid)	21401	25P25	R 818F / R842	89	IRE	LS	6548	MR- BL
8.	RH1531 (Frontline Gold)	21404	RH 1531	IR 68902A / EPR 6222	96	IRME	LS	6500 -7000	R- BL & MR- BS
9.	JKRH3333 (Hybrid)	20759	JKRH 3333	JKRA 1047 / JKRR 10092	105 – 110	IRM	MS	5980	
10.	CO4 (Hybrid)	21449	TNRH 174	COMS 23A / CB 174R	100 – 105	IRM	MS	5907	MR- BL, BS
11.	NDGR201	20048		Pure line selection from Pamser (Land race)	124	SDW	SB	3500 – 4000	MR- BS, SB
12	CR Sugandh Dhan 907	21044	CR 2616-3-3-3-1	Pusa 44 / Dubraj	90-95	SCR	MS	4000	MR-LBl, NBl, BS, ShR
State Releases									
Andhra Pradesh									
13.	Sheetal	20987	WGL-283	Chaitanya / Tella Hamsa	95 - 100	IRM	LS	6500 - 7500	MR- BPH
14.	Siddhi	19387	WGL-44	BPT 5204 / ARC 5984 // Kavya /// Kavya / BPT 5204	110 - 115	RSL	MS	7000 - 7500	MR- GM

Sl. No.	Variety Name	IET No.	Designation	Cross Combination	FD (Days)	Eco-System	Grain Type	Yield (kg/ha)	Reaction to pest / diseases
15.	Krishna	21492	RNR 2458	Chandan / Samba Mahsuri	100 - 105	IRM	SS	6500 -7000	R- BL
16.	Sujana	20141	JGL 11118	IET 8585 / JGL 1798	85-90	IRE	MS	6736	T-BLB, R-GM
17.	Prathyumna	22027	JGL 17004	WGL 14377 / JGL 3855	70-75	RUP	MS	5110	T-BL, MR-GM
18.	Pranahitha	19978	JGL 11727	JGL 420 / Vijetha	105	IRM	LS	6743	T-BL, BLB, MR-GM
19.	Nellore Sona	20552	NLR 3041	BPT 5204 / NLR 145	105 - 110	IRM	MS		T- BL
20.	Swetha	22764	NLR 40024	WGL 14280-1 / NLR 30491	90 - 95	IRE	MS		T- HEAT & BL
Assam									
21.	Kanaka Lata	20611	TTB103-3-1	Jaya / Mahsuri	140-145	Boro	MS	6000	MR- BLB, ShBl, BS
Bihar									
22.	Sabour Surbhit	19806	RAU 3036	Mutant of Rajendra Suwasini	90 - 95	IRE	LS	4278	MR- BL, BLB, BS, SB & BPH
Gujarat									
23.	GNR2	--	--	GR 103 / Pokkali	95 – 100	CS	MS	4500 – 5000	R-BLB
Maharashtra									
24.	Karjat8	19407	KJT 13-4-53-19-12	Ratna / Heera // KJT-4	110 - 115	RSL	SS	3500 - 4000	MR- BL, GM
25.	Phule RDN6	--	RDN 97-2-69-5-5-6		95 - 100	IRM	LS	4440	R- BLB, GLH, BPH, WBPH & MR- BL, SB
Odisha									
26.	Luna Sankhi	21237	CR 2577-1	IR 31142-14-1-1-3-2 / IR 71350	70-85	CS	MS	3600-4500	MR- LB, ShBl
27.	Arize Dhani (Hybrid)	21299	BS025 HRI-166	MO13 / CO 88	110	RSL	MS	5308	R- BLB
28.	Luna Barial	19472	CR 2092-158-3	Jaya / Lunishree	120-125	CS	SB	3800-4500	MR- ShBl, BS, LF
Uttar Pradesh									
29.	CSR43	18259	CSR89-IR 8	KDML 105 / IR 4630-22-2-5-1-3 // IR 20925-33-3-1-28	85	IRSA	SB	4165	MR- BS
Uttarakhand									
30.	Pant Sugandh Dhan21	--	UPR 2729-15-1-1	Govind / BR 4698-17-1-5 / UPRBS 92-4 // Harya Bas / Pusa Bas 1	105	SCR	LS	3602	MR- BL, SB
Manipur									
31.	Mangalphou	22833	CAU-R3	RCM 7 / V20-B	70	IRE	LS	4000	R-RTV
32.	Eenotphou	-	CAU-R4	-	115	SDW	-	-	MR-GM
33.	RC Mani-phou 12	22828	RCM 13	Leimaphou/Akhanphou	75	IRE	LB	4000	R-GM

Coordinated Varietal Testing

During the year 2012 which was the 48th year of AICRIP testing, 36 varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted as 771 experiments at 110 locations (47 funded, ~90 voluntary centers) in 27 states and 2 Union Territories in all the five regions of the country. In addition, hybrid rice trials were also conducted by 14 private seed companies. The 42 trials were constituted with 1090 entries including 154 checks and 103 experimental hybrids. Based on three years multi-location testing, 28 cultures including 4 hybrids were found promising for different ecologies (Appendix 1).

During the year 2012, five hybrid rice trials were conducted and 105 hybrids were tested in 23 – 34 locations representing different agro-climatic regions of the country.

INGER Nurseries

During the year under report, 14 IRRI coordinated INGER Observational Nurseries were evaluated to identify promising elite breeding lines and varieties developed in different countries for their suitability to Indian situation. A total of 783 elite rice lines of different nurseries were evaluated at 78 locations. Promising lines were identified based on yield, resistance/tolerance to biotic stresses; maturity duration and overall phenotypic acceptability in different trials are listed below.

Promising lines identified in INGER Nurseries

Sl.No.	Nursery	Promising lines
1.	International Irrigated Rice Observational Nurseries (IIRON)	Module-1: Karjat 3, IR 10M298, OM 6070, IR 04A395, CT 16658-5-2-3SR-2-1-MMP Module-2: BP10620F-BB4-17-BB6, IR 09N261, IR 76939-98-1-1-1, BP 10620F-BB4-19-BB8, IR 79538-1-1-1-1
2.	International Fine grain Aromatic Rice Observational Nursery (IRFAON)	TOX1768-3-1-1-103-3, IR 03A480, IR 07A166
3.	International Rainfed Lowland Rice Observational Nursery (IRLON)	IR 10L182, BR 7870-5*(NILS)-7-HR1, WANXIAN 77, IR 10L325, ZX115
4.	International Temperate Rice Observational Nursery (IRTON) International Upland Rice Observational Nursery (IURON)	PSB RC 2 (IR 32809-26-3-3), 97027-TR 1847-1-1-2, 99052-TR 2019-1-2-1, MILYANG 23 B 11338F-TB-26, IR 83142-60, IR 10L105, CT 15672-12-1-6-2-2-M, TB 368B-TB-25-MR-2
5.	Green Super Rice Irrigated and Rainfed (GSR)	GSR-IRLL:HHZ17-DT 6-SAL 3-DT 1, TME80518, YJ20, ZGY1, Weed Tolerant Rice 1 GSR-RFLL: YJ20, Zhonghua 1, IR 84678-25-5-B, HUA 564 and HHZ 5-SAL 10-DT 1-DT 1
6.	International Rice Soil Stress Tolerance Nurseries (IRSSTN)	Module-1: IR11T237, IR11T169, IR11T239, IR11T169; Module-2: FL 449 (IR66946-3R-149-1-1), IR11T164, A 69-1, IR11T230
7.	International Heat Tolerance Nursery (IRHTN)	HHZ 17-Y16-Y3-Y1, HHZ 5-SAL14-SAL2-Y2, IR 10C139, IR 10C110, HHZ 12-SAL8-Y1-Y2
8.	International Rice Blast Nursery (IRBN)	IRBL5-M/RL, CT18232-5-8-2-1-10-1, C1-4-11-7P-2P-1P-3P, IRBLI-F5, CT 18235-3-9-1-2-3-3
9.	International Rice Bacterial Blight Nursery (IRBBN)	AC19-1-1(ACC32753), KUNTLAN, IR 17494-32-1-1-3-2
10.	International Rice Brown Plant Hopper Nursery (IRBPHN)	PTB 33, RATHU HEENATI (ACC 11730), SINNA SIVAPPU (ACC 15444)

National Seed Project and Breeder Seed Production

Breeder seed production of 233 varieties and parental lines of 11 rice hybrids was organized at 39 centers across the country and a total of 11436.31 quintals of breeder seed against the target of 5267.05 quintals was produced as per the DAC indents. At DRR centre, 14 varieties and parental lines of DRRH-2 and DRRH-3 were included in breeder seed production and a total production of 332.05 quintals was achieved against the target of 302.25 quintals (Appendix 2). In addition, nucleus seed of 24 DRR varieties were also multiplied.

Crop Production

Agronomy

Response of rice cultures to Nitrogen

A total of 256 experiments were conducted at 49 locations under Agronomy discipline comprising experiments on nitrogen use efficiency, developing technologies for various ecosystems, identification of herbicides and resource conservation technologies in rice based cropping systems during 2012. Evaluation of 76 elite genotypes belonging to 16 categories for their response to nitrogen led to identification of 22 cultures based on the Grain Yield Efficiency Index values **(GYEI values higher than 1).**

Cultural Management

From AICRIP trials, it was found that rainfed upland rice yields can be improved by intercropping with soybean / cowpea / urad bean (4:2 in replacement series) and integrated weed management through pendimethalin @ 0.75 kg a.i./ha (pre-emergence) + hand weeding at 25 days after sowing proved promising for enhancing overall productivity of the system.

For aerobic rice experiments, optimum sowing (early June i.e. 10th June at many locations) with 30-35 kg/ha seed rate and close planting (20 cm) were found to be the most important to realize higher yields. The optimum dose of nitrogen i.e., 120 kg N/ha with a scheduling of N fertilizer indicated a 3 splits application (1/3 10-12 DAE+ 1/3 AT+ 1/3 PI stage) or (1/3 Basal+ 1/3 AT+ 1/3 PI stage); 4 splits (1/4 10-12 DAE + 1/4 AT stage + ¼ at PI stage + ¼ at flowering) proved most promising for aerobic rice. There was a saving of 25% N by increasing the number of splits from 3 to 4.

In SRI method of cultivation, use of 10-day old seedlings and optimum spacing (25 x 25 cm) were found to be critical and effective in increasing grain yield. SRI or direct seeded rice with SRI practices (DSRI) gave 24.2 and 12.8% higher yield than traditional transplanted rice. Slightly modified SRI (SMSRI) recorded higher grain yield of 6.16 t/ha and proved as productive as manual transplanted rice indicating significant reduction of drudgery and transplanting costs.

Weed management

For aerobic experiments, 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 was found to be effective in reduction of weeds contributing to realization of higher grain yields.

Among the combination herbicides, penoxsulam + cyhalofop-butyl @ 135 g / ha and 25 g a.i / ha found to be effective for transplanted rice. While, flucetosulfuron @ 20 or 25 g a.i. / ha or penoxsulam + cyhalofop-butyl @ 120 or 135 g a.i. / ha, and mispyribacsodium + metamifop @ 70 g a.i/ha along with wetter found to be effective depending on the weed intensity, soil type and duration of the variety for direct seeded rice under puddle condition.

Rice based cropping systems

In rice-based systems, soil application of organic manure + NPK + micro-nutrients was found to be promising with higher grain yields as compared to NPK alone suggesting judicious application of organic manure (in conjunction with NPK and micro-nutrients) in system approach. Impact of conservation agriculture on rice based cropping system studies revealed that rice crop yield was reduced (6-56%) with adoption of zero tillage (ZT) at four out of eight locations. Rice hybrids produced 14% higher yield (5.00 t/ha) than varieties (4.35 t/ha) in reduced tillage conditions.

Soil Science

Long term soil fertility management in rice-based cropping systems

The results of 24th year of study show that supplementary application of 5 t/ha FYM along with recommended fertilizer dose (100% NPKZnS) was superior among all the treatments at Maruteru and Titabar with positive growth over time and with corresponding increase in nutrient accumulation and improvement in soil nutrient status and organic carbon, while critical levels of NPK and sulfur nutrition appear to be important at Titabar (acid alluvium) for sustaining higher yields.

Rice productivity in relation to internal supply capacity of nutrients in farmers' fields

In order to fine tune the current fertilizer practices on the basis of realistic assessment of soil fertility and its variability across farm units for realizing region or cluster-specific yield targets, this trial was conducted in more than 30 farmers' fields around Titabar (20) and Mandya (10) representing irrigated and shallow low lands, besides validating the fertilizer prescriptions for target yields generated in the previous years in about 5-8 farmers' fields around Titabar, Mandya, Sirsi and Maruteru in comparison with farmers' and recommended fertilizers practices at these locations. Farmers' fertilizer practice produced significantly lower yields than with recommended fertilizer practice at all the sites with yield difference of 65 – 194% at Titabar and up to 26% at Mandya. Fertilizer doses estimated based on the nutrient uptake and its efficiency at each site for yield targets of 6.1 t/ha varied substantially between the sites from the currently followed blanket dose indicating the importance of site characteristics for recommending fertilizer prescriptions.

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

The third year of study conducted at three locations (sodic soils of Kanpur, acidic soils of Ranchi and Pattambi) to evaluate efficiency of management practices to improve rice productivity in problem soils. Gypsum application found to improve soil quality at Kanpur in addition to increasing rice productivity.

Screening of rice germplasm for high iron and zinc contents

About 230 cultures including four checks were screened at 10 locations to study the influence of environment on rice productivity and micronutrient contents and identify promising cultures. Among the cultures, TKM9 and Aghonibora recorded the highest Zn (386 ppm) and Fe uptake (529 ppm) respectively while the lowest Zn uptake was in Vasumathi (189 ppm) and Prafulla (192 ppm) and for Fe uptake in Prafulla (139 ppm). Aghonibora was consistently found promising for accumulation of both Fe and Zn at different locations in the past.

Nutrient and water requirement for aerobic rice cultivation

The study indicated significant effect of water regimes on the productivity of aerobic rice (non-puddled, direct sown and near saturated field water regime) at both the locations. Significant yield response to applied nutrients was recorded increasing by 0.9-1.8 t/ha with N, 0.5-1.1 t/ha with P and by 0.4-0.7 t/ha with K application Productivity of water (kg grain/ha mm water used) ranged from 2.9-3.5 and 1.9-2.4 kg grain/ha mm water at Kanpur and Mandya, respectively depending on the water regime.

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

The study initiated in 2011 to assess rice productivity and nutrient use efficiency under different times of crop establishment and nutrient management options was conducted at three locations (DRR, Ghagraghat and Raipur). Changes in crop calendar involving early and late crop establishment dates influenced yields at all the locations. Early and late planting/sowing resulted in loss of *kharif* rice productivity by 4.9 -11.9% at DRR, 14.5-41.5% at Ghaghraghat and 2.3-14.8% at Raipur.

Screening of genotypes suitable for acid soils and related nutritional constraints

In the trial on evaluation of genotypes for tolerance to soil acidity and related nutritional constraints at four centres (Moncompu, Ranchi, Sirsi and Titabar), the results indicated variable genotype response to lime application. Based on their performance, the genotypes IET 21009 and IET 21542 at Moncompu, IET 20884 and IET 21510 at Ranchi, IET 21477 and IET 22081 at Sirsi and Aghonibora, Prafulla and IET 20884 at Titabar (which exhibited low Fe toxicity score) were found promising.

Nutritional status of rice in farmers' fields in relation to productivity

The study was conducted in *kharif* 2012 from 15 farm sites around Ghagraghat, 25 from Mandya, 40 from Kanpur and 28 from Karaikal representing Indo Gangetic plains, the plateau region and Cauvery delta, to record all the package of fertilizer and crop management practices followed by the farmers, besides information about the nutrient availability status of the soils, and crop productivity. Rice productivity across different agro ecosystems varied as Kanpur> Ghagraghat> Mandya >Karaikal. Nitrogen concentration recorded at Kanpur and Ghagraghat was higher. The values of Internal Efficiency and nutrient ratios indicated sharp differences among farm sites with regard to nutrient uptake among genotypes indicating highly imbalanced nutrition which did not match with the crop nutrient requirements.

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

The trial was conducted at five locations (DRR, Karaikal, Faizabad, Maruteru and Chinsurah) in *kharif* 2012 to assess the requirements of all major nutrients (NPK) of recently released varieties and hybrids (two each) of mid early to mid duration group grown under different environments. Average productivity of rice at the test locations ranged from 1.5-5.3 t/ha highest being recorded under semi arid irrigated conditions at DRR. Based on the nutrient uptake data average applied fertilizer recovery was estimated which ranged from nil - 63% for N, nil - 87% for P and nil to > 100% for applied K. Nutrient requirement in general varied from 14.3 - 30.1 kg N, 0.6 - 39.4kg P_2O_5 and 6.7 - 68.4 kg K2O per ton of grain production.

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

From the trial on partitioning of Zn and Fe and prospective for enrichment in rice conducted at 4 locations (Kaul, Karaikal, Maruteru and Titabar), the genotypes HKR 127; Aghonibora; MTU 1001; Aghonibora and Prafulla were found superior at Kaul, Karaikal, Maruteru and Titabar, respectively. Out of total iron and zinc uptake, most of the Fe and Zn were retained in straw (70-90%) with only 10-30% translocation to grain.

Plant Physiology

Photothermic Indexing

The experiment was conducted at seven locations, with 34 cultures and the crop was sown up to 15 days early and normal sowing date so as to expose the crop to differential photo thermal periods IET 20924 maintained its relative photo sensitivity characteristic for the third consecutive year confirming its uniqueness of associating with sowing and critical CDD (1600-1700) and CNP (850-1000 and 1000-1200) periods at grain filling, PI and 50% flowering stages respectively.

Radiation Use Efficiency of genotypes

The study was conducted at three locations with an objective to understand why certain genotypes perform better than others under different planting dates? Genotypes differed significantly with respect to RUE, TDM accumulation and grain yields. Entries IET 20924, IET 22218, IET 22569, RP4918-16630 and DRRH3 were superior with respect to RUE, TDM and photosensitivity.

Crop Protection

Entomology

Host plant resistance

Host plant resistance studies comprised nine screening experiments involving 900 pre-breeding lines, 126 hybrids and 1078 germplasm accessions and 125 check varieties. These entries were evaluated against 10 insect pests in 171 valid tests (46 greenhouse reactions +125 field reactions). The results of these reactions identified 94 entries (4.6% of the tested) as promising against various insect pests. Of these promising materials, 8 entries (8.5%) were under retesting.

Promising entries identified for insect pest resistance

Pest	Trial	Promising entries
BPH & WBPH	PHS, GEMP, MRST, NSN, IRBPHN	**KAUM 166-2, KAUM 168-1**, CR 3005-77-2, CR 3006-8-2, CR 3005-230-5, IR 65482-7-216-1-2-B, IC # 449784, 450029, IET # 22489, 22989, 21709, 22218, 21423, 22345, 23000, 23396, 22984, 22951, 21765
Gall midge	GMS, GMSS, MRST, NSN	**JGL 18044, JGL 18080**, JGL 19618, IC363753, **CAUR-1**, Madhuri 9, RCM-10, IC# 462336, 463240, 353834, RP Patho-01, CB 07-540, IET # 22096, 21842, 21841, 22100, 22144, 22698, 22155, 22835, 22763, 23375, 23169, 23074, 23121, 23194, 23234, 23247, 23262
Leaf folder	LFST, GEMP, MRST, NSN	**W 1263** (CBT), **PTB 12**, IC 449877, CR 2711-76, RP Patho-04, TNRH 206, IET # 22548, 21850, 22568, 22552, 21858, 22222, 22552, 22155, 22199, 22223, 22439, 22449, 22486, 22489
Multiple pests	GEMP	IC# 346207, 545441, 459646, 17065, 86004, 145397, 449784, 450029, 449994, 413645
	MRST	**CR 2711-76**, HR-DRR-02, RP 4918-212(S), RP 4918-228(S)
	NSN -1	IET # 22489, 22096, 22155, 22439, 22486
	NSN-2	IET # 23000, 23148, 23033, 23040
	NSN H	IET 22950
	NHSN	IET 22941 (IHRTMS11)

Entries in bold were under retesting

Insect biotype studies

Under Gall midge biotype trial (GMBT), the standard set of 17 differentials carrying all the 11 known resistance genes and those with unknown genes and checks was evaluated at 17 locations and among all the differentials tested, Aganni (*Gm8* gene) was most promising at 5 locations followed by Kavya and W1263 (*Gm1*), RP 2068-18-3-5 (*gm3*) and INRC 3021 (*Gm8*) at 4 locations each. Gall midge population monitoring (GMPM) trial aimed at quantifying variation in virulence in the pest populations at three locations indicated that *Gm8* gene was effective both at Jagdalpur and Warangal. Planthopper Special Screening (PHSS) with 16 gene differentials evaluated in 6 greenhouse and 1 field test showed that only Ptb33 (*bph2+Bph3*+unknown factors) was promising in 6 tests whereas T12 (*bph7*), IR 65482-7-216-1-2-B (*Bph18*) and IR 710333-121-15 (*Bph20+Bph21*) were promising at two locations each.

Chemical control studies

Insecticide evaluation trial carried out at 34 locations revealed that sutathion - new formulation of triazophos - at higher dose performed well against stem borer and gall

midge. Against leaf folder, rynaxypyr was the best treatment and gave highest grain yield. Pesticide compatibility trial was carried out with the objective of evaluating the compatibility of newer insecticide and fungicide formulations as tank mix against major insect pests and diseases and its impact on grain yield, at 17 centres. There were no significant differences in the performance of the two newer insecticides (buprofezin + acephate and sulfoxaflor 24% SC) when applied alone or in combination with fungicides (hexaconazole and tricyclazole).

Ecological studies

Influence of Rice Cultivation Practices on rice pests (IRCP) studies at 6 locations showed significantly lower dead heart, white ear, hispa and whorl maggot damage, low BPH, WBPH, GLH incidence, higher leaf folder incidence and higher grain yield in direct seeded rice as compared to normal transplanted crop. Effect of Planting Date on Pest Incidence (EPDP) trial across 15 locations recorded relatively high incidence of stem borer, leaf folder, whorl maggot, gall midge, cut worm and gundhi bug and low incidence of BPH/WBPH in late planting as compared to early and normal plantings.

Biocontrol and Biodiversity studies

Monitoring of pests and natural enemies (MPNE) was conducted at 22 centers and four stem borer species, 2 leaf folder species viz., *C.medinalis* (80%) and *Marasmia* sp. (20%) and mixed populations of BPH and WBPH were recorded. Stem borer egg mass parasitisation ranged from 38-100% while the egg parasitisation varied from 3-90%. *Trichogramma chilonis* (egg), *Apanteles* sp (laval) and *Xanthopimpla* sp. (pupal) parasitoids were recorded on leaf folder. Mirid bugs, spiders, staphylinid beetles and coccinellids were the predators associated with planthoppers and *Platygaster oryzae* was recorded on gall midge. Ecological Engineering for Management of Planthoppers (EEMP) trial was conducted at five locations with the objective of managing hoppers through increased natural enemy fitness by non-pesticidal methods *viz.*, increasing floral diversity and augmenting egg predators. Such interventions reduced planthopper populations and increased natural enemy populations across locations.

Integrated Pest Management studies

Yield loss estimation trial (YLET) conducted at 7 locations for two pests *viz.*, stem borer and leaf folder revealed a significant negative correlation between i) grain yield and per cent white ears at Ludhiana and ii) grain yield and number of leaf folder larvae and damaged leaves at Puducherry and Pattambi. Pest Management Trial special (IPMs) conducted at 13 locations on farmers' fields revealed that pest incidence and Grain yield were high in FP than in IPM plots. Population monitoring of insect pests through light trap collections was carried out at 28 locations. Yellow stem borer, gall midge, BPH were the main insects reported.

Plant Pathology

AICRIP pathology trials including host plant resistance, virulence of plant pathogens, disease observation and disease management were conducted at 52 locations. Five national screening nurseries comprising of 1956 entries and 915 accessions of germplasm were evaluated.

Host plant resistance

Out of 1041 entries tested, 60 for leaf blast; 26 for neck blast; 16 for sheath blight; 30 for brown spot; 28 for sheath rot; 13 for glume discolouration; 8 for leaf scald; 32 for bacterial leaf blight and 27 for rice tungro disease were found resistant. Germplasm entries which were identified as resistant source are listed below.

Promising germplasm entries

Disease	Promising Accessions
Leaf Blast	IC # 450165, 459639, 459652, 17089, 450386, 450465, 450400, 461808, 450516, 544868 and 450052
Sheath blight	IC # 449829, 86009, 449948, 450296 and 449668
Bacterial blight	IC # 450305, 461160, 461818, 449553, 449798 and 545470
Rice Tungro Disease	Nil
Brown spot	IC # 346207, 450632 and 450123
Sheath rot	IC # 450385, 450387, 450424, 450557, 450595, 353862, 381962 and 351756.

Pathogenic variability of *Pyricularia oryzae* (Rice blast)

Cluster analysis of *P. oryzae* reactions from 21 locations with 25 cultivars consisting of international differentials, RILs, donors, NILs and commercial cultivars showed revealed tfour major groups with considerable variation in reaction at locations within each group.

Pathogenic variability of *Xanthomonas oryzae* pv. *oryzae*

From the trial of 22 near isogenic (IRBB) lines with different BLB resistance genes and their combinations and

different checks conducted at 20 different hot spot locations it was found that most of the entries having single resistance gene were susceptible at most of the locations. BB resistance gene *xa13* was found susceptible in 6 locations while *Xa21* was found susceptible in 10 locations. The *xa13 + Xa21* combination showed susceptibility at Kaul, Patna, Maruteru and Raipur. The *xa13 + Xa21* gene combination has shown susceptibility for consecutively 3 years at Kaul, suggesting a major shift in virulence.

Disease Observation Nursery

The trial was conducted at ten locations and the terminal disease severity of various diseases varied according to the location, variety and dates of sowing period. Across the locations, the leaf blast, neck blast, brown spot, sheath rot and bacterial blight disease severity was increased with delayed planting whereas sheath blight severity was high in the early sown crop.

Evaluation of fungicides for location specific diseases

The chemicals were evaluated against leaf blast, neck blast, node blast, sheath blight, brown spot, leaf scald and grain discoloration. Across the locations, trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) 0.4 g/l performed well in reducing the mean disease severity of leaf blast, neck blast, node blast, brown spot, leaf scald, false smut and grain discolouration. Among the seven treatments, trifloxystrobin 25% + tebuconazole 50 % (Native 75 % WG) @ 0.4 g/l reduced the sheath blight disease severity (22%) as well as incidence (26.6%) across the locations compared to check (DS- 54.1%; DI- 68.8%). Among the test chemicals kresoxim methyl @ 1ml/l was superior (29.5%) compared to check (60.2%) across the locations in reducing the sheath rot disease severity .

Evaluation of Biocontrol agents and formulations against rice diseases

The formulations for biocontrol agents *viz*., talc and liquid formulations of *Pseudomonas fluorescens* along with chemical check were tested against blast, sheath blight, brown spot, sheath rot, bacterial blight, leaf scald and glume discoloration at 22 locations. Both talc and liquid formulations of *Pseudomonas fluorescens* were performed on par and reduced the disease severity of blast, sheath blight, sheath rot and brown spot.

Evaluation of fungicides against false smut disease

In the trial on evaluation of fungicides against false smut disease conducted at 15 locations,the disease incidence was low to moderate in most of the locations. Panicle infection was reduced by spraying of propiconazole 25 EC (Tilt @ 1.0ml/l) at 50% PE stage (9.98) which was on par with the spray of trifloxystrobin 25% + tebuconazole (Nativo 75WG @ 0.4g/l) at 50% PE stage (10.68) compared to control (21.30). In case of spikelet infection, spray of trifloxystrobin 25%+ tebuconazole (Nativo 75WG @ 0.4g/l) at 50% PE stage reduced the infection (6.48) which was on par with the spray of propiconazole 25 EC (Tilt @ 1.0ml/l) at booting stage (6.56) compared to control (11.02).

Integrated Disease Management

Integrated disease management trial on leaf and neck blast was conducted at Ghagraghat, Khudwani and Malan; on sheath blight at Chiplima, Faizabad and Maruteru; on sheath rot at Puducherry and on bacterial leaf blight, the trial was conducted at Chiplima, Pusa and Maruteru. In case of fungal diseases, at most of the locations, cultivation of local resistant variety along with 100% RDN recorded the least disease severity. In case of bacterial blight, adoption of local hybrid or resistant variety with suitable fertilizer management practice reduced the disease severity.

Production Oriented Survey

The salient features of the Production Oriented Survey (POS) conducted in 16 rice growing states of India during kharif 2012 are as follows: the rainfall for the season (June-September) for country was 92 % of its long period average (LPA). In June, deficient rainfall was observed over most of the subdivisions (27 out of 36). Heavy rains followed by cyclone 'NILAM' in the first week of November in Andhra Pradesh caused severe damage to about 4-5 lakh hectares of standing rice crop. A large number of hybrid rice varieties are being grown in different states like Gujarat, Himachal Pradesh, Maharashtra, Madhya Pradesh, Odisha, Uttar Pradesh and Haryana. The diseases like blast (both leaf blast and neck blast), brown spot, sheath blight, sheath rot, false smut, grain discolouration and bacterial blight are widely prevalent across different states. Bakanae has become a major problem in Punjab and Haryana especially on basmati varieties. Bakanae/foot rot has been recorded in some parts of Andhra Pradesh also. The intensities of insect pests like leaf folder and BPH/WBPH was very high sin some places. Panicle/leaf mite was recorded in Andhra Pradesh and many parts of Gujarat.

Technology Transfer

For the year 2012, 572 FLDs on various rice production technologies covering 14 states and five rice ecosystems of the country. The analysis of yield advantages obtained in various ecosystems revealed that across the ecosystems, FLD technologies have recorded impressive yield advantages.

Research Achievements

Lead Research

GEY - Genetic enhancement of yield and stress tolerance

GEQ - Genetic enhancement of quality for domestic and 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)

Of the 42 future generation rice lines (FGR) evaluated in a replicated trial, 10 lines *viz.*, FGR21-17, FGR21-22, FGR 22-27, FGR21-23, FGR22-56, FGR22-46, FGR23-82, FGR 23-11, FGR24-8 and FGR23-3 recorded more than 20% yield advantage over the popular varietal checks (Jaya, NDR359, Swarna, Sampada and Dhanrasi). In another experiment, 19 other cultures also exhibited significant yield superiority over best varietal checks of respective categories. Based on yielding ability, phenotypic index, flowering duration and grain type more than 600 advanced lines were shortlisted from 5386 lines. More than 5400 single plants of different generations from 400 diverse crosses were selected. BPH resistant progenies of BC_1F_4 generation carrying *Bph17*, *Bph20*, *Bph21*, *Bph22* and *Bph23* genes were screened in glass house. BPH resistance has been introgressed from *O. rufipogon*, *O. longistaminata* and *O. nivara.*

Fifty lines derived from the cross of Swarna/*O. longistaminata* were screened for tolerance to yellow stem borer. The natural infestation was supplemented with artificial infestation by pinning egg masses. Despite heavy YSB infestation, 16 lines recorded <10% dead heart damage with good grain yield. The promising lines with less than 20% dead hearts were OLS181, 0810259, 0810308, 0810396, 0810359, 0810379, OLS9 and O810322 while recurrent parent Swarna had 68% dead hearts.

Technology Developed

- A short duration culture IET 22080 (RP5125-5-9-1 (IR 83876-B-F_3 Bulk) with 26.52%, 38.41% and 12.49% yield advantage over Sahbhagi Dhan, regional check and local check, respectively was identified for release for Tamil Nadu, Puducherri, Kerala and Karnataka by Varietal Identification Committee during 48th ARGM.
- Another entry, IET 22081 (RP5127-9-3-IR93376-B-B-130) with 28.5%, 34.2% and 20.2% yield advantage over Sahbhagidhan, regional check and local check have been identified for release in the states of Uttrakhand, Haryana, Bihar and Orissa by Varietal Identification committee.

GEY/CI/BR/9

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

During *rabi* 2012, progenies of 206 F_4 single plants selected in *rabi* 2011 from 10 cross combinations were raised in two row pedigree method and 124 single plant selections were made based mainly on two criteria, *i.e.*, plants showing good seedling growth at low temperature and simultaneously showing low sterility at flowering and good grain filling at high temperature and advanced to the next generation. Few other populations were also selected based on their general merit like high tiller number, long panicles, complete exsertion of panicle, good plant type etc. Evaluation of 6 F_3 populations along with 855 germplasm lines of early group was also taken up in *rabi* season. Three elite cultures developed under the project have been nominated jointly by DRR and RAU, Pusa to AICRIP and are being tested for the first time in IVT Boro 2013.

GEY/CI/ BR/16

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

One thousand recombinant inbred lines (RILs) from the crosses *viz.*, TN1 / Ptb 33, TN1 /Sinna sivappu, Samba Mahsuri /MO1 and NDR359 /MO1 were developed following single seed descent method of modified bulk breeding scheme. These RILs were screened for two consecutive seasons *i.e.*, *kharif* and *rabi* 2012 against mixed population of BPH and WBPH in field at Maruteru, a hot spot location and also an endemic area for natural infestation of planthoppers. The susceptible check as well as susceptible RILs showed severe hopper damage symptoms of complete drying and mortality. The insect counts of BPH and WBPH revealed seasonal variation. The data revealed the

predominance of WBPH over BPH during *kharif* at 60 days after transplanting whereas BPH was dominant during *rabi*. The insect pressure was so high that only highly resistant RILs could withstand WBPH insects as high as 600 per hill during *kharif*, 2012 and 790 BPH insects during *rabi*, 2012 with a damage score of 3. There were around 800 to 1000 WBPH insects (*kharif*, 2012) and 1200 to 2000 BPH insects (*rabi*, 2012) on TN1. Under this kind of severe hopper-burn situation 10 to 15 resistant lines (damage score-3**)** from each RIL population were identified. They survived without any apparent damage and remained green without wilting and could set seed. These lines would be registered as genetic stocks possessing high resistance to planthoppers and can be utilized as potential donors in planthopper resistance breeding programmes. These lines will also be assessed for yield and other agronomic attributes in replicated trials.

Information on resistant RILs selected under severe incidence of planthoppers

Parentage of cross	Designation	Damage score (BPH+ WBPH)	Number of insects per plant (*Kharif*, 2012)		Number of insects per plant (*Rabi*, 2012)	
			WBPH	BPH	BPH	WBPH
TN1 / PTB 33	RP 5448–RIL-501	3 (Resistant)	500-567	35-40	347-415	10-15
TN1 / Sinna sivappu	RP 5449–RIL-320	3 (Resistant)	495-600	35-40	470-790	10-15
Samba Mahsuri / MO1	RP 5435–RIL-216	3 (Resistant)	130-210	35-40	200-495	10-15
NDR 359 / MO1	RP 5316–RIL-243	3 (Resistant)	200- 520	35-40	120-459	10-15
TN1 (Susceptible check)	-	9 (Susceptible)	800-1000	35-40	1200-2000	10-15

GEY/CI/ BR/14

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

Seventy-two diverse genotypes consisting 40 entries of Green Super Rice (GSR)- 2nd batch, advanced lines, popular varieties, N22 mutants including checks were screened under graded levels of phosphorus (0, 20, 40, and 60 kg/ha) during *kharif* 2012 for assessing their tolerance to low P and response to its application. Mean grain yield of 3730 kg/ha was recorded with the application of 60kg/ha P and reduction of 25.73% and 37.53% in grain yield was recorded with 40 kg/ha P and 20 kg/ha P application, respectively. Maximum grain weight/hill at 20 kg/ha P was recorded (14.0 g/hill) by DRRH-3, whereas it was lowest in GSR-140 (1.08 g). Similarly, GSR-111 yielded highest (19 g/hill) at 40 kg/ha P application and GSR-123 recorded 21 g/hill grain yield at 60 kg/ha P application. Grouping of the genotypes into different categories *viz.*, tolerant, moderately tolerant, sensitive and highly sensitive to P deficiency has been done based on their performance under low P (1.5-2.0 ppm). Six genotypes namely, GSR-103, GSR-109, GSR-111, GSR-125, SM-363 and SM-686 were found to be tolerant to low P conditions as they could produce some seed and had more than 5 tillers/ hill and 17 genotypes bearing less than 5 tillers/hill and also could set seed were classified as moderately tolerant to low P conditions.

Grouping of genotypes based on their survival under very low P conditions

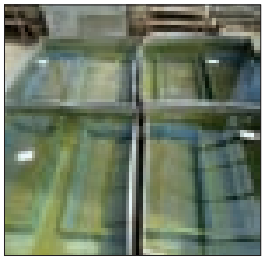
Particulars	No.	Name of Genotypes
Tolerant (genotypes with > 5 productive tillers with normal seed setting)	6	GSR-103, GSR-109, GSR-111, GSR-125, SM-363, SM-686
Moderately tolerant (genotypes with < 5 tillers and had seed setting)	17	DRRH-3, V6, 1139, GSR-101, GSR-102, GSR-104, GSR-105, GSR-106, GSR-110, GSR-113, GSR-114, GSR-116, GSR-137, GSR-145, NDR 359, Swarna, Rasi
Sensitive (genotypes just survived without seed setting)	18	Mahsuri, Tella Hamsa, KRH-2, Vardhan, 1137, 1136, GSR-112, GSR-115, GSR-117, GSR-118, GSR-119, GSR-128, GSR-130, GSR-135, GSR-138, GSR-143, GSR-144, IR 64,
Highly sensitive (genotypes failed to survive)	25	Sugandhmati, Prasanna, Vasumati, 4405, 4404, 4402, 4403, GSR-121, GSR-122, GSR-123, GSR-124, GSR-126, GSR-131, GSR-132, GSR-134, GSR-136, GSR-139, GSR-140, GSR-141, GSR-142, MTU 1010, Vandana,

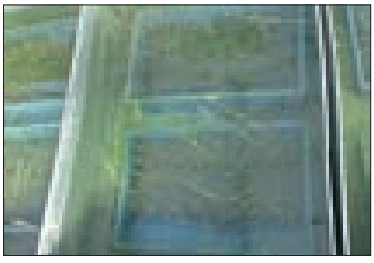
Progenies of 1354 selected F_3 plants belonging to 10 crosses wherein Swarna and Rasi were used as donors for low P tolerance were raised under sub-optimal level of phosphorus during *kharif* 2012 and based on comparative growth and other agronomic attributes including grain type, more than 1600 single plants were selected. Seventy-six new crosses involving donors from NE germplasm were successfully attempted.

GEY/CI/ BR/17

Development of high yielding rice varieties for conservation agriculture (K. Suneetha)

Six hundred and twenty seven diverse genotypes consisting of germplasm, aromatic short grain (ASG), soft rices, *O. nivara, O. rufipogon, O. glaberrima* introgression lines, IURON and AERON materials and released varieties were evaluated under direct seeded condition during *kharif* 2012. Aromatic short grain genotypes *viz.*, ASG73 (5107 kg/ha), ASG1 (4893 kg/ha), ASG235 (4893 kg/ha), ASG33 (4786 kg/ha) and ASG30 (4750 kg/ha) exhibited superior performance under direct seeded condition. These very tall statured landraces possessing sturdy stem without much yield penalty are potential donors and can be used in genetic improvement of rice for direct seeded condition. Other genotypes such as Maju chokua 2, Lahi chokua, CT15691-4-5-2-2-1-M, IR82589-B-B-44-2, IR82635-B-B-47-1, IR82635-B-B-72-2 and IR82589-B-B-2-2 also exhibited superior performance under direct seeding. The genotypes RP5129-17-8-3-2, IURON 74, IURON 82 were found to be promising for root characteristics. Three hundred and seventy eight F_3 families derived from the crosses namely, IR64 / Sabita, IR64 x IR79906-B-5-3-3, IR64 x CR691-58, IR64 x B644F-MR-6-0-0 and IR79906-B-5-3-3 x Sabita were evaluated in three row pedigree along with their respective parents under direct seeding condition and 256 superior segregants were selected. The promising genotypes identified are being utilized in hybridization to generate segregating populations. Six new crosses for direct seeding and 13 crosses for anaerobic germination (1) E773 x IURON102, (2) E773 x IURON31, (3) E778 x IURON102, (4) E1701 x IURON102, (5) E773 x IURON49, (6) E778 x IURON31, (7) E1777 x IURON102, (8) E1763 x IURON31, (9) E1049 x IURON49, (10) IURON59 x E1763, (11) IURON31 x E773, (12) IURON31 x E753 and (13) IURON59 x E1049 were made to study the genetics.





GEY/CI/ BR/19

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

More than 1100 diverse rice genotypes comprising of N22 mutants, introgression lines (ILs) from wild, AICRIP genotypes, parental lines of hybrids, land races from NEH, Tropical *japonicas* and wild rice acessions were screened for resistance to sheath blight disease during *kharif* 2012. In the preliminary screening, a total of 38 genotypes which include one each from N 22 mutant, introgression lines, AICRIP entries, B lines, 6 tropical *japonica* accessions, 18 landraces and 10 wild rice accessions showed a resistance score of 3 whereas 95 genotypes belonging to various groups recorded disease score of 5. Among the previously reported promising genotypes, Tetep and Teqing recorded disease score of 5 and 7 respectively. The genotypes with disease score of 5 or less are being screened under glass house conditions during *rabi* 2013.

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)

During *kharif* 2012, five hybrids developed at DRR *viz*., DRRH-83 (MS), DRRH-84 (MS), DRRH-85 (MS), DRRH-86 (MS) and DRRH-87 (MS). Among these, one hybrid DRRH-85 based on its excellent yield performance has been promoted to further evaluation. In a station trial, of the 36 hybrid combinations evaluated, six promising ones were identified.

Promising crosses identified (*kharif* 2012)

S. No.	Promising hybrid
1.	APMS 6A/BK 52-104
2.	Pusa 5A/BK 52-104
3.	IR 58025A/3005
4.	APMS 6A/BK 49-42
5.	APMS 6A/BK 49-120
6.	IR 79156A/BK 49-120

Out of 250 test crosses evaluated, 40 restorers and 28 maintainers were identified. Hybrid seed of 10 experimental hybrids was produced by barrier isolation method and 12 CMS lines were multiplied. The nucleus seed of the parental lines of DRRH-2 *viz*., IR 68897A (30 kg), IR 68897B (50 kg), DR 714-1-2R (50 kg); DRRH-3 *viz*., APMS 6A (50 kg), APMS 6B (100 kg) and RPHR 1005 (100 kg) were produced.

GEY/CI/HY/7

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

Fifteen promising genotypes were identified from the available breeding materials and crosses were attempted with tropical *japonicas* to infuse new variability in the restorer improvement. The promising restorers were crossed with different donor parents to introgress disease resistance genes in to the parental lines *viz*., RPHR 1096 x B 95-1, RPHR 1096 x Kavya, BCW 56 x RP Bio 226, BCW 56 x Kavya RPHR 612 x RP Bio 226. Five TGMS lines were evaluated under different temperature regimes to find their fertility behavior. Around 250 test crosses and 20 varietal crosses were made for further evaluation. Of the 250 test crosses evaluated, 15 promising hybrid combinations were identified for further evaluation. The promising single plants (around 100) were selected from the breeding materials in various segregating generations.

A promising restorer

Restorer line improvement with tropical *japonica* lines

RPHR-1005 x TJ 261	RPHR-1096 x TJ 228
RPHR-1005 x TJ 282	RPHR-1096 x TJ 279
RPHR-1005 x TJ 261	IBL-57 x TJ 243
RPHR-1005 x TJ-203	IBL-57 x TJ 230
RPHR-1096 x TJ 248	IBL-57 x TJ 258

GEY/CI/ HY/8

Breeding of parental lines and hybrids suited to aerobic and salinity/alkalinity conditions (P. Senguttuvel)

Twenty eight rice genotypes were screened under three water regimes (direct seeded, alternate wetting and drying and normal transplanted) and the genotypes *viz*., B644F-MR-6-0-0, DR2-IR 80013-B-1, IR79913-B-2, AYT 4, G719-SAL51-74101-3, IR82635-B-4, IR79915-B-83-4-3 and DSE316 were identified as promising for aerobic situation. D4098, SAGC 02, WANXIAN 77, ZHONGHUA 1 and weed tolerant rice 1 from 45 Green Super Rice lines evaluated were promising for aerobic situation. Two hybrids found suitable for aerobic conditions were IR58025A/ L2182, IR58025A/ ABHR65-R1207-SV25-4-1R (3005) and one for salinity *viz.*, IR58025A/363-12 and these have been nominated to AICRIP trials. Of the 44 hybrids evaluated in station trial under direct seeded conditions, promising combinations identified are IR 58025A/ABHR237-MACT93-3208-10-1R, ABHR74-RC154-14-B5-21-1R, SALHR197-IR72046-B-R-7-2-2-1R, SALHR96-IR72049-B-R-22-3-1-R, SALHR94-IR72593-B-3-3-5R, BK36-167 and BK49-42. IURON entries *viz.*, IR10L105, IR71146-97-1-2-1-3, IR09L179, IR78933-B-24-B-B-4 and IR83142-60 performed well under direct seeded aerobic conditions

Promising early maturing rice genotypes under direct seeded aerobic conditions

Based on 157 test crosses evaluation, the genotypes namely IURON47, IR79906-B-192-1, IR79971-B-475-1, CR6, ARSN316(DS), RP13, RP23, M16, 463, 3309 and ARSN 128-IR79913-1 were found to restorers whereas entries *viz.*, DS03-103, SN115-220 and AYT 24 were maintainers. These abiotic stress tolerant lines are being used in parental line improvement. 265 crosses involving different set of germplasm tolerant to abiotic stresses were successfully attempted.

GEY/CI/HY/6

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

Twenty eight maintainers were identified from 650 source nursery entries evaluated and some promising maintainers are OR2314-4, CR2389-5-2-1-1, CR2702-194, CR2702-11-8, Pusa5001-8-3-4, OR2345-19, CN1324913-303, RGL7003, RGL7004, IRC2008-3 and OR2325-12. The same 28 maintainers were also screened against BPH and WBPH in standard seed box screening. One entry TCP211 was found to be moderately resistant to both BPH (DS-4.9) and WBPH (DS-4), remaining entries were susceptible to both the hoppers. Identified maintainer lines are used for conversion into new CMS lines. They are in different generations which include APMS6A / TukadUNDA, IR79156A/OM 6377/Pusa 5A/CR2652-14 and IR68897A / CN1223-5-4-3-2. Several maintainer / maintainer crosses were made for genetic improvement of maintainers with focus on stigma exertion trait. Among the 8 genotypes phenotyped (five plant basis) BF-16B was found to have very high stigma exsertion (80.25%) which is much higher than APMS 6B (14.97%).

Crosses attempted (*kharif* 2012)

Female/ Male	DRR-9B	DRR-6B	IR-79156B	BF-16B	BF-2096
IR 68897B	√	√	√	√	√
APMS-6B (Improved)	√	√	√	√	√

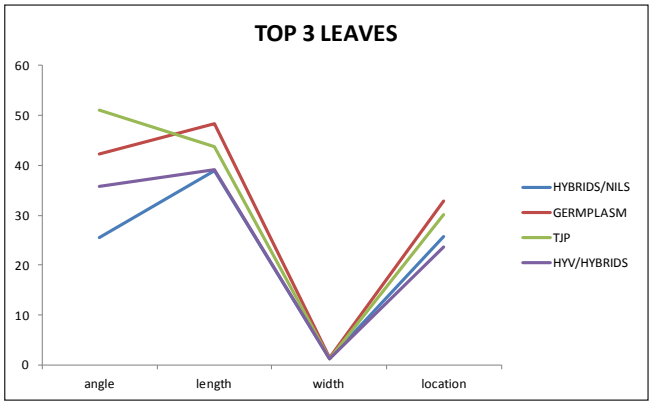
Parental polymorphism study using eight reported markers for stigma exertion has not showed any polymorphism for all the parental combinations hence, polymorphism studies for all the chromosomes is being planned.

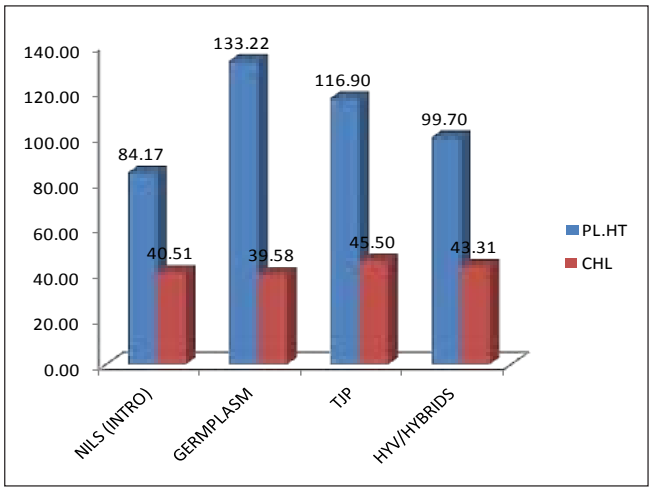
GEY/CP/ PP/12

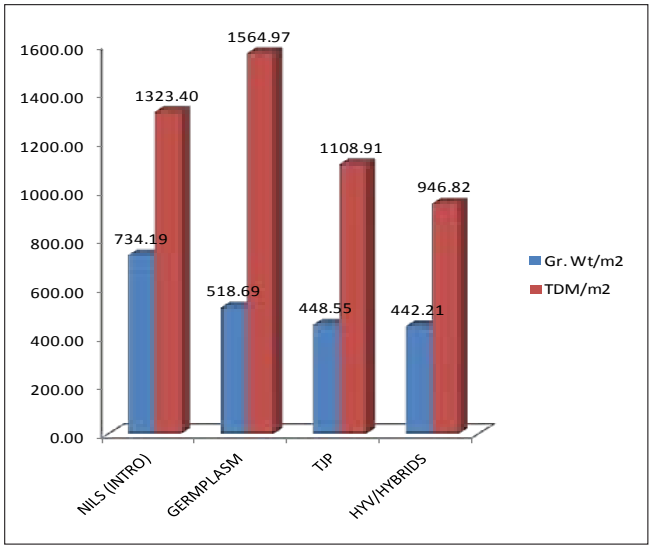
Physiological studies for improving ideotype breeding in rice (P. Raghuveer Rao)

Eighty two diverse genotypes comprising introgression lines (ILs) derived from KMR-3 x *O. rufipogon* and Swarna x *O. nivara*, restorer lines, germplasm accessions, advanced brreding lines, tropical *japonica*, high yielding varieties and hybrids were evaluated for different plant type characters based on physiological parameters for identifying suitable donors for using them in ideotype breeding. Plant height was higher in germplasm followed by Tropical *japonica* (TJP), high yielding varieties (HYV) and lowest in ILs. Leaf area Index was higher in TJP followed by germplasm, stem thickness was high in TJP and lowest in germplasm, chlorophyll was highest in TJP and lowest in germplasm. Quantum yield of light reaction of photosynthesis was higher in ILS/TJP/germplasm. Leaf angle to the main stem was higher in tropical *japonicas* (TJP) / germplasm / HYV and lowest in ILs. Biochemical parameters such as proteins, phenols, total soluble sugars and reducing sugars were estimated and it was found that they were high in ILS/HYV/TJP and germplasm. As per yield and biomass is concerned it was higher in ILs / germplasm/TJP.

Ideotype characters *viz.*, Top 3 leaves, plant height, chlorophyll contents, grain weight and total dry matter







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)

IET 22787 (RP4594-121-148-24-11) derived from the cross Basmati Kota / IET 16313 recorded 20.92% yield advantage over Pusa Basmati 1 the best check in region 3 (western UP) and promoted to AVT-1 BT. It has strong aroma and desirable basmati quality traits with moderate resistance to neck blast and gall midge biotype 4.

A total of 1855 lines of 47 crosses from various generations were evaluated in the field and 1826 single plant selections (SPS) were made. All the lines were screened for BLB and leaf blast in the field and major quality parameters. Among these, 274 lines exhibited high kernel length after cooking (KLAC) of which 245 possessed 15.1 to 17 mm and 29 showed 17.1 to 20 mm elongation which resulted in selection of 1184 SPS. RP5237-Vasumati/IET 18004, RP5250-IET 18033/IET 19492, RP4594-Bas.Kota/IET 16313 and IET 5238-Vasumati/IET 19492 were the promising crosses. A set of 203 gentoypes belonging to traditional Basmati, evolved Basmati, aromatic short grain rice, exotic aromatic rice, non-aromatic *indica* and *japonica* were analyzed using a set of 26 EST-SSR markers uniformly distributed across the rice genome. The traditional Basmati genotypes could be clearly distinguished from other genotypes (*i.e.* evolved Basmati and aromatic short grain rice varieties) using a combination of two to three markers, while a few traditional Basmati genotypes amplified a unique allele with some markers. We have also identified markers specific for the notified traditional and evolved Basmati genotypes.

Based on quality testing, genotyping and phenotyping for BLB resistance in the glass house of advanced basmati pyramided lines (BPLs) 80 bulks and 345 SPS were made during *rabi* 2012. 18 lines in the background Taroari Basmati and Basmati 386 introgressed with three genes (*Xa21*, *xa13*, *xa5*) and 206 lines with 2 gene combinations (*Xa21+ xa13*, *Xa 21+xa5*, *xa 13*) and 125 lines with individual BLB R genes (*Xa21/xa 13/xa5*) were identified. These lines on phenotyping showed high degree of resistance to BLB in the glass house testing. Among these, several lines have aroma, medium slender to extra long slender grains with high kernel elongation on cooking. 430 BC_1F_1 plants derived from crossing BPLs with new recurrent parents (RP) *viz.*, Vasumati, Vallabh Basmati, IET 18006, Pusa Sugandh4, Sugandhamati and Super Basmati were genotyped with markers linked to the BLB and Blast genes and 93 and 33 BC1F1s were found positive for two genes (*Xa21* and *PiK^h*) and three genes (*Xa21*, *PiK^h* and *Pi2*) respectively. The three genes positive plants were backcrossed with respective recurrent parents and 345 BC_2F_1 plants were generated.

Genotypic and phenotypic data of desirable aromatic Basmati Pyramided Lines (BPL) introgressed with BLB R genes

Sl. No.	BPL Line No	Recurrent Parent	Genotypic data			BLB score	Grain type
			Xa 21	*xa 13*	*xa 5*		
Xa 21, xa 13, xa 5							
1	BPL-4	Bas 386	√	√	√	1	MS
2	BPL -6	Bas 386	√	√	√	1	MS
3	BPL -23	Bas 386	√	√	√	1	LS
4	BPL -57	Bas 386	√	√	√	1	LS
5	BPL -81	T Bas	√	√	√	1	LS
6	BPL -86	T Bas	√	√	√	1	LS
7	BPL -99	T Bas	√	√	√	1	LS
8	BPL -129	T Bas	√	√	√	1	LS
Xa 21, xa 13							
9	BPL -1	T Bas	√	√	X	1	LS
10	BPL -3	T Bas	√	√	X	1	LS
11	BPL -5	Bas 386	√	√	X	1	
12	BPL -25	T Bas	√	√	X	3	LS
13	BPL -35	Bas 386	√	√	X	1	LS
14	BPL -37	Bas 386	√	√	X	1	LS
xa 13, xa5							
15	BPL -97	T Bas	X	√	√	1	LS
16	BPL -102	T Bas	X	√	√	3	LS
Xa 21							
17	BPL -13	Vasumati	√	X	X	3	LS
18	BPL -14	Bas 386	√	X	X	1	LS
xa 13							
19	BPL -9	Bas 386	X	√	X	3	LS
20	BPL -11	Bas 386	X	√	X	3	ELS
21	BPL -12	T Bas	X	√	X	3	LS
22	BPL -27	T Bas	X	√	X	3	ELS
xa 5							
23	BPL -64	Bas 386	X	X	√	3	LS
24	BPL -65	Bas 386	X	X	√	3	ELS

MS: Medium slender, LS: Long Slender, ELS: Extra Long Slender

DRR initiative on soft rice

A collection of seventy five soft rices, Bora (glutinous) and Chakua (semi-glutinous) from Assam were evaluated. Physico-chemical quality analysis revealed that the amylose content (AC) ranged from 5.59% to 26.10%. The AC of *bora* rices was <10 % while in *chakua* rices it varied from 10-20% with few exceptions. The milling and head rice recovery was high but the grains were completely opaque.

GEQ/CI/BR/13

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

For developing aromatic short and medium grain varieties, large number of segregating lines were evaluated from crosses between selected donors for yield and aromatic short grain varieties and promising genotypes identified. These include 1174 single plant selections (SPS) made from 21 F_2 populations; 203 SPS from 2253 segregating breeding lines in 2 row pedigree nursery. Twenty seven F_1 crosses are carried forward to F_2 generation. A total of 2253 entries in 2 rows were screened for bacterial leaf blight and leaf blast disease under artificial condition of which 435 lines were found moderately resistant to resistant to bacterial leaf blight and 11 were resistant to leaf blast.

Promising aromatic short grain lines

GEQ/CI/BR/8

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

One medium duration semi dwarf culture derived from the cross BPT 5204 X Chittimuthyalu possessing short bold grains, with high yield potential (> 4.5t/ha) and containing high iron (31.2 ppm) and zinc (40 ppm) in brown rice was identified with good quality characters *viz.*, high HRR% (67.5%), intermediate ASV (5.01), AC (24.05%) with mild aroma was nominated to AICRP, *kharif* 2012 with IET No. 23191. This entry was evaluated during at 23 locations with Badshah Bhog and Kalanamak as checks during *kharif* 2011. It has recorded overall mean grain yield of 2885 kg ha^{-1} which is on par with the checks and recommended for inclusion in the rice biofortification trial constituted during *kharif* 2013.

Three hundred fifty selections were made from F_5 and F_6 generations and another 250 selections were made from F_4 generation for high Fe and Zn lines developed at DRR through conventional breeding. Fifty four elite lines selected from different parts of the country were screened for high Fe and Zn at different locations *viz*., 1) DRR, Hyderabad; 2) GKVK, Bengaluru 3) RRS, Chinsurah 4) Dept. of Rice, Coimbatore 5) UAS, Dharwad. It was found that Fe and Zn contents (ppm) ranged from 9.8 to 20.3 and 26.2 to 51.9; 7.2 to 23.5 and 12.4 to 39.5; 7.4 to 17.4 and 13.2 to 39.4; 7.5 to 16.6 and 6.8 to 24.5; 8.6 to 59.3 and 12.2 to 28.1 at these locations respectively. All these 54 lines were also sown during *rabi* 2012-13 to study the seasonal effects. On overall basis out of 54 lines evaluated, 28 lines recorded high Fe (>12.0 ppm) and 11 lines high Zn content (>25 ppm) were shortlisted for further investigation. More than 400 landraces were evaluated for Fe and Zn during *kharif* 2012 and lines with > 15 ppm Fe and >35 ppm Zn were selected which would be used in the breeding programme for developing high Fe and Zn lines. Another 45 landraces of North-East region received from NIN were evaluated and identified lines with high Fe (16.2 ppm) and high Zn (45.3 ppm) were identified. During *kharif* 2012, 90 crosses were made involving donors with high Fe and Zn, high protein and high bran oil for further evaluation. Thirteen stable and fixed lines with high Fe and Zn received from Harvest Plus were evaluated and best five lines were selected with 35.6 ppm Zn and 13.1 ppm Fe which would be nominated to AICRIP trial on biofortification. One high yielding line derived from the cross BPT 5204 X Chittimutyalu with medium slender grains and high Fe (11.8 ppm) and Zn (38.8 ppm) identified for inclusion in AICRIP trial on biofortification.

GEQ/CI/BR/20

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

Two rice based products *viz.*, Rice Moisturizing Lotion and Rice Pain Relieving Gel with rice bran oil as key ingredient were developed for the first time in India at DRR. The moisturizing lotion is non-sticky and smooth after standardization of 5-15% rice bran oil and 1-5% brown rice content. Other key ingredients of the product are water and glycerol. Due to brown rice, the product also contains Oryzanol, vitamins and other nutrients and antioxidants like tocopherols, tocotrienols, phytosterols. The product is suitable for normal and oily skin. The product has been named as “Rice Riche Moisturizing lotion”. Feedbacks from volunteers were collected. All the users (100%) reported that the product does not cause any irritation, redness, rash or any negative effect and further reported that there was no

itching, burning or soreness after its use. At the same time the users felt that the skin becomes supple and hydrated after application. An oily gel for releiving minor aches and pains of muscles and joints associated with simple strains, bruises and sprain was also developed. The product has been named as "Rice Riche Pain Releiving gel". It contains rice bran oil (20-40%) and other analgesic ingredients (camphor, menthol, methyl salicylate, eucalyptus oil). Since rice bran oil is an active ingredient of the formulation, it gets absorbed very well and provides quick relief. All the users reported that they are satisfied or extremely satisfied with the performance of the product. Majority of the respondents (71.5%) felt that this product is better than the available products in the market. While, 28.5% users reported that the product is at par with the available products.

Rice bran oil based products

GEQ/CI/BR/18

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

Amylose content was estimated in the selected rice varieties and their status was identified as very low (2 to 9%), low (9 to 20%), intermediate (20 to 25%) and high (25 to 33%). Amylose content (AC) in the samples ranged from 6.3 to 29.07% . These AC values will increase if the sample weight lost due to moisture is added and this addition may also change their group position. Though grain moisture content ranged from 7 to 19% but it was around 14% in majority of the samples. In another experiment, it was found that ethanol is not a compulsory reagent for estimation of amylose content as there was no significant difference in amylose content recorded with or without ethanol. Similar amylose values were recorded when 0.01 N NaOH was used instead of 1N NaOH.

Selective nutrient profile of four rice genotypes *viz*., Aghoni bora, Swarna, Samba Mahsuri and DRRH-3 was done. Crude protein and fats, free sugars, soluble and insoluble starches, amino acid profile, total folate, total pyridoxine and panthothenic acid contents were estimated. DRRH-3 contains more crude protein; Aghoni Bora contains more free glucose and total-B6 while other tested paramaters were similar in all the varieties. Though percent loss of crude protein due to polishing was high in DRRH-3, protein content was more than the brown rice of other varieties.

Effect of moisture on amylose content

Sample No.	Moisture %	Sample wt (g) after moisture loss	Amylose content %	
			With moisture	Status
219	7	0.093	6.3	Very low
241	19	0.081	6.39	Very low
932	13	0.087	14.85	Low
1147	14	0.086	15.03	Low
852	11	0.089	22.32	Intermediate
556	13	0.087	24.84	Intermediate
552	9	0.091	29.07	High

ABR - Application of Biotechnology tools for Rice improvement

ABR/CI/BT/5

Introgression of yield contributing genes/alleles from wild species to rice using molecular markers (N. Sarla)

Three intogression lines (ILs) namely, IET 22625 (Swarna / *O. nivara*), IET 22632 (KMR3 / *O. rufipogon)* and IET 22626 (KMR3 / *O. rufipogon*) recorded 85, 63 and 29% yield increase over best check and were promoted to 2nd year of testing in AL & ISTVT trial of AICRIP. Other KMR 3 derived ILs *viz.*, IET 21944 (KMR3 / *O. rufipogon*) and IET 21943 (KMR3 / *O. rufipogon*) were promoted to third year of testing in CSTVT. Five ILs each of Swarna and KMR3 were also selected for allele mining for drought and salinity since they performed well in those stresses. IL RP4918-212 (Swarna / *O. nivara)* and RP4918-228 (Swarna / *O. nivara)* were identified as promising against 5 and 4 pests respectively in multiple resistance screening trial of *kharif* 2012. Nine genes which showed differential expression were identified between KMR3 and the elite IL 50-7 in the *yld2.1* region based on transcriptomics and real time expression data of leaf and panicle.

ABR/CI/BT/6

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

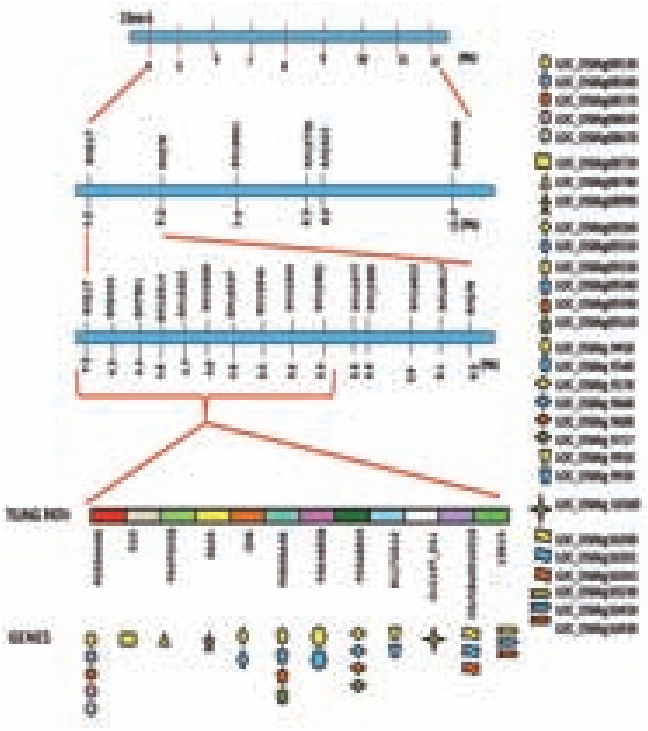
Among the 108 primers designed from eight cloned genes for yield components and 12 genes associated with grain filling (translocation process), twenty one primers showed polymorphism between Rasi and IC114927. Selective genotyping of polymorphic markers in eight groups comprising F_2 individuals of Rasi / IC114927 cross with high and low grain filling in upper and lower portions of the panicle showed association of three genes specific primers. Polymorphisms associated with *OsSPL-14* (SQUAMOSA PROMOTER BINDING PROTEIN LIKE) also known as WFP (wealthy farmer's panicle) showed association with higher yield *per se* in a mapping population (Fig). On screening of 70 germplasm lines (characterized for their grain filling) showed the presence of only two alleles. For expression analysis, 27 primers covering six genes (*AGPase*, *Apo1*, *Ghd7*, *qGW2*, *SUT1*, *WFP*) were tested and nine primers have shown clear amplification in RT-PCR in leaf and three stages of panicle.

Segregation of the marker targeting *Os SPL14* in the mapping population

ABR/CI/BT/8

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

A major QTL (*qGT-6*) which contributes 30.7% phenotypic variance for gelatinization Temperature (GT) was mapped in the interval of RM217- RM 276 on chromosome-6 spanning around 2.04 Mb. The RIL population developed from RB2816 and Pusa1401-97-7-1-5 was utilized for fine mapping, data obtained from single plant analysis of 18 polymorphic markers was used which led to the narrow down the *qGT-6* between RM 217 (4.2 Mb) - RM 19562 (5.35 Mb) and thus the *qGT-6* is narrow down to the around 1Mb from the initial mapping of 2.04 Mb. This QTL also differs in its location from the reported QTLs like Waxy locus, which was reported in many *japonica* populations. There were 12 BAC/PAC clones exist in the mapped region, in that 29 expressing genes were found, whose expression was checked using the expression database. Efforts are on to develop the candidate gene based markers to identify the genes underlying the effect of this QTL. Stability of the *qGT-6* was tested in Maruteru and Mandya and it showed the same phenotypic variance at a LOD score of 10.95, which shows that *qGT-6* is stable and a major QTL for the gelatinization temperature. QTL was validated in another RIL population derived from the cross RT206/ Jaya.



Fine mapping of *qGT-6*, a major QTL for Gelatinization Temperature

ABR/CI/BT/9

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

Three events (IC-5, AIC-2 and AIC-3) of Bt transgenic rice with *Cry1Ac* in the background of IR64 generated earlier were advanced up to T6 generation. Progenies of all these lines were screened by PCR analysis with *Cry1Ac* gene specific primer and almost all these plants were observed to be in homozygous condition. Twenty homozygous lines from each event of T6 generation were selected for bioassay against YSB (both cut stem and whole plant). Considering the damage score (dead hearts and white ears), grain filling and other phenotypic characters, only eight plants were short listed as the best performing lines (three plants from the Event # AIC 3-5-27; three plants from the Event # IC 5-4-20 and two plants from the Event # AIC 3-2-8) and found to be very good lines for further biosafety related trials.

One of the three independent events of transgenic rice with *AtDREB1A* gene (BD-33) developed in the background of BPT5204 was further advanced to T5 generation. Homozygous plants of T5 generation were screened for drought stress along with non-transgenic control BPT5204, Vandana and Rasi by withholding irrigation for 3-4 weeks both at vegetative and reproductive stages. Most of the transgenic lines showed greater tolerance up to three weeks. Tolerant lines at vegetative stage (21 day stress) were further screened for drought stress at booting and anthesis stages in real time situation in transgenic screen house conditions and subjected for 30 days stress along with Vandana, Rasi and wild type controls. All transgenic lines were greenish, without any wilting or drying, whereas wild type controls, Vandana, Rasi plants completely dried up.

a. Evaluation of transgenic BPT5204 for drought tolerance at vegetative stage b. Evaluation of transgenic BPT5204 for drought tolerance at reproductive stage

ABR/CPT/PATH/16

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

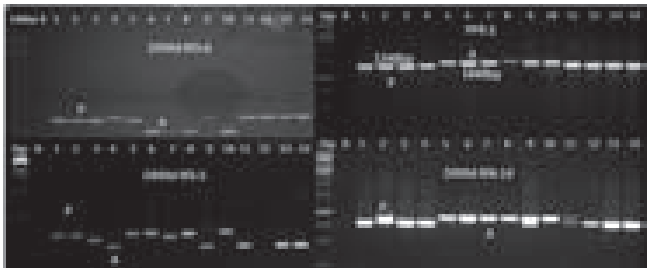
The complete RNA genome sequence (1271 nt) of south Indian isolate of Rice Tungro Spherical Virus (RTSV) was done and it codes for putative typical polyprotein of 3470 amino acids. Multiple alignment with other RTSV isolates showed its nucleotide sequence identity of 95 % to east Indian isolates and 90% to Philippines isolates. Twelve recombination events were detected in genome of RTSV using the Recombination Detection Program version 3(RDP3). Recombination analysis suggested significant role of 5' end and central region of genome in virus evolution.

Analysis of possible recombination in full-length RNA genome of RTSV isolates from India and Philippines. 12 recombination events (15 recombination sites) were detected in genome of RTSV. Each RNA segment is indicated by different colour bar.

ABR/CI/ HY/9

Molecular breeding for Parental Line Improvement in Hybrid Rice (P. Revathi)

Sixty three genotypes were found with both *Rf3* and *Rf4* genes out of 124 entries of IIRON modules of INGER screened. Two cultures namely, KMJ-135S-3-1-3 and Koimurali were also found to be restorers among 42 Assam cultures.



Screening with candidate gene based markers
(P- Restorer, A- Non restorer)

In restorer development programme, Swarna, Samba Mahsuri, Kavya and Improved Samba Mahsuri were crossed with RPHR1005, RPHR1096, RPHR1004, IBL57 and tropical *japonica* lines. F_2 populations of Swarna X IRGC48960 and Sampada x IRGC 44455 were genotyped for S5 MMS and found 1:2:1 segregation ratio. Forty two *Oryza rufipogon* accessions were screened for S_5 neutral allele and all were carrying S_5^n.

DRCP102 restorer and DRCP105 maintainer GMS population crossed with donors of biotic resistance were in fourth cycle of recurrent selection. Twenty BPH resistant F_3 plants from the cross RPHR1096 x IR71033-1-121-15B (*bph 20* and *21*) were advanced to F_4. A cross between DRR9B x

IR71033-1-121-15B (*Bph 20* and *21*) and DRR 9B x Tetep (blast) were advanced to F_5 generation. RPHR1096, DRR9B lines were again crossed with donors of BLB, blast and BPH resistance and backcrosses were attempted. Twenty hybrids along with three checks were evaluated for RTV. Phenotypic and genotypic evaluation (ORF-1 primer) revealed that hybrid DRRH2 is resistant against rice tungro disease and remaining all hybrids showed moderate resistance for tungro virus.

Other Research Related Activities

Mega seed project

Under Participatory seed production, 22 farmers were identified in 16 villages/*tandas* and more than 1221.0 quintals of quality seed of Improved Sambha Mahsuri, Krishna Hamsa, Akshyadhan, Varadhan, Sampada, DRR Dhan38, DRR Dhan39, Vasumathi and Kasturi were produced of which 342 quintals of seed was procured by DRR on payment basis for supplying to farmers and private and government seed agencies.

Establishment of National Rice Resource Database (ENRRD)

As per the primary objective 3080 germplasm accessions were evaluated in an augmented randomised experimental design. Each germplasm accession was represented by 3 rows of 4 m length with a spacing of 20 x 15 cm. 30 qualitative and quantitative characters were recorded.

DUS tests in rice 2012-13 and registration with PPV &FRA

Fourth set of 21 candidate varieties for DUS tests in rice were conducted for first season / year during *kharif* 2012 at DRR, Hyderabad. In addition 9 VCKs / Extant varieties, 623 Farmers varieties, 12 panicle sets for uniformity and 26 candidate varieties from third set of candidate varieties under 2nd year DUS testing were also grown for evaluation.

So far, DRR has facilitated the registration of 92 Extant notified rice varieties with PPV&FRA of which 8 varieties belong to DRR (Improved Samba Mahsuri, Krishna Hamsa, Dhanrasi, Sugandhamati, Vasumati, Jarava, Shanthi & Triguna). This year, registration certificates for 29 varieties have been issued by the Authority (Appendix 3).

Characterization and evaluation of germplasm

Agro-morphological characterization (20 Characters) of 915 germplasm accessions received from NBPGR was carried out at DRR in *kharif* 2012 and the same set was multiplied and dispatched to 30 centers for multilocation evaluation *i.e.* agro-morphological characterization at 8 centers and screening for biotic stresses at 22 hot spot locations.

Resistant/tolerant accessions identified for various biotic stresses

Pest and Diseases	Resistant/Tolerant Accessions.
Plant hoppers	IC. Nos 459646, 17065, 86004, 449784 and 450029
White Backed Plant Hopper	IC. Nos 450058,544895, 450584
Brown Plant Hopper	IC Nos 449784 and 450029
Stem Borer	IC. Nos 450128, 450122, 450120, 450135, 461155, 459621, 545441, 17090, 17092, 17098, 450388, 450566, 450598, 449551, 459351, 459352, 449654, 449656, 449781, 449823, 450497, 449822, 544953, 450027, 449994, 450015, 353862, 413638, 334058, 337626, 342620, 346207, 114180, 320875, 320872, 145370, 450538.
Leaf Folder	IC. 449877
Case Worm	IC. 450150
Blast	IC. Nos 450165, 459639, 459652, 17089, 450386, 450465, 450400, 461808, 450516, 544868 and 450052
Sheath Blight	IC. Nos 449829, 86009, 449948, 450296 and 449668.
Bacterial Blight	IC. Nos 450305, 461160, 461818, 449553, 449798 and 545470.
Sheath Rot	IC. Nos 450385, 450387, 450424, 450557, 450595, 353862, 381962 and 351756.
Brown Spot	IC. Nos 346207, 450632 and 450123.
Tungro	None

RUE – Enhancing Resource and Input Use Efficiency

RUE/CP/AG/10

System of Rice Intensification (SRI) - potential and sustainability (R. Mahender Kumar)

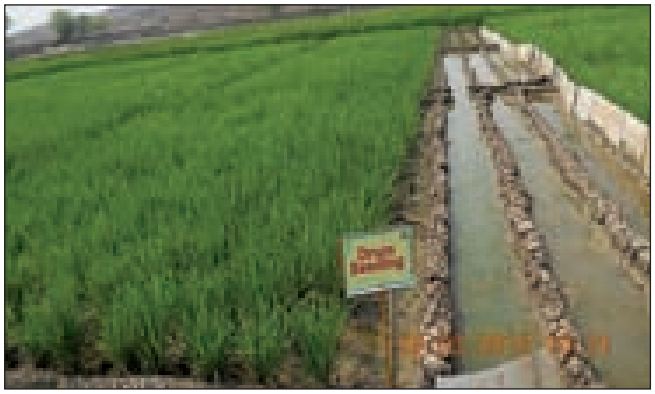
Evaluation of SRI method with 24 varieties of different durations indicated its better performance in terms of higher grain yield over conventional method. It was observed that per day productivity is higher in SRI due to reduced duration of the crop by about 7-10 days. Hybrids performed well under SRI. The performance of SRI – with organics also gave comparable yield of SRI with 50 organic + 50 % inorganic during *kharif* season. The incidence of leaf folder, thrips and hispa was below ETL while white ears were low in SRI with 25% organics treatment (38.53% WE) and NTP with 100% organics treatment (34.45% WE) as compared to other treatments.

Soil dehydrogenase and microbial biomass carbon (MBC) were found significantly higher in SRI-organic (11−18% and 34−38%, respectively) and SRI-inorganic (9−50% and 6−34%, respectively) treatments over best management practices (BMP). The microbial populations (total bacteria, fungi and actinomycetes) were always found higher in SRI-organic and SRI-inorganic treatments over BMP.

Comparison of soil biological activity as influenced by SRI-organic, SRI-organic + inorganic and best management practices (BMP)

Treatment	Soil dehydrogenase (µg g^{-1}+soil 24 h^{-1})	MBC (µg g^{-1}+soil 24 h^{-1})
	1st *kharif*	
SRI-org	188	672
SRI-org + inorg	186	643
BMP	170	500
LSD (5%)	13.6	120.7
	1st *rabi*	
SRI-org	*	*
SRI-org + inorg	326	1218
BMP	267	1153
LSD (5%)	26.2	19.5
	2nd *kharif*	
SRI-org	97	623
SRI-org + inorg	110	605
BMP	82	450
LSD (5%)	14.8	151
	2nd *rabi*	
SRI-org	*	*
SRI-org + inorg	274	781
BMP	183	706
LSD (5%)	89.5	4.3

MBC – microbial biomass carbon; * = not analyzed; LSD = least significant difference



RUE/CP/AG/13

Suitable agronomic management practices for improving the productivity of aerobic rice (B. Sreedevi)

Field experiments for developing suitable agronomic management practices for aerobic rice indicated that a seed rate of 30 kg / ha with 20 x 10 cm line spacing for high yielding variety MTU1010 and 25 kg/ha with 25/30 x 10 cm spacing for hybrid DRRH3 to be optimum for better yields. Further, application of recommended nitrogen dose in 4

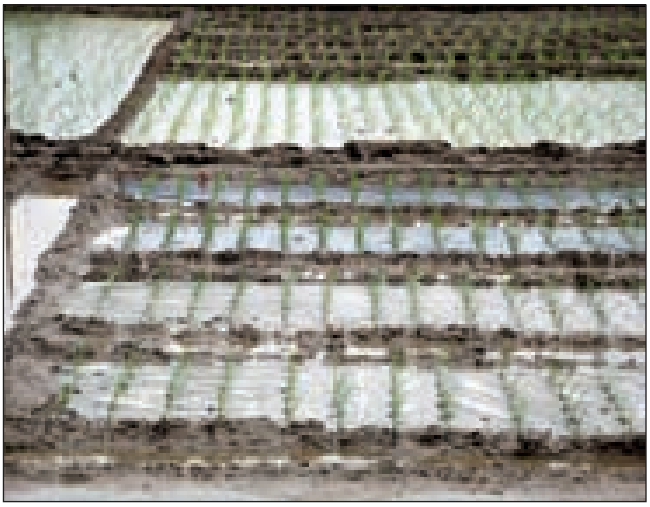
splits at flowering (¼ dose at 10-12 DAE; AT and PI stage) or ¼ dose at basal, AT, PI and flowering) was found to be optimum as against standard split application. Fertilizer dose of 100 % N, 75% of recommended P and recommended K per ha with combination of Azospirillum and PSB was found to be optimum with saving of 25% P fertilizer.

Weed management trial for aerobic rice trial indicated that combined application of herbicides (pendimethalin @ 1 kg a.i. / ha within 3-4 DAS) with bispyribacsodium 35 g at 15 and 30 DAS or chlorimuron + metsulfuronmethyl 40 g a.i. / ha at 25-30 DAS were found to be effective in suppressing the weeds and better yields.

Screening of early and mid-early advanced lines of varieties and hybrids during *kharif* 2012 indicated the superiority of 9 promising cultures for aerobic cultivation, *viz.*, RP 5213-69-13-7-4-1-2, LT50, RP 5214-38-14-9-5-2-1-B, 5218-49-13-9-2-1-1-B, ARP1, ARH2, ARH5, APR2 and ARH4.

RUE/CP/AG/14
Conservation agriculture studies in rice (B. Gangaiah)

A field study was conducted during *rabi* season to assess the effect of plastic mulching in transplanted rice grown under saturation moisture as compared to traditional flooded situation (control). The results indicated that mulching (4.65 t/ha) gave significantly improved rice crop yield over no mulching under saturation moisture regime (4.45 t/ha). However, the yields with mulching were statistically non significant with yields in traditional flooded conditions (4.79 t/ha). Saturated moisture regime saved 35% irrigation water and its integration with mulching has increased the water economy to 50% as compared to traditional flooded rice (100 cm). Plastic film mulching was also effective in suppressing the weed growth in rice crop. Cost benefit ratios are being worked out.



Plastic film mulching

Conservation Agriculture (CA) studies in rice during *kharif* season revealed that for unpuddled rice crop establishment through conventional tillage (CT), 5.24 x 10^3 MJ energy was required which was reduced by 62.5 and 87.6 % with rotary tillage (RT) and zero tillage (ZT). The yield data revealed that ZT and RT unpuddled rice encountered 25.7, 17.1% yield penalty as compared to CT (3.36 t/ha) rice.

Lodging management studies in direct wet seeded rice (WSR)

Studies to prevent crop lodging problem in direct wet seeded rice indicated that *dhaincha* cultivation in alleys of WSR without altering the rice crop productivity arrested crop lodging. The additional yield of *dhaincha* seed (0.36 t/ha) in WSR alleys has enhanced the rice equivalent yields (6.38 t/ha) significantly over rice cultivation alone (5.88 t/ha). This novel method in WSR reduced recommended dose of N (120 kg/ha) by 25% and also the lodging problems. Split application of potassium fertilizer failed to enhance the crop yields despite its role in reducing the crop lodging. Studies on wet seeded rice during *rabi* season to assess the role of *dhaincha* brown manuring revealed that besides effecting a 50% reduction in total weed count it contributed to 19 kg N to the rice crop.

Impact of potassium fertilization on productivity and lodging of wet seeded rice

K dose (kg/ha)	Time of K application	Grain yield (t/ha)	Mean lodging (%)
0	-	5.35	25.0
60	Basal	5.87	8.0
60	Basal + PI	6.00	2.5
90	Basal	5.91	6.5
90	Basal + PI	6.07	1.5
CD (p=0.05)		0.19	

SSP- Sustaining Rice System Productivity

SSP/CP/SS/12

Integrated nutrient and crop management to realize potential yields (K.V. Rao)

In *kharif* 2012, yield potential of 18 high yielding popular varieties in the duration group of 90 – 150 days was assessed under standard input management regime (120:50:60 40 kg NPKZn/ha) by fitting the data on crop phenology and weather parameters to Oryza 2000 Crop Growth Model. The estimated yields of the test cultures varied from were 2.6 – 11.0 t/ha reflecting the phenological events and growth rates estimated by the model which were mainly based on the values assumed in the model. The actual yields recorded on the field were 4.1 – 6.6 t/ha, which indicate a productivity gap of the test cultures of 1.0 - 6.5 t/ha presumably due to delay in transplanting of seedlings by almost 12-15 days. Further the model based potential yields were overestimated for varieties of mid late to late maturing group (>135 days). Among the crop parameters leaf area index (LAI) appeared to be critical in the estimation of potential yields.

SSP/CP/SS/11

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

The field experiment initiated in 2010 was continued during 2012 with 2 N levels (@ N-0 and N-100 kg/ha) as main treatments and 15 genotypes as sub treatments in a split plot design with 3 replications to evaluate the N use efficiency and to identify efficient rice genotypes for their responsiveness and use of soil and applied N. During *kharif*, all the genotypes recorded significantly higher grain yields at N100 (4.0-6.5 t/ha) over N0 (2.72-4.35 t/ha) and the mean % yield increase in N100 over N0 was 39%. During *rabi* 2011-12 also, grain yield was significantly higher at N 100 (5.26 t/ha) compared to N 0 (3.13 t/ha) which was higher by 68%. It is evident from the results that yield reduction in *rabi* due to reduction in N levels is higher as compared to *kharif* season. With regard to genotypes, all genotypes were

Estimated potential yields of popular varieties at DRR, *kharif* 2012

Varieties	PY (kg/ha)	GY (kg/ha)	Deviation (%)	Nu (kg/ha)	Pu (kg/ha)	Ku (kg/ha)	IEN (kg/kg)	IEP (kg/kg)	IEK (kg/kg)	NR (kg/t)	PR (kg/t)	KR (kg/t)
Akshayadhan	7556	6551	13.3	121.1	44.0	73.7	54.2	151.9	91.5	18.5	6.7	11.2
IET21542	8736	6220	28.8	115.4	38.9	75.6	54.1	169.5	86.2	18.6	6.3	12.1
Jarava	10994	6154	44.0	110.8	49.1	66.6	55.7	124.8	92.8	18.0	8.0	11.0
Jaya	7914	6052	23.5	111.7	42.3	68.6	54.3	143.2	92.4	18.4	7.0	11.1
PR113	7415	5856	21.0	115.4	40.4	74.2	50.7	145.8	79.2	19.7	7.0	12.7
DRRH3	6734	5675	15.7	99.5	42.5	69.4	57.4	135.0	83.0	17.6	7.5	12.3
Sampada	8736	5562	36.3	101.9	38.1	65.7	54.6	147.2	90.0	18.4	6.9	11.8
DRR Dhan39	8906	5383	39.6	105.6	39.1	60.0	51.0	138.3	90.5	19.6	7.3	11.1
NDR 97	9067	5242	42.2	94.4	35.1	64.4	55.8	149.2	87.6	18.0	6.7	12.1
Rasi	5447	4968	8.8	104.4	35.0	51.7	48.1	147.2	97.0	20.9	7.0	10.5
Swarnasub 1	10715	4932	54.0	98.6	30.9	46.4	50.0	165.7	109.3	20.0	6.3	9.4
Vikas	7640	4772	37.5	92.9	34.1	50.4	51.3	141.2	95.3	19.5	7.1	10.5
IR64	6633	4628	30.2	84.1	29.7	50.1	55.0	160.0	92.9	18.2	6.4	10.9
Swarna	10715	4482	58.2	92.2	32.9	50.2	48.6	138.0	92.7	20.6	7.4	11.3
Sahbaghidhan	2625	4463	-70.0	89.2	36.8	53.7	50.8	126.2	85.1	20.0	8.2	12.0
BPT 5204	10715	4201	60.8	81.2	31.9	49.1	51.9	136.1	88.7	19.3	7.7	11.7
Imp. Samba	10715	4194	60.9	97.6	33.6	56.4	43.1	125.9	77.5	23.3	8.0	13.4
Chittimuthyalu	7884	4069	48.4	89.1	27.1	60.5	46.3	172.3	69.0	21.8	6.5	15.1

superior at N100 over N0 in their grain yield. In the early group, all four genotypes were at par at N0 and at N 100. In the medium duration group, four genotypes were found to be more efficient in soil N utilization (3.1-3.8 t/ha at N0) and also responsive to applied N (5.7-6.1 t/ha). Most of the genotypes in this group recorded higher yields than early and late duration entries both at N0 and N100 levels. In the long duration group, Swarna was significantly superior to other two varieties with its consistent performance (by 20-35% higher yield) in both seasons.

Promising genotypes for high nitrogen use efficiency based on NUE indices

Kharif - 2011		
Early duration	**Medium duration (125-135)**	**Late duration (>145)**
Rasi	KRH 2	Swarna
Tulasi	Rp Bio 4918-248	
	Rp Bio 4919-458	
Rabi - 2011-12		
Tulasi	KRH 2	Swarna
Rasi	Rp Bio 4918-248	
	Akshyadhan	

SSP/CP/SS/9

Assessment of soil quality for improved rice productivity (Brajendra)

In order to economize the cost of inorganic fertilizers, a trial was conducted on fortifying the inorganic fertilizers. Over 30 % grain yield advantage was recorded in all the fortified treatments over control. Significantly higher nitrogen and phosphorus uptake in both grain and straw were recorded in manure fortified treatments over control and even over RDF. Higher nitrogen and phosphorus harvest index were recorded in both grain and straw in all the manure fortified treatments over control and RDF. Average nutrient requirement (kg/t grain) varied from a low of 14.4 to a high of 22.3 kg/t grain for nitrogen in manure fortified treatments and for phosphorus it varied from 1.9 kg/t grain to 3.6 kg/t grain. Post harvest soil assay was done and dehydrogenase activity measured was recorded higher in all the manure fortified treatments. Soil quality index were calculated in all the soil samples and was very good (>0.7) for manure fortified samples and was poor for soil samples under control (<0.2).

SSP/CP/SS/13

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

The population of nitrate ammonifying bacteria was enumerated in five different soils with varying soil characteristics with respect to carbon and nitrogen. The soils of DRR and Enabave village which contained detectable nitrate nitrogen content (modified Cataldo method) were found to support the highest populations of nitrate ammonifying bacteria. In addition, six nitrate ammonifying bacterial isolates obtained from enrichment cultures of these soils were biochemically characterized using gram character, catalase activity, and fermentation on Hugh leifson broth and Kovacs test and were found to belong enterobacteriaceae family.

Endophytic *Gluconacetobacter diazotrophicus* isolates from roots and shoots of rice varieties viz., Swarna, Rasi, Tellahamsa and Akshayadhan along with type culture stain PAL-5 were investigated for their ability to produce fructans and biofilms. Type culture strain PAL 5 of *G. diazotrophicus* which exhibited highest levan production (2.4 g levan / liter) when grown in LGIE medium and highest biofilm forming ability (OD of 1.21 at 590 nm in a crystal violet assay) was used for bacterization of surface sterilized seeds of rice variety Swarna. Germination assays after seven days of incubation showed that inoculation increased root and shoot length by 3.8% and 6.4% with a concomitant increase in vigour index of treated seeds by 5.2% . Germinated seeds were transferred to pots containing sterile soil and grown upto three leaf stage for analysis of fructans. Inoculated plants were found to accumulate around 200 µg of fructans per gram of fresh plant material. Thus it was observed that inoculation of *G. diazotrophicus* leads to increased fructan accumulation in rice plant which could be harnessed as a strategy for imparting tolerance to water stress.

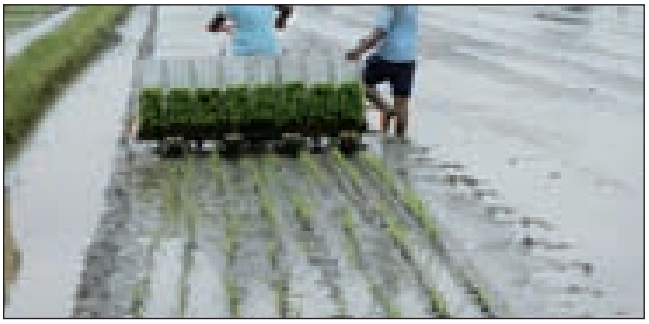
Nitrate ammonifying bacterial population in soils with varying chemical characteristics

Soils	Nitrate ammonifying bacteria (CFU/gDW)	Total soil C (mg/g)	Labile C (mg/g)	NH4-N (ug/g soil)	NO3-N (ug/g soil)	% soil moisture
Pokkali soils	3.6×10^3	84.13	10.89	150.19	-	49.67
Acid sulfate soils	7.3×10^3	34.47	15.53	498.94	-	23.43
Enabave soils	2.3×10^4	35.61	1.52	133.53	+	25.42
Patancheru soils	7.3×10^3	44.67	2.57	153.77	-	11.48
DRR soils	4.5×10^4	43.14	13.85	113.07	+	18.83

CP/ENG/6

Engineering: Selective mechanization in rice cultivation (T. Vidhan Singh)

The drum seeder to suit SRI cultivation with row to row spacing of 25 cm x 25 cm was developed and used for sowing pre-germinated seed. Attempts are being made to develop drum seeder using plastic material with size of the opening to ensure for minimum seed dropping. Prototypes for power operated broadcasting machine with uniform seed rate for better broad casting of the seeds are under development. Testing of Chinese transplanter for performance (VST Model) indicated planting was satisfactory with considerable savings in labour requirement. The machine can cover about 0.8 ha in a day with a net saving in labor of about 40 per cent.

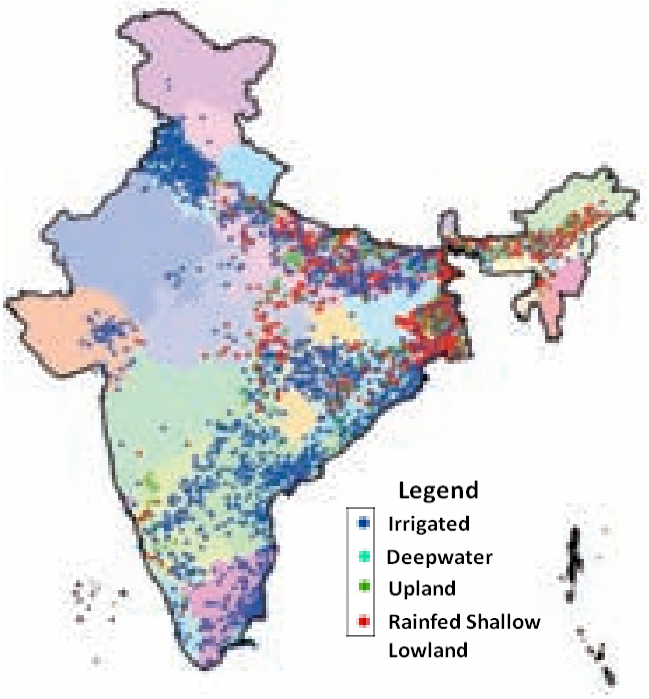


TTI/CP/CA/3

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

In India, rice is grown over a large spatial domain and wide range of landscape types. Modern space technologies can appropriately be utilized to derive the required information in shorter time. Parameters like soil, water, weather and crop are to be integrated with this spatial information for analyzing different situations. Hence there is a need to enhance decision support for rice growing ecologies using spatial technologies and crop models.

Secondary data on total rice area, irrigated area under rice at district level was downloaded from the Department of Agriculture website. Rice area under rainfed upland, deepwater and shallow low land were computed by using percentages of rice area under different ecosystems reported by Huke and Huke (1997). Dot density map was generated for the rice area under different ecologies using ARCGIS package. Dot density maps are used to represent precisely density of the attribute used in the map generation. From this map, it is easy to understand that Punjab showed high density for irrigated rice area and density of shallow low land rice is more in West Bengal. This map will be further used for comparing with satellite image data.



Decision Support System for Agrotechnology Transfer (DSSAT) was validated with nitrogen use efficiency experimental data of DRR, 2006. Comparison of Oryza 2000 and DSSAT showed good performance of both models and will be further validated.

CCR – Assessing and managing Crop Response to Climate Change

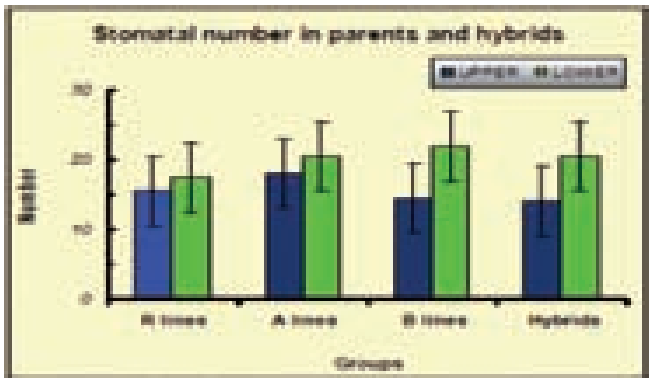
CCR/CP/9

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

Forty restorer lines, two A lines, four B lines and six released hybrids were grown in field for two consecutive years were assessed for heat tolerance. Hybrids and parents exhibited higher leaf rolling times (149-139 secs) with lower reduction in leaf area. Stomata number and aperture were supporting the above observation. Also, hybrids had lower leaf temperature contributing to the superior water relation characteristics. However, the superiority exerted by the hybrids in terms of leaf temperature and water retention characteristics appeared to be more influenced by restorers which hold the key for further developing climate resilient hybrids with better productivity.

The results of Oryza 2000 model showed increase in yield by decrease in mean temperature (-2° C) and decrease in yield by increase in temperatures (+2, +4, +6° C) in all six locations. It was observed from the results that enhanced CO_2 resulted 1-3% increase in yield while increase in temperature profoundly reduced (15 to 61%) the same. Lower CO_2 responsive areas are geographically widely separated (PTB, UMM, PNR). The sensitivity of rice crop to temperature is more or less uniform ranging from 27 to 50% across geographical locations.

Out of 800 germplasm evaluated in earlier experiments, 120 lines were short listed based on their physiological performance at field level under low nitrogen and elevated temperatures. In *kharif* 2013, the selected lines were validated under low nitrogen and elevated temperatures (>5^{0}C ambient) in an artificial tunnel and five entries exhibited superior performance.



Some physiological and yield attributes of selected entries (Pooled data)

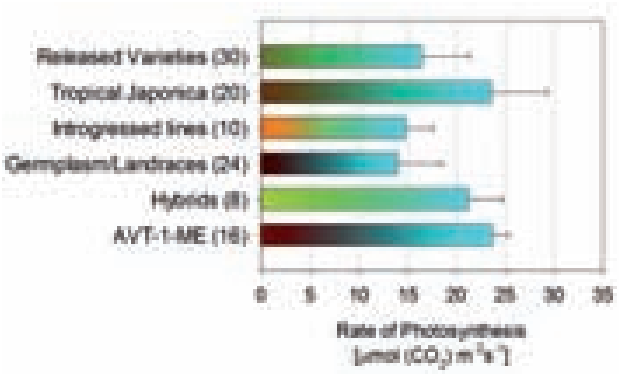
Irrespective of Treatment							
Traits	**SOMALY2-023-3-5-1-2-1**	**IR55178**	**GQ-25**	**SG26-120**	**IR82310-B-B-67-2**	**Variety (L.S.D<0.05)**	**Treatment (L.S.D<0.05)**
Leaf Temp (^{O}C)	27.775	25.78	25.065	23.84	23.215	4.5105	2.8527
Leaf Thickness (mm)	0.135	0.135	0.135	0.145	0.145	0.0454	0.0287
SPAD value	32.64	30.055	33.405	33.49	32.355	5.0443	3.1903
Rolling time (sec)	45.88	70.625	60.75	58	55.625	45.421	28.727
Plant Height (cm)	104.83	75.92	93.67	94.08	86.33	28.697	18.15
EBT/Plant	5.42	12.25	6.92	7.17	7.67	5.5023	3.48
Panicle Number	6.85	6.35	5.25	5.2	6.2	3.4576	2.1868
Panicle Weight (gm)/Plant	10.21	4.76	8	8.43	10.17	4.0559	2.5652
Filled grain weight (gm) /Plant	9.43	3.88	6.98	7.41	8.52	4.1124	2.6009
Total grain weight(gm) /Plant	9.75	4.36	7.46	7.9	9.4	4.0893	2.5863
TDM (gm) /Plant	20.68	12.23	17.97	18.91	20.77	3.8749	2.4507
HI (%)	46.85	30.93	39.66	40.97	39.61	22.168	14.02
Nitrogen in Grain (%)	1.03	1.22	1.29	1.29	1.29	0.2513	0.1589
Nitrogen in straw (%)	0.35	0.42	0.41	0.36	0.45	0.1223	0.0773

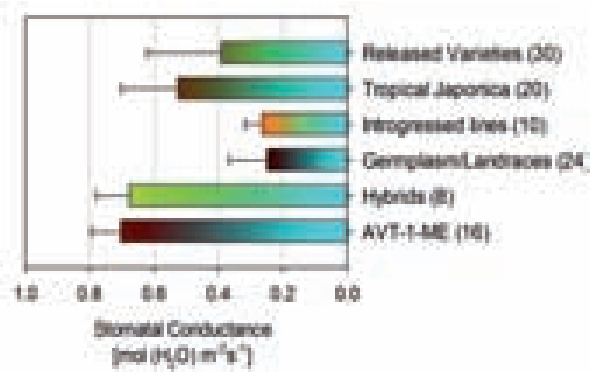
CCR/CP/PP/11

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

Leaf photosynthetic traits were evaluated under field condition during *kharif* 2012 for 108 divergent rice genotypes consisting of 30 released varieties, 20 tropical japonicas, 10 introgressed lines along with checks/parents, 8 hybrids, 16 advanced breeding lines (AVT-1-ME) and 24 land races / germplasm accessions. Leaf photosynthetic efficiency varied between a maximum of 32.4 (TJP-20) to a minimum of 6.98 (E-2729) with a mean of 18.6[µmol (CO2) m-2s-1]. The differences among the genotypes was highly significant (P<0.005). Significant variation in stomatal conductance was observed. The stomatal conductance (gs) varied between 1.0 (Jaya) to 0.133 (SOMCAU 70 A) with a mean of 0.441[mol (H2O)m-2s-1]. The transpiration rate was highest in Jaya (14.5) and lowest transpiration rate was observed in E-2729 (3.8) with a mean transpiration rate of 8.9 [mmol (H2O) m-2s-1]. This significant positive association indicates that the rate of photosynthesis (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 P_N/Ci ratio.

Significant variation in P_N was observed within each group. Among the AVT-1-ME (2012) entries, highest P_N was observed in IET 22603 and relatively lower P_N was recorded for IET-22595. In case of hybrids maximum P_N was recorded in PHB-71 and the P_N was lowest in PA-6444. Amongst the 30 released/popular rice varieties, the photosynthetic efficiency was highest in Jaya followed by Rasi and MTU-1010. The P_N was lowest in Pooja. Swarnadhan, Dehradun basmati, Bishubhog and Ranbir basmati are the other varieties which showed P_N <13 [µmol (CO_2)$m^{-2}s^{-1}$]. The genotypes identified with higher P_N have a potential to be used as a donor for increasing leaf photosynthesis efficiency for increasing biomass production.





CCR/CP/SS/10

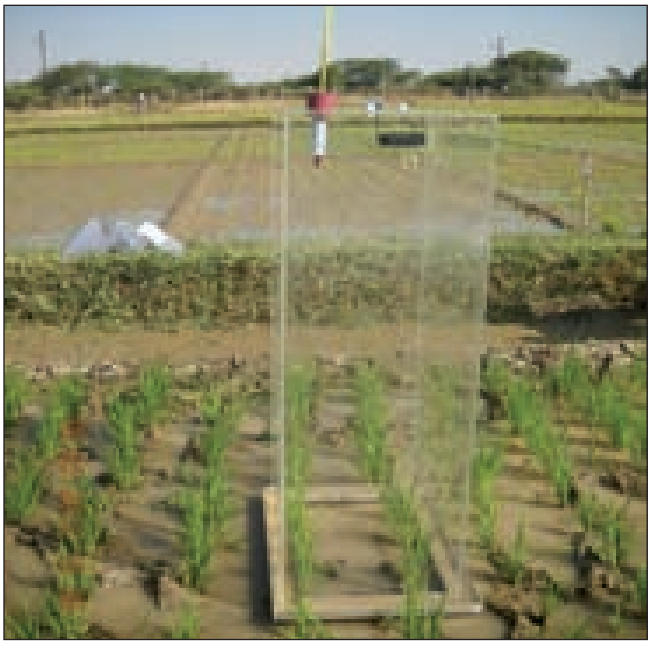
Impact of changing temperatures on nitrogen dynamics and use efficiency in rice (M.B.B. Prasad Babu)

Under the experiments of the impact of seasonal changes in temperature on nitrogen dynamics and use efficiency and N_2O emission, total emissions with urea, urea + DCD and NCU were 78, 46 and 58%, respectively, higher than control. Total N_2O–N emissions were in the range of 0.046% (with urea + DCD) to 0.056% (with urea alone) of the total nitrogen applied through different treatments (120 kg N/ha). The highest inhibition of total N_2O emission (41%) was recorded from plots treated with urea + DCD followed by

NCU (26%). N content of grain was significantly influenced by dose of N fertilizer applied only while that of straw was not influenced by both dose and source. Application of nitrogen (N) significantly increased grain yield as compared to absolute control where N was not applied (Table 1.). Dicyandiamide (DCD) + Urea applied at RDN gave the highest grain yield of 6611 kg/ha. The yield increase by the application of DCD + Urea and NCU was 15.7% and 7.9% respectively over urea. Application of 75% RDN (90 kg/ha) either through NCU or DCD + Urea yielded at par with RDN applied as PU. Reduction of N dose by 25 and 50% resulted in 28 and 46% loss in grain yield, respectively over RDN. Apparent N Recovery, Partial Factor Productivity and Agronomic efficiency of applied N were highest with the application of DCD+Urea (57.3, 64.9 and 29.2) followed by NCU (49.0, 61.1 and 25.3) and Urea (40.8, 56.7 and 20.9).

Effect of nitrification inhibitors and N doses on grain yield (kg/ha) (*kharif* 2012)

Source/Dose	Urea	DCD + Urea	NCU	Mean
RDN	5417	6611	5811	5946
75% RDN	4764	5372	5219	5118
50% RDN	4322	4801	4615	4579
Mean	4834	5595	5215	
Control				2972
CD (0.05)	Source/Dose		Source X Dose	Control Vs Rest
	451		602	552
CV (%)	6.45			



Closed chamber for collecting the gas samples

CCR/TTI/STAT/3

Crop growth models for simulating climate change response in irrigated rice (S. Ravichandran)

Rice crop often exhibits S-shaped growth patterns and hence non-linear crop growth models such as mono-molecular, Logistic, Gompertz and other crop growth models can be used to fit to describe crop growth patterns. A nonlinear growth pattern was observed for irrigated rice. It would be useful to describe the growth pattern of rice as the consequence of two nonlinear S-shaped growth models. The first model describes the vegetative and the second model for describing reproductive structures. Growth patterns of rice crops for a 5-year period showed that the time course of accumulation of above-ground dry matter did not follow a simple sigmoid curve. Instead, there was a decrease in growth around flowering, followed by an increase and then a final decrease of growth at crop maturity.

Logistic Model and Gompertz models were fitted separately to the vegetative parts of the crop and to the reproductive parts (the panicle). When the curves were summed, the combined curve gave a good description of the time course of above-ground dry matter, capturing the pause in growth and its resumption. The overall pattern of growth is the result of the two phase nature of the crop.

Variations in the panicle phase of growth were shown to be largely a consequence of year-to-year variations in the weather, whereas the vegetative phase seemed largely independent of those variations. Analysing rice growth as two components, each with a Logistic and Gompertz models, provide insight into the growth processes of the plant and the pattern of yield formation. Strong nonlinear relationship was observed while modelling yield and temperature during 1950 and 1977 was the same trend was observed for the data for the later period between 1978 and 2010. Temperature-yield relationship across subsamples is similar because of technological change, average yields in 1978-2010 are about twice those in the 1950-1977.

Yield growth increases gradually with temperature up to 29–32°C, depending on the crop, and then decreases sharply.

HRI – Host-plant Resistance against Insect Pests and its Management

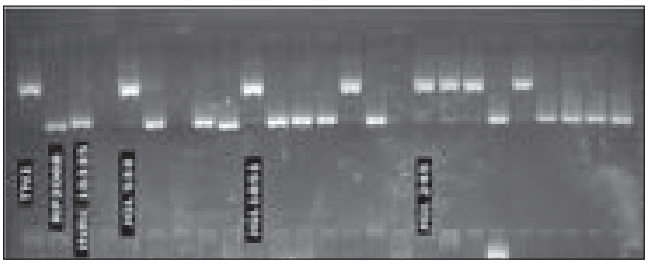
HRI/CPT/ENT/17

Host-plant resistance to gall midge in rice (J.S. Bentur)

Three new sources of gall midge resistance from germplasm accessions *viz.*, RCM10, IC466471, IC317651; one introgressed line (RP4918-212 (S) derived from *O. nivara*, one mutant line of ADT39 (CB07-540), two experimental hybrids (HR-DRR01, HR-DRR02) were identified through greenhouse evaluation.

To discover new resistance genes, a set of 100 resistant rice germplasm/genotypes was phenotypically and genotypically characterized. This set was field evaluated against gall midge biotype 4M at Warangal and against biotype GMB1 in greenhouse at DRR and was also genotyped with gene linked/specific markers. Three lines (INRC16335, RPE-349 and RP 4519-1-12) had presence of *gm3* gene; three other lines (S2207, RP3895 and RPE-27) had *Gm4* gene and two lines (Madhuri L9* and INRC2489) had *Gm11* gene. Interestingly, 6 test lines (JGL533, JGL245, JGL1851, INRC18108, Kharvela and IRGMN123) did not show any of the gene specific amplification with the markers tested indicating the presence of new gene(s).

An EST-cDNA library was developed through pyrosequencing of gall midge transcriptome of the GMB4 gall midge maggots feeding on susceptible TN1 and resistant Suraksha with over 1,60,000 unique EST sequences (deposited in gene bank). Ten of the EST-SSR primer pairs were designed and analysed for polymorphism among the different gall midge biotypes and between sexes. Three of the primers designated as OoESTSSR71, OoESTSSR76 and OoESTSSR84 showed polymorphism among different biotypes tested. Whereas, OoESTSSR5, OoESTSSR6 and OoESTSSR89 displayed polymorphism between the sexes of the same biotype.



Amplification of genomic DNA of test entries with *gm3* gene specific marker gm3del3.

HRI/CPT/ENT/11

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

Of the 2200 entries consisting of breeding lines and germplasm accessions evaluated against BPH and WBPH through mass screening tests in the greenhouse, 20 entries against BPH and 27 entries against WBPH were found promising (damage score <3.0). Seven entries viz., CR2689-3-2-1-2-1, CR3608-11-1-1-1, CR2815-2-4-2-1-1-1, KAUM 166-2, IC Nos 17065, 86004 and Lalat were resistant to both the planthoppers.

The wild rice accessions viz., IRGC86476, TRG51, TRP56, IRGC105710, TRP69, TRP36-1, TRP64-2, TRP38-2, TRP70, TRP80434, TRP38, TRP37, TRP62-1 survived for more than 34 days after exposure to BPH nymphs as compared to 5-6 days in susceptible check TN1 indicating the presence of high level of tolerance mechanism.

Field evaluation of 31 gene differentials for virulence against DRR BPH population indicated that Ptb33 (*bph2* + *Bph3* + unknown factors), Rathuheenathi (*Bph3*+*Bph17*), RP2068-18-3-5 and RPBio4918 (introgression line from *O.nivara*) had high level of resistance, whereas IR64 (*Bph1* + QTL) and OM4498 (unknown gene) had moderate level of resistance. Two breeding lines IR65482-7-216-1-2-8 (*Bph18*) and IR 71033-121-15 (*Bph20* + *Bph21*) were susceptible.

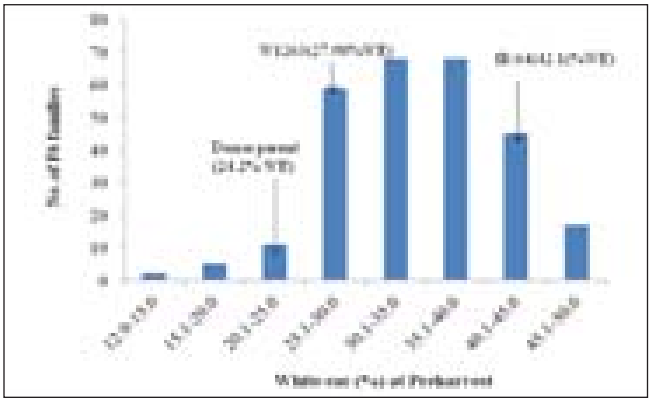
Field screening of BPH gene differentials at DRR, *kharif* 2012

HRI/CPT/ENT/18

Insect-plant interactions with special reference to yellow stem borer (*S. incertulas*) (A.P. Padmakumari)

Introgressed lines derived from IR64*3 / *O.glaberrima* were evaluated under field conditions for YSB tolerance at two phases of crop growth by supplementing natural infestation with stem borer egg masses and it was found that two F6 families had < 13% white ear damage with good grain filling. The damage in the susceptible checks was as high as 44.1% white ears and two families had 100 grain weight of more than 2.6 g despite high damage.

Field evaluation of imidazole (a silicon solubiliser) and grey ash from burnt rice husk, (a source of silicon) @ 40.8 mg/ha reduced both the dead heart (44-57%) and white head damage (23-40%) by yellow stem borer as compared to control when applied alone or in combination. Studies on yield loss by YSB in five varieties *viz.*, KRH2, BPT5204, MTU1010, Pusa Basmati 1 and Vandana indicated that there was no significant reduction in grain weight when there were two white ears per plant. But there was a significant loss in yield when > 2 white ears were present.



Frequency distribution of BC_3F_6 families of IR64*3 / *O. glaberrima* under different levels of WE damage by YSB Donor parent – Accession of *O. glaberrima*; Recurrent parent- IR64

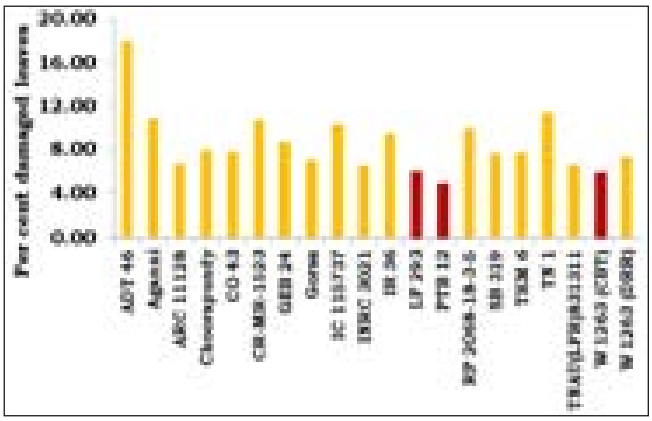
HRI/CPT/ENT/19

Host plant resistance for leaf folder in rice (Ch. Padmavathi)

Field screening of 77 entries including Swarna/ *Oryza nivara* introgressed lines by augmentative release of leaf folder adults 30 days after transplanting revealed that PTB12, W1263, LF293 and an introgressed line, 248(S), were promising with <7% damaged leaves as against the highest damage of 18% in ADT46.

Developmental studies on the leaf folder on different promising and susceptible entries showed that larval survival varied from 24% (TKM6) to 92% (TN1) and the adult emergence varied from 16% (TKM6) to 92% (TN1) which confirmed the presence of antibiosis mechanism of resistance in the promising entries.

Genetic variation in different *C. medinalis* populations detected with RAPD markers revealed that out of nine populations (Coimbatore, Mandya, Moncompu, Nellore, Rajendranagar, Cuttack, Karaikal, Chinsurah and Medak), Rajendranagar population was an out-group whereas populations from Karaikal and Moncompu; Nellore and Mandya were close to each other as neighbors.



Leaf damage by leaf folder *C. medinalis* recorded in test germplasm / breeding lines in field evaluation

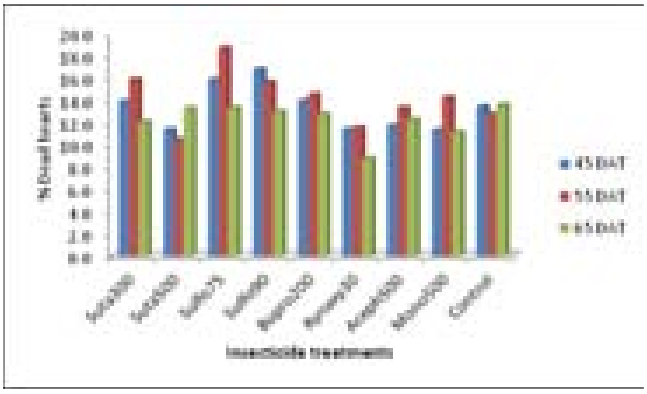
IPM – Integrated Pest Management

IPM/CPT/ENT/3

Chemical control of rice insect pests as component of IPM (Gururaj Katti)

A field experiment was conducted to screen new insecticide formulations *viz.*, triazophos (Sutathion) 40 EC @ 300 and 500 g a.i. / ha and sulfoxaflor (Sulfoximine group) 24 SC @ 75 and 90 g a.i. / ha along with buprofezin (Applaud) 25 SC @ 200 g a.i./ha, rynaxypyr (Coragen) 20 SC @ 30 g a.i. / ha, acephate 75 SP @ 500 g a.i./ha, monocrotophos 36 WSC @ 500 g a.i./ha and untreated control for their efficacy against insect pests of rice during *kharif* 2012. Stem borer incidence was the lowest in rynaxypyr treatment (8.8 to 11.6% DH) followed by triazophos @ 500 g (10.5 to 13.3% DH). There were no discernible differences among the treatments at white head stage. Rynaxypyr 20 SC was the best treatment in terms of low pest damage and high yield followed by triazophos @ 500 g a.i./ha.

Compatibility studies including two new insecticides *viz.*,, Buprofezin 20% + Acephate 50% WP (RIL-049/F1) @ 1000 g a.i. / ha and sulfoxaflor 24% SC @ 75 g a.i. / ha and two fungicides hexaconazole and tricyclazole applied alone and in combinations revealed no adverse effects due to the combination of fungicides with the newer insecticides in terms of efficacy against stem borer and there were no discernible differences in yield among the treatments.



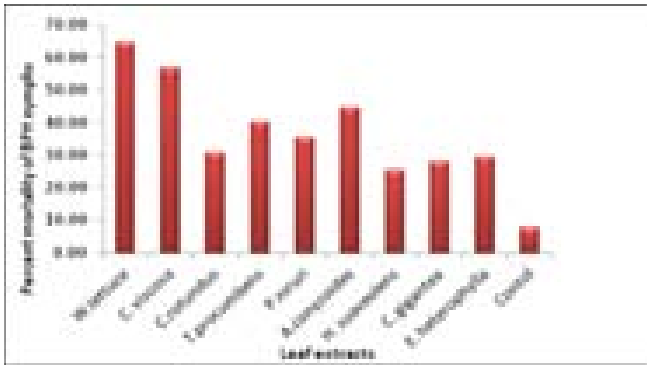
Efficacy of newer insecticides against yellow stem borer, *kharif* 2012

IPM/CPT/ENT/21

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

Fresh leaf extracts of various wild plants *viz.*, *Ageratum conyzoides, Euphorbia heterophylla, Tridax procumbens, Phyllanthus niruri, Cleome viscosa, Lantana camara, Hyptis suaveolens, Cyprus rotundus, Calotropis gigantea* and wild lettuce were evaluated at 20% concentration in the laboratory against BPH nymphs. Wild lettuce caused significantly high mortality (64.6%) followed by *C. viscosa* (56.9%) when compared to other leaf extracts and untreated control (7.8%).

Various seed oils *viz.*, *P. pinnata, A. indica, J. curcas, A. squamosa, A. mexicana* were evaluated at 0.5% for feeding deterrence and toxicity against 2nd instar larvae of leaf folder and at 0.2% against BPH nymphs in the laboratory. Pongamia oil caused significantly higher mortality (95.12%) of BPH nymphs followed by annona oil (93.1%) as compared to untreated control (13.88%). Annona oil recorded significantly low feeding (3.0%) by leaf folder larvae followed by Pongamia oil (9.0%) when compared to other oils and untreated control (70%).



Efficacy of aqueous leaf extracts against brown planthopper nymphs

IPM/CPT/ENT/13

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

Biology and predatory potential of the reduviid predator, *Rhynocoris fuscipes* was studied on different diets *viz.*, GLH, BPH, leaf folder, pink stem borer, combination of lepidopteran larvae and a mixed diet of hoppers and larvae. The mean developmental period of *R. fuscipes* ranged from 82.5 + 10.7 days. The shortest developmental period (59.9 days) was observed on a mixed diet of hoppers and lepidopteran larvae and the longest period (99.9 days) was observed on a diet consisting of only GLH.

An electrophoretic analysis of esterase profile of collected coccinellids to identity remnants of prey fed by them indicated that these coccinellids prey on leafhoppers and aphids associated with the weeds on bunds before moving in to rice fields.

The effect of flowering plants *viz.*, cowpea, Lucerne, French marigold, African marigold, Bhendi and Gaillardia on the

parasitization of hopper eggs was studied by planting them on the borders of rice field. Maximum parasitisation of BPH eggs (90 -100 %) by *Oligosita sp* was observed with African marigold. Maximum number of *Gonatocerus* adults (159) emerged from the GLH oviposited potted plants placed near cowpea border compared to those placed near control border.

Predatory Reduviid bug, *Rhynocoris fuscipes* feeding on GLH adult

IPM/CPT/ENT/14

Investigations on plant parasitic nematodes in rice (J.S. Prasad)

Twenty two rice genotypes were screened for their reaction to rice root-knot nematode *Meloidogyne graminicola*. Rice cultivars/lines *viz.*, Bala, N22, Ramakrishna, Annada, Agani, INRC2489 and BG380-2 showed resistant reaction based on gall index.

IPM/CPT/ENT/15

Evaluation of Entomopathogenic nematodes (EPN) for the management of insect pests in rice ecosystem (N. Somasekhar)

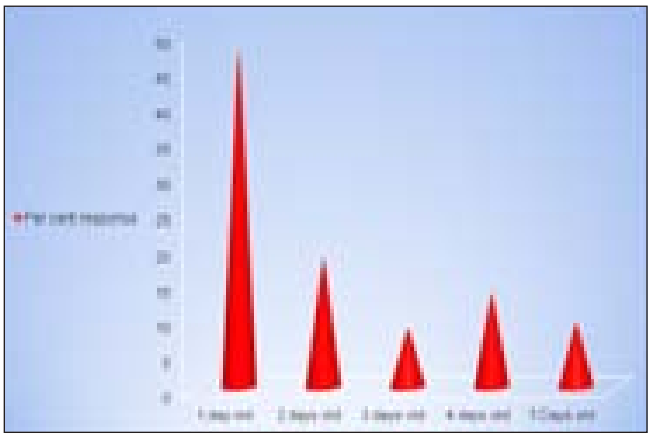
Based on similarities in morphological characters and DNA sequence data, the indigenous entomopathogenic nematode isolate (DRR-EPN1) collected from rice ecosystem was identified as *Metarhabditis amsactae.*

Field application of entomopathogenic nematodes (*Steinernema asiaticum, S. thermophilum, Meterhabditis amsactae* (*Oscheius amsactae*) and *Heterorhabditis indica*) @ 1 x105 IJs / m2 against yellow stem borer at reproductive stage reduced the white ear damage and maximum reduction (31.32 % white ears) was observed in case of *Heterorhabditis indica.* BPH population was reduced by 18.6 to 67% by field application of same EPNs. In laboratory bioassays, five EPN species *viz. Metarhabditis amsactae, Steinermema asiaticum, S. thermophilum, S. glaseri* and *H. indica* infected the grubs of rice hispa.

IPM/CPT/ENT/20

Semiochemical approaches to manage rice pests with special reference to sex pheromones (M. Sampath Kumar)

GC-MS analysis of the pheromone gland extract of pink stem borer (PSB), *Sesamia inferens* dissected out at 23.00 h for identification of biologically active components revealed the presence of an alcohol molecule as one of its components at a retention time of 14.2 minutes. Female abdominal tip extracts of *S. inferens* absorbed onto the cotton wool evoked 37, 80 and 53 per cent male response against 1, 2 and 3 female equivalents under laboratory assays. Gland extracts from one day old PSB female moths attracted significantly more male moths (49.14%) as compared to five day old females (9.48%). EAG response of female leaf folder moths to green rice leaf volatiles revealed a maximum response to hexanal (3.0 mV) followed by 1-pentanol (2.0 mV). Response to the other green leaf volatiles *viz*., 2-phenyl ethanol, trans-2-hexanal, hexyl acetate, benzaldehyde, 1-octanol was low (0.5 mV and 1.0 mV).



Response of males to crude extracts of different aged female *S. inferens*

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.S. Srinivas Prasad)

A total of 13538 rice lines drawn from various trials, advanced breeding lines and germplasm were evaluated on uniform blast nursery beds for resistance against leaf blast. The material generated under functional genomics project of the department was also evaluated for resistance against rice blast. It was observed that 817 out of 13538 lines were resistant against blast disease. The BC_3F_5 Plants of BPT5204/LAC/A51 // Tetep (*Pi-1+Pi-2+Pikh*) and BPT5204/LAC/Tetep (*Pi-1+Pikh*) crosses were phenotyped for blast resistance in UBN. Out of 250 plants, 180 were resistant and 70 were susceptible. Similarly in BPT5204/LAC/Tetep cross, 172 plants showed resistance reaction and 80 plants showed susceptible reaction out of 252 plants. The resistant phenotypes were genotyped with gene specific markers and found that 50 were positive for three gene (*Pi1*, *Pi2* and *Pikh*) combination in BPT 5204 background and 42 were positive for two gene (*Pi1* and *Pikh*) combination in BPT5204 background.

Management through Chemicals: The trial was conducted with an objective to evaluate some new and commercially available fungicides against rice blast disease at DRR. The formulations like trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) 0.4 g/l, kresoxim methyl (Ergon 44.3 SC) 1 ml/l, azoxystrobin 25 SC (Mirador) 1ml/l, tricyclazole 75 WP (Blastogan) 0.6 g/l, carbendazim 50 WP (Benmain) 1g/l, propiconazole 25 EC (Bumper) 1ml/l were evaluated. HR 12 was used as test variety. The observations were recorded on disease severity, incidence and yield. The disease severity of leaf blast, in trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) 0.4 g/l treated plots was less compared to check and the yields were high.

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: Five hundred and eighty cultures from different sources were evaluated for their resistance to bacterial blight of rice under controlled condition. These materials included 73 entries from IRBBN-12, 45 lines of green super rice, 13 selected lines from germplasm screening nursery, 52 entries from M/S Advanta, 48 selected lines from AICRIP Plant Pathology-2010, 69 entries from AICRIP Plant Pathology-2011 and 267 entries of germplasm from NE India. Some of these materials are being evaluated for broad spectrum resistance using multiple isolates of the pathogen.

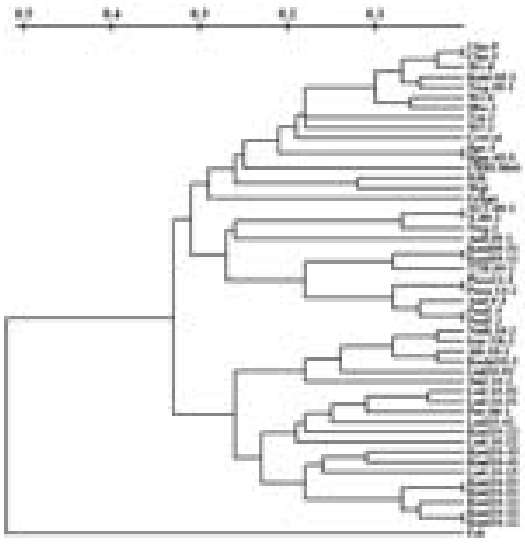
In addition, twenty four introgression lines (ILs) selected from 752 ILs based on their reaction under field condition were evaluated for their broad spectrum resistance with multiple isolates under glass house condition. Eight entries were found to have a broad spectrum resistance to all the four isolates tested. Some of the entries like PAU695, PAU896, PAU1061 and PAU1077 were found to be highly promising. The resistance reaction is being confirmed with more number of isolates.

Collection and characterization of isolates of *Xanthomonas oryzae* pv. *oryzae*: Fifty nine new isolates of *Xanthomonas oryzae* pv. *oryzae* were isolated from diverse rice growing regions in different states like Tamil Nadu, Andhra Pradesh, West Bengal, Tripura, Assam, Gujarat and Andaman and Nicober islands. Pathotyping of some of these isolates have been completed on a set of differentials. So far at this Directorate, 220 isolates were pathotyped and 186 isolates were categorized based on their reaction on the differentials and 22 pathotypes were identified. Genotyping of majority of the isolates have been done using Jel-1 (F) and Jel-2 (R)

Resistance evaluation of selected introgession lines with multiple *Xoo* isolates

Sl. No.	Designation	*Xoo* isolates/Lesion length in cm			
		FZB	ADT	Pusa-1460-1	CHN-J
1	PAU-695	2.8	2.2	3.2	1.2
4	PAU-747	4.8	2.3	3.8	3.0
5	PAU-797	3.4	1.5	3.8	3.4
7	PAU-848	3.4	1.5	3.1	2.4
8	PAU-896	2.7	2.2	2.9	2.4
16	PAU-1061	1.8	2.5	1.7	3.3
17	PAU-1077	0.6	1.0	3.2	2.2
18	PAU-1195	3.8	1.9	3.2	3.5
25	IRBB4	5.2	3.1	20.0	>20
26	IRBB5	1.1	9.3	20.0	>20
27	IRBB8	3.2	3.9	14.7	8.3
28	IRBB13	8.8	2.0	1.8	4.7
29	IRBB21	2.3	9.8	22.0	>20
30	IRBB55	7.2	6.7	-	-
31	IRBB59	2.4	2.4	1.8	1.9
32	TN1	11.0	15.9	16.4	19.1

primers which based on the repetitive element IS1112. We tried to correlate the phenotyping and genotyping by taking the genotyping data of two isolates from each pathotype group and grouping them using NTSyS package. Though, pathotype wise grouping was not observed, the virulent and highly virulent pathotypes clustered together.



Dendrogram showing relatedness among selected isolates of *Xoo*

HRP/CPT/ PATH/14

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

A total of 120 lines comprising of 51 lines from various international rice tungro nurseries (IRTN) and 65 N22 mutant lines were screened for varietal resistance to tungro virus disease. Two resistant cultures *viz.*, Vikramarya and Nidhi were used as resistant checks while TN1 as susceptible check. Of 51 IRTN lines tested, 20 lines *viz.*, ASD7 (ACC6303), IR62, IR72, Moddai Karuppan (ACC15471), Palasithari601 (ACC12069), Pankhari203 (ACC5999), Ptb8 (ACC6291), TKM6 (ACC237), ARC10312 (12428), ARC12596 (ACC22176), Utri Merah (ACC16680), Utri Merah (ACC16682), Utri Rajapan (ACC16684), Balimau Putih (ACC17204), Tjempo Kijik (ACC16602), CNTLR85033-9-3-1-1, DM24, DR31, Milagrosa (ACC5159), and ARC 11554 (ACC 21473) were identified with high degree of tungro resistance. Out of 65 N22 mutant lines only seven cultures (N22M RT 443, N22M RT 444, N22M RT 16, N22M RT 152-2, N22M RT 418, N22M RT 360 and N22M RT407) were expressed resistant reaction.

Screening of varieties for tungro resistance

The major QTL *qRTV-7* was being introgressed into IR64 (BC_2F_2), BPT5204 (BC_2F_2), MTU1010 (BC_2F_2), ADT39 (BC_2F_2) and CR1009 (BC_1F_2). The details of the crosses are listed below.

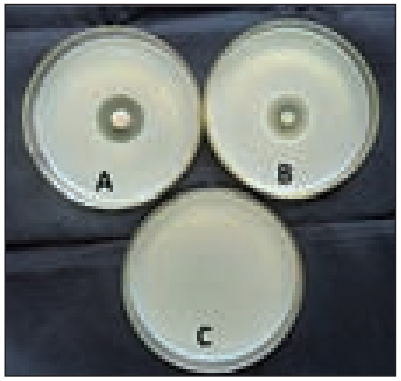
Sl. No.	Cross	Status
1	BPT5204/Utri Rajapan//BPT5204	BC_2F_2
2	IR64/ Utri Rajapan//IR64	BC_2F_2
3	ADT39/Utri Rajapan//ADT39	BC_2F_2
4	MTU1010 / Utri Rajapan// MTU1010	BC_2F_2
5	CR1009 / Utri Rajapan	BC_1F_1

HRP/CPT/ PATH/17

Biology of false smut disease of rice (D. Ladhalakshmi)

Sclerotia of *U. virens* were collected from different rice growing areas *viz.,* Rajendranagar, R. Puram and Barapani. To germinate the sclerotia, it was treated with UV light for 1 hr and then incubated in the sterile sand with water at 28^0C. All the incubated sclerotia became bulged and one month after incubation, it produced yellow colour mycelium. To study the morphological variation, a total of 28 isolates were selected representing different states of India. The medium used was potato sucrose agar. The characteristics *viz*., colony growth on 10 days after inoculation, colour (upper and lower side) and margin of the colony were recorded. The isolates *viz*., 11-11-2 (Tamil Nadu), 6-10-1 (Haryana) and 7-2-1 (Uttarakhand) recorded high growth rate. With respect to colour the isolates recorded with white, yellow and olive green colour according to the maturity and margin of the colony character was varied from entire to filiform. The false smut pathogen also produces a toxin known as ustiloxin. To confirm the production of toxin (Ustiloxin) in *Ustilaginoidea virens*, it was tested against *Candida albicans*. The toxin produced by *U. virens* inhibited the growth of *C. albicans* which was observed as inhibition zone. In this study *Sarocladium oryzae* was used as positive control.

Sclerotia on both sides of smut ball on TN1



Toxin production in *U. virens*

A- Positive control (*Sarocladium oryzae);*

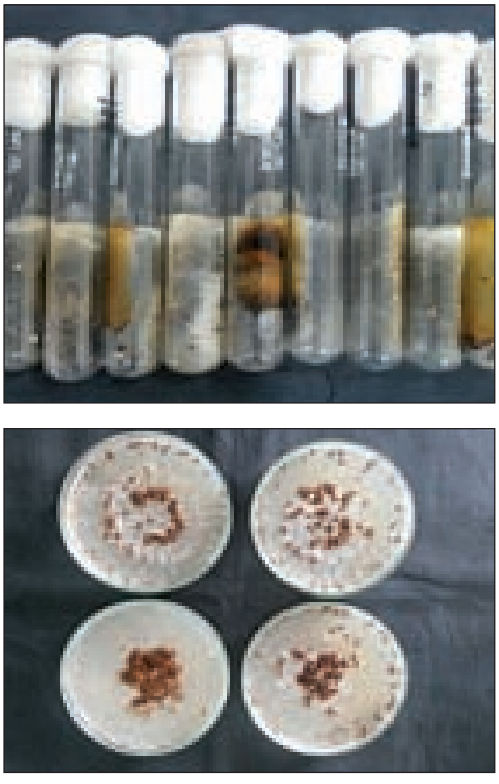
B- *Ustilaginoidea virens,*

C- Control

HRP/CPT/ PATH/17

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

Survey for collection of sheath blight samples of rice was conducted in Tamil Nadu, Karnataka and Andhra Pradesh during October, 2012. The disease incidence was very high in East and West Godavari districts of Andhra Pradesh. Different isolates (26) collected from Delhi, Haryana, Punjab, Uttarakhand, Karnataka, Andra Pradesh and Tamil Nadu, Odisha, Jharkhand, Uttar Pradesh and West Bengal were maintained as pure culture. Different fungicides were tested for their efficacy against sheath blight. Among them, trifloxystrobin 25% + tebuconazole 50 % (Native 75 % WG) @ 0.4 g/l reduced the disease severity (29%) compared to check (DS – 53.7%). This was followed by azoxystrobin 25 SC (@ 1ml/l iin reducing the sheath blight disease severity. Grain yield in the experimental plots were recorded, all the treatments increased the grain yield compared to check (1637 Kg/ha). Highest yield was recorded in the plots which were sprayed with trifloxystrobin 25% + tebuconazole 50% @ 0.4g/l treatment (3097 Kg/ha) followed by azoxystrobin 25 SC (3027 Kg/ha).



Different isolates of *R. solani* and their cultural variation

TTI – Training, Transfer of Technology and Impact analysis

TTT/EXT/7
A study on awareness, perception and constraints in adoption of Integrated Pest Management in rice farming (Mangal Sain)

Data collected from 400 farmers representing the states of Chhattisgarh, Kerala, Jharkhand, Odisha and Tamil Nadu revealed that most of the farmers were not able to adopt the IPM as they are finding it difficult to get the components of IPM such as good quality sex pheromones, bio-pesticides, multiple resistant varieties and recommended pesticides for need based application. Majority of the farmers (85%) were not aware about the natural enemies for major insect pests of rice. Only 20-30% farmers knew about predators like spiders, dragonfly, damselfly etc. Approximately 75% were not aware of the toxic effects of pesticides and it was evident as they did not take any protective measures while mixing and spraying of chemicals, some time found spraying opposite of wind, 45% farmers spraying mixture of pesticides in more or less recommended dosage of pesticide.

TTT/EXT/10
Gender dimensions in rice sector: An exploratory study on labor migration and livelihoods (Amtul Waris)

Gender analysis study in paddy cultivation indicated that majority (68%) of the farm women had access to resources like land, labour and inputs but their control over the resources was limited. The decision making pattern in the farm families revealed that in joint families, older women were consulted more and in nuclear families it was joint decision making. The women from large farm families were not involved in farming activities in West Godavari district of Andhra Pradesh in contrast to their supervisory role in Guntur District. Whereas, the women from small and marginal farm size were involved in farming activities both on their own farms and worked on others' farms during peak activities of transplanting, weeding and harvesting.

Mechanical harvesting is being used by farmers (63%) as a coping mechanism to overcome labor shortage especially during *rabi* than *kharif* as the fodder from *rabi* crop is not preferably fed to cattle due to high pesticide/chemical use.

Seasonal migration for transplanting was undertaken to nearby districts, Krishna and Nellore, in the *rabi* season for a period of 20 days in these two districts.

The marginal farmers and landless laborers of study area reported that they were involved in works under MGNREGA only during April and mid June and reported that MGNREGA activities were not affecting the paddy cultivation activities. Whereas, the large farmers' complained that due to MGNREGA the labor rates have increased.

TTT/EXT/8
Sustainable rice production practices: Problems and prospects (P. Muthuraman)

A sustainability study was carried out in the traditional rice growing areas of Kerala state in Kuttanad and Palakkad region. Rice land has consistently declined since 1965. Mostly rice lands are being converted for upland and plantation crops like tapioca, banana, yam and ginger for better remuneration. Kerala farmers have reported the problem of inadequate quantity of rice for domestic consumption. Irrespective of operational holding size, farmers depended on Public Distribution System for domestic rice consumption. The major constraints in Kerala were reported to be scarcity of labour, using old rice varieties, biotic stresses like BPH, stem borer, leaf folder, gall midge, blue beetle, BLB, blast and false smut. In Kuttanad region, flood was reported as a major problem whereas in Palakkad region intermittent drought was major problem. Government of Kerala has initiated special programmes like special Kuttanad package, group farming methods, incentives for rice cultivation in the form of subsidy for critical inputs and special thrust is given for farm level mechanization to overcome labour scarcity.

The major factors affecting sustainability in rice farming were identified as lack of labor force (100%), declining rice area (91%), shortage of quality seeds (75%), continuous rice cultivation for more than 5 decades (71%), excessive use of inorganic fertilizers (64%), deterioration of soil health (59%), poor water management practices and lack of drainage system (57%), no scope for new cropping system (45%), and slow mechanization process (41%).



TTT/EXT/12

Maximizing the impact of rice technologies through ICT applications (Shaik N. Meera)

A methodology has been developed to identify the critical unreached information and technology needs of rice sector. The methodology comprised of knowledge pathway analysis and personal interviews. This would be done at three levels – Farmers level, Extension workers and Organizational level. This will give complete details of information and knowledge needs at village level and available knowledge sources, delivery formats and knowledge interventions to be undertaken during the project period. Also, appropriate ICT tools, processes and strategies for enhancing the impact of rice technologies at farm level were identified.

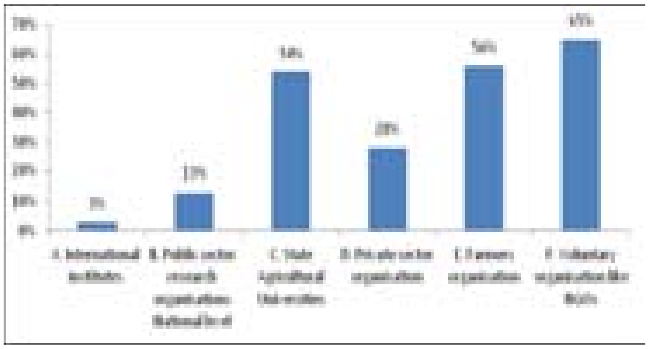
The indicators identified for exploring the usefulness of modern ICTs by involving rice farmers were 1. Access-Relative easiness in access, 2. Availability - Quality of knowledge, 3. Appropriateness – comprehensiveness 4. Complimentary of knowledge with the existing services / infrastructure, 5. Pre-requisite conditions and multiple deliveries, 6. Willingness of partners to uptake (ability of content to value add to their services) and 7. Attributing the 'knowledge' to productivity/ income/ other gains (Donor Committee for Enterprise Development (DCED) standards).

TTT/EXT/9

An exploratory study on partnerships: Impact and implications for the rice sector (S. Arun Kumar)

The stakeholder's perceptions and willingness in various partnership processes were prepared by using the primary data collected from the farmers of Karnataka, scientists of ZARS-Mandya and ICAR scientists. The study revealed that the farmers were not aware of any contract farming or partnership activities in rice farming but were willing to forge partnerships especially in the technology dissemination activities like demonstrations, organic rice farming etc. Majority of the farmers (70%) reported their willingness to join hands with the SAUs and local NGOs. Farmers also expressed their willingness to involve in seed production under contract farming.

With respect to researchers, their willingness ranged from the commercialization partnership type to frontier research partnerships. The contractual agreements between the ZARS Mandya (under the aegis of UAS –Bangalore) and more than 200 farmers for the seed production of varieties like Jaya, Thanu, BR2655, IR36, IR64 (1000 acres) and hybrids like KRH2, KRH4 (500 acres) were documented.



TTT/ECON/1

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

A study was conducted in four districts *viz.*, West Godavari, Guntur, Kurnool and Mahboobnagar of Andhra Pradesh to estimate the magnitude of yield gaps and the constraints in rice production. The difference between the potential yield (experimental station yield) and actual yield realized by the average sample farmers, which is known as the total yield gap was found to be 0.65 t/ha. The potential yield realized at research station was 5.09 t/ha, the yield obtained in the demonstration plot was 4.84 t/ha, whereas the average yield of the farmers was 4.45 t/ha. Yield gap I which is the difference between the potential yield (experimental station yield) and the potential farm yield (demonstration yield) is 5.16%. 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 8.18%. The index of the yield gap was found to be 13.37%.

The major constraints in rice production in each of the sample districts were quantified by using the Garret's ranking technique. According to the sample farmers, lack of remunerative price, problems of tenancy, shortage of labor during peak operation periods, non-release of canal water in time, non-availability of fertilizers in time and incidence of pests and disease were the major constraints.

Institutional Activities

Technologies assessed and transferred

Licensing

Awards/recognitions

Revenue generation

Linkages and collaborations

Significant events

Personnel

Publications

RFD

Appendices

Technologies Assessed and Transferred

Trainings

During the year 2012-13, seven structured training programmes were organized on various aspects of rice production technologies like IPM, SRI, water management and hybrid rice seed production. The training programs were sponsored by Directorate of Extension, Government of India, ICAR, Commissionerate of Agriculture (Andhra Pradesh), Odisha State Department of Agriculture and Mahindra and Mahindra Agro Industries with 170 participants from SAU's, ICAR, public and private institutions. Three hundred and forty three farmers and officials from public and private organizations from Andhra Pradesh, Madhya Pradesh, Jharkhand and Odisha have attended the one day training/ awareness programmes.

Training programs organized (2012-13)

S. No.	Title	Dates and Duration	Sponsors	Clientele	Number of participants
1	Rice Production Technology	April 26-28 2012 (3 days)	Commissionerate & Directorate of Agriculture - Andhra Pradesh	FTC officials from State department Agriculture of Andhra Pradesh	38
2	Hybrid Rice Seed Production and Seed Certification	Aug 21-25 2012 (5 days)	Odisha State OSSOPCA Department of Agrl.	Seed Certification officials from OSSOPCA, Odisha	20
	Winter School on New Frontiers in Rice IPM and rice based cropping systems	Sep 13-Oct 3 2012 (21 days)	ICAR, New Delhi	Scientists/Faculty from SAU/ ICAR	25
3	MTC on System of Rice Intensification	Oct 4-11 2012 (8 days)	Directorate of Extension, GOI New Delhi	Subject matter specialists from State department of agriculture of various states	17
4	Short course on Water Management and Water Saving Technology in Rice	Oct 30-Nov 8 2012 (10 days)	ICAR, New Delhi	Scientists/Faculty from SAU/ ICAR	18
5	MTC on Hybrid Rice Production Technology	Nov 16-23 2012 (8 days)	Directorate of Extension, GOI New Delhi	Subject matter specialist from State department of agriculture of various states	18
6	Rice Production and Capability Building Course	Jan 17-19 2013 (3 days)	Mahindra and Mahindra Agro Industries, Mumbai	Field functionaries of Mahindra and Mahindra Agro industries	34
	Total number of participants				**170**

One day training programmes					
1	Rice Production Technology	May 11 2012	Department of Agriculture, Chattisgarh.	20 tribal farmers from Bastar, Jagadalpur District	20
2	Plant variety protection and registration of plant varieties	Nov. 15 2012 and Mar 25 2013	PVP & Registration of plant varieties, ICAR, Delhi	Participants from State Dept Agrl, ANGRAU and private industries	219
3	Exposure visit cum training	Sep 25 2012	Department of Agriculture, Andhra Pradesh	SMS &Extension officials from SAMETI, Hyderabad Dept of Agrl (AP)	14
4	Exposure visit cum training	Sep 28 2012	Department of Agriculture, Madhya Pradesh through WALAMTARI	Farmers &Extension officials from Dept of Agrl, MP	15
5	Exposure visit cum training	Oct 17 2012	Department of Agriculture, Andhra Pradesh	SMS &Extension officials from Dept of Agrl (AP)	40
6	Training programme through Interface	Dec 5, 2012	Interface Hyderabad	Executives from private industries	20
7	Training programme for progressive farmers	3 Oct, 2012	CARD, New Delhi	Farmers from Chhattisgarh	15
Total number of participants					**343**

On-farm evaluations

As part of on-farm evaluation programmes, DRR technologies viz., DRRH3, Improved Samba Mahsuri and IPM practices were demonstrated on farmers' fields in Andhra Pradesh and Karnataka. FLDs on Improved Samba Mahsuri in West Godavari showed a yield advantage of 16% over the local check. In Mahaboobnagar, IPM technology was demonstrated in collaboration with KVK-Madnapuram and the FLDs recorded a yield advantage of 12%. Six FLDs on DRRH-3 in collaboration with ARS, Gangavathi have shown better performance of hybrid in the problem soils with 13% increase over the popular variety BPT5204. The demonstrated techonologies with significant yield advantage have motivated other farmers for their adoption.

Tribal Sub-Plan

As a part of Tribal Sub-plan, activities were undertaken to improve the livelihoods of the tribal farmers from two tribal villages of Amrabad Mandal in Mahaboobnagar District of Andhra Pradesh. In Macharam and Jangareddypalli villages, various constraints in rice cultivation were identified and suitable technological interventions were planned. The farmers were trained about nursery management practices and soil health management in rice cultivation. Around 400 kg seed of Improved Samba Mahsuri and Krishnahamsa was distributed to the beneficiaries of Tribal Sub-Plan.

Blightout programme

Under the CSIR 800 scheme in collaboration with CCMB, Hyderabad, 500 demonstrations were conducted in Andhra Pradesh with the help of KVKs of Gaddipalle (Nalgonda dist), Banaganapalle (Kurnool dist), Kalvacharala and Undi (East and West Godavari dists) to demonstrate the performance of bacterial leaf blight resistant variety 'Improved Samba Mahsuri'. His Excellency, Sri E.S.L. Narasimhan, the Governor of Andhra Pradesh visited demonstrations at Nalgonda district and appreciated the effort of DRR and CCMB. The package of practices about Improved Samba Mahsuri were printed in Telugu language and distributed to all the beneficiary farmers.

Frontline Demonstrations

For the year 2012-13, 572 FLDs on various rice production technologies like improved varieties, hybrids and other practices were conducted covering 14 states and five rice ecosystems of the country and 27 promising technologies have been identified. About 55% of the total FLDs were conducted in irrigated ecosystem, 9.4% in rainfed uplands, 30% in shallow lowlands and 3.5% in flood prone ecosystems. FLD technologies have recorded yield advantage ranging from 28.45 to 31.71% across the ecosystems suggesting the attainable yield potential in the farmers' fields and need of the extension programs in these regions.

Farmers' Day

Under the theme 'Farmers First- An innovative approach to reach farmers', Farmers' day was organized on 28th October 2012 at DRR farm which was attended by more than four hundred and fifty farmers from the districts of Ranga Reddy, Mahaboobnagar, Warangal, and Nalgonda. The motto of the event was 'of the farmers, for the farmers, by the farmers' with a progressive farmer, Shri Dushtarla Satyanarayana from Nalgonda acting as the Chief Guest followed by a session of sharing experiences by five farmers and felicitation of five progressive farmers. Experiments related to sustainable rice production technologies related to water, nutrient and pest, improved varieties and hybrids, seed production, labour saving technologies and mechanization were demonstrated to farmers along with detailed question-answer session.

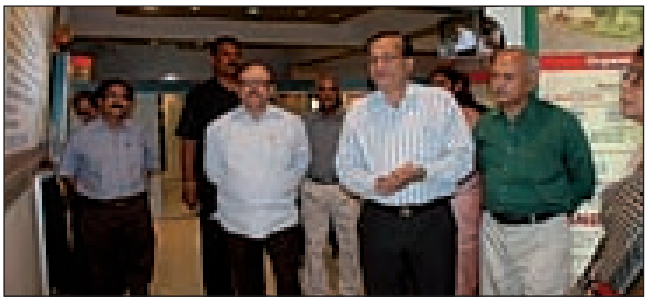
Participation in farmers' fair / exhibitions

DRR production technologies were displayed in the following state / national / international level Agri-expos and visiting farmers / scientists / students / extension officials from various parts of the country were acquainted with the technologies.

1. Farmers day at DOR, Hyderabad (2 Sep 2012)
2. National Convention – the Next Frontier of Agri-business and Technology at Gandhinagar (Sep 3-4 2012)
3. 6th International Hybrid Rice Symposium (Sep 10-12, 2012)
4. COP 11 meeting, Hyderabad (Oct 1 - 19 2012)
5. Krishi Mela at UAS, Raichur (Dec 1 - 3 2012)
6. Exhibition at NAARM (Jan 7, 2013), Hyderabad visited by Honorable Minister of State for Agriculture, Government of India, Shri Tariq Anwar

Visitor's services

About 2000 visitors comprising students, farmers, extension officials from various parts of the country and 40 visitors from various countries were acquainted with the activities and achievements of DRR during the year 2012-13.



Mass Media Coordination and Kisan Call Centre

About twelve scientific talks on various aspects of Rice Production Technologies were delivered by DRR Scientists and broadcasted by AIR, Hyderabad. DRR as a part of Kisan Call Centre programme has answered the queries from farmers through the toll free phone number 1551 related to rice production technologies with respect to Andhra Pradesh state.

Rice Knowledge Management Portal (RKMP)

Under NAIP funded RKMP project, awareness activities were undertaken in Andhra Pradesh, Karnataka, Odisha, Jharkhand, New Delhi and Uttarakhand. Around 15 Meetings/Hands on trainings/Workshops were conducted all over the country for extension workers, officials of KVKs, DAATT Centers, Kisan call centers, Agricultural officers and private sector officials to popularise RKMP and also to familiarize the participants about the portal. RKMP publicity materials were distributed to the various rice stakeholders of the country. Features like state wise statistics in Rice Stats Domain, recommended rice varieties in Service Domain, contingency plans in Extension Domain were added along with availability of seeds, instant content upload service and updates on ARGM. Farmers were made aware of RKMP portal during farmers' days and kisan melas, in addition to rice researchers during 47th ARGM, 6th International Hybrid Rice Symposium in addition to RKMP on You tube.

Intellectual Property Management and Transfer/Commercialization of agricultural technology Scheme

Licensing of DRR technologies through Memorandum of Agreements (MoAs)

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 2012-13, three MoAs for DRRH-2 and two MoAs for DRRH-3 were signed by DRR with the following companies and an amount of Rs. 22,47,200 was received as upfront payment.

MoA with Zuari Seed Limited for DRRH-2

Sl. No	Licensee	Date of MoA Signed
DRRH-2		
1	Zuari Seed Limited	13/07/2012
2	M/S Rohini Seeds Private Limited	28/09/2012
3	JK Agri Genetics Ltd	08/10/2012
DRRH-3		
4	RJ Biotech Pvt Ltd	15/06/2012
5	Siri Seeds (India) Private Limited	03/12/2012

Four organizations were supplied seed through MTA; 13 import permit applications were scrutinized and forwarded to NBPGR; 8 soft registration applications were screened and recommended for submission. DRR participated in two ZTMC-BPD meetings organized by CIFT, Cochin and displayed DRR potential technologies under the theme "Best Practices & Business Models" in the National Convention – The Next Frontier of Agri-Business and Technology, organized by Govt. of Gujarat in coordination with Gujarat Agro Industries Corporation Limited & Confederation of Indian Industry (CII) Gandhinagar, Gujarat, 3-6 September, 2012.

Awards and Recognitions

- **Dr. N. Shobha Rani**, Principal Scientist and Head, Crop Improvement section received the prestigious M.S. Swaminathan award for the year 2011 constituted by RICAREA and Nuzivedu Seeds Private Limited
- **Dr. N. Sarla**, Principal Scientist has been awarded National Professor Chair by ICAR.
- **Dr. Brajendra**, Senior Scientist, Soil Science, Crop Production was awarded "Krishi Shodh Shiromani Award, 2012" by farmers youth foundation, a conglomerate of award winning farmers of Bihar during Kisan Diwas Celebrations on 23rd December, 2012.
- **Dr. N. Somasekhar** was conferred as Fellow of Plant Protection Association of India (PPAI), Hyderabad.
- **Dr. R.M. Sundaram and Dr. M. Sheshu Madhav**, Senior Scientists, Biotechnology been elected as Associate Fellows of National Academy of Agricultural Sciences, New Delhi w.e.f. January 2013 for a period of five years for their outstanding contribution to rice biotechnology.
- **Ms. P. Vijayalakshmi** (Research Associate, NICRA Project) got young scientist award from Indian Society of Plant Physiology.

Sports Awards

Thirty four DRR staff participated in the south zone sports meet held at Sugarcane Breeding Institute, Coimbatore from 18-22 February, 2013 and won gold, silver and bronze medals.

Revenue Generation

An amount of Rs. 1,15,30,000 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 Rs. 1,90,000 was generated as course fee for M.Sc research project students.

Testing Fees

Through testing of varieties and hybrids an amount of Rs. 1,57,00,00 was generated.

Linkages and collaboration in India and abroad

DRR signed MOU with ICGEB for collaborative research project 'Common basis of defense induction in rice and mustard against sucking and gall insect pests'.

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 2012-13 is given in Appendix 4.

Externally funded projects

Eleven externally funded projects have been sanctioned during 2012-13. A total of 43 externally funded projects are currently being handled at DRR (Appendix 5).

Sl. No.	Event	Category	Single/double	Name	Remarks
1	Table Tennis	Women	Single	Dr. K. Surekha	Silver Medal
2	Table Tennis	Women	Doubles	Dr. K. Surekha & Dr. G. Padmavathi	Gold Medal
3	100m-Running	Women	-	Dr. Revathi	Bronze Medal
4	Long jump	Women	-	Dr. P. Revathi	Silver Medal
5	High jump	Women	-	Dr. P. Revathi	Gold Medal
6	Shuttle Badminton	Women	-	Dr. P. Revathi & Ms. Kousalya	Silver Medal
7	Carrom	Men	-	Mr. S. Sadanandam	Gold
8	Table Tennis	Men	-	Dr. V. Ravindra Babu, Dr. R. Mahendra Kumar & Mr. Amudan Srinivas	Silver Medal

Significant events

Meetings

Quinquennial Review Team (2007-2012)

A quinquennial review team (QRT) under the chairmanship of Dr. B. Mishra, Ex-Vice Chancellor, Sher-E-Kashmir University of Agricultural Sciences & Technology, Jammu, consisting of five other members viz., i. Dr. S.R. Das, Former Professor and Rice Breeder, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, ii. Dr. N.P. Sarma, Former Head, Biotechnology, DRR, Hyderabad, iii. Dr. S.K. Sharma, Former Director, Project Directorate of Cropping Systems Research, Modipuram, Uttar Pradesh, iv. Dr. A.P.K. Reddy, Former Head, Plant Pathology, DRR, Hyderabad and v. Dr. K.P.C. Rao, Former Head, Economics, National Academy of Agricultural Research and Management, Hyderabad reviewed work done under the lead research at DRR, Hyderabad and AICRIP, during the period 2007-2012.

After the initial meeting with Dr. S.K. Datta, DDG (Crop Sciences) and Dr. R.P. Dua, ADG (FF & C) for cognizance of the expectations of ICAR, QRT reviewed the recommendations of the previous QRT and Action Taken Report as well as progress of research carried out at DRR. Five meetings of the QRT were held to review the work done under AICRIP at UAS, Bangalore (June 21-22, 2012), PAU, Ludhiana (September 19-20, 2012), CRRI, Cuttack (October 05-06, 2012), DRR, Hyderabad (October 22, 2012) and ICAR complex for NEH region, Barapani (November 16, 2012).

During these regional and central meetings, QRT critically examined the mandate of the Directorate of Rice Research in the context of the country's rice production and productivity scenario in the past five years and evaluated progress of research and extension activities and came out with a set of recommendations to further strengthen the research and infrastructure facilities to enable DRR to meet the future challenges in maintaining National Food and Nutritional Security. Based on the quality of basic, strategic and applied research output and volume of work in terms of innovative approach for the development of varieties, hybrids and technologies along with other measurable parameters, QRT rated the performance of DRR as excellent. QRT also appreciated the effective coordination by DRR under AICRIP while there was mixed reaction about the performance of cooperating centers. Performance of some of the centers was rated excellent, while many of the centers were rated very good and good.

Research Advisory Committee meeting

The new Research Advisory Committee (RAC) (2011-14) committee constituted by ICAR has Dr. E.A. Siddiq, Former DDG (Crop Sciences), ICAR as Chairman, with Dr. R.K. Samantha, Ex-VC, BCKVV, Kalyani; Dr. R.S. Sonti, Chief Scientist, CCMB, Hyderabad; Dr. Madan Mohan, Professor, Delhi Univ. New Delhi; Dr. R.P. Singh, Former Project Director, PDCSR, New Delhi; Dr. S.N. Sinha, Ex-Head, IARI, Regl. Station, Karnal as members; Dr. B.C. Viraktamath, Project Director, DRR, Hyderabad as Ex. Officio Member and Dr. Gururaj Katti, DRR as Member Secretary. The first meeting of the newly constituted was held on 4 May, 2012 with participation of all the scientific staff of DRR. Project Director Incharge Dr. N. Shobha Rani made a detailed presentation giving an overview of the achievements of DRR under AICRIP and Lead Research. Dr. G. Katti, convenor of RAC presented Action Taken Report (ATR) for recommendations of the first RAC meeting held on 10th May, 2011. After an elaborate discussion on the PD's Report and ATR, Principal Investigators of all the disciplines presented the salient findings of the work done during 2011-12. Each of the presentation was followed by detailed interaction as well as discussion of the Chairman and members with the scientists which led to the observations and recommendations of the RAC for the period 2012-13.

Institute Management Committee meeting

The 17th Institute Management Committee meeting of DRR was held on 08.03.2013. The IMC meeting was chaired by Dr. B.C. Viraktamath, Project Director and was attended by other members of the committee, Dr. R.P. Dua, ADG (FFC), Dr. K.S. Varaprasad, Project Director, DOR, Dr. R. N. Rao, Principal Scientist, CRRI, Dr. Y. G. Prasad, Principal Scientist, CRIDA, Dr. S.M. Balachandran, Convener, Shri M.K.M. Nair, Administrative Officer and member secretary and heads of the sections of DRR. Proceedings of the previous IMC meeting along with Action Taken Report were presented by Dr. S.M. Balachandran. The IMC recommended that the proposed activities of purchase of prioritized equipments and farm implements, repair and renovation work of Rice Museum and CTC hostels and library could be taken up as per the availability of funds during 2013-14 under XII Plan.

Institute Research Council meeting

The Institute Research Council (IRC) meetings were conducted from May 16 to 18, 2012 in additional to a special IRC on July 16, 2012 under the chairmanship of Dr. B.C. Viraktamath, Project Director. Dr. V.V. Shenoy, Barwale foundation (crop improvement), Dr. Raji Reddy, ANGRAU (crop production), Dr. T. Ratna Sudhakar, ANGRAU and Dr. K. Satyanarayana, Retd Principal Scientist, DRR (crop protection) and Dr. R. Ratnakar, ANGRAU (TTT) acted as Subject matter specialists. The ongoing and new projects were thoroughly discussed and approved (Appendix 6)

Institutional Biosafety Meeting

14th Institutional Bio-safety meeting was held on 22nd March, 2013 under the chairmanship of Dr. B.C. Viraktamath with Prof. P.B. Kirti, Professor, HCU was the expert from DBT. Six other members attended the meeting. Dr. S.M. Balachandran presented the progress of the ongoing projects on GM rice and action taken report of the previous IBSC meeting.

Orientation and sensitization meeting of research project staff

A meeting for orientation and sensitization was organized on December 28, 2012 addressed by Dr. B.C. Viraktamath to sensitize the research project staff about the guidelines and work ethics. A total of 120 Project staff, 17 Principal Investigators under 42 externally funded projects attended the meeting with briefings by Mr. M.K.M. Nair, AO, Dr. N. Sarla and Dr. J.S. Bentur on administrative procedures, laboratory etiquette and importance of publications.

Awareness program on PPV& FRA

One day awareness-cum-training program on Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act 2001 with special emphasis on registration of farmers' varieties was held at DRR on March 25, 2013. About 130 participants from Dept. of Agriculture, Horticulture and ANGRAU attended the meeting.

Celebration of Women in Agriculture Day

Women in Agriculture Day was celebrated on December 4, 2012, to acknowledge the significant contribution of women to the agricultural field. On this occasion, a series of activities were organized for all the staff and farm labour of DRR under the guidance of the Project Director, Dr. B.C. Viraktamath. The guest speaker, Dr. K.B.R.S. Visarada, Principal Scientist, Directorate of Sorghum Research, Hyderabad highlighted the important contribution of women farm labour and urged them to be aware of their rights as workers and motivated them to form groups specializing in different field based activities. The activities in rice cultivation as perceived by the women farm labour were analyzed using a matrix ranking exercise followed team games and competitions for women farm labor.

Marathon Run for Rice

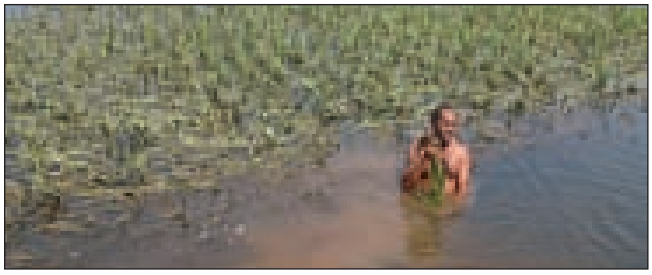
A marathon run with focus on rice was organised on 31st December 2012 to create awareness about the rice with 70 participants. The event was unique and many people were impressed with the ideas displayed as placards on do's and don'ts of rice consumption and production and other interesting facts about rice.

New Year cum Annual day celebrations

On January 5, 2013, DRR jointly celebrated Annual day and New Year involving all the staff and their family members which was organized by recreation club. A plethora of cultural activities were organized which enthralled all the staff members along with a series of indoor and outdoor games.

Assessment of Crop Damage by Nilam Cyclone

As desired by the Honorable Director General, ICAR, two teams comprising Dr. B.C. Viraktamath, Dr. K.V. Rao, Dr. V. Ravindra Babu (East Godavari), Dr. T. Ram, Dr. Mangal Sain and Dr. P.V. Satyanarayana (West Godavari) visited the flood affected areas in coastal AP and interacted with Shri Ch.Nagi Reddy, Member of ICAR Governing body, Agricultural Departmental officials and farmers. The rice crop nearing maturity was either lodged or submerged due to the torrential rains during this period and sprouting was observed in the varieties BPT 5204 and Swarna. Rice crop in 4-5 lakh ha was estimated to be lost due to this cyclone.



Discussion on Rice IPM

Dr. Chirantan Chattopadahay, Director, NCIPM, New Delhi, visited DRR on February 27, 2013 and discussed in detail about integrated pest management in rice and forecasting of rice pests and diseases.

International Dialogue on Designer Rice

International Dialogue on Designer Rice was organized by the Society for the Advancement of Rice Research (SARR) at ICRISAT Hyderabad during 9-10 July, 2012 as a brain-storming session on the prospects of designing rice that would be capable of meeting the future food and nutritional needs. Ten scientists from DRR participated in this dialogue in which has rice researchers across the world participated capturing novel ideas and their feasibility, practicability in the context of existing scientific knowledge and tools in the futuristic scenario in all the relevant fields of rice. Some of the prominent rice scientists who participated in this event were Dr. Robert Zeigler, DG, IRRI, Prof. E.A Siddiq, Dr. S.K. Datta, DDG (CS), Dr. William Dar, DG, ICRISAT, Dr. V. Nagi Reddy, VC, ANGRAU, Dr.Rod Wing USA, Dr. A K Tyagi, NIPGR, Dr.G.L.Wang, USA.

6th International Hybrid Rice Symposium

6th International Hybrid Rice Symposium was organized by IRRI and ICAR, its constituent organization DRR during September 10-12 in Hyderabad. Around twenty scientists from DRR attended this event covering several aspects of hybrid rice and presented the progress of research relevant to hybrid rice as oral and poster presentations.

48th Annual Rice Group Meetings

DRR organized 48th Annual Rice Research Group Meeting during April 14-16, 2013 at Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir (SKUAST), Srinagar. The Chief Guest was Jenab Ghulam Hassan Mir Hon'ble Minister of Agriculture, J&K and Jenab Nazir Ahmad Khan Gurezi Hon'ble Minister of State for Animal&Sheep Husbandry PHE, I&FC Horticulture, Agriculture & Floriculture, J&K was the Guest of Honor during the inaugural session. Dr. Swapan Kumar Datta, DDG (Crop Sciences) and Dr. Dua, ADG (FFC) ICAR underscored the importance of rice in Indian agriculture scenario. About 450 rice researchers actively participated and the AICRIP trials of the last year were reviewed and new programmes were planned. During 2012-13, 11 hybrids and 22 varieties were released. On this occasion, 13 publications (10 from DRR, 1 each from ANGRAU, TNAU and SKUAST) were released.

Recommendations of 48th Annual Rice Group Meetings

Varietal Improvement

The Varietal Identification Committee recommended the 11 hybrids and 22 varieties.

Agronomy

- Twenty two AVT-2 cultures were found promising on the basis of Grain Yield Efficiency Index (GYEI). Use of young (10-12 days) seedlings for transplanting in SRI proved to be most important component. Mechanical transplanting of SRI not only excluded drudgery but also produced 20-25% higher yields as compare to manual transplanting.
- Application of organic manures in conjunction with recommended NPK fertilizers along with micronutrients (Zn and Fe) enhanced rice productivity by 4-14% over NPK only in neutral soils in rice-rice and rice-wheat cropping system.

Soil Science

- Omitting nutrients or reduced application of nutrients considerably affected the sustainability of the production system as indicated by soil nutrient depletion and negative balance of N, K and soil carbon stocks.
- In the acid soils of Ranchi (pH 5.0), rice nutrition and productivity could be increased by judicious application of major nutrients at recommended levels combined with organic manuring and application of borax (0.2% spray) and potassium silicate (@ 50 kg/ha) or basic slag (@ 150 kg/ha).
- China 1039 (Khudwani), WGL 14377 (MTU), Aghonibora (FZB, MCP, TTB) and Triguda (RPR) were found promising for both high Fe and Zn contents in the brown rice.
- In Fe toxicity prone acid soils, genotypes like IET 21009, IET 21542; IET 20884, IET21510, IET 21477, IET 22081, Aghonibora and Prafulla were found promising.
- Combined application of organic manure, zinc/iron and cytokinin (8 ppm) spray significantly improved Fe content in grain in the acid soils of Assam valley.

Plant Physiology

- IET 20924 continues to perform better at 9 locations for the consecutive third year under normal and early sown conditions with stable physiological characteristics. Other promising genotypes include IET 22218, IET 22569, RP-4918-16630 and DRRH-3 with relative photo insensitivity and high radiation use efficiency.
- IET 22116 and PA-6129 were found to be tolerant to high temperature up to 10°C at four locations. Phosphorus application @ 40 Kg/ha improved the grain yield of Swarna-sub1 under submergence condition.

Entomology

- Two breeding lines from Moncompu - KAUM 166-2, KAUM 168-1 and two from Jagtial - JGL 18044, JGL 18080 were found promising against brown planthopper and gall midge respectively.·
- Promising multiple resistant culture, CR 2711-76 will be registered with NBPGR by CRRI as unique germplasm.
- A new insecticide molecule, Sulfoxaflor 24% SC @ 75 g a.i. per hectare, proved very effective against brown planthopper.

Plant Pathology

- The multiple disease resistant lines CB 05 –031, CH 45, GSR 101, GSR 104, GSR105,GSR 111, GSR 112, GSR 113, GSR 126,GSR 127, GSR 130, GSR 138, GSR140, GSR 141, GSR 142, K014, RP- Biopatho-3, RP- Patho-10, RP- Patho-12, RP-Patho-2, RP- Patho-6, RP- Patho-7, RP- Patho-8, RP- Patho-9, VL 31289, VL 31598,VL 31611, VL 31716 and VL 8654 for more than two diseases have been identified.

Visits

Honorable Minister of State for Agriculture, Shri Tariq Anwar

Honorable Minister of State for Agriculture, Government of India, Shri Tariq Anwar visited Directorate of Rice Research on January 8, 2013 and addressed scientific staff of DRR. He appreciated Project Director for significant achievements of DRR. He underscored the importance of national food and stressed for the reach of the technologies to the farmers.

Prof. Yuan Long Ping

The Father of Hybrid Rice and Director General, China National Hybrid Rice Research and Development Centre, Chongtha, China, visited DRR on September 11, 2012. Prof Yuan Long Ping, recipient of World Food Prize for the year 2004, has visited the hybrid rice experimental plots of DRR and motivated all the researchers with keen observations and suggestions.

Deputations abroad

1. Dr. B.C. Viraktamath attended Agriculture Task Force meeting of UNEP on "Sustainable Consumption and Production" in Rome, Italy during April 4 - 5, 2012.
2. Dr. V. Ravindra Babu participated in the Harvest Plus Rice Team meeting in Dhaka, Bangladesh during April 15-18, 2012.
3. Dr. Shaik. N. Meera was deputed to IRRI, Philippines from October 7, 2012 to April 6, 2013.
4. Dr. M.S. Ramesha completed 3 years deputation to IRRI July 3, 2009 to July 2, 2012.
5. Dr. B.C. Viraktamath attended 2nd Global Science Forum on 'Structural transformations in the rice sector; Implications for Research and Development' at IRRI, The Philippines during October 11-12, 2012.
6. Dr. T. Ram and Dr. P. Revathi participated in the 'Integrated Breeding Multi Year Course' at Netherlands during October 15 - 26, 2012.
7. Dr. B.C. Viraktamath and Dr. L.V. Subbarao attended Sloan Foundation Conference on 'South Asian Science Engagement' in Singapore during October 18-19, 2012
8. Dr. S.K. Mangrauthia, Scientist was deputed to Purdue University, USA as Indo-US research fellow award at from January 15, 2013 to January 14, 2014.

Visitors list

S.No.	Name and Affiliation	Dates
1	Ms. V. Usha Rani, Commissioner, Agriculture, Hyderabad	05.01.2012
2	Mr. Nader Baksh and Mr. Nigel Grimes of Ministry of Food Production, Land and Marine Affairs, Trinidad & Tobago	11.01.2012
3	Mr. Sudhir Bhargava, Member, KAPGB	30.01.2012
4	Dr. Zhikang Li, Chief Scientist, Chief Scientist, Chinese Academy of Agricultural Sciences, Beijing, Dr. Guo Liang Wang, Professor, Ohio State University and Dr.Rod Wing, Director, Arizona Genomics Institute, USA	07.11.2012
5	Prof. A.C. Sinha Vice chancellor, Uttar Banga Krishi Visva Vidhyalaya (UBKV)	21.07.2012
6	Dr. Rolly O. Torres and Dr. Leny Bneno of IRRI, Phillipines	13.09.2012
7	Dr. C.A. Viraktamath, Retired Prof. of Entomology, UAS, Bangalore	18.09.2012
8	Dr. OP Yadav, Project Director, DMR, New Delhi	22.09.2012
9	Mr. Francois Balumuene, Ambassador of the Democratic Republic of Congo	28.09.2012
10	Dr. P.K. Gupta, CCS University, Dr. B.D. Singh, B.H.U., Varanasi and Dr. H.S. Balyan Meerut	12.10.2012
11	Dr. Ajay Kohli and Dr. Arvind Kumar of IRRI	20.12.2012
12	Rockefeller Foundation Team along with Dr. Robin of TNAU	18.01.2013

Project Completion Reports

I. Molecular Basis of Insect-Plant Interactions in Rice (2006-2012)

The Asian rice gall midge *Orseolia oryzae* (Wood-Mason) (Diptera: Cecidomyiidae) is an important pest causing significant yield loss. The interaction between the Asian rice gall midge and rice is known to be based on gene-for-gene interaction, highly defined and qualitative. In compatible interaction plant proves to be susceptible and insect completes its development producing gall. In incompatible interaction, insect proves to be avirulent and plant successfully prevents attack by killing the insect within 48h with or without the expression of hypersensitive interaction (HR). In this project various functional genomics tools were employed to understand molecular basis of host-plant susceptibility and resistance with and without HR.

Susceptibility in rice-gall midge interaction is not a default phenomenon and requires a suite of transcriptional reprogramming to change a growing meristematic tissue into a nutritive tissue for insect feeding and is the result of coherent interplay of a large number of genes. These studies showed that virulent insects induced the plants to step up metabolism and transport nutrients to their feeding site and suppressed defense responses. But Kavya rice mounted an elevated defense response during early hours of virulent gall midge infestation, which was over-powered later, resulting in host plant susceptibility. Among the validated genes, Transcriptionally Controlled Tumor Protein (TCTP) gene can be considered a key susceptibility gene that needs further investigation.

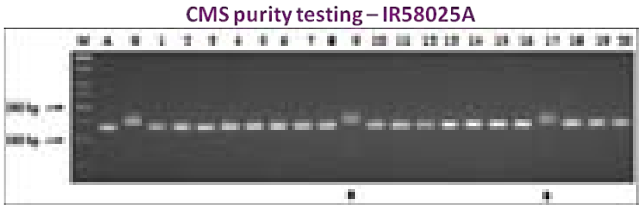
Resistance in Suraksha rice with *Gm11* gene against gall midge (HR+ type) is similar in nature to the resistance observed in plants against pathogens. Results revealed early (*OsPR10α* and Cytochrome P450) and late responsive (amino acid permease, NBS-LRR and phenylalnine ammonia lyase) differentially expressed genes that are likely to be involved in rice-gall midge interactions. The results also indicated involvement of the phenylpropanoid pathway related genes like NBS-LRR, Phenylalanine ammonia lyase and *OsPR10α* in HR+ mediated resistance.

Gall midge resistance in Kavya variety of rice carrying *Gm1* gene and expressing HR- type resistance against the GMB1 could be due to the constitutive expression of an R gene and a case of extreme resistance which is devoid of cell death. This is the first report of a novel resistance mechanism in rice against gall midge.

II. Application of biotechnological tools for understanding molecular basis of yield heterosis and WA-CMS trait in rice (PI- Dr. R.M. Sundaram, 2007-2012) (Code: CI/BT/7)

Using EST-SSR markers for prediction of yield heterosis in rice: A set of 150 EST-SSR markers designed from rice genome and validated in a set of 100 rice varieties, which included 20 hybrid rice parental lines. Among these, 70 markers showed clear, amplification pattern with high PIC values (> 0.5). The coefficient of marker polymorphism (CMP) among the parental lines of six popular public-bred rice hybrids was correlated with the standard heterosis for per day grain yield. A set of 35 EST-SSR markers targeting (GATA)n motifs in the genic regions of the rice genome were also designed observed to be positively correlated with heterosis in the above mentioned parental lines/hybrids (R2 = 0.73). Four markers were rated as very good for preliminary sorting of parental lines. From these analyses, a set of 10 'key informative' EST-SSR markers capable of accurately predicting heterosis were identified validated in a set of 14 experimental hybrids. These markers displayed a very high positive correlation with respect to the both grain yield heterosis (r = 0.79) and per day productivity (r = 0.82).

Analysis of mitochondrial genes associated with respiration to identify candidate genes associated with WA-CMS trait in rice: A total of 70 PCR primers targeting the exonic region and 5' upstream region of 13 genes/subunit genes of mitochondria associated with respiration/CMS trait were designed and 50 out of the 70 primers pairs showed clear amplification pattern. The analysis revealed presence of a (AT)6 repeat SSR, which is polymorphic between WA-CMS lines and their maintainers. Targeting this SSR motif, a marker named *drrcms* has been designed for distinguishing WA-CMS lines of rice from their maintainers and using this marker, an assay has been designed for rapid and reliable estimation of purity of seeds of WA-CMS lines. This assay is now used by DRR and many hybrid seed companies for assessment of contamination of their CMS seed-lots.



A mitochondrial SSR marker (drrcms) based assessment of genetic purity of WA-CMS lines

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Publications

Research articles

Sl. No.	Paper	NAAS rating
1	Anuradha K, Agarwal S, Batchu AK, Babu AP, Swamy BPM, Longvah T, Sarla N (2012) Evaluating rice germplasm for iron and zinc concentration in brown rice and seed dimensions. Journal of Phytology Vol 4:19-25.	
2	Anuradha K, Agarwal S, Rao YV, Sarla N(2013) Quantitative trait loci and candidate genes for yield and related traits in Madhukar x Swarna RIL population of rice. J Crop Science and Biotechnology. Vol 16: 85- 95.	
3	Anuradha K, Agarwal S, Rao YV, Rao KV, Viraktamath BC, Sarla N (2012) Mapping QTLs and candidate genes for iron and zinc concentrations in unpolished rice of Madhukar × Swarna RILs. Gene, Vol 58: 233–240.	7.7
4	Babu VR, Bhushan VS, Padmavathi Ch, Mohan M, Balachandran SM, Ramesh B (2013) Carboxylesterase and Glutathione-S-Transferase (GST's) Induced Resistance to Bacillus thuringiensis Toxin Cry1Ab in Rice Leaf Folder, *Cnaphalocrocis medinalis* (Guenee) populations. Journal of Agricultural Science and Technology Vol 3: 53-59.	6.9
5	Bimolata W, Kumar A, Sundaram RM, Laha GS, Qureshi IA, Reddy GA, Ghazi IA (2013) Analysis of nucleotide diversity among alleles of the major bacterial blight resistance gene *Xa27* in cultivars of rice (*Oryza sativa*) and its wild relatives. Planta (published online).	7.8
6	Borney SI, Lenka NK, Brajendra, Patiram (2012) Effect of Land Use on Forms of Sulphur in Soils of Meghalaya. Journal of the Indian Society of Soil Science, Vol 60: 304-308.	
7	Brajendra, Patiram, Singh LS (2012) Soil test based fertilizer recommendation and verification for maize grown in mid hills of Meghalaya. Asian Journal of Soil Science. Vol 7: 124-126.	
8	Brajendra, Shukla LM, Kherawat BS, Lal M (2012) Mineralization of native soil sulphur under different temperature and moisture regimes. International Journal of Agricultural Research. Vol 8: 530-534.	
9	Brajendra, Shukla LM, Kherawat BS, Lal M (2012) Critical Limit of Sulphur for Mustard in alfisols and ultisols of Jharkhand. Asian Journal of Soil Science. Vol 7 : 211-213.	
10	Brajendra, Shukla LM, Kherawat BS, Lal M (2012) Critical Limit of Sulphur for Safflower in alfisols and ultisols of Jharkhand. Asian Journal of Soil Science. Vol 7: 223-225.	
11	Brajendra, Vishwakarma AK, Pathak KA, Kherawat BS, Lal M (2012) Rainfall distribution pattern in Kolasib district of Mizoram. International Journal of Agricultural Research. Vol 8: 509-513.	
12	Gopalkrishnan S, Kumar RM, Humayun P, Srinivas V, Ratnakumari B, Vijayabharathi R, Singh A, Surekha K, Ch.Padmavathi, SomaShekar N, Rao PR, Latha PC, Rao LVS, Babu VR, Viraktamath BC, Goud VV, Gujja NLB, Rupela O (2013) Assessment of different methods of rice (*Oryza sativa*. L). cultivation affecting growth parameters, soil chemical, biological and microbiological properties, water saving and grain yield in rice-rice system. Paddy Water Environment: (published online)	7.4
13	Hari Y, Srinivasarao K, Viraktamath BC, HariPrasad AS, Laha GS, Ahmed MI, Natarajkumar P, Sujatha K, Prasad MS, Pandey M, Ramesha MS, Neeraja CN, Balachandran SM, Rani NS, Kemparaju KB, Mohan KM, Sama VSAK, Hajira SK, Balachiranjeevi CH, Pranathi K, Reddy GA, Madhav MS, Sundaram RM (2013) Marker-assisted introgression of bacterial blight and blast resistance into IR 58025B, an elite maintainer line of rice, Plant Breeding (published online)	7.6
14	Kumar A, Guha A, Bimolata W, Reddy AR, Laha GS, Sundaram RM, Pandey, MK, Ghazi IA (2013) Leaf gas exchange physiology in rice genotypes infected with bacterial blight: An attempt to link photosynthesis with disease severity and rice yield. Australian Journal of Crop Sciences. Vol 7:32-39.	7.6
15	Kumar CVM, Gouda PK, Saikumar S, Shenoy V, Shashidhar HE, Sarla N (2012) Transgressive segregation for yield and related traits in advanced backcross population from the cross Oryza sativa IR58025B X *Oryza meridionalis* Ng. evaluated under irrigated and aerobic conditions. J Crop Science and Biotechnology, Vol 15: 231 – 238.	7.7
16	Kumar PN, Sujatha K, Laha GS, Rao KS, Mishra B, Viraktamath BC, Hari Y, Reddy CS, Balachandran SM, Ram T, Madhav MS, Rani NS, Neeraja CN, Reddy GA, Hajira S, Sundaram RM (2012) Identification and fine-mapping of *Xa33*, a novel gene for resistance to *Xanthomonas oryzae* pv *oryzae*. *Phytopathology*. Vol 102: 222-228.	7.8

Sl. No.	Paper	NAAS rating
17	Ladhalakshmi D, Laha GS, Singh R, Karthikeyan A, Mangrauthia SK, Sundaram RM, Thukkaiyannan R, Viraktamath BC (2012) Isolation and characterization of *Ustilaginoidea virens* and survey of false smut disease of rice in India. *Phytoparasitica* Vol 40:171–176.	7.3
18	Lal M, Nataraj KC, Kherawat BS, Brajendra, Arvind Kumar (2012) Effect of nitrogen and managenese on yield and uptake of nutrients by oats. Asian Journal of Soil Science. Vol 7 : 127-130	
19	Lalasa LM, Radhika K, Neeraja CN, Babu VR (2012) Molecular Mapping of the Chromosomal Regions Associated with Zinc Content in Grains of Rice (*Oryza sativa* L.) using Microsatellite Markers. Journal of Microbiology and Biotechnology Vol 2: 900-905.	7.5
20	Malathi P, Brahma U, Singh J, Krishnaveni D, Balachandran SM, Neeraja CN, Laha GS, Viraktamath BC, Mangrauthia SK (2012) PCR Based Diagnosis of Rice Tungro Bacilliform and Spherical Virus from Infected Plants and Insect Vectors. Indian Journal of Plant Protection. Vol 39: 294-298.	4.3
21	Malathi P, Mangrauthia SK (2013) Deciphering the multiplication behavior of Rice tungro bacilliform virus by absolute quantification through real-time PCR. *Archives of Phytopathology and Plant Protection*, (published online).	
22	Mangrauthia SK, Malathi P, Agarwal S, Kumar GR, Krishnaveni D, Neeraja CN, Madhav MS, Ladhalakshmi D, Balachandran SM, Viraktamath BC (2012) Genetic variation of coat protein gene among the isolates of *Rice tungro spherical virus* from tungro-endemic states of the India. Virus Genes Vol 44:482- 487.	7.6
23	Mangrauthia SK, Malathi P, Agarwal S, Sailaja B, Singh J, Kumar GR, Krishnaveni D, Balachandran SM (2012b) The Molecular Diversity and Evolution of Rice tungro bacilliform virus from Indian perspective. Virus Genes, Vol 45:126–138.	7.6
24	Nagesh P, Usharani G, Neeraja CN, Babu VR, Reddy TD (2013) Molecular mapping of high iron and zinc rich regions in rice (*Oryza sativa* L.) grain using microsatellite markers. Helix Vol 1: 231-237	
25	Nirmala B, Sailaja B, Meera SN, Muthuraman P, Mangal Sain (2012) Rice yield gaps in India: Causes and strategies to narrow the gaps. Journal of Agrotechnology Vol l: 1- 56.	
26	Nirmala B, Vasudev N, Suhasini K (2012) A Comparison Of Economic Potential Of HYV *Vs.* Hybrid Rice Cultivation In Ambedkar Nagar District of Uttar Pradesh World Research Journal of Agronomy Vol 1: 07-10.	
27	Nirmala B, Vasudev N, Suhasini K, Meera SN, Viraktamath BC (2012) Contract Farming: A case of hybrid rice seed production in Andhra Pradesh, Agricultural Economics Research Review, Vol: 25, 539.	4.7
28	Padmavathi Ch, Katti G, Padmakumari AP, Voleti SR, Rao LVS (2013) Effect of leaffolder, *Cnaphalocrocis medinalis* (Guenee) injury on leaf physiology and yield loss in rice. Journal of Applied Entomology, Vol 137 : 249 – 256.	7.5
29	Pandey MK, Rani NS, Madhav MS, Sundaram RM, Varaprasad GS, Sivaranjini AKP, Bohra A, Kumar GR (2012) Different isoforms of starch-synthesizing enzymes controlling amylose and amylopectin content in rice (Oryza sativa L.). Biotechnology Advances. Vol 30 : 1697–1706.	9.1
30	Pandey MK, Shobha Rani N, Sundaram RM, Laha GS, Madhav MS, Srinivasa Rao K, Sudharshan I, Hari Y, Varaprasad GS, Rao LVS, Suneetha K,. Sivaranjani AKP, Viraktamath BC (2012) Improvement of two traditional Basmati rice varieties for bacterial blight resistance and plant stature through morphological and marker-assisted selection. Molecular Breeding, Vol 31: 239-246.	7.8
31	Pogorelko GP, Lionetti V, Fursova O, Sundaram RM, Qi M, Whitham SA, Bogdanove AJ, Daniela D, Zabotina OA (2013) *Arabidopsis* and *Brachypodium* transgenic plants expressing *A. nidulans* acetylesterases have decreased degree of polysaccharide acetylation and increased resistance to pathogens. Plant Physiology, Vol 162: 9–23.	8.6
32	Prasanth VV, Chakravarthi DVN, Kiran TV, Rao YV, Panigrahy M, Mangrauthia SK, Viraktamath BC, Subrahmanyam D, Voleti SR, Sarla N (2012) Evaluation of rice germplasm and introgression lines for heat tolerance. Annals of Biological Research, Vol 3 :5060-5068	
33	Raman A, Verulkar SB, Mandal NP, Variar M, Shukla VD, Dwivedi JL, Singh BN, Singh ON, Swain P, Mall AK, Robin S, Babu RC, Jain A, Ram T, Hittalmani S, Haefele S, Piepho HP, Kumar A (2012) Drought yield index to select high yielding rice lines under different drought stress severities. Rice, 5:31.	7.9

Sl. No.	Paper	NAAS rating
34	Rao DN, Ramesha MS, Rao PR, SR Voleti (2012) Combining ability analysis to identify suitable parents and Hybrids for cultivation in Rice under alternate wetting and drying conditions. The Andhra Agric, Vol 59 : 625-629.	3.3
35	Rao DN, Voleti SR, Subrahmanyam D, Rao PR, Ramesha MS (2012) Heterosis for antioxidant enzymes in rice hybrid under abiotic stress conditions. Indian Journal of Plant Physiology Vol 17: 175-178.	5.5
36	Rao PR, Sailaja B, Subrahmanyam D, Rao DN, Voleti SR, Reddy PS, Rao GV (2012) Variable radiation use efficiency in rice cultures grown at different locations. Indian Journal of Plant Physiology Vol 17: 57-60.	5.5
37	Rao PR, Subrhamanyam D, Sailaja B, Singh RP, Ravichandran V, Rao S, Swain GVP, Sharma SG, Saha S, Nadaradjan S, Reddy PJR, Shukla A, Dey PC, Patel DP, Ravichandran S, Voleti SR (2013) Influence of Boron on Spikelet Fertility under Varied Soil Conditions in Rice Genotypes. Journal of Plant Nutrition Vol 36: 390-400	7.2
38	Rao PS, Bharathi M, Reddy KB, Keshavalu K, Rao LVS, Neeraja CN (2012) Varietal identification in rice (*Oryza sativa* L.) through chemical tests and gel electrophoresis of soluble seed proteins. Indian Journal of Agricultural Sciences. Vol 82: 304-311.	6.6
39	Ratna KM, Prasad MS, Madhav MS, Laha GS, Madhan MK, Sundaram RM, Jahnavi B, Vijitha S, Rao PR, Viraktamath BC (2012) Introgression of Blast Resistance Gene Pi-kh into Elite indica Rice Variety Improved Samba Mahsuri. Indian Journal of Plant Protection Vol 40: 52-56.	4.3
40	Rawat N, Neeraja CN, Sundaram RM, Nair S, Bentur JS (2012) A novel mechanism of gall midge resistance in the rice variety Kavya revealed by microarray analysis. Functional and Integrative Genomics Vol 12: 249-264.	7.8
41	Rawat N, Himabindu K, Neeraja CN, Nair S, Bentur JS (2013). Suppressive subtraction hybridization reveals that rice gall midge attack elicits plant-pathogen like responses in rice. Plant Physiology and Biochemistry 63:122-130	7.7
42	Rawat N, Neeraja CN, Nair S and Bentur JS. 2012. Differential gene expression in gall midge susceptible rice genotypes revealed by suppressive subtraction hybridization (SSH) cDNA libraries and microarray analysis. Rice 5:8 (on line)	7.6
43	Revathi P, Medoju P, Singh AK, Sundaram RM, Raju S, Senguttuvel P, Kemparaju KB, Prasad ASH, Ramesha MS, Neeraja CN, Rani NS, Viraktamath BC (2013) Efficiency of molecular markers in identifying fertility restoration trait of WA-CMS system in rice. Indian J. Genet., Vol 73: 89-93.	6.6
44	Roja V, Sarla N, Manorama K, Radhika K (2012) Mapping of QTLs for grain Iron and Zinc in Samba Mahsuri and wild rice (*Oryza rufipogon*) using RM and gene specific markers. Journal of Research ANGRangaAgricUniversity, Vol 39 : 37-40.	
45	Sailaja B, Voleti SR, Subrahmanyam D, Rao NH, Nathawat MS (2013) Validation of Oryza2000 model under combined nitrogen and water limited situations. Indian Journal of Plant Physiology . (Published online)	5.5
46	Sailaja B, Anjum N, Patil YK, Agarwal S, Malathi P, Krishnaveni D, Balachandran SM, Viraktamath BC, Mangrauthia SK (2013) The complete genome sequence of a South Indian isolate of Rice tungro spherical virus reveals evidence of genetic recombination between distinct isolates. Virus Genes.	7.6
47	Sama VSAK, Himabindu K, Naik SB, Sundaram RM, Viraktamath BC, Bentur JS (2012) Mapping and marker-assisted breeding of a gene allelic to the major Asian rice gall midge resistance gene *Gm8*. Euphytica Vol 187:393-400.	7.6
48	Sarla N, Swamy BPM, Kaladhar K, Anuradha K, Rao YV, Batchu AK, Agarwal S, Babu AP, Sudhakar T, Sreenu K, Longvah T, Surekha K, Rao KV, Reddy GA, Roja TV, Kiranmayi SL, Radhika K, Manorama K, Cheralu C, Viraktamath BC (2012) Increasing iron and zinc in rice grains using deep water rices and wild species identifying genomic segments and candidate genes. Quality Assurance and Safety of Crops & Foods, Vol 4: 138.	
49	Senguttuvel P, Vijayalakshmi C, Thiyagarajan K, Bapu JRK, Sritharan R, Viraktamath BC (2012) Differential response of rice seedlings to salt stress in relation to antioxidant enzymes activity and membrane stability index. Archives of Agronomy and Soil Science (Published online)	
50	Sinha DK, Nagaraju J, Tomar A, Bentur JS, Nair S (2012). Pyrosequencing-based transcriptome analysis of the Asian rice gallmidge reveals differential response during compatible and incompatibleinteraction. International Journal of Molecular Sciences 13:13079-13103.	7.2

Sl. No.	Paper	NAAS rating
51	Sinha DK, Atray I, Bentur JS and Nair S. 2012. Expression of nucleoside diphosphate kinase (OoNDPK) is enhanced in rice gall midge feeding on susceptible rice hosts and its over-expression leads to salt tolerance in E. coli. Insect Molecular Biology **21**(6), 593–603	7.8
52	Singh H, Gangaiah B (2012) Seed production of *dhaincha* (*Sesbania aculeata*) as influenced by nitrogen and phosphorus fertilization. Indian Journal of Agronomy,Vol 57: 397-402.	5.0
53	Srinivasarao Ch., Venkateswarlu B, Lal R, Singh AK, Kundu S, Vittal, KPR., Balaguravaiah G, Babu MVS, Chary GR, Babu MBBP, Reddy TY (2012) Soil carbon sequestration and agronomic productivity of an Alfisol for a groundnut-based system in a semiarid environment in Southern India. European Journal of Agronomy, Vol 43:40-48.	7.7
54	Sripathy KV, Ganesh M, Keshavulu K, Sundaram RM, Sama VSAK (2012) Assessment of Genetic Purity Using Informative EST- SSR Markers in Rice (*Oryza Sativa* L.) Hybrids. Bioinfolet Vol 9: 128-133.	4.2
55	Sudhakar T, Batchu AK, Sarla N, Ramanan R (2012) *Os11Gsk* gene from a wild rice, *Oryza rufipogon* improves yield in rice. Functional and Integrative Genomics Vol 12 : 277-289	7.8
56	Sudhakar T, Panigrahy M, Lakshmanaik M, Babu AP, Reddy CS, Anuradha K, Swamy BPM, Sarla N (2012) Variation and correlation of phenotypic traits contributing to high yield in KMR3-*Oryza rufipogon* introgression lines. International Journal of Plant Breeding and Genetics Vol 6 : 69-82.	
57	Sujatha KB, Babu SM, Ranganathan S, Rao DN, Ravichandran S, Voleti SR (2013) Silicon Accumulation and its Influence on some of the Leaf Characteristics, Membrane Stability and Yield in Rice Hybrids and Varieties Grown under Aerobic Conditions. Journal of Plant Nutrition Vol 36: 963-975.	7.2
58	Surekha K, Rao KV, Shobha Rani N, Latha PC, Kumar RM (2013) Evaluation of Organic and Conventional Rice Production Systems for their Productivity, Profitability, Grain Quality and Soil Health. Agro technology (Published online).	
59	Suresh PB, Srikanth B, Kishore VH, Rao IS, Vemireddy LR, Dharika N, Sundaram RM, Ramesha MS, Sambasivarao KRS, Viraktamath BC, Neeraja CN (2012) Fine mapping of *Rf3* and *Rf4* fertility restorer loci of WA-CMS of rice (Oryza sativa L.) and validation of the developed marker system for identification of restorer lines. Euphytica Vol 187:421–435.	7.6
60	Swamy BPM, Ahmed HU, Henry A, Dixit S, Vikram P, Ram T, Verulkar SV., Perraju P, Mandal NP, Variar M, Robin S, Chandrababu C, Singh ON, Dwivedi JL, Das SP, Mishra KK, Yadaw RB, Aditya TL, Karmakar B, Mauleon R, Moumeni KSA, Kikuchi S, Leung H, Kumar A (2013) Genetic, physiological, and gene expression analyses reveal that multiple QTLs enhance yield of rice mega-variety IR64 under drought. PLoS ONE, Vol 8 : 1-11.	10.0
61	Upadhyay P, Neeraja CN, Kole C, Singh VK (2012) Population structure and genetic diversity in popular rice varieties of India as evidenced from SSR analysis. Biochemical Genetics Vol 50: 770-783.	7.6
62	Vishwakarma AK, Brajendra, Pathak KA, Kherawat BS (2012) Effect of varying doses of lime on yield and attributes of Maize in Mizoram. Asian Journal of Soil Science. Vol 7 : 271-273.	
63	Vishwakarma AK, Brajendra, Pathak KA,Ramakrishna YS (2012) Effect of different sources of nutrient application on productivity, nutrient uptake and economics of groundnut in Kolasib district of Mizoram. Indian Journal of Soil Conservation. Vol 7 : 152-157.	4.6
64	Waris A, Sain M, Meera SN, Kumar RM, Kumar SA, Muthuraman P (2012) Farm Women's empowerment for sustainable rural and community development. Journal of Agro technology, Vol l : 86.	
65	Yasala AK, Rawat N, Sama VSAK, Himabindu K, Sundaram RM, Bentur JS (2012) In silico analysis for gene content in rice genomic regions mapped for the gall midge resistance genes. Plant Omics Journal Vol 5: 405-413.	7.6

Presentations in Conferences / Symposia / Seminars / other fora

International Conference on Agricultural and Horticultural Sciences organized by *OMICS publishing Group, USA*, held at Hyderabad, during 14 – 15 September 2012

Amtul Waris, Mangal Sain, S.N. Meera, RM Kumar, Arun Kumar S and P. Muthuraman (2012). Farm Women's empowerment for sustainable rural and community development. paper presented in "*International Conference on Agricultural and Horticultural Sciences*" organized by OMICS publishing Group, USA, held at Hyderabad, during 14–15 Sept. 2012.

Nirmala, B., B. Sailaja, Shaik N. Meera, P. Muthuraman and Mangal Sain (2012) 'Rice yield gaps in India: Causes and strategies to narrow the gaps' "*International Conference on Agricultural and Horticultural Sciences"* organized by *OMICS publishing Group, USA*, held at Hyderabad, during 14th – 15th September 2012.

Mahender Kumar R, S. Gopalkirishnan, K. Surekha, Ch. Padmavathi, N. Somasekhar, M.S. Prasad, V.R. Babu, P. Raghuveer rao, P.C. Latha, S. Ravichnadran P. Muthuraman and B.C. Viraktamath (2012). SRI- as sustainable intensification of rice production system for enhancing the water productivity.

Ladhalakshmi, D., G.S. Laha, D. Krishnaveni, M. Srinivas Prasad and B. C. Viraktamath. 2012. 'False smut disease – A serious concern to rice farmers' at International Conference on Agricultural and Horticultural Sciences during September 14-15, 2012 at Hyderabad, Andhra Pradesh, India.

Sailaja, B, S.N. Meera, B. Nirmala and B.C. Viraktamath. AICRIP Intranet – a digital repository of multilocational experimental data.

Surekha, K., K.V. Rao, N. Shobarani, P.C. Latha and R.M. Kumar (2012). Evaluation of organic and conventional rice production systems for their productivity, profitability, grain quality and soil health.

Meera, S.N., R.M. Kumar, Arun Kumar S. and P. Muthuraman (2012). Farm Women's empowerment for sustainable rural and community development.

Vara Prasad C., Arun Kumar S, Sailaja B, Amtul Waris, Mangal Sain and Shaik N. Meera. (2012) Technology Mediated e-Learning Opportunities for Agricultural Extension Professionals.

6th International Hybrid Rice Symposium organised by IRRI and ICAR at Hyderabad from Sept. 10 - 12, 2012

Arun Kumar S, N. Meera Shaik, Muthuraman P, Amtul Waris, Mangal Sain, Hari Prasad A.S, Viraktamath B.C, 2012, An exploratory study on Public-Private Partnership: Implications to Hybrid Rice.

Viraktamath, B.C. A.S. Hari Prasad, M.S. Ramesha, P. Senguttuvel, P. Revathi and K.B. Kempa Raju "Hybrid rice research and development in India"

Sreedevi, B., S.P. Singh, B. Brajendra, R. Mahender Kumar 2012. Yield response of rice cultivars in aerobic unpuddled condition.

Nirmala, B., N. Vasudev, S.N. Meera and B.C. Viraktamath (2012) 'An economic analysis of hybrid rice technology in India'.

Nirmala, B., N. Vasudev, S.N. Meera, P. Muthuraman, Mangal Sain, B. Sailaja and B.C. Viraktamath 'Economics of hybrid rice cultivation: a case study of Eastern Uttar Pradesh in India'.

Gangaiah, B. and Prasad Babu, M.B.B. 2012. Performance of rice hybrids under different methods of establishment.

Hari Yadla, Srinivasarao K, Viraktamath B.C, Hari Prasad A.S, Ilyas Ahmed M, Laha G.S, Natarajkumar P, Sujatha K, Madhav M.S, Srinivas Prasad M, Ramesha M.S, Neeraja C.N, Balachandran S.M, Shobha Rani N, Sundaram R.M, 2012, Molecular marker-assisted introgression of bacterial blight and blast resistance into the maintainer line of the popular WA-CMS line of rice, IR 58025A.

Kempa Raju K.B., Hari Prasad AS, Senguttuvel P, Revathi P, Ramesha MS, Sheshumadav M, Shobha Rani N, Virktamath BC, "Genetics of stigma exsertion in parental lines of hybrid rice".

Krishnaveni, D., G.S. Laha, M. Srinivas Prasad, Ladhalakshmi, Satendran Kumar Mangruthia, V. Prakasam and B.C. Viraktamath. 2012. Disease resistance in hybrid rice: experience from All India Coordinated Plant Pathology Program.

Mahender Kumar R, Ravindra Babu Vemuri, Subba Rao Lella Venkata, Surekha Kuchi, Padmavathi Ch, Sreenivasa Prasad M, Somasekhar N, Raghuveer Rao P, Sreedevi B, Gangaiah B, Hariprasad A, Muthu Raman P, Viraktamath BC. 2012. SRI (System of Rice Intensification) – a viable option for profitable hybrid rice cultivation.

Muthuraman P, N. Meera Shaik, Arun Kumar S, Mangal Sain, Amtul Waris, Nirmala B, Viraktamath BC (2012). Information and Training Needs Assessment of Stakeholders with Special Reference to Hybrid Rice.

Shobha Rani, N., Sunitha Kota, G.S. Varaprasad, P. Senguttuvel, P. Revathi, A.S. Hari Prasad, K.B. Kemparaju and B.C. Virktamath "Development of hybrid rice in India: A transformation toward improved grain quality with enhanced yield gain"

Padmavathi Ch, Gururaj Katti and Jagdish S. Bentur. 2012. Insect pest incidence in hybrids under different rice cultivation systems.

Prasad Babu, M.B.B., Gangaiah, B., Rao, K.V. and P.C. Latha. 2012. Effect of sources of nitrogen on performance of two high yielding varieties and a hybrid.

Krishnamurthy, P., B. Sreedevi, P.C. Latha 2012. Evaluation of rice genotypes under Phosphorus mineral stress conditions.

Pranathi Karnati, Viraktamath B.C, Madhav M.S, Balachandran S.M, Neeraja C.N, Hajira S.K, Balachiranjeevi Ch,

Koteshwere Rao P, Hari Prasad A.S, Revathi P, Kemparaju K.B, Senguttuvel P, Sundaram R. M2012, A PCR based marker specific for maintainer line of WA-CMS system.

Ravichandran, V, Radhamani, S, Voleti SR and Sabariyyappan 2012. Performance of rice varieties and hybrids under intermittent irrigation.

Revathi Ponnusamy, Arun Kumar Singh, Pavani M, Sravanraju N, Senguttuvel P, Kemparaju K B, Sundaram R M, Hariprasad A S, Neeraja CN, Shobharani N, Viraktamath B.C. Efficiency of molecular markers in identifying fertility restoration trait of WA-CMS in rice.

Sailaja Banda, Sitapathi Rao Voleti, Hari Prasad A.S, Viraktamath B.C, 2012 Identifying suitable areas for hybrid rice seed production.

Sakthivel K, Sundaram RM, Hari Prasad AS, Ramesha MS, Virktamath BC, Revathi P, Neeraja CN, Sandhya P, Hari Y "Marker-aided Identification of wide compatible varieties in rice".

Senguttuvel P, Ramesha M.S, Sravanraju N, Suneetha Kota, Hari Prasad A.S, Reavthi, Kemparaju K.B, Bhadana V.P, Shobha Rani N, Mahender Kumar R, Sreedevi B, Viraktamath B.C, 2012. Evaluation of hybrid rice parental lines suitable for aerobic condition.

Shaik N. Meera, Mangal Sain, Arun Kumar S, Ch. Vara Prasad, Nirmala B and B.C. Viraktamath BC (2012) Frontline demonstrations on Hybrid Rice: Status and Prospects.

Surekha, K, K.V. Rao, Bhadana VP, Voleti SR, Neeraja CN, Kumar RM, Viraktamath, BC. (2012). Evaluation of rice hybrids and varities for Nitrogen use efficiency under irrigated system.

Sravanraju N, Senguttuvel P, Hari Prasad A.S, Voleti S.R, Bhadana V.P, Revathi P, Kemparaju K.B, Arun Kumar Singh, KoteswarRao P, Shobha Rani N, Viraktamath B.C. 2012. Studies on germination ability under optimum and high temperature stress in hybrid rice parental lines.

Ram, T., N. Shobha Rani, G. Padmavathi, P. Revathi, V. Ravindra Babu, V.P. Bhadana, Akanksha Srivatsava, L.V. Subba Rao and B.C. Viraktamath 2012 Hybrid rice yield improvement over inbred/varieties - Present status and future strategies.

Vishnu Kiran T, Sravan Raju N, Senguttuvel P, Vijayalakshmi P, Venkateswara Rao Y, Surekha K, Neeraja CN, Voleti SR* 2012. Screening of Hybrids and parental line for high temperature tolerance and nitrogen use efficiency.

International conference on Plant health management for food security organised by Plant Protection Association of India at DRR, Hyderabad, Nov 28 - 30, 2012.

Jhansi lakshmi V., T. Ram, P.M. Chirutkar and V. Sailaja 2012. Mechanisms of resistance to rice planthoppers in wild rices and their accessions.

Chitra Shanker, Amudhan, S., Lydia Ch, Sampathkumar, M and Gururaj Katti. 2012. Effect of flowering plants on longevity and fecundity of the parasitoids of the Green Leafhopper. *Nephotettix virescens* on Rice.

Krishanveni D, C.N. Neeraja, S.K. Mangrauthia, G.S.V Prasad, G.S Laha, Chitra Shanker and D. Ladhalakshmi 2012. Host-plant Resistance, Strainal Variation and Molecular Detection of Rice Tungro Virus Disease.

Ladhalakshmi, D., G.S. Laha, Ram Singh, J.S. Lore, A. Karthikeyan, D. Krishnaveni, M. Srinivas Prasad and B.C. Viraktamath.

Mahender Kumar R, Raghuveer Rao P, Somasekhar N, Padmavathi Ch, Surekha K, Gangaiah B, Sreedevi B and Vidhan Singh T. 2012. Evaluation of crop establishment and weed management practices for enhancing productivity and profitability under System of Rice Intensification.

Mangal Sain, Chitra Shanker, D. Krishnaveni, B. Sreedevi, S. Arun Kumar, B. Nirmala, Amtul Waris, P. Muturaman, Shaik N. Meera and G. Samuel. 2012. Development and Promotion of Farmer-Participatory IPM Technology in Rice-A Case Study.

Mohan, M., Sampathkumar, M., Chitra Shanker, Karthikeyan, K., Shanas Sudheer, Padmakumari, A.P., Lydia, Ch and J.S. Prasad. 2012. Rice white stem borer, *Scirpophaga fusciflua*: Biology, Alternate hosts and Susceptibility to Bacillus thuringiensis.

Padmakumari A P and T Ram. 2012. Wild Rices as Source of Tolerance to Yellow Stem Borer, Scirpophaga incertulas. Paper presented in "International Conference on Plant Health Management for Food Security: held at DRR, Hyderabad, India, OP 29, pp 40.

Padmavathi Ch, Gururaj Katti, V Sailaja, AP Padmakumari, V Jhansi Lakshmi, M Prabhakar and YG Prasad. 2012. Degree day models – a tool to forecast leaf folder activity in rice

Prasad, J.S., Padmakumari, A.P., Somasekhar, N. and Katti, G. 2012. Entomopathogenic nematodes as a component of integrated pest management in rice- a journey from lab to land.

Malathi, P., D. Krishnaveni, S.M. Balachandran and Satendra K. Mangrauthia (2012). Rapid detection of rice tungro virus disease using molecular approaches. *International Conference on Plant health management for food security at Hyderabad*, India during Nov. 28-30, 2012.

Ramesh Babu, V, Shashi vemuri, Ch. Padmavathi, M Mohan and SM Balachandran. 2012. Toxicity of Bacillus thuringiensis crystal toxins to field populations of rice leaf folder *Cnaphalocrocis medinalis* and establishment of baseline susceptibility to cry1Ab.

Lydia, Ch, Sampathkumar, M., Mohan, M., Gururaj Katti and Chitra Shanker. 2012. Weeds as reservoir of alternate prey for Coccinellids of Rice. *Poster presented in International Conference on Plant Health Management for Food Security*: held at DRR, Hyderabad, India, Abstract no 102, pp 135-136.

Satendra K. Mangrauthia, P. Malathi, B. Sailaja, S.M. Balachandran, D. Krishnaveni, G.S. Laha, and M. Sheshu Madhav (2012) Application of aRNAi Technology for the Resistance Development against Rice Diseases.

Somasekhar N., Sivakrishna, KV., Prasad, J.S., Padmakumari, A.P. and Katti, G. 2012. Evaluation of mass-production and storage methods for indigenous entomopathogenic nematodes.

Somasekhar N., Sivakrishna, KV., Prasad, J.S. and Voleti, S.R. 2012. Influence of elevated CO_2 on seedling vigour and infectivity of root-knot nematode *Meloidogyne graminicola* in rice.

ARRW Golden Jubilee International Symposium on Sustainable rice production and livelihood security: Challenges and opportunity, Organised by Association of Rice Research Workers at Cuttack, Odisha, India from March 2 - 5, 2013.

Sreedevi, B., P Senguttuvel and T Ram. Weed management in direct seeded aerobic rice.

Sreedevi, B., P. Senguttuvel and T. Ram 2013. Cultivar response under different fertilizer scheduling in Aerobic Rice.

Divya D, Tunginba YS, Nair S and Bentur JS. 2013. Functional genomics of gall midge-rice interactions.

Divya Balakrishnan, Robin S., Rabindran R., Senthil N., Raveendran M. and John Joel A. Marker assisted back cross breeding for introgression of blast (*Pyricularia Oryzae*) resistance genes into the elite susceptible rice (Oryza *Sativa* L.) variety ADT 43. Genetic Improvement for Enhancement of Yield, Quality and Stress Tolerance.

Shobha Rani, N., V.P. Bhadana, S.R. Voleti, S. Srikant, Motilal, M. Kumara Swamy, L.V. Subba Rao, P. Senguttuvel and B.C. Viraktamath, 2013: Identification of donors for heat tolerance in rice (*Oryza sativa).*

Shobha Rani, N., Suneetha Kota, R.K. Chowdhury, G.S. Varaprasad, V.P. Bhadana, Mridula Devi, Seshu Madhav, and B.C. Viraktamath; 2013, Characterization and Genetic Diversity Evaluation of Soft Rices (*Bora* and *Chakua)* of Assam, India.

Shobha Rani, N., VP Bhadana, SR Voleti, S. Srikanth, Motilal, M Kumaraswamy, Suneetha Kota, LV Subba Rao, Senguttuvel P. and B.C. Viraktamath. Genetic improvement of rice for conservation agriculture.

Latha, P.C., B. Sreedevi, K. Surekha, S.R. Voleti, C. Chandrakala and G. Anka Rao. 2013. Acc Deaminase Producing Bacteria For Abiotic Stress Tolerance In Rice.

Sarao P.S, Kaur H. and Katti G. 2013. Bio-efficacy of insecticides against insect-pests of rice. In: *ARRW Golden Jubilee International Symposium:* Sustainable Rice Production and livelihood Security: Challenges & Opportunities.

Ramadevi S.J.S, Kuldeep singh, Prasad M.S, Umakanth B, Ram kumar G, Viraktamath B.C. and Madhav M.S. Identification and mapping of new genetic resources for durable blast resistance in India.

Ratna Madhavi K, Srinivas Prasad M*, Rambabu R, Abilash Kumar V, Vijay Kumar S, Aruna J, Sheshu Madhav M and Viraktamath B.C. "Developing rice lines with durable resistance to blast and bacterial blight diseases through marker assisted backcross breeding".

Weed Threat to agriculture, biodiversity and environment at Jabalpur on 19-20 April, 2012

Sreedevi, B., P. Krishnamurthy, R. Mahender Kumar and B.C. Viraktamath. Sequential herbicide application for effective weed management in irrigated rice presented.

20th Annual Conference of Agricultural Economics Research Association of India at IARI, New Delhi during 09-11 Oct. 2012

Nirmala, B., N. Vasudev, K. Suhasini, S.N. Meera and B.C. Viraktamath (2012) Contract Farming: A case of hybrid rice seed production in Andhra Pradesh.

International Dialogue on Designer Rice for Future: Perceptions and Prospects, July 9-10, 2012, India

Shobha Rani, N., M. Sheshu Madhav, GSV Prasad, K Suneetha, V Ravindra Babu, LV Subba Rao, RM Sundaram, AKP Sivaranjani and S Sri Kanth, "Perspectives towards designing rice grain quality".

Bentur, JS, Rawat N, Sinha DK, Nagaraju J and Nair S. 2013. New genetic avenues for insect pest management as revealed by studies on gall midge.

International Conference on Bioresource and Stress Management at Bose Institute, Kolkata on 6 - 9 Feb., 2013

Chandrakala, C., G. Anka Rao, K.V. Prasad Babu S.R. Voleti and P.C. Latha, 2012. Silicate mobilization by bacteria with multiple plant growth promoting traits.

IV National Symposium on Plant Protection in Horticultural Crops: Emerging Challenges and Sustainable Pest Management. AAPMHE, IIHR, Bangalore. April 25-28, 2012.

Divya Balakrishnan, E. Sreenivasan, V.V. Radhakrishnan, R. Sujatha and K.V. Suresh Babu Fruit and shoot borer [*Earias vittella* Fab.] resistance in okra [Abelmoschus spp.].

Divya Balakrishnan, E. Sreenivasan, V.V. Radhakrishnan, R. Sujatha and K.V. Suresh Babu. 2012. Generation mean analysis for fruit and shoot borer [Earias vittella Fab.] resistance and yield traits in okra (Abelmoschus spp.).

India Geospatial world forum 2013 at Hitech city, Hyderabad 22 - 24 January 2013.

Gayatri, S, Saritha, B, Sailaja, B and Voleti SR. Identifying vulnerable temperature zones for rice crop in India .

"National Workshop on Khapra Beetle" organized by National Institute of Plant Health Management (NIPHM), Rajendranagar, Hyderabad on 15 March, 2013.

Katti G. 2013. Khapra beetle, bioecology and behavior. Lead Presentation

International Conference on Insect Science, Indian Society for advancement of Insect Science, at Bangalore on Feb. 14-17, 2013

Mohan M, Sampath Kumar M, Chitra Shanker, Sivakumar G, Karthikeyan K and Shanas Sudheer. 2013. Toxicity of *Bacillus thuringiensis* strains and Cry toxins to rice stem

borers, *Sesamia inferens* (Noctuidae: Lepidoptera) and *Scirpophaga fusciflua* (Pyralidae: Lepidoptera), Presented.

Sampathkumar M and Ravi G. Influence of indigenously developed rice stem borer sex pheromones on the bahaviour of its egg, paper presented.

National Seminar on Plant Genetic Resources for eastern and north eastern India at ISGPB, Barapani, Meghalaya on 11-12 May, 2012.

Shobha Rani, N., Suneetha Kota, R.K. Chowdhury, G.S. Varaprasad, V.P. Bhadana, Mridula Devi, Brajendra, Seshu Madhav, S.Srikanth, M.Kumarswamy, A.P.K. Sivaranjani and B.C. Viraktamath. Collection, Characterization and Evaluation of Soft Rices- Bora and Chakua of Assam.

National symposium on Innovative Approaches to Crop Improvement and adaptation: Meeting Challenges of Climate Change held at UAS, GKVK, Bangalore on Feb, 2013.

Nihar Sahu, G. Padmavathi, K. Ramesh, Tahseen, B.C. Viraktamath and J.S. Bentur. Poster presented on Identification of putative genes / QTLs for brown planthopper resistance in rice variety-Ptb33.

National Symposium on climate change and agriculture: Slicing down uncertainties at CRIDA, Hyderabad. Jan, 22 - 23, 2013

Sailaja, B, Voleti SR, Saritha, B, Gayatri, S and Subrahmanyam, D. Vulnerability of rice yields under changed climatic conditions.

International Symposium on Entomopathogenic Nematodes and Multitrophic interactions in the Rhizosphere, Society of Nematologists, Savannah, Georgia, USA on Aug. 12-15, 2012

Somasekhar N., Jagdale, G.B. and Grewal, P.S. Interactions among entomopathogenic nematodes and other nematode trophic groups and plants in agroecosystems.

National Symposium on Blending Conventional and Modern Plant Pathology for Sustainable Agriculture Organized by Indian Institute of Horticultural Research, at Bangalore on 04-06, December 2012

Srinivas Prasad M*, Ratna Madhavi K, Rambabu R, Abilash Kumar V, Vijay Kumar S, Aruna J, Sheshu Madhav M and Viraktamath B.C. "Performance of rice blast resistant genes (*Pi-1*,*Pi-2* and *Pikh*) across India". India, poster presented.

National Symposium of Plant Physiology Physiological and Molecular approaches for development of climate resilient crops at ANGRAU, Hyderabad on 12th-14th Nov 2012.

Swamy, KN, Vishnu Kiran, T, Srikanth, B, Subhakar I, Sailaja, N Surekha, K Raghuveer Rao, P, Neeraja, CN, Voleti SR and Subrahmanyam, D. Influence of nitrogen fertilization on root growth in rice (*Oryza sativa L*) varieties.

Voleti SR, Subrahmanyam, D, Raghuveer Rao, P and Ranganathan, S. Role of silicon in alleviating biotic and abiotic stress tolerance with special emphasis on rice.

Raghuveer Rao, P., S. Ravichandran, R. Maheder Kumar, D. Subrhamanyam, A.S. Ram Prasad and S.R.Voleti. Increasing the yield potential in Irrigated Rice : Manipulating Source and Sink.

Raghuveer Rao, P., Sivasanker, A, Subrahmanyam, D and Voleti SR. Water saving technologies in rice.PP 213-233

Tulasi Guru, Ramesh Thatikunta, Raghuveer Rao, P, Subrahmanyam. D, Voleti. S, R and Sreedhar, M. Effect of Boron spray on yield and yield components of Rice (*Oryza sativa* L.).

Vijayalaxmi, P, Vishnu Kiran T, Venkateswara Rao, Y, Yugandhar, P, Neeraja, CN Subba Rao, LV and Voleti SR. Screening aromatic rice for NUE and influence of different N levels on scavenzing enzyme activity.

National Seminar on Management of Salt Affected soil and waters: challenges of 21st century March 16-17, 2012

Ram, T., G. Padmavathi and BC Viraktamath 2012. Recent Advances and Future Strategies to Improve Salt tolerance in Rice.

Abstracts of Biennial conference of Indian Society of Weed Science on Weed Threat to Agriculture, Biodiversity and Environment, at Kerala Agricultural University, Thrissur, Kerala on April 19-20, 2012.

Yaduraju, N.T. and Prasad Babu, M.B.B. Knowledge sharing in agriculture with special reference to weed management.

Research, Technical and Extension bulletins

Hari Prasad, A.S., P Senguttuvel P Revathi KB Kemparaju MS Ramesha N Shobha Rani and BC Viraktamath 2013. **Rice Hybrids Released in India**. Technical bulletin 68, DRR, Hyderabad-30

Viraktamath, B.C., MS Ramesha AS Hariprasad P Senguttuvel P Revathi KB Kemparaju and B Sailaja 2012. **Two Decades of Hybrid Rice Research in India**. Technical bulletin, DRR, Hyderabad-30

Rao, K.V., K. Surekha, P.C. Latha, M.B.B Prasad Babu, Brajendra, T.J. Ghose, D. Srinivas, B.R. Jagadeesh, S.F.A. Zaidi and B.C. Viraktamath (2013) **Sustainable Rice Production: Experiences from long term fertilizer experiments.** DRR Bulletin no.70 / 2013. DRR, Hyderabad, AP PP- 96 *(Released in 48 ARGM)*

Surekha, K., K.V. Rao, Brajendra and B.C. Viraktamath (2013) **Rice Residue Management**. DRR Bulletin No. 73 / 2013, DRR, Hyderabad, AP PP: 53 *(released in 48 ARGM)*

Padmavathi G, Ram T, Bhadana VP, Prasad GSV, Ravindra Babu V, Subba Rao LV, Suneetha K Jyothi B, Hari Prasad AS and Shobha Rani N 2013. **Rice varieties developed by Directorate of Rice Research**. Tech Bulletin No. 74/2013. Directorate of Rice Research, Rajendranagar, Hyderabad 30, AP, India. pp 56.

Prakasham, V., Ladhalakshmi, D., Laha, G.S., Krishnaveni, D., Sheshu Madhav, M., Badri, J., Prasad, M.S. and Viraktamath,

B.C. (2013). **Sheath blight of rice and its management**. Technical Bulletin No. 72/2013. DRR, Rajendranagar, Hyderabad-30, AP, India, PP 58.

Kumar, R.M., B. Gangaiah, B. Sreedevi, Gulshan Mahajan, P. Raghuveer Rao, P. Senguttuvel, B. Nirmala, K.V. Rao and B.C. Viraktamath (2013) **Water saving technologies in Rice** . DRR Bulletin No. /2013 DRR, Hyderabad, AP. PP: *(Released in 48 ARGM)*

Sreedevi, B., Krishnamurthy, P., Mahender Kumar, R. and Viraktamath. B.C. 2012. **A ready reckoner for rice weeds**. Technical Bulletin No.64, Directorate of Rice Research, Rajendranagar, Hyderabad – 500030, A.P., India. pp 105.

Ram, T., Bhadana VP, Laha GS, Padmakumari AP, Jyoti Badri, Azam MM, Amtul Waris, Sarla N, Padmavathi G, Dinesh Chandra, Balakrishnan D and Viraktamath BC. 2013. **Wild rices in rice improvement**. DRR Technical Bulletin No 71. DRR, Hyderabad-30

Varaprasad GS, Shobha Rani N, Padmavathi G, Seshu Madhav M, Bentur JS, Jhansi Laksmi V, Padma Kumari AP, Kondala Rao Y, Prasad MS, Laha GS and Viraktamath BC. 2013. **Aromatic Short Grain Rices of India**. DRR Technical Bulletin No. 69 /2013. Directorate of Rice Research. p 112.

Voleti SR, Raghuveer Rao P, Jyothi Badri, Subrahmanyam D, Sivarama Prasad S, Swamy KN and Viraktamath BC 2013. **Grain shattering and dormancy in rice**. Tech Bulletin No. 67/2013. Directorate of Rice Research, Rajendranagar, Hyderabad 30, AP, India. pp 52.

Books (Authored/ Edited)

Gangaiah, B. and Ompal Singh. 2012. *Arhar*. In: *Kharif Phasalonki Kheti* (Eds. Vyas, A.K., Dinesh Kumar and Rana, D.S.). pp 33-37.

Subba Rao L.V, N. Shobha Rani, M. Chiranjivi, U. Chaithanya, I. Sudarshan, K. Suneetha, Jyothi Badri and Dipal Rai Choudhary 2013, DUS Characterization of Rice Varieties, 524pp.

Radhamani, S., S. Robin, P. Muthu Krishnan, Subbalakshmi Lokanadhan, S.P. Singh, R. Mahender Kumar and B. Sreedevi (2012). AICRIP Research accomplishments from agronomic experiments. Rice farming – TNAU pp 190-199 Edited by P. Muthukrishnan *et. al.*,

Vijai Pal Bhadana, R.K. Sharma, Kalikant Chaudhury, Sushil Kumar, V.K. Yadav, H.C. Dixit, U.P. Sahi, M. P. Singh, Munna Lal and Rajeev Kumar. 2013. Samanya Krishi Vigyan (General Agriculture Science) in Hindi. Published by Parmar Publishers and Distributors, Dhanbad-828109. pages 159.

Book Chapters/ Booklets /Technical reports

Singh, A.K., Vijai Pal Bhadana, Janardan Jee and Vandana Tyagi (2012) Faba Bean (*Vicia faba* L.) Descriptors. *In:* Faba Bean (*Vicia faba* L.)- A Potential Leguminous Crop of India. (Eds). A.K. Singh and B.P. Bhat. Director, ICAR Research Complex for Eastern Region, Patna, Bihar. pp. 53-77.

Singh, A.K., R. Rlanchezhian, Santosh Kumar and Vijai Pal Bhadana (2012) Improvement of Seed Protein Content and Quality in Faba Bean. *In:* Faba Bean (*Vicia faba* L.)- A Potential Leguminous Crop of India. (Eds). A.K. Singh and B.P. Bhat. Director, ICAR Research Complex for Eastern Region, Patna, Bihar. pp. 155-162.

Arun Kumar S, P. Senguttuvel, Vara Prasad, C and Shaik N. Meera. 2013. Rice Knowledge Management Portal: Overview, Registration and searching content. In Compendium for Model Training Course on Rice Knowledge Management Portal-ICT Applications for Rice Ecosystems held at CRRI, February 12-19, 2013; Pp.65-75

Arun Kumar S, Senguttuvel P, Brajendra, Chitra Shanker, Sailaja B, Muthuraman P, Vara Prasad C and Shaik N. Meera. 2013. Rice Knowledge Management Portal: Farmers domain, Service Domain, General domain and E-Learning platform. In Compendium for Model Training Course on Rice Knowledge Management Portal-ICT Applications for Rice Ecosystems held at CRRI, February 12-19, 2013. Pp 76-100.

Arun Kumar S, Brajendra, Chitra Shanker, Muthuraman P, Vara Prasad C and Shaik N. Meera. 2013. Rice Knowledge Management Portal: Extension Domain Features and content upload. In Compendium for Model Training Course on Rice Knowledge Management Portal-ICT Applications for Rice Ecosystems held at CRRI, February 12-19, 2013. Pp 101-123

Viraktamath B.C. and N. Shobha Rani, 2012. All India Coordinated Rice Improvement Project: Role of AICRIP in Rice Improvement – Hisotry and Development, International Symposium on "100 Years of Rice Science and Looking Beyond", Paddy Breeding Station, Coimbatore 1912-2012 Souvenir. Pp 144-151.

Behera, B.K., V.P. Bhadana, I.M. Singh and N. Prakash (2012). Paddy-cum-Fish culture: A Livelhood Option for the Farmers. *In:* Rice and Food Security. (Eds) B.P. Bhatt, Alemla Ao, B. Sahoo and I. Amenla. Today & Tomorrow's Printers and Publishers. pp. 42-46.

Krishnaveni, D. 2012. Rice disease management in India – An over view – Compendium of Lectures on ICAR sponsored winter school on New frontiers in Integrated Pest Management in Rice and Rice based cropping systems, Sept. 13-Oct, 03, 2012, DRR, Hyderabad, p184-194.

Krishnaveni, D. 2012. Recent developments in the manage-ment of rice viral diseases. Compendium of Lectures on ICAR sponsored winter school on New frontiers in Integrated Pest Management in Rice and Rice based cropping systems, Sept. 13-Oct, 03, 2012, DRR, Hyderabad, p195-210.

Krishnaveni, D., Laha G.S. and Ladhalakshmi, D. (2012). Integrated Disease Management in Rice. Training Manual on Hybrid Rice Seed Production, Testing and Seed certification: 21-25, August 2012 (5 days) **Odisha** State OSSOPCA Department of Agrl. 20 Seed Certification officials from OSSOPCA, Odisha.

Gururaj Katti A.P. Padmakumari and IC Pasalu. 2013. Egg parasitoids in cereal ecosystems. In- "Biological Control of Insect Pests Using Egg Parasitoids". Sithanantham, S.; Ballal, C.R.; Jalali, S.K.; Bakthavatsalam, N. (Eds.) 2013, 410 p. 12 illus. (Springer and Verlag publication)

Rao, K.V., B. Sailaja, B. Nirmala and B.C. Viraktamath (2013) Important socio-economic and ecological factors affecting rice production in India in 'Innovation in rice production' Editors: P.K. Shetty, M.R. Hegde and M. Mahadevappa, National Institute of Advanced Studies, Bangalore, India pp.117-126

Laha, G.S., Ladha Lakshmi, D., Srinivas Prasad, M., Krishnaveni, D., Mangrauthia, S.K. and Viraktamath, B.C. (2012). Integrated Management of Rice Diseases. Pages 489-504, In: Eco-friendly Innovative Approaches in Plant Disease Management (Eds: Vaibhav K. Singh, Yogendra Singh and Akhilesh Singh), International Book Distributors, 9/3, Ist Floor, Rajpur Road, Dehradun-248 001. (Uttarakhand), INDIA.

Ladha Lakshmi, D., Laha, G.S., Krishnaveni, D., Srinivas Prasad, M., Mangrauthia, S.K. and Viraktamath, B.C. (2012). False Smut Disease: An Emerging Problem in Rice Cultivation and its Management. Pages 517-528, In: Eco-friendly Innovative Approaches in Plant Disease Management (Eds: Vaibhav K. Singh, Yogendra Singh and Akhilesh Singh), International Book Distributors.

Laha, G.S. and Krishnaveni, D. (2012). Innovative methods of plant disease management. pages: 241-255. In: Training Manual of the winter school on "New frontiers in Integrated Pest Management in Rice and Rice Based Cropping System" (Eds: Padmavathi, Ch., Sreedevi, B., Ladha Lakshmi, D., Arun Kumar, S and Sampath Kumar, M), Sept 13-Oct 03, 2012, DRR, Hyderabad-30, India.

Muthuraman P and Brajendra. 2013. Role of ICTs in Agriculture Development. In Compendium for Model Training Course on Rice Knowledge Management Portal-ICT Applications for Rice Ecosystems held at CRRI, February 12-19, 2013. Pp 5-10.

Sarla, B. Jyothi and E.A. Siddiq 2012. Increasing rice yield using wild species. In: *International Dialogue on Perception and Prospects of Designer Rice* Eds: Muralidharan and E.A. Siddiq pp.

Shobha Rani, N., G.S.V. Prasad, K. Suneetha, M. Sheshu Madhav, V. Ravindra Babu, V.P. Bhadana and R.M. Sundaram. Paper on "Rice Grain Quality", Vol. 1 proceedings of International Symposium on "100 years of rice science and looking beyond" 9-12 January 2012, TNAU, Coimbatore, Tamil Nadu, 255-258p.

Senguttuvel, P., Arun Kumar S, Vara Prasad C, Sailaja B and Shaik N. Meera.2013. Rice Knowledge Management Portal: Research Domain Features and content upload. In Compendium for Model Training Course on Rice Knowledge Management Portal-ICT Applications for Rice Ecosystems held at CRRI, February 12-19, 2013. Pp. 124-136.

Prasad, J.S. and Somasekhar N. (2012). Bioefficacy and biosafety of entomopathogenic nematodes. In: *Environmental safety of biotech and conventional IPM technologies* (eds. H.C. Sharma, M.K. Dhillon and K.L. Sahrawat). Chapter 7, Pp. 127-137. Studium Press LLC, Houston, Texas, USA.

Raghuveer Rao, P, Sivasanker, A, Subrahmanyam, D and Voleti SR (2012) Water saving technologies in rice. pp 213-233 National Seminar of Plant Physiology on "Physiological and Molecular approaches for development of climate resilient crops" Dec, 12-14, at ANGRAU, Hyderabad.

Rani NS, Sheshu MM, Prasad GSV, Suneetha K, Babu VR, Rao LVS, Sundaram RM, Sivaranjani AKP and Srikanth S, 2013. "Perspectives towards designing rice grain quality", International Dialogue on Perception and Prospects of Designer Rice, Society for Advancement of Rice Research, DRR, Hyderabad, pp 310-319.

Satendra K. Mangrauthia, Surekha Agarwal, M. Sheshu Madhav, G.S. Laha, D. Krishnaveni, M. Srinivas Prasad and D. Ladha Lakshmi 2012. RNAi: A novel tool to develop virus resistance in plants. In: Eco-friendly Innovative Approaches in Plant Disease Management (Eds: Vaibhav K. Singh, Yogendra Singh and Akhilesh Singh), International Book Distributors, 9/3, Ist Floor, Rajpur Road, Dehradun-248 001. (Uttarakhand), INDIA.

Somasekhar, N. and Dhawan, S.C. (2012). Prospects of rhizobacteria in the management of plant parasitic nematodes. In: Status and prospects for enhancing the uptake of antagonistic organisms for nematode management in India (eds. M. Nagesh, Rajkumar, B.S. Bhumannavar, N.K. Krishna Kumar). Chapter 9. Pp 90-97. National Bureau of Agriculturally Important Insects, Bangalore, India.

Somasekhar, N. and Prasad, J.S. (2012). Nematodes as indicators of environmental health. In*: Environmental safety of biotech and conventional IPM technologies* (eds. H.C. Sharma, M.K. Dhillon and K.L. Sahrawat). Chapter 15, Pp 313-323. Studium Press LLC, Houston, Texas, USA.

Shaik N. Meera, Arun Kumar. S., Saha, P.K. and B.C. Viraktamath (2012). A Brief Report on Frontline Demonstrations on Rice 2011-12. Directorate of Rice Research, Hyderabad. Pp. 68.

Viraktamath B.C., Mangal Sain, L.V. Subba Rao, M.S. Ramesha and B. Nirmala (2012) Training Manual on 'Hybrid rice seed production, testing and certification', Directorate of Rice Research (ICAR), Rajendranagar, Hyderabad, AP, India.

Voleti SR, Subrahmanyam, D, Raghuveer Rao, P and Ranganathan, S (2012) Role of silicon in alleviating biotic and abiotic stress tolerance with special emphasis on rice. PP 23-27. National Seminar of Plant Physiology on "Physiological and Molecular approaches for development of climate resilient crops" Dec, 12-14, at ANGRAU, Hyderabad.

Voleti SR, Subrahmanyam, D and Rao, P, Raghuveer 2012. Developing C4 rice: A Physiological perspective in relation to climate change. In "International Dialogue on perception and prospects of Designer Rice. PP 345-355. Society for

advancement of Rice Research, DRR, Held at Nov 2012 Hyderabad (Muralidharan, K and Siddiq, EA (2013).

Ravindra Babu, V., C.N. Neeraja, T. Longvah, K. Surekha, N. Shobha Rani and B.C. Viraktamath. Abstract on "Improvement of iron and zinc in rice varieties through conventional and molecular approaches", Vol. 1 Proceedings of International Symposium on "100 years of rice science and looking beyond" 9-12 January 2012, TNAU, Coimbatore, Tamil Nadu, 47-48p.

Popular articles

Nirmala, B. 2012. Narrowing the rice yield gap for sustaining food security *Kisan World* 39 (9) 24-25

Nirmala, B., P. Muthuraman, Shaik N. Meera and Mangal Sain 2013 Yield gaps and constraints in rainfed low land rice production, *DRR Newsletter* 11 (1) pp 5

Nirmala, B. 2013. Kshetrasthayi Arthika Vishleshanaku Pakshika Budgeting Vidhanam (Partial budgeting technique for farm level economic analysis) *Vyavasaya Padipantalu* 3 (4) pp 36

Nirmala, B. 2013. Bridging the rice yield gap for sustaining food security *Kisan World* 40 (3) 39-40.

Prasad, J.S., D. Krishnaveni, A.P. Padamakumari, N. Somasekhar, Ch. Padmavathi, Chitra Sankar, V. Jhansilakshmi, M.S. Prasad, G.S. Laha, D. Ladhalakshmi and G. Katti. 2012. Varinasinchu Cheeda Peedalu- Nivarana Charyalu. In : Adhika Vari digubadulaki adhunika sakethika suchanalu. A Technical guidance released on Farmer's day Programme, on 21st October, 2012. p26-38.

Srinivas Prasad, M., B.C. Viraktamath, K. Ratnamadhavi, R. Rambabu, M.S. Madav, V. Abhilash Kumar, J. Aruna and S. Vijay Kumar (2012). Pyramyding of blast resistance genes in to elite rice cultivars, DRR News Letter, Vol 10 (3) 2-3.

Mangal Sain, P. Muthuraman, Meera Shaik N, Arun Kumar and BC Viraktamath (2012) Chaval sagnikaran paditi (system of Rice Intensification). Unnath Krishi, 49(2):03-07.

Mangal Sain (2012). Dhan ke Phesal ko Kito se Bachaye. Kheti Dunya Patila, 17(30): 03-04.

Mahenderkumar R and Surekha, K (2012). Management practices for Improved Samba Mahsuri (Telugu). Technical folder prepared for farmers in Telugu.

Shobha Rani, N., G. Padmavathi, G.S.V. Prasad, T. Ram, V.P. Bhadana and A.S. Hari Prasad. 2012. DRR rupondinchina nutana vari vangadamulu. In: Adhika vari digubadulaku adhunika sanketika suchanalu, DRR, Hyd.Pp 6-11.

Padmakumari A.P. 2012. Trap crop in rice – an ecofriendly method for yellow stem borer management. Swarnasedyam. Sept 2012. Pp 51-52.

Prakasam, V (2012). Rice pests : Sheath blight. *DRR News letter*, 10 (4) :11.

Ramadevi, S.J.S., Kuldip Singh, B. Umakanth, M.S. Prasad, B.C. Viraktamath and M.S. Madhav (2013) "Identification of New genetic resources for durable blast resistance in India" DRR News Letter, Vol 11 (1) : 4-5

Satendra K. Mangrauthia, Malathi, P., Sailaja, B., Sheshu Madav, Ladhalakshmi. D., Laha, G.S., Krishnaveni, D., Voleti, S.R., Balachandran, S.M. and Sarala, N. 2012. Harnessing RNAi Technology for Rice Improvement. DRR News Letter, April, (10) 2: 1-3

Suneetha Kota, V.P. Bhadana, P. Senguttuvel, L.V. Subbarao, G.S.V. Prasad, N. Shobha Rani and D. Subramanyam (2012). Standardization and screening rice germplasm for anaerobic germination. *DRR Newsletter*. 10 (4): P.3.

Surekha K, Latha P.C. and Rao K.V. (2012). Integrated Nutrient Management in Rice and Soil and nutrient related constraints in rice and their management. (Telugu). In: Improved Technologies for higher rice productivity. Booklet published for Farmers' Day at DRR on 28-10-2012. pp 14 - 19.

Somasekhar, N. 2012. Pests of Rice: Root-Knot Nematode. *DRR Newsletter* 10(3): 11

Sreedevi, B. 2012. Vari Sagnto Paryavarava Parirakshan. P. 34 Vyavasaya Padipantalu.

Annual (April 1, 2012 to March 31, 2013) Performance Evaluation Report of RFD 2012-13 of DRR

Objective	Weight	Action	Success indicator	Unit	Weight	Target/ Criteria value					Achieve-ments	Performance		% achieve-ments against Tar-get values of 90% col	Reasons for shortfalls or excessive achievemnts, if applicable
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score (%)	Weighted Score		
Strengthening frontier research for enhancing rice production, productivity and quality to meet domestic and export demands	28	Development of better hybrids for different rice ecologies	Development and evaluation of test hybrids	No.	5	40	30	20	10	5	31	100	5	103	N/A
			Improvement of parental lines	No.	5	15	10	7	5	3	10	95	4.75	100	N/A
		Development of better varieties for domestic and export purpose	Development and evaluation of breed-ing lines for higher yield and quality	No.	5	6	5	4	3	2	5	90	4.5	100	N/A
			Development and improvement of varieties with stress tolerance	No.	5	5	4	3	2	1	4	90	4.5	100	N/A
		Characterization and evaluation of germplasm for biotic stresses	Agro-morphologi-cal characterization and screening of new germplasm ac-cessions for stress resistance	No.	8	1000	800	700	600	500	830	100	8	104	N/A
Identification of technologies suitable for dif-ferent ecologies/ environments	25	Organization of coordinated trials in different disciplines	Data receipt and analysis	Date	5	25/01/13	31/01/13	10/02/13	20/02/13	28/02/13	31/01/13	90	4.5	-	N/A
			Report preparation & presentation	Date	10	26/03/13	27/03/13	28/03/13	29/03/13	30/03/13	25/03/13	100	10	-	N/A
			Constitution & Conduct of trial	No.	5	75	65	60	50	40	92	100	5	142	At the Annual Rice Group Meeting, more number of voluntary centres have come forward to conduct more trials.
			Monitoring of trials at centers	No.	5	40	35	30	25	20	37	100	5	106	N/A

Objective	Weight	Action	Success indicator	Unit	Weight	Target/ Criteria value					Achieve-ments	Performance		% achieve-ments against Tar-get values of 90% col	Reasons for shortfalls or excessive achievemnts, if applicable
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score (%)	Weighted Score		
Improving efficiency of resources, inputs and farm machinery for sustainable production	15	Improving pro-ductivity of rice and rice based cropping systems	Evaluation of crop management prac-tices for improved productivity	No	5	8	6	4	2	0	6	100	5	100	N/A
		Enhancing efficiency of resources and inputs	Evaluation and monitoring for improved efficiency of soil, water and inputs	No	5	7	5	3	2	0	5	100	5	100	N/A
		Assessment of crop responses to changing climate	Identification of crop parameters/ indicators and efficient genotypes for heat and water stress tolerance and modelling	No.	5	20	15	10	5	3	15	100	5	100	N/A
Integrated management of biotic stresses	15	Identification of new sources of resistance	Screening advanced breeding lines for resistance	No.	5	500	475	350	250	150	624	100	5	131	Since more no. of breeding lines were nominated by the cooperat-ing centres, more lines were screened.
		Evaluation of new molecules and formulations of pesticides for bio-efficacy and safety	Screening of pesti-cides in greenhouse and field trials	No.	5	35	30	25	20	15	27	85	4.25	90	N/A
		Development and evaluation of novel methods of pest management and their integra-tion	Studies on biology, ecology, biocontrol, botanicals and other means of pest mgmt. and their integration	No.	5	5	4	3	2	1	4	90	4.5	100	N/A

Objective	Weight	Action	Success indicator	Unit	Weight	Target/ Criteria value					Achieve-ments	Performance		% achieve-ments against Tar-get values of 90% col	Reasons for shortfalls or excessive achievemnts, if applicable
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score (%)	Weighted Score		
Validation, dis-semination and commercializa-tion of technolo-gies developed and promoting public-private partnership	5	On-farm validation and popularization of technologies	Laying out FLDs/ OFDs	No.	1	350	325	300	275	250	572	100	1	176	As per the re-quest of DAC more number of FLDs were taken up, espe-cially because FLDs have come under NFSM.
			Multi-location breeder seed pro-duction for varieties and parental lines	No.	1	300	260	200	150	100	244	85	0.85	94	N/A
		Organization of sponsored and need based train-ing programs and maintenance of rice knowledge portal	Conducting training programmes on rice production technologies	No.	2	11	10	8	6	5	8	75	1.5	80	N/A
			Web articles updated/added to the portal	No.	1	600	550	500	450	400	570	100	1	104	N/A
Efficient Functioning of the RFD System	3	Timely submis-sion of RFD	On-time submis-sion	Date	2	23/03/12	26/03/12	27/03/12	20/03/12	25/03/12	22/02/12	100	2	-	N/A
		Timely submis-sion of Results	On-time submis-sion	Date	1	01/05/13	02/05/13	03/05/13	06/05/13	07/05/13	25/04/13	100	1	-	N/A

Objective	Weight	Action	Success indicator	Unit	Weight	Target/ Criteria value					Achieve-ments	Performance		% achieve-ments against Tar-get values of 90% col	Reasons for shortfalls or excessive achievemnts, if applicable
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score (%)	Weighted Score		
Administrative reforms	5	Implement ISO 9001	Prepare ISO 9001 action plan	Date	1	04/06/12	05/06/12	06/06/12	07/06/12	08/06/12	30/05/12	100	1	-	N/A
			Implementation of ISO 9001 action plan	Date	2	25/03/13	26/03/13	27/03/13	28/03/13	29/03/13	-	-	0	0	Tender for hiring the services of Consultant has been advertised. Response is awaited
		Implement miti-gat-ing strategies for reducing potential risk of corruption	Implementation of corruption reducing strategies	%	2	100	95	90	85	80	100	100	2	105	N/A
Improving Inter-nal 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	N/A
			Independent Audit of Implementation of public griev-ances redressal system	%	2	100	95	90	85	80	100	100	2	105	N/A

Composite Score : 94.35

Appendix 1

Promising cultures for different ecologies based on three years multi-location testing (2010-12)

S. No.	IET No. / Designation	Cross Combination	FD (Days)	Grain Type	Yield (Kg/ha)	Remarks	Suitable for
1.	21974 CR 2459-12-8	Swarna /IR 64	120	LB	4911	MR-WM	Shallow lowland areas in West Bengal
2.	21341 OR 2331-14	OR 1301-32 / IR 52561	115	SB	3866	MR-LF, LBL, ShBl, BLB	Lowland areas in Odisha and Assam
3.	21719 CR 2682-4-2-2-2-1	CRLC 899/Ac. 38606	132	MS	3728	-	Lowland areas in Odisha, Assam
4	21716 CR 2683-28-45-1-5	CRLC 899 / Ac. 38700	147	LB	4106	-	Lowland areas in Odisha
5	22066 C1446-5-18-17-2-MLD 2	CN 540 / IR 50	88	MS	5032	-	Irrigated areas in Uttarkhand, Maharashtra, Tamil Nadu.
6.	22081 RP5127-9-3 (IR 93376 - B-B- 130)	IR 71700-247-1-1-2 / IR 03L 120	91	LS	4743	-	Irrigated areas in Haryana, Uttarakhand.
7.	21777 US314 (Hybrid)	-	89	MS	5257	-	Irrigated areas in West Bengal
8.	22083 RP5125-5-9-1 (IR 84898 - B- 171- 19)	IR 78877-208-B-1-1 / IR 78878-53-2-2-2	88	LS	4773	MR-LBL	Irrigated areas in Tamil Nadu and Puducherry.
9.	22096 UPR 3425-11-1-1	Mahamaya / Gayabyeo	99	LS	5015	R-GMB-1	Irrigated areas in Odisha and Bihar
10.	21785 NK 6303 (Hybrid)	-	93	MS	5029	MR-RTV	Irrigated areas in Chhattisgarh and Haryana
11.	21433 27 P 52 (Hybrid)	-	106	MS	5665	-	Irrigated areas in Andhra Pradesh, Chhattisgarh
12.	21434 27 P 88 (Hybrid)	-	102	LS	5622	-	Irrigated areas in Maharashtra.
13.	22164 OR 2405-KK-9	OR 1206-26-2 / IR 62140	113	LB	5098	MR-ShBl, BLB	Irrigated areas in Gujarat
14.	21960 Pusa 1509-03-3-9-5	Pusa 1301 / Pusa 1121	93	LS	3880	-	Traditional Basmati growing areas
15.	21953 UPR 3506-7-1-1	UPRBS 9241/ UPR 2268-5-1-5	110	ELS	4784	MR- LBl, NBl	Traditional Basmati growing areas of Punjab, Haryana, Uttarakhand, Uttar Pradesh

S. No.	IET No. / Designation	Cross Combination	FD (Days)	Grain Type	Yield (Kg/ha)	Remarks	Suitable for
16.	22289 Pusa 1592-06-5-2	Pusa Sugandh 5/ Pusa 1460// Pusa Sugandh 5*2	98	ELS	5012	-	In states where Pusa Sugandh 5 was released
17.	22290 Pusa 1612-07-6-5	Pusa Sugandh 5/ C 101A51// PS 5 *2/PS 5 / Tetep// PS 5 *2	97	ELS	5172	-	In states where Pusa Sugandh 5 was released
18.	21264 NDR 9543	Pusa Basmati 1 / Kalanamak	115	MS	3881	MR-NBL	Irrigated areas in West Bengal, Bihar, Uttar Pradesh, Gujarat
19.	21260 RNR 2354	RNR M7 / RNR 19994	111	SS	3974	-	Irrigated areas in Bihar, Odisha Andhra Pradesh
20.	21267 NDR 6311	Selection from Sonachoor	114	SB	4210	MR-LF, ShR, ShBl	Irrigated areas in West Bengal, Odisha, Gujarat, Andhra Pradesh
21.	21755 VL 31407	Basmati 370 / VR 539-2	102	LB	3960	MR-BLB	Irrigated areas in Uttarakhand under medium elevation
22.	21393 VL 31449	IR 74963-362-5-1-3-3	91	SB	3701	-	Irrigated areas in Uttarakhand under medium elevation
23.	21766 VL 31348	Ch. 4 / BL 122	94	LB	3297	-	Irrigated areas in Uttarakhand under medium elevation
24.	21744 VL 8116	VL 6446 / VL 81	81	LS	2246	-	Upland areas under medium hills in Uttarakhand
25.	21743 VL 8094	VL 6394 / VL 9588	98	MS	2197	MR-ShBl	Upland areas under medium hills in Uttarakhand
26.	21933 CR2729-4-1-IR 84899 -B-182-CRA-12-1	IR 78811-208-B-1-1 / IRRI 1132	84	MS	3986	MR-LBL	Aerobic areas in Jharkhand
27.	21917 CR 2715-13-IR-84887-B-154	IRRI 148/ IR 78877-208-B-1-1	84	SB	3966	-	Aerobic areas in Odisha
28.	22836 RP 5208-3 (IR 87707-445-B-B-B)	Aday sel/*3 IR 64	94	LS	855	-	Promising for moderate drought situation

Appendix 2

Variety wise Breeder Seed Production during *kharif* 2012

Sl. No.	Name of variety / Hybrid	Produced by	Actual allocation as per BSP-I	Actual Produ-ction
I	**HYBRIDS**			
1	Ajay (CRHR-7)	CRRI		
	A Line		0.60	-
	B Line		0.35	-
	R Line		0.40	-
2	DRRH-3 (IET -19543)	DRR		
	A Line		0.30	0.30
	B Line		0.10	0.10
	R Line		0.10	0.10
3	DRRH-2 (DR 714-1-2-R)	DRR		
	A Line		0.15	0.15
	B Line		0.05	0.05
	R Line		0.05	0.05
4	KRH2	Bangalore		
	IR 58025A		2.05	1.00
	IR 58025B		0.70	5.00
	KMR-3R		0.70	5.00
5	Pant Shankardhan-1	GBPUAT		
	A Line		0.30	0.25
	B Line		0.10	0.50
	R Line		0.10	0.50
6	Pant Sankar Dhan3 (UPHR 1010)	GBPUAT		
	A Line		0.45	0.25
	B Line		0.15	0.50
	R Line		0.15	0.50
7	Pusa RH10	IARI, Karnal		
	Pusa 6A		0.10	0.30
	Pusa 6B		0.05	0.15
	PRR 78		0.05	0.10
8	RAJALAXMI (CRHR-5)	CRRI Cuttack		
	A Line		0.60	--
	B Line		0.20	--
	R Line		0.20	--
9	SAHYADRI 1	Karjat		
	A Line		4.70	4.80
	B Line		1.55	1.60
	R Line		1.00	1.10
10	SAHYADRI -2	Karjat		
	A Line		0.15	0.16
	B Line		0.05	0.06
	R Line		0.05	0.06
11	SAHYADRI-3	Karjat		
	A Line		0.15	0.16
	B Line		0.05	0.06
	R Line		0.05	0.06
	Total (Hybrids)		15.75	22.86
II	**VARIETIES**			
1	Abhishek	Hazaribagh	10.00	45.90
2	ADT (R)-46	Coimbatore	1.00	1.00
3	ADT(R)-48	Coimbatore	1.00	1.00
4	ADT-37	Coimbatore	13.50	13.50
5	ADT-39	Coimbatore	6.50	6.50
6	ADT-42	Coimbatore	0.50	0.50
7	ADT-43	Coimbatore	8.00	8.00
8	ADT-44	Coimbatore	0.50	0.50
9	ADT-45	Coimbatore	1.00	1.00
10	Akshayadhan	DRR	0.50	2.00
11	Amara	ANGRAU, Hyderabad	6.00	30.00
12	Anjali	Hazaribagh	8.00	8.70
13	Annada	Cuttack	7.50	
14	ASD-16	Coimbatore	0.50	0.50

Sl. No.	Name of variety / Hybrid	Produced by	Actual allocation as per BSP-I	Actual Production
15	Athira	Pattambi	2.00	2.50
16	Bahadur	Jorhat	8.00	8.00
17	Bamleshwari	Raipur	36.00	50.00
18	Barani Deep	Faizabad	2.00	14.00
19	Basmati-370	Kaul	4.00	13.00
20	Basamati-386	Ludhiana	5.50	11.00
21	Bhadra	Moncompu	8.00	8.37
22	Bharani	ANGRAU, Hyderabad	3.00	3.00
23	Bhogavati	Radhanagari	5.00	27.60
24	Bhrigu Dhan	Malan	0.50	0.14
25	Birsa Dhan-108	Ranchi	10.00	--
26	Birsa Vikas Dhan-109	Ranchi	58.00	7.50
27	Birsa Vikas Dhan-110	Ranchi	8.00	3.50
28	Birsamati	Ranchi	10.00	8.00
29	BPT-3291	Hyderabad	32.00	34.00
30	Chandrahasini	Raipur	61.00	68.00
31	Chenab	Khudwani	2.00	4.00
32	Cotton Dora Sannalu	Raipur, Jabalpur, ANGRAU, Hyderabad	480.00	1276.10
33	CR Boro Dhan2	Cuttack	9.00	
34	CR Dhan 40	Hazaribagh	1.00	13.80
35	CR Dhan 401	Cuttack	0.80	1.50
36	CR Dhan-10	Cuttack	6.00	5.50
37	CR Dhan-70	Cuttack	1.00	2.00
38	CR Sugandh Dhan-3	Cuttack	0.50	
39	CR-1014	Cuttack	15.00	8.00
40	CSR 30	CSSRI	50.00	85.00
41	CSR -13	CSSRI	7.00	8.50
42	CSR -27	CSSRI	3.00	5.00
43	CSR -36	CSSRI	29.00	35.00
44	Danteshwari	Raipur	69.00	85.00
45	Daya	Bhubaneshwar	0.50	1.71
46	Dhanrasi	DRR	7.50	8.00
47	Dharitri	Cuttack	1.00	5.60
48	Erramallelu	ANGRAU, Hyderabad	15.00	15.00
49	Gajapati	Bhubaneshwar	0.50	0.51
50	Gautam	Pusa	10.00	9.00
51	Gayatri	Cuttack	10.00	20.00
52	Geetanjali	Cuttack	4.00	1.80
53	Gontra Bidhan-1	BCKVV, Nadia	27.00	60.00
54	Govind	Pantnagar	6.50	21.60
55	GR-11	Nawagam	5.00	5.00
56	Gurjari	Nawagam	0.50	0.50
57	Hazaridhan	Hazaribagh	1.50	7.80
58	HKR-126	Kaul	0.50	0.50
59	HKR-127	Kaul	25.00	45.00
60	HKR-47	Kaul	13.00	45.00
61	HPR 2143	Malan	4.00	6.72
62	HPR-1068	Malan	5.00	12.48
63	HPR-1156	Malan	0.50	4.52
64	Improved Pusa Basmati -1	IARI, Karnal	44.50	39.72
65	Improved Samba Mashuri	DRR	86.00	165.00
66	Improved White Ponni	Coimbatore	1.00	1.00
67	Indra	ANGRAU, Hyderabad	5.00	40.00
68	Indrayani	Vadgaon	22.50	70.00
69	Intan	Mugad	3.00	-
70	IR-20	DRR, DSR, Mau	15.00	-
71	IR 36	DSR, Mau, Cuttack, Raipur	75.00	63.86
72	IR-30864	Bangalore	1.00	1.00
73	IR-50	DRR	4.50	5.00

Sl. No.	Name of variety / Hybrid	Produced by	Actual allocation as per BSP-I	Actual Produ-ction
74	IR-64	DRR, Raipur, Jabalpur	190.00	306.95
75	Jajati	Bhubaneswar	3.00	6.30
76	Jaldhubi	Raipur	2.50	1.00
77	Jaldi Dhan-6	Cuttack	1.00	
78	Jaldidhan-13	DSST, New Delhi	0.50	2.00
79	Jarava	DRR	1.50	4.20
80	Jaya	DRR	51.00	52.00
81	JGL 11470	ANGRAU, Hyderabad	3.00	9.00
82	JGL-1798	ANGRAU, Hyderabad	24.00	26.00
83	JGL-384	ANGRAU, Hyderabad	6.50	8.00
84	Jhelum	Khudwani	4.00	20.00
85	Jogesh	Bhubaneswar	3.00	0.32
86	JR-503	Jabalpur	1.00	10.80
87	Jyothi	Pattambi	30.00	50.00
88	Karjat-2	Karjat	5.00	5.00
89	Karjat-3	Karjat	1.50	1.50
90	Karjat-7	Karjat	1.50	1.60
91	Karma Mahsuri	Raipur	50.00	71.00
92	Kasturi	Hyderabad	0.50	0.50
93	Ketekijoha	Cuttack	8.00	8.00
94	Khandagiri	Bhubaneshwar	54.00	123.30
95	Khitish	Cuttack, Chinsurah	20.00	8.20
96	KMD-2 (Abhilash)	Mugad	5.00	5.00
97	Konark	Bhubaneswar	6.50	0.60
98	Kranti	Jabalpur	23.00	2909.96
99	Krishna Hamsa	DRR	2.50	4.90
100	Lachit	Jorhat	10.00	6.30
101	Lalat	Bhubaneswar	54.00	175.00
102	Luit	Jorhat	10.00	10.00
103	Lunasampad	Cuttack	0.50	1.00
104	Lunasuwarna	Cuttack	0.50	1.50
105	Lunishree	Cuttack	8.50	4.00
106	Mahamaya	Raipur	105.00	143.00
107	Mahsuri	DRR, Jorhat	25.00	29.60
108	Malaviya Sugandh -105	Varanasi	13.00	20.00
109	Malaviya Sugandh 4-3	Varanasi	19.00	29.00
110	Manaswini	Bhubaneswar	5.50	7.00
111	Mandakini	Bhubaneswar	1.50	1.50
112	Manohar Sali	Jorhat	10.00	10.50
113	Maruteru Sannalu	ANGRAU, Hyderabad	1.00	2.00
114	Moti	Cuttack	3.00	4.00
115	Mrunalini	Bhubaneswar	1.00	11.00
116	Tholakuri	ANGRAU, Hyderabad	1.50	2.50
117	Pushyami	ANGRAU, Hyderabad	10.00	25.00
118	MTU-1032	ANGRAU, Hyderabad	2.10	3.00
119	Swarna	ANGRAU, Hyderabad, PRDF Gorakhpur, Raipur	400.00	471.50
120	Mukthi	Bangalore	1.00	5.00
121	Narendra – 8002	Faizabad	28.00	35.00
122	Narendra Usar Dhan -2008	Faizabad	10.00	16.00
123	Narendra Usar-3	Faizabad	9.00	26.00
124	Narendra Dhan 3112-1 Prakhar	Faizabad	9.00	40.00
125	Narendra Dhan-359	Faizabad	11.00	170.00
126	Narendra Dhan-97	Faizabad	2.50	19.00
127	Narendra Jal Pushp	Faizabad	18.00	-

Sl. No.	Name of variety / Hybrid	Produced by	Actual allocation as per BSP-I	Actual Production
128	Narendra Lalmati	Faizabad	6.00	15.00
129	Narendra Mayank	Faizabad	18.00	-
130	Naveen	Cuttack	48.00	
131	NDR 2064	Faizabad	3.00	26.00
132	NDR 2065	Faizabad	1.00	-
133	Nellore Mashuri	ANGRAU, Hyderabad	9.00	30.00
134	NLR-145	ANGRAU, Hyderabad	6.00	25.00
135	Nua Chinikamini	Cuttack	0.30	1.50
136	Nua Kalajeera	Cuttack	0.60	2.00
137	Onam	Moncompu	1.00	-
138	Padmini	Cuttack	3.00	3.00
139	Palam Dhan-957	Malan	5.00	--
140	Pankaj	Bhubaneswar	1.50	
141	Pant Dhan -10	Pantnagar	3.00	60.00
142	Pant Dhan -11	Pantnagar	2.50	25.00
143	Pant Dhan -12	Pantnagar	9.00	35.00
144	Pant Dhan -16	Pantnagar	1.50	3.06
145	Pant Dhan -19	Pantnagar	22.00	60.00
146	Pant Sugandha Dhan – 15	Pantnagar	1.00	10.00
147	Pardhiva	ANGRAU, Hyderabad	3.00	3.00
148	Parijat	Bhubaneswar	10.50	10.50
149	PAU-201	Ludhiana	34.00	38.00
150	Phalguni	Cuttack	0.50	
151	Phule Samrudhi	Vadgaon	3.00	70.00
152	PKV HMT	Sindewahi	103.00	182.00
153	Pooja	Cuttack	80.00	135.00
154	Poornima	Raipur	5.00	78.00
155	PR-111	Ludhiana	7.00	13.00
156	PR-113	Ludhiana	105.00	105.00
157	PR-114	Ludhiana	31.00	51.00
158	PR-115	Ludhiana	13.00	13.00
159	PR-116	Ludhiana	30.00	32.00
160	PR-118	Ludhiana	19.00	33.00
161	Prathyasa	Moncompu	1.00	3.60
162	Pratikshya	Bhubaneswar	33.00	126.00
163	PTB-58	Pattambi	1.00	1.00
164	Pusa Basmati -6	IARI, Karnal	12.00	13.00
165	Pusa Basmati -1121	IARI, Karnal, BEDF N Delhi, DSST, N Delhi	74.00	84.50
166	Pusa -44	IARI, Karnal	27.00	59.00
167	Pusa -834	DSST, N Delhi, IARI, Karnal	48.00	84.50
168	Pusa Basmati -1	BEDF, N Delhi, IARI, Karnal, DSST, N Delhi	30.00	68.50
169	Pusa Sugandh -2	IARI, Karnal	9.50	10.20
170	Pusa Sugandh -3	IARI, Karnal	23.00	25.00
171	Pusa Sugandh -5	IARI, Karnal	106.00	74.00
172	Pusa-677	IARI, Karnal	0.50	0.50
173	Rajendra Bhagvati	Pusa	22.00	40.00
174	Rajendra Kasturi	Sabour, Pusa	16.00	17.00
175	Rajendra Mahsuri-1	Sabour, Pusa	37.00	85.00
176	Rajendra Suwasini	Sabour, Pusa	15.00	37.00
177	Rajendra Sweta	Sabour	21.00	25.00

Sl. No.	Name of variety / Hybrid	Produced by	Actual allocation as per BSP-I	Actual Produ-ction
178	Rajshree	Pusa	31.00	35.00
179	Ramachandi	Bhubaneswar	1.00	4.00
180	Rani Dhan	Bhubaneswar	21.00	126.00
181	Ranjeet	Jorhat	80.00	101.00
182	Rashmi	Jabalpur	60.00	151.83
183	Rasi	DRR	7.00	10.50
184	Ratna	Cuttack	21.00	
185	Ratnagiri-1	Shirgaon	2.50	3.00
186	Ratnagiri-24	Shirgaon	4.00	6.00
187	RP-2421	Malan	8.00	2.16
188	Sabhagi Dhan	Hazaribagh,	190.00	166.10
189	Sabita	Chinsurah	2.00	3.00
190	Sadabahar	Hazaribagh	1.00	1.50
191	Samalei	Bhubaneshwar	1.50	
192	Samba Mahsuri	PRDF Gorakhpur ANGRAU, Hyderabad	186.00	242.00
193	Samleshwari	Raipur	36.00	60.00
194	Sampada	DRR	0.50	3.50
195	Sarala	Cuttack	21.00	35.00
196	Sarathi	Bhubaneshwar	0.50	0.82
197	Sarjoo-52	Faizabad, PRDF, Gorakhpur	19.00	274.50
198	Sashi	Chinsurah	0.50	1.00
199	Satabadi	Cuttack, Chinsurah	83.00	12.00
200	Savitri	Cuttack	29.00	29.00
201	Shusk Samrat	Faizabad	0.50	38.50
202	Sidhanta	Bhubaneswar	6.00	0.62
203	Sita	Sabour	8.00	20.00
204	Somasila	Hyderabad	5.00	5.00
205	Sree Kurma	Hyderabad	2.00	2.00
206	Srikakulam Sannalu	Hyderabad	20.00	24.00
207	Surendra	Bhubaneswar	7.00	15.90
208	Swarna Sub -1	Varanasi, Cuttack	220.00	297.00
209	SYE-75	Sindewahi	5.00	4.00
210	Taraori Basmati	Kaul	3.50	8.00
211	Tejaswani	Bhubaneswar	1.00	32.00
212	Tellahamsa	ANGRAU, Hyderabad	18.00	26.00
213	Thanu	Bangalore	4.00	4.00
214	TRY 1	Coimbatore	0.50	0.50
215	Tunga	Bangalore	7.00	6.40
216	Uma	Moncompu	15.50	16.00
217	Upahar	Bhubaneswar	2.50	2.50
218	Utkal Prava	Cuttack	6.00	5.00
219	Vallabh Basmati-22	Modipuram	6.00	3.00
220	Vandana	Hazaribagh	20.00	11.40
221	Vardhan	DRR	90.00	44.00
222	Varsha	Pattambi	4.50	4.50
223	Varshadhan	Cuttack	6.00	--
224	Vasundhara	ANGRAU, Hyderabad	21.00	30.00
225	Vijetha	ANGRAU, Hyderabad	205.00	250.00
226	Vivek Dhan 154	Almora	2.50	3.00
227	Vivek Dhan-62	Almora	2.50	2.50
228	VL Dhan -208	Almora	3.00	1.10
229	VL Dhan 209	Almora	2.00	2.00
230	VL Dhan 85	Almora	2.50	2.50
231	Warangal Samba	ANGRAU, Hyderabad	9.00	20.00
232	Warangal Sannalu	ANGRAU, Hyderabad	52.00	56.00
233	WGL-3962	ANGRAU, Hyderabad	0.50	0.50
TOTAL (VARIETIES)			**5251.30**	**11432.45**
GRAND TOTAL			**5267.05**	**11455.31**

Appendix 3

List of PPV&FRA Registration Certificates of Extant Varieties issued in 2013

Sl. No.	Certificate Sl. No.	Registration No.	Denominations
1	000575	29/2013	Vasumati (IET-15391)
2	000577	31/2013	KAUM-57-9-1-1 (K-16) (MO18- Karishma) IET 15095
3	000578	32/2013	Indira Dhan-1 (IET 15376) (R636-405)
4	000579	33/2013	Vivek Dhan-154
5	000580	34/2013	VL Dhan 61 (IET 13485) (VL 89-1179)
6	000581	35/2013	KAUM-42-6-3 (D1) (MO 16-UMA) IET 14758
7	000582	36/2013	Neeraja (IET 11865)
8	000583	37/2013	VL Dhan 85 (IET 16455)
9	000584	38/2013	Luit (TTB 127-216-2/IET 13622)
10	000585	39/2013	Sugandhamati (IET 16775)
11	000586	40/2013	Trighuna (IET 12875)
12	000587	41/2013	CSR-13 (IET 10348)
13	000588	42/2013	KAUM 20-19-4 (MO 15 – Remanika) IET 13981
14	000589	43/2013	Dhanrasi (IET 15358)
15	000590	44/2013	KAUM 45-20-1 (D6) (MO 17 – Revathy) IET 15322
16	000591	45/2013	Gouri (MO-20)
17	000592	46/2013	BR 2655
18	000593	47/2013	Jarava (IET 15420)
19	000594	48/2013	KAUM 57-18-1-1 (K-18 (MO 19- Krishnanjana) IET 15096
20	000595	49/2013	KAUM 59-29-2-1-2 (GM-1) (MO 13- Pavithra) IET 13983
21	000596	50/2013	GR-9
22	000597	51/2013	GR-12
23	000598	52/2013	Dandi (IET 14905)
24	000599	53/2013	GR-104
25	000621	75/2013	JGL-1798
26	000622	76/2013	Anjali (IET 16430) (RR-347-166)
27	000623	77/2013	JGL 384
28	000624	78/2013	Indur Samba (PDR 763)
29	000627	81/2013	Pusa Basmati 1121

Appendix 4

Funded AICRIP centers with staff positions during 2012-13

Sl. 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 projects (2012-13)

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

Programme Leader: B.C. Viraktamath

Project Title/Code	Project Leader & Associates
Development and evaluation of three line hybrids with better grain quality and resistance to major pests and diseases **(GEY/CI/ HY/1)**	**B.C. Viraktamath**, A.S. Hari Prasad, P. Senguttuvel, P. Revathi, K.B. Kemparaju, N. Shobha Rani, C.N. Neeraja, D. Ladhalakshmi
Exploitation of inter sub-specific heterosis in rice (*Oryza sativa* L.) **(GEY/CI/ HY/7)**	**A.S. Hari Prasad**, P. Revathi, R.M. Sundaram, B.C. Viraktamath, K.B. Kemparaju, S. Arun Kumar, P. Senguttuvel
Breeding of parental lines and hybrids suited to aerobic and salinity conditions **(GEY/CI/HY/8)**	**P. Senguttuvel**, A.S. Hariprasad, P. Revathi, R. Mahender Kumar, D. Subramanyam, Brajendra, Suneetha Kota, K.B. Kemparaju, B.C. Viraktamath
Molecular breeding for fertility restoration, wide compatibility and disease resistance in rice **(ABR/CI/ HY/9)**	**P. Revathi,** A.S. Hariprasad, P. Senguttuvel, B.C. Viraktamath, K.B. Kemparaju, M. Sheshu Madhav, V. Jhansi Lakshmi
Genetic improvement of maintainers and development of CMS lines **(GEY/CI/ HY/6)**	**K.B. Kemparaju**, B.C. Viraktamath, N. Sobha Rani A.S. Hari Prasad, P. Senguttuvel, P. Revathi, G.S. Laha, V. Jhansi Lakshmi
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. **(GEY/CI/ BR/12)**	**T. Ram**, G.S. Laha, V. Jhansi Lakshmi, A.P. Padamakumari, D. Krishanaveni, R.M. Sundaram, B. Sreedevi, S.K. Mangrauthia, D. Ladhalakshmi
Breeding varieties for Boro areas **(GEY/CI/ BR/9)**	**L.V. Subba Rao**, N. Shobha Rani, T. Ram, V. Ravindra Babu, Ch. Padmavathi, M. Srinivas Prasad, R. Mahendra Kumar
Breeding rice varieties for resistance to planthoppers **(GEY/CI/ BR/16)**	**G. Padmavathi**, V. Jhansi Lakshmi, G.S.V. Prasad, M. Seshu Madhav, P.V. Satyanarayana, K. Vasantha Bhanu
Development of value added rice based products for different uses **(GEY/CI/ BR/20)**	**M.M. Azam**, D. Sanjeeva Rao, N. Shobha Rani, V. Ravindra Babu, V.P. Bhadana, Suneetha Kota, Amtul Waris
Breeding rice for enhanced phosphorous use efficiency **(GEY/CI/ BR/14)**	**VP Bhadana**, T. Ram, G.S.V. Prasad, D. Subrahmanyam, R.M. Sundaram, P. Brajendra, R. Mahender Kumar
Development of high yielding rice varieties for conservation agriculture **(GEY/CI/ BR/17)**	**Suneetha Kota**, N. Shobha Rani, V.P. Bhadana, P. Senguttuvel, S.P. Singh, M.B.B. Prasad Babu, B. Gangaiah, G. Katti
Germplasm screening and identification of genes for developing resistance to sheath blight in rice **(GEY/CI/ BR/19)**	**Jyothi Badri**, N Shobha Rani, V.P. Bhadana, Suneetha Kota, M. Sheshu Madhav, G.S. Laha, V. Prakasam
Physiological studies for improving ideotype breeding in rice **(GEY/CP/ PP/12)**	**P. Raghuveer Rao**, A.S. Hariprasad, V.P. Bhadana

P2 GEQ: Genetic enhancement of grain and nutritional quality for domestic and export purposes
Programme Leader: N. Shobha Rani

Project Title/Code	Project Leader & Associates
Genetic enhancement of quality rice varieties through conventional and molecular breeding approaches **(GEQ/CI/ BR/11)**	**N. Shobha Rani**, G.S. Varaprasad, L.V. Subba Rao, V. Ravindra Babu, R.M. Sundaram, M.S. Madhav, G.S. Laha, M.S. Prasad, V. Jhansi Lakshmi, K. Suneetha
Enhancing nutritional quality of rice through bio-fortification **(GEQ/CI/ BR/8)**	**V. Ravindra Babu**, N. Shobha Rani, L.V. Subba Rao, B. Sreedevi, K. Surekha, C.N. Neeraja, G. Padmavathi, D. Sanjeeva Rao, S. Ravichandran, T. Longvah (NIN)
Genetic enhancement of aromatic short and medium grain rices **(GEQ/CI/ BR/13)**	**G.S. Varaprasad**, B.C. Viraktamath, N. Shobha Rani, G. Padmavathi, M. Sheshu Madhav, J.S. Bentur, V. Jhansi Lakshmi, G.S. Laha
Investigation into starch properties and chalkiness on rice cooking quality **(GEQ/CI/BR/18)**	**D. Sanjeeva Rao**, N. Shobha Rani, V. Ravindra Babu, G.S.V. Prasad, Suneetha Kota

P3 ABR: Development and application of biotechnology tools for rice improvement
Programme Leader: N. Sarla

Project Title/Code	Project Leader & Associates
Introgression of yield contributing genes/alleles from wild species to rice using molecular markers **(ABR/CI/ BT/5)**	**N. Sarla**, Jyothi Badri
Genetic improvement of rice against biotic and abiotic stresses through transgenic approach **(ABR/CI/ BT/9)**	**S.M. Balachandran**, A.P. Padmakumari, Ch. Padmavathi, D. Subrahmanyam, S.K. Mangrauthia
Identification of genes for grain filling in rice (*Oryza sativa* L.) **(ABR/CI/ BT/6)**	**C.N. Neeraja**, S.R. Voleti, L.V. Subba Rao, S.M. Balachandran, M. Sheshu Madhav, G.S.V. Prasad
Development of molecular markers for important quality traits in rice **(ABR/CI/ BT/8)**	**M. Sheshu Madhav**, N. Shobha Rani, G.S.V. Prasad, R.M. Sundaram, C.N. Neeraja
Suppression of Rice tungro virus through RNA interference **(ABR/CPT/PATH/16)**	**S.K. Mangrauthia**, S.M. Balachandran, D. Krishnaveni
Molecular breeding for fertility restoration, wide compatibility and disease resistance in rice **(ABR/CI/ HY/9)**	**P. Revathi,** A.S. Hariprasad, P. Senguttuvel, B.C. Viraktamath, K.B. Kemparaju, M. Sheshu Madhav, V. Jhansi Lakshmi

P4 RUE: Enhancing resource and input use efficiency
Programme Leader: R. Mahender Kumar

Project Title/Code	Project Leader & Associates
Evaluation of the system of rice intensification (SRI) for its potential to save water and sustaining rice productivity **(RUE/CP/AG/10)**	**R. Mahender Kumar**, V. Ravindra Babu, L.V. SubbaRao, K. Surekha, P.C. Latha, Ch. Padmavathi, N. Somasekhar, M. Srinivas Prasad, P. Raghuveer Rao, P. Muthuraman, S. Ravichandran, B. Nirmala, Shaik N. Meera, B. Sailaja, T. Vidhan Singh, B. Sreedevi, B.C. Viraktamath
Resource conservation studies in rice cultivation **(RUE/CP/AG/14)**	**B. Gangaiah**, M.B.B. Prasad Babu, P. Raghuveer Rao, T. Vidhan Singh, P.C. Latha
Development of suitable agronomic management practices for aerobic rice **(RUE/CP/AG/13)**	**B. Sreedevi**, T. Ram, P. Brajendra, N. Soma Sekhar, P. Senguttuvel

P5 SSP: Sustaining rice system productivity
Programme Leader: K.V. Rao

Project Title/Code	Project Leader & Associates
Integrated crop and nutrient management to realise potential yields **(SSP/CP/SS/12)**	**K.V. Rao**, K. Surekha, B. Sailaja, P. Brajendra, R.M. Kumar, D. Subrahmanyam
Assessment and improving nitrogen use efficiency in irrigated rice **(SSP/CP/SS/11)**	**K. Surekha,** K.V. Rao, V.P. Bhadana**,** S.R. Voleti, C.N. Neeraja, R. Mahender Kumar
Assessment of soil quality for improved rice productivity **(SSP/CP/ SS/9)**	**P. Brajendra,** K.V. Rao, K. Surekha, P.C. Latha, V.P. Bhadana, B. Sailaja
Utilization of plant growth promoting micro organisms for improving nitrogen and water use efficiency in rice **(SSP/CP/SS/13)**	**P.C. Latha,** S.R. Voleti, K. Surekha, B. Sreedevi

P6 CCR: Assessing and managing crop response to climate change
Programme Leader: S.R. Voleti

Project Title/Code	Project Leader & Associates
Physiological studies on Heat tolerance due to ambient and Elevated carbon dioxide in rice **(CCR/CP/ PP/9)**	**S.R. Voleti**, P.R. Rao, B. Sailaja, N. Somasekhar, N. Shobha Rani, P.C. Latha, K. Surekha, Chitra Shanker, D. Krishnaveni, Shaik N. Meera, M. Vanaja (CRIDA)
Evaluation of genotypic variation in leaf photosynthetic efficiency and its associated factors in rice **(CCR/CP/ PP/11)**	**D. Subrahmanyam**, S.R. Voleti, V.P. Bhadana
Impact of changing temperatures on nitrogen dynamics and use efficiency in rice **(CCR/CP/ SS/10)**	**M.B.B. Prasad Babu,** P.C. Latha, K.V. Rao, B. Gangaiah

P7 HRI: Host-plant resistance against insect pests and management
Programme Leader: J.S. Bentur

Project Title/Code	Project Leader & Associates
Host-plant resistance to gall midge in rice **(HRI/CPT/ ENT/17)**	**J.S. Bentur**, C.N. Neeraja, K. Suneetha, A.P. Padma Kumari
Assessment of host plant resistance to rice planthoppers and their management **(HRI/CPT/ENT/11)**	**V. Jhansi Lakshmi**, J.S. Bentur, G.Padmavathi
Insect-plant interactions with special reference to yellow stem borer **(HRI/CPT/ ENT/18)**	**A.P. Padmakumari**, S.R. Voleti, T. Ram
Host plant resistance for leaf folder in rice **(HR1/CPT/ENT/19)**	**Ch. Padmavathi**, L.V. Subba Rao, N. Sarla

P8 HRP: Host-plant resistance against pathogens and its management
Programme Leader: M.S. Prasad

Project Title/Code	Project Leader & Associates
Assessment of host plant resistance to rice blast disease and management through botanicals **(HRP/CPT/ PATH/15)**	**M.S. Prasad**, S.M. Balachandran, M.S. Madhav, GSV Prasad
Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice **(HRP/CPT/PATH/13)**	**G.S. Laha**, D. Krishnaveni, R.M. Sundaram, T. Ram, S.K. Mangrauthia, D. Ladha Lakshmi
Assessment of host plant resistance and strainal variation in rice tungro disease **(HRP/CPT/PATH/14)**	**D. Krishnaveni**, G.S. Laha, Chitra Shanker, C.N. Neeraja, S.K. Mangrauthia, D.Ladhalakshmi
Biology of false smut disease of rice **(HRP/CPT/ PATH/17)**	**D. Ladhalakshmi**, G.S. Laha, S.K. Mangrauthia, P. Senguttuvel
Characterization and management of rhizoctonia solani causing sheath blight of rice **(HRP/CPT/ PATH/18)**	**V. Prakasam**, M.S. Prasad, G.S. Laha, T. Ram, M. Sheshu Madhav, Jyothi Badri

P9 IPM: Integrated Pest Management

Programme Leader: J.S. Prasad

Project Title/Code	Project Leader & Associates
Investigations on plant parasitic nematodes in rice **(IPM/ CPT/ENT/14)**	**J.S. Prasad**, N. Somasekhar, M. Mohan, K.S. Varaprasad (NBPGR)
Chemical control of rice insect pests as a component of rice **(IPM/ CPT/ENT/3)**	**Gururaj Katti**, V Jhansi Lakshmi, A.P. Padmakumari, Ch. Padmavathi, Chitra Shanker
Botanicals for sustainable management of major pests of rice **(IPM/CPT/ENT/21)**	**B. Jhansi Rani**, Chitra Shanker, M.S. Prasad, M.M.Azam
Evaluation of Entomopathogenic Nematodes for the Management of Insect Pests in Rice Ecosystem **(IPM/ CPT/ENT/15)**	**N. Somasekhar**, J.S. Prasad, A.P. Padmakumari, G. Katti
Invertebrate biodiversity of irrigated ecosystem, its functional significance and potential for natural control of pests **(IPM/ CPT/ENT/13)**	**Chitra Shanker**, Gururaj Katti, G.S. Laha
Semiochemical approaches to manage rice pests with special emphasis on sex pheromones **(IPM/CPT/ENT/20)**	**M. Sampath Kumar**, J.S. Bentur, Ch. Padmavathi, G.R. Katti, Subhaharan (CPCRI)

P10 TTI: Transfer of technology and training

Programme Leader: Mangal Sain

Project Title/Code	Project Leader & Associates
A study on awareness, perception and constraints in adoption of Integrated Pest Management in rice farming **(TTT/EXT/7)**	**Mangal Sain**, P. Muthuraman, Shaik N. Meera, S. Arun Kumar
Sustainable rice production practices: Problems and prospects **(TTT/EXT/8)**	**P. Muthuraman**, Shaik N. Meera, Mangal Sain, S. Arun Kumar, S. Ravichandran
Gender Dimensions in Different Rice -Eco systems-An Exploratory Study in Andhra Pradesh **(TTT/EXT/10)**	**Amtul Waris**, N. Shobha Rani, Mangal Sain, R. Mahender Kumar, P. Mutthuraman, Shaik N. Meera, S. Arun Kumar
Maximizing the impact of rice technologies through ICT applications **(TTI/ TTT/EXT/11)**	**Shaik N. Meera**, S. Arun Kumar, Amtul Waris, Chitra Shanker, D. Krishnaveni, B. Sailaja, P. Brajendra, Mangal Sain, P. Muthuraman, P. Senguttuvel, B.C. Viraktamath
An Exploratory study on public-private-partnerships: Impact and implications **(TTI/TTT/EXT/9)**	**S. Arun Kumar**, Shaik N. Meera, P. Muthuraman, Mangal Sain, B.C. Viraktamath
Yield gaps and constraints in rice production- An econometric analysis **(TTI/ TTT/ECON/1)**	**B. Nirmala**, Mangal Sain, P Muthuraman, Shaik N. Meera, B. Sailaja
Development of crop growth models for simulating climate change response in irrigated ecosystems. **(CCR/TTI/STAT/3)**	**S. Ravichandran**, D. Subramanyam, B. Sailaja, P. Raghuveer Rao
Delineation of rice growing ecologies using spatial technologies and crop models **(TTI/ CP/CA/3)**	**B. Sailaja,** D. Subrahmanyam, K.V. Rao, Shaik N. Meera, B. Nirmala
Selective mechanization in rice cultivation **(CP/ENG/6)**	**T. Vidhan Singh**, R. Mahender Kumar, B. Gangaiah

List of approved new projects

Project Title/Code	Project Leader & Associates
Breeding for Quality Improvement of Rice through Conventional and Molecular Approaches **(GEQ/CI/BR/21)**	**K. Suneetha,** N. Shobha Rani, G.S.V. Prasad, V. Ravindra Babu, M. Mohibbe Azam, D. Sanjeeva Rao, G.S. Laha, M. Srinivasa Prasad, R.M. Sundaram, M. Seshu Madhav
Development of parental lines and Hybrids with tolerance to salinity and suitability to aerobic situations **(GEY/CI/ HY/10)**	**P. Senguttuvel**, A.S. Hari Prasad, P. Revathi, K.B. Kemparaju, Suneetha Kota, V.P. Bhadhana, B. Sreedevi, R. Mahender Kumar, P. Brajendra, R.M. Sundaram, M. Sheshu Madhav, D. Subbramanyam, N. Somasekhar, B.C. Viraktamath
Genomic studies on grain yield heterosis and WA-CMS trait in rice **(ABR/CI/ BT/10)**	**R.M. Sundaram,** S.M. Balachandran, C.N. Neeraja, M.S. Madhav, A.S. Hariprasad, P. Revathi, S.R. Voleti, S. Ravichandran
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.) **(ABR/CI/ BT/11)**	**Divya Balakrishnan** N Sarla, G Padmavathi, Jyothi Badri
Investigations on Nematodes of Importance to Rice Cultivation **(IPM/ CPT/ENT/22)**	**N.Soma Sekhar,** A.P. Padmakumari, G. Katti, V. Prakasam, P.C. Latha, M. Sheshu Madhav
Insect-plant interactions with special reference to rice pests – yellow stem borer and gall midge **(HRI/ CPT/ENT/23)**	**A.P. Padmakumari,** S.R. Voleti, T. Ram, C.N. Neeraja, K. Suneetha

Appendix 6

Externally funded projects sanctioned during 2012-2013

Sl. No.	Title of the Project / Schemes	Name of PI	Funding Agency	Period	Amount in Rs (Lakhs)
1	Molecular mapping and introgression of stigma exertion trait in hybrid rice parental lines	Dr. B.C. Viraktamath/ Dr. A.S. Hariprasad	DBT	2012-15	24.31
2	Enhancing scope of marker assisted selection using genomics technologies (En MAS)	Dr. M. Sheshu Madhav	CSIR	2012-2017	261.16
3	Marker assisted introgression of different traits to develop new generation climate adapted varieties	Dr. T. Ram	DBT	2013-2018	88.18
4	Evaluation of new herbicide molecules (Rice Co-Herbicide) for its efficiency in Transplanted Rice	Dr. B. Sreedevi	Rice-Co	*kharif* 2012-13	4.49
5	Evaluation of new herbicide molecules (Rice Co-Herbicides) for its efficiency in Direct Seeded Rice	Dr. B. Sreedevi	Rice-Co	*kharif* 2012-13	7.19
6	Evaluation of new fertilizer product "Geofert" An Agro-Nano Technology product in transplanted rice	Dr. R. Mahender Kumar	Geofert	*kharif* 2012 and *rabi* 2012-13	2.69
7	Evaluation of "Metal Glyainates" in Paddy	Dr. R. Mahender Kumar	AMSRI Chemicals Ltd	*rabi* 2012-13 and *kharif* 2013	1.00
8	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	2013-16	18.80
9	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
10	Marker-assisted introgression of Pup1 into elite rice varieties	Dr. R.M. Sundaram	DBT	2013-2015	41.65
11	National Professor Project: Development of chromosome segment substitution lines (CSSL) of rice from elite x wild crosses to map QTLs/genes for yield traits	Dr. N. Sarla	ICAR	2013-2018	250.00

Ongoing Externally funded projects (2012 - 2013)

Sl. No.	Title of the Project/Schemes	Name of PI	Funding Agency	Period	Amount in Rs (Lakhs)
1	Seed Production and seed technology research in Rice (NSP)	Dr. L.V. Subba Rao	ICAR	2002-12	2.00/year
2	DUS Tests in Rice(PPV&FRA)	Dr. L.V. Subba Rao	DUS (PPV&FRA)	2007-12	37.50
3	Generation, characterization and use of EMS induced mutants of Upland variety Nagina 22 for functional Genomics of Rice.	Dr. N. Sarla	DBT Project	2007-12	66.98
4	ICAR Network for Transgenics in crops : Rice (Transgenic Component)	Dr. S.M. Balachandran	ICAR, GOI	2007-13	70.38
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-component-4	2008-13	66.27
6	Transgenics in crops	Dr. N. Sarla	ICAR-NPTC - Iron Zinc	2008-13	135.00
7	Gene and protein expression study in salt-tolerant and sensitive cultivars of indica rice	Dr. N. Sarla	DST	2009-12	21.00
8	Development and maintenance of Rice Knowledge Management Portal Development	Dr. Shaik N. Meera	NAIP	2009-14	656.46
9	Establishment of National Rice Resource Data base	Dr. B.C. Viraktamath / Dr. L.V. Subba Rao	DBT Project	2009-13	51.21
10	Functional Validation of Identified candidate gall midge resistance genes FGR Ph II 4A	Dr. J.S. Bentur	DBT Project	2009-14	88.67
11	Identification and functional validation of BPH resistance genes FGR Ph II 5A	Dr. J.S. Bentur	DBT Project	2009-14	39.80
12	Functional analysis of gene regulatory networks during flower and seed development in rice FGR Ph II 7	Dr. S.M. Balachandran	DBT Project	2009-14	89.05
13	High resolution fine mapping, identification and functional analysis of rice tungro virus resistance genes FGR PH II 6	Dr. C.N. Neeraja	DBT Project	2009-14	59.18
14	Identification and functional analysis of novel blast resistance genes in rice FGR Ph II 3B	Dr. M.S. Prasad	DBT Project	2009-14	58.11
15	Fine mapping of yield enhancing QTLs from wild rice FGR Ph II 1A	Dr. N. Sarla	DBT Project	2009-14	92.84
16	Development of biotic stress resistant rice through marker assisted breeding sub project- I A&B (DBSRR - GCP)	Dr. B.C. Viraktamath	DBT Project	2009-14	146.88

Sl. No.	Title of the Project/Schemes	Name of PI	Funding Agency	Period	Amount in Rs (Lakhs)
17	Functional Characterization of novel bacterial blight resistance genes from wild relative of *Oryza* spp FGR PhII 2A	Dr. B.C. Viraktamath / Dr. R.M. Sundaram	DBT Project	2009-14	74.38
18	Multi locational evaluation of rice germplasm	Dr. L.V. Subba Rao	ICAR/NBPGR	2010-12	6.25
19	BMGF "Stress tolerant rice for poor farmers in Africa and South Asia" STRASA	Dr. T. Ram	IRRI	2011-14	14.50
20	Marker assisted breeding of abiotic stress tolerant rice varieties with major QTLs for drought, submergence and slat tolerance	Dr. T. Ram	DBT Project	2010-14	104.29
21	Seed Production in Agriculture (MEGA SEED)	Dr. L.V. Subba Rao	ICAR	2010-14	65.60
22	National Initiative on Climate Resilient Agriculture	Dr. S.R. Voleti	ICAR	2012-17	600.00
23	National Centre For Integrated Pest Management (NICRA) 2011-12	Dr. J.S. Bentur	ICAR-NCIPM	2010-15	5.00
24	Identification of candidate genes for enhanced water use efficiency in rice through activation tagging	Dr. S.M. Balachandran	DBT Project	2010-15	68.53
25	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 Project	2012-17	123.00
26	Conversion of elite partial restorers of rice cultivars in to restorer by Marker-assisted introgression of major fertility restorer genes, Rf4 & Rf3	Dr. P. Revathi	DBT Project	2012-15	25.44
27	Marker Assisted Recurrent Selection (MARS) for improvement biotic stress resistance in parental lines of hybrid rice	Dr. P. Revathi	DST- women scientist	2012-15	23.50
28	Investigations on System of Rice Intensification (SRI) for water saving and yield optimization in irrigated ecosystem	Dr. R. Mahender Kumar	Ministry of Water resources	2012-2015	49.76
29	Exploitation of RNAi technology for management of yellow stem borer in rice	Dr. M. Sheshu Madhav	DBT	2012-2015	66.19
30	Metabolic and molecular profiling of aromatic rice germplasm of India for gaining insights about aroma	Dr. N. Shobha Rani	DBT	2012-2015	228.00
31	Molecular and functional characterization of yield enhancing QTL from wild rice	Dr. N. Sarla	DBT	2012-2015	12.03
32	Identification and Molecular Mapping of a novel neck blast resistance gene (s) from local landraces and introgression lines of *Oryza*	Dr. M. Sheshu Madhav	DBT-BCIL	2012-15	26.75

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