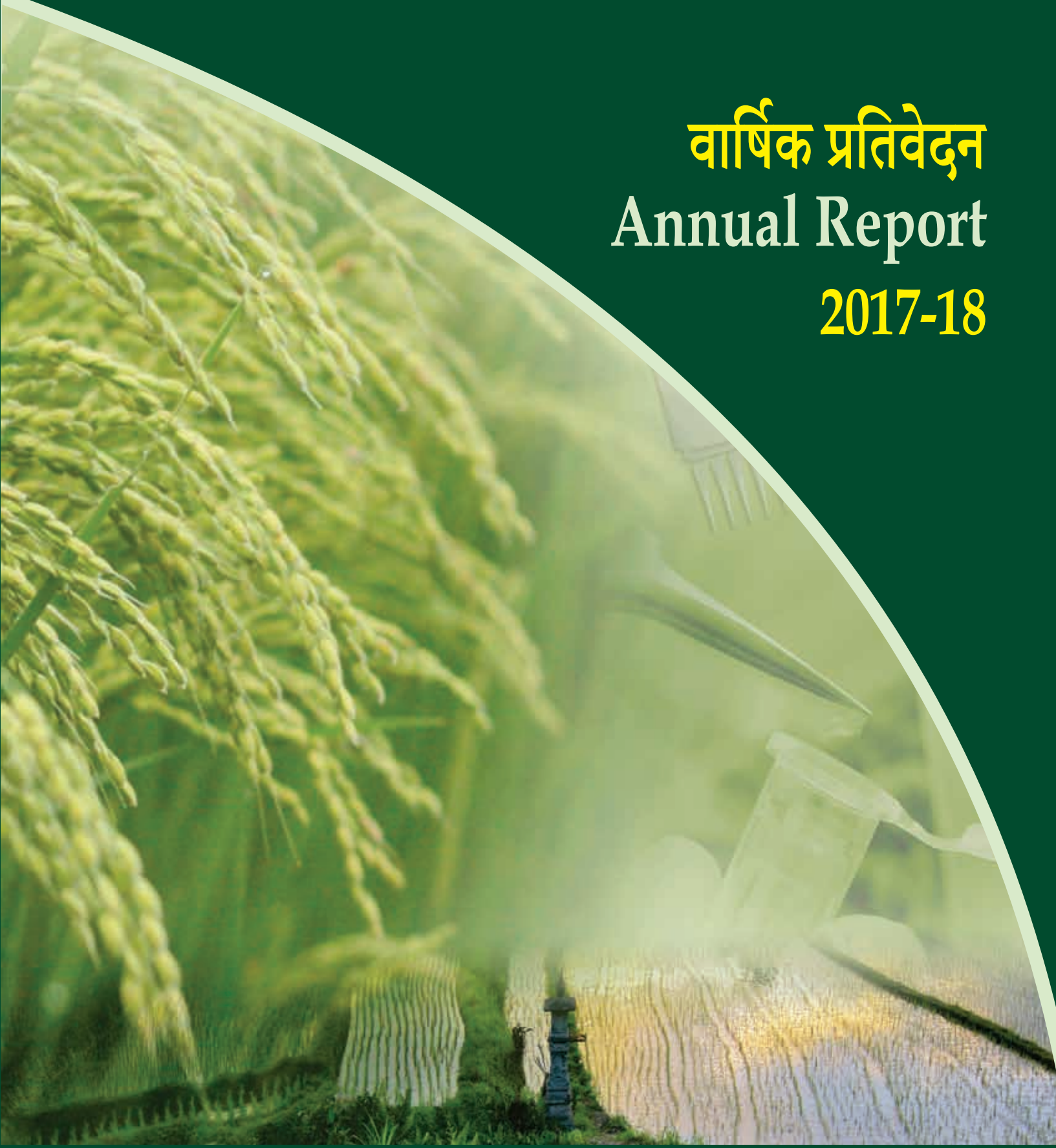

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ICAR-Indian Institute of Rice Research

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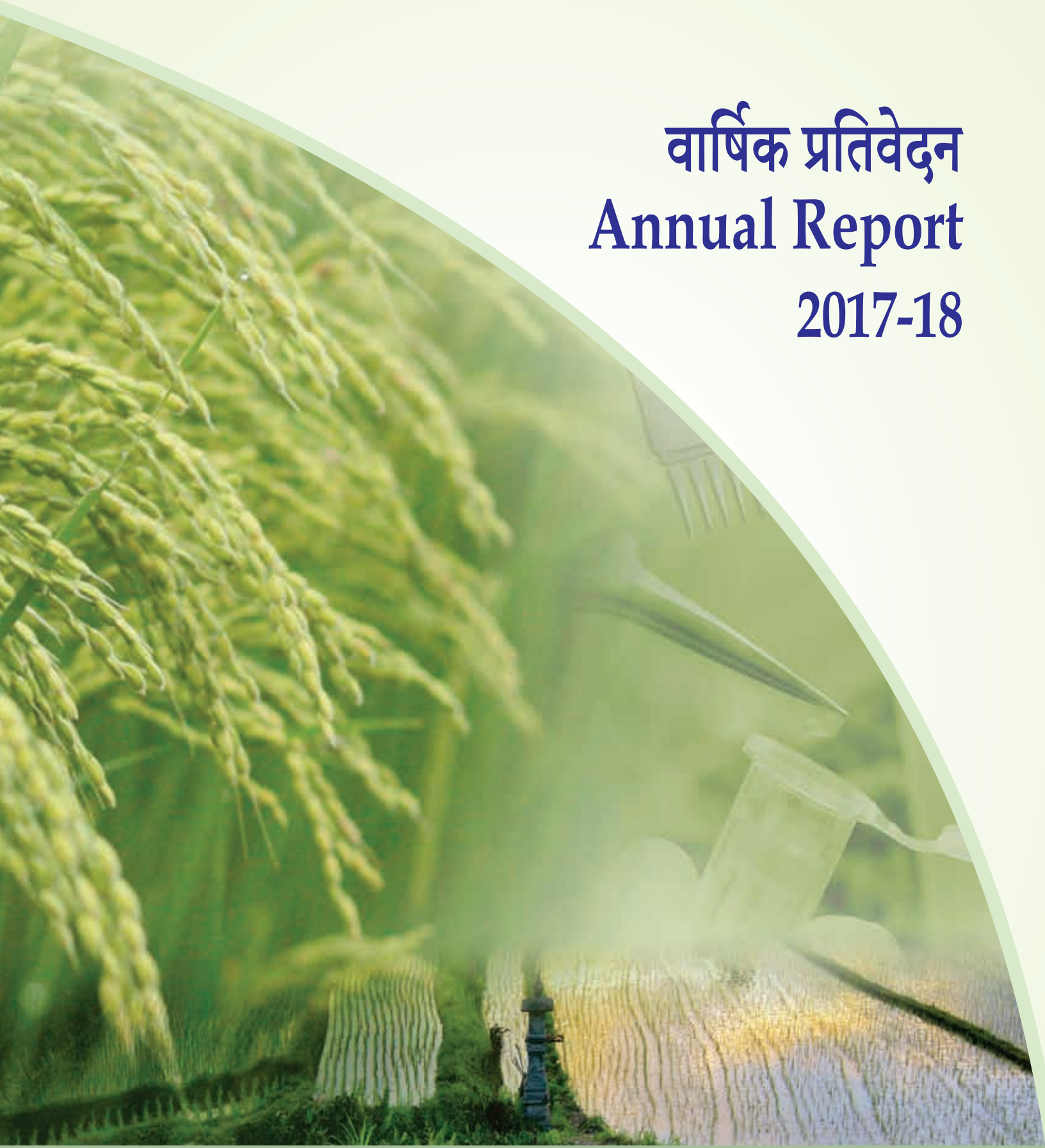

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Preface

I am privileged to place before you the annual report of ICAR-Indian Institute of Rice Research for the period 2017-18. The Institute is justifiably considered as one of the leading research Institutions of ICAR conducting basic and strategic research on rice and also co-ordinating the largest network program in the country, perhaps in the world. During 2017-18, the rainfall in the monsoon season over the country as a whole was 95% of its long period average resulting in an estimated record rice production of 111.0 million tonnes, which shall be an all time record.

The progress of research during the period is quite encouraging with release of 94 varieties including 22 hybrids across the country. Of these, five varieties have been developed by the institute. The Breeder seed production was also substantial with 7571 quintals of 262 varieties produced and distributed. Several proven rice technologies were demonstrated through 723 FLDs covering 20 states of which 50 were identified as promising. Significant breakthroughs were achieved in identifying resistant genetic stocks, promising rice lines for low phosphorous conditions, three gene pyramided BB resistance and bio-fortified zinc lines and cultures for drought tolerance. All these achievements would be contributing towards doubling of farmers' income.

The year is also significant in that the Scientists of the institute were conferred with several awards including Lal Bahadur Shastri Award for outstanding young scientist and Jawaharlal Nehru Award for outstanding thesis. Scientists were deputed on special assignments to other countries and Food Agricultural Organisation (FAO). Several new externally funded projects with a total outlay of Rs. 562 lakhs were also sanctioned to the Institute.

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

Hyderabad
30th May 2018

(S R Voleti)
Director (A)

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कार्यकारी सारांश

Executive summary

अखिल भारतीय समन्वित चावल सुधार कार्यक्रम

वर्ष 2017-18 के दौरान केंद्रीय उपसमिति (फसल मानक, अधिसूचना और किस्मों की रिलीज़) और राज्यवार किस्म पहचान समिति ने कुल 92 किस्मों जिसमें से 20 संकर हैं (केंद्र- 33; राज्य-59) को जारी करने के लिए अनुमोदित किया । इनमें से, असम (9), ओडिशा (7), मध्य प्रदेश (5), पश्चिम बंगाल (4), गुजरात (5), उत्तर प्रदेश एवं बिहार प्रत्येक (4), आंध्र प्रदेश, पंजाब, महाराष्ट्र एवं तमिल नाडु प्रत्येक (3), छत्तीसगढ़, उत्तराखंड, कर्नाटक और अंडमान और निकोबार आइलैंड प्रत्येक (2) और मणिपुर (1)

फसल सुधार

- वर्ष २०१७ के दौरान, एआईसीआरआईपी परीक्षण के ५३ वें वर्ष में ४८ विविधता परीक्षण, १ स्क्रीनिंग नर्सरी और ५ हाइब्रिड चावल परीक्षणों को २५ राज्यों में १२३ स्थानों (४५ वित्त पोषित, ७८ स्वैच्छिक केंद्र) में ८१३ प्रयोगों और २ केंद्र शासित प्रदेशों में आयोजित किया गया था। देश के ७ जोन को सम्मिलित किया गया |
- विभिन्न राज्यों और पारिस्थितिकी के लिए दो सौ पचास आशाजनक प्रविष्टियों की पहचान की गई।
- चार हाइब्रिड चावल परीक्षणों जैसे आईएचआरटी-ई, आईएचआरटी-एमई, आईएचआरटी-एम, आईएचआरटी-एमएस में २७-३३ विभिन्न स्थानों में देश के विभिन्न कृषि-जलवायु क्षेत्रों का प्रतिनिधित्व करने वाले कुल ९५ संकरों का मूल्यांकन किया गया और इनमें से ११ संकरों को आशाजनक पाया गया |
- किस्म पहचान समिति ने विभिन्न राज्यों में रिलीज के लिए ५ हाइब्रिड और १८ किस्मों की प्रविष्टियों की पहचान की।
- ४५ स्थानों पर ३९० प्रविष्टियों में आईएनजीईआर अवलोकन नर्सरी में मूल्यांकन की गई और ३२ प्रविष्टियों को स्वीकार्यता और उपज के आधार पर आशाजनक पाया गया।
- डीएसी इंडेंट्स के अनुसार चावल की किस्मों और संकर की अभिभावकीय रेखाओं के ब्रीडर बीज उत्पादन देश भर के ३८ केंद्रों में आयोजित किया गया था, जिसमें २७१ किस्मों और आठ संकरों की अभिभावकीय रेखाएं शामिल थीं। ४२६४ क्विंटल के लक्ष्य के मुकाबले ७८३३१ क्विंटल ब्रीडर बीज का कुल उत्पादन हासिल किया गया था। आईआईआरआर केंद्र में, २२ किस्मों को ब्रीडर बीज उत्पादन में १८३ क्विंटल के कुल उत्पादन के साथ शामिल किया गया।

सस्य विज्ञान

- पहाड़ियों के लिए ८ श्रेणियों से संबंधित कुल ७० किस्मों का मूल्यांकन किया गया। प्रारंभिक समूह में शालीमार चावल- ३ और विवेक धान- ८६; मध्यम समूह में, वीएल धान ६५, विवेक धान ६२ और एचपीआर २१४३ को आशाजनक प्रविष्टियों के रूप में पहचाना गया।
- एकीकृत प्रबंधन परीक्षण के तहत, पहचाने जाने वाली आशाजनक किस्में थीं: प्रारंभिक सिंचित (आईईटी-२४७९७, गोल्ड विधान-३ और आईआर-६४), मध्यम (आईआर-६४, कर्जत-७, एमटीयू-१०१०, सरजू-५२, एनडीआर -२०६४, एचकेआर-१२७, १२८, पीआर ११३, पंत धान १९, २२, २४, महामाया, नुमाली और जया) और लम्बी अवधि (स्वर्णा, सांबा महसूरी और पुश्वामी)। सुगंधित श्रेणी के तहत, पूसा १५०९, एनडीआर ६०९३, पुसा २५११, नुमाली, पुसा ११२१, पंत सुगंध २५, २७ और सीजी सुगंधित भोग को आशाजनक पाया गया | आशाजनक संकर एचआरआई-१७४, एज़ ८४३३ और एरिज ६४४४ थे। एएल और आईएसटीवीटी के तहत एसआर २६ बी, जया और सीएसआर २३ थे ।
- अधिकाँश स्थानों पर, उच्च एनपीके खुराक (१५०% आरएफडी) के पश्चात एकीकृत पोषक प्रबंधन प्रबंधन ५०% आरएफडी + ५ टन/ हेक्टेयर एफ.वाई.एम के आवेदन को आशाजनक पाया और उच्च पोषक तत्व उपयोग क्षमता को देखा गया |
- पैनिकल निकलने के के बाद (३+/-२ सेमी) तक संतृप्ति स्तिथि में रखरखाव से प्लॉट्स के परिणामस्वरूप उच्चतम अनाज उपज (५.२८ टन/हेक्टेयर) के परिणामस्वरूप वैकल्पिक गीले और सुखाने (५.११ टन/ हेक्टेयर) होते हैं। मैकेनिकल प्रत्यारोपण ने मैनुअल प्रत्यारोपण (५.८७ टन/हेक्टेयर) पर उच्चतम अनाज उपज (६.०२ टन/हेक्टेयर) दर्ज किया गया ।
- फसल प्रतिष्ठान की विधि के बावजूद, वीडर का उपयोग करके १० दिनों के अंतराल पर तीन बार यांत्रिक खरपतवार से करने पर अनाज की पैदावार में ६७% तक वृद्धि देखी गयी | प्लावित सीधी बुवाई में, ३० दिनों तक खरपतवार मुक्त अवधि बनाए रखने से और इस विधि में डीआरआर धान ४६, डीआरआर धान ४४, डीआरआर धान ४२ और स्वर्णा श्रेया किस्मों का आशाजनक परिणाम देखा गया | एरोबिक चावल में, ६० दिनों तक खरपतवार मुक्त अवधि बनाए रखने से डीआरआर धान ४२, डीआरआर धान ४६, डीआरआर धान ४४ और सहभागी धान जैसी किस्मों का आशाजनक परिणाम देखा गया और बेहतर खरपतवार प्रतिस्पर्धी क्षमता पाया गया ।

मृदा विज्ञान

- मरुतेरु में खरीफ और रबी में और तीताबार में रबी में, चावल आधारित फसल प्रणाली (आरबीसीएस) में दीर्घकालिक मिट्टी

प्रजनन प्रबंधन पर अध्ययन के २९ वें वर्ष में, आरडीएफ + ५ टन एफ.वाई.एम/हेक्टेयर और आरडीएफ उपचार बराबर थे और अन्य उपचारों से काफी बेहतर थे |

- किसानों के खेतों में पैदावार के अंतर विश्लेषण ने तीताबार में ५०% के लिए बहुत अधिक उपज अंतर १ और २ का संकेत दिया | फैजाबाद में, उपज गैप १२०% थी जो लगभग प्रबंधनीय थी, जबकि चिनसुराह में यह न्यूनतम था क्योंकि लक्षित उपज अपेक्षाकृत कम थी | संकीर्ण अंतर के साथ, मरुतेरु में, किसानों के खेतों में प्राप्त उपज लगभग अनुसंधान केंद्र की पैदावार से मेल खाती है।
- मूल सोडिक स्थितियों के लिए जीनोटाइप की स्क्रीनिंग जैसे डीआरआर धान ४६, डीआरआर धान ४२, डीआरआर धान ४५, डीआरआर धान ४३, डीआरआर धान ४४ और कानपुर में डीआरआर धान ४० और आईआर ३०८६४, डीआरआर धान ४१, सीएसआर २३, डीआरआर धान ४३, और मंड्या में डीआरआर धान ४० ने १००% जीआर के साथ पूरक और जिप्सम आवेदन के बिना देशी सोडिक स्थितियों के तहत उच्चतम उपज दर्ज की | फैजाबाद में, एनडीआरके ५०००५१ जीनोटाइप, आईआरएसएसटीएन३०, आईआरएसएसटीएन ११०, जया और एनडीआरके ५००६३ ने जिप्सम आवेदन के बिना उच्चतम उपज दर्ज की |
- जीनोटाइप एचआरआई १९७ , उमा, २७पी ६३ और डीआरआर धान ४२ चूना आवेदन के लिए प्रभावी थे और उमा, केएयू १०९ और डीआरआर धान मोनकंपू में देशी मिट्टी की अम्लता के तहत कुशल पाए गए थे | जबकि, आरआरआई में एचआरआई १९६, २७ पी ६४, २७पी ६३; तीताबार में गितेश, प्रफुला और अघोनिबोरा; रायपुर में इंदिरा महेश्वरी और आरपी ५९७४-३-२-८-३८-१२ ने एसिड मिट्टी की स्थिति के चूना आवेदन और बिना आवेदन के भी तहत अच्छा प्रदर्शन किया।
- सीधी बुवाई चावल और एरोबिक चावल की तुलना में प्रत्यारोपित चावल की सर्वोच्चता कई स्थानों पर पायी गयी, क्रमश: कानपुर, में १४-२२% और पुडुचेरी में १३-१९% अधिक उपज देखी देखी गयी, जबकि मोनकंपू में उत्पादन प्रणालियों में सीधी बुवाई चावल ने प्रत्यारोपित और एरोबिक चावल की तुलना में पर १४% तक अधिक उपज का बेहतर प्रदर्शन दिया।
- न्यूट्रिएंट विशेषज्ञ के आधार पर साइट विशिष्ट पोषक प्रबंधन (एसएसएनएम) ने अधिकतर स्थानों पर ३५४९ से ७६०१ किलोग्राम/हेक्टेयर अधिक अनाज उपज दर्ज की है जो कि आरडीएफ की तुलना पर ८-२५% अधिक अनाज की वृद्धि देता है ।
- "बायो-गहन कीट प्रबंधन (बीआईपीएम)» पर अध्ययन के तीसरे वर्ष ने दस स्थानों में से पांच (चिनसुराह, आईआईआरआर, कर्जत, जगदलपुर और तीताबार) में किसानों के अभ्यास (एफपी) पर बीआईपीएम की श्रेष्ठता का संकेत दिया, जिसमें उल्लेखनीय रूप से २२-४४% तक अधिक अनाज उपज दर्ज की गई ।

पादप कार्यिकी

- सिलिक्सॉल आवेदन का कुल सूखे पदार्थ, अनाज उपज प्रति वर्ग मीटर और हार्वेस्ट इंडेक्स के संदर्भ में सकारात्मक भूमिका देखी गयी | परीक्षण की गई किस्मों में, पीएचबी-७१ और आईआर ६४ ने कुल शुष्क पदार्थ के संदर्भ में सिलिक्सोल आवेदन को अच्छी तरह से प्रतिक्रिया दी, जबकि अनाज उपज प्रतिक्रिया और फसल सूचकांक केआरएच-४ में अधिक थे। ऊंचे तापमान के तहत, सभी प्रविष्टियों और स्थानों के लिए औसत अनाज उपज ६०% से कम हो गई थी। गर्मी तनाव की स्थिति के तहत बेहतर उपज वाले जीनोटाइपों में से, आईईटी २६७७८ और आईईटी २६७६३ ने गर्मी के तनाव के तहत अच्छी फसल इंडेक्स (<१०% कमी) बनाए रखा।
- तीन संस्कृतियों (एमएएस 306, एमएएस ३१४, एमएएस ३१७) की पहचान तनाव सहनशीलता के तहत अंकुरण, शूट, रूट वृद्धि और बीजिंग शक्ति के संदर्भ में उनके प्रदर्शन के आधार पर की गई थी।
- कम प्रकाश तनाव के परिणामस्वरूप उपज और उसके घटकों में महत्वपूर्ण नुकसान हुआ। परीक्षण की गई किस्मों में आईईटी २५२०६, आईईटी २५८१४, आईईटी २३३५६ और आईईटी २५८७६ में अनाज उपज में कमी आई है।

पादप रोग

- विषाणु के क्षेत्र की निगरानी ने *पीरिय्युल्युलिया ऑरिज़ा* और *एक्सं-थोमोनास ओरिज़ा पीवी* की दौड़ के विभिन्न समूहों को अस्तित्व में इंगित किया और संकेत दिया कि एकल बैक्टीरियल ब्लाइट प्रतिरोध जीन ज्यादातर स्थानों पर अतिसंवेदनशील थे |
- फसल की जल्दी बुवाई में *राइज़ोक्टोनिया सोलानी* और बीएलबी का प्रकोप ज्यादा रहा और देर से बोए गए फसल में, शीथ ब्लाइट और भूरे रंग की जगहों की बीमारियां अधिक प्रचलित थीं | दक्षिणी क्षेत्र में, १५ दिन देर से बुवाई करने से बीमारी से बचने में मदद मिली।
- संयोजन कवकनाश एज़ोक्सीस्ट्रोबिन १८.२% डब्ल्यू / डब्ल्यू + डिसेनोकोनाज़ोल ११.४% डब्ल्यू / डब्ल्यू एससी (१.० मिली / एल) पत्ती विस्फोट, शीथ ब्लाइट और शीथ सड़ांध के खिलाफ प्रभावी पाया जाता है और फसल की पैदावार में भी वृद्धि करता है।
- आईडीएम अध्ययनों से पता चला है कि बीज उपचार के बाद स्वच्छ मेड़ , जैविक खाद के साथ विभाजित खुराक में उर्वरक आवेदन की इष्टतम खुराक, इसके बाद ट्रायकोडर्मा के आवेदन और जरुरत के अनुसार कवकनाशक का आवेदन करने से चावल में बीमारी की का प्रकोप काम होता है ।

- कवकनाश ☒ज़ो क्सीस्ट्रोबिन १८.२ % + डिफेनोसोनाज़ोल ११.४% डब्ल्यू/डब्ल्यू एससी @ १.० मिली / लीटर (टी 3) संक्रमित पैनिकल्स प्रति वर्ग मीटर के प्रतिशत और संक्रमित स्पाइकलेट / पैनिकल का प्रतिशत उच्च अनाज उपज पर अच्छा प्रभाव देखा गया |
- प्रोड☒ न ओरिएंटेड सर्वे (पीओएस) ने खुलासा किया कि चावल संकर उत्तरी और मध्य राज्यों में एक महत्वपूर्ण क्षेत्र पर क☒ । करते हैं।
- किसानों द्वारा सामना की जाने वाली प्रमुख सम☒ ाओं में कृषि श्रमिकों की कमी, बीज की अनुपलब्धता और समय में इनपुट, कृषि मशीनीकरण बाजार सुविधा और कृषि ☒ ण के लिए उपकरण की कमी पायी गयी |
- छत्तीसगढ़ और पूर्वी उत्तर प्रदेश के कई स्थानों पर गंभीर पत्ता और गर्दन विस्फोट की बीमारी को दर्ज किया गया ।
- छत्तीसगढ़, पंजाब, पूर्वी उत्तर प्रदेश और पश्चिम बंगाल में अधिक शीथ ब्लाइट दर्ज किया गया।
- तेलंगाना में खम्मम, वारंगल और निजामाबाद में कई जगहों पर बैक्टीरियल ब्लाइट की असामान्य उच्च ती☒ता दर्ज की गई।

कीट विज्ञान

- पोषिता संयंत्र प्रतिरोध अध्ययन में १७२८ प्रविष्टियों से जुड़े सात स्क्रीनिंग परीक्षण शामिल हैं जिनमें १३९८ प्री-प्रजनन लाइनें, ११४ संकर, १६ किस्में, ६२ जर्मप्लाज्म एक्सेस और १२४ चेक किस्में शामिल हैं | इन प्रविष्टियों का मूल्यांकन २३६ वैध परीक्षणों में १३ कीटों के खिलाफ किया गया था (५० ग्रीनहाउस प्रतिक्रियाएं + १८६ [ील्ड प्रतिक्रियाएं) | इन परीक्षणों के परिणामों ने विभिन्न कीट कीटों के खिलाफ आशाजनक रूप में ७४ प्रविष्टियों (४.२८%) की पहचान की | इनमें से २२ प्रविष्टियां (२९.७३ %) पुनर्वितरण में थीं।
- सीआर २७११-१४९, धनरासी और केएनएम ११३ को कई कीटों के खिलाफ ६० परीक्षणों के ७-९ परीक्षणों में आशाजनक रूप में देखा गया | एमआरआई ७-३६ से था और पी पी आर १.१७-६.० था | ३ प्रविष्टियों में से, केएनएम ११३ परीक्षण के तीसरे वर्ष में था।
- पोषिता संयंत्र प्रतिरोध अध्ययन से पता चला कि चार प्रविष्टियां - सीआर २७११-१४९, केएयूएम १७९-१, केएयूएम १७९-२ और केएयूएम १८२-१ ने परीक्षण के दूसरे वर्ष के दौरान प्लांटहोपर के खिलाफ लगातार प्रतिरोध प्रतिक्रिया दिखाई। आईसी ५७८१३३ और सीओजीआर २ को प्रतिरोध के लिए आशाजनक पाया गया । तीन प्रविष्टियां जैसे सीआर ३००६-८-५, आरपी १९१८-२२८ (एस) और जेजीएल १९८६१८ को कई कीट प्रतिरोध के लिए आशाजनक पाया गया।
- जीन अंतरों का मूल्यांकन ए☒ी (जीएम ८), आईएनआरसी ३०२१ (जीएम ८) और डब्ल्यू १२६३ (जीएम १) को १० परीक्षणों में से ५-६ में आशाजनक रूप में पहचाना गया। प्लांटहोपर के मामले में, १६ का परीक्षण किया गया, टी १२ (एसीसी ५६९८९), आरपी २०६८-१८-३-५, राथु हेनाती और पीटीबी ३३ नुकसान स्कोर ☒ ५ के साथ आशाजनक देखे गए |
- स्टेम बोरर द्वारा नुकसान को कम करने में वनस्पति विज्ञान-देवदार और नीलगिरी के तेल प्रभावी पाए गए थे। गॉल मिज के मामले में, कपूर तेल ने रजत शूट क्षति को कम करने में प्रभावकारिता दिखायी। पत्ती के [ोल्डर के खिलाफ, नींबू घास के तेल का प्रदर्शन बेहतर था, जबकि देवदार बग गंधी बग द्वारा नुकसान को कम करने में प्रभावी था। नीलगिरी का तेल कट कीड़े के खिलाफ प्रभावी पाया गया था और प्रभावकारिता रयनाक्सीपीर के साथ तुलनीय था
- पारिस्थितिक इंजीनियरिंग के साथ जल प्रबंधन किसान अभ्यास (१५४.३७/पहाड़ी) की तुलना में हॉपर जनसंख्या (७.४५/पहाड़ी) को काफी कम कर सकता है | हस्तक्षेपों ने प्राकृतिक द☒ न आबादी जैसे मिरर, मकड़ियों और कोक्सीनेलिड्स और स्थानों पर अंडे परजीवीकरण में वृद्धि की | किसान अभ्यास (०.६०) की तुलना में पारिस्थितिक इंजीनियरिंग (१.३८) के साथ लाभ लागत भी काफी अधिक थी।
- छह स्थानों पर किए गए प्लांटहोपर प्रबंधन (ईईपीएम) परीक्षण के लिए पारिस्थितिकीय इंजीनियरिंग से संकेत मिलता है कि एक या अधिक हस्तक्षेपों का संयोजन जैसे कि बंड, कार्बनिक खपत, गली, दूरी और जल प्रबंधन पर फूलों के पौधों की बढ़ती वृद्धि ने मकड़ियों और कोक्सीनेलिड्स की आबादी में वृद्धि की साथ ही किसानों के अभ्यास की तुलना में पारिस्थितिक इंजीनियरिंग भूखंडों में अंडे परजीवीकरण देखा गया |
- आईपीएम प्रथाओं को अपनाने के परिणामस्वरूप एफ.पी. भूखंडों की तुलना में आईपीएम भूखंडों में खरपतवार, कीट और बीमारियों की कम घटनाएं हु☒। सभी स्थानों पर दर्ज खरपतवार जनसंख्या और खरपतवार बायोमास किसानों के प्रथाओं की तुलना में आईपीएम लागू भूखंडों में २-५ गुना कम हो गया और इसके परिणामस्वरूप काफी अधिक अनाज पैदावार हुई।

तकनीकी ☒ नांतरण

- चावल प्रौद्योगिकियों का एक कैफेटेरिया ७२३ हेक्टेयर क्षेत्र में प्रदर्शित किया गया था जिसमें २० राज्य और देश के पांच प्रमुख चावल पारिस्थितिक तंत्र शामिल थे। किसानों की क्षेत्र की स्थितियों में उनके प्रदर्शन के आधार पर २० राज्यों में कुल ५० प्रौद्योगिकियों की पहचान की गई है।

अग्रणी अनुसन्धान

फसल सुधार

पादप प्रजनन

- पहली गर्मी सहिष्णु संस्कृति आईईटी २३३५४ (आरपी ५१२५-१२-५-३-बी-आईआर ८४८९८-बी-बी; डीआरआर धान ५२) की पहचान हरियाणा, गुजरात और ओडिशा में ५३ वें एआरजीएम के दौरान हुई | इसमें गर्दन विस्फोट और पत्ती विस्फोट और ६६% की उच्च एचआरआर के साथ वांछनीय खाना पकाने की गुणवत्ता के प्रतिरोध का मध्यम स्तर है।
- आईईटी २६८१५ (आरपी ५१६३-१०२-३-५-२-२) जगितल संनलू/आईसी ३४६२५५ से व्युत्पन्न पश्चिमी क्षेत्र में एवीटी-१ आईएम में पदोन्नत किया गया |
- आईआरई २६८५० (आरपी ५४०५-४३-८-३-१-१) स्वर्णा/ आईआरजीसी ४१०५/ एमटीयू १०८१ से व्युत्पन्न एवीटी १-आईएम को पदोन्नत किया गया |
- एक नवीन जेनेटिक स्टॉक (आईसी ०६१९२२६) एनबीपीजीआर के साथ पंजीकृत था जिसमें वनस्पति और प्रजनन चरणों में दोनों पौधों के प्रतिरोध का प्रतिरोध था |
- नए पौध प्रकार (एनपीटी) के प्रजनन में, स्वर्णा*२/आईआरजीसी ४१०५ से ली गई एक पंक्ति (जेबीबी ६३१-१) को गोल बिधान (२१.९१ µmol प्रति वर्ग मीटर) की तुलना में उच्चतम पत्ती प्रकाश संश्लेषण दर (२३.३५ µmol प्रति वर्ग मीटर सेकंड) के साथ सर्वश्रेष्ठ जीनोटाइप के रूप में पहचाना गया था और पसंदीदा अनाज गुणवत्ता के लक्षणों के साथ देखा गया |
- चावल की जंगली प्रजातियों में जीएन १ जी जीन के कई नए एलीलों की पहचान की गई |
- ओरीज़ा ग्लैबेरिमा के ३१ अभिगमों की दो वर्षों तक जांच की गई, जिसमें पांच लाइनों (ईसी ८६१७८५, ८६१७९०, ८६१७९२, ८६१७८६, ८६१८०७, ८६१८१२ और ८६१८०८) की पहचान की गयी जो कि बीबी (आईएक्स ०२०) के लिए स्थिरता प्रतिरोध दिखा रही है | प्रारंभिक आण्विक अध्ययन से पता चला कि Xa४१ या नवीन जीन के कारण प्रतिरोध की सबसे अधिक संभावना हो सकती है।
- 'एनडीआर ३५९' X हबाताकी [जीएन १ ए + एससीएम २] से जुड़े क्रॉस से कई बैकक्रॉस लाइनों का व्युत्पन्न और मूल्यांकन किया गया था, जिनमें से ९ आशाजनक लाइनें (स्टारफ़्स ४२९, २६१, ४३६, ४३१, २, २९, ४२८, ४३३ और २२६) थे अधिक उपज के लिए साथ पहचाना > ५.0 टन/हेक्टेयर और स्वीकार्य गुणवत्ता मानकों के साथ पाया गया |.
- मनोनीत छह उम्मीदवारों में से, तीन प्रविष्टियां (आईईटी २६९१३, २६९१७ और २६८०३) को एवीटी-१ परीक्षण में पदोन्नत किया गया |
- आईआर १४ एम १२३ (२३.८६ पीपीएम) में उच्चतम जिंक मात्रा देखी गई, इसके बाद आईआर ९५०९७:३-बी-१६-११-४-जीबीएस (२२.६७ पीपीएम) और आईआर १५ एम १२९८ (२२.६३ पीपीएम) देखा गया |
- उच्चतम लौह मात्रा आईआर ९५०९७:३-बी-१६-११-४-जीबीएस (१०.३६पीपीएम), इसके बाद आईआर १५ एम १००३ (९.९ पीपीएम) और आईआर ९५०४०: १२-बी-३-१०-२-जीबीएस (९.६७ पीपीएम) में अधिक लौह की मात्रा देखी गयी |
- आईआर ९५०९७: ३-बी-१६-११-४-जीबीएस में उच्चतम लौह (१०.३६ पीपीएम) की मात्रा और बहुत अधिक जस्ता (२२.६७ पीपीएम) की मात्रा दर्ज की गयी |
- कम'पी' मिट्टी की स्थिति (शून्य 'पी'), एचडब्ल्यूआर २, एचडब्ल्यूआर ७, एचडब्ल्यूआर ८ और एचडब्लूआर १ के तहत मूल्यांकन की गई नौवीं प्रविष्टियों में से कम पी मिट्टी की स्थिति के तहत अच्छा पाया गया।
- के-४६-१ मार्कर पप १ क्यू टी एल से जुड़ा हुआ) के साथ लैंड्रेस रत्न चुडी के आणविक चरित्र से पता चला कि इसमें कम पी सहिष्णुता के लिए उपन्यास जीन हो सकता है क्योंकि इसमें पिल्ला १ क्यूटीएल नहीं है।

संकर धान

- २०१७ के दौरान आईएचआरटी परीक्षणों में तीन आशाजनक संकर नामित किए गए थे | स्टेशन परीक्षण में मूल्यांकन किए गए 38 संकरों में से सात वादा संयोजन जैसे आईआर ७९५६ ए/टीसीपी - १६६९; आईआर ७९१५६ ए/पीआरपी ११९; एपीएमएस ६ ए / टीसीपी १३९४; एपीएमएस ६ ए/५०-१०; सीआरएमएस ३२ ए/टीसीपी १३९४; सीआरएमएस ३२ ए/५०-१०; और आईआर ६८८९७ ए/पीआरपी ११९ की पहचान की गई |
- दो नए हाइब्रिड संयोजन जैसे एपीएमएस ६ ए / एसएल- १२-१२ आर और एपीएमएस ६ ए / एआर ९-१८ आर की पहचान एआईसीआरआईपी २०१८ के एएल और आईएसटीवीटी और एरोबिक ट्रेल्स में की गई।
- तीन एरोबिक इनब्रेड्स जैसे आईईटी २६१६८, २६१७१, २६१९४ पैरेंटल लाइन सुधार कार्यक्रम के माध्यम से विकसित किए गए थे और एवीटी-२ एरोबिक परीक्षण में थे |

- नए विकसित छ चावल संकर जैसे एपीएमएस ६ ए X पीआरपी ७३, आईआर ७९६ ए X पीआरपी ७८, एपीएमएस ६ ए X पीआरपी १२३, एपीएमएस ६ ए X एसआरआई, सीआरएमएस ३२ ए X पीआरपी ७४ और सीआरएमएस ३२ ए X पीआरपी १०९ के लिए संकर बीज उत्पादन शुरू किया गया था |
- आईआर ५८०२५ बी और आईजी ७९१५६ के 35 बेहतर संस्करणों को आशाजनक पाया गया और इन लाइनों को लिए ट । एक्सप्रेशन गुण के लिए पहचान की गई और सीएमएस लाइन में परिवर्तित होने के लिए उपयोग किया गया, जो बीसी 1 पीढ़ी में हैं |

जल प्र ो ाकी

- जीन कंस्ट्रक्ट पीएसक्यू ५ के साथ विकसित बीपीटी ५२०४ की सक्रिय चावल लाइनों ने सक्रिय जल उपयोग दक्षता के साथ तनाव की स्थिति के तहत बेहतर सहनशीलता देखी गयी |
- माध्यमिक शाखाओं (~१५०) पर बड़ी संख्या में अनाज के साथ गणजीकल्ली/ कलानामाक से व्युत्पन्न नौ पुन संयोजक रेखाएं (आरआईएल) की पहचान की गई |
- ट्रांसक्रि ान कारकों, ट्रांसपोर्टरों और रूट लक्षणों से संबंधित जीन की उच्च संख्या बीआरटी ५२०४ की तुलना में सीआर धान २०२ के शूट ऊतक की तुलना में जड़ों में अत्यधिक व्यक्त की गई थी, जो सीआर धान २०२ में एरोबिक अनुकूलन तंत्र है।
- २४ ईएसटी-एसएसआर, ४२ हाइपर-वेरिएबल जीनोमिक एसएसआर और २० (जीएटीए) एन लोकस विशिष्ट एसएसआर मार्करों सहित एक मार्कर सेट (एन ८०) की पहचान की गयी जिसमें >७०% की सीमा तक हीटरोसिस की भवि वाणी करने के लिए की गई थी।
- जंगली गर्भपात साइटोप्ला िक मेल स्टेराइल लाइन (डब्ल्यूए-सीएमएस; आईआर ५८०२५ ए) और रखरखाव (आईआर ५८०२५ बी) के प्री-एंथेसिस चरण (स्पोरोफिटिक चरण) में एकत्र किए गए पैनिकल्स की ट्रांसक्रि ोम प्रोफाइल पराग गर्भपात और पुरुष स्टेरिलिटी में शामिल संभावित उम्मीदवारों से पता चला।
- ९२ रेस्टोरर लाइनों (आरएफ ३ और आरएफ ४ रखने) और २१ संभावित मेंटेनर लाइनों (आरएफ ३ और आरएफ ४ के संबंध में पुनर्स्थापक एलीलों से रहित) का एक नया सेट २२० जर्मप्लास्म लाइनों की जांच से पहचाना गया था |
- सांबा महसूरी के तीन ईएमएस उत्परिवर्ती शीथ ब्लाइट को सहिष्णुता के चरम स्तर और पीले स्टेम बोरर (वाईएसबी) को सहिष्णुता रखने वाले दो उत्परिवर्तकों की पहचान और विशेषता की गयी।
- प्रारंभिक परिपक्व ईएमएस उत्परिवर्ती (आईआईआरआर ९३ आर), सांबा महसूरी जैसे समान खाना पकाने के गुणवत्ता वाले पालों को महत्वपूर्ण उपज लाभ और वाईएसबी, ब्राउन प्लांट हॉपर (बीपीएच) के प्रति सहिष्णुता के साथ पहचाना गया था। प्रवेश एआईसीआरपी में परीक्षण के तीसरे चरण में है |
- जैव परख अध्ययनों से संकेत मिलता है कि ताइपे ३०९-पीजी-पीजीए ३६२६ आरएनएआई की दो ट्रांसजेनिक लाइनें आरटीडी के लिए अत्यधिक सहनशील थीं (स्कोर ३).

फसल ादन

सस्य विज्ञान

- चावल सगनहीकरण प्रणाली (एसआरआई) विधि मशीनीकृत एसआरआई से बेहतर पाया गया | संतृप्ति विधि और ३ डीएडी-पीडब्ल्यू सिंचाई करने से ५ डीएडीपीडब्ल्यू पर सिंचाई पर काफी अधिक पानी उत्पादकता दर्ज की गई | एनटीपी की तुलना में एमएसआरआई में औसत ग्लोबल वार्मिंग संभावित मूल्य काफी कम थे |
- खेती की एरोबिक प्रणाली में, धान की स्ट्रॉ म िंग, हरी पत्ती की नकली और पोटेशियम डाइहाइड्रोजन ऑर्थोफॉस्फेट के साथ बीज प्राइमिंग ने बीजिंग शक्ति सूचकांक में सुधार करने में बेहतर प्रदर्शन दिखाया है जिसके परिणामस्वरूप खरपतवार बायोमास कम हो गया है जिसके परिणामस्वरूप उच्च उपज गुण और अनाज उपज प्राप्त हुआ |
- ३० जून तक चावल के मैनुअल प्रत्यारोपण के बाद रबी में पारंपरिक टिल म । के परिणामस्वरूप काफी अधिक सिस्टम उत्पादकता हुई।
- एकीकृत पोषक प्रबंधन + ३०% चावल अवशेष प्रतिधारण उच्च पैनिकल्स प्रति वर्ग मीटर, पैनिक वजन, परीक्षण वजन दर्ज किया गया जिससे अनाज उपज (४.७४ टन/ हेक्टेयर) और आरपीबीओ २२६ की पैदावार हुई |

मृदा विज्ञान

- अनाज उपज प्रदर्शन और कई एनयूई सूचकांक संकेत देते हैं कि केआरएच २, वरदान, पीयूपी २२१ और पीयूपी २२३ दोनों मिट्टी एन उपयोग और प्रतिक्रिया के लिए सबसे अधिक आशाजनक पाए गए थे| एन के विभिन्न ोतों के साथ एन के वर्गीकृत स्तर पर, अनाज उपज १०० किलो नत्रजन/ हेक्टेयर के साथ अधिकतम था और एन ोतों में, बहुलक लेपित यूरिया (पीसीयू) और नीम लेपित यूरिया (एनसीयू) अन्य सभी ोतों से काफी बेहतर थे | अनाज उपज प्रदर्शन के आधार पर बहु स्थान परीक्षण में, प्रत्येक केंद्र में शीर्ष ५ जीनोटाइप की पहचान की गई | विविधता, एमजीडी-१६०५ को नंबर १ में स्थान दिया जा सकता है क्योंकि यह सभी स्थानों की शीर्ष ५ सूची पर क । कर लिया गया है, इसके बाद एमओ २२- श्रेयस और आरएनयूई-१०३ स्थानों पर हैं, इसके बाद २ स्थानों पर जीवी-एनयूई-१ पायी गयी |

- रोपण विधियों ने फसल की वृद्धि अवधि में मीथेन और नाइट्रस ऑक्साइड गैसों के उत्सर्जन दोनों को काफी प्रभावित किया। मीथेन के लिए मौसमी एकीकृत प्रवाह परंपरागत प्रत्यारोपित (टीपीआर) विधि (२५.६१ किलोग्राम/हेक्टेयर), एसआरआई (१२.७३ किलो ग्राम/हेक्टेयर), एडब्ल्यूडी ५ सेमी (१०.५२ किलो ग्राम/हेक्टेयर) और एडब्ल्यूडी पर १० सेमी पर ८.१२ किलो ग्राम प्रति हेक्टेयर प्राप्त हुआ | एसआरआई में मीथेन उत्सर्जन ५०% से अधिक और एडब्ल्यूडी में ५९ और ६८% की गिरावट के साथ ५ और १० सेमी पर टीपीआर की तुलना में हुई | प्रत्यारोपित चावल में सबसे कम नाइट्रस नाइट्रोजन का उत्सर्जन देखा गया (०.६२३ किलोग्राम प्रति हेक्टेयर) | एसआरआई (०.८२९ किलो हेक्टेयर) और एडब्ल्यूडी विधियों (०.८९२ और १.०२४ किलोग्राम प्रति हेक्टेयर) की तुलना में नाइट्रस नाइट्रोजन का मौसमी एकीकृत प्रवाह टीपीआर (०.६२३ किलोग्राम प्रति हेक्टेयर) में कम था | एसआरआई में नाइट्रस नाइट्रोजन का उत्सर्जन ३३ प्रतिशत और टीपीआर पर एडब्ल्यूडी विधियों में ४३-६४% अधिक था | परंपरागत टीपीआर विधि की तुलना में एसआरआई और एडब्ल्यू-डी तरीकों ने ग्लोबल वार्मिंग क्षमता (जीडब्ल्यूपी) को कम मीथेन उत्सर्जन के कारण कम कर दिया।
- कुछ भूगर्भीय उपकरणों का उपयोग करके मृदा स्वास्थ्य कार्ड में दी गई जानकारी का उपयोग करके विभिन्न मिट्टी थीम मानचित्रों का परीक्षण किया गया और पाया गया कि इनवर्टेड दूरी भार (आई-डीडब्ल्यू) और सामान्य क्रिगिंग (ठीक) का संयोजन अलग-अलग मिट्टी विषयों के इंटरपोलेशन के लिए अच्छा था | मिट्टी स्वास्थ्य कार्ड में दिए गए भू-निर्देशांक के संदर्भ में गूगल धरती डेटा की सफाई में अत्यधिक मदद की थी। इसी तरह, सैटेलाइट डेटा के टाइम सीरीज़ विश्लेषण के लिए एक और स्वतंत्र रूप से उपलब्ध सॉफ्टवेयर, टाइम्ससेट को वनस्पति के विभिन्न फिनोलॉजी मेट्रिक्स प्राप्त करने के लिए खोजा गया था और परिणाम उत्साहजनक थे.
- एंडोफेटिक *ग्लुकोनैसेटोबैक्टर डाइज़ोट्रोफिकस* और *राइज़ोस्फेरिक बेसिलस सबटिलिस* के संयुक्त इनोक्यूलेशन ने पौधों में कुल घु-लनशील चीनी सामग्री और एंटीऑक्सीडेंट गतिविधि में वृद्धि की है जबकि साथ ही पानी की तनाव की स्थिति में चावल के पौधे के विकास में सुधार के लिए मिट्टी कार्बोहाइड्रेट सामग्री को बढ़ाया है।खरीफ २०१७ के दौरान आईआईआरआर अनुसंधान खेत में आयोजित एक क्षेत्र प्रयोग में तीन चावल प्रतिष्ठान विधियों जैसे एरोबिक चावल, वैकल्पिक गीले और सुखाने और चावल बाढ़ के साथ, एरोबिक चावल प्रणाली में सबसे ज्यादा सूक्ष्म जीवाणु दर्ज किए गए और यह नाइट्रोजन फिक्सिंग की उच्चतम आबादी का समर्थन करता है जीवाणु (१९७ x १०६ सीएफयू / मिट्टी का ग्राम). पृथक की डाइनिट्रोजेनेस एंजाइम गतिविधि (१४६६-६९८ एनएमओएस सी २ एच ४ प्रोटीन के एचआर-१ एमजी-१ उत्पादित) से हुई थी और इन तीन चावल प्रतिष्ठान विधियों से १५ संभावित फास्फोरस घुलनशीलता सूक्ष्मजीवों की पहचान की गई |
- जेएनओ नैनो कणों की विशेषता विभिन्न तरीकों से की जाती है जैसे एक्सआरडी, एसईएम, टीईएम, एफटीआईआर और ईडीएक्स | आगे वर्णित जेएनओ नैनो कणों का प्रयोग बीज अंकुरण, बीजिंग शक्ति और चावल की फसल के बीजिंग विकास (एमटीयू १००१) पर इसके प्रभाव के मूल्यांकन के लिए किया गया था।
- हाइड्रोजेल को इसके पानी और पोषक तत्वों की होल्डिंग क्षमता के लिए चिह्नित किया गया | हाइड्रोजेल की जल अवशोषण क्षमता आसुत पानी के साथ खनिज पानी और नल के पानी के साथ अधिक थी | पॉट संस्कृति प्रयोग हाइड्रो जेल की विभिन्न खुराक के साथ आयोजित किया गया था और हाइड्रोगेल आवेदन @०.२ ग्राम/किग्रा मिट्टी अन्य उपचारों की तुलना में पानी की उपयोग दक्षता के लिए बेहतर पाया गया था।

पादप कार्यिकी

- पत्ती प्रकाश संश्लेषण दक्षता में जीनोटाइपिक परिवर्तनशीलता का मूल्यांकन और चावल में इसके संबंधित कारकों ने पैरेंटल लाइन की तुलना में उच्च पैनिकल संख्या के साथ स्वर्ण एक्स ओनिवरा (आईएलएस) की १० अंतर्निहित रेखाएं प्रकट की | आईएल २३० एस ने आईएलएस की तुलना में प्रति पौधों की पैदावार में वृद्धि के साथ उच्चतम पीएन दिखाया।
- आइडोटाइप प्रजनन में, सिंचाई वाले पारिस्थितिक तंत्र के लिए उपयुक्त एनपीटी मॉडल का प्रस्ताव देने के लिए विभिन्न दाताओं की पहचान की गई। उष्णकटिबंधीय जैपोनिकास (टीजेपी २७ , टीजेपी १५७ , टीजेपी १३९ और टीजेपी १९७) और हाइब्रिड (केआरएच २ , पीएचबी ७१ और पीए ६४४४) से सामग्री उच्च प्रकाश संश्लेषण के लिए अच्छे दाताओं के रूप में उपयोग की जा सकती है | उच्च पैदावार वाली किस्मों में, जया, स्वर्ण और संपदा का उपयोग माता-पिता के रूप में उच्च उपज और बायोमास के लिए किया जा सकता है।

फसल सुरक्षा

कीट विज्ञान

- २२९५ प्रविष्टियों में बीपीएच प्रतिरोध के लिए मूल्यांकन किया गया, १७ प्रविष्टियां जैसे स्वर्णा / सिन्नासिवु आरआईएलएस-३००, २५४, ६४ और २९७; स्वर्णा / ओरीज़ा निवरा इंट्रेग्रेशन लाइन एनपीएस ५५, एनपीएस ६०, एनपीएस ६७; एजीबीडी २०१७ जर्मप्लाज्म लाइन-१९८, १०६, ५६३, ३०३, ४१२ और ४४१; आरपी २०६८-१८-३-५, सीआर २७११-१४९, आईईटी

२६५१० और आईईटी २६४८९, ब्राउन प्लांटहोपर के लिए ० से १ के नुकसान स्कोर के साथ अत्यधिक प्रतिरोधी थे।

- क्षेत्र स्क्रीनिंग विधि का उपयोग करते हुए चावल के पत्ते के [ोल्डर के प्रतिरोध के लिए उ ृ ष्ट आईआरआरआई (एचडब्लूआर लाइन) से उष्णकटिबंधीय जैपोनिकास (जेबीबी लाइन) और २९ जंगली चावल लाइनों से प्राप्त ५३ कुलीन उच्च उपज इंट्रेस न लाइनों का मूल्यांकन किया गया | ८२ लाइनों में से १२ लाइनों को चावल के पत्ते के [ोल्डर के लिए प्रतिरोधी के रूप में पहचाना गया था।
- स्टेशन परीक्षणों में स्टेम बोरर क्षति से बचने के लिए के लिए आशा-जनक रूप में पहचाने गए आरपी ५५८७ (आईईटी २५१०९) का उपज परीक्षण के लिए नामित किया गया है।
- चावल कीटों के प्रयोगों के जैविक नियंत्रण से पता चला है कि बंडों पर फूलों को लंबी उ और हॉपर अंडे पैरासिटोइड की फैकंडिटी में वृद्धि हुई थी, जैसे अपेंटेलस एसपी, गोनाटोसेरस एसपी, माईमार टैप्रोबैनिकम, अनाग्रस एसपी, टेट्रा टचस स्किनोबि और ब्रेकन प्रजाति ।
- चावल की प्रमुख कीट कीटों के खिलाफ दस आव क तेलों के फील्ड मूल्यांकन से पता चला कि नीलगिरी का तेल तना छेदक के खिलाफ सबसे प्रभावी था। ८.७४% डेड हार्ट के नुकसान के बाद ओरे ी, पा रोसा और रोसमेरी तेलों में १०.३४-१०.८१% दर्ज की गई, जबकि १२.४० % की तुलना में नियंत्रण मिला |
- जैव गहन आईपीएम प्रौद्योगिकियों का आकलन, पीले मैरीगोल्ड के साथ पारिस्थितिकीय इंजीनियरिंग, टैगेटस इरेटा को बंड फसल के रूप में और नए पर्यावरण के अनुकूल कीटनाशक अणु के एकल अनुप्रयोग, अनुसंधान खेत और किसान के खेतों में पायराक्स ने खुलासा किया कि उच्चतम फायदेमंद कीट जैव विविधता के साथ इलाज किए गए ब्लॉक में देखा गया था |
- चावल रूट-गाँठ नेमाटोड के प्रतिरोध के लिए जीवाणुरोधी अभिगम, भूमि दौड़ और बेहतर किस्मों सहित ९० चावल जी-नोटाइप की स्क्रीनिंग ने बताया कि दो जीनोटाइप (एलडी 24 और खाओ पहक मा) ने अत्यधिक प्रतिरोधी प्रतिक्रिया दिखाई दी जबकि ११ जीनोटाइप ने नेमाटोड को प्रतिरोधी प्रतिक्रिया दिखाई परीक्षण के दूसरे वर्ष में |

पादप रोग

- आईईटी २५४८४ (आरपी ५९४० पैथो - ७-५-९) मार्कर सम ित बैकक्रॉस प्रजनन (एमएबीबी) द्वारा विकसित किया गया जिसमें पीआई 2 (विस्फोट के खिलाफ) शामिल है, में आवर्ती माता-पिता स्वर्ण के साथ ९५.६% जीनोम समानता है, लेकिन विस्फोट के प्रतिरोधी है और यह १३५-१४० दिन (आवर्ती माता-पिता से 5 दिन पहले)।
- आईईटी २५४८३ (आरपी ५९६१ बायो पाथो २ -१८-५) बीएलबी के खिलाफ एक जीन (एक्सए२१) के साथ बेहतर सांबा महसूरी * २/टेटेप के पार से विकसित हुआ और विस्फोट प्रतिरोध के लिए एक जीन (पिख) ने बीएलबी और विस्फोट दोनों के लिए मध्यम प्रतिरोध दिखाया बेहतर उपज दिया ।
- नया कवकनाश अणु ट्राईसी जॅाल २० % + टेबुकोनाज़ोल १६ % (३६ % एससी) @ २.२५ मिली / लीटर और बीएएस ७५० ०२ एफ ४०० जी/ लीटर एससी (मे[नट्राई ुकोनाज़ोल ४०० जी/लीटर एससी) 0.७ मिली / एल हेक्साकोनाज़ोल ५ % एससी के बराबर था |
- ४२ , २४ और २० लाइनों के जीएसएन ने आरटीडी के खिलाफ क्रमश प्रतिरोधी, मामूली प्रतिरोध और संवेदनशील प्रतिक्रिया दिखाई। खरपतवार, इचिनो ोआ कॉलोनम और पैनिकम रिपेंस ४२ दिनों के लिए आरटीडी वायरस ले जाने के लिए पाए गए थे।
- आईआईआरआर, हैदराबाद से ट्रायकोडर्मा एस्पेरेलम आईआई-आरआरके १, शीथ ब्लाइट और विस्फोट के खिलाफ सबसे प्रभावी साबित हुआ |
- सांबा महसूरी और एपीएमएस ६ बी की पृष्ठभूमि में एक्सए २१ और एक्स ए ३८ की पिरामिडिंग मार्कर सहायता चयन के माध्यम से की जा रही है और प्रजनन रेखाएं बीसी४ एफ३ (सांबा महसूरी) और बीसी४ एफ५ (एपीएमएस ६ बी) में हैं।
- सत्तर एक Xoo पृथकों को उनके रोगजनक और अनुवांशिक विविधता के लिए विशेषता थी। Xoo की प्रतिक्रिया के आधार पर चावल के अंतर पर पृथक होता है, इन पृथक को १० पथदर्शी में बांटा गया था। पथोटाइप, XoIt-१ और XoIt-२ कम से कम विषाक्त थे और XoIt १८-२२ अत्यधिक विषाक्त थे। पथोटाइप XoIt-१९ जो xa१३ को छोड़कर सभी एकल बीबी प्रतिरोध जीन पर विषाक्त था, प्रमुख पथप्रवाह (२२.५% पृथक) गठित किया गया था और इसे भारत में व्यापक रूप से वितरित किया गया था।

तकनीकी ानांतरण

- आईसीटी अनुप्रयोगों के माध्यम से चावल टे ोलॉजीज के प्रभाव को अधिकतम करने के लिए, उत्पादकता और लाभप्रदता पर प्रभाव डालने के लिए स्थापित किया गया है, उत्पादन/ संरक्षण, बाजार और क्रेडिट/वित्त (बीमा सहित) को बढ़ाने के लिए अधिक डेटा-संचालित सेवाओं और उत्पादों को प्रदान करने की आव - कता है। ।

- तेलंगाना के याददाड़ी और नलगोंडा जिलों में चयनित जलवायु-लचीला चावल उत्पादन प्रौद्योगिकियों का प्रसार करने के लिए अनुभवी, सुदृढीकरण और एकीकृत विस्तार विधियों का एक संयोजन नियोजित किया गया था।. अनुभवात्मक तरीकों (विधि प्रदर्शन, प्रशिक्षण) ने किसानों को सीधे बोए गए चावल के लिए ड्रम सीडर के उपयोग में कौशल हासिल करने और जल प्रबंधन के लिए पानी पाइप के उपयोग करने में सक्षम बनाया।

  विभिन्न केस स्टडीज और सफलता की कहानियों के आधार पर विभिन्न समूह आधारित विस्तार दृष्टिकोणों में से, किसान उत्पादक संगठन (एफपीओ) को इसकी बढ़ती संख्या और किसानों के शामिल चावल प्रौद्योगिकी हस्तांतरण में तेजी लाने के लिए महत्वपूर्ण दृष्टिकोणों में से एक के रूप में पहचाना गया ।

- चावल के किसानों द्वारा चावल की खेती से संबंधित जलवायु परिवर्तन को कम करने के लिए अनुकूलन उपायों की शुरुआत शुरुआती परिपक्व किस्मों (७८%), प्रारंभिक रोपण (६५%), सीधी बुवाई (७३%), कुओं के उपयोग और सिंचाई के लिए पंपों की खेती थी (६६ %), खेती कम खेत क्षेत्र (५१%), वैकल्पिक फसल की खेती (४९%), कृषि बीमा (१८%) और रुकाई खेती (११%)।

- मशीनीकरण के लिए किसानों की प्राथमिकता को प्रभावित करने वाले कारक श्रम की अनुपलब्धता, कृषि संचालन में समयबद्धता, कटाई में कमी और थ्रेसिंग और कम समय में गारेट के ७०, ६५, ५९ और ५७ के स्कोर के साथ काम की उपलब्धि. चावल की खेती में मशीनीकरण को प्राथमिकता देने के अन्य कारणों से कम मानव और पशु श्रम, अच्छी गुणवत्ता का काम, महंगा इनपुट का कुशल उपयोग और कुशल श्रमिकों की अनुपलब्धता अन्य कारण थे।

- पीपीवीएफआरए डेटा विश्लेषण ने चावल संकर में निजी क्षेत्र के निरंतर प्रभुत्व का खुलासा किया। सामान्य रूप से पौधों की किस्मों के लिए आईपीआर सुरक्षा में उभरते मुद्दों और चुनौतियों में विशेष रूप से चावल की किस्मों में ओवरलैपिंग आईपीआर, बीज उद्योग में एकाग्रता, जटिल आईपीआर और अन्य नियामक वेब और किसानों की भेद्यता शामिल है |

All India Coordinated Rice Improvement Programme (AICRIP)

A total of 92 varieties including 20 Hybrids (Central-33; State-59) for different ecologies have been released by both central and state varietal release committees during 2017-18. Among these, 9 varieties for Assam, 7 for Odisha, 5 each for Madhya Pradesh and Gujarat, 4 each for Uttar Pradesh, West Bengal and Bihar, 3 each for Andhra Pradesh, Maharashtra, Punjab and Tamil Nadu, 2 each for Chhattisgarh, Uttarakhand, Karnataka and Andaman & Nicobar islands while 1 for Manipur were released.

Crop Improvement

- During the year 2017, which is the 53rd year of AICRIP testing, 48 varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted as 813 experiments at 123 locations (45 funded, 78 voluntary centres) across 25 states and 2 union territories in all the 7 zones of the country.
- Two Hundred and fifty three entries were identified as promising for different states and ecologies.
- A totally 95 hybrids were evaluated in four hybrid rice trials viz., IHRT-E, IHRT-ME, IHRT-M, IHRT-MS, in 27-33 different locations representing different agro-climatic regions of the country. 11 hybrids were found to be promising.
- The Varietal Identification Committee identified 5 hybrids and 18 varietal entries for release in different states.
- Of the 390 entries evaluated in INGER observation nurseries at 45 locations, 32 were found to be promising based on phenotypic acceptability and yield.
- Breeder seed production of rice varieties and parental lines of hybrids as per DAC indents was organized at 38 centers across the country, involving 268 varieties and parental lines of eight hybrids. A total production of 7571 quintals of breeder seed was achieved against the target of 4264 quintals. At IIRR centre, 22 varieties were included in breeder seed production with a total production of 163 quintals.

Crop Production

Agronomy

- A total of 70 cultivars belonging to 8 categories were evaluated for hills. In early group, Shalimar Rice -3 and Vivekdhan-86; in the medium group, VL Dhan 65, Vivekdhan 62 and HPR 2143 were identified as promising entries.
- Under Integrated Management Trial, the promising cultivars identified were: early irrigated (IET-24797, Gontra Vidhan-3 and IR-64), medium (IR-64, Karjat-7, MTU-1010, Sarjoo-52, NDR-2064, HKR-127, 128, PR 113, Pant Dhan 19, 22, 24, Mahamaya, Numali and Jaya) and late (Swarna, Samba Mahsuri and Pushvami). Under scented category, Pusa 1509, NDR 6093, Pusa 2511, Numali, Pusa 1121, Pant Sugandha 25, 27 and CG Sugandhit Bhog were found to be promising. The promising hybrids identified were HRI-174, Az8433, Arize 6444. Under AL & ISTVT, SR 26B, Jaya and CSR 23.
- At most of the locations, integrated agronomic management practice of higher NPK dose (150% RFD) followed by 50% RFD + 5 t/ha FYM was found to be promising and exhibited higher nutrient use efficiency.
- Saturation maintenance up to PI and (3+/-2 cm) after panicle initiation treated plots resulted in highest grain yield (5.28 t/ha) followed by alternate wetting and drying (5.11 t/ha). Mechanical transplanting recorded the highest grain yield (6.02 t/ha) over manual transplanting (5.87 t/ha).
- Irrespective of the method of crop establishment, by mechanical weeding thrice at 10 days interval using weeder increased grain yields (67%). Under puddled DSR,

maintaining weed free period upto 30 DAS, the varieties DRR Dhan 46, DRR Dhan 44, DRR Dhan 42, Swarna and Shreya were found promising. Under aerobic system of cultivation, maintaining weed free period upto 60 DAS, the varieties DRR Dhan 42, DRR Dhan 44, DRR Dhan 46 and Sahbaghidhan, exhibited better weed competitive ability.

Soil Science

- In the 29th year of study on long term soil fertility management in rice based cropping systems (RBCS), the treatments RDF+5t FYM/ha and RDF were at par and significantly superior to other treatments in both seasons at Maruteru and in *rabi* at Titabar. FYM alone treatment was on par to RDF in *rabi* and significantly superior to RDF in *kharif* at Titabar.
- Yield gap analysis in farmers' fields indicated very high yield gap 1 and 2 at Titabar to the tune of 50%. At Faizabad, yield Gap 1 was to the tune of 20% which was almost manageable, whereas, at Chinsurah it was minimum since the targeted yields fixed were comparatively low. At Maruteru, with narrow gap, yields obtained at farmers' fields almost matched the research station yields.
- Screening of genotypes for native sodic conditions the genotypes viz., DRR Dhan 46, DRR Dhan 42, DRR Dhan 45, DRR Dhan 43, DRR Dhan 44 and DRR Dhan 40 at Kanpur and IR 30864, DRR Dhan 41, CSR 23, DRR Dhan 43, and DRR Dhan 40 at Mandya recorded highest yields when supplemented with 100% GR and also under native sodic conditions without gypsum application. While at Faizabad, the genotypes NDRK 500051, IRSSTN 30, IRSSTN 110, Jaya and NDRK 50063 recorded highest yields without gypsum amendment.
- The nutrient management practice of 150% RDF +Zn with N in 3 splits either as 1/2 + 1/4 + 1/4 or 1/3+1/3+1/3 performed better over others in terms of nutrient uptake and rice productivity.
- The genotypes HRI 197, Uma, 27 P63 and DRR Dhan 42 were responsive to liming and Uma, KAU 109 and DRR Dhan 42 were efficient under native soil acidity at Moncompu. Whereas, HRI 196, 27 P64, 27 P63 at Ranchi; Gitesh, Prafulla, and Aghonibora at Titabar and Indira Maheswari and RP5974-3-2-8-38-12 at Raipur performed well with liming as well as without liming under acid soil conditions.
- The supremacy of transplanted rice over DSR and aerobic rice was reported by 14-22% and 13-19% at Kanpur, Puducherry respectively while production systems at Moncompu indicated superior performance of DSR over transplanted and aerobic rice by 14%.
- Site Specific Nutrient Management (SSNM) based on Nutrient Expert recorded higher grain yields in most of the locations ranging from 3549 to 7601 kg/ha and recording 8-25 % increase over RDF.
- Third year of study on "Bio-intensive pest management (BIPM)" indicated the superiority of BIPM over Farmers' practice (FP) at five (Chinsurah, IIRR, Karjat, Jagdalpur and Titabar) out of ten locations that recorded significantly higher grain yield by 22-44%.

Plant Physiology

- Silixol had positive role with reference to enhanced total dry matter, grain yield/ m2 and Harvest index. Among the tested varieties, PHB-71 and IR64 responded well to silixol application with reference to total dry matter, whereas grain yield response and harvest index were more in KRH-4.
- Under elevated temperature regime, the mean grain yield for all entries and locations was reduced by > 60%. Among the better yielding genotypes under heat stress conditions, IET 26778 and IET 26763 maintained good harvest index (<10% reduction) under heat stress.

- Three cultures (MAS 306, MAS 314, MAS 317) were identified based on their performance in terms of germination, shoot, root growth and seedling vigour under for multiple abiotic stress tolerance.
- Low light stress resulted in significant loss in yield and its components. Among the tested varieties, IET 25206, IET 25814, IET 23356 and IET 25876 showed lesser reduction in grain yield.

Crop Protection

Entomology

- Host plant resistance studies comprised of seven screening trials involving 1728 entries consisting of 1398 pre-breeding lines, 114 hybrids,16 cultivars, 62 germplasm accessions and 124 check varieties. These entries were evaluated against 13 insect pests in 236 valid tests (50 greenhouse reactions+186 field reactions). The results of these tests identified 74 entries (4.28%) as promising against various insect pests. Of these, 22 entries (29.73%) were under retesting.
- CR 2711-149, Dhanrasi and KNM 113 as promising in 7-9 tests of the 60 tests against multiple pests. The MRI varied from 7-36 with a PPR of 1.17-6.0. Of the 3 entries, KNM 113 was in the third year of testing.
- Host plant resistance studies revealed that four entries - CR 2711-149, KAUM 179-1, KAUM 179-2 and KAUM 182-1 showed consistent resistance reaction against planthoppers during second year of testing. IC 578133 and COGR 2 were found promising for gall midge resistance. Three entries *viz*., CR 3006-8-5, RP 4918-228(S) and JGL 19618 were found promising for multiple pest resistance**.**
- Evaluation of the gene differentials identified Aganni (Gm8), INRC 3021(Gm8) and W1263 (Gm1) as promising in 5-6 of the 10 tests. In case of planthoppers, among the 16 differentials tested , T 12 (ACC 56989), RP 2068-18-3-5, Rathu Heenati and PTB 33 were promising with a damage score ≤5.
- The botanicals-cedarwood and eucalyptus oils were found effective in reducing damage by stem borer. In case of gall midge, camphor oil showed efficacy in reducing silver shoot damage. Against leaf folder, performance of lemon grass oil was superior, while cedarwood oil was effective in reducing the damage by gundhi bug. Eucalyptus oil was found effective against cut worm and the efficacy was comparable with rynaxypyr.
- Water management along with ecological engineering can significantly reduce hopper population (7.45/hill) when compared to farmers practice(154.37/ hill). The interventions increased the natural enemy populations like mirids, spiders and coccinellids and increased egg parasitisation across the locations. The benefit cost was also significantly higher with ecological engineering (1.38) when compared to Farmers practice (0.60).
- Ecological engineering for planthopper management (EEPM) trial carried out at six locations indicated that a combination of one or more interventions such as growing of flowering plants on bunds, organic manuring, alleyways, spacing and water management increased the populations of mirids, spiders and coccinellids as well as egg parasitisation of hoppers in EE plots as compared to farmers practice.
- Adoption of IPM practices resulted in low incidence of weeds, insect pests and diseases in IPM plots compared to FP plots. Weed population and weed biomass recorded at all the locations were considerably reduced by 2-5 times in IPM implemented plots compared to farmers practices and resulted in significantly higher grain yields.

Plant Pathology

- Field monitoring of virulence indicated the existence different groups of races of *Pyricularia oryzae* and *Xanthomonas oryzae* pv. *oryzae* indicated that single bacterial blight resistance genes were susceptible at most of the locations.
- Early sowing of the crop favoured *Rhizoctonia solani* and BLB and in late sown crop, sheath rot and brown spot diseases were more prevalent. In the Southern region, late sowing by about 15 days helped in the escape of disease.
- Combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) found effective against leaf blast, sheath blight and sheath rot and also increasing the yield of the crop.
- IDM studies revealed that seed treatment followed by clean bunds, optimum dose of fertilizer application in split doses with organic manures, followed by application of *Trichoderma* and need based application of fungicides reduced disease incidence in rice.
- Fungicides azoxystrobin 18.2% + difenoconazole 11.4% w/w SC @ 1.0 ml/l (T3) reduced both percentage of infected panicles/m2 and percentage of infected spikelet/panicle in addition to higher grain yield.
- Production Oriented Survey (POS) revealed that rice hybrids occupy a significant area in North and Central states.
- Major problems faced by the farmers were shortage of agricultural labours, non-availability of seeds and inputs in time, implements for farm mechanization market facility and farm loan.
- Severe leaf and neck blast was recorded in many places in Chattishgarh and Eastern Uttar Pradesh.
- Sheath blight was recorded more in Chattishgarh, Punjab, Eastern Uttar Pradesh and West Bengal.
- Unusual high intensity of bacterial blight was recorded in several places in Khammam, Warangal and Nizamabad in Telangana.

Transfer of Technology

- A cafeteria of rice technologies were demonstrated in 723 hectare area covering 20 states and five major rice ecosystems of the country. In total 50 technologies have been identified from 20 states based on their performance in farmers field conditions.

Lead Research

Crop Improvement

Plant Breeding

- The first heat tolerant culture IET 23354 (RP5125-12-5-3-B-IR84898-B-B; DRR Dhan 52) was identified for release in Haryana, Gujarat and Odisha during 53rd ARGM. It has moderate level of resistance to neck blast and leaf blast and desirable cooking quality with high HRR of 66%.
- IET 26815 (RP 5163-102-3-5-2-2) derived from Jagityal sannalu/IC 346255 was promoted to AVT-1-IM in Western Zone.
- IET 26850 (RP 5405-43-8-3-1-1) derived from Swarna/IRGC 4105//MTU 1081 was promoted to AVT1-IM.
- A novel genetic stock (IC 0619226) was registered with NBPGR having resistance to both the planthoppers at vegetative and reproductive stages.
- In breeding for new plant type (NPT), one line (JBB 631-1) derived from Swarna*2/IRGC4105 was identified as the best genotype with highest leaf photosynthetic rate (23.35 µmol/m^2.s) than Gont*rabi*dhan (21.91µmol/m^2.s) and also with preferred grain quality traits.
- Several new alleles of *Gn1a* gene were identified in wild species of rice.
- Among the 31 accessions of *O. glaberrima* screened for two years, we identified five lines (EC 861785, 861790, 861792, 861786, 861807, 861812 and 861808) showing consistence resistance to BB (IX 020 isolate). Preliminary molecular studies revealed that the resistance could be most likely due to *Xa41* or novel gene.
- From the cross involving 'NDR 359' X Habataki [*Gn1a*+*SCM2*] several backcrossed lines were derived and evaluated, out of which nine promising lines (STRAF's 429, 261, 436, 431, 2, 29, 428, 433 and 226) were identified with yield >5.0 ton /ha and with acceptable quality parameters.
- Among the six promising lines nominated, three entries (IET 26913, 26917 and 26803) were promoted to AVT-1 trial.
- Highest zinc content was observed in IR14M123 (23.86 ppm) followed by IR 95097:3-B-16-11-4-GBS (22.67ppm) and IR15M1298 (22.63ppm).
- Highest iron content was recorded in IR 95097:3-B-16-11-4-GBS (10.36 ppm) followed by IR15M1003 (9.9ppm) and IR 95040:12-B-3-10-2-GBS (9.67 ppm).
- IR 95097:3-B-16-11-4-GBS recorded highest iron (10.36 ppm) and very high zinc (22.67ppm) content.
- Among the twenty nine entries evaluated under low 'P' soil condition (Zero 'P'), HWR 2, HWR 7, HWR 8 and HWR 19 were found to be good under low P soil condition.
- Molecular characterization of Ratna Chudi, a landrace with K-46-1 marker (lined to *Pup* 1 QTL) revealed that it may carry novel gene for low P tolerance as it does not contain *Pup 1* QTL.

Hybrid Rice

- Three promising hybrids were nominated in IHRT trials during 2017. Of the 38 hybrids evaluated in the station trial, seven promising combinations viz., IR 7956A/TCP-1369; IR 79156A/PRP 119; APMS 6A/TCP 1394; APMS 6A/50-10; CRMS 32A/TCP 1394; CRMS 32A/50-10; & IR 68897A/ PRP 119 were identified.
- Two new hybrid combinations viz., APMS6A/SL-12-12R and APMS6A/AR9-18R were identified and nominated in AL&ISTVT and Aerobic trails of AICRIP 2018.

- Three aerobic inbreds viz., IETs 26168, 26171, 26194 were developed through parental line improvement programme and were in AVT 2 Aerobic trial.
- Hybrid seed production was taken up for the newly developed six rice hybrids viz., APMS 6A X PRP 73, IR79156A X PRP 78, APMS 6A X PRP 123, APMS 6A X SRI, CRMS 32A X PRP 74 and CRMS 32A X PRP 109.
- Promising 35 improved versions of IR 58025B and IR 79156 lines for Stigma exsertion trait were identified and used for converting into CMS line, which are in BC_1 generation.

Biotechnology

- Activation tagged rice lines of BPT5204 developed with the gene construct pSQ5 showed better tolerance under stress condition with better water use efficiency.
- Nine recombinant lines (RILs) derived from Ganjeikalli/Kalanamak with high number of grains on secondary branches (~150) were identified.
- The higher number of transcription factors, transporters and root traits related genes were highly expressed in roots compared to shoot tissue of CR Dhan 202 than BPT 5204 under aerobic condition, implying aerobic adaptation mechanism in CR Dhan 202.
- A marker set (n = 86) consisting of 24 EST-SSRs, 42 hyper-variable genomic SSRs and 20 (GATA)n locus specific SSR markers were identified to predict heterosis to the extent of > 70 %.
- Transcriptome profiles of panicles collected at pre-anthesis stage (sporophytic stage) of wild abortive cytoplasmic male sterile line (WA-CMS; IR58025A,) and maintainer (IR58025B) revealed the possible candidates involved in pollen abortion and male sterility.
- A new set of 92 restorer lines (possessing Rf3 and Rf4) and 21 potential maintainer lines (devoid of the restorer alleles with respect to Rf3 and Rf4) were identified from screening 220 germplasm lines.
- Three EMS mutants of Samba Mahsuri having extreme level of tolerance to Sheath blight and two mutants having tolerance to Yellow stem borer (YSB) were identified and characterized.
- An early maturing EMS mutant (IIRR 93 R), possessing similar cooking quality characters like Samba Mahsuri was identified with significant yield advantage and having tolerance to YSB, Brown plant hopper (BPH). The entry is in the 3rd of testing in AICRP.
- Bioassay studies indicated that two transgenic lines of Taipei 309-PG-pGA3626 RNAi, were highly tolerant to RTD (score 3).

Crop Production

Agronomy

- The System of Rice Intensification (SRI) method was found superior to mechanized SRI. The saturation method and irrigating 3DADPW recorded significantly higher water productivity over irrigating at 5 DADPW. The mean global warming potential values were significantly lower in MSRI as compared to NTP.
- In aerobic system of cultivation, paddy straw mulching, green leaf mulching and seed priming with Potassium dihydrogen orthophosphate have shown superior performance in improving seedling vigour index which resulted in reduced weed population and weed biomass which intern resulted in higher yield attributes and grain yield.
- Manual transplanting of rice by 30th June followed by conventional tilled maize in *rabi* resulted significantly higher system productivity.
- Integrated nutrient management+30% rice residue retention recorded higher panicles/m2, panicle weight, test weight which led to increased grain yield (4.74 t/ha) and straw yield of RPBio226.

Soil Science

- Grain yield performance and several NUE indices indicated that KRH2, Varadhan, PUP 221 and PUP 223 were found most promising for both soil and applied N utilization and responsiveness. At graded levels of N with different sources of N, grain yield was maximum with 100 kg N/ha and among the N sources, polymer coated urea (PCU) and neem coated urea (NCU) were significantly superior to all other sources. In the multi location trial, based on the grain yield performance, top 5 genotypes at each centre were identified. The variety, MGD -1605 can be ranked number 1 as it occupied top 5 list of all locations followed by MO 22- Shreyas and RNUE-10 at 3 locations, followed by GV-NUE-1 at 2 locations.

- Rice planting methods significantly impacted both the green house gases i.e., methane and nitrous oxide emissions throughout the crop growth period. The seasonal integrated flux for methane was the highest in conventional transplanted (TPR) method (25.61 kg ha^{-1}) followed by SRI (12.73 kg ha^{-1}), AWD at 5 cm (10.52 kg ha^{-1}) and AWD at 10 cm 8.12 kg ha^{-1}. Methane emissions decreased by more than 50 % in SRI and by 59 and 68 % in AWD at 5 and 10 cm, respectively as compared to TPR. The lowest N_2O-N emissions was observed in TPR. The seasonal integrated fluxes of N_2O-N were the least in TPR (0.623 kg ha^{-1}) as compared to SRI (0.829 kg ha^{-1}) and AWD methods (0.892 and 1.024 kg ha^{-1}). N_2O-N emissions were higher by 33 per cent in SRI and 43 – 64% in AWD methods over TPR. SRI and AWD methods lowered the global warming potential (GWP) due to lower methane emissions as compared to the conventional TPR method.

- A method of generation of various soil theme maps using the information given in Soil Health Cards by using certain geostatistical tools was tested and found that a combination of Inverted Distance Weightage (IDW) and Ordinary Kriging (OK) was good for interpolation of different soil themes. Google Earth was of immense help in data cleaning in terms of geo-coordinates given in the soil health cards. Similarly, another freely available software for Time Series analysis of satellite data, TIMESAT was explored for obtaining different phenology metrics of vegetation and results were encouraging.

- Combined inoculation of endophytic *Gluconacetobacter diazotrophicus* and rhizospheric *Bacillus subtilis* increased the total soluble sugar content and antioxidant activity in plants while simultaneously enhancing soil carbohydrate content to improve rice plant growth under water stress conditions.

- In a field experiment conducted at the IIRR research farm during *kharif* 2017 with three rice establishment methods viz., aerobic rice, alternate wetting and drying and flooded rice, the aerobic rice system recorded the highest number of microbes and it supported highest population of nitrogen fixing bacteria (197 $x10^6$ CFU/ gram of soil). The dinitrogenase enzyme activity of the isolates ranged from (1466 - 6989 nmoles of C_2H_4 produced $hr^{-1}mg^{-1}$ of protein) and 15 potential phosphorus solubilization microbes were identified from these three rice establishment methods.

- Characterization of ZnO nano particles was carried out by different methods such as XRD, SEM, TEM, FTIR and EDX. Further characterized ZnO nano particles were used for evaluation of its effect on seed germination, seedling vigour and seedling growth of rice crop (MTU 1001).

- Hydrogel has been characterized for its water and nutrient holding capacity. The water absorption capacity of hydrogel was more with distilled water followed by mineral water and tap water. Pot culture experiment was conducted with different doses of hydrogel and hydrogel application @ 0.2g/ Kg of soil was found better for water use efficiency than other treatments.

Plant Physiology

- Significant variation was observed for all the gas-exchange traits. The P_N varied between 14.2 (YPK-1095) (SWARNA/ST 6/ ST 12//SWARNA) and 26.1 µmol (CO_2) $m^2 s^{-1}$ (YPK)1126 (MTU 1010*2/HABATAKI) YPK-1126 showed highest (0.596 mol (H_2O) ($m^{-2}s^{-1}$) stomatal conductance followed by YPK-1129 (MTU1010/ST6/ST12//MTU 1010). Very significant positive association was observed between the leaf photosynthetic efficiency (P_N) and stomatal conductance (gs), P_N/C_i (carboxylation efficiency). The intercellular CO_2 and the Ci/Ca (ratio of intercellular and ambient CO_2 concentration) show a significant ($p<0.01$) negative association with P_N. The association between P_N and grain yield and TDM is significant. Very strong positive association was observed between TDM, 1000 grain weight and Harvest Index. P_N show non-significant association with total chlorophyll and carotenoid content suggesting that the variation in P_N between the genotypes was not entirely due to leaf photosynthetic pigment content.
- In Ideotype breeding, different donors were identified to propose a NPT model suitable for irrigated ecosystem. Material from tropical japonicas (TJP27, TJP157, TJP139 and TJP197) and hybrids (KRH2, PHB71 and PA6444) can be used as good donors for high photosynthesis and stomatal conductance. In high yielding varieties, Jaya, Swarna and Sampada may be used as parents for having high yield and biomass.

Crop Protection

Entomology

- Out of 2295 entries evaluated for BPH resistance, 17 entries *viz*., Swarna/ Sinnasivappu RILs-300, 254, 64 and 297; Swarna/*O. nivara* introgression lines NPS 55, NPS 60, NPS 67; AGBD 2017 germplasm lines-198, 106, 563, 303, 412 and 441; RP 2068-18-3-5, CR 2711-149, IET 26510 and IET 26489 were highly resistant to brown planthopper with a damage score of 0 to 1.
- Evaluated 53 elite high yielding introgression lines derived from tropical japonicas (JBB lines) and 29 wild rice lines from IRRI (HWR lines) for resistance to rice leaf folder using a rapid field screening method. Out of 82 lines, 12 lines were identified as moderately resistant to rice leaf folder.
- Selection of RP 5587 (IET 25109) identified as promising for stem borer damage in station trials is nominated for yield trial.
- The biological control of rice pests experiments revealed that the flowers on bunds were found to increase the longevity and fecundity of hopper egg parasitoids viz., *Apanteles* sp., *Gonatocerus* sp., *Mymar taprobanicum*, *Anagrus* sp., *Tetrastichus schoenobii* and *Bracon* sp.
- Field evaluation of ten essential oils against major insect pests of rice revealed that, eucalyptus oil was the most effective against stem borer with 8.74% dead hearts damage followed by oregano, palmarosa and rosemary oils which recorded 10.34-10.81% when compared to 12.40% in control.
- Assessment of bio intensive IPM technologies comprising ecological engineering with Yellow marigold, *Tagetus erecta* as bund crop and single application of newer eco-friendly insecticide molecule, pyraxalt at the research farm and farmer's fields revealed that the highest beneficial insect biodiversity was observed in blocks treated with pyraxalt.
- Screening of 90 rice genotypes including germplasm accessions, land races and improved cultivars for resistance to rice root-knot nematode *Meloidogyne graminicola* in glasshouse revealed that two genotypes (LD24 and Khao Pahk Maw) showed highly resistant reaction while 11 genotypes showed resistant reaction to the nematode during the second year of testing.

Plant Pathology

- IET 25484 (RP 5960 patho-7-5-9) developed by marker assisted backcross breeding (MABB) containing *Pi2* (against blast), has 95.6% genome similarity with the recurrent parent Swarna, but resistant to blast and it

also matures in 135-140 days (5 days earlier than the recurrent parent).

- IET 25483 (RP 5961 Bio Patho 2-18-5) developed from the cross of Improved Samba Mahsuri*2/Tetep with one gene (*Xa21*) against BLB and one gene (*Pikh*) for blast resistance showed moderate resistance to both BLB and blast with better yield.
- New fungicidal molecule Tricyclazole 20% + tebuconazole 16% (36% SC) @ 2.25 ml/l and BAS 750 02 F 400 g/l SC (Mefentrifluconazole 400 g/l SC) 0.7 ml /l was on par with Hexaconazole 5% SC.
- GSN of 42, 24 and 20 lines showed resistant, moderately resistance and susceptible reaction, respectively against RTD. The weeds, *Echinocloa colonum* and *Panicum repens* were found to carry RTD virus for 42 days.
- *Trichoderma asperellum* IIRRCK1 from IIRR, Hyderabad was found to be the most effective against sheath blight and blast and also induced growth activities in rice.
- Pyramiding of *Xa21* and *Xa38* in the background of Samba Mahsuri and APMS6B through marker assisted selection is being carried out and the breeding lines are at BC4F3 (Samba Mahsuri) and BC4F5 (APMS6B).
- Seventy one Xoo isolates were characterized for their pathogenic and genetic variation. Based on the reaction of the Xoo isolates on the rice differentials, these isolates were grouped into 10 pathotypes. Pathotypes, IXoPt-1 and IXoPt-2 were least virulent and IXoPt 18-22 were highly virulent. Pathotype IXoPt-19 which was virulent on all single BB resistance genes except xa13 constituted the major pathotype (22.5% isolates) and was widely distributed in India.

Transfer of Technology

- Study on maximizing the Impact of Rice Technologies through ICT applications, established that to create an impact on the productivity and profitability, there is a need to provide more data-driven services and products that enhance production/protection, markets and credit/finance (including insurance).
- A combination of *experiential, reinforcement and integrative* extension methods were employed to disseminate selected climate-resilient rice production technologies in Yadadri and Nalgonda districts of Telangana. The experiential methods (method demonstration, training) enabled the farmers to acquire skills in use of drum seeder for direct sown rice and use of paani pipes for water management.
- Among various group based extension approaches, based on the various case studies and success stories, the Farmer Producer Organizations (FPOs) was identified as the one of the significant approaches to accelerate the rice technology transfer owing to its growing numbers and farmers involved
- The adaptation measures by the rice farmers to mitigate the climate change related to rice farming were cultivation of early maturing varieties (78%), early planting (65%), direct sowing (73%), usage of wells and pumps for irrigation (66%), cultivation less farm area (51%), alternative crop cultivation (49%), agricultural insurance (18%) and stop farming (11%).
- Factors affecting farmers' preference for mechanization were non-availability of labour, timeliness in farm operations, less loss in harvesting and threshing and accomplishment of work in less time with Garrett's scores of 70, 65, 59 and 57 respectively. Reduced human and animal labour, good quality work, efficient use of costly inputs and non-availability of skilled workers were the other reasons for preferring mechanization in rice cultivation.
- PPVFRA data analysis revealed continuing dominance of private sector in rice hybrids. The emerging issues and challenges in IPR protection to plant varieties in general and rice varieties in particular include overlapping IPRs, concentration in seed industry, complex IPR and other regulatory web and vulnerability of farmers.

Introduction

Genesis

Mandate

Organization

Infrastructure

Linkages

Staff & Budget

Significant Achievements

Introduction

Genesis

The All India Coordinated Rice Improvement Project (AICRIP) was established in 1965 at Hyderabad, with the responsibility to organize multi-disciplinary, multi-location testing and develop suitable varietal and production technologies. AICRIP capitalized upon the available research infrastructure in different states of India and successfully introduced a national perspective in technology development and testing. AICRIP was later elevated to the status of Directorate of Rice Research (DRR) from April 1983 with the added mandate of pursuing research on irrigated rice.

In 1965, AICRIP was started with 22 centers (19 main and 3 testing centers) with 7 zonal centers and 12 regional centers. During fifth five year plan (1974-79) the main and sub centers were classified single cropped (24) and double cropped (21) centers. Excepting Pondicherry and Varanasi which were fully funded by the ICAR, the rest of the centers were financed on a 75:25 with State Agricultural Universities (SAUs – 25%) or 50:50 percent basis with State Departments of Agriculture (SDAs – 50%). During VI plan period (1980-85), 8 more sub centers were sanctioned raising the total to 53. There were a total of 61 centres including 8 subject related special centers. In the VII plan period (1985-89) the number of centers was reduced to 50 (18 main and 32 sub centers. During the eighth plan (1992-97) there were 51 approved centers of which six centres were withdrawn and and Karnal centre was merged with Kaul in the IX plan period (1997-2002). The total number of centers during X plan (2002-2007) increased to 46 with the approval of Kanpur and Nagina centers and to 47 during XI plan (2007-2012) with addition of Navsari in southern Gujarat in western India. The Directorate has evolved into an efficient and successful program of partnership in rice research bringing together more than 300 rice researchers from 47 funded and over 100 voluntary research centers. The Directorate was upgraded to Indian Institute of Rice Research (IIRR) in December 2014.

The Mandate

Basic and strategic research for enhancing rice productivity under irrigated ecosystem.

Coordination of multi-location testing to develop location specific varieties and technologies for various ecosystems.

Dissemination of technologies, capacity building and establishing linkages.

The Organisation

IIRR is an important constituent institute of ICAR under direct supervision of the Deputy Director General for Crop Sciences. For fulfilling its mandate effectively, IIRR 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. Presently there are 45 funded and more than 100 voluntary centers involved in rice research activities. Research and institutional activities are planned and guided by Research Advisory Committee and Institute Management Committee while the progress is critically evaluated once in five years by the Quinquennial Review Committee (QRT).

Infrastructure

The Institute is equipped with state of the art facilities with fully equipped laboratories for all the sections, centrally air cooled greenhouses for screening germplasm for resistance against pests and diseases, net-houses, growth chambers,

screening nursery beds, containment transgenic poly-houses and heat tunnels. Field facilities include a well laid out experimental farms at Rajendranagar (20 ha) and Ramachandrapuram (40 ha) with a wild rice garden and pollination chambers along with adequate farm machinery, godowns and limited cold storage facilities. A centrally air conditioned auditorium with 350 seating capacity, seminar halls, guest house, hostel facilities and a canteen, for imparting training and to disseminate information using latest multi-media and ICT tools. The Central library of the institute is a fully digitized with over 4,654 books, 6,500 bound volumes and subscribes to 55 Indian and 13 foreign journals. The significant achievements of the Institute are exhibited in the form of posters, graphs and other visuals for the benefit of visitors through a state of the art museum.

Linkages & Collaborations

ICAR-IIRR has a strong and wide network of linkages and collaborations with research organizations both in India and abroad. Under AICRIP, it has 45 funded centres affiliated to State Agricultural Universities and Departments of Agriculture of 27 states and 2 Union territories besides five ICAR institutes. 90-100 voluntary centres are providing support in the evaluation and testing work.

Research Linkages: ICAR-IIRR has a strong collaboration with CGIAR institutes such as International Rice Research Institute (IRRI), Philippines and International Crop Research Institute for Semi Arid Tropics (ICRISAT), Hyderabad and many National institutes like CRIDA, NBPGR, New Delhi (ICAR); PPV&FRA, New Delhi, IICT (CSIR) and NIN (ICMR), Hyderabad and IICPT, Delhi University, Centre for Cellular and Molecular Biology (CCMB), Hyderabad and Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad.

Academic linkages: ICAR-IIRR has accreditation from several universities such as ANGRAU, PJTSAU, IGKV, Raipur, Osmania University, University of Hyderabad, Jawaharlal Nehru Technological University, Yogi Vemana University, Kakatiya University, University of Agricultural Sciences, Bangalore, Acharya Nagarjuna University etc.,

ICAR-IIRR also has a strong **Public Private Partnership** (PPP) mode of operational linkage with the private sector, especially relating to

hybrid rice technology and its commercialization. This partnership started two decades back has turned out to be one of the best examples of PPP in the country.

The Staff

S. No.	Category	Sanc-tioned	Filled	Vacant
1	Scientists	71	66	05
2	Administration	32	25	07
3	Technical	44	**37**	07
4	Supporting	15	08	07
	Total	**162**	**136**	**26**

Budget (2017-18)

(Rupees in lakhs)

Item	2017-18 (Plan)	
	Outlay	Expenditure
IIRR, Hyderabad	3216.00	3093.53
AICRP Rice, Hyd	2280.00	2266.00

Research Achievements

Till date more than 25,000 elite lines developed by different cooperating centres were tested in multi-location trials across the country under the umbrella of All India Coordinated Rice Improvement Programme (AICRIP) at funded, voluntary centres and in partnership with private sector for hybrid rice. The dynamic time tested multilocation three tier testing programme involving one year of Initial Varietal Trial (IVT) and two years of Advance Varietal Trial (AVT – 1 and AVT -2) as well as screening of elite breeding lines at hotspot locations for generating information on their pest/disease resistance/tolerance, grain quality attributes and agronomic performance has led to release of varieties including hybrids suitable for all the ecosystems. AICRIP was instrumental in testing and release of 1188 varieties including 97 hybrids till date. Having realized the scope and potential of quality rices for export, special thrust was given for genetic enhancement of quality rices in the country which lead to the release of 30 export quality basmati and short grain rice varieties. Many of these varieties posses tolerance / resistance to major pest and diseases.

Rigorous screening of advanced breeding lines through National Screening Nurseries viz., NSN-1, NSN-2, NSN for hills and National hybrid Screening Nursery (NHSN), under both artificial and natural pest infestation regimes at hot spot locations under AICRIP has led to release of varieties resistant to major insect pests. In the last decade, about 180 entries have been identified as promising donors for resistance to multiple insect pests and more than 80 multiple disease resistant lines. Some of the acheivements of the Institute are :

- ✓ Six high yielding varieties namely DRR Dhan 40, DRR Dhan 41 (aerobic cultivation), DRR Dhan 42 (drought tolerant), DRR Dhan 43 (early duration and drought tolerant), DRR Dhan 44 (early duration, weed competitive, suited to aerobic and transplanted cultivation) and DRR Dhan 46 (early duration) were developed and released for commercial cultivation.
- ✓ Low glycemic index (GI) rice varieties – IIRR in collaboration with National Institute of Nutrition (NIN) evaluated three rice varieties viz., Lalat (GI=53.17), BPT 5204 (GI=51.42), Sampada (GI=51) and Improved samba mahsuri (GI= 50.9) and identified to be low in GI and suitable for diabetic patients.
- ✓ Development of first medium slender hybrid "DRRH3" which is similar to Samba Mahsuri with 25-30% higher yield has already proven its merit by being most sought after hybrid.
- ✓ The first high zinc and high yielding variety DRR Dhan 45 was developed and notified at national level.

- ✓ Dhanrasi, Jarva and DRR Dhan 40 were the varieties developed by introgression of yield traits from wild species with higher yield than hybrid check. They were released for shallow lowland, coastal saline and irrigated ecosystem and DRR Dhan 39 for coastal saline areas.
- ✓ IIRR has developed drought tolerant varieties through its AICRIP system, namely, Vandana (90-95 days duration), DRR Dhan 42 (115- 120 days), CR Dhan 305 (120-125 days), Birsa VikasDhan 203 (115-120 days), Birsa VikasDhan 111 (90-95 days), Rajendra Bhagwati (100-105 days), Sahbhagi Dhan (110-115 days) and Jaldi Dhan 6 (100-105 days) are tolerant to drought and suitable to direct seeded upland situations. Of these DRR Dhan 42 is drought tolerant moderate resistance to leaf blast and identified for drought prone areas of Andhra Pradesh, Telangana, Tamil Nadu, Madhya Pradesh and Chhattisgarh.
- ✓ IIRR has been recognized as one of the best DUS centers for maintaining a large reference collection of 629 varieties and for promotion of registration of rice varieties.
- ✓ On IIRR initiative, 71 extant, notified varieties of rice were IPR enabled with PPV&FRA granting registration certificates.
- ✓ Molecular markers for the major fertility restorer genes *Rf3* and *Rf4* heve been developed and used in hybrid rice programme and for targeted improvement of elite restorer and maintainer lines for disease resistance.
- ✓ Identified superior alleles of blast resistance genes *Pi54, Pita and Pib* from germplasm collections which widened the spectrum of resistance and helped to establish suitable gene deployment strategies.
- ✓ Novel resistant genes *Xa33* (for BB), *Gm3 & Gm8* (for gall midge) are fine mapped.
- ✓ Functional markers have been developed for major blast resistance gene *Pi54* and the major QTL controlling grain length, *Gs3*, for aroma (*BADEX 7-5*).
- ✓ Important genes associated with insect metabolism have been identified from yellow stem borer. Presently, RNAi based strategy is being designed targeting these key genes for effective resistance in rice.

- ✓ Several candidate genes associated with yield, quality and nutrition have been identified and the outcome of transgenic research is visible with 3Bt transgenic rice events with *Cry1A* showing resistance to stem borer and 3 independent events with *DREB1A* gene in Samba Mahsuri background short listed for Bio-Safety Research Level (BRL-1) testing.
- ✓ A major QTL controlling the important grain quality trait of gelatinization temperature called qGT6 has been identified and fine-mapped. The QTL is being deployed in elite rice varieties through MAS, thus making quality improvement programs cost and time effective, particularly in reference to Basmati rice.
- ✓ Unique genetic stocks developed by IIRR were granted soft registration by NBPGR, New Delhi. These include six restorer lines

viz., RPHR 2, RPHR 12, RPHR 517, RPHR 619, RPHR 1005 and RPHR 1096, four CMS lines viz., DRR 4A, DRR 5A, DRR 9A and DRR 10A, nine biotic stress resistant lines viz., RP 4518-2-

- ✓ 6, RP 4621-1842, RP 4621-1845, RP 4639-110, RP 4642-669, Aganni, ARC 15831, INRC 3021, INRC 202, BLB pyramided line – IET 19045, Basmati line- IET 15833 and low phosphorus line – IET 9691, were registered with NBPGR, New Delhi.
- ✓ IIRR has developed a rapid and reliable assay for assessment of purity of seed-lots of rice hybrids and CMS lines. The DNA marker-based assay is cost effective (saves 30-50% of cost) as the whole assay can be completed within a time period of 1-2 days as compared to the conventional morphology based Grow-out test which takes a full growing season and involves lot of cost in terms of seed-storage.
- ✓ Direct seeding of rice (DSR) is considered as one of the potential alternatives to transplanted rice to overcome problems regarding water and labour.
- ✓ Adoption of SRI at proper locations with suitable genotypes has a scope for area increase, enormous saving on seed and 36% saving on water, additional yield of 1.0 to 1.5 t/ha which will add 4-6 million tonnes to our food basket.
- ✓ Modification of leaf colour chart (LCC) by IIRR under SSNM and distribution of 2-3 lakhs of LCC to farming community has significantly reduced N application and recorded 5-16% higher yields over RDF
- ✓ Suitable package for aerobic rice system which reduced the water requirement by 30-40% over continuous flooding was developed and several suitable rice-based cropping systems (RBCS) and organic farming for sustaining rice productivity were recommended.
- ✓ Seed priming by soaking paddy seed in water and shade drying for 2 1/2 to 3 hours, and repeating the cycle for 5-6 times before sowing improve germination, seedling vigor and establishment in direct sown rice.
- ✓ Application of Sulphur 30-45 kg/ha to *kharif* rice in deficient soils for rice-blackgram; Application of Sulphur 30 kg/ha to *kharif* rice and 30 kg/ ha to *rabi* sunflower in rice-sunflower cropping systems is recommended for higher productivity, rice equivalent yields and economic returns.
- ✓ Regular supply of Zinc sulphate @ 50 kg/ha once in 3 seasons for normal soils and 100 kg initially for sodic soils is recommended for sustaining rice production in intensively cultivated rice soils.
- ✓ An efficient 8 row drum seeder has been designed and developed. The drum seeder technique not only saves on cost of labour but also enhances yield.
- ✓ Organic farming systems requires 4-8 crop cycles to stabilize productivity and improvement of physical, fertility and biological proper ties of soil.
- ✓ A number of donors like Velluthacheera, Banglei, Aganni, ADR 52, Pandi, Chennellu etc. with proven multiple resistance to gall

midge, BPH and WBPH have been identified. Utilizing these donors, multiple resistant varieties were developed.

- ✓ Studies on variation in insect pest population have identified seven distinct gall midge populations in the country while no variation in BPH population was noted.
- ✓ Effective insecticides identified are granular formulations of carbofuran, phorate, diazinon, mephospholan, quinalphos, MIPC, chlorantriniprole and spray formulations of phosalone, chlorpyriphos, monocrotophos, carbosulfan, carbaryl, ethofenprox, cartap hydrochloride, fipronil, imidacloprid, buprofezin and pymetrozyne.
- ✓ Pheromone mediated monitoring (8 traps with 5 mg impregnated lures per hectare) as well as mass trapping (20 traps per hectare) of yellow stem borer was developed as a practical, cost effective and environmental friendly option for the farmers.
- ✓ Planting of one row of Pusa Basmati 1 (PB1), an aromatic cultivar highly susceptible to yellow stem borer, for every 9 rows of any main crop reduced stem borer damage considerably giving additional income from PB1 crop.
- ✓ Utilizing some of the resistant donors, several disease resistant varieties have been developed like Swarnadhan, Rasi, Sasyasree, Kasturi, VLK Dhan 39, Himalaya, Sujatha, Co43 for blast, Nidhi, Vikramarya for rice tungro virus.
- ✓ A national facility of AICRIP MIS was developed and successfully hosted at the URL http://www. aicrip-intranet. in and links are available with IIRR.
- ✓ New products like Rice Riche Pain Relieving Gel, Rice Riche Moisturizing Lotion, Rice Riche Cream for Dry and Cracked heel and Rice based face scrub which keeps skin smooth, soft and moist are developed.
- ✓ Transfer of rice production technology is being successfully carried out through Transfer of technology and training (TTT) centre of IIRR by organizing as many as 242 training programmes during the last 25 years catering to the farmers and extension functionaries.
- ✓ IIRR coordinates the Rice frontline demonstration which is organized every year all over the country demonstrating suitable elite cultivars and appropriate crop management technologies in farmers' fields in association with SAU's and state department of agriculture. Since 1990 to 2000, about 16404 FLDs of 1 acre each have been conducted benefitting rice 33100 farmers. From 2001-02 to 2016-17, about 14140 FLDs of 1 hectare each have been conducted benefitting 30200 rice farmers.
- ✓ Rice Knowledge Management Portal (www. rkmp. co.in) is the largest repository of knowledge on any single crop (rice) across the globe. With 16000 pages of knowledge, 18 platforms, more than 50 videos, 6000 minutes of audio, "user specific" platforms like Service domain, Data repository, Diagnostic tools, E-Learning platforms etc, this is one-stop solution for the rice related information.

Research Achievements

Coordinated Research

Crop Improvement

- New Varieties and Hybrids Released

Crop Production

- Agronomy
- Soil Science
- Plant Physiology

Crop Protection

- Entomology
- Plant Pathology

Transfer of Technology

All India Coordinated Rice Improvement Project (AICRIP)

Crop Improvement

New Varieties and Hybrids released

Atotal of 92 varieties including 20 Hybrids (Central-33; State-59) for different ecologies have been released by both central and state varietal release committees during 2017-18. Among these, 9 varieties for Assam, 7 for Odisha, 5 each for Madhya Pradesh and Gujarat, 4 each for Uttar Pradesh, West Bengal and Bihar, 3 each for Andhra Pradesh, Maharashtra, Punjab and Tamil Nadu, 2 each for Chhattisgarh, Uttarakhand, Karnataka and Andaman & Nicobar islands while 1 for Manipur were released.

KPH-459

Varieties released by Central and State variety release committee during 2017-18

	Variety/ Hybrid	IET No.	Cross combination	FD	Eco	Grain type	Reaction to Pests	Notified States
CENTRAL RELEASES								
1	27P22	24122	Hybrid (R834F/RA320)	96	IRME	MS	MR-BL & BLB	PU, HA
2	27P36	24103	Hybrid	102	IRM	LB	MR-BL, BLB, NB, BS	BI, MP, JH, CH, OD
3	27P37	24844	Hybrid	97	IRM	LB	MR-BL, T-NBL & BS	CH, MP, MH
4	28P09	24156	Hybrid (RA204F/ RA208)	106	IRM	MS	T-BS, & LF	OD, WB, UP, AS, CH, MH, GU, TN, AP
5	28P67	24879	Hybrid	103	IRM	LB	MR-BL, T-NBL & BS	UP, BI, JH, OD, WB, CH, MH
6	28S41	24891	Hybrid	106	IRM	MS	R-BLB, T-BL	UP, JH, OD, WB, CH, MH, MP, TS, AP, KA, TN
7	BIO 799	22919	Hybrid	103	IRM	LB	MR-BL, BLB, BPH & WBPH	OD, BI, JH, WB, UP
8	CAU-R1	23544	Leimaphou/BR-1	102	HRUR	LB	MT-BL,BS	MN, ME
9	CN 1272-55-105	19886	Swarna/IR36//Mohan/Khitish	118	IRL	SB	R-GM4	WB, BI, OD, MH, AP, KA
10	CNRH 102	22913	**Hybrid**	103	IRM	MS	MR-NBL, BL, BS, SB, WBPH	OD, CH, BI, WB

	Variety/ Hybrid	IET No.	Cross combination	FD	Eco	Grain type	Reaction to Pests	Notified States
11	CO 51	21605	ADT 43/RR 272-1745	75	IRE	MS	MR-BL, BPH, GLH	HA, UT, OD, BI, WB, UP, MP, MH, GU, AP, KE, KA, TN
12	Co-43 Sub1	25676	CO 43*3/FR 13A	107	NIL (Sub)	SB	MR-BL, NBL	TN, AP, OD, KA
13	CR Dhan 506	23053	CRLC899 / Warda 2	120	SDW	LB	MR-RTV, ShBI, SB &LF	AS, AP, KA
14	CR Dhan 508	23601	CRLC899 / AC38700	130	RSL	SB	MR-BL, BLB & SB	AS, WB, OD
15	CR Dhan 909	23193	Pankaj/padumoni	113	RSL	MS	T-BL, SB & LF	AS, BI, UP, MH
16	CR Sugandh Dhan 908	23189	Swarna / Geetanjali	116	IRL	MS	MR-BL, BLB & SB	OD, WB, UP
17	DRR Dhan 47	23356	IR 78877-208-B-1-1/ IR 78878-53-2-2-2	83	IRE	LB	R-BL, MR-NBL, ShBI, BS, RTV & BLB	AP, TS, KA, KE, PY
18	DRR Dhan 48	24555	RPBio 226*1/CSR 27	107	IRM (Sodic)	MS	R-BLB, MR-RTD, Shr, NB, BS	TS, AP, KA, KE, TN
19	DRR Dhan 49	24557	RP Bio 226*1/CSR 27	97	IRM	MS	B-BLB	GU, MH, KE
20	DRR Dhan 50 (Drt + Sub)	25671	Sambamasuri Sub-1/ IR 81896-B-B-195	112	RSL	MS	MR-BLB, BL	AP, TS, TN, KA, BI, OD, CH, UP,MP
21	DRR Dhan 51	25484	Swarna *2/C101A51	106	RSL	SB	R-Bl	UP, GU, TS, CH
22	GK 5022	23445	Hybrid	93	AEROB	LS	R-GLH, MR-BLB	BI, CH
23	HPR 2795	22978	Pure line selection from IC 3131180	92	HRUR	LB	-	HP, ME, MN
24	HRI 180	24120	C112/M019	98	IRME	LB	R-BL, MR-BLB	PU, HA, UT
25	HRI 183	24082	Hybrid (C140/M018)	91	IRME	LB	R-BLB	HA, UT, UP, GU
26	KPH 459	24888	KCMS-1017A / KMRB-395-12-2-1-1-1	100	IR	MS	MR-BLB	GU, MH
27	KPH 473	24825	KCMS-1020A / 0814-110-3-4-1-1	98	IR	LB	MR-BL	CH, MP, MH
28	MRP 5408	24143	PMS 255 / PR540	102	IRM	LS	MR-BL, RTV & BS	AP, KA, PY
29	NPH 8899	23494	Hybrid (NP 8001 A X NP1001 R)	100	Boro	SB	MR-BL & GM	UP, BI, AS
30	Pusa Basmati 1718	24565	PB1121/SPS97 // PB1121*3	107	IRM	LS	R-BLB	PU, HA, DE
31	Surabhi	24760	PRN 19045/PRN14	107	IRL	MS	MR-BLB, ShBI & BS	MH, GU

	Variety/ Hybrid	IET No.	Cross combination	FD	Eco	Grain type	Reaction to Pests	Notified States
32	TKM13	22565	WGL32100/Swarna	98	IRME	MS	MR-BL, GLH, SB & LF	GU, MH
33	VL Dhan 158	22982	RCPL 1-45/VL 3861	88	RUP	SB	MR-BL, BPH, WBPH & LF	HP, UT
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34	CARI Dhan 1	25029	Selection from Quing Livan No.1	103	RSL	MS	T-SB, ShBl	AN
35	CARI Dhan 5	16885	Pure line selection from Pokkali Somalones	114	CS	SB	-	AN
36	Bheema / Dheera	23933	MTU 5249/PLA 8572	112	SDW	MS	-	AP
37	Nandyala Sona	23715	BPT 3291/CR 157-212	100	IRM	SS	MT-BL, T-BPH, GM & LF	AP
38	Tarangini	23300	MTU 1010/MTU 1081	93	IRME	LV	MR-LBL, NBL	AP
39	Bahadur Sub 1	25265	Bahadur/Swrana Sub-1	113	Nil (Sub)	MB	-	AS
40	Dehangi (IC-574471)	18243	Maibi/ CRM 49	88	RUP	B	MR-BL	AS
41	Gitesh	17963	Akisali x Kushal	122	IRL	-	MR-BL	AS
42	Ingolongkiri (IC-559417)	17452	Maibi x CRM53	85	RUP	SB	-	AS
43	Jalashree	17357	Pankaj / FR13 A	125	IRL	-	-	AS
44	Jalkunwari	20275	Pankaj/FR 13A	150	IRL	-	-	AS
45	Kanaklata	20611	Jaya / Mahsuri	135	IRM, Boro	-	MR-GLH	AS
46	Ranjit Sub 1	25678	Ranjit/Swarna Sub-1	122	Nil (Sub)	MS	-	AS
47	Rongkhang (IC-574472)	18242	Maibi x IR 64	88	RUP	SB	-	AS
48	Rajendra Nilam	24010	OG 6709-7/APO	86	RUP	SB	MR-BS, T-SB, R-LF	BI
49	Sabour Ardhjal (BRR007)	24036	Dhagaddeshi/ IR78585-98-2-2	88	ARB	LS	T-BLB, ShBI & GLH	BI
50	Sabour Deep	21098	VG-56 X Type3	82	IRE	LS	T-BLB, ShBI, BS, GLH & SB	BI
51	Sabour Surbhit	19806	Mutant of Rajendra Suwasini	92	IRME	LS	MR-BLB, BS, BL	BI
52	HRI 179	22878	C112/M018	90	IRE	LB	R-BL & BLB, T-GLH	CH
53	Chhattisgarh Su-gandhit Bhog	21842	R302-111/Ganga Baru	110	IRM	SB	MR-BL, Shr, BS, RTB, GM	CH
54	GAR 3	24633	Gurjai/IET 14714/1-1-2-3-7	94	AEROB	LS	-	GU
55	GNR 5	25075	Jaya X GR-6	100	IRM	LS	MR-BLB, Shr, BPH	GU

	Variety/ Hybrid	IET No.	Cross combination	FD	Eco	Grain type	Reaction to Pests	Notified States
56	GNRH 1	25734	NVSRMS-1 x 12SP105	85	IRE	LS	MR-BLB, Shr, BPH, LF	GU
57	Mahisagar	22100	CN540/IR50	93	IRME	MS	MR-BLB, NBL	GU
58	Purna	18654	Annada x RR 151-3	65	RUP	SB	-	GU
59	Daksha	22698	Thanu/IET 15963	86	AEROB	MS	T-ShBl, ShR	KA
60	Gangavati Ageti	19251	Gaurav/Kalinga-III	82	IRE	MS	MR-LBL, NBL, BLB	KA
61	Karjat 8	19407	Ratna/Heera / KJT - 4	113	IRL	SS	MR-BL, BLB, RTV & GM, T-BPH & WBPH	MH
62	Karjat 9	20900	Kasturi/IR50	92	IRME	MS	MR-BLB & SB, R-BPH & WBPH	MH
63	PDKV Kisan	20880	SKL 6-1-23/SYE3-17	103	IRM	MS	R-BL, BLB & GM, MR-NBL	MH
64	RC Maniphou 13	24200	KD-2-6-3 Akhanphou	111	HRIR	LB	-	MN
65	Improved Chinnor	-	Field Selection	128	ASG	MS	R-BLB, MR-BL	MP
66	Improved Jeera Shankar	-	A Selection from farmers field	112	ASG	SB	R-FS, MR-BL	MP
67	*Indam 200-022*	*20710*	*Hybrid*	84	IRE	MS	MR-LBL, NBL, BS, WBPH	*MP*
68	JR 81	24305	NPT 89/IR 64	95	IRNE	LS	MR-BL, RTV	MP
69	JRB 1	23422	Local Selection	90	IRE	SB	-	MP
70	CR 409	23110	Chakaakhi/AC 38687	124	IRL	LS	-	OD
71	CR Dhan 207	23448	IR71700-247-1-1-2/ IR57514-PM15-B-1-2	NA	ARB	MS	MR-BL, BS, GLH, SB, GM & LF	OD
72	CR Dhan 209	23467	IR72022-46-2-3-3-2/ IRRI 105	84	ARB	LS	MR-RTV	OD
73	CR Dhan 408	20265	CR149-5010-228/ T1242	132	RSL	LB	MR-BL, BLB, SB, WBPH & LF	OD
74	CR Dhan 507	22986	Gayatri/Sudhir // Varshadhan	139	RSL	MS	MR-BL, ShBI, BS, R-SB	OD
75	CR Dhan 800 (Swarna-MAS)	20672	Swarna / IRBB60	115	RSL	MS	T-BLB	OD
76	CR Sugandh Dhan 910	22649	Swarna / Geetanjali	117	IRL	MS	MR-BL, BS, SB, WBPH & LF	OD
77	PR-126	24721	Huanghuazhan/ Fenghuazhan	93	IRME	LS	R-BLB	PU
78	Punjab Bas-mati-4	25399	Bas370/IET17948// Bas370*2///PB1121	116	SCR	LS	R-BLB	PU

	Variety/ Hybrid	IET No.	Cross combination	FD	Eco	Grain type	Reaction to Pests	Notified States
79	Punjab Basmati-5	26153	Bas386/IET17948//Bas386*2///PB1121	107	SCR	LS	R-BLB	PU
80	CO 52	25487	BPT 5204/CO (R) 50	100	IRM	MS	MR-ShR, BS, ShBl	TN
81	CR 1009 Sub 1	22197	CR 1009/FR13A	122	Nil (Sub)	SB	MR-BL, BS, BPH & WBPH	TN
82	MDU 6	23994	MDU5/CAN 96136	83	IRE	LS	MR-BL, BLB, WBPH, GLH, LF & SB	TN
83	Bauna Kalanamak 102	24761	Kalanamak KN3/ Improved samba masuri	94	Biofort	MS	-	UP
84	Malviya Sugandha Dhan	21838	Dehradoon Basmati Selection-13	107	ASG	MS	MR-NBI	UP
85	SHIATS Dhan-2	22576	IR 73008-138-22-2-2/ IR6561024-3-3-2-3	98	IRME	LS	-	UP
86	SHIATS Dhan-3	22522	IR 02N141/IR 6805-7-1-2/IR72890-81-3-2-2	102	IRM	LS	-	UP
87	Pant Dhan 23	21000	UPR2870-98-125/ BBL180-5-1-4-1	95	IRME	LS	MR-BLB & SB	UT
88	Pant Dhan 26	22057	Mahamaya / Gayabyeo	89	IRE	MS	MT-BLB & ShBI	UT
89	Dhruba	20761	IR42/Patnai 23	117	IRL	SB	MR-BL, BS & LF	WB
90	*PAN 2423*	21395	*Hybrid*	91	IRE	SB	MR-ShR	*WB*
91	*PAN 802*	*23498*	*Hybrid (014AXAN268)*	136	*IRME, Boro*	*LS*	MR-BL, BLB & RTV, T-SB & LF	*WB*
92	Rajdeep	17713	Sabita x IR57540-8	130	SDW	LB	T-ShBI, SB & LF	WB

Coordinated varietal testing

During the year 2017 which is the 53rd year of AICRIP testing, 48 varietal trials, 1 screening nursery and 5 hybrid rice trials were conducted as 813 experiments at 123 locations (45 funded, 78 voluntary centres) across 25 states and 2 union territories in all the 7 zones of the country. Hybrid rice experiments were also conducted by 10 private seed companies. The 48 trials were constituted with 1284 entries including 160 checks. The receipt of data has been 84.75% for funded, 64.19% for voluntary with the overall being 76.19%. In all 18 promising elite lines were identified (Appendix 1) and the Promising hybrids identified based on overall mean yield advantage over the checks in hybrid trials are given in Appendix 2.

INGER Observational Nurseries

INGER nurseries are the important source of improved genetic resources developed in different countries for utilization in the breeding programme. During 2017, nine INGER Observational Nurseries with 390 elite rice lines were evaluated at 45 different locations and 38 supe-

rior lines were identified in different trials based on yield, resistance/tolerance to biotic stresses, maturity duration and overall phenotypic acceptability. (Appendix 3)

National Seed Project and Breeder Seed Production

Breeder seed production (BSP) of 268 rice varieties and parental lines of 8 rice hybrids was organized at 38 centers across the country as per the DAC indents. A total production of 7571 quintals of breeder seed was achieved against the target of 4264 quintals. (Appendix 4) At IIRR, 163 quintals of Breeder Seed of 22 varieties were produced.

Crop Production

Agronomy

The Coordinated Agronomy Programme organized included 245 experiments conducted at 49 locations (37 Funded + 12 Voluntary) during *Rabi* 2016-17 and *Kharif* 2017.

Integrated Management Trial (IMT)

A total of 70 cultivars belonging to 8 categories were evaluated at different locations under three levels of nutrients, i.e., 50, 100 and 150 % of recommended dose of nutrients along with standard and local cultivars tested under normal and late planted situations.

Promising cultivars identified in different groups were Shalimar rice -3, Vivekdhan-86 in early; VL Dhan 65, Vivekdhan 62 and HPR 2143 in medium under hill ecology grown under normal sowing time.

The promising cultivars identified were: for early irrigated (IET-24797, Gontra Vidhan-3 and IR-64), for medium (IR-64, Karjat-7, MTU-1010, Sarjoo-52, NDR-2064, HKR-127, 128, PR 113, Pant Dhan 19, 22, 24, Mahamaya, Numali and Jaya), for late (Swarna, Samba Mahsuri and Pushvami), for scented (Pusa 1509, NDR 6093, Pusa 2511, Numali, Pusa 1121, Pant Sugandha 25, 27 and CG Sugandhit Bhog); Hybrids (HRI-174, Az8433, Arise 6444) and AL and ISTVT (SR 26B, Jaya and CSR 23) with better yields over other cultivars.

Similarly the varieties identified for late planting (15-20 days delay) were Shalimar rice-3, 4 and HPT 1068 in early, Shalimar rice-1, 2, VL Dhan 65 and HPR 2612 in medium duration under hill ecology; IET-24797 (3.92 t/ha), IR-64 (3.86 t/ha) and Gontra Vidhan-3 (3.80 t/ha) in early irrigated, IR 64, Karjat-7, MTU 1010, Narendra Lahar, Sabour Shree, HC-HRI-174, Pant Dhan 19, NDR-359, GNR 4, 13, Pant Dhan 19, 22, 44, Mahamaya and Numali in medium, Muktashree, Prateeksha, Pushyami, Swarna and R. Mahsuri late duration; Aishwarya, Ketkibhog, Punjab Basmati-4, Pant basmati 1, Pant Sugandha 25, 27 and Sugandhit Bhog in scented; HRI-174, Az8433, WGL- 14, KRH-2 and Arize 6444 in hybrids and GNR 5 and CSR 23 in Alkaline saline tolerant situation with their higher yields over other cultivars. At most of the locations integrated agronomic management practice of higher NPK dose (150% RFD) followed by 50% RFD + 5 t/ha FYM was found to be promising and exhibited higher nutrient efficiency..

Cultural Management Trials.

Aerobic rice was found to be the best establishment method with grain yield of 4.05 t/ha under unpuddled condition. Whereas, mechanical transplanting followed with all the principles of SRI found suitable under puddle condition was with recorded yield of 5.83 t/ha. Saturation maintenance up to PI and (3 + / - 2 cm) after panicle initiation treated plots resulted in the highest grain yield (5.28 t/ha) followed by alternate wetting and drying (5.11 t/ha). Mechanical transplanting recorded the highest grain yield (6.02 t/ha) over manual transplanting (5.87 t/ha) across 5 locations. There was a loss of 1.06 t/ha due to 20 days delay in transplanting. Adoption of organic nutrient management recorded 11 % and 5.4% lesser grain yield compared to 100% RDF and INM, respectively

Weed Management Trials

Long term evaluation of different weed management practices in different rice establishment methods:

Among the weed management practices, me-

chanical weeding three times at 10 days interval yielded 4.66 t/ha; pre-emergence herbicide application followed by post-emergence herbicide application yielded 4.37 t/ha and hand weeding twice yielded 4.11 t/ha and were found promising in reducing weed population, weed dry biomass and weed competition in terms of increased crop growth, yield attributes and grain yield. Irrespective of the method of crop establishment, increase in grain yields by mechanical weeding thrice using weeder (67%) followed by hand weeding (47%) were promising..

Evaluation of cultivars for weed competitiveness under puddled direct wet seeding condition:

Among the test varieties, DRR Dhan 44 was superior at five locations; DRR Dhan 46, DRR Dhan 42, Swarna shreya were found superior at four locations each; whereas, other varieties, NDR 359 at Ghaghraghat; GAR 13 at Nawagam; HPR 2880 at Malan and ADT 43 at Aduthurai were superior and exhibited better weed competitiveness, lower weed population, lower weed dry biomass, higher yield attributes and grain yield.

Evaluation of cultivars for weed competitiveness under aerobic system:

At six out of ten locations, maintaining weed free period upto 60 DAS was significantly superior followed by 30 DAS and 45 DAS maintenance (4 locations) of weed free were equally effective. Among the aerobic varieties, DRR Dhan 42, DRR Dhan 44, DRR Dhan 46 and Sahbaghidhan, exhibited better weed competitive ability, lower weed populations and lower weed dry biomass at majority of the locations.

Integrated Pest Management–(Collaborative trial with Entomology and Pathology):

IPM special trial was conducted with an aim to manage pests (including insects, diseases and weeds in a holistic way in farmers' fields involving them in a participatory mode and allowing them to select IPM practices from a basket of options available). Across the locations, weeds, insect pests, and disease incidence was low in IPM plots. Weed population and weed biomass recorded at all the locations were reduced by two to five times in IPM implemented plots compared to farmers practice, resulted in significantly higher grain yields.

Rice Based Cropping Systems

Climate resilient management practices in rice and rice based cropping systems:

The application of Azotobacter + PSB + Brown manuring with Dhaincha + residue mulch @ 2 t/ha + 75% RDF recorded significantly higher system productivity (7.60-13.27 t/ha) at Puducherry, Kanpur and Chinsurah indicating the substitution of 25% RDF with organic manures. It was observed that the system productivity was higher (rice equivalent yield (REY)) in various rice based cropping system due to application of Azotobacter + PSB + Brown manuring with Dhaincha + residue mulch @ 2 t/ha + 75% RDF thereby yield gap could be reduced.

Enhancing productivity of rice-pulse system under different crop establishment methods:

Under rice-pulses system, the higher average system productivity was recorded under rice-cowpea and rice-rice-mungbean systems at Mandya, Chinsurah (8.56 and 11.67 t/ha). Weed population was low under transplanting method but the average cost of cultivation was higher. Wet seeding was promising at Mandya. Pre-*kharif* pulse increased grain yield significantly (14%) over rice-rice system at Chinsurah.

Soil Science

Long-term soil fertility management in rice-based cropping systems

In the 29th year of study on long term soil fertility management in RBCS, the treatments RDF+5t FYM/ha and RDF were at par, but significantly superior to other treatments in both seasons at MTU and in *rabi* at TTB. FYM alone treatment was on par to RDF in *rabi* and significantly superior to RDF in *kharif* at TTB. Soil fertility status at the end of *kharif* 2017 indicated an improvement

in important soil properties in INM treatments at both locations. Additional dose of FYM @5t/ha along with RDF improved the growth rate substantially with 72 kg/ha/year at MTU and 71 kg/ha/year at TTB.

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

Yield gap assessment trial was conducted in farmers' fields across four centres: Chinsurah, Faizabad, Titabar and Maruteru to assess the variability in nutrient supply, to find out the yield gap between RDF and farmers' practice and fine-tune the fertilizer nutrient requirement for specific target yields (6-8 t/ha) in a given environment and validation of fertilizer recommendations for targeted yields. Technology Yield Gap I was estimated based on the RDF prevalent across the region as recommended by the research farm/ centre and gap 2 was estimated based on the recommended practice of SSNM for a target yield. Yield gap analysis in farmers' fields indicated very high yield gap 1 and 2 at Titabar to the tune of 50%. At Faizabad, yield Gap 1 was to the tune of 20% which was almost manageable. Whereas, the yield gap at Chinsurah was minimum since the targeted yields fixed were comparatively low and at Maruteru, with narrow gap, yields obtained at farmers' fields almost matched the research station yields. Fertilizer prescriptions were given for target yields and they will be validated in the next year.

Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS

Rice yields at Kanpur and Mandya increased by 66-127% and 7-15.0% respectively by NPK fertilization along with gypsum amendment. The genotypes viz., DRR Dhan 46, DRR Dhan 42, DRR Dhan 45, DRR Dhan 43, DRR Dhan 44 and DRR Dhan 40 produced the highest yields when supplemented with 100% GR (4.63-4.43 t/ha) and also under native sodic conditions without gypsum application (2.21 -2.00 t/ha), at Kanpur. IR 30864, DRR Dhan 41, CSR 23, DRR Dhan 43, and DRR Dhan 40 recorded highest yields with 100% GR application (5.89 t/ha- 5.27 t/ha) and also exhibited tolerance to sodicity with yields ranging from 5.33 – 4.95 t/ha at Mandya. In Faizabad, the genotypes NDRK 500051, IRSSTN 30, IRSSTN 110, Jaya and NDRK 50063 recorded highest yields (5.06 -3.85 t/ha) without gypsum amendment.

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

This study was conducted at 12 locations to assess the extent of change in rice productivity and nutrient use efficiency due to changing crop calendar and to identify management options to mitigate the loss in yield and nutrient use efficiency. At all the centres, the productivity was significantly influenced by the time of crop establishment with normal sowing recording highest grain yields. The nutrient management practice of 150% RDF + Zn with N in 3 splits either as 1/2 + ¼ +1/4 or 1/3 +1/3 +1/3 performed better over others in terms of nutrient uptake and rice productivity.

Screening of rice genotypes for acid soils and related nutritional constraints

Application of lime amendments to acid soil and fertilization with double the rates of PK fertilizer significantly increased yields ranging from 10-23% at Moncompu, Raipur, Ranchi and Titabar. At Moncompu, the genotypes responsive to liming were HRI 197, Uma, 27 P63 and DRR Dhan 42 while the acid tolerant genotypes were Uma, KAU 109 and DRR Dhan 42. At Ranchi, the genotypes HRI 196, 27 P64, 27 P63 performed better under both limed and acid soil conditions. Similary, Gitesh, Prafulla, and Aghonibora recorded superior yields in comparison than other genotypes at Titabar in the treatments with and without liming. At Raipur, Indira Maheswari and RP5974-3-2-8-38-12 recorded higher yields in all the three nutrient management treatments viz., NPK(RD), NPK (RD)+Lime and N (RD)+double PK.

Monitoring soil quality and crop productivity under emerging rice production systems

The results indicated consistently superior performance of transplanted rice over DSR and aerobic rice by 14-22% and 13-19% at Kanpur, Puducherry respectively while at Moncompu superior performance of DSR was recorded. The result at Pusa indicated slightly superior performance of AR over DSR and transplanted rice. In case of nutrient management practices, maximum yields were obtained with RDF+50% NPK through organics sources (6.14, 5.3 and 5.4 t/ha) at Kanpur, Puducherry and Pusa respectively, while, 100% recommended dose of fertilizer (RDF) was found superior at Moncompu. Nutrient uptake and use efficiency was higher in transplanted rice followed by DSR.

Yield maximization of rice through Site Specific Nutrient Management (SSNM)

Under the yield maximization trial, majority test sites reported higher grain yields in SSNM based on Nutrient Expert (NE), which ranged from 3549 to 7601 kg/ha. Similarly, in case of straw yield also SSNM based on NE, Leaf Colour Chart (LCC) and recommended regional fertilizer recommendations were better than control or other treatments. The beneficial effects of SSNM were also visible in the yield components including tillers and panicles per m2 and 1000 grain weight, which contribute to the yields.

Bio - Intensive Pest Management (BIPM) in rice under Organic Farming

The results from the third year of study on "Bio-intensive pest management" indicated the superiority of BIPM over farmers' practice (FP) at five (CHN, IIRR, KJT, JDP and TTB) out of ten locations that recorded significantly higher grain yield (by 22-44%). Whereas, BIPM was on par to FP at PDU and LDN; but recorded lower yield compared to FP at RPR, PTB and RCI. The observations on pest incidence indicated the beneficial effect of BIPM at most of the locations with reduced pest incidence and increased population of natural enemies. Most of the soil properties improved with organics in BIPM compared to FP in the third year after repeated application of organics where organic carbon content increased by a minimum of 4 % at CHN to the maximum of 46 % at IIRR in BIPM.

Plant Physiology

Physiological studies under All India Co-Ordinated Rice Improvement Program were conducted at eight funded centres and five voluntary centres.

Influence of silicon solubilizers on stress tolerance in rice genotypes

Plants vary in their capacity to absorb silicon. Silicon accumulators possess 4 – 7 % silicon while non accumulators can only store 0.5 – 1.5% silicon. Rice exhibits highest uptake of silicic acid among the grass family. In the presence of large quantities of silicon fertilizers, rice can accumulate 10 – 15 % (dry weight) silicon in stem and leaves. Hence, a trail was conducted at ten locations spread across the country with four hybrids and two varieties- Sahbhagidhan and IR64 with the objective to study the effect of silixol on the uptake of silicon by rice under water stress situation and its influence on yield. Among the test entries, PHB-71 and IR64 showed enhanced total dry matter whereas grain yield and harvest index increased in KRH-4. With the imposition of water stress condition, Sahbhagidhan and PA-6129 were able to maintain good total dry matter, grain yield and harvest index.

Screening for elite rice cultures for drought tolerance:

In Asia, about 45% (25% of the world's rice area) of the total rice area is not supported by irrigation. Yield in rainfed lowland rice is drastically reduced by drought due to unpredictable, insufficient and uneven rainfall during cultivation. Development of drought resistant cultivars with higher yield potential is necessary for these areas. Hence, a trail was conducted with 42 varieties and two treatments (rainfed and irrigated) at Pattambi, Raipur, Rewa and Faizabad locations. Reduction in grain yield was lesser than the av-

erage for 19 varieties. Lowest reduction in mean grain yield was observed at Rewa. The mean grain yield was maximum in IET 26617 and IET 26616 under irrigated and rainfed conditions respectively.

Screening for high temperature tolerance in rice genotypes

Increased atmospheric CO2 and other Green House Gases- methane and nitrous oxide resulted from various anthropogenic activities have contributed for increasing the global temperature. By the end of 21st century, global average surface temperature may increase by 1.4 - 5.8oC. Eventually, it becomes difficult to produce adequate food grain. Hence, in this trial, crop was covered with polythene tunnel from panicle initiation stage to maturity to elevate the temperature. All the 30 entries showed maximum reduction in mean grain yield at IIRR followed by Pattambi, Pantnagar and Titabar. Conversely, minimum grain yield was noticed at Rewa, Chinsurah and Maruteru. Reduction in grain yield was < 30% over control in IET Nos. 26768, 26778, 26763, 26772 and 26776, S-458 and 175-2(K). IET 26768 noted less (< 20%) reduction in filled grain number per panicle and panicle number per square meter. IET 26778 and IET 26763 maintained good harvest index (<10% reduction) under heat stress.

Physiological characterization of selected rice genotypes for multiple abiotic stress Tolerance

Development of abiotic stress tolerance plants is a major objective of several breeding programs around the world. Hence, in this trial, detrimental effect of various abiotic stresses (1% mannitol, 2% mannitol, anaerobic stress, salt stress and cold stress) on seedling germination and growth were studied at 9 locations. At 1% mannitol water stress condition, MAS Nos. 317, 314, 319 and 306 were superior in the measured traits- germination %, root and shoot lengths and seedling vigour. At 2% mannitol stress, MAS Nos. 303, 308, 302 and 304 showed better performance. MAS 317 showed higher seedling vigour under salt, anaerobic and cold stresses.

Evaluation of Radiation and Nitrogen use efficient promising rice genotypes

High yield potential of rice varieties must be supported by adequate solar radiation. It was estimated that, a cumulative solar radiation of 200 hrs bright sunshine during the 30 day before harvest could be optimum for grain yield. Nitrogen is another important factor that influences rice productivity. Though nitrogen use efficiency (NUE) is a complex phenomenon and always increase in N application may not necessarily increase the grain yield, the genotypic potential in absorbing and utilization of applied N plays important role in enhancing grain yield. Hence, in this trial, both radiation use efficiency (RUE) and NUE were focussed.

RUE was estimated using Oryza 2000 model based on meteorological data and total dry matter accumulation by the individual genotypes at maturity stage. The accumulated PAR (APAR) was more under 100% RDN level and it was similar at 0% and 50% RDN levels. Highest APAR was recorded at Pantnagar followed by Coimbatore and IIRR. The mean RUE was reduced by 15% under 50% RDN level and it was highest at Pattambi followed by Titabar and Maruteru. Mean RUE was highest in Sampada x Jaya/2 (0% RDN) and Sampada x Jaya/3 (50% RDN and 100% RDN). Three different N levels (0, 100 and 50% RDN) were applied on 12 varieties. Varadhan x MTU 1010/2 noted minimum reduction in grain yield with N limitation. Highest grain yield was observed in BPT 5204 and Varadhan x BPT 5204/6 at 0% RDN. Among the high yielding varieties, Varadhan x BPT 5204/6 performed well at all the three N levels.

Screening of rice varieties for tolerance to low light stress

This trial was formulated to identify rice genotypes with low light tolerance. The trail was conducted at seven locations with 21 varieties with Swarnaprabha as check. Higher grain yield was recorded by Swarnaprabha followed by IET

25865. IET Nos. 25206, 25814 and 23356 showed lesser reductions in grain yield (33%, 34% and 35% respectively). Inspite of better grain yield, IET 23356 and IET 25835 showed lower extent of reduction in stem weight and shoot weight at maturity. IET 25876 maintained better grain yield (36% reduction), panicle weight at flowering (11% reduction), TDM (10% reduction) at flowering and harvest index (1% reduction).

Crop Protection

Entomology

All India Coordinated Entomology Program was organized and conducted during *kharif* 2017 with seven major studies encompassing various aspects of rice Entomology involving 363 experiments that were carried out at 41 locations (32 funded+9 voluntary) in 23 states and one Union territory.

Host plant resistance studies

Host plant resistance studies comprised of seven screening trials involving 1728 entries consisting of 1398 pre-breeding lines, 114 hybrids, 16 cultivars, 62 germplasm accessions and124 check varieties. These entries were evaluated against 13 insect pests in 236 valid tests (50 greenhouse reactions+186 field reactions). The results of these tests identified 74 entries (4.28%) as promising against various insect pests. Of these, 22 entries (29.73%) were under retesting. (Table 1)

Table 1: Promising entries identified against various insect pests in AICRIP 2017-18

Pest	Trial	Promising Entries
Planthoppers	PHS	BPT 2411, BPT 2611, BPT 2776, BPT 2787, JGL 24497, MTU 1245 (MTU 2139-7-1-1-1), RP 5995 Bphk17-5, IR 73382-80-9-3-13-2-2-1-3-B (HWR-16) and RP 5690-20-6-3-2-1
	NSNH	IET No 26565 (BPH) IET 26583 and 26594 (WBPH)
	NHSN	IET No 26551 (BPH), IET Nos 26464, 26469, 26466, 26544, NDR 359, IR 64 and MO1(WBPH)
	NSN1	IET Nos 25970, 26752 and Pooja (Planthoppers)
	NSN2	IET Nos 26661, 26966, 26825, 26837, 27193, 27206, 27243 and 27272 (Planthoppers)
Stem borer	SBST	CN 2069, IIRR-BIO-SB-5 and IIRR-BIO-SB-3
	NSN1	IET Nos 26347, 26263, 25521, 26373, 26746, 27280, Swarnadhan
Gall midge	GMS	WGL1191 and WGL1196
	GMSS	ASD 7, KAKAI (K 1417), Sudu Hondarawala, AC 6248, PTB 12, WGL 1127, WGL 1145 and IET 19792
	NSN1	IET Nos 25970, 25994, 25749, CR Dhan 201 (NC) and 25613
	NSNH	IET Nos 26593, 26598, 26603, 26609
	NHSN	IET Nos 26527, 26537, 26544 and 26550
Leaf folder	LFST	NWGR-13017, HPR 2613, HPR 2617, HWR 3, NWGR- 9080, NWGR-13108, Mahisagar and MP 209, HPR 2873, HWR 24, RP 5587-B-B-B-51 and MP 11, Varundhan and RP 5588-B-B-B-B-76.
	NSN1	MO1
	NSN2	IET Nos 27070, US 314 (HC) and 26778
	NHSN	IET Nos 26470, 26485, 26511, 26510, 26493, 26527, 26544

Pest	Trial	Promising Entries
Multiple Resistance	MRST	CR 2711-149, Dhanrasi and KNM 113
	NSN1	IET Nos 26263, 25970 and Pooja(RP), PTB 33 and RP 2068-18-3-5
	NSN2	IET Nos. 26674, 27071, 27193, 27206, 27070 and PTB 33
	NSNH	IET 26565, 26594 and 26605
	NHSN	IET Nos 26537, 26544, 26503, 26527, NDR 359, PTB 33 and RP 2068-18-3-5

Chemical Control studies

Chemical control studies consisted of two trials viz., Pesticide compatibility trial (PCT) and Botanical Insecticide Evaluation Trial (BIET).

Pesticide compatibility trial (PCT) 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 of rice and consequent impact on grain yield, at 24 centres during *kharif* 2017. There were no significant differences in the performance of the two newer insecticide formulations spinetoram+methoxyfenozide and triflumezopyrim in their proven efficacy when applied alone or in combination with fungicides. Individually spinetoram + methoxyfenozide performed better against stem borer and leaf folder, while triflumezopyrim showed superior efficacy against plant and leafhoppers.

Botanical Insecticide Evaluation Trial (BIET) was carried out at 30 locations to evaluate the efficacy of four essential oils. The botanicals-cedarwood and eucalyptus oils were found effective in reducing damage by stem borer. In case of gall midge camphor oil showed efficacy in reducing silver shoot damage. Against leaf folder, performance of lemon grass oil was superior, while cedarwood oil was effective in reducing the damage by gundhi bug. Eucalyptus oil was found effective against cut worm and the efficacy was comparable with rynaxypyr. Botanical formulations were found moderately effective in reducing damage by hispa and whorl maggot.

Ecological studies

Ecological studies consisted of one trial on Effect of Planting Dates on Insect Pest Incidence (EPDP) conducted at 20 locations during *kharif* 2017. In general, the pest incidence was low to moderate in different dates of planting across locations. Stem borer, Gall Midge, Leaf folder, Case worm, BPH & WBPH damage was maximum under late planting conditions. Minor pests such as horned caterpillar at Navasari, rice skipper and grasshopper incidence at Khudwani and thrips at Jagdalpur were observed in all the three plantings.

Biocontrol and Biodiversity studies

Biocontrol and Biodiversity studies covered i) Ecological Engineering for Planthopper Management (EEPM) ii) Bio-intensive Integrated Pest Management (BIPM) and iii) Monitoring of Pest Species and their Natural Enemies (MPNE). Ecological engineering for pest management was taken up with a combination of interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering plants on bunds. The results indicated that water management along with ecological engineering can significantly reduce hopper population.

Bio intensive pest management trial was initiated to explore the approaches for managing pests for organic rice cultivation at 10 locations. The stem borer incidence was reduced in BIPM plots

Integrated Pest Management studies

Integrated Pest Management special (IPMs) trial was carried out in a participatory mode in

farmers' fields at 17 locations during *kharif* 2017 with the aim of managing all the pests including insects, diseases and weeds in a holistic way by providing a basket of options to the farmers. Across the locations, adoption of IPM practices resulted in low incidence of weeds, insect pests, and diseases in IPM plots compared to FP plots.

Population dynamics of major insect pests assessed through light trap catches

Assessment of insect populations throughout the year using light traps in 29 locations revealed that stem borers and planthoppers, mainly BPH continued to be the most widespread pests in terms of numbers as well as spread across the zones except Northern hills (Zone-I). There was a substantial increase in the populations of stem borers (up to a maximum of 5940/week in 16 SW), GLH (up to a maximum of 96494/week in 40 SW), BPH (70357/week in 40 SW), and WBPH (29455/week during 15 SW) across locations. The leaf folder catches were slightly lower compared to that of last year.

Plant Pathology

During 2017, a total of 14 trials were conducted at 47 locations on host plant resistance, field monitoring of virulence in major pathogens and disease management. Host plant resistance studies comprised of 5 national screening nurseries with 1430 entries of advanced breeding lines, new rice hybrids were evaluated for their reactions against major rice diseases at various locations. In various screening nurseries, many of the test entries were showing resistance against two and more than two major diseases. (Table 2)

Field monitoring of virulence of *Pyricularia oryzae (Blast)*

The nursery included 25 cultures consisting of international differentials, donors and commercial cultivars and conducted at 24 with different dates of sowing during the crop season. The reaction pattern at Almora, Cuttack, Imphal, Gangavati, Navsari, Lonavla, Ghaghraghat, Ponnampet, Malan, Jagadalpur, New Delhi, Umiam and Karjat were in group one; Khudwani, Nellore and Pattambi in group two; Mandya in group three; Coimbatore, Gudalur and Hazaribagh in group four; and Upper Shillong and Raipur in group five and six respectively; IIRR and Rajendranagar are in group seven.

Table 2: Promising entries identified against various pathogens in AICRIP 2017-18

Screening nursery	IET no's
NSN-1	IET # 25310 (MR/R to Sheath blight and brown spot), IET # 25610 (moderately resistant to neck blast and bacterial leaf blight), 25804 (MR to neck blast and brown spot)
NSN-H	IET # 26565 (moderately resistant to leaf blast, neck blast and bacterial leaf blight) and 26593 (moderately resistant to neck blast, sheath blight and brown spot)
NHSN	IET Nos. 26472 (moderately resistant to brown spot and rice tungro disease), 26473 (moderately resistant to leaf blast and brown spot) and 26484 (moderately resistant to leaf blast and neck blast)
DSN	CB14161 (resistant to leaf blast, moderately resistant to sheath blight, brown spot and rice tungro disease) and V - MSM – 141 (resistant to neck blast, moderately resistant to bacterial leaf blight and rice tungro disease)

Field monitoring of virulence of *Xanthomonas oryzae* pv. *oryzae* (Bacterial Leaf Blight).

This trial consisted of twenty eight near isogenic lines (IRBB lines) possessing different bacterial blight resistant genes (singly) or various combination 5 BB resistance genes viz., *Xa*4, *xa*5, *Xa*7, *xa*13 and *Xa*21 in the background of rice cultivar IR 24 and different checks. The trial was conducted in 25 hot spot locations in India during *kharif* 2017. Most of the differentials possessing single bacterial blight resistance genes were sus-

ceptible at most of the locations. BB resistance gene *xa*13 was susceptible in 12 locations while *Xa*21 was susceptible in 14 locations. The differential, IRBB 55 possessing two BB resistance genes *xa* 13 and *Xa*21 showed susceptibility at 12 hot spot locations. The isolates from Aduthurai, Chiplima, Maruteru, Gangavati and New Delhi were highly virulent. Most of the 3, 4 and 5 gene combinations lines also showed susceptibility at some locations indicating minor changes in the Xoo pathogen population.

Disease observation nursery

The trial was conducted at 7 locations. The results concluded that early sowing of the crop favoured the inoculum build up of *Rhizoctonia solani* and BLB and in late sown crop sheath rot and brown spot was more. Sheath blight disease severity was high and Maruteru was found to be the most vulnerable area. In the Southern region, late sowing by about 15 days helps in the escape of disease due to the relatively dry periods during the subsequent stages.

Evaluation of Combination Fungicides Against Location Specific Diseases

The combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) found effective in minimising the disease severity of leaf blast, sheath blight and sheath rot. The next best combination product is trifloxystrobin 25% + tebuconazole 50% WG (0.4g/l) to manage the leaf blast and sheath blight severity and neck blast incidence.

Integrated Disease Management

The trial conducted at 10 locations with different components of integrated disease management both at nursery and main field. Trial was taken up against the management of sheath blight, neck blast, brown spot, sheath rot and bacterial leaf blight. Seed treatment followed by clean bunds, optimum dose of fertilizer application in split doses with organic manures, followed by application of *Trichoderma* and also need based application of fungicides prevent the build up of pathogen and there by reduces the disease severity and increases the grain yield.

Special Screening Trial on IPM practices

The trial was proposed at 7 locations. Results indicated that the IPM practices which integrates all the necessary components for the reduction of pathogen inoculum, providing necessary nutrients for the development of a healthy host and also creating an atmosphere that is not favourable for the pathogen to survive, helps in the overall condition of less disease development.

Screening Trial on False Smut (Special Trial)

The chemical control of false smut disease trial was conducted at 12 locations. Percentage of infected panicles/m^2 was varied from 0.06% to 38.37%. The performance of fungicides varied according to locations. Fungicides viz., azoxystrobin 18.2% + difenoconazole 11.4% w/w SC @ 1.0 ml/l, Propiconazole 25 EC @1.0 ml/l, Metiram 55% + pyraclostrobin 5% WG @ 1.5 g/l, Pencycuron 22.9 % @ 1.25 ml/l reduced percentage of infected panicles/m^2.

Production Oriented Survey

Production Oriented Survey (POS) was conducted in 16 states of India by 21 AICRIP centres. A total of 120 scientific staff and 56 officials and technical staffs from the different States Department of Agriculture surveyed 142 Districts in 16 States.

The rainfall over the country as a whole during the monsoon season (June-September) was 95% of its long period average (LPA). Seasonal rainfall over Northwest India, Central India, south Peninsula and Northeast (NE) India were recorded at 90%, 94%, 100% and 96% of respective LPAs. Rice hybrids occupy a significant area in states like Chhattishgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra and Uttar Pradesh and its area is increasing in states like Karnataka, Gujarat, Telangana and West Bengal. The major problems faced by the farmers were

shortage of agricultural labours especially at the time of peak agricultural operations like planting and harvesting and irrigation water. Many farmers from different states also expressed timely availability of seeds of different hybrids in time, availability of different inputs in time, farm mechanization (on hire basis/custom hiring), market facility and farm loan. The diseases like leaf blast, neck blast, brown spot, sheath blight, false smut and bacterial blight were widespread almost throughout India. Severe leaf and neck blast was recorded in many places in Chhattishgarh and parts of eastern Uttar Pradesh. High intensity of sheath blight was recorded in many fields in Chhattishgar, Punjab, parts of eastern Uttar Pradesh and West Bengal. Unusual high intensity of bacterial blight was recorded in several places in Khammam, Warangal and Nizamabad in Telangana. Among the insect pests, stem borer, leaf folder and BPH were widespread throughout India. Heavy infestation of BPH was recorded in many fields in Chhattishgarh, Haryana, Karnataka, Kerala and Telangana. Moderate to severe incidence of army worm was recorded in Karnataka.

Transfer of Technology

A cafeteria of rice technologies were demonstrated in 723 hectare area covering 20 states and five major rice ecosystems of the country. Out of 723 Front Line Demonstration (FLDs) reported, about 78.7% were conducted in irrigated rice ecosystem; whereas about 6.87% of FLDs were conducted in rainfed uplands. More than 11.51 % of FLDs were organized in shallow lowlands and 2.07% in hill ecologies. There is a scope to increase the number of FLDs in rainfed ecologies. The summary statement reveals that the mean yield advantage was the highest in Hill ecologies (29%). There is a tremendous scope to bridge the yield gaps (particularly Yield gap-II) in case of Rainfed uplands (24.66 % mean yield advantage), irrigated ecologies (20.66%) and shallow lowlands (20.97%).

FLD technologies demonstrated in irrigated ecosystems have recorded mean yield of 5.16 t/ha whereas in shallow lowlands FLD technologies have recorded an average yield of 5.34 t/ha. Average demonstration yields in rainfed uplands was 3.94 t/ha. The range of yield advantages explains that there are few promising technologies, if properly adopted by the farmers may result in enhancing the farm level productivity.

In total 50 technologies have been identified from 20 states based on their performance in farmers field conditions.

Research Achievements

Lead Research

GEY- Genetic enhancement of yield and stress tolerance

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/25:

Broadening the genetic base of *indica* rice and modify plant type by introgressing traits from Tropical *japonica* -Donor identification

New plant type (NPT) core set was evaluated during *Kharif* 2017 and genotypes with trait combinations of high grain number, panicle weight and strong culm were profiled with reported gene specific markers. Genotypes with a variant allele to the known sources identified are KJ 241 for *SCM2, GS5* and *GS3* alleles, KJ 182 for *SCM2, GS5, Gn1a, SPL14* and *Ghd7*, KJ 274 for *Gn1a*, *Ghd7* and *GS3,* KJ 55 for *Gn1a*, *Ghd7*, *SPL14* and *GS3*, KJ 199 for *Gn1a, Ghd7, SPL14* and *GS3*, KJ54 for *TGW6*, *Ghd7* and *SPL14*, KJ 251 for *GS3* and *GS5*, KJ 244 for *TGW6*, D107 and KJ 263 for *GS5* and KJ 204 for *Ghd7*. About 29 breeding lines were identified with trait combination of high grain number and strong culm from 9 crosses and 16 breeding lines with high grain number (342-516) from five crosses.

Evaluated 383 selected lines derived from 22 BC_1F_3/three-way crosses for NPT traits. Ten lines from two crosses (one line [JBC 138-5] from the cross of RP Bio 226/KJ 225) // Nidhi /// MTU1081 and nine lines [JBC 173-1, 8, 10, 12, 13, 15, 18, 19 and 20] from RP Bio 226/ KJ 225) // Nidhi /// MTU1081 //// B 95-1-) were found with desirable traits. JBB 631-1 derived from Swarna*2/IRGC4105 was identified as the best genotype (*Kharif* 2017 and *Rabi* 2017 at IIRR and *Kharif* 2017 at Kampasagar) with highest leaf photosynthetic rate (23.35 µmol/m^2.s) than Gont*rabi*dhan (21.91µmol/m^2.s) and also with preferred grain quality traits. Of the 110 F_1 crosses made during *Kharif* 2016, 58 crosses were forwarded in *Kharif* 2017 to get F_2. IET 26850 (RP 5405-43-8-3-1-1) derived from Swarna/IRGC 4105//MTU 1081 was promoted to AVT1-IM.

GEY/CI/BR/22:

Identification and introgression of agronomically important traits from wild species of rice.

The study of allelic variations of *Gn1a* gene (reported for high grain number) in 18 *Oryza* sp., (25 accessions of *O. rufipogon* and 8 indica rice varieties) identified several new alleles in wild species of rice. Fifty three SSR markers were used for genotyping of 31 accessions of *O. Glaberrima* and based on the study they were grouped into five clusters.

A BC_1F_2 population consisting of nearly 2000 introgression lines were developed by crossing Samba Mahsuri with 25 accessions of *O. rufipogon*. Further, a total of 20 BC_2F_1 populations derived from cross between *O. sativa* cv. Samba Mahsuri and *O. rufipogon* (25 different accessions) successfully developed to introgress yield enhancing traits/QTLs. Another set of 22 inter-specific F_1 derived from *O. sativa cv.* IR64 and *O. glaberrima* (22 accessions) were backcrossed to recurrent parent IR64 to generate BC_1F_1s. Among the 31 accessions of *O. glaberrima* screened for two years we identified five lines (EC 861785, 861790, 861792, 861786, 861807, 861812 and 861808) showing consistence resistance to BB (IX 020 isolate). Molecular validation showed negative for *Xa5*, 13, 21, and preliminary study revealed resistance could be most likely due to *Xa41* or novel gene.

Fig. Resistance reactions of O. glaberrima for bacterial blight infestation (for IX 020 isolate)

GEY/CI/BR/16:

Traditional and molecular approaches for breeding improved rice varieties with resistance to planthoppers

Towards developing resistance varieties to planthoppers, sixteen crosses were made using five high yielding varieties namely Pushyami, Jaya, Improved Samba Mahsuri, Swarna and Gontra Bidhan 3 by crossing with 7 donors i.e. RP 4918-230, RP 2068-18-3-5, IET Nos. 25358, 25499, 25287, 24339 and 24333. The F_2 (15 crosses), F_3 and F_4 (10 crosses) segregating populations were evaluated in field under normal conditions. Selected 500 single plants in F_2; 50 superior plants from 100 $F_{3;}$ and F_4 progenies based on yield potential, desirable plant type, maturity and grain type. Ten superior F_5 families in the genetic background of Sona Mahsuri, Swarna, Samba Mahsuri, IR 64 and NDR 359 were bulked for yield evaluation.

Among 25 advanced lines with resistance under hopper-burn, seven superior lines in the genetic background of IR 64, Swarna, Jagityala sannalu and Improved Samba mahsuri were nominated and IET 26815 (RP 5163-102-3-5-2-2) derived from Jagityal sannalu/IC 346255 was promoted to AVT-1-IM in Western Zone. To identify the resistant lines, a set of 72 lines (F_6-F_7) derived from 18 crosses were screened at APRRI, Maruteru, the hot spot location for planthoppers (Fig. 1). Under severe hopper-burn situation, 12 lines derived from four crosses Sugandhamati/SRAC 34997, IR 64/IR SS-179-313-11-3, Swarna/MO1 and Swarna/CR 3005-230-5 showed field resistance along with other desirable agronomic traits. However four lines displayed resistance (DS: 3) at seedling stage when subjected to glass house screening. Registered a novel genetic stock (IC 0619226) with NBPGR having resistance to both the planthoppers at vegetative and reproductive stages.

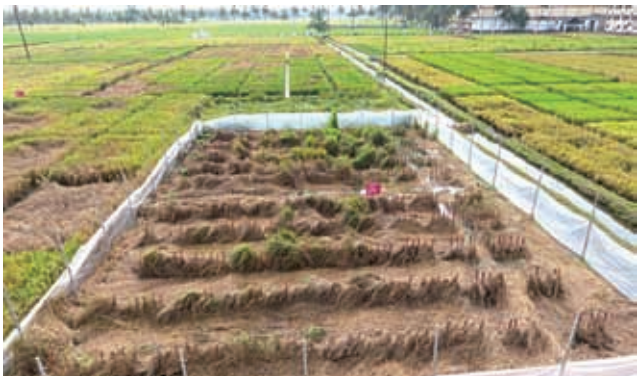


Fig: Screening advanced breeding lines for hopper- burn

GEY/CI/BR/23:

Breeding high yielding rice lines possessing multiple biotic stress resistance/tolerance through conventional and molecular approaches

Two sets each of 260 and 317 rice germplasm consisting of donors, Green Super Rices, and released varieties were screened against Blast and Bacterial leaf blight diseases. Among 260 rice germplasm, 25 were resistant to blast disease (score of 3) and out of 317 lines screened against bacterial blight resistance, 17 resistant lines (score 1) were identified. The introgressed lines in the genetic background of Swarna (possessing the target yield enhancing genes, *Gn1a* + *SCM2* + *OsSPL14*) were crossed with the donor line 'Introgressed line of Improved Samba Mahsuri' (IL of ISM; possessing bacterial blight resistance genes, *Xa*21+*xa*13+*xa*5 and blast resistance genes *Pi*2+*Pi*54). The positive F_1s identified were crossed with recurrent parent to develop BC_1F_1 lines. During *Kharif* 2017, two BC_1F_1 plants processing grain type similar to recurrent parent were selected and backcrossed with 'Swarna' to develop backcross derived lines (BC_2F_1s).

A total of 80 F_1s ('NDR 359' X Habataki [*Gn1a*+*SCM2*] were developed during *kharif* 2016 and positive F_1 plants identified were backcrossed with 'NDR 359' to develop backcross derived lines (BC_1F_1's). During *Kharif* 2017, two BC_1F_1 plants possessing grain type similar to recurrent parent were selected and backcrossed with 'NDR 359' to develop backcross derived lines (BC_2F_1s). Nine promising lines such as STRAF's 429, 261, 436, 431, 2, 29, 428, 433 and 226 were identified. All the selected lines yielded more than 5.0 ton/ha and has acceptable quality parameters.

During *Kharif* 2017, six promising lines were nominated to AICRIP 2017, among which three entries namely IET 26913, 26917 and 26803 were promoted to AVT-1 trial.

GEQ/CI/BR/8:

Enhancing nutritional quality of rice through bio-fortification

About 150 samples were evaluated for yield and yield-related traits during *Kharif* 2017. The samples were also analysed using XRF instrument for estimation of iron and zinc content. Iron content varied from 6.2 ppm to 10.36 ppm and Zinc content varied from 15.27 ppm to 23.86 ppm. Highest zinc content was observed in IR14M123 (23.86ppm) followed by IR 95097:3-B-16-11-4-GBS (22.67ppm), IR15M1298 (22.63ppm). Similarly, highest iron content was recorded in IR 95097:3-B-16-11-4-GBS (10.36 ppm) followed by IR15M1003 (9.9ppm) and IR 95040:12-B-3-10-2-GBS (9.67 ppm). Among these, the entry IR 95097:3-B-16-11-4-GBS recorded highest iron and high zinc content and hence very useful in providing both iron and zinc nutrients. Two mapping populations IR14M110/JAMIR (300 RILs) and IR14M141/KALIBORO (350 RILs) are being evaluated for iron, zinc and other yield attributing parameters during *Rabi* 2017-18.

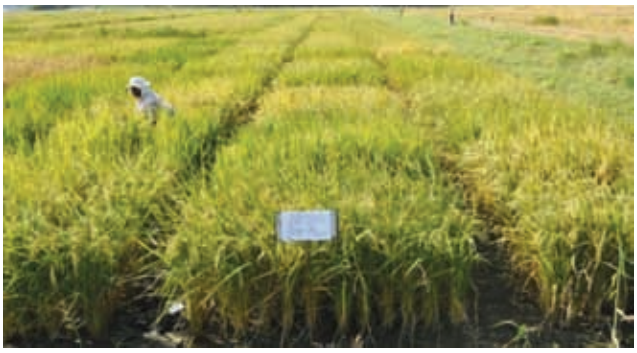


Fig: Field experiment conducted for estimation of Iron and Zinc at IIRR Farm - ICRISAT

GEY/CI/BR/9:

Breeding varieties for Boro areas

Boro Breeding material of F_5 population from 12 crosses have been evaluated at ideal locations viz., Chinsurah, Pusa, Karimgunj and Titabar and IIRR. Advanced the F_3 populations of fresh crosses generated and selected the lines for boro trials. Twenty one F_1 crosses were made by using local boro germpalsm and high yielding varieties during *rabi* 2016-17

GEY/BR/14:

Breeding high yielding Rice cultivars tolerant to low soil phosphorus and nitrogen

Advance breeding lines (1060) in F_5 and F_6 generation involving donors for low phosphorus tolerance and agronomically superior varieties were evaluated and approximately 650 promising lines were selected. Twenty nine HWR entries were evaluated under low phosphorus soil condition (Zero Phosphorus plot), out of which, HWR 2, HWR 7, HWR 8 and HWR 19 were found to be performing well under low P soil condition. Twenty Eight genotypes were evaluated at P_0, P_{20}, P_{40} and P_{60} Kg/ha phosphorus levels. The results showed that average grain yield/plant were 1.14g, 9.76g, 14.63g and 15.89g respectively and days to 50% flowering were 104 days, 102 days, 97 days and 96 days respectively. Among

Fig: Ratna chudi, a land race tolerant to low soil phosphorus at P_0 kg/ha

the genotypes, under P_0 kg/ha, Gangavati Sona (2.77g), GNV-1109 (2.33g), FL-478 (2.26g) and Ratna chudi (1.95g) recorded highest grain yield. These lines were characterized for the presence of *Pup 1* QTL using K 46-1 (a dominant functional PCR-based marker) and identified 15 lines positive for *Pup1* allele. Ratna Chudi, a landrace had good tolerance to low soil phosphorus. Molecular characterization of Ratna Chudi with K-46-1 marker (lined to *Pup 1* QTL) revealed that it did not contain *Pup 1* QTL and presumed that the land race may carry novel gene for low P tolerance.

GEY/CI/HY/7:

Development and evaluation of three line hybrids with better grain quality and resistance to major pests and diseases

Three promising hybrids were nominated in AICRIP IHRT trials. Of the 38 hybrids evaluated in the station trial, seven promising combinations viz., IR 7956A/TCP-1369; IR 79156A/PRP 119; APMS 6A/TCP 1394; APMS 6A/50-10; CRMS 32A/TCP 1394; CRMS 32A/50-10; & IR 68897A/PRP 119 were identified and of the 250 test crosses evaluated, 10 promising combinations were identified.

Fifty eight promising genotypes were identified from the available breeding materials and 30 crosses were attempted between the promising lines. Four hundred single plant selections were made from the breeding materials in various segregating generations for traits like good plant type and biotic stress tolerance.

Fig: Panicles with increased grain number from IJ derived lines

GEY/CI/ HY/10:

Development of parental lines and hybrids with tolerance to salinity and suitability to aerobic situations

APMS6A/AR19-18R hybrid was nominated in IHRT Medium trial during *Kharif* 2017, two new hybrid combinations (APMS6A/SL-12-12R and APMS6A/AR 9-18R) were identified and nominated in AL&ISTVT and Aerobic trails of AICRIP 2018. Three aerobic inbreds (IET 26168, 26171, 26194) developed through parental line improvement programme were in AVT 2 Aerobic trial. Three promising aerobic restorers (PSV24, PSV372 and PSV 375) were utilized in development of station trail hybrids with a set of 4 CMS lines.

29 best performing RILs derived from KMR3/Shabhagidhan cross combination were genotyped for qDTY12.1, fertility restoration *(Rf3* and *Rf4*) and simultaneously phenotyped for morphological traits under drought and direct seeded aerobic conditions.

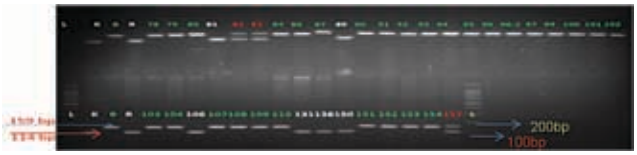


Fig : Screening of improved parental lines for fertility restoration (*Rf4*)

Screened available B and R line in differentially graded P starved plots (P-0, P-20, and P-40) and identified 8 promising lines viz., ATR 226, PSV15, AR 19-18R, MTP5, ATR253, BK49-42, NH12-124R, RPHR612-1 based on their performance in graded P soil condition and generated 32 hybrid combinations in line x tester design. The hybrids viz., APMS6A/ATR216, IR68897A/ATR372, APMS6A/HSRV1, IR7915A/HSRV2 performed well under graded P plots.

Best performing 50 BC_2F_4 lines of APMS6B/Kasalath, 26 BC_1F_3 lines of KMR3/Kasalath genotyped for Pup markers and backcross population (BC_2F_7) with qDTY 12.1, saltol and Sub1 in the background of KMR3R for respective stresses. 24 BC_2F_3 lines of IR58025B/Apo cross were evaluated for morphological traits and genotyped for qDTY2.1 and qDTY3.1. 9 BC_2F6 lines possessing saltol 1 in the background of APMS6B were phenotyped and assessed for maintainer ability.

GEY/CI/HY/12:

Development of superior restorers and identification of new restorer (Rf) genes for WA-CMS system in rice by conventional and molecular approaches

Sixty improved lines and seven newly developed hybrids from partial restorer improvement program were selected and evaluated for various agro morphological traits along with 12 checks. Four CMS lines (APMS 6A, IR 79156A, CRMS 32A & IR 68897A) were crossed with 3R lines: PRP 92, PRP 119, PRP 192). DRCP-102 restorer, DRCP-105 maintainer genetic male sterile population were crossed with donors of BLB, Blast, BPH and gall midge resistance and abiotic stress resistance (drought, salinity and P use efficiency).

During *Kharif* 2017, seeds harvested from 8th recurrent selection were sown to advance the recurrent selection to 9th cycle. In the 9th cycle 500 plants were selected for genotyping for the presence of biotic and abiotic tolerance with the help of molecular markers. Around 1000 plants were phenotyped for sterility and fertility by morphological evaluation.

GEY/CI/HY/1:

Development of cms line with good agronomic base and out crossing ability

Agro-Morphological traits were recorded on promising 35 improved versions of IR 58025B and IR 79156 lines and 13 were used for converting into CMS line, which are in BC_2 generation. Validation is planned for improved lines of APMS 6B & IR 68897B (> 500 lines) for stigma exsertion trait and plant type using identified eight SSR markers.

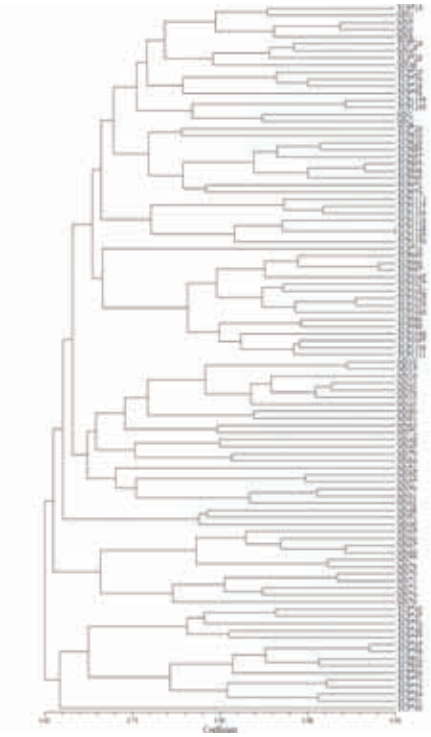


Fig: Morphological Diversity analysis

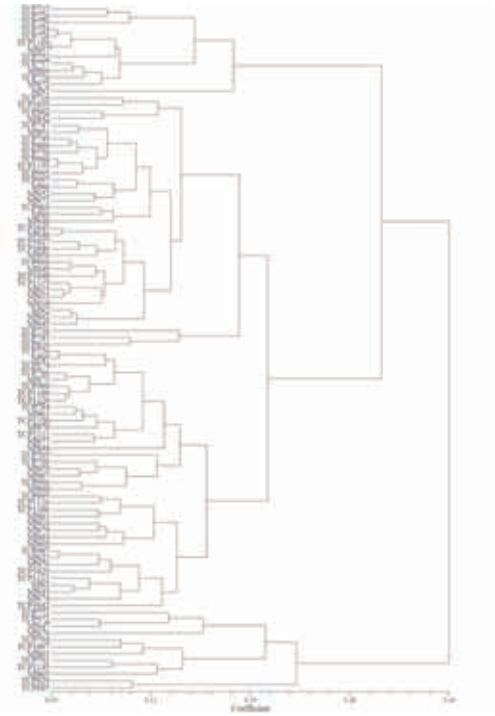


Fig: Molecular Diversity analysis

Evaluated 334 F_1 in the Test Cross Nursery. Among them, 28, 72 & 35 combinations were identified as maintainers, restorers and heterotic crosses respectively. Morphological characters were recorded on 100 maintainers. Both morphological and molecular based diversity were analyzed. Important maintainers (entry TCN numbers) are 1717, 1806, 1809, 1814, 1815, 1817, 1819, 1827, 1828, 1829, 1830, 1831, 1843, 1844, 1845, 1968, 1992, 1995, 2004, 2007, 2035, 2055, 2065, 2066, 2075 and 2079.

On the basis of agro-morphological similarity to the recurrent parent of IR58025B and IR79156, best 20 plants out of 8 families (200 plants each) were selected based on the phenotypic characterization with respect to total stigma exsertion (plants showing more than 70%) and agronomic traits.

GEY/CI/HY/14:

Establishment and validation of heterotic gene pools in hybrid rice.

Ninety six hybrid rice parental lines (31 maintainers and 65 restorers) were characterized by using a random set of 50 SSR markers used by IRRI under Generation Challenge Programme for diversity studies. Out of 50 SSR markers, 39 were found to be polymorphic, 1 monomorphic and 10 were not amplified. A total of 173 alleles were amplified by 39 polymorphic markers. Allele no. per locus generated by each marker ranged from 2 to 8 with an average of 4.435 alleles per locus. The value of major allele frequency, gene diversity, heterozygosity and PIC was ranged from 0.30 to 0.89, 0.20 to 0.79, 0.01 to 0.23 and 0.19 to 0.76, respectively. The cluster pattern generated by DARwin software resolved 96 parental lines into two clusters.

Morphological clustering was done using DARwin software which grouped 110 parental lines into total 8 clusters (6 major clusters and 2 minor clusters). Major clusters manifested for late duration genotypes. The restorer line, IR10198 formed separate minor cluster with mid early duration (96 days) and two more genotypes, TCP-1145 and TCP-343 formed separate minor cluster for late duration. Each cluster is having both maintainers and restorers except one minor cluster with single genotype. The correlation between molecular and morphological data was tested by Mantel's test. Non-significant correlation was found between two distance matrices of genotypic and phenotypic data.

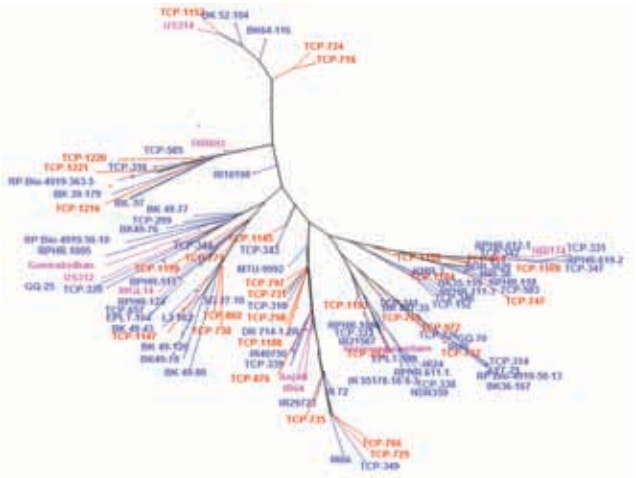


Fig: Molecular diversity-Radial representation of phenotypic cluster of 110 parental lines

GEY/CP/PP/12

Physiological studies for improving ideotype breeding in rice.

Efforts were made to identify donors for various physiological traits from indica and tropical japonica (TJPs) germplasm. Landraces, ILs, Restorer line, new plant types (NPTs), TJPs, high yielding varieties (HYVs), green super (GSR) lines, FGK lines, hybrids with their restorer lines were studied for physiological, morphological and yield attributing characters. TJP Nos. 27, 157, 139 and 197 and hybrids- KRH2, PHB71 and PA6444 could be used as good donors for high photosynthesis and stomatal conductance. HYV- Jaya, Swarna and Sampada may be used as parents for high yield and biomass.

GEQ/CI/BR/26

Investigation into the role of major metabolites on rice grain quality.

Aim of this project is to understand the reasons for the variation of cooking quality among similar amylose containing varieties. Twenty varieties along with Improved Samba mashuri were used in the study. Quantities of amylose, amylopectin and protein showed positive relationship with individual grain weight. The pattern of amylopectin to amylose content ratio varied among the varieties and it was similar in RP BIO 226 (Improved Samba Mashuri) and Tellahamsa at different stages of grain filling period.

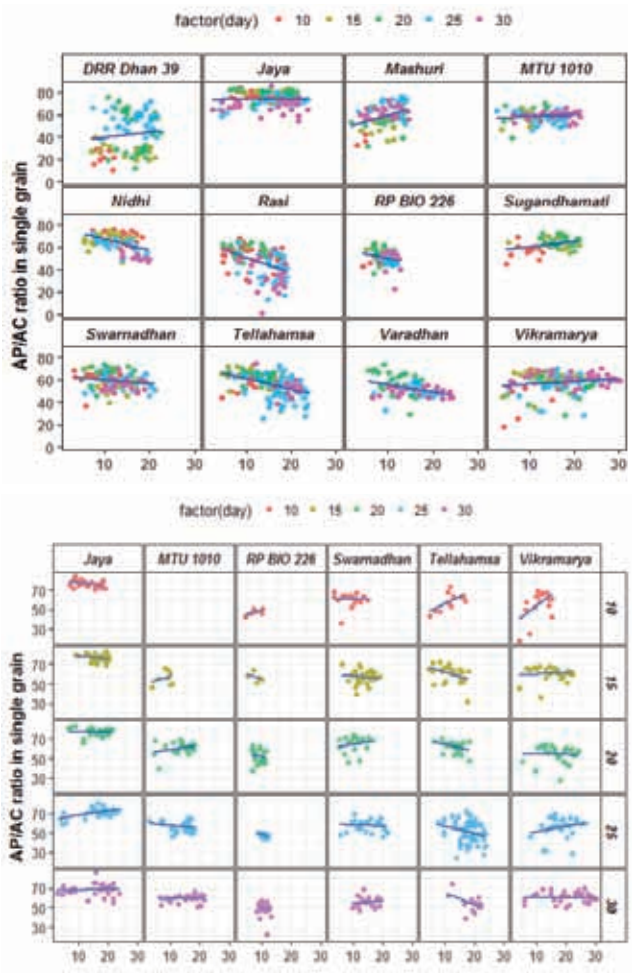


Fig: Amylopectin (AP) to amylose (AM) content ratio (y-axis) and grain weight (x-axis) in individual rice grain among the varieties (top) and also during different days of grain filling period (bottom).

ABR - Application of Biotechnology tools for Rice improvement

ABR/CI/BT/9:

Genetic improvement of rice against biotic and abiotic stresses through transgenic approach.

Development and evaluation of stable activation tagged lines using pSQ5 construct for water use efficiency (WUE)

Forty transformed rice lines of BPT5204 with gene construct pSQ5 were confirmed through PCR by targeting HPT and RFP genes. Out of 38 lines, 31 lines were homozygous Ac-Ds (~630 plants), 3 lines were Ac (60 plants) and only 10 plants were Ds which obtained from three Ac-Ds lines and one Ds line. T_6 seeds were harvested from PCR confirmed homozygous Ac-Ds (31 lines) lines, Ac (3 lines) and Ds (1 line) lines and are being advanced to next generation.

We evaluated three Ds stable lines of T4 generation for WUE through creating limited water stress condition. Out of three lines, one line (Ds-1) showed better tolerance under stress condition. In continuation, Ds-1 stable lines were further screened for water stress tolerance in T_5 generation and observed the similar resluts as previous studies.

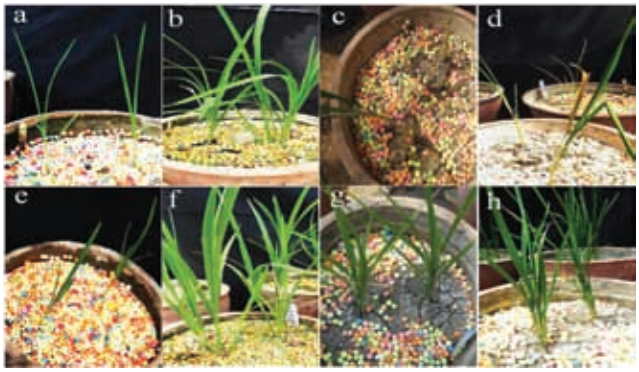


Fig: Screening of Ds-1 stable line for water use efficiency. a) 15 days old BPT 5204 plants, b) Six week old BPT 5204 plants under well watered condition; c & d) BPT 5204 control plants under 4 weeks water stress; e) 15 days old Ds-1 plants f) Six week old Ds-1plants under well watered condition; g & h) Ds-1 plants under four weeks of water stress.

The results indicated that Ds-1 line showed better WUE compared to control plants of BPT 5204. The same experiment was repeated with T5 plants and confirmed the Increased WUE in Ds-1 line when compared to WT.

Identification of flanking sequences through Tail-PCR in the Ds-1 line

To identify the flanking sequences in the Ds-1 line, Tail PCR was performed. Accordingly, we identified an integration locus on chromosome number 12. Apart from mapping of the Ds insertion on the corresponding rice chromosome, a 10kb region on either side of the insertion site was also mapped and results revealed that the transposed Ds element in Ds-1 plant was reintegrated in non-coding region at 24.88 Mb region on chromosome number 12.

Nearby genes from integrated loci were identified as LOC_Os12g40190 (G-protein alpha subunit, putative, expressed) which reside within 10kb region from Ds insertion. The results revealed that the LOC_Os12g40190 is at a distance of ~1.3kb downstream from the reintegrated 5Ds element.

The relative expression of "G-protein alpha subunit" LOC_Os12g40190 results revealed a 1.93 fold up-regulation as compared with WT control plant under control conditions. Thus, it was confirmed that the gene LOC_Os12g40190 tagged with enhancer element could be attributed to physiological variations observed in Ds-1 plant.

Development of transgenic lines in BPT5204 with En-Bar construct:

The homozygous lines (T5) confirmed through PCR were advanced to T6 generation and seeds from these lines were harvested. Fifteen homozygous lines were screened for WUE and identified one line which showed higher intrinsic WUE (iWUE) when compared to control (BPT5204) through physiological studies. This particular mutant line, EN-62 showed variations in leaf blade area, leaf length and leaf width as compared to control plants. In subsequent generation also the plants derived from EN-62 mutant showed similar phenotype. Flanking sequence analysis through Thermal Asymmetric Interlaced Polymerase Chain Reaction (TAIL-PCR) and real time PCR analysis revealed that an uncharacterized gene referred as "Conserved hypothetical protein" which located on chromosome 6 is responsible for variation in iWUE.

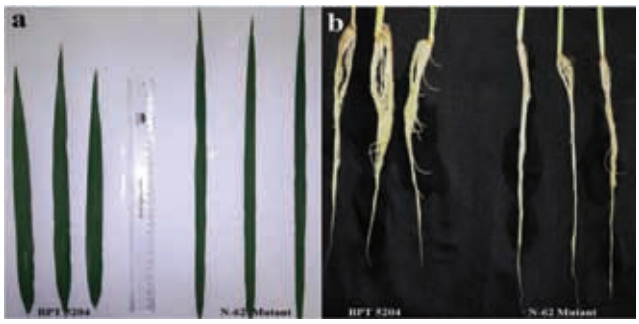


Fig: Phenotypic variations observed in N- 62 mutant at homozygous condition. (a): Thin and long flag leaf in EN-62 and broad and short flag leaf in WT (BPT 5204); (b): elongated rooting system in EN-62 mutant and dense rooting system in WT.

ABR/CI/BT/6:

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

Nine recombinant lines with high number of secondary grains (~150) were identified from 318 RIL population of Ganjeikalli (with higher number of grains on secondary branches of lower portion/Kalanamak (with higher number of grains on secondary branches of upper portion) grown during *kharif* 2018. In a subset of 36 RILs with higher number of grains on secondary branches, increased expression of triose phosphate/phosphate translocator (LOC_Os05g07870) was observed in panicle tissues, in addition to relatively enhanced expression of sucrose transporter (LOC_Os02g09170). In another sub set of 12 RILs with lower number of grains on secondary branches, the expression of these two genes was relatively low.

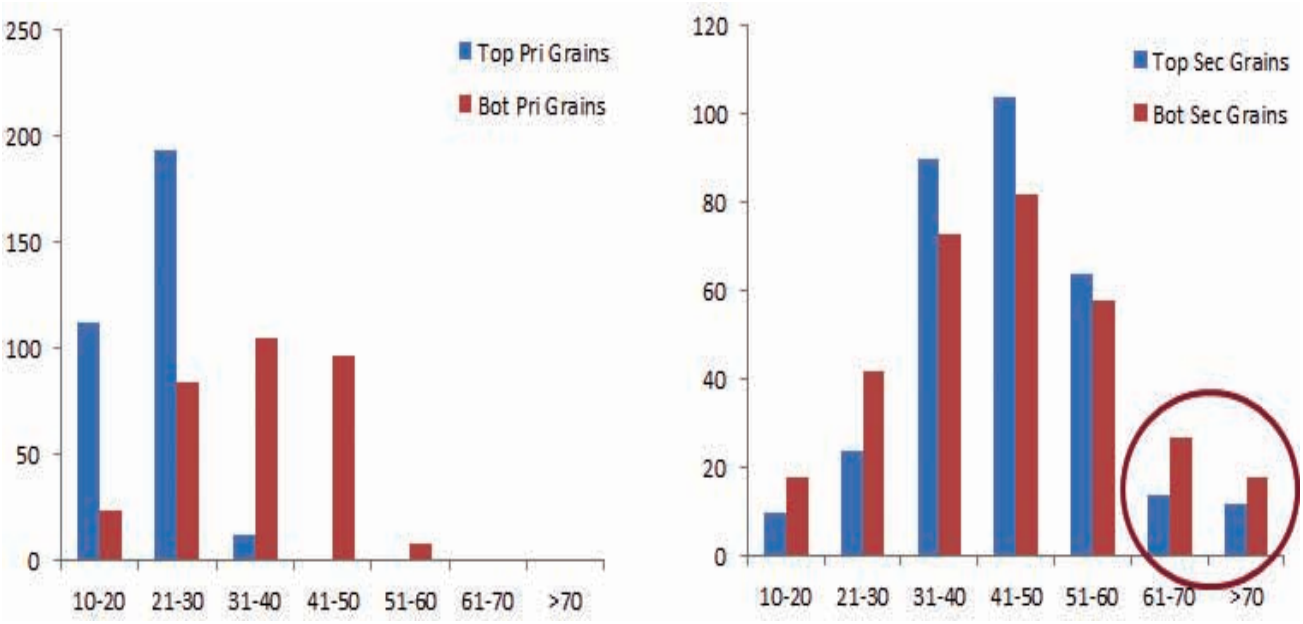


Fig: Transgressive variants with higher grains on secondary branches across the panicle

ABR/CI/BT10:

Genomic studies on grain yield heterosis and WA-CMS trait in rice.

Validation of molecular markers (SSRs/SNPs) associated with heterosis and utilization of the RIL population for marker-based heterosis prediction:

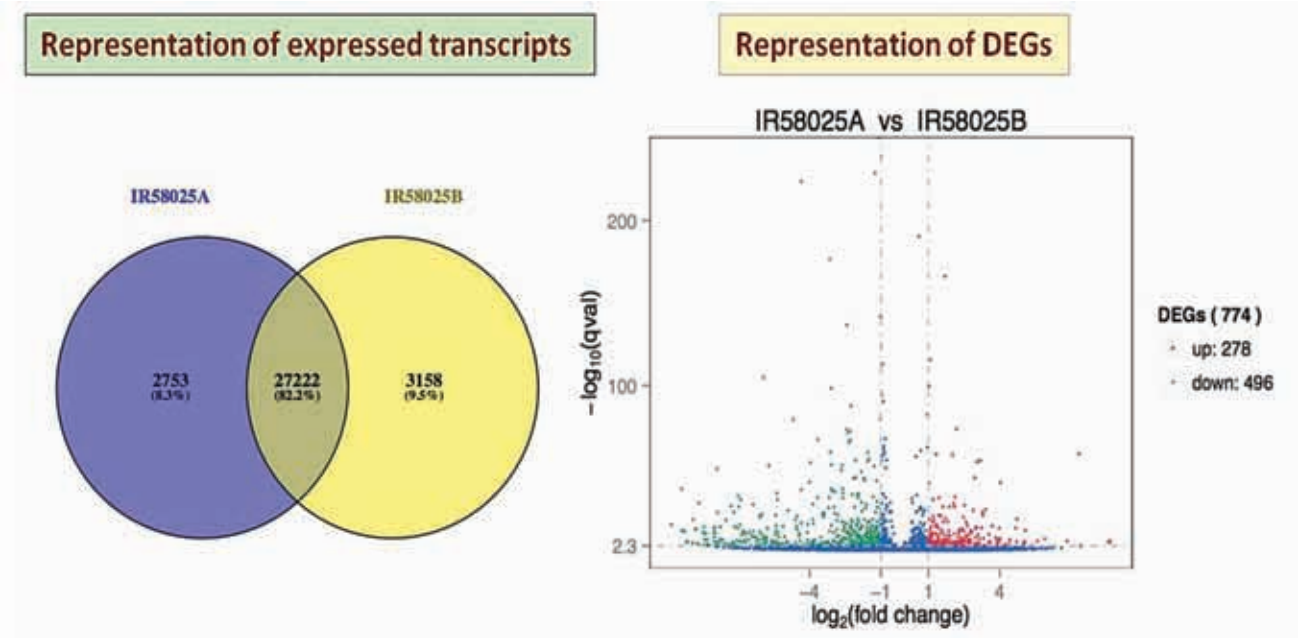
A set of 24 EST-SSRs, 42 hyper-variable genomic SSRs and 20 $(GATA)_n$ locus specific SSR markers were analyzed for their potential with respect to their utility in prediction of heterosis of cross combinations. While a single marker class was not able to predict heterotic potential of cross combinations, utilization of the complete marker set (n = 86) in Toto was helpful to predict heterosis to an extent of > 70 %.

In another study, a set of 21 RIL populations have been developed by crossing elite WA-CMS lines and/or their maintainer lines with multiple restorer lines. These 21 RIL populations (each of approx. 100 Nos.; @ F_{10} generation) were grown in the field during *Kharif* 2017 and the RIL population derived from the cross IR58025B/ KMR3R (i.e. parents of the hybrid, KRH2) were grown in *Kharif* 2018 to identify high yielding and low yielding RILs. A set of five each of best and worst performing RILs of KRH2 were crossed with IR258025A to generate a fresh set of hybrids The RIL population and also the newly generated hybrids are under evaluation.

Wild abortive cytoplasmic male sterility (WA-CMS) Trait:

RNA-seq analysis of immature panicles of the WA-CMS line, IR58025A and its cognate, isonuclear maintainer line, IR58025B (collected at pre-anthesis stage):

The whole transcriptome profiles of panicles of IR58025A, wild abortive cytoplasmic male sterile line (WA-CMS) and its isonuclear maintainer, IR58025B, collected at pre-anthesis stage (sporophytic stage) were compared to delineate the possible candidates involved in pollen abortion and male sterility. Among the 774 differentially expressed transcripts (DETs), 496 were down regulated and 278 were up regulated in IR58025A.



Gene ontology analysis showed the genes associated with defense, stress response, particularly related with oxidative stress, cell wall modifications and pectinesterase activity were enriched in IR58025A.

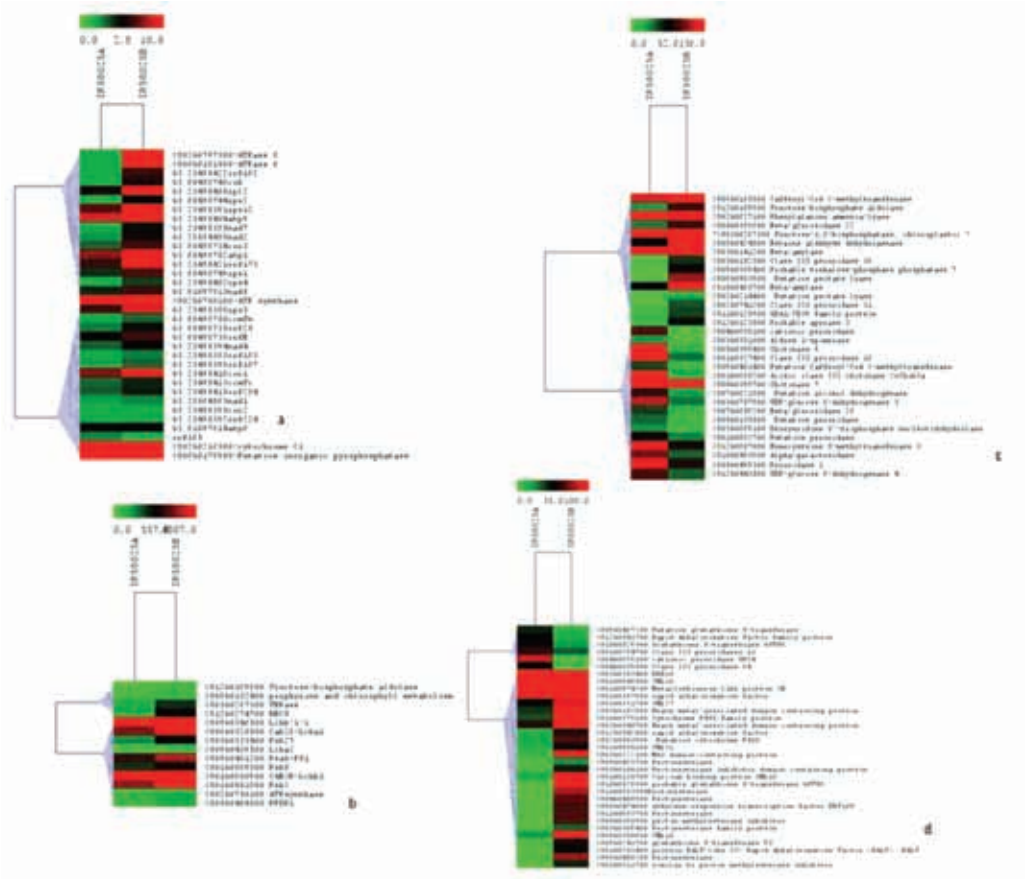


Fig: Representation of differentially expressed genes associated with key KEGG pathways as heat map

Further, pathway enrichment analysis showed the down regulation of DETs (both nuclear and organellar genes) involved in key metabolic processes of cell, respiration, photosynthesis and other energy yielding metabolites in the WA-CMS line relative to its maintainer line and the data derived from RNA-seq analysis perfectly correlated with qRT-PCR analysis . Based on the results obtained, it can be hypothesized that pollen abortion principally occurs due to up-regulation of pathways leading to oxidative stress leading to energy starvation conditions in consonance with reduced expression of genes associated with the cell wall formation and other key metabolic processes.

Identification of restorer/maintainer lines among rice germplasm:

Utilizing the co-dominant, functional markers targeting the two fertility restoration loci, upon screening with 220 germplasm lines resulted in identification of a new set of 92 restorer lines (i.e. possessing the restorer alleles with respect to Rf3 and Rf4) and 21 potential maintainer lines (i.e. devoid of the restorer alleles with respect to Rf3 and Rf4).

ABR/CI/BT/1:

Exploring the mutant resources for rice improvement.

To obtain novel/new resistant/ tolerant sources to various biotic stresses (yellow stem borer, Sheath blight and Bacterial leaf blight), a novel methodology of genomics assisted mutation breeding was started.

Molecular characterization of YSB resistant mutants and screening for resistance.

To study the molecular similarity of three YSB resistant lines viz., M-SMY-7, M-SMY-4 and M-SMY-1 with BPT-5204 as control, 120 SSRs uniformly spread across the genome were used. The three lines showed the percent similarity of 97, 98 and 95 with the wild type (BPT-5204). These three lines selected based on their superior performance in the Stem borer screening trail at AICRP in two successive years were tested in three different locations., two entries M-SMY-7 and M-SMY-4 showed high level of tolerance across the locations.

Molecular characterization of most promising sheath blight tolerant mutant and their screening multiple isolates

One hundred and twenty SSRs were used to determine the similarity of three extremely tolerant sheath blight mutants (SB-5, 6, 8) and found that these three lines have genome similarity of 97 % with the wild type (BPT-5204). Upon screening with 10 virulent *R. Solani* isolates collected from various hotspot regions of India, SB-5, SB-8 and SB-6 showed mean score of (2.84, 2.24 and 2.28) whereas BPT-5204 (wild type), TN-1 and resistant control showed score of (9, 9 and 4.45). This indicates that these three lines are extremely good resistant sources for the sheath blight.

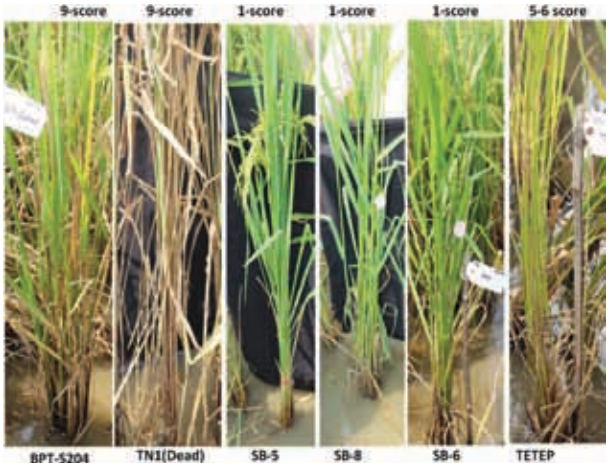


Fig: Sheath blight resistant lines

Mapping the mutant locus using NGS

To determine the mutated loci that conferring the resistance for ShB in Sb-5, MUTMAP (NGS based approach) was chosen. Analysis of SNP index plots (prepared based on the comparison of resistant bulks with wild type) indicated a peak region in the chromosome-1 40.1 Mb to 41 Mb region, in the same region where there was a valley in the SNP index (prepared based on the comparison of susceptible bulks with resistant mutant) also found. This region indicated the causative SNPs for the mutation which are leading to the resistance.

Identification and characterization of useful mutants

Two high yielding mutant lines, IIRR-93-R and TI-6 were evaluated across multiple locations (MLTs) in Telangana region. The mutant line, IIRR-93-R performed well over the checks in all locations. It matures 28 days than BPT5204, having tolerance to YSB, BPH and GM. It has cooking and milling qualities similar to BPT and gave high yield of 8.0 to 8.5 ton/ ha based on the plot size of 1.0 acre tested in three different locations.

Fig: Field performance of early maturing mutant line IIRR93-R

ABR /CI/BT/14:

Exploring RNAi Technology for Management of Rice Diseases.

Developed transgenic rice lines of Taipei 309 with the gene construct, PG-pGA3626 RNAi. Twenty seeds from each of the Taipei 309- PG-pGA3626 RNAi positive plants were advanced to next generation and all plants were maintained in biosafety glass house. Out of 115 T_1 plants, 78 plants were PCR positive with gene specific primers. Further bioassay studies were carried out to evaluate the effectiveness of the sheath blight tolerance among the transgenic plants through typha mediated inoculation method. Screening was carried out in *kharif* 2017 under glasshouse condition along with untransformed controls TN1 and Tapei 309. The scores were recorded as per 0-9 scale of SES, IRRI, 2014. The degree of disease severity was recorded on 5th & 10th day after inoculation. We observed that out of seven T_1 Tapei 309- PG-pGA3626 RNAi lines, two lines were highly tolerant (score 3). Remaining lines showed good level tolerance (Score 5) to sheath blight, when compared to controls (score 9)

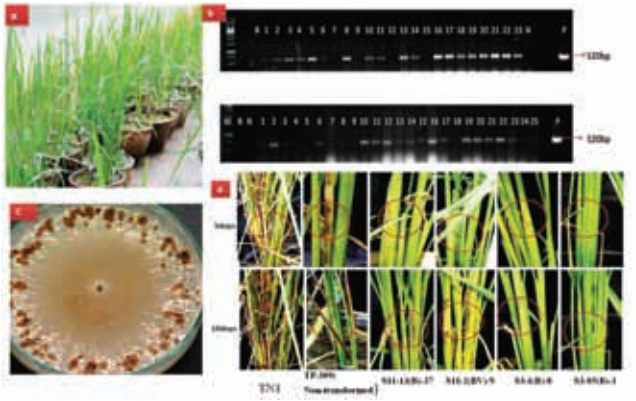


Fig: a) T1 Tapei 309 (S11& S3) sheath blight transgenic lines maintained in biosafety glass house b) T1 TP309 (S11& S3) plants carrying R. solani PG gene was screened by PCR using gene specific primers . M: 1 Kb DNA ladder; B: Blank; N: non-transformed plant (control); 1-23 and 1-25: transgenic plants, and P: positive control (Plasmid DNA) c) R.solani culture on PDA d) Typha leaf bit method for screening against sheath blight disease along with controls TN1, Tapei 309. T1 Tapei309- S11-13B-37, S11-2BV-9 and S3-1B-8, S3-85BV-3 transgenic lines showed high level of tolerance.

ABR/CI/BT/13:

Candidate gene identification for manipulating growth related genes in rice through computational and expression studies.

qPCR expression studies and physiological assessment of four select genes were performed in two different varieties Jarava and Gondra Bidhan 3. The relative expression of PGM and PG4AGT genes associated with cellular growth were down regulated and SPS was up regulated during late vegetative phase. The differences in physiological parameters and growth observed for mid and late vegetative phases have shown correlation with the expression pattern.

ABR /CI/BT/15:

Molecular and functional characterization of useful root traits in rice.

The seedling vigor index (SVI) and emergence was recorded for the diverse 150 lines/ genotypes at 14 days after germination and best lines were selected on the basis of dry weight, seedling length, mesocotyl/hypocotyl lengths. Fifteen lines including mutants, and segregates showed comparatively high seedling vigor index with early emergence. The lines showing robust root traits like high volume, deeper length and higher dry weight were selected for further studies. It is expected that such lines may have allelic variation at the locus identified for such traits.

A total of 27 root traits related genes reported to be involved in root development, root elongation, nutrient uptake and stress tolerance were selected for relative gene expression analysis in root tissue at panicle initiation stage under aerobic and anaerobic conditions. The expression data shown that genes related to nutrient uptake, root elongation were highly expressed under aerobic condition. Similarly, expression of functionally significant transcripts each in shoot and root was validated through qRT-PCR under aerobic and anaerobic conditions in CR Dhan202 and BPT 5204 based on the priori knowledge from RNA-seq data analysis. The transcripts for brassinosteroid insensitive protein BK1, DREB transcription factor, Metallothionein-like protein 2A MT2A, Nicotianamine synthase 1 NAS1, Inorganic phosphate transporter 1;6 PHT1,6, Water stress-inducible protein Rab21, Metal-nicotianamine transporter YSL2 were highly expressed in root tissue of CRDhan under aerobic condition signifying the importance and role of these transcripts in aerobic adaptation.

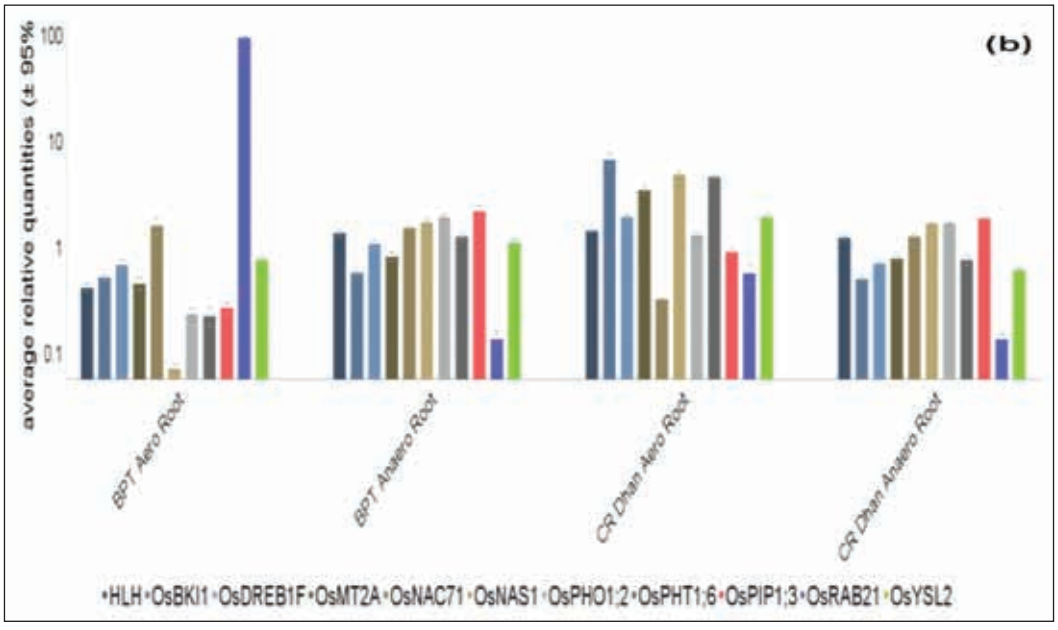


Fig: Relative expression of transcripts in root under aerobic and anaerobic conditions.

ICAR-NPP-OXX02332:

Development of chromosome segment substitution lines of rice from elite x wild crosses to map QTLs/genes for yield traits.

Development of new CSSL and QTL mapping:

Three hundred six BC_4F_2 families derived from MTU1010/*O. rufipogon* (IC309814) were evaluated for yield related traits during *kharif* 2017. Based on pair-wise mean comparison, 152 significantly different lines were identified for 6 traits; 71 lines were identified as positively significant and 132 lines negatively significant as compared to MTU1010.

From the cross of Swarna/*O. rufipogon* (IC309814), 350 BC_4F_1 were backcrossed to get BC_4F_2 for developing CSSLs. From the same cross, 314 BC_2F_2 families were evaluated in field for 13 yield related traits. Of which 78 lines were taller and one line was significantly shorter; 11 had higher biomass; one line had significantly higher stem diameter, 16 lines had higher flag leaf width. Stem diameter showed significant positive correlation with plant height (PH), single plant yield (SPY), SPAD, flag leaf length (FLL), flag leaf width (FLW) and biomass (BM). Two lines A-184, A-301 showed significance for six yield related traits and A-301 showed 56% higher yield than Swarna but only in wet season. Lines A-214, A-124, A-224 were significantly different from Swarna for 7 traits in dry season. An additional cross Swarna x *O. nivara* (IC336681) was advanced upto BC2F3 without marker assisted backcross. Phenotypic data for 10 yield and 3 yield derived traits was collected from six single plants from 230 BC_2F_3 in dry season 2017. BC_2F_4 was raised in dry season 2018. The BC2F6 BILs are a good resource for sharing and screening for several agronomic traits.

ABR/ CI/BR/28:

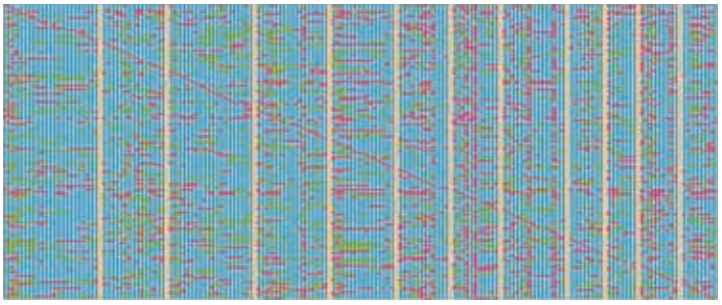


Fig. CSSL Finder output of MTU1010/*O. rufipogon* in BC2F2 population.

Fig. BC2F2 population of Swarna /O. rufipogon in field

Exploring wild introgression lines and mutants to identify novel genes/ QTLs for yield contributing traits.

One hundred and five NPS lines derived from Swarna/*O. nivara* (IRGC81848) were evaluated for 10 yield related traits in three years. Among them, 67 positively significant lines were identified for six traits, while 49 were negatively significant than the parent Swarna. The line NPS-53 (220S) was found significantly better for panicle weight and NPS-64 (235S) for biomass.

Sixty two significantly better lines selected from three years screening data from different mapping populations viz., Swarna x *Oryza nivara*(IRGC81848 (S), Swarna x *Oryza nivara* IRGC81832 (K), KMR3 / *O. rufipogon* WR120 were screened in *Kharif* 2017 along with high yielding lines of Jalmagna/Swarna, BPT5204/ *O.rufipogon*, BIL x BIL crosses and mutants. Mutants NH663, NH 56, NH162, NH201, NH156 NH 363 NH 733-1, NH101 , 377-24, 212 S, 24 K, 13-7, NSR68, 248J, NSR86, 132 J were found promising with higher bulk yield. The superior lines with better yield than the checks were entered in various AICRIP trials based on duration and grain type.

RUE – Enhancing Resource and Input Use Efficiency

AGRO/IUE/11:

Strategic research on enhancing water Use efficiency and productivity in irrigated rice system

In order to estimate the potential water saving technologies, the trials were conducted in different water saving methods at IIRR. The treatments consisted different methods of crop establishment and water regimes under different management practices. The results indicate that the SRI method recorded significantly higher grain yields (5.91 t/ha.) and straw (7.67 t/ha) compared with mechanized SRI (5.74 and 6.75 t/ha) respectively. SRI method gave slightly higher gross returns and net returns (Rs. 83,280 and Rs. 42,860 /ha) over MSRI (Rs. 80,926 and Rs. 42,686). However, the planting methods did not differ significantly between MSRI and SRI with respect to B:C ratio during both years of study.

Among irrigation management practices, the saturation treatment registered significantly higher gross returns (Rs. 87,400/ha) and net returns (Rs. 46,570/ha) which were significantly superior over irrigation at 5 DADPW (Rs. 75,083/ ha and Rs 36,352/ha).

Water productivity

Water productivity was significantly higher with SRI (5.02 kg ha mm^{-1}) over MSRI (4.91 kg ha mm^{-1}). The saturation method and irrigating 3DADPW recorded significantly higher water productivity (5.21and 5.03 kg ha mm ^{1}) over irrigating at 5 DADPW.

Experiments were also conducted 2015 to 2017 to assess the productivity and green house gas emission in different irrigation regions and crop establishment methods for addressing the climate changes. The mean global warming potential values were significantly lower in MSRI (3090 kg CO_2 eq ha^{-1}) as compared to NTP (32.90 kg CO_2 eq ha^{-1}). Hence, MSRI can be adopted in wide scale for mitigating global warming as well as enhancing the productivity of rice system with limited resources in India.

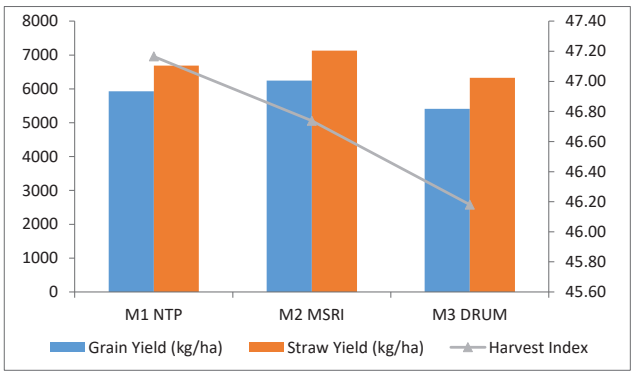


Fig. Grain, Straw yield and HI % as influenced by methods of Crop establishment er saving potential for SRI over NTP in different soil conditions also indicated the saving of water to the tune of 28%. The percent water saving varied from soil type and management condition.

RUE/CP/AG/13:

Development of suitable agronomic management practices for improving the productivity of aerobic rice and aerobic rice based cropping systems.

Plant Growth Promoters usage in Aerobic rice cultivation

The trial was initiated during *Kharif* 2016, with the objective of evaluating different plant growth promoters on growth and yield of aerobic rice. The trial was executed in RBD with 10 treatments viz., seed treatment with *Trichoderma viridi*, *Trichoderma harzianum*, chitinase producing bacteria isolate 1, chitinase producing bacteria isolate 4, *Trichoderma viridi* isolate1, *Penicillium oxalium*, *Glucano acetobactor*, *Bacillus subtillis* and Potassium Dihydrogen Orthophosphate 4% against non treated control. Additionally two mulching treatments with green matter @ 5 t/ ha and paddy straw 2.5 t/ha were included to find out the impact on weed population and weed biomass. The test variety was high yielding short duration variety DRRDhan46. The data on seedling vigor index, growth parameters, yield attributes and yield indicated that, paddy straw mulching, green leaf mulching and seed priming with potassium dihydrogen orthophosphate improved seedling vigor index and resulted in higher yield.

Fig: Green mulching

Fig: Paddy straw mulching

Fig: KH2PO4 priming

Agronomic management for new drought tolerant varieties suitable for rabi season

Field experiment was carried out at IIRR Farm during second consecutive *rabi* season of 2016/17 to study the influence of N rates and drought tolerant varieties on green house gas emissions of puddled direct sown rice. Treatments comprised of four rates of nitrogen- Control (no nitrogen), N_{100} (100 kg N/ha), N_{120} (120 kg N/ha) and N_{140} (140 kg N/ha) as main plots and four drought tolerant rice varieties (V_1-DRR Dhan 42; V_2-DRR Dhan 44; V_3-DRR Dhan 46 and V_4-IR 64). There was no considerable difference in CH_4 and N_2O and CO_2 emissions between the test Varieties. The CO_2 flux was comparatively lower in the treatment of DRR Dhan 44. The N_2O flux was low in IR64 and higher in DRR Dhan 42, DRR Dhan 44 and DRR Dhan 46. The CH_4 flux was considerably low in DRR Dhan 42 when compared to other test varieties. Among the nitrogen doses, there was an increase in CH_4; N_2O; CO_2 emissions with increase in Nitrogen dose from 100 to 140 kg/ha.

Fig: GHG sampling

Table: Global Warming potential of Varieties &N levels

Varieties	GWP kg CO_2 eq./ha	N levels	GWP kg CO_2 eq./ha
IR 64	3954.38	N0	3207.55
DRR Dhan 42	3964.54	N100	3539.30
DRR Dhan 44	3934.82	N120	4146.82
DRR Dhan 46	3918.54	N140	4722.70

RUE/CP/AG/17:

Comparative study of organic and conservation agriculture for enhanced resource use efficiency, yield and quality of rice

The experiment was laid out in split-plot design with six main plot treatments T_1-100% RDF through inorganic sources + 30% RR (rice residue) retention, T_2- Integrated nutrient management + 30% RR (rice residue) retention, T_3- Need based nutrient application + 30% RR (rice residue) retention, T_4-100% RDF through inorganic sources + No residue retention, T_5- Integrated nutrient management + No residue retention, T_6- Need based nutrient application + No residue retention. Four popular varieties of the region were assigned to sub plot namely V_1- RP Bio 226, V_2- Varadhan, V_3- DRR Dhan 45 and V_4-Telangana Sona. T_2- recorded higher no of tillers /m^2 at 60 and 90 DAS, panicles/m^2 (285 and 292), panicle weight (41.50), test weight (21.68 g) which led to increased grain yield (4.74 t/ha), Straw yield (5.93 t/ha). V_1 performed significantly superior than other varieties for both Grain yield and straw yield.

RUE/CP/SS/16

Study of rice vegetation in terms of crop stress to model the yield using NDVI

MODIS images pertaining to West Godavari and Nalgonda districts (736 each) were arranged for analysis. These data sets were subjected to Time Series Analysis using a software, TIMESAT, which is freely available and works with smoothing using Savitzky-Golay,Asymmetric Gaussian and Double Logistic filters, was done.

During the course of investigation, certain geostatistical methods were tested to generate various soil theme maps using the data given in the soil health cards pertaining to West Godavari district. The data points were purified with regard to geographic coordinates using Google Earth as the reference. Resultant datasets were subjected to analysis using Ordinary Kriging (OK), Inverted Distance Weightage (IDW) and Nearest Neighbour(NN) interpolators. The models were compared for efficiency and errors and found that OK and IDW were better in combination for different soil variables. This method could better be adopted in making soil fertility maps where there is repeatability every three years as per the policy. Certain soil theme maps pertaining to 10 different mandals of West Godavari districts were presented to demonstrate the utility of the method.

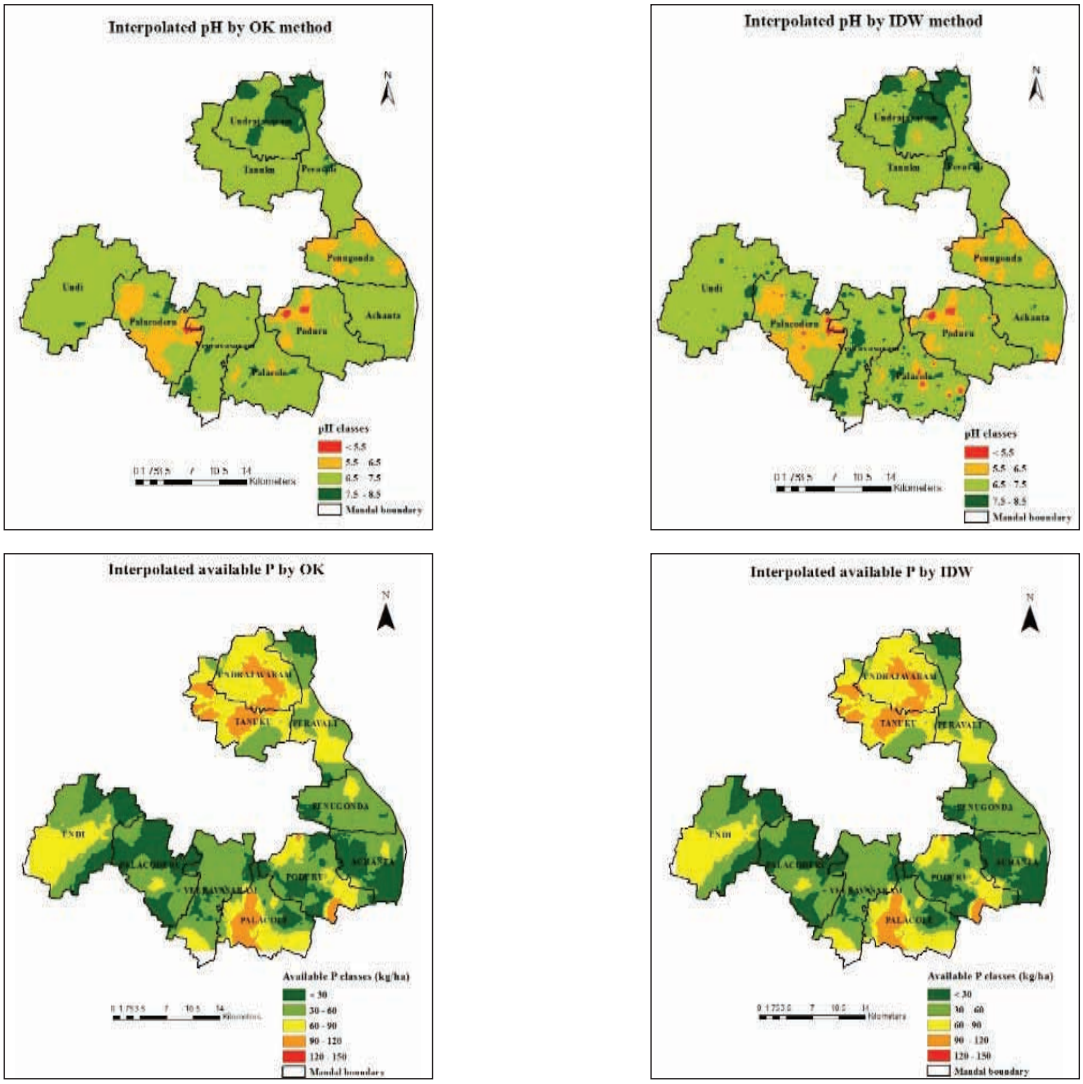


Fig: Soil theme maps pertaining to 10 different mandals of West Godavari

RUE/CP/SS/19

Evaluation of ZnO nano particles on performance of Rice

ZnO nanoparticles were subjected to analyses for its crystalinity, particle size, shape and composition by different characterization methods like X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and energy dispersive (EDX). Characterization of ZnO nano particles revealed that particles were in the range of less than 100 nm.

Nano particles were further used for its evaluation on rice seed germination, seedling vigour and seedling length with different doses of bulk ZnO (500, 1000 and 1500 mg L^{-1}) and nano ZnO (50, 100 and 150 mg L^{-1}) with two different soaking times (24 and 48 hrs). Results have clearly shown that application of nano-ZnO at 150 mg L^{-1} found to be better in germination percentage and seedling vigour in rice crop.

RUE/CP/SS/20

Efficacy of hydrogel on yield and soil properties of rice

Hydrogel has been characterized for its water holding capacity, nutrient holding capacity. Water holding capacity of hydrogel was tested by using different types of waters. The water absorption capacity of hydrogel was more with distilled water followed by mineral water and tap water. One gram of hydrogel can hold near about 250 ml distilled water (pH – 7.69, EC- 0.15), 170 ml mineral water (pH – 7.67, EC- 0.52), 120 ml tap water (pH – 7.41, EC- 1.29). The water holding capacity decreases with increased salinity level in water. Hydrogel has also been characterized for its nutrient holding capacity. With increasing doses of hydrogel, potassium absorption increased and also with increased levels of Potassium nitrate, potassium absorption level of hydrogel was increased.

Pot culture experiment was conducted with different doses of hydrogel. With increasing doses of hydrogel water absorption was increased. Hydrogel application @ 0.2g/kg of soil was found better than other tested treatments.

SSP- Sustaining Rice System Productivity

SSP/CP/SS/11

Assessment of Genotypic variability and improving nitrogen use efficiency (NUE) in irrigated rice

This field experiment was initiated in 2010-11 and was continued during *kharif* and *rabi* seasons of 2014 with 2 N levels (@ N-0 and N-100 kg/ha) as main treatments and 16 genotypes and 20 PUP lines 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. Based on the grain yield, out of 16 genotypes, KRH2, Varadhan, PUP 221 and PUP 223 were found most promising for both soil and applied N utilization and responsiveness. At graded levels of N with different sources of N, grain yield was maximum with 100 kg N/ha and among the N sources, polymer coated urea (PCU) and neem coated urea (NCU) were significantly superior to all other sources viz., urea, vermi-compost and rice straw compost with their slow N release and high recovery efficiency under transplanted conditions.

Table: Top five nitrogen use efficient genotypes at different locations

S.No.	Bapatla		Chinsurah		Dharwad		Gangavati	
	Variety	Yield (t/ha)	Variety	Yield (t/ha)	Variety	Yield (t/ha)	Variety	Yield (t/ha)
1	MO 22-Shreyas	6.84	MO 22-Shreyas	4.59	MGD -101	7.27	RNUE-10	8.74
2	MGD-1605	6.64	Varadhan	4.45	MO 21-Pratyasa	6.17	MGD-1605	8.01
3	BPT-NUE-1	6.76	RNUE-10	4.35	MO 22-Shreyas	5.47	BPT-NUE-3	7.44
4	BPT-NUE-2	6.35	IR 64	4.33	MGD-1605	5.51	GV-NUE-1	7.64
5	GV-NUE-1	5.66	MGD-1605	4.17	RNUE-10	4.57	IR 64	7.37

SSP/CP/SS/18

Studies on Soil Organic Carbon Status. Mapping and stocks in Rice Soils of India.

The team consisting of scientists from ICAR-IIRR, Hyderabad had a transect walk in around the watershed areas. A first hand report was generated about the existing landforms, soils, geographical locations, farming system prevalent and cropping pattern followed. As the land is sloppy and steeply undulating at places, problem of soil depth was encountered and most of the land was monocropped. The physiography of the watershed is divided into sloppy/ small hills, small valley and flat lands. The primary occupation of all the villagers in and around the watershed area is agriculture and farm operations prevalent are not very advanced.

The landform ranges are inclined north to south direction in parallel series. The ranges are separated from one another by narrow semi deep small narrow gullies or stretching sometimes to valleys. The terrain of the watershed is young and immature, shows prominent relief feature with moderately to steep and very steep slopes and is still undergoing denudation in response to various exogenetic processes. The soils of different physiographic units of the watershed areas are of homogenous nature, mainly derived from Sandstones, Shales and Siltstones. The surface of the soils of the watershed areas are dark, highly leached and poor in bases and have neutral to slightly lower pH values ranging from 6.8 to 6.0. The texture of soil is mostly sandy to sandy clay loam (where complete black soils were observed). Clays contents do not increase with depth and no Argillic horigen is identified indicating that the soil is yet on its way to pedogenic horizon development.

SSP/CP/SS/13

Utilization of plant growth promoting microorganisms for improving nitrogen and water use efficiency in rice.

A pot culture experiment was conducted to study the effect of single and combined inoculation of *Gluconacetobacter diazotrophicus* Pal 5 *and Bacillus subtilis* (GenBank accession number- MF171124) on water stress tolerance of rice. The highest shoot biomass of individual tiller was observed under combined nnoculation (11.98 g) under water stress condition. Combined inoculation also resulted in significantly higher total soluble sugar content and antioxidant activity in leaves of both stressed and unstressed plants implying the benefits accrued to rice plants due to bacterial inoculation. Soil carbohydrate content, which is indicative of soil moisture retention was also observed to be higher in soil with combined inoculations of both the bacteria.

SSP/CP/SS/15

Microbial population dynamics in different rice establishment method in relation to nutritional availability and acquisition."

The experiment was conducted with three rice establishment methods *viz.*, like Aerobic rice, Alternate wetting and drying rice, flooded rice. Soil samples were collected for total microbial enumeration and aerobic rice method was observed with highest number bacteria (270 $x10^6$ CFU/ gram of soil), Actinomycetes (120 $x10^4$ CFU/ gram of soil) and fungi (25 $x10^3$ CFU/ gram of soil).

The soil samples were enumerated for nitrogen fixing bacterial population using Rennie's N free medium it was observed that aerobic rice methods were supported highest population of nitrogen fixing bacteria (197 $x10^6$ CFU/ gram of soil) followed by Alternate wetting and drying rice and flooded rice. Among 197 purified isolates, 120 were analysed for the presence of dinitrogenase enzyme by ARA (Acetylene Reducing Assay) through GC analysis.

SSP/CP/AG/15:

Sustainable intensification of rice-maize system through conservation agriculture.

Sustainable nutrient management in rice maize system is a tough challenge in southern India. Conservation agriculture (CA) based tillage and crop establishment options such as reduced tillage and maintaining stubble mulch may hold potential to increase yield, reduce crop establishment costs, and increase income of the farmers. The results of the experiment indicated that manual transplanting method followed by conventional tillage in *rabi* maize resulted significantly higher system productivity of 13.2 t/ha than those of other treatment combinations. Minimum tillage in maize resulted low system productivity compared to conventional tillage irrespective of treatments. There was no clear trend in terms of major soil nutrients (N, P and K) gain/loss over initial soil status.

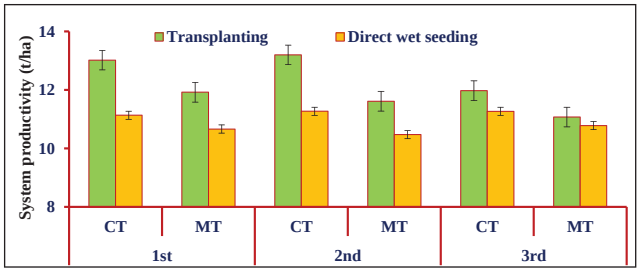


Fig. Effect of different date of sowing, establishment method and tillage intensity on system productivity of rice-maize cropping system.

CP/ENG/6

Selective mechanization in rice cultivation.

An experiment was conducted to compare DSR (Mechanical & manual) and Transplanted rice cultivation in terms of crop establishment, labour requirement, herbicide requirement irrigation requirement, yield etc. Wet land weeder developed by NIPHM and IIRR was tested after modification. Modified weeder was tested in *Kharif* 2017 and it was found to be very useful.

TTI/CP/CA/4:

Computer Applications: Wireless Sensor Networks integrating with Rice DSS model for real time advisories.

To analyse E-Crop model to integrate with Rice DSS

In continuation to the development of web based spatial DSS by integrating Oryza2000 model, GIS layers and economic interface, this project was initiated with the main objective of validating Spatial DSS at field level. This DSS will be integrated with weather sensors and real time advisories can be sent to farmers through mobile apps by executing crop model in the background.

During this year, Electronic Crop (E-Crop) model has been analysed for suitability to rice crop. E-Crop developed by ICAR-CTCRI,

provides real-time agro advisories directly from the field using crop models and weather sensors. The standalone software E-Crop Scheduler gets activated in the local machine at a stipulated time and this scheduler downloads the day's weather parameters and the other data updated through interface to the local machine. In the local machine the corresponding crop simulation model gets executed and generates agro advisory. This advisory is sent to the mobile of the concerned farmer in the form of SMS. Since crop simulation models are used and weather and soil data are collected directly from the field, the forecasts from this device are more accurate and reliable. Crop simulation module of E-Crop can be replaced by Spatial DSS module and different modules of Spatial DSS can be customised to use with E-Crop.

A software program has been developed to convert the output file of weather sensor data into weather file of Oryza2000 model. One command button (***Convert WSN weather*** **file)** was designed in the DSS interface to convert WSN weather file to Oryza2000 model weather file .

CCR – Assessing and managing Crop Response to Climate Change

CCR/CP/PP/11:

Evaluation of genotypic variability in leaf photosynthetic efficiency and its associated factors in rice.

Thirty six rice genotypes containing a combination of 5 yield enhancing genes were assessed for leaf photosynthetic traits. Significant variation was observed for all the gas-exchange traits. The P_N varied between 14.2 (YPK-1095) *[SWARNA/ST 6/ST 12///SWARNA]* and 26.1 µmol (CO_2) m^{-2} s^{-1} (YPK-1126) *[MTU 1010*2/HABATAKI]* with a mean value of 20.8 µmol (CO_2) m^{-2} $s^{-1.}$ Stomatal conductance is another important trait which varied significantly ($p<0.01$) amongst the tested genotypes. YPK-1126 *[MTU 1010*2/HABATAKI]* showed highest (0.596 mol (H_2O) m^{-2} s^{-1}) stomatal conductance followed by YPK-1129 *[MTU1010/ ST6/ST 12///MTU 1010]* with a mean of 0.484(0.566 mol (H_2O) m^{-2} s^{-1}).

Multiple correlation analysis was done to understand the relationship between the leaf gas change traits and some important yield parameters. Very significant positive association was observed between the leaf photosynthetic efficiency (P_N) and stomatal conductance (gs), P_N/C_i (carboxylation efficiency). The intercellular CO_2 and the Ci/Ca (ratio of intercellular and ambient CO_2 concentration) showed a significant ($p<0.01$) negative association with P_N. The association between P_N and grain yield and TDM was significant. Very strong positive association was observed between TDM, 1000 grain weight and Harvest Index. P_N show non-significant association with total chlorophyll and carotenoid content suggesting that the variation in P_N between the genotypes was not entirely due to leaf photosynthetic pigment content. In order to

identify the contribution of each gas-exchange parameters and leaf pigment content to PN, multiple regression analysis was performed. The data revealed that the PN/Ci contributed >20% to the R^2 (regression coefficient) value followed by gs Ci and Ci/Ca to the R^2 when "lmg (Lindeman, Merenda and Gold)" method was used. However, the "pmvd (Feldman)" method indicated that >35 % was contributed by PN/Ci to R^2 during *kharif* season. The ratio of intercellular CO_2 and ambient CO_2 showed a strong negative correlation associated with the P_N and along with *Ci* it played a significant role in determining the photosynthetic efficiency in rice.

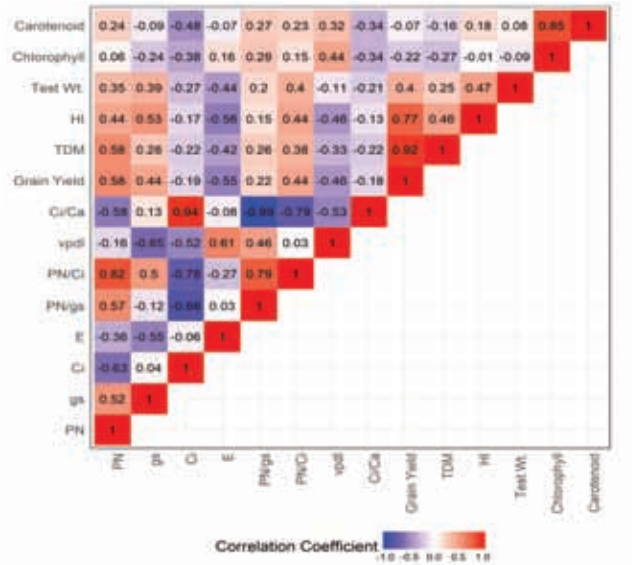


Fig: Relationship between leaf gas-exchange traits and grain yield in rice genotypes

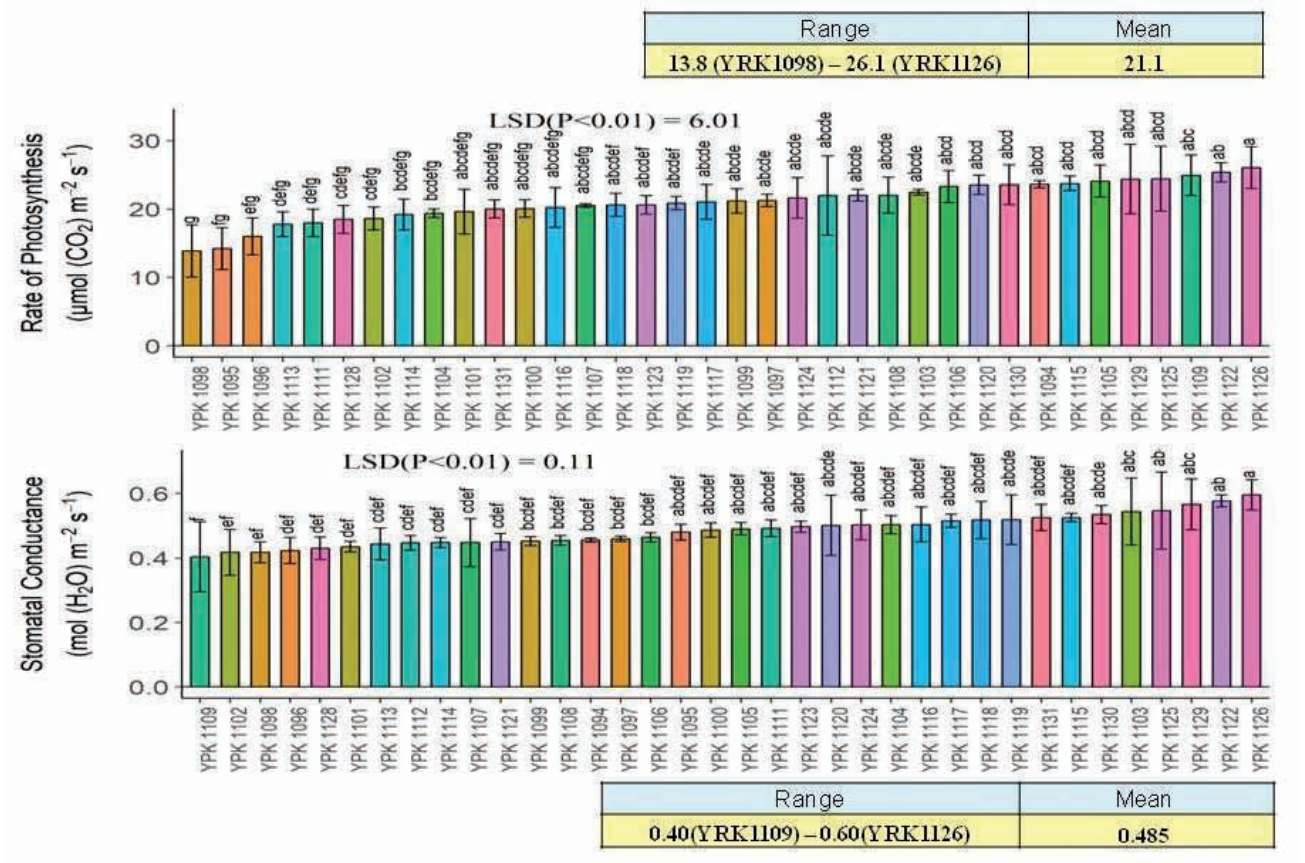


Fig: Variation in leaf photosynthetic traits in divergent rice genotypes. Each bar represents the mean of 3 replications ±stdev. Bars with same letters are statistically non-significant

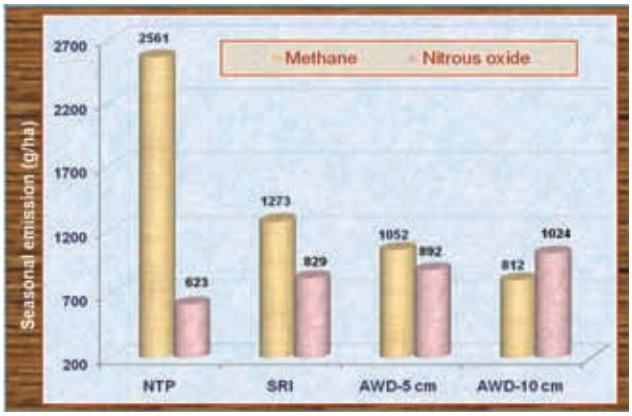
CCR/CP/SS/17

Studies on emission of green house gases (GHGs) from rice soils and their mitigation.

The different establishment/planting methods significantly impacted both the green house gas i.e., methane and nitrous oxide emissions throughout the crop growth period. The seasonal integrated flux (SIF) for methane was the highest in normal / conventional transplanted (TPR) method (25.61 kg ha^{-1}) followed by SRI (12.73 kg ha^{-1}) and AWD resulted in lower flux values of 10.52 and 8.12 kg ha^{-1} with irrigation at 5 and 10 cm depletion of ponded water. Methane emissions decreased by more than 50 per cent in SRI and by 59 – 68 per cent in AWD methods as compared to TPR.

The lowest N_2O-N emissions were observed in TPR. The seasonal integrated fluxes of N_2O-N were the least in TPR (0.623 kg ha^{-1}) as compared to SRI (0.829 kg ha^{-1}) and AWD methods (0.892 and 1.024 kg ha^{-1}). N_2O-N emissions were higher by 33 per cent in SRI and 43 – 64 per cent in AWD methods over TPR.

Global Warming Potential (GWP): SRI and AWD methods lowered the GWP due to lower methane emissions as compared to the conventional TPR. The GWP in SRI decreased by 32 per cent while in AWD by 36 – 38% over TPR.



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

HRI/CPT/ENT/11:

Assessment of host plant resistance to rice planthoppers viz., brown planthopper *Nilaparvata lugens* and whitebacked Planthopper *Sogatella furcifera* and their management

Evaluation of breeding lines for planthopper resistance:

Out of 2295 entries evaluated for BPH resistance, 17 entries *viz*., Swarna/Sinnasivappu RILs- 300, 254, 64 and 297; Swarna/*O. nivara* introgression lines NPS 55, NPS 60, NPS 67; AGBD 2017 germplasm lines- 198, 106, 563, 303, 412 and 441; RP 2068-18-3-5, CR 2711-149, IET 26510 and IET 26489 were highly resistant to brown planthopper with a damage score of 0 to 1. Eleven hundred and thirty entries from screening nurseries and breeding lines were evaluated against WBPH in greenhouse through mass screening tests. Three entries *viz*., RP 6121Bphk17-2, RP 6121Bphk17-1 and IET 26469 were highly resistant with a damage score of <1.0 and 73 entries were promising with a low damage score (<5.0).

Molecular characterization of BPH populations from different parts of India:

BPH populations were collected from different places in India and their reaction to host plant differentials was evaluated. Molecular analysis was done with eight BPH populations using 98 BPH specific-SSR-markers and SSR markers data were analyzed by unweighted pairgroup method with Arithmetic Mean (UPGMA) using DARwin V6.0. This analysis clustered eight BPH populations into three groups.

HRI/CPT/ENT/19

Assessment of host plant resistance to leaf folder and semiochemical approaches for the management of insect pests of rice:

Evaluation of 53 elite high yielding introgression lines derived from tropical japonicas (JBB lines) and 29 wild rice lines from IRRI (HWR lines) for resistance to rice leaf folder was done along with a susceptible check, TN1 and resistant check, W 1263 using a rapid field screening method. Out of 82 lines, 12 lines (10 JBB lines and 2 HWR lines) were identified as moderately resistant to rice leaf folder. A negative correlation was found between leaf width and leaf folder damage. Leaf folding behavior studies revealed that larva took more time to select a leaf for folding; made less binds and less number of head swings on moderately resistant line (JBB 623) as compared to the susceptible line, JBB 686.

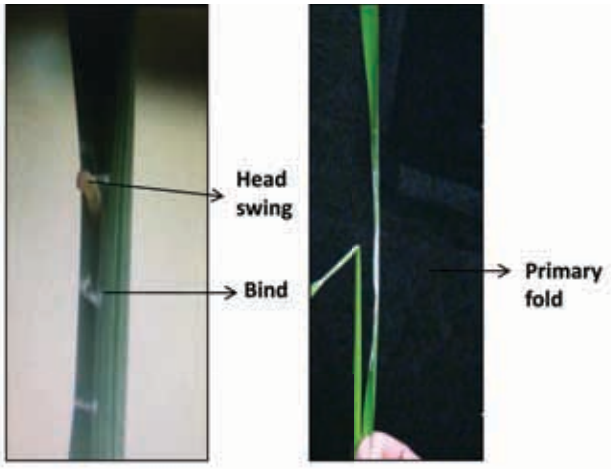


Fig. Leaf folding characteristics of *C. medinalis*

HRI/CPT/ ENT/23:

Insect-plant interactions with special reference to rice pests – yellow stem borer and gall midge

Yellow Stem borer: A selection of RP 5587 (IET 25109) identified as promising against stem borer damage in station trials was nominated for yield trial in IVT aerobic in *kharif* 2016. Field screening of material at vegetative and reproductive phase of crop growth for yellow stem borer identified new sources of tolerance in KMR 3 improved lines BK 49-76, BK 39-179, BK 49-42, BK 35-155, BK 64-116 in second year of testing.

Phenotyping was carried out in the 9 select lines of RP 5588 and RP 5587 through cut stem assays, whole plant bioassay and quantification of grain yield under both infested and uninfested conditions and grain yield indices were calculated. The selection indices suggested that the test lines had high antibiosis index of >1.

Gall midge: Evaluation of 40 pyramided lines with Gm4 + Gm8 lines in the background of MTU1010 identified all lines as resistant to gall midge except for 3 lines which showed susceptibility. Mapping populations of JGL 542 x TN 1, INRC 17470 x TN 1 and INRC 18108 x TN1 were advanced to next generation.

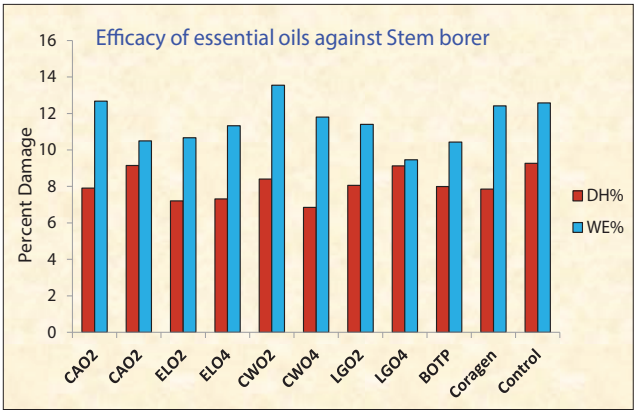
IPM- Integrated Pest Management

IPM/CPT/ENT/26:

Bio-intensive pest management with emphasis on biological control of rice pests

Bio-intensive pest management experiments aimed at conservation biological control, mass production and release of natural enemies and to incorporate non pesticidal methods for organic rice production were conducted. Border crops tested were *Tagetus erecta*, *Vigna unguiculata*, *Vigna mungo*, *Vigna radiata*, *Coriandrum sativum*, *Abelmoschus esculentus* and *Crotalaria juncea* during *Kharif* and *Rabi* 2017-18. Planting of flowering plants on rice bunds had significant impact on biodiversity and parasitization

Fig. Ecological engineering with marigold planted on rice field bunds



rates. Significant differences were observed in parasitism of hopper eggs in plots with different crop borders in comparison to plots without flower borders (F= 4.91; df 7; p <0.01). It ranged from 10-50% between treatment plots and the mean highest parasitism of hopper eggs was observed near a bund of black gram (45.6 %) while the lowest was observed in farmer's practice plots without flower border (11.4%). The flowers on bunds were found to increase the longevity and fecundity of hopper egg parasitoids. *Apanteles* sp., *Gonatocerus* sp., *Mymar taprobanicum*, *Anagrus* sp., *Tetrastichus schoenobii* and *Bracon* sp. were some of the parasitoids observed in yellow pan traps placed near the flowering borders.

IPM/CPT/ENT/21:

Botanicals for sustainable management of major pests of Rice. Evaluation of effect of treating water in rice beds with essential oils on incidence of rice pests:

Four essential oils in emulsified formulation were tested in field by treating water in the rice beds at 0.2% and 4.0% in a randomized block design for their efficacy against major pests of rice during *kharif*, 2017. Cedar wood oil recorded lowest stem borer damage of 6.85% dead hearts followed by eucalyptus oil 7.21% at 4% when compared to 9.27% in control. Lemongrass oil recorded lowest white ear damage 9.46% as compared to 12.42% in rynaxypyr and 12.58% in control.

Four solvent extracts-acetone, chloroform, ethyl acetate and methanol- from *Ocimum* spp (*O. americanum, O. basillicum, O. gratissimum, O. sanctum*) were tested for toxicity against BPH. Methanol extracts which showed highest mortality were tested for their effect on oviposition and hatching. Highest pre-oviposition period of 3.82 days and longest incubation period of 9.87 days was recorded in *O. gratissimum* extract followed by *O. sanctum* treatment as compared to 2.44 and 7.42 in control respectively. Lowest number of eggs (69.62 eggs) was laid in *O. gratissimum* while as many as 115.14 eggs in control. *O. gratissimum* extract also recorded lowest number of eggs hatched (42.52) as against 120.42 in control.

IPM/CPT/ENT/3:

Chemical control of rice insect pests as a component of rice IPM

An on farm trial was carried out on 'Integration of triflumezopyrim with ecological engineering for management of planthoppers", during *kharif* 2017 in two farmers' fields covering an area of 5 acres in the Neelayagudem and Dilawarpur villages of Nalgonda district of Telangana. There were six treatments including farmers practice plots as control for comparison of performance. The insecticidal applications ranged from one to four across treatments. The ecological engineering technique included planting of marigold flowering plants on bunds around the paddy field blocks planted with BPT 5204 variety. The results clearly revealed the superiority

of single application of the newer insecticide triflumezopyrim in reducing the planthopper population significantly compared to other recommended insecticides such as dinotefuran, buprofezin and acephate, at both the villages.

IPM/CPT/ENT/24:

Bioecology and Management of Emerging Insect and Mite Pests of Rice

A survey was conducted to record emerging insect pests in rice. Leaf mite and thrips caused considerable damage at Coimbatore and Karaikal. In certain pockets of Mandya and Mysore army worm occurred in severe form. Panicle mite occurred in moderate to severe form in parts of costal Andhra Pradesh and Telangana. Root knot and white tip nematodes were reported from parts of Malan. Severe damage by black beetle and high incidence of chaffer beetles was also reported from isolated pockets of Malan. Snails and Root Knot nematode was reported in moderate to severe form from Chatha. Rearing methodologies for swarming caterpillar are being standardised on semi-synthetic chickpea and rajmah based diets under controlled conditions (26±1°C Temp., 60±5% RH and 14:10 light:dark). On chick pea based diet, though the insect could complete its life cycle successfully, it was prolonged as compared to natural host. Larval duration was prolonged by 10 days as compared to natural host. Other life parameters namely; larval weight, percentage pupation, adult emergence, longevity, fecundity, and hatchability were satisfactory. Further treatment combinations are being tested to optimise the diet composition.

IPM/CPT/ENT/22:

Investigations on Nematodes of Importance to Rice Cultivation

Thirty rice germplasm lines, 13 promising BPT 5204 mutant lines and aerobic rice lines were screened for resistance to rice root-knot nematode. Four germplasm lines (GP 9281, GP 9440, GP 9472 & GP 9501), One mutant line T93 and one aerobic rice entry MTP 5 found moderately resistant to the nematode. Of the Seventeen rice cultivars were evaluated in field, the rice cultivar KPM showed resistant reaction with mean nematode population of 177 nematodes/5g root as compared to the 1502 nematodes/5g root recorded in susceptible cultivar TN1. Investigations on mechanisms of resistance revealed that resistance mechanism in cv. KPM is operating at three levels *i.e.* nematode penetration, establishment of feeding site & reproduction, implicating physical barriers and hypersensitivity. Histochemical studies showed high lignin content in roots of resistant cultivar compared to susceptible cultivar.

Soil samples from different weed and crop management treatments in aerobic rice were analysed for nematodes. Population of plant parasitic nematodes was observed to be significantly low in treatments with bioagents *viz. Trichoderma viride* and *Gluconacetobacter* sp. Analyses of soil samples from SRI and NTP plots under different nutrient management systems showed that the relative abundance of plant parasitic nematodes was significantly low in SRI method compared to the NTP method across the nutrient management regimes.

IPM/CPT/ENT/25:

Development of Entomopathogenic Nematodes (EPN) for Biointensive Integrated Pest Management in Rice

The compatibility of the entomopathogenic nematode *Heterorhabditis indica* to 14 insecticides, 6 fungicides and 7 herbicides commonly used in rice ecosystems was tested under laboratory conditions. *H. indica* was tolerant to most of the insecticides tested with less than 10% nematode mortality in all insecticides except monocrotophos (19.5%) and cartap hydrochloride (100%) after 72h of exposure. Less than 10% nematode mortality was observed in all the fungicides tested except tricyclazole (14.5%) and carbendazim +mancozeb (21.5%) after 72h of exposure. Nematode mortality in case of herbicides ranged from 3.5% to 18% after 72 h of exposure. These results

showed that *H. indica* was compatible with all the tested agrochemicals except monocrotophos and cartap hydrochloride among insecticides, tricyclazole and carbendazium+mancozeb among fungicides, and pendimethalin among herbicides.

Field evaluation of EPN, *H. indica* against rice root aphid *Tetraneura nigriabdominalis* was carried out during *kharif,* 2017. Spot application of nematodes at the rate of 1 lakh IJs/hill on rice plants significantly reduced (71.82%) the population of root aphids over the plants in control after one month of treatment in naturally infested field of aerobic rice.

Molecular characterization of entomopathogenic nematodes was carried out based on DNA sequences of ITS regions of ribosomal genes to confirm the identity of the nematode. The EPN isolate IIRREPNHI1, IIRREPNHI2 and IIRREPNHI3 were identified as *Heterorhabditis indica* and IIRRMA4 is identified as *Metarhabditis amsactae*. The ITS sequences of these nematode isolates have been deposited in the NCBI gene bank with accession number MH3684, MH379674, MH388300 and MH392568.

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

A total of 4076 rice breeding materials comprising of different donors, NILs, advanced breeding lines, germplasm were evaluated against rice blast disease caused by *Pyricularia oryzae* under artificial inoculation in uniform blast nursery method. Out of which 1117 were found to be resistant against the blast disease. One of the entries IET 25484, a near isogenic line (NIL) of Swarna having *Pi-2* gene with tall plant type, erect, high tillering and non-lodging plant habit was highly resistant to blast disease whereas recurrent parent Swarna showed the susceptible reaction. It was released as DRR Dhan 51 through CVRC. Another culture IET 23354 resistant to blast and tolerant to heat stress was identified by VRC 2018. Eight NILs carrying different blast resistance genes in the background of Samba Mahsuri, Swarna and ISM were nominated in AICRIP under AVT1 NIL trial.

As part of the integrated green management strategy, the efficacy of extracts of *Ocimum* spp., were evaluated against blast disease in UBN. It was observed that 50%, 75% and 100% of *Ocimum sanctum* in the water extract showed 38.15%, 29.26% and 25.93% PDI at seven days after first spray, 53.33%, 40.74% and 28.15% at seven days after second spray, 74.07%, 62.96% and 39.63% PDI at seven days after third spray were recorded respectively. Similarly, the methanolic extract showed 38.15%, 29.26% and 25.93% PDI after 7 days of first spray, 51.48%, 38.15% and 28.15% PDI after 7 days of 2nd spray and 84.81%, 68.89% and 29.26% PDI after 7 days of 3rd spray at 0.5%, 1% and 10%, respectively.

Management of rice blast disease through chemicals:

The trial was conducted with an objective to evaluate commercially available combination fungicides registered under Central Insecticides Board (CIB), Government of India (GOI) against various paddy diseases caused by fungi. The combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) was found effective in minimizing the disease severity of leaf blast followed by trifloxystrobin 25% + tebuconazole 50% WG (0.4g/l) and increased the yield.

HRP/CPT/PATH-13:

Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice.

Out of 45 entries (IRBBN 2017), two entries viz., IRBBN # 31 and 34 showed highly resistant reaction and 12 entries showed high level of resistance with an average score below 3. In a separate trial, out of 43 wild rice introgression lines screened for BB resistance, two entries of *O. officinalis* viz., HWR23 (IR75084-15-3-B-B) and HWR43 (IR75084-74-8-B-B-B) showed immune level of resistance. Using the two donors mapping populations were developed in the genetic background of Samba Mahsuri. The F1s developed from both the crosses were resistant to the disease indicating dominant nature of resistance. Analysis of F_2 population indicated possible role for a single dominant resistance gene in both HWR23 and HWR43. In another trial, out of 31 accessions of *Oryza glaberrima* evaluated for BB resistance, 11 accessions showed very high level of resistance with a score of 1 and another 15 accessions showed high BB resistance with score 3. Ninety gene-pyramided lines in the genetic background of Tellahamsa and MTU 1010 were received from PJTSAU for evaluation against BB. These lines possessed different combinations of two bacterial blight resistance genes (*Xa21* and *xa13*), two blast resistance genes (*Pi54* and *Pi1*) and one gall midge resistance gene (Gm4). About 90% of the entries showed very high level of BB resistance with a score of 1. Four lines with BB resistance gene *Xa21* and blast resistance gene (either *Pi54* or *Pi1*) showed high BB resistance with an average disease score ranging from 2.3-3.6. Eleven promising entries from NSN-1-2016 and 25 promising entries from NSN-2-2016 were re-evaluated for their resistance to bacterial blight of rice against 8 different isolates of *Xoo* under glass house condition. Six entries showed broad-spectrum resistance to all the 8 *Xoo* isolates with a lesion length ranging from 1-3 cm. Another 7 entries showed very good level of resistance to 6-7 isolates with lesion length ranging from 1-3 cm. Remaining entries showed resistance to 2-5 Xoo isolates with lesion length ranging from 1-3 cm. Newly identified gene, *Xa33* and another dominant BB resistance gene, *Xa23* also showed high level of broad-spectrum resistance to all the X isolates with a lesion length of 1 cm.

Figure: Severe bacterial blight infection in rice variety, Samba Mahsuri in Dammupeta Manda in Khammam district of Telangana

Characterization of isolates of *Xanthomonas oryzae* pv. *oryzae*

Seventy one Xoo isolates were characterized for their pathogenic and genetic variation. Based on the reaction of the Xoo isolates on the rice differentials, these isolates were grouped into 10 pathotypes (Table 1). Among these isolates, one strain each belonged to Pathotype IXopt-10 and IXopt-18, 2 strains each to IXopt # 2,6,7 and 14, 7 strains to IXopt-17, 8 strains to IXopt-21, 22 strains to IXopt-22 and 24 strains to IXopt-19. Most of the differentials possessing single BB resistance gens including Xa21 showed susceptibility to many Xoo strains. Most of the 3-genes combinations involving BB resistance genes Xa4, xa5, xa13 and Xa21 were resistant to majority of the Xoo isolates. Genetic variation was studied by rep-PCR using primers pJel1 and pJel-2 and based on the genetic variation, 71 Xoo isolates were grouped into 7 clusters. There was a good correlation between pathogenic and genetic variation.

HRP/CPT/PATH/14:

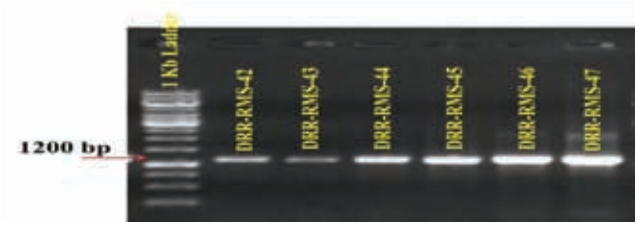
Assessment of host plant resistance and development of diagnostic tools for rice tungro disease

A total of 555 germplasm were screened consisting of 86 lines from germplasm screening nurseries (GSN), 149 wild rice cultivars, 20 donors and 300 segregating lines for the source of resistance for RTD. Among the 86 GSN lines screened, 42 were recorded as resistant lines with a score of 3.

Wild rice derivatives: 149 rice genotypes consisting of 81 introgression lines obtained from the back crosses of BPT 5204 x *Oryza rufipogon* and 68 advanced backcross generation of Swarna x *Oryza nivara* were screened against RTD. Among them, four genotypes obtained from the back cross of BPT 5204 x *Oryza rufipogon*, recorded disease score of three after 21 days of inoculation with RTD using viruliferous GLH vector but on par with the resistant check Vikramarya and producing mild or no symptoms at the time of scoring and were considered as resistant genotypes. In case of Swarna X *Oryza nivara,* back cross lines none of the populations was found to be resistant to RTD.

Donors screening: Out of 20 donors, six lines (Palasithari 601, Balimau Putih, Habiganj DW 8 (ACC 11751), Utri Merah (CC16680), Utri Merah (ACC16682) and Utri Rajapan (ACC 16684) showed high level of resistance to RTD. The other important lines *viz*., ASD 8 (ACC6393), Pankhari 203 (ACC5999), PTB 8 (ACC6291), TKM 6 (ACC 237), SHULI2 (ACC26527), Milogrosa (ACC5159), ARC 10343 (ACC12437) and ARC 11554 (ACC 21473) also showed resistant reaction to both tungro and leaf hopper remaining five (5) donors were expressed moderate level of resistance to RTD.

Role of weed hosts on tungro survival during off-season: Fifteen weed host species belonging to *Graminaceae* and *Cyperaceae* family were tested for host range studies against rice tungro disease. These weed species were inoculated by forced feed inoculation method using viruliferous green leafhopper (*Nephotettix virescens*) under glasshouse conditions and maintained suitable controls. After inoculation presence and absence of the virus on weed host species were recorded at seven intervals. Out of 15 weeds tested, only two weeds (*Echinochloa colonum* and *Panicum repens*) showed presence of virus up to 42 days. After 50 days after inoculation none of the weed showed the virus presence.



HRP/CPT/PATH/20:

A consortia approach to the biological management of diseases in rice

To establish the species of most potential isolate of *Trichoderma* fungi, tested both under controlled and field conditions, screening with *Trichoderma* specific ITS sequences of the 18sRNA region was conducted. The results indicated that the *Trichoderma* strain was *T. asperellum* and designated as *T. asperellum* IIRRCK1. The application of *T.asperellum* IIRR1CK1 prevented the early incidence of blast diseases in the blast nursery. The incidence and severity of blast and sheath blight were found to reduce upon treatment with the antagonistic microbes *T.asperellum*, *P. oxalicum* and ***Penicillium chrysogenum***

Isolate Code	Accession Number	Similarity %	Given name
Isolate-1	KF723005.1	99%	*Trichoderma asperellum*
Isolate-2	KF723005.1	97%	*Trichoderma asperellum*
Isolate-3	KF723005.1	100%	*Trichoderma asperellum*
Isolate-4	KF723005.1	93%	*Trichoderma asperellum*

Fig: Artificially inoculated BPT 5204 plants expressed symptom under glasshouse conditions – Kharif 2017

Molecular characterization of *Trichoderma* isolates using ITS regions sequencing

In field trail with farmer, the *Trichoderma* was treated with seeds of variety MTU 1010 as well as applied with the potential strain of *T.asperellum* both as seed treatment and in the main field by mixing with FYM. The treated field had less incidence of blast compared with the other untreated fields in the same area.

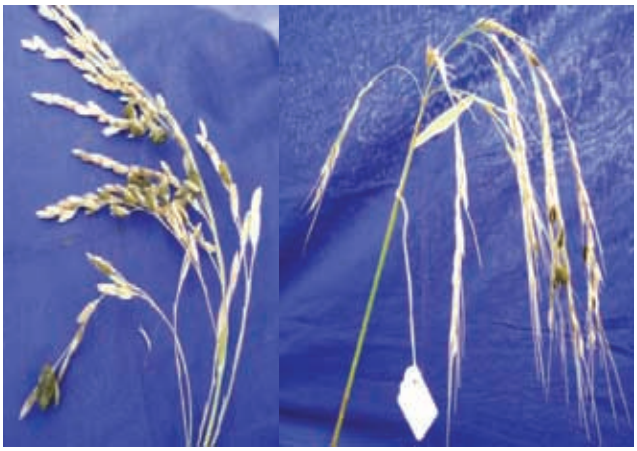


Fig: Artificially inoculated Germplasm accessions expressed symptom under field conditions – Kharif 2017

HRP/CPT/PATH/19:

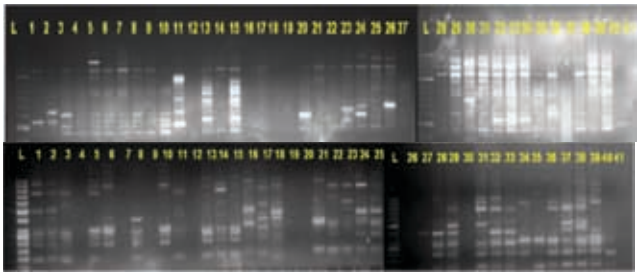
Epidemiology and Management of false smut disease of rice

Artificial inoculation technique of *U. virens* under glasshouse conditions was standardized. Injection method of inoculation of *U. virens* conidia (1×10^6 conidia ml^{-1}) during booting stage of the susceptible cultivar BPT 5204 produced 34 number of smut balls with 100% panicle infection.

Under field conditions, two types of inoculums (chlamydospores and conidial suspension) were used for artificial screening and pathogen was inoculated (1×10^6 conidia ml^{-1}) at booting stage of the plants and disease symptoms were observed 10 to 15 days after inoculation. False smut symptoms were expressed only in the lines, which were inoculated with conidial suspension. Among the tested lines, few germplasm entry nos. viz., 203 (IC282512), 204 (IC277330), 211 (IC346913), 216 (IC346899) and 217 (IC334169) were produced smut balls (1-21) and germplasm entry nos 200 (IC334233), 201 (IC346824), 202 (IC283089), 206 (IC335422), 207 (IC280528) were free from infection.

HRP/CPT/PATH/22:

Population dynamics of rice sheath blight pathogen and sustainable disease management



ISSR marker RAPD marker

Characterization of *R. solani* isolates from Chhattisgarh State: Forty one isolates of *R. solani* were collected from major rice growing areas of Chhattisgarh and characterized for cultural, morphological, pathogenic and molecular

diversity. Variation was observed in colony colour, morphological characters like hyphal width, branching near distal septa and distance between septa. All the isolates proved to be pathogenic in nature on rice *cv.* BPT-5204 and showed moderate to high susceptible reactions. RAPD analysis with random primers and cumulative analysis of similarity values placed the isolates into eight distinct main cluster at 22% similarity coefficient and further first main cluster was again divided into six sub clusters.

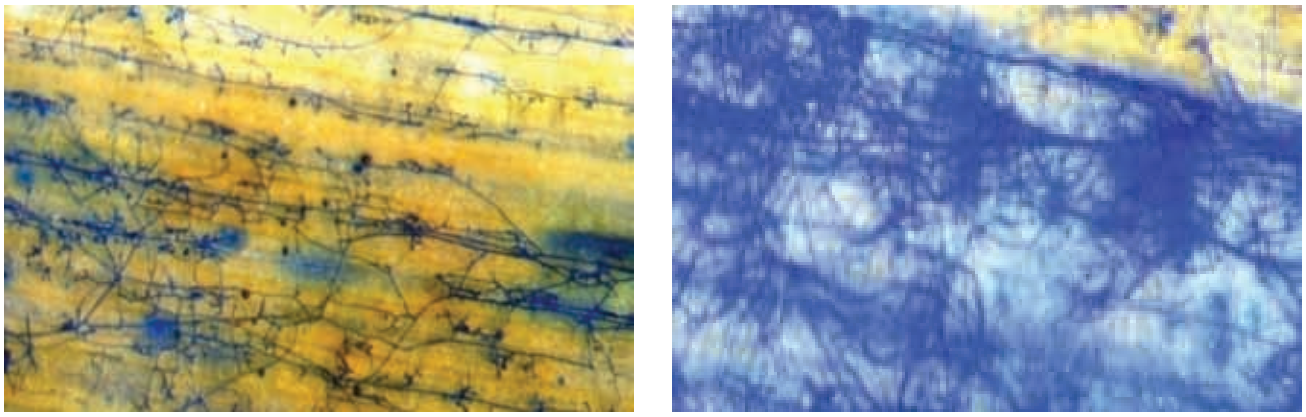


Fig: Infection cushion having more dense hyphae on leaf surface of IR-50 @ 72 HAI than Wazuhopehk

Higher intraregional variation was observed in case of isolates from Bhagima (RS-CG-01 and RS-CG-02). Microsatellite primers (ISSR) showed reproducible banding pattern on *R. solani* which was grouped into five major clusters at 18 % similarity coefficient.

Cultural variability of *R. Solani* (RS-CG-01 to RS-CG-40) isolates collected from major rice growing areas of Chhattisgarh

Host plant resistance studies were conducted with the F7 population (330) of improved Samba Mahsuri X Wazuhopehk. The plants were categorized based on SES score (7 plants with 3 score, 286 plants with 5 score, 34 plants with 7 score and 3 plants with 9 score). Microscopic studies indicated the different level of pathogenesis by *R. solani* on resistant (Wazuhopehk) and susceptible (IR-50) cultivars. On both the cultivars appresoria had formed 24hrs after inoculation. However, 72 HAI more dense mycelial growth and infection cushion was formed on IR-50 and sparse mycelia growth and micro sclerotia on Wazuhopehk.

In the studies on the evaluation of fungicides against sheath blight, The combination fungicide *viz.*, azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) and azoxystrobin 11% + tebuconazole 18.3% w/w SC (1.5 ml/l) sprayed plot showed less disease severity (DS: 33.3%) and higher yield when compare to other treatments.

TTI – Training, Transfer of Technology and Impact analysis

TTI/EXT/11:

Maximizing the Impact of Rice Technologies through ICT applications

During the year 2017-18, few pilot experiements were conducted in collaboration with KVKs (Kampasagar, Jammikunta, Madanapuram and Garikapadu), involving farmers, extension agencies, value chain players with randomised control trials and primary surveys.

The yield gains in T1 (Demonstrations with Video/ WhatsApp) were significantly higher compared to T2, T3 and Control (.782*, 1.122*, 1.696*) at 5% level of significance. However,

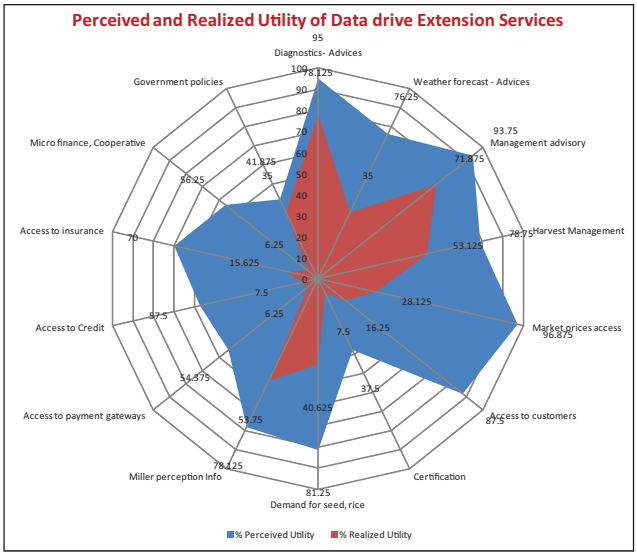


Fig: Perceived and realised utility of data driven extension services by farmers

"only WhatsApp extension intervention" (T2) did not have significant influence on the yield levels compared to farmers' practice. But it has resulted in better yields compared to benchmark yields (.914*). The preliminary outcomes suggest that there was a considerable increase in the awareness and interest on the practices that were disseminated through WhatsApp. While there was a clear evidence of increased awareness of various practices/knowledge due to social media (WhatsApp), the adoption and hence productivity remains unaffected. This may be due to the fact that WhatsApp has been used in an informal manner without organized efforts to provide sequential information that are truly applicable in the field. There is a need to disseminate sequential and most appropriate knowledge in a well organized way in order to harness WhatsApp as an extension tool.

TTI/EXT/12

Dissemination of climate resilient rice production technologies to farmers in selected Districts of Telangana State

A combination of *experiential, reinforcement and integrative* extension methods were employed to disseminate selected climate-resilient rice production technologies viz, SRI, use of Bowmans' pipes for irrigation management and contingency crop planning on farmers' fields in Yadadri and Nalgonda districts of Telangana. Majority of the farmers (68%) adopting SRI reported saving in seeds, irrigation water and low pest and disease attack with a yield advantage of one ton over normal transplanted method. Lack of trained labour to transplant young seedlings and line sowing was reported as the major deterrent to adoption of SRI.

Visual questionnaire was used to assess farmers' awareness and adoption of selected climate-resilient technologies viz. SRI, Direct Seeded Rice, INM, Leaf color chart, Drought tolerant varieties and Crop diversification from farmers of 13 *Tandas* in Nalgonda district. Stated preference method was used to analyze farmers' choice of CSA technologies and farmers were asked to score each technology from 0 to 3 scale. The preferences for institutional support in the form of crop insurance and timely weather forecasts were rated high by majority of the farmers. The farmers opined that the weather forecast information should be timely and provide them the agro-advisories such as which crops to grow, cultivar selection, planting date, planting density, weeding, water and pests and diseases management.

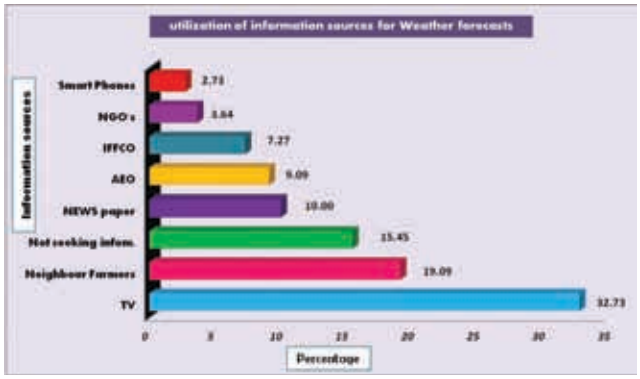


Fig: Utilization of information sources by farmers for accessing weather forecasts

Barrier Analysis as a rapid assessment tool was utilized to collect information from farmers for selected climate resilient rice production technologies and were classified under two broad categories. The first related to the physical means or resources considered as the hardware barriers and include shortage of labour, equipment etc. The second, referred to as the non-physical or software barriers, like lack of information, knowledge and skill about SRI process, drum seeder and green manure crops.

Utilization of Information Sources and Dissemination Pathways : Utilization of information sources indicated that TV was the major source followed by fellow farmers.

TTI/EXT/14:

Innovations in Group based Extension Approaches: Accelerating Rice Technology Transfer through Farmer based Organisations

The main objective of this research project was to undertake technology transfer activities involving IIRR technologies through group approach. Among various group based extension approaches, based on the various case studies and success stories, the Farmer Producer Organisations (FPOs) have been identified as the one of the significant approach to accelerate the rice technology transfer owing to its growing numbers and farmers involved. In order to undertake action research with a partnership framework involving IIRR and FBO, Malaikottai Farmer Producer Company Ltd, Lalgudi, Trichirapalli was purposively selected for undertaking project interventions. The profiling of the company was done which revealed that they were registered in the year of 2016 with an initial membership of 750 farmers among 20 villages and as on today they have 1000 members, Board of directors (15 nos). Till now, 40 BOD meetings conducted for the benefit of the company. Every month shareholders mobilization meeting conducted in each location to strengthen the companies. An agro inputs shop was established with an initial investment of Rs.5 lakhs and all kinds of agro inputs are being sold to farmers at a competitive price. A benchmark survey was conducted among the 60 member farmers to understand and document the existing practices among the farmer members. Regarding the awareness of IIRR varieties, 38% of the respondents were aware of Improved Samba Mahsuri (ISM) and none of them were aware of DRR Dhan 45. About 43% expressed their willingness to grow ISM for seed purposes and only 35% were willing to grow DRR Dhan 45. ISM had the possibility of getting better price than DRR Dhan 45 owing to its grain quality. These two varieties were demonstrated in 10 member farmer fields. The package of practices were discussed and the field staff were informed about them regularly. The company was willing to forge partnership for seed production of IIRR varieties like Improved Samba Mahsuri. But, majority of the farmer members preferred to grow ISM for one more season before taking up the seed production . The other rice production practices that were followed were documented and the rice extension messages suitable for social media and other traditional methods are being developed.

TTI/EXT/15:

Climate Change and Rice Farming: Farmers Perception and Adaptation Strategies

Eight villages representing four taluks and two districts namely Thanjavur and Tiruvarur of Tamil Nadu were selected for the study. Data from 200 farmers representing small, middle, big and very big landholding size was collected. The study revealed that the farmers irrespective of the operational landholding size had experienced climate change in the last two decades (96%). Almost all the farmers expressed that they had not cultivated both the *kuruvai* (June-July) and Early samba (August) rice due to climate change and no water flow in the river Cauvery. Almost as much as 42% of the farmers even witnessed terminal droughts even in the samba season (Sep-Oct) leading to poor yield and at times total crop failure.

Due to severe climate change the ground water source was thoroughly exploited by the rice farmers by immersing bore wells (64%) mostly in the category of middle, big and very big farmers. As a result of over exploitation of ground water the aquifers started depleting at alarming levels in the delta and sea water has intruded in most of the areas resulting in salinity problems with the EC levels reaching 3 as expressed by the line department officials.

The prevalent adaptation measures followed by the rice farmers to mitigate the climate change related to rice farming were cultivation of early maturing varieties (78%), early planting (65%), direct sowing (73%), usage of wells and pumps for irrigation (66%), cultivation less farm area (51%), alternative crop cultivation (49%), agricultural insurance (18%) and stop farming (11%). The farmers perceived barriers in adoption of some adaptation measures as given in table.

Table. Barriers to Adopt the Adaptation measures by the Farmers

Sl. No	Threats to sustainable rice production	Number of Farmers	Percentage
1	Non –availability of climate resilient rice varieties	196	98%
2	Poor information on climate change	174	87%
3	Poor knowledge of mitigation and adaptation facilities	138	69%
4	Poor Extension contact	138	69%
5	Low subsidy on necessary inputs	104	52%
6	Insufficient insurance coverage	100	50%
7	Lack of community action	98	49%

TTI/ECON/2:

Socio-economic impact assessment of rice production technologies

A study on the farm level impact of System of Rice Intensification (SRI) was conducted with a sample size of two hundred and sixty SRI adopter farmers from 13 villages of Jangaon, Yadadri Bhuvanagiri and Siddipet districts of Telangana, in 2017. The data obtained through survey was analysed. Grain yield was 16.6 % higher in SRI as compared to transplanted method. For transplanted method, the total variable cost per hectare was Rs.48,042.6 which accounted for 71 % of the total cost. In case of SRI method the total variable cost per hectare was Rs.40,527.2 which accounted for 67 % of the total cost. The net returns obtained by the sample farmers for transplanted and SRI method were Rs.4,035.3/ ha and Rs.23,520.7 /ha respectively. The Break Even Output (BEO) was 48.7 quintals per hectare and 29 quintals per hectare for transplanted and SRI methods respectively.

The extent of mechanization and the reasons for preferring mechanization in paddy cultivation were studied. The mechanization indices for transplanted and SRI method were calculated. The mechanization index is the ratio of cost of use of machinery to the total human labour cost, animal and machinery cost. The mechanization index for transplanted and SRI method was 0.54 and 0.66 respectively. The farmers who had undertaken machine transplanting had to incur 40.62 percent higher expenditure on transplanting operation than that of manual transplanting. Garrett ranking technique was used to analyse the factors influencing the farmers' preference for mechanization in rice production. It is observed that factors affecting farmers' preference for mechanization were non-availability of labour, timeliness in farm operations, less loss in harvesting and threshing and accomplishment of work in less time with Garrett's scores of 70, 65, 59 and 57 respectively.

The energy consumption for SRI and transplanted method was estimated. The adoption of SRI ensured higher productivity with higher energy efficiency and returns. The energy use efficiency obtained for SRI method was 10.4, while for the transplanted method it was 5.04. The results indicated that the system of rice intensification (SRI) method was more energy-efficient as compared to transplanted method. The average energy productivity was 0.344 kg/MJ for SRI method and 0.166 kg/MJ for transplanted method, which means 0.344 kg of paddy was produced per unit energy in SRI method and 0.166 kg of paddy was produced per unit energy in transplanted method.

The results of the specific energy indicated that the transplanted method required 6.01 MJ of energy to produce a kilogram of paddy while with the SRI method, about 2.9 MJ of energy was consumed to produce one kilogram of rice. The results revealed that the lower energy input through SRI produced higher energy output.

TTI/ECON/3:

Intellectual Property Rights (IPR)-Competition interaction in Indian rice seed sector -emerging scenario- implications for enhancing quality seed use

During the year 2017-18, PPVFRA data updated and analysed. Some secondary data on rice hybrid seed market in India, major seed companies, country-wise rice hybrid seed exports from India were also collected. PPVFRA data analysis revealed continuing dominance of private sector in rice hybrids. As on 31-12-2017, for 63 rice varieties statutory protection was over. Out of these 63 varieties, only 3 were hybrids and only one was private hybrid. Based on analysis of concentration in Rice hybrid PVP certificates and rice hybrid seed markets, some correlation was observed in terms of upstream research players and downstream seed market players.

In 2017 Gross margin in the case of OPV rice varieties seeds ranged from 17.14 to 24.63% across different players. On the other hand in the case of hybrid rice seeds gross margin ranged from 21.68% to 46.11% across different players.

During the year 2017-18, an attempt was made to document emerging issues and challenges in IPR protection to plant varieties in general and rice varieties in particular. Attempts to handle some of these issues across different countries were documented. The major issues identified were (i) overlapping IPRs (ii) Concentration in seed industry (iii) Complex IPR and other regulatory web and (iv) vulner*abi*lity of farmers. To arrest loss of control over germplasm and promote decentralised breeding process, Open Source Seed Initiative (OSSI), Open Source Seed Licence (OSL), Bio-bricks were some initiatives abroad. In India also some initiatives are there. For handling transition from "proprietary" seeds to generic seeds " AgAccord" is the initiative observed in USA. For enhancing access to quality seeds some non-IP based initiatives were observed in some countries. They are "access to seed index", and "pull mechanism" under AgResults project.

Institutional Activities

Technologies Assessed and Transferred

IPR Management and Revenue Generation

Awards/Recognitions

Significant Events

Sports & Games

Personnel

Publications

Appendices

Technologies Assessed and Transferred

Training and Extension

During the year 2017-18, a total of 13 training programs were planned, organized and evaluated various aspects of Rice Production technologies, through which 81 Master trainers and 379 farmers were trained. Of the total 13 training programs 5 were exclusively for the Master Trainers, rice specialists, executives from agro input agencies and faculty members of ICAR Institutes and State Agricultural Universities. These five programs were sponsored by ICAR, MANAGE, Hyderabad, Mahindra & Mahindra and VAAS, Vietnam. Of the total 8 training programs organized for the rice farmers these were sponsored by IIRR, ATMA, Sampalpur (Odisha), ATMA, Valsad (Gujarat), Govt of Madhya Pradesh, Govt of Tamil Nadu and Govt of Telangana.

Training programs organized during 2017-18

S. No	Training Title	Training Duration	Sponsored by	Number of Participants
I. Training for the Master Trainers				
1	Crop management Capability Building Program	4th and 5th May 2017	Mahindra & Mahindra	36
2	Module II' Certified Farm Advisor Programme	11-25 sep 2017	MANAGE	7
3	ICAR-Short course on ''New extension approaches for inclusion of Rural Youth, Small holder farmers and integration of MGMG activities with ongoing extension programs'' 21-30 November 2017	21-30 November 2017	ICAR	15
4	International Training on Critical Production and Processing Technologies in Rice	20 Feb – 06 March, 2018	USAID GOI (FTF ITT)	20
5	Traditional and Modern Breeding Approaches for development of High Quality Rice Varieties	27th Nov 2017 – 12th Feb 2018	Vietnam Academy of Agril. Sciences. (VAAS)	3
II Training program for Farmers				
1	Workshop &Training-cum Orientation Program on Vermiculture and Organic Farming	22-April -2017	IIRR	30
2	Farmers Training Programme on Rice Production Technology	4th and 5th May 2017	ATMA, Sambalpur	25
3	Farmers Training Programme on Rice Production Technology	21-24 Aug 2017	ATMA Valsad, Gujarat	18
4	Farmers Training Programme on Improved Rice Production Technologies	28-31 August 2017	Govt. of Madhya Pradesh	207
5	Farmers Training Programme on Rice Production Technology	31-August 2017	ATMA, Tamil Nadu	12
6	Farmers Training Programme on Rice Production Technology	4th sep 2017	Govt. of Telangana	21
7	Farmers Training on Advanced Agriculture Technology	16-sep-2017	ATMA Gujarat	50
8	Farmers Training Programme on Paddy Production Technologies	15-Nov-2017	Govt. of Telangana	16

Frontline Demonstrations (FLDs)

During the year 2017-18 through Front Line Demonstrations (FLD) programme, a cafeteria of rice technologies were demonstrated in 723 hectare area covering 20 states and five major rice ecosystems of the country. FLDs organized during this year have been effective in creating the awareness about the potential of new rice varieties, hybrids and other management technologies. In majority of the cases the yield advantages recorded by the FLD technologies were significant.

Out of 723 FLDs reported, about 78.7 % were conducted in irrigated rice ecosystem; whereas about 6.87% of FLDs were conducted in rainfed uplands. More than 11.51 % of FLDs were

organized in shallow lowlands and 2.07% in hill ecologies. There is a scope to increase the number of FLDs in rainfed ecologies. The summary statement reveals that the mean yield advantage was the highest in Hill ecologies (29%). There is a tremendous scope to bridge the yield gaps (particularly Yield gap-II) in case of Rainfed uplands (24.66 % mean yield advantage), irrigated ecologies (20.66%) and Shallow lowlands (20.97%). For this, proper extension strategies need to be deployed for large scale adoption of these technologies. FLD technologies demonstrated in irrigated ecosystems have recorded mean yield of 5.16 t/ha where as in Shallow lowlands FLD technologies have recorded an average yield of 5.34 t/ha. Average demonstration yields in rainfed uplands was 3.94 t/ha. This shows the attainable yield potential in the farmers' fields, which needs to be considered for planning the extension programs in these regions. The range of yield advantages explains that there are few promising technologies, if properly adopted by the farmers may result in enhancing the farm level productivity.

In total 50 technologies have been identified from 20 states based on their performance in farmers field conditions. These technologies will help either in withstanding abiotic stresses (such as submergence –Samba Sub-1, IR 64 Drt-1), improving the field productivity (JRH 19, HUBR 2-1,), solving the local problems (Problem soil management, Indira Aerobic -1), labour scarcity (Demonstrations of Paddy Thresher, mechanical transplanting), early harvest for facilitating *rabi* crops (Sahbhagi dhan), better basmati options for farmers (Pusa 1509 and Basmati 564), consumer preferences (RC Maniphou-13), replacing the popular varieties (CO 52, CR Dhan 909) etc., But a viable strategy should be in place before these promising technologies making a difference in the livelihoods of farmers. During this year, monitoring was done across the country in select locations involving a team of IIRR scientists. The monitoring teams have visited FLD sites and interacted with the farmers.

Seed & Farmers' Day

IIRR Farmers Day was organized on 30th October, 2017 at IIRR experimental fields, Rajendranagar. The major objectives of the Farmers Day was to showcase latest varieties, hybrids and technologies developed at IIRR which would help rice farmers to increase their productivity, profitability and sustainability. Around 500 farmers from RangaReddy, Mahaboobnagar, Karimnagar and Nalgonda districts took active part in this event . Dr. E.A Siddique was the Chief Guest. More than 20 agro-input agencies and ICAR institutes installed their exhibition stalls. Dr. P. Ananda Kumar, Director (A) addressed the gathering along with the dignitaries. A Scientists- farmers interaction was conducted

after the field visit. A question-answer session was also organized to clarify the farmers doubts related to rice production. Several farmers sought solutions on their field problems from the experts. A seed sale counter was opened to help the farmers to buy and adopt improved rice varieties. Rice related literature in local language were distributed to the farmers. Farmers purchased the seeds of improved rice varieties, other critical inputs and health care products from the sale counters installed by different agencies.

Tribal Sub-Plan activities

Under the Tribal sub-plan a total of 160 triabl farm households were supported with improved rice production technologies to enhance their livelihood. Two districts viz., Mahabubnagar and Nalgonda were selected. The interventions undertaken were introduction of Improved varieties like Improved Samba Mahsuri and DRR Dhan 45, and critical inputs like Neem Cake mixed with urea, Zinc sulphate, Sprayers, distribution of need based insecticides, soil test based nutrient management. Due to the interventions yield increase was observed to the level of 10-14% with minimization cost of cultivation. Increased awareness about improved rice production practices and technologies was also observed.

Blightout Program

Seeds of Improved Samba Mahsuri were sent to the states of Andhra Pradesh, Chhattisgarh, Karnataka, Tamil Nadu, Telangana and Uttar Pradesh under the CSIR-800 Program jointly implemented by ICAR-IIRR and CSIR-CCMB. Overall 1200 demonstrations were conducted in the BLB endemic areas. In case of Tamil Nadu the state department of agriculture is roped to popularize this variety. Thanjavur and Karur districts were chosen to demonstrate this variety. The extension information were provided in the form of video films and information brochure in both Tamil and Telugu languages. A farmers day was organised at the Gorakhpur district of Uttar Pradesh through the NGO Centre for Agriculture and Rural Development. In the states of Andhra Pradesh, Telangana, Chhattisgarh, Karnataka and Tamil Nadu the program was implemented through state department of Agriculture and AICRIP centres and yield increase was observed to the tune of 19-22%.

Visitors' Services

During the year 2017-18, about 5210 visitors comprising students, extension professionals, scientists, farmers, foreign delegates, policy makers, private input dealers visited the Institute and got acquainted with the ongoing activities and achievements of IIRR.

Exhibition of IIRR Technologies at Various Events

IIRR Participated in the farmers day organized by IIOR, IIMR, NRRI, Cuttack by installing exhibition stalls on rice production technologies.

Drs. Shaik N. Meera, P. Jeya Kumar and S. Arun Kumar from IIRR participated in the AP Agritech Summit 2017 at Visakhapatnam, Andhra Pradesh and exhibited IIRR technologies to the farmers, technocrats and other participating delegates. The Summit and the exhibition was inaugurated on 15 November 2017 by the Honorable Vice President of India, Shri M Venkaiah Naidu in the august presence of Honorable Chief Minister of Andhra Pradesh Shri N Chandrababu Naidu. The posters on ICAR-IIRR vision and mission, Varieties / Hybrids, Water Saving Technologies, Weeds and their Integrated Management, Integrated Pest Management, Nutrient Management, RKMP, Rice value added products, etc. were displayed along with seed samples of varieties and hybrids released from ICAR-IIRR. Honourable Chief Minister of Andhra Pradesh Shri N Chandrababu Naidu visited IIRR stall and he was appraised about the activities and achievements of IIRR. He appreciated IIRR efforts and instructed the state officials to take cue from the range of institute activities like technology development, technology dissemination, rice digital strategies and rice based value products.




Intellectual Property Management and Transfer/Commercialization of agricultural technology Scheme

During 2017-18, More than 100 entries of seed was provided to various institutes and private companies through MTA. Several applications for germplasm registration were screened and certified by ITMU members for soft registration with NBPGR, New Delhi. As an authorized institute, IIRR received several import permit applications which were scrutinized and forwarded to NBPGR and EXIM committees for processing.

Revenue Generation

An amount of Rs. 1,84,40,489.00 was received through testing of varieties and hybrids, contractual services for the evaluation of breeding lines for quality, diseases, insects and also assessing the efficacy of new molecules/ chemicals.

Revolving Fund

IIRR is actively involved in production of quality seed in research farms and farmers' fields and supplying it to Pvt. Seed companies, Govt. seed agencies and also to farmers earning huge revenue. A profit of Rs. 8,21,925.00 was generated for the financial year 2017-18.

Externally funded projects

Twenty new externally funded projects have been sanctioned during 2017-18 (Appendix 6) with a budget outlay of Rs. 561 lakhs. A total of 30 externally funded projects are currently being handled at the Institute (Appendix 7) with a sanctioned budget of Rs. 1687 lakhs.

Awards and Recognitions

- Dr. Satendra Kumar Mangrauthia was awarded with Lal Bahadur Shastri Outstanding Young Scientist Award in the field of Crop & Horticultural Sciences during 89th Foundation Day of Indian Council of Agricultural Research on 16 July 2017.
- Dr. Satendra Kumar Mangrauthia was awarded the CERTIFICATE of OUTSTANDING CONTRIBUTION by the Journal Plant Physiology and Biochemistry (Elsevier) and French Society of Plant Physiology for his Outstanding Contribution as a Reviewer.
- Mrs. B Sailaja (PhD under the supervision of Dr. Satendra Kumar Mangrauthia, Biotechnology Section) was awarded with ICAR- Jawaharlal Nehru Award for best thesis.
- V. Manasa Received UAS gold medal for Ph.D during 30th convocation of University of Agricultural Sciences, Dharwad
- Dr. V. Prakasam Received MK Patel Young scientist Award from Indian phytopathological Society, New Delhi, during Jan.2018 at Jorhat, Assam.
- Dr. B. Nirmala, Scientist (Agricultural Economics) was Awarded with Dr. R.T.Doshi Award - first prize for Best Paper presentation in 24th Annual Conference of Agricultural Economics Research Association (AERA) for paper entitled ''Linking agriculture and nutrition: an ex-ante analysis of zinc biofortification of rice in India'' published in Agricultural Economic Research Review (2016) 29 (conference number) :171-177. She Received the prize from Agricultural Economics Research Association (AERA), New Delhi, during 25th AERA Annual conference held at NAARM, Hyderabad during 7 th to 9th November 2017.
- Dr. R.M. Sundaram has been selected as Chief Editor, Journal of Rice Research, published by Society for Advancement of Rice Research
- Dr. R.M. Sundaram has been selected by Indian Journal of Plant Biochemistry and Biotechnology to be a member of its Editorial Board.
- Dr. R.M. Sundaram has been selected by PLos One Journal to be an Academic Editor
- Dr. M. S. Madhav has been selected by Journal of Phytopathology as Reviewer
- Dr. M. S. Madhav has been selected by Telangana University as member of Board of studies for Biotechnology Department.
- Dr. Satendra Kumar Mangrauthia was selected as Associate of Prestigious Science Academy-National Academy of Agricultural Sciences (NAAS) with effect from 2017.

- Dr. R.M. Sundaram has been elected as a Fellow, Indian Society of Genetics and Plant Breeding for the year 2017.

Deputations

- Dr V Ravindra Babu, Director, ICAR-IIRR, Hyderabad; Dr H. Pathak, Director, ICAR-NRRI, Cuttack and Dr A S Hari Prasad, Principal Scientist, ICAR-IIRR, Hyderabad were nominated by the Department of Agricultural Research & Education (DARE), Ministry of Agriculture, GOI, to participate in the ASEAN Countries' visit. The expert team visited five countries viz., Indonesia, Malaysia, Vietnam, Cambodia and Thailand during May 20-31, 2017.
- Dr.P.Senguttuvel deputed to IRRI to attend under ICAR –IRRI project 8 (New source of resistance to biotic and wild rice introgression) and 11 (introgression of yield enhancing genes into popular Indian varieties) from 25-10-2017 to 31-10-2017.
- Dr M.S. Madhav attend the International workshop on " Capacity Building of Institutional Biosafety Committee Members of Bangladesh" at Bangladesh Agricultural Research Institute (BARI) from 25-27th JULY, 2017
- Dr. R.M. Su1ndaram attended the International Hybrid Rice Symposium conducted by IRRI, Philippines and held at Yogyakarta, Indonesia from 27th Feb. 2018 to 1st March 2018 and delivered a lead talk on "Application of biotechnology tools for Hybrid Rice Improvement"
- Dr. B. Sreedevi attended and presented two research papers on Nitrogen scheduling and impact on weed management in Aerobic rice and Influence of herbicides on plant parasitic nematodes infecting Aerobic rice in oral sessions of 26th Asian Pacific Weed Science Society Conference on Kyoto, Japan,19-22 September 2017.
- Dr. Brajendra attended the 7th ITPS working meeting at FAO, ROME, Italy from 30th October to 3rd vNovember,2017.
- Dr. Shaik N. Meera, Principal Scientist was deputed to participate in the 7th International Hybrid Rice Symposium, Yogyakarta, Indonesia during 27-2-2018 to 1-3-2018.
- Dr. Shaik N. Meera, Principal Scientist was deputed to participate in the IGAD and RDA Meetings at Berlin, Germany organized during 19-23 March 2018. He conducted a session on Digital Extension Advisory Services: Towards a Data Driven Disruption during the visit.
- Dr. Shaik N. Meera, Principal Scientist was deputed to attend the IGAD Pre-Meetings and RDA Plenary Meetings organized in Barcelona, Spain during 3-7 April 2017.
- Dr. G. Padmavathi, Principal Scientist was deputed to IRRI, Philippines for training on "Screening for reproductive stage tolerance to salinity" during 16 to 19th November 2017 under ICAR-IRRI work plan.

Significant Events

Research Advisory Committee Meeting:

Research Advisory Committee (RAC) meeting of ICAR-IIRR was held during 13-14 June, 2017 under the Chairmanship of Dr. Darshan Singh Brar, Adjunct Professor, School of Agri-Biotechnology, PAU, Ludhiana. Members of RAC, Dr. I. S.Solanki, ADG (FFC), ICAR, New Delhi; Dr. Randhir Singh, ADG (Ag. Extn), ICAR, New Delhi; Dr. A. K Singh, Principal Scientist & Head, Division of Genetics, IARI, New Delhi; Dr Himanshu Pathak, Director, NRRI as a special invitee; Dr. D. Raji Reddy, Director of Research, PJTSAU, Hyderabad; Shri. A. Brahmaiah, Farmer representative, Dr. V. Ravindra Babu, Director, IIRR and Dr. R. Mahender Kumar, Head, Agronomy as member secretary attended the meeting. All the heads of the section and National Professor also attended the meeting. Dr. D. S. Brar appreciated the strong collaborative efforts of IIRR with CSIR- CCMB and DBT and the resultant awards. He applauded the outstanding work done by Drs. L. V. Subba Rao and V. Ravindra Babu under PPVFRA and the awards they received. Committee appreciated the efforts of IIRR scientists in addressing most of the recommendations made. P Krishnamoorthy (a renowned agronomist) low 'P' screening facility was inaugurated on 14th June and committee appreciated the efforts done in maintaining nematode sick plot. An interactive session with all the scientists of the institute was also held.

Institute Research Council Meeting organized

Institute Research Council (IRC) Meeting was held during 14-17th June,2017. ICAR-IIRR Director, Dr.V. Ravindra Babu chaired the meeting. In the meeting all the Scientists of IIRR made presentations about research work carried out during 2016-17 under various projects approved by the Institute. 7 projects were concluded and 12 new projects were approved in the meeting.

Awareness Program on Crop Insurance Scheme of Government of India

Awareness Program on Crop Insurance Scheme of Government of India was organized on 6 May 2017 at Pocahmpally village of Nalgonda district of Telangana. The farmers were apprised of the benefits of the crop insurance scheme. The program was coordinated by Drs. Amtul Waris and B. Nirmala.

One day training programme on "e Procurement

One day training programme on "e Procurement was organized for administrative staff on 9 May 2017. Mr. Y. S. Murthy from NIC briefed the concepts and methodology involved.

Rice Millers Meet

Rice Millers Meet was organized on 22 June 2017 to discuss issues related to rice quality for export and consumption. Representatives from Agro input agencies also participated in the meeting.

International Yoga day

Third International Yoga day was celebrated at ICAR-IIRR on 21st June, 2017. Dr. M. Singa Rao (Retd. Professor, Acharya N. G. Ranga Agricultural University) demonstrated some of the *Asanas* and *Pranayama*. The health benefits of Yoga and its advantages were briefed in the programme. All the staff and students actively participated in the programme.

National Integration Events:

Commemorating the "Quit India Movement" during independence struggle a "*Sankalp se Sidhi* Pledge" was administered to the staff of the Institute on 9th August 2017.

Sadbhavana Diwas was organized on 18th August 2017 and a pledge was taken by the staff of the Institute.

Hindi *Pakhwada*

"Hindi *Pakhwada*" was celebrated at the Institute during 14th -27th September 2017. Various events and competitions were organised during the fortnight to motivate the staff to adopt Hindi in official work as well as research purposes. Mrs. Manisha Singh, Head, Department of Hindi, Delhi School of Excellence was the chief guest on valedictory function. Director (A) Dr. P. Ananda Kumar distributed trophies, certificates and cash awards to the winners of various competitions.

Swacch *Pakhwada*

As a part of the Swachh Bharat Mission, *Swacchata Pakhwada* was observed at the institute from 15th September- 2nd October, 2017. The staff voluntarily undertook various activities such as cleaning the institute premises and cleaning of nearby tourist spot, Himayat Sagar Lake. Cleaning and beautification of ICRISAT farm was also undertaken. As a part of the programme various competitions were held to school children and on the closing day prizes were distributed to the winners. Staff, who contributed towards the maintenance and cleanliness of the institute, were also awarded. The *pakhwada* ended with the remarks by Director (A), Dr. P. Ananda Kumar about Mahatma Gandhi's vision of clean India.

Mahila Kisan Divas and World Food Day

Mahila Kisan Divas and World Food Day were celebrated on October 16, 2017 at Kondanaguda village, Shadnagar District. Several Women were gathered and the importance of Women in Agriculture, Nutritional and healthy food habits were briefed to the gathered Women.

Vigilance awareness week

Vigilance Week was observed at this Institute during 30th October to 4th November 2017. On this occasion, the Director (A) administered oath to all the staff on the vigilance awareness. An essay and poster competitions were organized on the occasion. Dr Madhukar Shetty IPS, National Police Academy was the Guest of Honor on the Closing day and prizes were distributed to the winners.

World Soil Day

ICAR-IIRR organised world soil day on 5th of December, 2017 at Burgula, Shadnagar Mandal, Ranga Reddy district. There were around 30 farmers participated in the programme. Farmers from nearby villagers brought 30 soil samples. Soil samples were analysed by the rapid soil health testing kit and the soil health cards were generated on the spot and they were distributed in the function organised. Farmers were also given Leaf Colour Charts and the importance of urea economy was made known. From, ICAR-IIRR, 5 scientists and one technical officer participated in the function.

Institute Foundation Day

ICAR-Indian Institute of Rice Research (IIRR), Hyderabad celebrated its 3rd Foundation Day on 15th December 2017. The foundation day was observed highlighting the theme: Roadmap for second green revolution in rural India - Progress of agricultural research *vis a vis* administrative and political will. The Directors and representatives of local ICAR institutes as well as Institute scientific, administrative and supporting staff participated in the celebrations.

Dr. S.R. Voleti, Director (Acting), in his welcome address, appraised the participants about the historical progress of the institute from AICRIP to Directorate of Rice Research culminating to the present upgradation to IIRR. Director also highlighted the attainment of two padmasri awards by our earlier Directors Dr. S V S Shastri and Dr. E.A. Siddique.

Dr. W.R. Reddy, Director General, National Institute of Rural Development and Panchayat Raj (NIRD & PR), Hyderabad, in his key note address highlighted the contribution of agricultural scientists in the success of first green revolution bringing the country to self sufficiency status. He advocated the need for five strategies *viz*., enabling rural employment, creating infrastructure such as roads and housing, empowerment of women, skill development particularly among youth and social security assistance programmes. He emphasized that Second green revolution possibility is linked to tailoring existing technologies to suit different ecosystems, ability to sustain productivity without adversely affecting natural resources and reaching out to small and marginal farmers through all possible means.

The web page on Facilities Corner (Sophisticated Analytical Instrument Facility) of IIRR was launched during this occasion to link to National Portal for facilitating use of major equipments. The function ended with vote of thanks proposed by Dr. Gururaj Katti, Principal Scientist and Head, Crop Protection.

Visit of Honourable Vice President of India

To motivate and inspire agricultural scientists and young ARS probationers, Hon'ble Vice President of India Sri. Venkaiah Naidu visited ICAR Indian Institute of Rice Research, Hyderabad on 31st March 2018. He was the chief guest for an interactive meeting conducted to chalk out strategies for Doubling of Farmers Income especially in Telangana and Andhra Pradesh. Hon'ble Director General ICAR and Secretary DARE Dr. T. Mohapatra and Deputy Director General (CS) Dr. A.K. Singh graced the occasion. Padmasri Sri SVS Sastry, Padmasri Dr EA Siddiq, , National Professor Dr N. Sarla, Vice Chancellor of PJTSAU, Dr V.Praveen Rao and Directors of ICAR institutes based in these Telugu speaking states along with 350 ICAR scientists and ARS probationers took part in the meeting.

Dr. Mohapatra elucidated the efforts of ICAR in chalking out location specific and state specific strategies to double the farmers' income level. He highlighted the significant achievements of ICAR in post independence era especially in last four years. He assured the Hon'ble Vice President that no stone will be unturned in realizing the vision of Hon'ble Prime Minister of India.

In the Interactive session that followed, Padmasri awardees gave a brief account of strategies that could be adopted to make rice farming profitable. Directors of other Institutes provided brief account of how they could contribute to the mission of doubling of farmers income and what activities were already undertaken.

In his remarks, Honourbale Vice President Sh. Venkaiah Naidu expressed his happiness about the progress made by ICAR Institutes and urged upon the scientific community not to be complacent with the achievements.

He called upon the governments to strengthen eNational Agricultural Markets (eNAM) that will ultimately benefit Indian farmers in realizing better prices. He urged agricultural scientists to spend equal amount of time both in lab and land. He emphasized on harnessing latest digital technologies in reaching out to farmers with timely knowledge and services. He concluded by saying that a happy farmer make a happy nation.

The event ended with the vote of thanks proposed by Dr. S.R. Voleti, Director, ICAR-Indian Institute of Rice Research, Hyderabad.

Soil Health Card Scheme Hoarding :

ICAR IIRR Installed a permanent hoarding containing information about soil health card distribution to the 10 crore farmers by Government of india and benefits of soil test based fertilizer application. Toll free numbers to contat for more information were also provided on the hoarding.

Vermi Compost Unit

On the occasion of the 69th Republic Day and as a part of the Swachh Bharat mission, a Vermicompost unit was constructed at Rajendranagar farm with locally available farm resource materials. Vermicompost unit was inaugurated by Shri S. M. Subhani, Former Head Master. The Director, Dr. S. R. Voleti explained about the importance of composting, recycling of farm waste into valuable inputs and emphasized the vision of IIRR working towards recycling, reuse, regeneration and income generation from farm wastes.

Sports Meet-Medals' galore

- IIRR staff performance in Sports was commendable. Dr. K. Surekha and Dr. G. Padmavathi won gold medal in Table Tennis (Women-doubles) during ICAR Inter-zonal sports meet-2017 held from 21st April -25th April 2018 at ICAR-NAARM.
- Dr. K. Surekha and Dr. G. Padmavathi won gold medal in Table Tennis (Women-doubles) during ICAR South Zone sports tournament-2017 held from 9th Oct – 13th Oct 2017 at ICAR-SBI Coimbatore, TN.
- Dr. K. Surekha won gold medal in Table Tennis (Women-singles) during ICAR South Zone sports tournament-2017 held from 9th Oct – 13th Oct 2017 at ICAR-SBI Coimbatore, TN.
- Dr M.N. Arun, Dr R Mahendra Kumar, Mr B. Ramesh, Dr Mangaldeep Tuti and Vijay Kumar won gold medal in Table Tennis **(Team Events)** during ICAR South Zone sports tournament-2017 held from 9th Oct – 13th Oct 2017 at ICAR-SBI Coimbatore, TN.

Seminars Organized / Important Visitors

As part of interactive and educational programs seminars by eminent personalities were regularly organized in the institute for the benefit of the staff, scholars and students.

S. No.	Name of the Speaker	Designation and organization	Title	Date
1	Dr Adam Price	Prof. Plant Molecular genetics, institute. Of Biological and Env. Sci.Univ. of Aberdeen	Accurate Genetic mapping in rice at last	20th Feb 2017
2	Dr Nese Srinivasiulu	IRRI	Translational genomics of low glycemic rice	5th may 2017

S. No.	Name of the Speaker	Designation and organization	Title	Date
3	Ashish Kumar Srivatsava	Scientific Officer, BARC , Mumbai	Chemical and Genetic approaches for improving abiotic stress tolerance in plants	7th Dec. 2017
4	Dr Jitender Giri	Scientist III, NIPGR, New Delhi	Molecular regulation of adaptive response to low phosphate in rice	6th January , 2018

Pre-Rice Group Meeting for hill Region

The 5th Annual Hill Rice Research Group Meeting" was held on February 21st, 2018 at SKUAST-Jammu Main Campus Chatha. It was organized by Indian Institute of Rice Research (ICAR), Hyderabad in collaboration with AICRP (Rice) group of SKUAST-Jammu. The Group Meeting was organized under the patronage of Hon'ble Vice Chancellor SKUAST-J Prof. Pradeep K. Sharma who was Chief Guest in the inaugural session.

Dr. Subba Rao enlisted the activities of AICRP (Rice) Centres in the Hill zone and underlined the need to add more testing stations in each agro-ecology and promotion of more entries in the trials. He requested SKUAST-J authorities to allow conductance of AICRP (Rice) trials at Bhaderwah Centre. He informed that hilly areas at some stations are suitable for development of rice hybrids through two line system. He emphasised that data should be precisely recorded and calculated before submission to IIRR, Hyderabad.. He expressed concern over less attendance of the AICRP (Rice) scientists from South Indian Centres. The data was presented and the members actively participated in the one day work shop.

53rd Annual Rice Research Group Meetings, 13th-16th April, 2018

The inaugural session of the 53rd Annual Rice Research Group Meeting was held in the SVS Shastry Auditorium, Indian Institute of Rice Research, Hyderabad on April 14, 2018 (Saturday) at 10.30 AM, with ICAR Song followed by lighting of the lamp by the dignitaries. Dr. S.R Voleti, Director, IIRR welcomed the dignitaries and delegates of AICRIP co-operators and seed industry. He thanked the support and cooperation of all senior members of AICRIP who had contributed immensely to the success of AICRIP for more than five decades.

Dr. I.S. Solanki, ADG (FFC). ICAR in his remarks mentioned the importance of AICRIP as the largest of All India Coordinated Programme addressing the technology development and dissemination in the major staple food of Rice in India with largest production and area. He stressed upon the low productivity of rice in the many ecologies which needs to be enhanced. He pointed out that it is not only important to develop varieties /technologies but, it should reach the ultimate beneficiaries i.e. farmers. He suggested that breeders also should take responsibility of popularizing their varieties. AICRIP has to go a long way to meet the challenges due to climate change and address the drudgeries faced by the farmers.

Dr. A. K. Singh, DDG (Crop Science & Horticulture Science), ICAR in his remarks complimented the AICRIP as the oldest coordinated programme and contributed much to the country's food production and a lot more to be done in the coming years to meet the farmers demands and new challenges. He pointed out that time has arrived for diversification and motivated rice scientists to do more efforts to make farmers life better. Several publications were released on the occasion. In the 3 day group meetings Scientists across the disciplines deliberated on the results of the trials and proceedings were brought out.

Personnel

Scientific Staff

Name	Designation
Dr. S.R. Voleti	Director (A)
Dr. V. Ravindra Babu	Director - Retd. on 30-06-2017
Plant Breeding	
Dr. T. Ram	Pr. Scientist - Retd. on 30-04-2017
Dr. L.V. Subba Rao	Principal Scientist
Dr. G. Padmavathi	Principal Scientist
Dr. Aravind. J	Sr. Scientist - Joined on 07-07-2017 (Transferred from CAZRI, Jodhpur)
Dr. Gireesh. C	Scientist
Dr. Suneetha Kota	Scientist (Deputation to IRRI)
Dr. R. Abdul Fiyaz	Scientist
Dr. Jyoth Badri	Scientist
Dr. M.S. Anantha	Scientist
Dr. Suvarna Rani Ch.	Scientist - Joined on 17-04-2017
Hybrid Rice	
Dr. A.S. Hari Prasad	Principal Scientist
Dr. P. Senguthuvel	Scientist
Dr. P. Revathi	Scientist
Dr. Kemparaju K.B	Scientist
Ms. K. Shruti	Scientist
Biotechnology	
Dr. P. Ananda Kumar	Pr. Scientist - Retd. on 30-11-2017
Dr. S.M. Balachandran	Principal Scientist
Dr. C.N. Neeraja	Principal Scientist
Dr. R.M. Sundaram	Principal Scientist
Dr. Seshu Madhav	Principal Scientist
Dr. Divya P.S	Scientist
Dr. S. K. Mangrauthia	Scientist
Dr. Kalyani Kulkarni	Scientist
Agronomy	
Dr. R. Mahendra Kumar	Principal Scientist
Dr. B. Sreedevi	Principal Scientist
Dr. Mangal Deep Tuti	Scientist
Mr. S. Saha	Scientist (Study Leave)
Dr. Aarti Singh	Scientist
Soil Science	
Dr. K. Surekha	Principal Scientist

Name	Designation
Dr. M.B.B. Prasad Babu	Principal Scientist
Dr.DVK.Nageswara Rao	Principal Scientist
Dr. Brajendra	Principal Scientist
Dr. P.C. Latha	Principal Scientist
Dr. Bandeppa	Scientist
Mr. R. Gobinath	Scientist
Ms. V. Manasa	Scientist
Physiology & Biochemistry	
Dr. D. Subrahamanyam	Principal Scientist
Dr. P. Raghuveer Rao	Principal Scientist
Dr. D. Sanjeeva Rao	Scientist
Agril. Engineering	
Dr. Vidhan Singh	Principal Scientist
Agril. Chemicals	
Dr. M.M. Azam	Principal Scientist
Computer Applications	
Dr. B. Sailaja	Principal Scientist
Entomology	
Dr. G.R. Katti	Principal Scientist
Dr. B. Jhansi Rani	Principal Scientist
Dr. V. Jhansi laxmi	Principal Scientist
Dr. N. Somashekar	Principal Scientist
Dr. A.P. PadmaKumari	Principal Scientist
Dr. Chithra Shanker	Principal Scientist
Dr. Ch. Padmavathi	Principal Scientist
Dr. Y. Sridhar	Principal Scientist
Mr. S. Chavan	Scientist
Plant Pathology	
Dr. M. Sreenivasa Prasad	Principal Scientist
Dr. G.S. Laha	Principal Scientist
Dr. D. Krishna Veni	Principal Scientist
Dr. C. Kannan	Principal Scientist
Dr. Lakshmi Ladha	Scientist
Dr.V. Prakasam	Scientist
Sh. K. Basavarj	Scientist - Joined on 15-04-2017
Mr. S. Jasudas Gompa	Scientist - Joined on 16-10-2017

Name	Designation
Dr. Valarmathi	Scientist - Transfer to CICR Nagpur on 24-06-2017
Transfer of Technology & Training	
Dr. P. Muthuraman	Principal Scientist
Dr. Amtul Waris	Principal Scientist
Dr. Shaik N. Meera	Principal Scientist
Dr. Jeya kumar	Principal Scientist
Dr. Lakshmi Prasanna	Sr. Scientist
Dr. B. Nirmala	Scientist
Dr. S. Arun Kumar	Scientist
National Professor	
Dr. N Sarla	Retd. on 30-04-2017 and continuing as National Professor
Dr. Divya Balakrishnan	Scientist
Technical Staff	
C. Sadanandam	Senior Technical Officer
Uddaraju Chaitanya	Senior Technical Officer
Srinivasan Amudhan	Senior Technical Officer
K. Chaitanya	Senior Technical Officer
M Ezra	Senior Technical Officer
Chirutkar Prakash	Senior Technical Officer
M Vijay Kumar	Technical Officer
Mohd.Tahseen	Technical Officer
A. Narsing Rao	Technical Officer
Emkolla Nagarjuna	Technical Officer
CH.Sivannarayana	Technical Officer
Mohd. Sadath Ali	Technical Officer
K. Ramulu	Technical Officer
U.Pullaiah	Technical Officer
P.Vittalaiah	Technical Officer
P. Chandrakanth	Senior Technical Assistant
A Venkataiah	Senior Technical Assistant
Tupakula Venkaiah	Senior Technical Assistant
C. Muralidhar Reddy	Senior Technical Assistant
Ch. Anantha Reddy	Senior Technical Assistant
Y Roseswara Rao	Senior Technical Assistant
Kova Shravan Kumar	Senior Technical Assistant
K Janardhan	Senior Technical Assistant
Bidyasagar Mandal	Technical Assistant
S. Vijay Kumar	Technical Assistant
K.H. Devadas	Technical Assistant
V. Srinivas Goud	Technical Assistant
B. Venkaiah	Technical Assistant
M. Chandrakumar	Technical Assistant
T. Narender Prasad	Technical Assistant
Koteswara Rao Potla	Technical Assistant
T.P. Sharma	Technician - Retd. on 31-10-2017
E. Ramulu	VRS w.e.f. 05-08-2017
B.P. Anajaneyulu	Technical Asst. Retd. on 30-04-2017

Name	Designation
Administrative Staff	
Sathish B	Senior Administrative Officer (Joined on 24-04-2017)
Ajay K. Maheshwari	Finance & Accounts Officer (Joined on 28-04-2017)
K. Srinivasa Rao	Finance & Accounts Officer (Transferred to IIOR, Hyderabad)
K. Kumara Swamy	Asst. Administrative Officer
K Kousalya	Asst. Administrative Officer
Judith Daniel	Private Secretary - Retd. on 31-10-2017
R. Udaya Kumar	Private Secretary
Uppalapati Rama	Assistant
P Lakshmi	Assistant
S Prabhakar	Assistant
B Vidyanath	Assistant
T.D.Pushpalatha	Assistant
K. Sudhavalli Tayaru	Assistant
Sudha Nair	Assistant
Vijaya Kumar	Junior Accounts Officer
S.Hemalatha	Personal Assistant
Sandiri Rama Murthy	Personal Assistant
Aparna Das	Personal Assistant
Bommakanti Ramesh	Personal Assistant
Vanitha	Upper Division Clerk (re-joined after deputation on 04-12-2017)
Bharath Raju	Upper Division Clerk
Shaik Ahmed Hussain	Upper Division Clerk
G. Satyanarayana	Upper Division Clerk
K Mallikarjunudu	Upper Division Clerk
Kota Jashwanth	Lower Division Clerk
S. Rekha Rani	Lower Division Clerk
Ashfaq Ali	Stenographer
K. Janardhan	Senior Technical Assistant
K Narasimha	Technical Assistant
V Srinivas Rao	Technical Assistant
P Govinda Raju	Technical Assistant
A Ramesh	Senior Technician
Chander	Skilled Supporting Staff (SSS)
Giyar Shankaraiah	Skilled Supporting Staff (SSS)
M Anthamma	Skilled Supporting Staff (SSS)
R Sathamaiah	Skilled Supporting Staff (SSS)
B Susheela	Skilled Supporting Staff (SSS)
S Yadaiah	Skilled Supporting Staff (SSS)
R Yellaiah	Skilled Supporting Staff (SSS)
Ahmed Ullah Khan	Skilled Supporting Staff (SSS)
V Golu Naik	Skilled Supporting Staff (SSS)

Publications

(I) Papers in Research Journals (National/International):

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Anjum N, Methre R, Boghireddy S, Laha GS, Sundaram RM and Mangrauthia SK* (2017). Expression Analysis of Genes and MicroRNAs in the Rice Cultivars during Infection by Xanthomonas Oryzae pv. Oryzae. Journal of Rice Research, 10: 40-45.

Anusha CH, Padmakumari AP, Maheswari T. Uma, Malathi S, Prakash, S. Om and Raju, CH. Damodar .2017. Evaluation of rice pre-breeding lines for gall midge resistance. *Agric. Update*, 12 (TECHSEAR-5): 1300-1307; DOI: 10.15740/HAS/AU/12. TECHSEAR (5)2017/1300-1307.

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Chitra Shanker, Lydia CH, Sampathkumar M, Sunil V, Amudhan S and Katti GR. 2018. Non Crop Plants as Reservoir of Alternate Prey for Coccinellids of Rice. *European Journal of Entomology* 115 : (In print).

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Appendix-1

Promising Entries in Varietal Trials, Kharif 2017

Sl. No.	IET No.	Designation	Cross combination	Source trial	Yield (kg/ha)	FD (days)	GT	Promising for
1	23354	RP 5125-12-5-3-B (IR84898-B-B)	IR 78877-208-B-1-1 / IR 78878-53-2-2-2	IVT-E TP	5594	90	LB	Suitable for irrigated ecology in Haryana, Karnataka, Madhya Pradesh and Gujarat
2	24904	NK-17508	Hybrid	IVT-E TP	6308	89	LB	Suitable for irrigated ecology in Haryana, Uttar Pradesh, Jharkhand and Maharashtra (Zone V)
3	25331	RNR 19399	IR 64 / Erramallelu	AVT 2-IME	6092	94	MS	Suitable for irrigated ecology in Gujarat (Zone VI)
4	24951	VNR 218	Hybrid	AVT 2-IME	6469	99	MS	Suitable for irrigated ecology in Chhattisgarh (Zone III)
5	25419	HUR-156	Taroari Basmati dwarf mutant-2 / MTU 7029	AVT 1- ASG	5220	106	SS	Promising in UP (Zone III)
6	24197	TRC 2014-8/IR 83928-B-B-9-1	IR 78878-208-B-1-2 / IR 74371-54-1-1	AVT 1-E (H)	5053	94	MS	Suitable for low elevation hills of Himachal Pradesh
7	25378	CSR 2013 M1- 10	IR 4630-22-2-5-1-3 / IR 05N204	AVT 1-AL & ISTVT	3983	96	LS	Suitable for saline and alkaline affected area of UP and Pondicherry
8	25640	RCPR-22-IR84899-B-183-20-1-1-1	IR78877-208-B-1-1 / IRRI 132	AVT 2-AERO	4705	83	LS	Suitable for aerobic rice cultivation in JH and CG
9	25610	PAU-2K 10-23-53-14-52-20-0-4	PAU 201 / PAU 3699-13-2-3-1 // PAU 201	AVT 2-AERO	4090	98	LS	Suitable for aerobic rice cultivation in Gujarat and Bihar
10	25662	TRC-2015-12	Naveen / Kataktara	AVT 2-AERO	4041	85	LS	Suitable for aerobic rice cultivation in Chhattisgarh
11	25493	RTN 28-1-5-3-2	IR-64 / KJT-182	AVT 2-MS	6190	109	MS	Promising for Zone - V
12	24993	PR-15108	Hybrid	AVT 2-MS	5948	104	MS	Promising for Zone - III
13	25495	MTU 1190 (MTU 2142-9-2-1)	MTU 1081 / Swarna Sub1	AVT 2-MS	6098	106	MS	Promising for Zone – V
14	24990	MR-8666	Hybrid	AVT 2-MS	7585	104	MS	Promising for Zone – III
15	25523	CR 3505-7-1-1-1-2-1	IR 36 / Vijetha	AVT 2-MS	4913	107	MS	Promising for Zone –V
16	25521	AD 13121	CR 1009 / ADT 49	AVT 2-MS	4504	128	MS	Promising for Zone - V
17	25489	CR 3511-3-2-2-5-1-1	IR 36 / Surendra	AVT 2-MS	4406	117	LB	Promising for Zone - V
18	24898	HRI 186	Hybrid	IVT-BORO	6904	127	MS	Suitable for boro rice cultivation area in Bihar and West Bengal

Appendix-2

Promising hybrids identified in different hybrid rice trials (2017)

Name of the Hybrid	IET No.	DFF	Promising in
IHRT-E			
LP 17201	26464	88	Overall
NK 20031	26474	90	Overall
JKRH-2354	26468	89	Zone V
IHRT-ME			
RH-110647	26498	90	Zone III
YRH-2052	26487	89	Zone VI
US 344	26493	96	Zone III
IHRT-M			
PHI-17101	26535	98	Overall
PHI-17103	26538	97	Zone II
PHI-17104	26517	101	Zone VII
IHRT-MS			
PHI 17108	26549	100	Overall
S 8001	26547	103	Zone VI

Appendix-3

List of promising entries in INGER nurseries

Trial/ Screening Nurseries	Promising Entries
International Irrigated Rice Observational Nursery (IIRON):	TPs 30614, 30754, 30601, 24370 and 30600
International Temperate Rice Observational Nursery (IRTON)	TPs 25175, 24368, 30753, 16199 and 26783
International Rainfed Lowland Rice Obser. Nursery (IRLON):	TPs 30531, 30543, 20081, 30560 and 30557
International Upland Rice Observational Nursery (IURON):	TPs 29788, 30596, 30531, 30575 and 30582
International Rice Soil Stress Tolerance Nurseries (IRSSTN-SS1):	TPs 200, 30650, 21654, 30646 and 30648
International Rice Soil Stress Tolerance Nurseries (IRSSTN-SS2):	None
International Rice Blast Nursery (IRBN):	2017IRBN-005, 2017IRBN-006 and 2017IRBN-007
International Rice Bacterial Blight Nursery (IRBBN):	2017IRBBN-021, 2017IRBBN-028, 2017IRBBN-032 and 2017IRBBN-034
International Rice Brown Planthopper Nursery (IRBPHN):	2017IRBPHN-001, 2017IRBPHN-022, 2017IRBPHN-026, 2017IRBPHN-035, 2017IRBPHN-049 and 2017IRBPHN-009

Appendix-4

Variety Wise Breeder Seed Production During Kharif, 2017 (As Per Dac Indent)

Quintals

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
	VARIETIES			
1	Abhishek (IET - 17868)	40.00	40.00	CRURRS, Hazaribagh
2	ADT 50	0.10	0.00	TNAU, Coimbatore
3	ADT-37	11.00	0.00	TNAU, Coimbatore
4	ADT-39	5.00	0.00	TNAU, Coimbatore

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
5	ADT-43 (IET-14878)	3.00	0.00	TNAU, Coimbatore
6	ADT49	0.10	0.10	TNAU, Coimbatore
7	Akashaya	0.10	8.55	ANGRAU, Guntur
8	Amara (MTU-1064)	8.00	45.00	ANGRAU, Guntur
9	Anjali (IET-16430)	2.00	5.70	CRURRS, Hazaribagh
10	Anna (R) 4	0.10	0.00	TNAU, Coimbatore
11	Annada	11.00	12.00	NRRI, Cuttack
12	Athira (PBT-51)	0.50	2.50	KAU, Pattambi
13	Badshah bhog Selection-1	3.00	6.60	IGAU, Raipur
14	Bamaleshwari (IET 14444)	20.00	21.00	IGAU, Raipur
15	Basmati CSR 30 (IET-14720, YAMINI)	7.00	13.50	CSSRI, Karnal
16	Basmati-370	2.00	8.40	CSSRI, Karnal
17	Bhadra (MO-4)	3.50	4.05	RRS, Monocompu
18	Bharani (NLR 30491)	0.10	0.12	ANGRAU, Guntur
19	Bhavapuri Sannalu	0.10	52.00	ANGRAU, Guntur
20	Bhogavati	1.50	10.25	ARS, Radhanagari
21	Bhuvan (IET 7804)	1.00	7.50	OUAT, Bhubaneshwar
22	Binadhan-10	0.60	0.00	ICAR-IIRR, Hyderabad
23	Binadhan-12	0.90	0.00	ICAR-IIRR, Hyderabad
24	Binadhan-8	0.30	0.00	ICAR-IIRR, Hyderabad
25	Birsa Vikas Dhan -110	3.50	3.90	BAU, Ranchi
26	Birsa Vikas Dhan-109	15.00	14.00	BAU, Ranchi
27	Birsmati	1.50	2.70	BAU, Ranchi
28	BPT-3291 (SONAMASURI)	8.00	32.90	ANGRAU, Guntur
29	BR-2655	3.00	3.00	UAS, Bangalore
30	CG Zinc Rice -1 (CGZR-1)	10.00	10.00	IGAU, Raipur
31	Chandan	11.50	18.00	PJTSAU, Rajendra Nagar
32	Chandrahasini (IET - 16800)	68.00	52.00	IGAU, Raipur
33	Chandrama (IET9354,10419)	30.00	0.00	NRRI, Cuttack
34	CHENAB (SKAU-23)	1.00	1.00	SKUAT, Khudwani
35	Chinsurah Rice (IET 19140)	1.00	1.25	RRS, Chnisurah
36	Ciherang Sub-1 (BINADHAN-11)	15.00	10.00	ICAR-IIRR, Hyderabad
37	CO 51	10.00	0.20	TNAU, Coimbatore
38	Cottondora Sannalu (MTU-1010)	400.00	577.95	ANGRAU, Guntur
39	CR Boro Dhan-2(IET-17612)	1.00	1.00	NRRI, Cuttack
40	CR Dhan- 10 (IET 18312)	1.00	0.60	NRRI, Cuttack
41	CR Dhan 300 (IET 19816)	3.00	2.30	NRRI, Cuttack
42	CR Dhan 303(CR2649-7)(IET 21589)	13.00	0.00	NRRI, Cuttack
43	CR Dhan 304 (IET 22117)	4.00	4.00	NRRI, Cuttack
44	CR Dhan 305 (IET 21287)	1.00	1.00	NRRI, Cuttack
45	CR Dhan 40 (IET 19253)	2.00	0.00	NRRI, Cuttack
46	CR Dhan 401 (Reeta) (IET19969)	2.60	2.20	NRRI, Cuttack
47	CR Dhan 500 (IET 20220)	55.00	27.80	NRRI, Cuttack
48	CR Dhan 501 (IET 19189)	3.10	0.00	NRRI, Cuttack
49	CR Dhan 601 (IET 18558)	6.50	2.50	NRRI, Cuttack
50	CR Dhan-201 (AEROBIC)	44.00	0.00	NRRI, Cuttack
51	CR Dhan-203	0.50	1.50	NRRI, Cuttack
52	CR Dhan-301	2.00	0.00	NRRI, Cuttack
53	CR Dhan-307	3.00	4.80	NRRI, Cuttack

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
54	CR Dhan-311	1.50	1.00	NRRI, Cuttack
55	CR Sugandh Dhan 907 (IET 21044)	2.50	1.00	NRRI, Cuttack
56	CR-1009 Sub-1	6.10	1.20	NRRI, Cuttack
57	CR-1014	0.50	1.40	NRRI, Cuttack
58	CSR- 43	2.00	12.25	CSSRI, Karnal
59	CSR-1017	5.00	0.00	CSSRI, Karnal
60	CSR-1018	3.00	0.00	CSSRI, Karnal
61	CSR-36	5.00	12.25	CSSRI, Karnal
62	Danteshwari (IET NO. 15450)	35.00	38.00	IGAU, Raipur
63	Deepti (MTU-4870)	0.50	0.10	ANGRAU, Guntur
64	Dhanrasi (IET 15358)	0.50	0.50	ICAR-IIRR, Hyderabad
65	DRR Dhan -43	4.00	4.00	ICAR-IIRR, Hyderabad
66	DRR Dhan-39 (Jagjeevan)	12.50	4.00	ICAR-IIRR, Hyderabad
67	DRR Dhan-44	71.00	30.00	ICAR-IIRR, Hyderabad
68	DRR Dhan-45	1.00	1.80	ICAR-IIRR, Hyderabad
69	DRR Dhan-46	0.50	0.50	ICAR-IIRR, Hyderabad
70	Dubraj Selection-1	3.00	9.90	IGAU, Raipur
71	Erra Mallelu (WGL-20471)	8.00	8.00	PJTSAU, Rajendra Nagar
72	Gajapati (IET-13251)	0.50	0.00	OUAT, Bhubaneshwar
73	Geetanjali (IET-17276)	4.00	0.75	NRRI, Cuttack
74	Gontra Bindhan-1 (IET-17430)	66.50	42.00	BCKVV, Nadia
75	Gontra Bindhan-3 (IET-22752)	17.50	24.00	BCKVV, Nadia
76	Govind	1.00	15.00	GBPUAT, Pantnagar
77	Hazari Dhan	3.50	5.40	CRURRS, Hazaribagh
78	Hiranmayee	1.50	0.00	OUAT, Bhubaneshwar
79	HKR-127 (HKR-95-222)	7.00	15.60	CSSRI, Karnal
80	HKR-128	1.50	0.00	CSSRI, Karnal
81	HKR-47	5.00	12.00	CSSRI, Karnal
82	HPR 2143	8.00	8.20	CSKHPKVV, Malan
83	HPR-1068	8.00	8.30	CSKHPKVV, Malan
84	HPR-1156 (IET-16007)	5.00	5.00	CSKHPKVV, Malan
85	HPR-2612 (Palam Basmati-1)	2.00	2.80	CSKHPKVV, Malan
86	IET 23189	0.50	0.00	NRRI, Cuttack
87	IGKVR-1 (IET 19569)	85.00	86.00	IGAU, Raipur
88	IGKVR-2 (IET 19795)	52.50	48.60	IGAU, Raipur
89	IGRKVR-1244 (IET 19796)	58.00	61.00	IGAU, Raipur
90	Improved Lalat	2.50	0.00	OUAT, Bhubaneshwar
91	Improved Pusa Basmati-1 (IET-18990)	1.00	1.75	IARI, Regional Station, Karnal
92	Improved Samba Mahsuri	15.50	35.50	ICAR-IIRR, Hyderabad
93	Indira Aerobic-1 (IET 21686)	16.00	17.00	IGAU, Raipur
94	Indira Barani Dhan-1(IET-21205)	35.00	32.70	IGAU, Raipur
95	Indra (MTU – 1061)	10.60	15.90	ANGRAU, Guntur
96	Indrayani (IET - 12897)	15.50	23.00	Vadagaon
97	Intan	2.00	0.00	ARS, Mugad
98	IR-36	50.00	39.79	IGAU, Raipur; JNKVV, Jabalpur
99	IR-50	0.10	0.00	TNAU, Coimbatore
100	IR-64	92.00	666.76	IGAU, Raipur; JNKVV, Jabalpur
101	IR-64 DRT-1 (DRR Dhan-42)	95.00	117.40	IGAU, Raipur; IIRR, Hyderabad
102	Jaldbi (IET - 17153)	1.00	1.00	IGAU, Raipur

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
103	Jarava (IET -15420)	1.00	1.00	ICAR-IIRR, Hyderabad
104	Jaya	16.00	14.00	ICAR-IIRR, Hyderabad
105	JGL 11470 (Jagityal Mahsuri)	0.10	0.10	PJTSAU, Rajendra Nagar
106	JGL 3855(Karimnagar Samba)	0.10	0.10	PJTSAU, Rajendra Nagar
107	JGL-1798	5.00	5.00	PJTSAU, Rajendra Nagar
108	JGL-18047	4.00	8.00	PJTSAU, Rajendra Nagar
109	JR 503 (RICHA) (IET-16783)	1.00	1.35	JNKVV, Jabalpur
110	Jyothi	8.00	35.00	KAU, Pattambi
111	Kalachampa	8.10	0.00	OUAT, Bhubaneshwar
112	Karjat -8	0.50	6.43	RARS, Karjat
113	Karjat-184	2.00	2.95	RARS, Karjat
114	Karjat-2	2.00	10.15	RARS, Karjat
115	Karjat-3	4.00	9.25	RARS, Karjat
116	Karjat-5	2.50	5.17	RARS, Karjat
117	Karjat-6	1.50	4.37	RARS, Karjat
118	Karjat-7	7.00	10.37	RARS, Karjat
119	Khandagiri	21.50	24.00	OUAT, Bhubaneshwar
120	Khitish (IET-4094)	18.00	16.75	NRRI, Cuttack; RRS, Chnisurah
121	KHP-10	0.50	0.00	UAS, Bangalore
122	KMD-2 (Abhilash)	1.50	0.00	ARS, Mugad
123	KN3	0.10	30.00	PRDF, Gorakhpur
124	Kranti (R-2022)	14.50	1420.20	JNKVV, Jabalpur
125	Krishna Hamsa	0.50	1.20	ICAR-IIRR, Hyderabad
126	Lalat (IET-9947)	48.00	40.30	OUAT, Bhubaneshwar
127	Luna Sankhi	1.50	1.50	NRRI, Cuttack
128	Lunasampad (IET 19470)	1.50	0.40	NRRI, Cuttack
129	Lunasuwarna (IET 18697)	1.50	1.00	NRRI, Cuttack
130	Lunisree	1.50	0.50	NRRI, Cuttack
131	Mahamaya (IET-10749)	32.50	81.90	IGAU, Raipur
132	Malaviya Sugandh 4-3 (HUR-4-3)	5.00	8.50	BHU, Varanasi
133	Malaviya Sugandh-105 (HUR-105)	3.00	14.00	BHU, Varanasi
134	Manaswini(IET 19905)	2.50	4.60	OUAT, Bhubaneshwar
135	Mandakini (OR 2077-4)(IET 17847)	2.50	11.40	OUAT, Bhubaneshwar
136	Maruteru Sannalu (MTU-1006)	3.00	6.00	ANGRAU, Guntur
137	Masuri	2.50	1.80	ICAR-IIRR, Hyderabad
138	Matta Triveni	1.10	5.00	KAU, Pattambi
139	MO 21 (PRATIKSHA)	0.10	5.03	RRS, Monocompu
140	Moti Gold (NP 1024)	0.05	0.00	ICAR-IIRR, Hyderabad
141	Moudamani	3.00	0.00	OUAT, Bhubaneshwar
142	Mrunalini (OR 1898-18) IET 18649	15.50	21.00	OUAT, Bhubaneshwar
143	MTU 1001 (Vijetha)	121.00	121.00	ANGRAU, Guntur
144	MTU 1031 (Tholakuri)	0.50	0.65	ANGRAU, Guntur
145	MTU 1075 (IET 18482)	20.00	26.29	ANGRAU, Guntur
146	MTU-1032 (Godavari)	1.00	0.60	ANGRAU, Guntur
147	MTU-1187	1.00	0.00	ANGRAU, Guntur
148	MTU-7029 (Swarna)	226.50	276.80	ANGRAU, Guntur
149	Narendra Dhan 3112-1 PRAKHAR	3.00	42.38	NDUAT, Faizabad
150	Narendra Dhan-359 (NDR-359)	7.50	50.86	NDUAT, Faizabad
151	Narendra Dhan-97	1.50	5.85	NDUAT, Faizabad

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
152	Narendra Lalmati (IET 21051)	1.50	5.24	NDUAT, Faizabad
153	Narendra Usar Dhan 2008 (IET-18699)	12.00	0.00	NDUAT, Faizabad
154	Naveen (CR-749-20-2) (IET-14461)	36.50	20.00	NRRI, Cuttack
155	NDR 2064 (IET 17475)	5.00	6.60	NDUAT, Faizabad
156	NDR 2065 (IET 17476)	20.50	73.35	NDUAT, Faizabad
157	NDR-357	4.00	0.00	NDUAT, Faizabad
158	NDR-8002	5.00	63.89	NDUAT, Faizabad
159	Nellore Mahsuri (NLR-34449)	27.00	32.40	ANGRAU, Guntur
160	NLR-145	6.50	7.80	ANGRAU, Guntur
161	NUA Chinikamini (IET 18394) CR 2580)	1.00	1.00	NRRI, Cuttack
162	Pankaj	0.05	0.00	NRRI, Cuttack
163	Pant Dhan 18 (IET 17920) (UPRI 99-1)	2.00	15.00	GBPUAT, Pantnagar
164	Pant Dhan-10 (IET - 8616)	1.00	8.00	GBPUAT, Pantnagar
165	Pant Dhan-12 (IET-10955)	1.50	5.00	GBPUAT, Pantnagar
166	Pant Dhan-19(IET 17544)	0.50	20.00	GBPUAT, Pantnagar
167	Pardhiva (NLR – 33892)	2.50	3.00	ANGRAU, Guntur
168	Parijat (IET-2684)	5.50	7.20	OUAT, Bhubaneshwar
169	PAU-201	5.00	7.00	PAU, Ludhina
170	PB-1609	0.60	1.00	IARI, Regional Station, Karnal
171	Phalguni (IET 18720) CRAC 2224-1041)	2.00	0.75	NRRI, Cuttack
172	Phule Samrudhi	6.50	26.00	Vadagaon
173	PNR-546 (IET-11347)	0.50	0.00	DSST & IARI, New Delhi
174	Pooja (IET-12241)	38.00	70.20	NRRI, Cuttack
175	Poornima (IET-12284,R-281-PP-31-1)	6.00	4.30	IGAU, Raipur
176	PR-111	8.00	15.00	PAU, Ludhina
177	PR-113	10.00	11.00	PAU, Ludhina
178	PR-114	24.00	40.00	PAU, Ludhina
179	PR-116	3.50	5.00	PAU, Ludhina
180	PR-118	18.00	26.00	PAU, Ludhina
181	PR-121	38.00	56.00	PAU, Ludhina
182	PR-122	21.00	30.00	PAU, Ludhina
183	PR-123	3.00	5.00	PAU, Ludhina
184	PR-124	18.00	25.00	PAU, Ludhina
185	PR-125	11.50	0.00	PAU, Ludhina
186	PR-126	40.00	60.00	PAU, Ludhina
187	PR-127	15.50	0.00	PAU, Ludhina
188	PR-128	2.00	0.00	PAU, Ludhina
189	Prabhat	32.50	35.00	RAU, PUSA
190	Pratap-1 (RSK-1091-10-1-1)	0.01	0.10	MPUAT ,Kota
191	Pratikshya (ORS 201-5)(IET-15191)	39.00	70.00	OUAT, Bhubaneshwar
192	Pusa 44	43.10	44.00	IARI, Regional Station, Karnal
193	Pusa Basmati 1	7.00	10.00	BEDF, New Delhi
194	Pusa Basmati 1121	80.00	90.00	IARI, Regional Station, Karnal
195	Pusa Basmati-1 (IET 10364)	15.00	11.00	IARI, Regional Station, Karnal
196	Pusa Basmati-1509	62.00	69.00	BEDF, New Delhi; ICAR-IARI, Regional Station, Karnal
197	Pusa Basmati-1637	3.00	3.00	IARI, Regional Station, Karnal
198	Pusa Basmati-6 (IET 18005)	1.00	1.00	IARI, Regional Station, Karnal
199	Pusa Sugandh -2 (IET-16310)	0.50	0.00	DSST & IARI, New Delhi

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
200	Pusa Sugandh-5(IET-17021)	57.00	60.00	DSST & IARI, New Delhi
201	Pusa-1301	1.00	0.00	DSST & IARI, New Delhi
202	Pusa-1592	2.50	3.00	DSST & IARI, New Delhi
203	Pusa-1790	1.00	0.00	DSST & IARI, New Delhi
204	Pusa-6 (pusa-1612)	6.00	6.00	DSST & IARI, New Delhi
205	Pushpa (IET-17509)	1.60	1.00	RRS, Chnisurah
206	Rajendra Suwasini	1.55	2.00	RAU, PUSA
207	Rajendra Bhagvati	55.10	90.00	RAU, PUSA
208	Rajendra Kasturi	2.20	3.00	RAU, PUSA
209	Rajendra Mahsuri-1	58.00	80.00	RAU, PUSA
210	Rajendra Sweta	35.00	40.00	RAU, PUSA
211	Rajshree (TCA-80-4) (IET-7970)	0.20	0.70	RAU, PUSA
212	Rani Dhan (IET-19148)	3.10	11.60	OUAT, Bhubaneshwar
213	Ranjeet (IET - 12554)	17.00	19.00	AAU, Titabar
214	Rashmi (JR-201)	45.00	2.70	JNKVV, Jabalpur
215	Rasi (IET- 1444)	1.00	1.00	ICAR-IIRR, Hyderabad
216	Ratna	0.10	0.50	NRRI, Cuttack
217	RATNAGIRI-1	1.00	75.00	ARS, Ratanagiri
218	RATNAGIRI-24 (IET-19812)	4.00	22.00	ARS, Ratanagiri
219	RGL-22116	2.10	0.00	ANGRAU, Guntur
220	RNR-15048	51.00	60.00	PJTSAU, Rajendra Nagar
221	Sabita (IET-8970)	6.00	6.50	RRS, Chnisurah
222	Sadabahar	1.00	1.60	CRURRS, Hazaribagh
223	Samba Mahsuri (BPT-5204)	108.00	516.00	ANGRAU, Guntur
224	Samba Sub-1 (IET21248)	4.10	92.75	NDUAT, Faizabad
225	Samleshwri (IET-17455)	90.10	68.00	IGAU, Raipur
226	Sampada (IET 19424)	55.10	16.00	ICAR-IIRR, Hyderabad
227	Sarala CR-260-77 (IET-10279)	1.00	22.00	NRRI, Cuttack
228	Sarjoo-52	10.00	33.88	NDUAT, Faizabad
229	Satabdi (IET-4786)	74.00	15.00	NRRI, Cuttack; RRS, Chnisurah
230	Satyabhama	6.00	0.00	OUAT, Bhubaneshwar
231	Savitri (IET - 5897)(CR 1009)	3.00	2.00	NRRI, Cuttack
232	Shusk Samrat (NDR 1045-2) (IET-17458)	0.50	0.00	NDUAT, Faizabad
233	Shyamala (IET-12561, R 259-WR-37-2)	0.10	2.85	IGAU, Raipur
234	Sita	3.00	0.00	RAU, PUSA
235	SJR 5	0.50	0.50	SKUAST, Chatha
236	Somasila (NLR-33358)	1.00	1.20	ANGRAU, Guntur
237	Sonamani (CR-644) (IET-11365)	0.50	0.00	NRRI, Cuttack
238	Srikakulam Sannalu (RGL-2537)	6.00	14.80	ANGRAU, Guntur
239	Sugandha Samba (RNR-2465)	1.00	1.00	PJTSAU, Rajendra Nagar
240	Sujala (CNR-2) (IET 20235)	3.00	3.50	RRS, Chnisurah
241	Sukhadhan-5	0.80	0.00	ICAR-IIRR, Hyderabad
242	Sukhadhan-6	0.60	0.00	ICAR-IIRR, Hyderabad
243	Sunbhagi Dhan (IET 19576)	206.00	280.00	CRURRS, Hazaribagh
244	Surendra (IET-12815)	1.00	1.00	OUAT, Bhubaneshwar
245	Swarna Dhan (IET-5656)	1.50	1.50	ICAR-IIRR, Hyderabad
246	Swarna Sub-1 (CR 2539-1) IET-20266	252.00	190.00	NRRI, Cuttack
247	Tejaswani (OR 1912-22)	0.10	0.12	OUAT, Bhubaneshwar
248	Tellahamsa	3.00	3.00	PJTSAU, Rajendra Nagar
249	Thanu	3.00	3.00	UAS, Bangalore

S. No	Variety/ Hybrid	Allocation BSP-I	Production	Producing centre
250	TRY-3	0.10	0.00	TNAU, Coimbatore
251	Tunga (IET-13901)	6.00	0.00	UAS, Bangalore
252	Uma	9.00	11.56	RRS, Monocompu
253	Vallabh Basmati -22(IET 19492)	3.00	0.00	SVBAUA& T Meerut
254	Vallabh Basmati-24(IET 20827)	9.00	0.00	SVBAUA& T Meerut
255	Vandana (RR-167-982)	8.00	8.00	CRURRS, Hazaribagh
256	VARSHADHAN(CRLC-899) (IET-16481)	5.00	4.50	NRRI, Cuttack
257	Vishnu Bhog Selection-1	3.00	5.10	IGAU, Raipur
258	VL DHAN 157 (VL31611) (IET 22292)	1.50	0.45	VIHA, Almora
259	VL.DHAN 208 (VL-9632)	0.50	0.50	VIHA, Almora
260	VL.DHAN 68 (VL-31611) (IET-22283)	5.00	1.55	VIHA, Almora
261	WARANGAL SAMBA (WGL-14)	0.50	0.50	PJTSAU, Rajendra Nagar
262	WARANGAL SANNALU (WGL-32100)	45.50	45.50	PJTSAU, Rajendra Nagar
	Sub Total	**4260.76**	**7571.16**	
	HYBRIDS			
	DRRH-3 (A-Line)	0.02	0.05	IIRR, Hyderabad
	DRRH-3 (B-Line)	0.02	0.05	IIRR, Hyderabad
	DRRH-3 (R-Line)	1.00	1.00	IIRR, Hyderabad
	Total	**1.04**	**1.10**	
	KRH-4			
	A-Line	0.35	0.80	UAS, Bangalore
	B-Line	0.12	0.30	UAS, Bangalore
	R-Line	0.12	10.00	UAS, Bangalore
	Total	**0.59**	**11.10**	
	SAHYADRI-1			
	A Line	0.10	0.30	RARS, Karjat
	B Line	0.05	0.20	RARS, Karjat
	R Line	0.06	0.20	RARS, Karjat
	SAHYADRI-2			
	A Line	0.15	0.30	RARS, Karjat
	B Line	0.05	0.30	RARS, Karjat
	R Line	0.06	0.30	RARS, Karjat
	SAHYADRI-3			
	A Line	0.15	0.45	RARS, Karjat
	B Line	0.05	0.40	RARS, Karjat
	R Line	0.06	0.30	RARS, Karjat
	SAHYADRI-4			
	A Line	0.15	0.35	RARS, Karjat
	B Line	0.05	0.25	RARS, Karjat
	R Line	0.80	0.27	RARS, Karjat
	SAHYADRI-5			
	A Line	0.15	2.00	RARS, Karjat
	B Line	0.05	1.70	RARS, Karjat
	R Line	0.05	1.00	RARS, Karjat
	Total	**1.98**	**8.32**	
	Total (Hybrids)	**3.61**	**20.52**	
	Grand Total (Varieties + Hybrids)	**4264.37**	**7591.68**	

Appendix-5

List of Institute projects (2017-18)

Sl. No.	Project Code	Project Title	PI and Co-PI
CROP IMPROVEMENT DIVISION			
Plant Breeding			
1	GEY/CI/BR/9	Enhancing nutritional quality of rice through bio-fortification	**Dr L.V. Subba Rao** and Drs G Padmavathi, K Surekha,B Sreedevi, CN Neeraja, D Sanjeeva Rao, T Longvah (NIN)
2	GEY/CI/BR/16	Traditional and molecular approaches for breeding improved rice varieties with resistance to plant-hoppers	**Dr G. Padmavathi** and Drs C. Gireesh, V. Jhansi Lakshmi, M. Sheshu Madhav, P.V.Satyanarayana, PS, Plant breeding, APRRI, Maruteru; N.Mallikarjuna Rao, SS, Entomology, APRRI, Maruteru.
3	GEY/CI/BR/22	Identification and introgression of agronomically important traits from wild species of rice	**Dr C. Gireesh** and Drs MS Anantha, Divya B, Suneetha K, G. Padmavathi, Abdul Fiyaz R, Jyothi B, Senguttvel P, KB Kemparaju, RM. Sundaram, Sheshu Madhav, GS Laha, Prakasham V, Sridhar Y, Jhansi Laksmi V, P Raghuveer Rao
4	GEY/CI/BR/23	Breeding high yielding rice lines possessing multiple biotic stress resistance/tolerance through conventional and molecular approaches.	**Dr R.Abdul Fiyaz** and Drs R.M. Sundaram, Sheshumadhav, L.V. Subba Rao, C. Gireesh, M.S. Anantha, M.S. Prasad, G.S. Laha,
5	GEY/CI/BR/25	Broadening the genetic base of *indica* rice varieties and modify plant type by introgressing traits from Tropical *japonica*	**Dr Jyothi Badri** and Drs LV Subba Rao, Divya Balakrishnan, Aravind Kumar, P Revathi, P Raghuveer Rao, Dr V Prakasam, CH Padmavathi, B Sreedevi, Ch Suvarna Rani.
6	GEY/CI/BR/24	Breeding high yielding Rice cultivars for tolerance to low phosphorus and nitrogen	**Dr M. S. Anantha,** Drs C Gireesh, R Abdul Fiyaz, P Senguttuvel, R M Sundaram, R Mahender Kumar, K Surekha, Brajendra, Raghuveer Rao, Aarthi Singh, H K Ranganath
Hybrid Rice			
7	GEY/CI/HY/13	Development and evaluation of three line hybrids with better grain quality and resistance to major pests and diseases.	**Dr A.S. Hari Prasad** and Drs P Senguttuvel, P Revathi, KB Kemparaju, K Sruthi, RM Sundaram
8	GEY/CI/HY/10	Development of parental lines and Hybrids with tolerance to salinity and suitability to aerobic situations	**Dr P. Senguttuvel** and Drs AS HariPrasad, P.Revathi, KB Kemparaju, RM Sundaram, Sheshu Madhav, G.Padmavathi, C Gireesh, MS Anantha, B.Sreedevi, Mahender Kumar, Brajendra, Gopinath and D.Subrahmanyam
9	GEY/CI/HY/12	Development of superior restorers and Identification of new restorer(*Rf*) genes for WA-CMS system in rice by conventional and molecular approaches	**Dr P. Revathi** and Drs Jyothi Badri, Satendra Kumar Mangrauthia Divya balakrishnan, M. Srinivas Prasad, V. Jhansilakshmi.
10	GEY/CI/HY/11	Development of CMS line with good agronomic base and higher out crossing ability.	**Dr K.B. Kemparaju** and Drs A. S Hari Prasad, P Senguttuvel, P Revathi, RM Sundaram, M Sheshu Madhav
11	GEY/CI/HY/14	Establishment and validation of heterotic gene pools in hybrid rice	**Dr K. Sruthi** and Drs A.S. Hari Prasad, P. Senguttuvel, P. Revathi, K.B.Kemparaju and R.M. Sundaram

Sl. No.	Project Code	Project Title	PI and Co-PI
Biotechnology			
12	ABR/CI/BT/9	Improvement of rice against biotic and abiotic stresses through transgenic approach inside	**Dr S.M. Balachandran** and Drs A.P. Padmakumari, Ch. Padmavathi, D. Subrahmanyam, S.K. Mangrauthia
13	ABR/CI/BT/6	Identification of genes for grain filling in rice (*Oryza sativa* L.)	**Dr CN Neeraja** and Drs S.R. Voleti, L.V. Subbha Rao, M. Sheshu Madhav, S.M. Balachandran, P.S. Divya, D. Sanjeeva Rao, S. Kalyani Kulkarni
14	ABR/CI/BT/10	Genomic studies on grain yield heterosis and WA-CMS trait in rice	**Dr R.M. Sundaram** and Drs S.M. Balachandran, M.S. Madhav, A.S. Hariprasad, P. Revathi, P. Raghuveer Rao, K. Sruthi
15	ABR/CI/BT/16	Exploring the mutant resources for rice improvement	**Dr M. Sheshu Madhav** and Drs R. M. Sundaram, Kalyani Kulkarni, D. Sanjeeva Rao, B. Sreedevi, P. Senguttuvel, L.V. Subba Rao, C. Gireesh, A.P. Padma kumari, Jhansi Laxmi, Ch. Padmavathi, Y. Sridhar, G.S. Laha, M.S. Prasad, D. Ladhalakshmi
16	ABR/CI/BT/13	Candidate gene identification for manipulating growth related genes in rice through computational and expression studies	**Dr P.S. Divya** and Drs S.M. Balachandran, D. Subrahmanyam
17	ABR/CI/BT/14	Exploring RNAi Technology for Management of Rice Diseases	**Dr Satendra Kumar Mangrauthia** and Drs P. Anand Kumar, S.M. Balachandran, G.S. Laha, D. Krishnaveni, P Revathi, V. Prakasam, Kalyani Kulkarni
18	ABR/CI/BT/15	Molecular and functional characterization of useful root traits in rice	**Dr Kalyani M. Barbadikar** and Drs M. Seshu Madhav, D. Subrahmanyam, P. Senguttuvel, S. M. Balachandran, Divya P. S.
National Professor			
19	NP/1	Development of chromosome segment substitution from elite x wild species crosses for mapping of yield enhancing QTLs/genes in rice"	**Dr N Sarla,** Dr Divya Balakrishnan
20	ABR/ CI/BR/28	Exploring wild introgression lines and mutants to identify novel genes/ QTLs for yield contributing traits	**Dr Divya Balakrishnan** and Drs N Sarla, D. Subrahmaniyam, G Padmavathi, Jyothi B, P. Revathi, C.Gireesh, Ladha Lakshmi , B.Kalyani, Suvarna C
CROP PRODUCTION DIVISION			
Agronomy			
21	RUE/CP/AG/14	Strategic research on enhancing water Use efficiency and productivity in irrigated rice system	**Dr R. Mahender Kumar** and Drs Drs.B.Sreedevi, L.V.Subba Rao, K. Surekha, Ch Padmavthi, P.C. Latha, M.Sreenivas Prasad, N.Somashekhar, P.Muthuraman, P. Raghuveer Rao, S.Ravichandran, B.Nirmala, B.Shailaja, Shaik N .Meera, DVK Nageswar Rao, Vidhan Singh, MBB. Prasad Babu, K.Srinivas , PS, CRIDA (For Biochar work), Prof. Saran Sohi, University of Edinburgh, UK.
22	RUE/CP/AG/13	Improved Agro-techniques for sustainable aerobic rice based cropping systems	**Dr B. Sreedevi** and Drs N.Somasekhar, P.C.Latha, P.Senguttuvel, Mangal Deep Tuti, C. Kannan, D.V.K. Nageswararao, R. Mahenderkumar and B. Jhansirani
23	SSP/CP/AG/15	Sustainable intensification of rice-maize system through conservation agriculture	**Dr Mangal Deep Tuti** and Drs R. Mahender Kumar, B. Sreedevi, Soumya Saha, Aarti Singh, B. Nirmala, T. Vidhan Singh, Bandeppa and M.N. Arun

Sl. No.	Project Code	Project Title	PI and Co-PI
24	RUE/CP/AG/17	Comparative study of organic and conservation agriculture for enhanced resource use efficiency, yield and quality of rice	**Dr Aarti Singh,** and Drs V. Manasa, M.D. Tuti, Anantha M.S., Sanjeeva Rao, K. Sruthi, Vidhan Singh, Satish Chavan, R.M. Kumar and M.N. Arun
Soil Science			
25	SSP/CP/SS/11	Assessment of Genotypic variability in nitrogen use efficiency and improving NUE in irrigated rice	**Dr K. Surekha** and Drs R. Mahender Kumar, P.C.Latha and Brajendra
26	CCR/CP/ SS/17	Studies on emission of green house gases (GHGs) from rice soils and their mitigation	**Dr M.B.B.Prasad Babu** and Drs R. Mahender Kumar, P.C. Latha and Brajendra
27	RUE/CP/SS/16	Study of rice vegetation in terms of crop stress to model the yield using NDVI	**Dr D.V.K. Nageswara Rao** and Drs K. Surekha, R. Mahender Kumar, B. Sridevi, Ch. Padmavati and V. Prakasam
28	SSP/CP/SS/18	Studies on Soil Organic Carbon Status. Mapping and stocks in Rice Soils of India	**Dr Brajendra** and Drs B Sailaja, MBB Prasad Babu, P Muthuraman
29	SSP/CP/SS/13	Utilization of plant growth promoting micro organisms for improving nitrogen and water use efficiency in rice	**Dr PC Latha** and Drs. Bandeppa, MBB Prasad Babu and B. Sreedevi
30	SSP/CP/SS/15	Microbial population dynamics in different rice establishment method in relation to nutritional availability and acquisition.	**Dr Bandeppa** and Drs P. C Latha, K. Surekha, Mangal Deep Tuti and Kalyani M Barbadikar
31	RUE/CP/SS/19	Evaluation of ZnO nanoparticles on performance of rice	**Dr R. Gobinath** and Drs K. Surekha, Brajendra, P.C. Latha and V. Manasa
32	RUE/CP/SS/20	Efficacy of hydrogel on yield and soil properties of rice	**Dr V. Manasa** and Drs K. Surekha, Mr. R. Gobinath, Bandeppa, Aarti Singh, M.M. Azam
Plant Physiology			
33	CCR/CP/PP/11	Evaluation of genotypic variability in leaf photosynthetic efficiency and its associated factors in rice	**Dr D. Subrahmanyam,** Dr S.R.Voleti,
34	GEY/CP/PP/12	Physiological studies for improving ideotype breeding in rice	**Dr P. Raghuveer Rao,** and Drs A.S. Hariprasad, Jyoti Badri
35	GEQ/CI/BR/26	Investigation into the role of major metabolites on rice grain quality	**Dr D. Sanjeeva Rao** and Drs C. N. Neeraja, D. Subrahmanyam, M. Seshu Madhav, P. Senguttuvel and Jyothi Badri
Agricultural Engineering			
36	RUE/CP/ ENG/6	Selective mechanization in rice cultivation	**Dr T. Vidhan Singh** and Drs R.Mahender Kumar and B. Nirmala
Computer Applications			
37	TTI/CP/CA/4	Wireless Sensor Networks integrating with Rice DSS model for real time advisories	**Dr B. Sailaja** and Drs Shaik N Meera, D. Subrahmanyam, K. Surekha
Agricultural Chemicals			
38	RUE/CP/AC/1	*Post Harvest Treatment of Rice and Rice By-Products for Health Benefits and on-farm application*	**Dr M.M. Azam** and Drs PC Latha, R Mahendra Kumar, R Abdul Fiyaz, Surekha Kochi, Amtul Waris, V Manasa, T Vidhan Singh, SR Voleti, D Sanjeeva Rao, GR Katti, MS Prasad, GS Laha, AP Padmakumari and V Prakasam

Sl. No.	Project Code	Project Title	PI and Co-PI
CROP PROTECTION DIVISION			
Entomology			
39	IPM/ CPT/ ENT/3	Chemical control of rice insect pests as a component of rice	**Dr Gururaj Katti** and Drs V. Jhansilakshmi, A.P. Padmakumari and Chitra Shanker
40	IPM/CPT/ ENT/21	Botanicals for sustainable management of major pests of rice	**Dr B Jhansi Rani** and Drs Chitra Shankar, M.M. Azam, M. Srinivas Prasad
41	HRI/CPT/ ENT/11	Assessment of host plant resistance to rice planthoppers viz., brown planthopper *Nilaparvata lugens* and whitebacked Planthopper *Sogatella furcifera* and their management	**Dr V Jhansi Lakshmi** and Drs D. Sanjeeva Rao, Y Sreedhar
42	IPM/ CPT/ ENT/22	Investigations on Nematodes of Importance to Rice Cultivation	**Dr N. Soma Sekhar** and Drs S.N. Chavan, P.C. Latha and M. Sheshu Madhav
43	HRI/ CPT/ ENT/23	Insect-plant interactions with special reference to rice pests – yellow stem borer and gall midge	**Dr A.P.Padmakumari** and Drs Y. Sreedhar, Dr S.R Voleti
44	IPM/ CPT/ ENT/26	Biointensive pest management with emphasis on biological control of rice pests	**Dr Chitra Shanker** and Drs Gururaj Katti, B. Jhansi Rani, N. Somasekhar and C. Kannan
45	HRI/CPT/ ENT/27	HPR and Semiochemical approaches for the management of insect pests of rice	**Dr Ch. Padmavathi** and Drs. Y Sridhar, Divya Balakrishnan, G Katti
47	IPM/CPT/ ENT/24	Bioecology and Management of Emerging Insect and Mite pests of rice	**Dr Y. Sridhar** and Drs Jhansi Rani, M. Sheshu Madhav, C. Gireesh, Sanjeeva Rao, S. Chawan
48	IPM/CPT/ ENT/25	Development of Entomopathogenic Nematodes (EPN) for Biointensive Integrated Pest Management in Rice	**Dr Mr. Satish N. Chavan** and Drs N. Somasekhar, Gururaj Katti, A.P. Padmakumari, C. Kannan.
Plant Pathology			
49	HRP/CPT/ PATH/15	Assessment of host plant resistance to rice blast disease and its management	**Dr M.S. Prasad** and Drs M. Seshu Madhav, S.M. Balachandran, V. Prakasam, P. Valarmathi, Divya Blalakrishnan
50	HRP/CPT/ PATH/13	Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice	**Dr G.S. Laha** and Drs D. Krishnaveni, D. Ladha Lakshmi, R. M. Sundaram and S. K. Mangrautia
51	HRP/CPT/ PATH/14	Assessment of host plant resistance and development of diagnostic tools for rice tungro virus disease	**Dr D. Krishnaveni** and Drs G.S. Laha, C. N. Neeraja, Chitra Shanker, S.K Mangrauthia, and D. Ladhalakshmi
52	HRP/CPT/ PATH/20	A consortia approach to the biological management of diseases in rice	**Dr C. Kannan** and Drs M.Srinivas Prasad, D.Krishnaveni, G.S.Laha, V.Prakasam, D.Ladhalakshmi, Chitra Shanker, P.C.Latha and B. Sridevi
53	HRP/CPT/ PATH/19	Epidemiology and management of False smut disease	**Dr D. Ladhalakshmi** and Drs G.S. Laha, M. S. Prasad, D. Krishnaveni, K. Suneetha
54	HRP/CPT/ PATH/22	Population dynamics of *Rhizoctonia solani* and sustainable management of rice sheath blight disease	**Dr V. Prakasam** and Drs M S Prasad, G S Laha, D Ladha lakshmi, Jyothi badri
TRANSFER OF TECHNOLOGY & TRAINING			
55	TTT/EXT/15	Climate change and rice farming: Farmers perception and adaptation strategies	**Dr P. Muthuraman** and Drs Shaik N. Meera, S. Arun Kumar, P. Jeyakumar , Brajendra, Ranganath

Sl. No.	Project Code	Project Title	PI and Co-PI
56	TTT/EXT/12	Dissemination of climate resilient rice production technologies to farmers in selected Districts of Telangana State	**Dr Amtul waris** and Drs Mahender Kumar S. N. Meera, Dr .Arun Kumar , K. Surekha, B. Sreedevi, V Jhansi lakshmi, T. Vidhan Singh, B. Nirmala and Brajendra
57	TTT/EXT/11	Maximizing the impact of rice technologies through ICT applications	**Dr S.N. Meera** and Drs Arun Kumar S , Dr P. Muthuraman, Dr Amtul Waris, Dr Chitra Shanker, D. Krishnaveni, Dr B. Sailaja, Dr Brajendra, and Dr P. Senguttuvel and S.R. Voleti
58	TTI/TTT/ ECON/3	IPR - Competition interaction in rice seed sector – Emerging scenario- implications for enhancing quality seed use.	**Dr P.A.Lakshmi Prasanna** and Drs L.V.Subba Rao, A.S.Hari Prasad, Amtul Waris, S. N. Meera, B. Nirmala, S. Arun Kumar and Divya P.Symaladevi
59	TTT/ECON/2	Socio-economic impact assessment of rice production technologies	**Dr B. Nirmala** and Drs P.Muthuraman, Amtul Waris, R.Mahender Kumar,A.S.Hari Prasad and T.Vidhan Singh
60	TTI/TTT/ EXT/14	Innovations in group based extension approaches: Accelerating rice technology transfer through farmer based organisations	**Dr S. Arun Kumar** and Drs Shaik N. Meera, Amtul Waris, P Jeya Kumar, P. Muthuraman

Appendix-6

Externally funded projects sanctioned during 2017-18

Sl. No.	Title of the Project / Schemes	Name of the PI and Co-PI	Funding Agency	Duration	Budget (lakh Rs.)
1	Identification of novel alleles of wild rice derived bacterial blight resistance genes and their functional analysis.	**RM Sundaram (PI)** GS Laha Gireesh C	DST-SERB	2018-2021	18.28
2	Characterization of strong culm Samba Mahsuri mutants and identification of candidate gene associated with strong culm.	**M SheshuMadhav (PI)** Kalyani M Barbadikar R M Sundaram	DST-SERB	2018-2021	45.0
3	Genetic improvement of rice for yield, NUE, WUE, abiotic and biotic stress tolerance through RNA Guided Genome Editing (CRISPR/Cas9/Cpf1).	**S K Mangrauthia (PI)** M SheshuMadhav G S Laha R M Sundaram P Senguttuvel	ICAR-NASF	2018-2021	83.85
4	Science and Engineering Research Board (SERB), Government of India (Early Career Research): RNA-seq based mapping of robust root system architecture for identification of candidate genes.	**Kalyani M Barbadikar(PI)**	DST-SERB	2018-2021	47.0
5	ICAR-IRRI Development of high Zinc rice varieties.	**L V Subba Rao (PI)** C N Neeraja M S Ananatha	IRRI	2017-2022	USD 6000
6	Advance breeding technologies to speed up genetic gain, create durable resistance to biotic and increase Indian farmers and consumers food and nutritional security.	**L V Subba Rao (PI)** R Abdul Fiyaz	IRRI	2017-2022	USD 8900
7	ICAR-IRRI Seed dissemination and production of nucleus & breeder seed of stress tolerant varieties.	**L V Subba Rao (PI)**	IRRI	2017-2022	USD 7000

Sl. No.	Title of the Project / Schemes	Name of the PI and Co-PI	Funding Agency	Duration	Budget (lakh Rs.)
8	Mapping and introgression of weed competitiveness in hill rice genotypes in NEH regions of India under DBT program for NE.	**Gireesh C (PI)** M S Anantha P Senguttuvel R Abdul Fiyaz Mangal Deep Tuti	DBT-BCIL	2017-2019	11.34
9	Genetic Improvement of Hybrid Rice Parental Lines for enhancing yield heterosis	**A S Hari Prasad (PI)** P Senguttuvel	ASEAN- India Cooperation Fund, Indonesia.	2017-2020	38.00
10	Identification of heterotic yield QTLs in Swarna X *Oryzarufipogon* introgression lines (ILs) and transferring into parental lines of hybrid rice to enhance the magnitude of heterosis.	**P Revathi (PI)** S K Mangrauthia	DST-SERB	2018-2021	33.59
11	Evaluation of bioefficacy of BCS CL 733507 SC 200 (W/V) against yellow stem borer in rice.	**GururajKatti (PI)** A P Padmakumari	Bayer Crop Science Ltd.	2017-2018	21.01
12	IRRI-Odisha Collaborative Project on "Increasing productivity of rice-based cropping systems and farmers' income in Odisha" (STRASA Phase III).	**ChitraShanker (PI)** Brajendra D Krishnaveni	IRRI	2017-2019	14.12
13	Transgenic over expression of phosphite dehydrogenase: A comprehensive strategy to enhance phosphorus use efficiency with integrated weed and disease management for sustainable agriculture.	**M Srinivas Prasad (PI)**	ICAR-NASF	2017-2019	53.78
14	Pest and disease management for climate change adaptation.	**V Prakasam (PI)** M S Prasad G S Laha G R Katti ChPadmavathi ChitraShanker S K Mangrauthia M S Madhav D Subrahmanyam P Muthuraman	DST-GOI	2018-2023	87.96
15	CRP Project on "Evaluation of BAS 750 02 F 400 g/l SC (Mefentrifluconazole 400 g/l SC) against sheath blight and Metiram 70% WG against blast of rice"	**V Prakasam (PI)** M S Prasad D Ladhalakshmi	BASF India Ltd	2017-2018	10.04
16	Evaluation of Iron Coated Seed for Direct Seeded Rice.	**R Mahender Kumar (PI)**	JFE Steel India Pvt. Ltd., Haryana.	2017-2019	15.07
17	Studies on performance of Wonder Paddy.	**R Mahender Kumar (PI)**	Dhana Crops Pvt. Ltd., Sec'bad	2017-2018	4.85
18	Evaluating the effect of Sea6 Biostimulant on the grain yield of rice under puddle conditions.	**R Mahender Kumar (PI)**	Sea6 Energy Pvt. Ltd., Bangalore	2017-2018	3.89
19	Evaluation of Council Prime (Triafonamone 200 SC) for puddle direct seeded and transplanted rice.	**B Sreedevi (PI)**	Bayer Crop Sciences	2017-2019	7.08

Sl. No.	Title of the Project / Schemes	Name of the PI and Co-PI	Funding Agency	Duration	Budget (lakh Rs.)
20	Technological Empowerment of Tribal Farm Women through Good Agricultural Practices and Eco-entre preneurship Development in rice based cropping systems in Deverkonda-mandal of Telangana.	**AmtulWaris (PI)** B Nirmala R Mahender Kumar B Jhansi Rani P Revathi V Sandhya (AgriBiotech Foundation)	DST-SEED	2017-2020	51.97
				Total	**~562**

Appendix-7

Ongoing Externally funded projects at ICAR-IIRR

Sl. No.	Title of the Project / Schemes	Name of the PI & Co-PI	Funding Agency	Duration	Budget (lakh Rs)
1	DBT Programme Support on "Development of sheath blight disease resistant transgenic rice: Resistance tests in PR-protein- expressing trans-genic rice and discovery of new RNA silencing strategies.	**S M Balachandran (Co-Leader & PI-1)** S K Mangrauthia ((PI-2) M Srinivas Prasad G S Laha	DBT	2014-2019	153.53
2	CRP- Biofortification in selected crops for nutri-tional security-Rice- IIRR.	**C N Neeraja (PI)** K Surekha Kalyani Kulkarni D Sanjeeva Rao L V Subba Rao R M Sundaram AmtulWaris U Chaitanya	ICAR	2017-2020	159.85
3	ICAR-Consortia Research Platform on Molecu-lar Breeding in Crops.	**R M Sundaram (PI)** LV Subba Rao R Abdul Fiyaz C Gireesh MS Anantha P Senguttuvel S M Balachandran MS Madhav MS Prasad GS Laha AP Padmakumari V Jhansi Lakshmi	ICAR	2017-2020	38.125
4	ICAR-Plan Scheme: "Incentivizing Research in Agriculture"Project: Genetic modifications to improve biological nitrogen fixation for aug-menting nitrogen needs of cereals.	**R M Sundaram (PI)** PC Latha Bandeppa KalyaniMBarbadikar MBB Prasad Babu	ICAR	2017-2020	104.00
5	ICAR-Plant Scheme: "Incentivizing Research in Agriculture". Project: Molecular genetic analy-sis of resistance/tolerance to different stresses in rice, wheat, chickpea and mustard including sheath blight complex genomics.	**R MSundaram (PI)** GS Laha V Prakasam D Ladha Lakshmi JyothiBadri	ICAR	2017-2020	48.01

Sl. No.	Title of the Project / Schemes	Name of the PI & Co-PI	Funding Agency	Duration	Budget (lakh Rs)
6	DBT sponsored Project on "Marker-assisted introgression of yield enhancing genes to increase yield potential of Indian rice varieties.	**RM Sundaram (PI)** MS Madhav SM Balachandran P Senguttuvel JyothiBadri	DBT	2016-2021	82.504
7	Development of high yielding, non lodging and biotic stress resistant varieties of black scented rice of Manipur and Assam through biotechnological interventions.	**M SheshuMadhav (PI)** MSPrasad	DBT	2016-2019	30.0
8	Exploiting amiR technology to target viral genes for curtailing the tungro virus infection in rice.	**S K Mangrauthia (PI)** S M Balachandran D Krishnaveni M SheshuMadhav	DBT	2015-2018	31.40
9	Maintenance, characteri-zation and use of EMS Mutants of Upland Variety Nagina 22 for functional genomics in rice-Phase-II.	**S K Mangrauthia (PI)** S R Voleti DivyaBalakrishnan	DBT	2015-2020	93.03
10	Enhancing growth in rice through re-engineering genes in rice.	**Divya P Syamaladevi (PI)**	DST-SERB	2016-2019	29.85
11	DUS Tests in Rice	**L V Subba Rao (PI)** J Aravind Kumar JyothiBadri	PPV&FRA	2008 – Long term	13.0
12	CRP on Agro-biodiversity.	**L V Subba Rao (PI)** C Gireesh, M S Anantha	ICAR	2014-2020	4.0 /year
13	Mega Seed Project.	**L V Subba Rao (PI)** R Abdul Fiyaz M S Anantha ChSuvarna Rani U. Chaitanya	ICAR	2006- Long term	8.0/year
14	National Seed Project.	**L V Subba Rao (PI)** R Abdul Fiyaz M S Ananatha G Padmavathi U. Chaitanya	ICAR	1992 – Long term	3.5/year
15	CSIR 800 (Blight Out).	**L V Subba Rao (PI)** R M Sundaram P Muthuraman G S Laha U Chaitanya	CSIR-CCMB	2012-2019	25.0 /year
16	Pre-breeding to broaden the genetic base of rice for yield enhancing traits, heterotic yield QTLs, brown plant hopper and stem borer resistance by utilizing wild species and land races.	**G Padmavathi (PI)** Gireesh C P Revathi	ICAR	2016-2019	44.71
17	Stress Tolerant Rice for Africa and South Asia (STRASA)"	**G Padmavathi (PI)** B JyotiBadri G S Laha MS Prasad S N Meera B Sreedevi	IRRI/Bill & Melinda Gates Foundation.	2014 -2019	9.36

Sl. No.	Title of the Project / Schemes	Name of the PI & Co-PI	Funding Agency	Duration	Budget (lakh Rs)
18	Marker assisted introgression of different traits for development of new generation varieties.	**JyothiBadri (PI)** M S Prasad, G S Laha AP Padmakumari B Sreedevi	DBT	2013-2018	88.18
19	STRASA-Drought Breeding Network.	**JyothiBadri (PI)** G Padmavathi Jhansi Lakshmi G S Laha	IRRI	2014-2019	USD4000 (INR 2.733)
20	CRP on Hybrid Technology (Hybrid Rice).	**A S Hari Prasad (PI)** P Senguttuvel P Revarhi K B Kemparaju	ICAR	2015-2020	112.89
21	National Innovations in Climate Resilient Agriculture (NICRA): Phase III.	**P Raghuveer Rao (PI)** S R Voleti, N Sarla D Subrahmanyam C N Neeraja V Jhansi Lakshmi B Sailaja P Senguttuvel SK Mangrauthia DivyaBalakrishnan	ICAR	2017-2020	46.5 Per Annum
22	Newton-Bhabha Virtual Centre on Nitrogen Efficiency of Whole Cropping Systems for improved performance and resilience in agriculture (NEWS India-UK).	**D Subrahmanyam (PI)** S R Voleti R Mahendra Kumar K Surekha, C N Neeraja	DBT	2016-2019	90.78
23	Mass Production and field release techniques of *Tetrastichusschoenobii* Ferriere an egg parasitoid of rice stem borer ."	**ChitraShanker (PI)** M Sampath Kumar GururajKatti	DBT	2015-2018	44.00
24	Molecular cross talk between defence pathways in rice: antagonism to synergism.	**M Srinivas Prasad (CC PI)**	ICAR-NASF	2015-2018	36.09
25	ICAR-National Professor Project on "Development of Chromosome segment substitution lines of rice from elite x wild crosses to map QTLs/genes for yield traits".	**N Sarla (PI)** DivyaBalakrishnan	ICAR	2013-2020	250.00
26	ICAR-NPTC Project: Functional Genomics of Rice Micronutrients -Iron & Zinc.	**N Sarla (PI)** S K Mangrauthia	ICAR	2017-2020	3.60
27	Strategy for sustainable crop production in direct seeded rice in India.	**R M Kumar (PI)**	IIRR-BASF Project	2015-2017	16.08
28	Lal Bahadur Shastri Challenge Award: Enhancing the Farmers' Learning and Skill Development in Rice Sector: Creating Impact through Video and Mobile Extension Approaches.	**Shaik N Meera (PI)**	ICAR	2015-2018	35.00
29	Accelerating Impact & Equity: Adoption & impact Assessment under ICAR-IRRI Collaborative project #3.	**Shaik N Meera (PI)** S Arun Kumar	IRRI	2016-2019	14.10
30	Green Super Rice (GSR) for the Resource-Poor of Africa and Asia Phase III.	**Shaik N Meera (PI)** K B Kempa Raju Abdul Fiyaz R	IRRI	2017-2020	70.00
				Total	**~1688**

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