भाकृअनुप
ICAR

वार्षिक प्रतिवेदन
Annual Report
2022

भाचाअनुसं
IIRR

भाकृअनुप-भारतीय चावल अनुसंधान संस्थान

ICAR-Indian Institute of Rice Research

Rajendranagar, Hyderabad - 500 030

वार्षिक प्रतिवेदन

Annual Report 2022

भाकृअनुप-भारतीय चावल अनुसंधान संस्थान

ICAR-Indian Institute of Rice Research

Rajendranagar, Hyderabad - 500 030

ISSN No. 2347-8985

Correct Citation:
Annual Report 2022
ICAR-Indian Institute of Rice Research
Rajendranagar, Hyderabad - 500 030,
Telangana, India

Compiled and Edited by:
Dr. Chitra Shanker, Chief Editor and Chairperson
Dr. Y. Sridhar, Dr. K.B. Kemparaju, Dr. D. Ladha Lakshmi, Dr. S. Arun Kumar, Dr. Divya Balakrishnan, Dr. Kalyani M. Barbadikar, Dr. S. Bandeppa, Dr. Mangaldeep Tuti, Dr. Akshay Sakhare and U Chaitanya

Hindi Translation by:
Dr. Brajendra, Dr. Mahesh Kumar

Cover Page Photograph : DRR Dhan 64

Published by:
Dr. R M Sundaram
Director
ICAR-Indian Institute of Rice Research
Rajendranagar, Hyderabad - 500 030, India
Tel : +91-40-2459 1216, 2459 1218
Tel fax : +91-40-2459 1217
email : director.iirr@icar.gov.in
Website : www.icar-iirr.org

Printed at:
Balaji Scan Pvt. Ltd.,
11-2-1145, Beside Matas Temple, Opp: Subhan Bakery,
Nampally, Hyderabad, Telangana – 500001, INDIA.
Tel: 23303424/25, 9848032644 Press: 9248007736/37

Contents

Preface

It's a privilege to place before you the annual report of ICAR-Indian Institute of Rice Research for the year 2022 which saw a record rice production of 130.29 million tonnes of which 21.21 million tonnes was exported earning Rs 72000 crores. 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 involving 45 funded centers, around 100 voluntary centers and 300 rice scientists.

The progress of research during the period is quite encouraging with the release of 61 varieties including 4 Hybrids for different ecologies by both central (28) and state (33) varietal release committees. Of these 7 varieties and 1 hybrid were developed at this institute. Breeder seed production of 305 rice varieties and parental lines of rice hybrids was undertaken at 49 centres across the country as per DAC indent and 4450 quintals of breeder seed production was achieved. Significant breakthroughs were achieved in identifying resistant genetic stocks against blast, leaf folder, Low P tolerance, Climate resilient nutrient efficient and biofortified lines which can be exploited as donors in the research programmes. The institute brought several accolades during the reporting period for the CRISPR/Cas based multiplex genome editing of indica rice cultivars for yield improvement, whole genome sequence data for biocontrol agents, depositing beneficial microbial cultures and gene sequences to NCBI.

The Scientists and staff have been bestowed with awards and recognitions in various research and development platforms. Four scientists have been deputed abroad for advanced training, workshops and as consultants. On the research front, in addition to institute funded projects and Consortia Research Platforms (CRP), a record 25 new externally sponsored projects were sanctioned to the institute with a total outlay of Rs. 714 lakhs, a commendable achievement by the scientists of the institute.

I take this opportunity to express my sincere gratitude to Dr. T. Mohapatra, former Secretary DARE and DG (ICAR); Dr. Himanshu Pathak, Secretary DARE and DG (ICAR); Dr. T.R. Sharma, DDG (Crop Science), Dr. D.K. Yadava, ADG (Seeds), Dr. R.P. Singh, ADG (CC), Dr S.K Pradhan, ADG (F&FC), Dr. B. Mishra, Chairman RAC and members of RAC for providing valuable guidance and suggestions towards implementation of various research programmes. I appreciate the support and cooperation from SAUs, AICRPR centres and sister ICAR institutes for their tremendous support for consistent progress in rice improvement.

Dr R. M. Sundaram
(Director)

Hyderabad

1st March, 2023

कार्यकारी सारांश
Executive Summary

चावल पर अखिल भारतीय समन्वित अनुसंधान परियोजना (चावल पर अभासअनुप)

फसल सुधार

- केंद्रीय तथा राज्य, दोनों किस्म लोकार्पण समितियों (केंद्रीय-28; राज्य-33) के द्वारा विभिन्न पारिस्थितिकी के लिए 2022 के दौरान 4 संकर व 57 किस्म, सहित कुल 61 किस्मों का लोकार्पण किया गया है।
- देशभर के सात अंचलों में 28 राज्यों तथा 2 केंद्र शासित प्रदेशों में 123 स्थानों (45 वित्त पोषित, 78 स्वैच्छिक केंद्र) पर 944 प्रयोगों (810 किस्म और 134 संकर चावल) में 48 किस्म एवं 4 संकर परीक्षण किए गए।
- एक सौ नवासी मानक (चेक) सहित (1392 किस्मों तथा 100 संकर चावल) 1492 प्रविष्टियों का परीक्षण किया गया, जिसमें 3 संकर सहित 21 आशाजनक पंक्तियों की पहचान की गई।
- किस्म पहचान समिति (वीआईसी) के द्वारा 32 किस्मों एवं 4 संकरों सहित कुल 36 प्रस्तावों पर विचार किया गया तथा 31 किस्मों व 1 संकर सहित 34 प्रविष्टियों की पहचान की गई।
- देश भर के 49 केंद्रों से चावल की 305 किस्मों को शामिल करते हुए, कृषि सहकारिता विभाग की मांग 3598.67 क्विंटल की अपेक्षा कुल 4449.06 क्विंटल प्रजनक बीज का उत्पादन किया गया।

फ़सल उत्पादन

सस्यविज्ञान

- पैंतालीस स्थानों पर कुल 245 प्रयोग में 50 तथा 100% उर्वरक की अनुशंसित मात्रा (आरडीएफ) पर एकीकृत पोषक तत्व प्रबंधन की प्रतिक्रिया के लिए 18 समूहों से संबंधित 132 आशाजनक किस्मों का मूल्यांकन किया गया।
- इसके अलावा, संवर्धन प्रबंधन पर छह परीक्षण, खरपतवार प्रबंधन पर चार परीक्षण एवं चावल आधारित फसल प्रणाली तथा जलवायु अनुकूल कृषि के अंतर्गत तीन परीक्षण किए गए।
- अधिकांश परीक्षण, मृदा विज्ञान (2), कीटविज्ञान (2), तथा रोगविज्ञान (2) के साथ सहयोगी परीक्षण थे, जबकि सभी पोषक तत्व प्रबंधन परीक्षण चावल तथा चावल आधारित फसल प्रणालियों में लागत प्रभावी खेती व प्रौद्योगिकियां विकसित करने के लिए पादप प्रजनन के सहयोगी थे।

मृदा विज्ञान

- विशिष्ट मृदा तथा फसल प्रणालियों एवं महत्वपूर्ण चावल उगाने वाले क्षेत्रों का प्रतिनिधित्व करने वाले 18 स्थानों में कुल आठ परीक्षण किए गए।
- आरबीसीएस में दीर्घकालिक मृदा उर्वरता प्रबंधन पर अध्ययन के 33वें वर्ष में, उर्वरकों की संस्तुत मात्रआ (आरडीएफ) + गोबर की खाद (एफवाईएम) के उपचार के परिणामस्वरूप सभी तीन स्थानों पर अनाज की उपज अधिकतम हुई तथा मांड्या में खरीफ के दौरान आरडीएफ की अपेक्षा उल्लेखनीय रही। मांड्या में *खरीफ* के दौरान केवल एफवाईएम उपचार आरडीएफ के बराबर था।
- मृदा पैरामीटरों के एकल आंकड़ों से आकलित मृदा गुणता सूचकांक ने सभी किसानों श्रेणियों में मृदा गुणता व स्वास्थ्य में भिन्नता दर्शायी।
- नैनो जिंक सूत्रन परीक्षण में, अनाज तथा पुआल दोनों में जिंक की मात्रा एमटीयू 1001 जीनप्ररूप (क्रमशः 1513 तथा 3795 ग्रा हे$^{-1}$) में अधिक थी।
- अम्ल सहिष्णु जीनप्ररूप श्रेयस, उमा, एआरआरएच-7576, तथा शरबोनी को आशाजनक पाया गया एवं ना.फा.पो. (आरडी) + सिलिक्सोल छिड़काव के प्रयोग से अनाज उपज अत्यधिक उच्च दर्ज की गई।
- परिणामों से पता चलता है कि बिना किसी उपज क्षति के, अनुशंसित नाइट्रोजन के एक भाग को फसल अवशेषों से स्थानापन्न करने के लिए प्रयुक्त किया जा सकता है।
- अधिकांश स्थानों पर एआरआरएच7576, वरदान, सीएनएन5 तथा सीएनएन3 किस्मों ने पैदावार एवं नाइट्रोजन उपयोग दक्षता अधिकतम दर्ज की।
- पोषक तत्व विशिष्ट सॉफ्टवेयर आधारित उर्वरक अनुप्रयोग ने भिन्न-भिन्न प्रतिक्रियाएं दर्शायी; मारुटेरू-*रबी* में नगण्य प्रतिक्रिया तथा मारुटेरू-*खरीफ* में अनाज व पुआल, दोनों की पैदावार में वृद्धि तथा तत्वों के ग्रहण में महत्वपूर्ण प्रभाव देखा गया।
- खुदवानी में जैविक चावल की खेती में, 50% N (FYM) + 50% N (हरी खाद/हरी पत्ती खाद) अनाज की उपज और उपज मापदंडों के मामले में अन्य उपचारों से काफी श्रेष्ठ था,

तथा चिनसुराह में अन्य उपचारों की तुलना में जैविक उपचार से अधिकांश मृदा गुणों में 100% N (FYM) के साथ सुधार हुआ।

पादप कार्यिकी

- एआईसीआरआरपी के अंतर्गत आठ वित्त पोषित केंद्रों, दो भाकृअनुप संस्थानों तथा छह स्वैच्छिक केंद्रों पर छह परीक्षणों में कार्यिकी अध्ययन किए गए।
- सिलिकन के प्रयोग से औसत अनाज उपज में 5% की वृद्धि हुई तथा 27पी63, डीआरआर धान-48, सहभागधन एवं यूएस-312 सबसे अच्छा प्रदर्शन करने वाली प्रविष्टियां थीं।
- अनाज की उपज के आधार पर वर्षा आधारित खेती के लिए आईएल-19072, आईएल-19081, आईएल-19082, आईएल-19132 तथा डब्ल्यूजीएल-14 जीनप्ररूपों की अपेक्षाकृत सूखा सहिष्णु जीनप्ररूप के रूप में पहचान की गई।
- ताप तनाव के अंतर्गत, आईईटी 29943, आईईटी 29946, आईईटी 22946, 29947, 29948, आईईटी 29949, आईईटी 29952, आईईटी 29956 तथा आईईटी 29958 जीनप्ररूपों ने उच्च उपज तथा स्थिरता के साथ अच्छा प्रदर्शन किया।
- सीआर-2862-आईसी-10 को कई अजैविक तनावों (अवायवीय अंकुरण, लवणता तथा परासरणीय) के प्रति सहिष्णु पाया गया, आईईटी-27051, सीआर-2862-आईसी-10 एवं दुलार, अवायवीय अंकुरण तथा परासरणीय दबावों के प्रति सहिष्णु थे; एसी 43037, सीआर-3818-आसी-225, सीआर-2862-आईसी-10 लवणता व परासरणीय दबावों के प्रति सहिष्णु थे।
- एसी 43025, दुलार, एनपीएस17 तथा एनपीएस18 ने 14 दिनों तक पूर्ण जलमग्नता में 70% से ज्यादा उत्तरजीविता दर्शायी एवं जलमग्नता सहिष्णु विशेषता में सुधार हेतु संभावित दाताओं के रूप में इसका उपयोग किया जा सकता है।
- अनाज उपज के आधार पर, परीक्षण की गई प्रविष्टियों में आईईटी 28276 तथा आईईटी 29031 कम प्रकाश तनाव के प्रति सापेक्ष सहिष्णुता दर्शाते हैं।

फसल सुरक्षा

कीटविज्ञान

- इक्कीस राज्यों तथा 2 केंद्र शासित प्रदेशों में 38 स्थानों पर 268 प्रयोग शामिल 7 प्रमुख परीक्षण किए गए।
- तेरह प्रमुख कीट पीड़कों के प्रति 1562 प्रविष्टियों के 182 वैध परीक्षणों में मूल्यांकन के परिणामस्वरूप 80 प्रविष्टियों की कीट पीड़कों के प्रति आशाजनक प्रविष्ठियों के रूप में पहचान हुई।
- अगन्नी (जीएम8), आईएनआरसी 3021 (जीएम8), डब्ल्यू1263 (जीएम1) तथा काव्या (जीएम1) पिटिका मशकाभ (गॉल मिज) के प्रति आशाजनक पाए गए। जीएम8 तथा जीएम1 जीन युक्त दाता एवं आईएनआरसी 17470 (नया दाता) पिटिका मशकाभ के प्रति प्रतिरोध प्रदान करते हैं।
- जगित्याल, रागोलू और वरंगल में अगन्नी (जीएम8) एकल मादा संतती के माध्यम से पिटिका मशकाभ के प्रति आशाजनक हैं।
- पीटीबी 33 (बीपीएच2+बीपीएच3+बीपीएच32+अज्ञात कारक), आरपी 2068-18-3-5 (बीपीएच33(टी)), स्वर्णलता (बीपीएच 6), T12 (बीपीएच7 जीन), राठू हीनाती (बीपीएच3+बीपीएच17), एएसडी 7 (बीपीएच2), बाबावी (बीपीएच 4), आईआर 36 (बीपीएच2) और आईआर 64 (बीपीएच1+), चिनसाबा (बीपीएच8) व मिलयांग 63 को धान का टिड्डा (प्लांट हॉपर) के प्रति आशाजनक पाया गया।
- भूरे प्लांट हॉपर का प्रकोप गंगावती में भाचाअनुसं, राजेंद्रनगर, कोयम्बतूर तथा लुधियाना से बहुत ज्यादा था।
- पिटिका मशकाभ के प्रति दानेदार कीटनाशकों के क्षेत्र मूल्यांकन से पता चलता है कि थियामेथोक्जेम के साथ बीज उपचार के पश्चात मुख्य क्षेत्र में बुआई के 20-25 दिनों के बाद फाइप्रोनिल 3%जीआर का प्रयोग, सिल्वर शूट के काफी कम प्रतिशत के साथ अत्यधिक प्रभावी था।
- नीमजल, नीम का तेल तथा ट्राइफ्लूमेज़ोपाइरीम उपचार का संयोजन भूरे प्लांट हॉपर के प्रति प्रभावी पाया गया।
- चावल गहनता प्रणाली (एसआरआई), वायवीय (एरोबिक) चावल और अर्द्ध शुष्क चावल विधियों की तुलना में मशीनी रोपण, सामान्य रोपण व सीधी बुआई विधियों में पीड़कों का प्रकोप अपेक्षाकृत अधिक था।
- पीले तना छेदक, चावल पत्ती मोडक के धीमे मुक्त होने वाले फेरोमोन मिश्रण तथा पत्ती मोडक और पीले तना छेदक के बहुप्रजाति फेरोमोन मिश्रण प्रभावी पाए गए।
- किसानों की प्रचलित प्रथा की तुलना में पारिस्थितिक अभियांत्रिकी के साथ-साथ जल प्रबंधन ने प्लांट हॉप्पर की संख्या को काफी कम किया। पारिस्थितिक अभियांत्रिकी तथा जल प्रबंधन से लाभ-लागत भी काफी ज्यादा थी।

- प्राकृतिक शत्रु की उच्च समष्टि के साथ पीड़क से होने वाली क्षति को कम करने, तथा उच्च उपज हेतु जैव गहन कीट प्रबंधन युक्तियां प्रभावी थीं।
- समेकित पीडक प्रबंधन (स.पी.प्र.) कार्यान्वित भूखंडों में कीट पीड़कों, रोगों और खरपतवारों के प्रभावी प्रबंधन के कारण अनाज उपज काफी ज्यादा थी, परिणामस्वरूप सकल प्रतिफल उच्च प्राप्त हुआ। समग्र रूप से, उच्च उपज व कम आगत लागत के कारण, "किसान" प्रथाओं की अपेक्षा स.पी.प्र. भूखंडों का लाभ-लागत अनुपात श्रेष्ठ था।
- प्रकाश जाल द्वारा कीट पीड़कों की निगरानी से पता चलता है कि सभी स्थानों में पीला तना छेदक, पत्ती मोजक, और प्लांट हॉप्पर सबसे महत्वपूर्ण पीडक बने हुए हैं।

पादप रोगविज्ञान

- पचास अभासचाअनुप स्थानों पर परपोषी पादप प्रतिरोध, प्रमुख चावल रोगजनकों के प्रकोप तथा रोग प्रबंधन के प्रक्षेत्र अनुवीक्षण पर 15 परीक्षण किए गए।
- सभी स्थानों पर परीक्षित 1449 प्रविष्टियों के मूल्यांकन में 74 प्रविष्टियों को दो से चार रोगों के लिए मध्यम प्रतिरोधी पाया गया।
- पाइरिक्युलिया ग्रिसिया के प्रकोप के प्रक्षेत्र अनुवीक्षण ने प्रतिरोध पद्धित में परिवर्तन दर्शाया।
- अधिकांश स्थानों पर एक्सए1, एक्सए3, एक्सए4, एक्सए5, एक्सए7, एक्सए8, एक्सए10, एक्सए11 तथा एक्सए14 जैसे एकल जीवाण्विक अंगमारी प्रतिरोधी जीन युक्त विशेषक अतिसंवेदनशील थे।
- अगेती व सामान्य बोई गई फसलों की अपेक्षा देरी से बोई गई फसलों में पर्ण झोंका की घटनाएं ज्यादा पाई गई। आवरण अंगमारी का प्रकोप अगेती बोई गई फसल में अधिक पाया गया, जबकि अगेती बोई गई फसल में बैकने अधिक पाया गया तथा देर से बोई गई फसल में आवरण सड़न का प्रकोप ज्यादा पाया गया।
- कवकनाशी किटाज़िन 48% ईसी (1.0 मिली/लीटर), तथा आइसोप्रोथियोलेन 40% ईसी (1.5 मिली/लीटर) पर्ण झोंका के प्रति प्रभावी थे। आइसोप्रोथिओलेन 40% ईसी (1.5 मिली/लीटर) नेक झोंका के प्रति प्रभावी था, एवं थिफ्लुज़ामाइड 24% एससी (0.8 ग्राम/लीटर) और डाईफेनोकोनाजोल 25% ईसी (0.5 मिली/लीटर) (डीएस: 36.5%) आवरण अंगमारी के प्रति प्रभावी थे। डाईफेनोकोनाजोल 25% ईसी (0.5 मिली/लीटर) आवरण सड़न तथा भूरे धब्बे को कम करने में प्रभावी था। टेबुकोनाजोल 25.9% ईसी (1.5 मिली/लीटर) ने आवरण अंगमारी, आवरण सड़न, भूरे धब्बे तथा झोंका के प्रति व्यापक गतिविधियां दर्शायी।
- कार्बेन्डाजिम @ 2 ग्राम/किग्रा से बीज उपचार तथा 0.4 ग्राम/ली ट्राइफ्लॉक्सीस्ट्रोबिन 25% + टेबुकोनाज़ोल 50% का छिड़काव रोग की गंभीरता को अत्यधिक प्रभावी ढंग से कम करता है। सभी स्थानों पर, बीज उपचार तथा रोपण के 15-20 दिन बाद जैव-नियंत्रक कारक (10 ग्राम/लीटर) के छिड़काव के साथ पर्णछद अवस्था में प्रोपिकोनाज़ोल (1 ग्राम/लीटर) का एक छिड़काव पत्ती, नेक झोंका, आवरण अंगमारी तथा आवरण सड़न के प्रति प्रभावी था।
- स.पी.प्र. पद्धतियों ने पर्ण झोंका, नेक झोंका तथा फाल्स कंड रोग की घटनाओं को कम किया।
- रोग सूचकांक पर्ण झोंका हेतु 62.6 -33.3% के कारण उपज में 48.1-17.8%; आवरण अंगमारी हेतु 67.2-38.8% के कारण उपज में 51-23% तथा बीबी हेतु 67.2-38.8% के कारण 44 = 18% उपज में कमी आई।
- लेहयुक्त सीधी बुआई विधि नेक झोंका तथा आवरण सड़न रोगों को कम करने एवं हस्त रोपण से अनाज का विरंजन तथा आवरण सड़न को कम करने में आशाजनक पाया गया, परंतु आवरण अंगमारी में वृद्धि हुई। चिनसुराह में, सीधे बीज बोने वाले पौधों की तुलना में हाथ से की गई रोपाई में सबसे ज्यादा बीमारी दर्ज की गई।

उत्पादन उन्मुख सर्वेक्षण

- चौदह राज्यों के 98 जिलों में सर्वेक्षण किया गया।
- उत्तर प्रदेश, हरियाणा, गुजरात तथा बिहार जैसे राज्यों में संकर चावल किस्मों की उल्लेखनीय क्षेत्र में खेती की जा रही है एवं कर्नाटक तथा महाराष्ट्र जैसे राज्यों में इसका क्षेत्र बढ़ रहा है।
- आंध्र प्रदेश तथा तेलंगाना में जीवाण्विक अंगमारी की तीव्रता गंभीर थी, जबकि जम्मू व कश्मीर में झोंका, भूरा धब्बा तथा अनाज का विरंजन अधिक था।
- तेलंगाना में तना छेदक, पत्ती मोडक तथा पुष्पगुच्छ घुन जैसे कीट पीडक बहुत ज्यादा थे एवं कावेरी कमांड क्षेत्र में ब्लडवर्म की समस्या देखी गई थी।

एआईसीआरआईपी प्रायोगिक डाटाबेस - http://www.AICRPR-intranet.in

- इस वर्ष के दौरान 75% से ज्यादा केंद्रों ने अभासचाअनुप इंट्रानेट के माध्यम से डेटा अपलोड किया। अखिल भारतीय चावल समूह की 57वीं बैठक की नई कार्यवाही के अनुसार पादप प्रजनन एवं संकर चावल की राज्य तथा क्षेत्रीय रिपोर्टों के विश्लेषण मॉड्यूल को परिष्कृत किया गया।

अग्रणी अनुसंधान

फसल उन्नयन

पादप प्रजनन

- आंध्र प्रदेश, तेलंगाना, छत्तीसगढ़ और पंजाब में खेती के लिए जारी डीआरआर धान 65 (आईईटी सं. 27641) एक उच्च उपज वाली कम फास्फोरस सहिष्णु किस्म है।
- भू-प्रजातियां सहित जननद्रव्यों का मूल्यांकन किया गया तथा प्रजनन कार्यक्रम में उच्च जिंक (>25 पीपीएम) के साथ बीपीएच प्रतिरोध हेतु दाताओं के रूप में उपयोग हेतु दो जीनप्ररूप - जीएम-3 (बिन्नीधन) तथा जीएम-86 (महाराष्ट्र से चयन) की पहचान की गई।
- दो केंद्र परीक्षणों में 16-141, एसडब्ल्यू-22-01, एसडब्ल्यू-22, एसडब्ल्यू-22-07 तथा आरपी 6252-बीवी/ आरआईएल-बीवी 228 एवं एनएसआर-101 को आशाजनक पाया गया।
- डीआरआर धान 54, डीआरआर धान 47, जया, रासी, डीआरआर धान 39, उन्नत सांबा मसूरी, डीआरआर धान 50 तथा डीआरआर धान 60 की उपज हेतु श्रेष्ठ दाताओं के रूप में पहचान की गई।
- स्वर्ण/सिननासिवप्पु से व्युत्तपन्न पुनर्योगज अंतःप्रजात वंशक्रम (आरआईएल) मैपिंग समष्टि से एसएनपी चिह्नक सी2_24136056 तथा एसएसआर चिह्नक आरएम 13606 के पास 0.53 एमबी क्षेत्र में गुणसूत्र 2 पर अस्थायी रूप से डब्ल्यूबीपीएच13 (टी) के रूप में अनंतिम रूप से एक नया जीन तैयार किया गया।
- उच्च अनाज प्रोटीन युक्त जीनप्ररूपों जैसे - जेएके 16, जेएके 47, जेएके 75, जेएके 686, जेएके 713 की पहचान की गई। अमीनो अम्ल रूपरेखा के माध्यम से जेएके16 (5.61 ग्राम/100 ग्राम प्रोटीन), जेएके 686 (9.52 ग्राम/100 ग्राम प्रोटीन) तथा जेएके 686 (8.49 ग्राम/100 ग्राम प्रोटीन) में क्रमशः लाइसिन, मेथिओनिन, सिस्टीन सामग्री उच्चतम पाई गई।
- आईआर64*1/*ओरिज़ा ग्लोबेरिमा* से व्युत्पन्न बीसी1एफ7 समष्टि में से खरपतवार प्रतिस्पर्धात्मकता हेतु आशाजनक अंतर्मुखी वंशक्रम, जैसे आईएल 40-2, आईएल 179-2, आईएल 48, आईएल 143, आईएल 23-2, आईएल 80 तथा आईएल 80-2 की पहचान की गई और फिर एफ2 समष्टि के विकास हेतु आईआर 64 के साथ प्रतीप संकर किया गया। अवायवीय अंकुरण के लिए खाओ हलान ऑन (केएचओ), डी14 (शून्य युक्त एजी क्यूटीएल) जीनप्ररूप की पहचान की गई।
- गर्मी सहनशीलता, पौद एवं प्रजनन लवणता सहिष्णु, पोषक तत्व उपयोग दक्षता, बाढ़ सहिष्णु तथा उपज बढ़ाने वाले जीन जीएन1, एससीएम2 व ओएसएसपीएल14 जैसे वांछनीय लक्षणों वाले माता-पिता शामिल मैजिक समष्टि तथा प्रजनन लवणता सहिष्णुता के लिए लक्षणप्ररूपण पद्धति विकसित की गई।
- खरीफ 2022 के दौरान उच्च अनाज संख्या (320-472) वाले उन्नत प्रजनन वंशक्रमों जैसे जेबीबी 5952, 5960, 5962, 5964, 5966, 5967, 5973 की पहचान की गई।
- तीन सौ पचास जननद्रव्य वंशक्रमों में से कम फास्फोरस सहिष्णु आशाजनक जीनप्ररूप - 16-302, पीएन 42-16, एफ5 एमएसएसी 23-31, 16-518 की पहचान की गई। रासी x उन्नत सांबा मसूरी समष्टि का कम फास्फोरस एवं सामान्य स्थितियों में लक्षणप्ररूपण किया गया।
- एक सौ एक रंगीन चावल जननद्रव्य एकत्र किए गए और कृषि-रूपात्मक तथा उपज संबंधी लक्षणों के लिए उनकी विशेषताओं का वर्णन किया गया एवं चयनित विशेष चावल का उपयोग करके 15 संकरण किए गए।
- स्वर्ण/*ओरिजा निवारा* प्रतीप संकरण इंट्रोग्रेशन समष्टि में 48% पीवीई के साथ अनाज के वजन में वृद्धि के प्रेरक जीन के रूप में जीआरएएस ट्रांसक्रिप्शन कारक को एनकोड करने वाले ओएस03जीओ103400 की पहचान गई।
- स्वर्ण/*ओ निवारा* से पिटिका मशकाभ (गालमिज) सहिष्णुता हेतु आरपी बायो 4918-224, आरपी बायो 4918-228-1, बहु-पीडक प्रतिरोध हेतु आरपी बायो 4918-269 तथा आरपी बायो 4918-230 एवं जीवाण्विक झुलसा प्रतिरोध हेतु एनपीएस19-1, एनपीएस56-2, एनपीएस58-1 और एनपीके77-3; एवं केएमआर3/ओ. रुफिपोगॉन वंशक्रमों से तना छेदक सहनशीलता हेतु आरपी बायो 491-एनएसआर10 व आरपी बायो 491- एनएसआर 88 की आशाजनक दाता के रूप में पहचान की गई।

- नए संकरणों के लिए प्रयास किया गया तथा केतकिजोहा, टीसीवीएम-1, जीएआर1, जीराबत्ती, बीआरआरआई धान75, पूसा बासमती 1121, धनगुरी, एचयूआर 4-3 का उपयोग करके सुगंध संबंधी लक्षणों के लिए उन्नत प्रजनन वंशक्रमों का मूल्यांकन किया गया।

संकर चावल

- विभिन्न क्षेत्रों में वाणिज्यिक खेती के लिए सीएससीसीएसएन तथा आरवी के द्वारा 17 संकर (केंद्रीय स्तर हेतु लोकार्पित -16; राज्य स्तर हेतु लोकार्पित-1) लोकार्पित तथा अधिसूचित किए गए।
- सात संकर अर्थात आईआईआरआरएच 150, आईआईआरआरएच 151, आईआईआरआरएच 152, आईआईआरआरएच 153 (आईएचआरटी - ई); आईआईआरआरएच 148, आईआईआरआरएच - 154 (आईएचआरटी-एमई); आईआईआरआरएच 154 (आईएचआरटी - एम) को अ.भा.स.चा.अनु.प. परीक्षणों के लिए नामांकित किया गया।
- पूसा 5ए X आईजेडी13 तथा पूसा 5ए X आईजेडी 13, दो श्रेष्ठ संकरों की पहचान की गई।
- विश्व का पहला सार्वजनिक प्रजनित वायवी संकर डीआरआरएच 4 (आईईटी 27937), लोकार्पित तथा अधिसूचित (एस.ओ. 4065 (ई)। दिनांक 31 अगस्त, 2022) किया गया।
- बहु रोग प्रतिरोध युक्त, अगेती परिपक्वन (115-120 दिन) एवं नाइट्रोजन उपयोग दक्ष डीआरआर धान 64 [आईईटी 28358 (आरपी 5599-212-56-3-1)] चावल किस्म (एस.ओ. 4065(ई). दिनांक 31 अगस्त, 2022.) लोकार्पित की गई।
- आरपी6338-9(आईएनजीआर22065) एकगर्मीसहिष्णुउन्नत पुनर्स्थापक तथा आरपी 5593-83-12-3-1(आईएनजीआर 22102) एक सोडिक/अम्लीय/वायवी अनुकूलित पुनर्स्थापक वंशक्रम को पादप जननद्रव्य पंजीकरण समिति (पीजीआरसी), भाकृअनुप-रापाआसंब्यू में पंजीकृत किया गया।
- बहु तनाव (बीएलबी, झोंका, आवरण अंगमारी, बीपीएच, जीएम और सूखा, लवणता, कम फास्फोरस) प्रतिरोध/सहिष्णुता के साथ उन्नत पुनर्स्थापक वंशक्रमों का एसएनपी चिह्नकों की सहायता से जीनप्ररूपण किया गया तथा बहु तनाव सहिष्णु जीन वाले वंशक्रमों की पहचान की गई।
- तीन सौ पचास परीक्षण संकरणों का मूल्यांकन किया गया और 65 अनुरक्षकों की पहचान की गई, जिसमें टीसीपी 3901, 3905, 3912, 3916, 3921, 3922, 3924, 3927, 3959, 3966, 3970, 3971, 3972, 3974, 3980, 3981, 3984, 3987 शामिल हैं।

जैव प्रोद्यगिकी

डीआरआर धान 66, एक अधिक उपज देने वाली, लम्बी-पतली दानेवाली चावल की किस्म है, जो कम मिटटी फास्फोरस की स्थिति के लिए अत्यधिक सहिष्णु है, जिसे सी वी आर सी के माध्यम से विकसित, जारी और अधिसूचित किया गया था।

यह फास्फोरस उर्वरको की अनुशंसित खुराक के 40% आवेदन पर भी सामान्य रूप से बढ़ सकता है और उपज दे सकता है। डीआरआर धान 66 मेगा-किस्म, MTU 1010 का एक शुन्य है, जिसमे कम मिटटी फास्फोरस, PUP1 के प्रति सहनशीलता से जुड़ा प्रमुख क्युटिएल है। PJTSAU और ANGRAU के सहयोग से, WGL1487, एक उच्च उपज देने वाली, लम्बी-पतला अनाज प्रकार की चावल की किस्म है, जो कम मिटटी फास्फोरस स्थितियों के लिए अत्यधिक सहिष्णु हर और CVRC के माध्यम से जारी की गयी थी। WGL1487 आंध्र प्रदेश की लोकप्रिय किस्म MTU1121 का एक शुन्य है और इसमें PUP1 है।

CHR *O. ओफ्फिसिनेलिसिस* की एक अंतर्मुखी रेखा से 11 L एक ब्रीडिंग लाइन, IET 30261 क्रॉस से निकली गयी, MTU 1121 *2 / स्वर्ण जिसमे कम नाइट्रोजन तनाव है, ने AICRPR के कम नाइट्रोजन परीक्षण (LNT) परीक्षण में वादा दिखाया और परीक्षण के दूसरे वर्ष के लिए पदोन्नत किया गया। मेगा-चावल किस्म की अनुवांशिक पृष्ठभूमि में एक प्रजनन रेखा, उन्नत साम्बा महसूरी, IET 30084, जिसमे उपज बढ़ाने वाले जीन, Gn1a, और OsSSPL14 है, को जोन VI में AVT1-MS में पदोन्नत किया गया। उन्नत साम्बा महसूरी की एक और प्रजनन लाइन जिसमे उपज बढ़ाने वाले जीन है, को समग्र आधार पर और जोन III और जोन VI में भी AVT1-MS में पदोन्नत किया गया है।

चावल विविधता पैनल 1 का जीनोम वाइड एसोसिएशन अध्ययन (GWAS) जिसमे 5.2M SNP डाटा का उपयोग करके 188 जीनोटाइप शामिल है, क्रोमोसोम 3 पर अनाज भरने % कुल (GFTOT) के लिए मार्कर - विशेषता संघो की पहचान की गयी है। लिंकेज डिसिपीलिब्रियम (LD) के भीतर क्युटिएल अंतर्निहित उम्मीदवार जीन GFTOT के लिए 205 kb की खोज की गयी थी।

कैंडिडेट जीन LOC_OS3g62720 को बीज विकास चरणों में शामिल पाया गया। एक उपन्यास चीटिनेस OS10G0416500 को टेटेप से क्लोन किया गया। और ताइपेई ओवर - एक्सप्रेस ट्रांसजेनिक लाइनों ने शीथ ब्लाइट रोगो में उल्लेखनीय कमी दिखाई।

बी पी टी 5204 ईएमएस म्युटेंट लाइन सीपीआई 109 और वाइल्ड टाइप पैरेंट बी पी टी 5204 का उपयोग करके पूर्ण पुष्पगुच्छ उद्भव (सीपीआई) के लिए मैपिंग, क्युटिएल सीक, और आर एन ए सीक के संयोजन का एक एकीकृत दृष्टिकोण क्रोमोसोम 4 पर जीनोमिक्स क्षेत्रों 5.45 एम् बी और 3.06 एम् बी का खुलासा करता है। और 12 क्रमशः, 12-12 एस एन पी मार्कर और एपी2 / एथिलीन उत्तरदायी तत्व बाध्यकारी प्रोटीन एक उम्मीदवार जीन गवर्निंग सीपीआई के रूप में। उत्परिवर्तित वंशक्रम अर्थात SM92, SM74, SM72, और SM 48 पीले तना बेधक प्रतिरोध के लिए आशाजनक पाए गए; म्युटेंट डेराइवेड लाइन SP-M_MS-70 (शुन्य स्कोर के साथ) ब्राउन प्लांटहॉप्पर के प्रति सहिष्णु पाई गयी। बीस साम्बा महसूरी म्युटेंट लाइन्स और उनके डेरिवेटिव ए आई आर पी आर के राष्ट्रीय परीक्षणों में है।

लम्बे गैर-कोडिंग आर एन ए अनुक्रमण को इल्लुमिना नोवासेक 6000 केमिस्ट्री का उपयोग उच्च अंकुर शक्ति, मजबूत जड़ प्रणाली वास्तुकला TI-128, बाढ़ अनुकूलित मेगा किस्म, BPT-5204, और एरोबिक अनुकूलित किस्म, सी आर धान 202 के साथ म्युटेंट लाइन में निष्पादित किया गया है।

फसल उत्पादन

कृषि विज्ञान

खेती की प्रणालियों में, मशीनीकृत श्री विधि में पानी की सबसे कम मात्रा की आवश्यकता होती है (क्रमशः ड्रम सीडिंग और सामान्य रोपाई की रूलणा में औसत अनुप्रयुक्त पानी का 11.61% और 13.21% कम)। डीआरआरधान 43 ने अन्य किस्मो की तुलना में उच्च जल उत्पादकता के साथ-साथ डब्लू यू ई दर्ज की ।

चावल की डीआरआर धान 43 (लम्बे और मोटे दाने वाली किस्म) या एनएलआर-34449 (बारीक़ दाने वाली) किस्म उच्च उपज और आर्थिक लाभ के लिए वैकल्पिक गीला और सुखाने वाली सिचाई प्रणाली के साथ बुवाई की श्री या ड्रम सीडिंग विधि के तहत आशाजनक थी। 25-30 DAS पर PYRAZOSULFURON ETHYL 70% WDG @ 21g ai/ha fb penoxsulam + cyhalofop butyl @ 150g ai/ha के उपचार में खरपतवार की आबादी और खरपतवार बायोमास कम दर्ज किया गया। इसके बाद 25 -30 DAS पर pyrazosulfuron ethyl 70% WDG @ 21 g ai / fb Triafamone 20 % + Ethoxysulfuron 10% WG @ 67.5 ai/ha दिया जाता है। पूल किये गए विश्लेषण से पता चला कि पारम्परिक रूप से जुताई वाली चावल- मक्का के परिणामस्वरूप अध्ययन अवधि के दौरान संरक्षण कृषि (सी ऐ) के समान प्रणाली उत्पादकता हुई। लागत-लाभ विश्लेषण से पता चला कि प्रत्यारोपित चावल और पारम्परिक रूप से जुताई की गयी मक्का से रुपये का उच्च शुद्ध लाभ प्राप्त हुआ। 1,11,074 और रु 1,01,658 / हेक्टेयर, क्रमशः सीधे-गीले बीज वाले चावल और सीए की ऊपर।

CA-आधारित चावल- मक्का प्रणाली के परिणामस्वरूप मिटटी की 0-5 सेमी गहराई में पारम्परिक प्रणाली की तुलना में अत्यधिक अस्थिर (0.194%) और अस्थिर (0.196%) कार्बन सांद्रता पाई गई।

डीआरआर धान 42 ने MTU 3626 (6.08 t/ha) और आई आईआरआरएच 124 (6.15 t/ha) की तुलना में काफी अधिक अनाज उपज (6.49 t/ha) का उत्पादन किया।

मृदा विज्ञान

नाइट्रोजन उपयोग क्षमता (एनयूई) चावल की किस्मो की पहचान बीबी 1704, निधि, टेला हमसा, पी इस वी344, पी इस वी 181, और पीयू पी 221 थी परीक्षण की गई 190 बी ए ए पी प्रविष्टियों में से शीर्ष पांच प्रविष्टियां एन-150 पर अनाज की उपज पर आधारित थी. स्तर थे : 39 से बीएसपी 81 छोला बोरो (2) जी 1) 126 बीएपी 199 (DULA ऑस्ट्रेलिया IRGC 49180-1); 180- बीएएपी 266 ढाली बोरो आई आर जी सी 29314-1) 133 BAAP-210 (JATI AUS IRGC 34940-1) और 8-BAAP-13 (SADUCHO) बेहतर एन स्त्रोत जैसे एन - (एन थिओफास्फोरिक ट्राईमाईड एनबीपीटी और एलिसीन ने एनसी यू उपज में वृद्धि दर्ज की और एनयूई एनबीपीटी 1000 पीपीएम के साथ काफी अधिक था।

NTP की तुलना में SRI में मीथेन में के उत्सर्जन में 40% से अधिक और AWD में क्रमशः 5 और 10 सेंटीमीटर पर 49 और 54 प्रतिशत की कमी आयी N2O-N उत्सर्जन NTP की तुलना में SRI में 28 प्रतिशत और AWD में क्रमश 5 और 10 सेमी पर 33

और 47% अधिक था AWD और SRI ने विधियों ने कम मीथेन उत्सर्जन के कारण ग्लोबल वार्मिंग क्षमता को कम किया।

2016-17 से शुरू होने वाले छह जल वर्षों में फैले मल्टी-टेड MODIS टेरा डेटा का उपयोग TIMESAT का उपयोग करके समय श्रृंखला विश्लेषण बनाने के लिए किया गया था लगभग 112000 मृदा स्वास्थ्य कार्डो की अवधि के बाद तेलंगाना राज्य से संबंधित मृदा स्वास्थ्य कार्डो से इंटरपोलेशन तकनीकों द्वारा बारह प्रथम सन्निकटन डिजिटल मृदा विषय तैयार किए गए।

तेलंगानाराज्य के रंगारेड्डी जिले के महेश्वरम कथा कुंदूकर और अमंगल मंडल से मिट्टी के पोषक मानचित्र विकसित करने के लिए 1400 नमूने एकत्र किए गए थे।

अध्ययन क्षेत्र में परीक्षण की गई मिट्टी का प्रमुख क्षेत्र रेतीला (4034 एकड़) था।

दोमट (884 एकड़) और मिट्टी (398 एकड़) और मिट्टी का प्रमुख रंग लाल और उसके बाद भूरा है बायोएक्टिव मेटाबोलाइट् की पहचान करने के लिए, एक दुर्लभ एक्टिनोमीसेट जींस अमीकोलाटोप्सिस ओरिएंटलिस IIRRACT9 के मेटाबोलोम का अध्ययन किया गया संस्कृति सतह पर तैरने वाला में पहचान जाने वाले बायोएक्टिव यौगिकों में जीवाणु रोधी एंटीफंगल एंटीहेल्मैटिक मेटाबोलाइट्स शामिल है पौधे के विकास को बढ़ावा देने की क्षमता वाले जिबरेलिन और सिडरोफोर भी आइसोलेट द्वारा उत्पादित किए गए थे इसके अलावा, चयापचय में एंटीवायरल मेटाबोलाइट्स भी पाए गए।

एंड मुक्त मीडिया पर 35 नाइट्रोजन फिक्सिंग बैक्टीरिया को अलग किया गया एसिटिलीन रेड्यूसिंग एसे (एआरए) के माध्यम से नाईट्रोजेनेस गतिविधि के लिए 12 अद्वितीय मर्फोटाइप्स को शुद्ध और मूल्यांकन किया गया और 3 संभावित फास्फोरस घुलनशील (पीएसबी) रोगाणुओं को अलग किया गया नेशनल एग्रीकल्चुरली इंपॉर्टेंट माइक्रोबॉयल कल्चर कलेक्शन (एनआईएससीसी) आईसीएआर- एनबीएआईएम, मऊ में जमा पीएसबी कल्चर इल्यूमिना मीसेक से आधारित 16S Rrna जीन एंप्लीकान मेटैजिनोमिक्स चावल राइसोस्फीर मिट्टी का विश्लेषण किया गया ZNSO4 के दो स्प्रे ने उच्चतम अनाज उपज (4.39 t ha-1) दर्ज की और उसके बाद नैनो ZnO @ 250mg L-1 दर्ज किया नैनो ZnO @ 150mg kg-1 के बाद 0.5% ZNSO4 (26.9 mg kg-1) के प्रयोग से पुआल में Zn मात्रा मे महत्वपूर्ण सुधार देखा गया नैनो ZnO की 500mg L1 की बढ़ती सांद्रता ने एक उच्च sod (25.7 U/ min/g wt), CAT (87.3 H2O2 कम/मिनट/ G WT) और POX (2.7 μmol गोआईकॉल गठित/मिनट/ g wt) दर्ज किया है क्रमशः कम सांद्रता की तुलना में।

फास्फोरस घुलनशील बैक्टीरिया (पीएसबी) के संयोजन में 40 किलोग्राम पी के प्रयोग से सबसे अधिक संख्या में टिलर एम-2 (442), पुष्पगुच्छ एम-2 (405), अनाज उपज(5.7 टन हेक्टर-1) और पुआल उपज (7.7 t ha-1) अन्य उपचारों की तुलना में

लेपित फास्फोरस उर्वरकों के अनुप्रयोग ने उनके संबंधित अनकोटेड उपचारों की तुलना में उच्च कृषि दक्षता दर्ज की।

प्लांट फिजियोलॉजी एंड बायोकेमेस्ट्री

पानी के तनाव की स्थिति में सिलिकॉन के प्रयोग से अजैव के प्रति सहनशीलता में सुधार हुआ।

प्रारंभिक अवलोकनों के आधार पर ब्लैकगोरा E MOOM, IRGC, 132252, IC-438644, IC-124667, IC-124667, IC-44975, ADAYSEL, RASI, BAKAL, VANAPRAVA जैसे कुछ जीन प्रारूपों को ताप तनाव के प्रति अत्यधिक सहिष्णु पाया गया प्रजनन अवस्था जिसमें स्पाइकलेट प्रजनन क्षमता 80% से अधिक हो. चावल के दाने में उम्र बढ़ने से संबंधित परिवर्तनों का पालन प्राकृतिक उम्र बढ़ने की तुलना में कम समय में करने के लिए त्वरित बढ़ने का उपचार आशा जनक प्रतीत होता है।

कंप्यूटर अनुप्रयोग इस वर्ष के दौरान

70% से अधिक केंद्रों ने एआईसीआर आईपी इंट्रानेट के माध्यम से डाटा अपलोड किया एआईसीआरपी इंट्रानेट मैं आरबीडी और स्प्लिट एनालिसिस मॉड्यूल, मौसम डेटा प्रविष्टि के लिए एक्सल कॉपी इंटरफेस वर्चुअल फील्ड मॉनिटरिंग और फसल की स्थिति इंटरफ़ेस पर मासिक टिप्पणी जैसी नहीं विशेषताएं जोड़ी गई हैं।

मौसम संवेदकों के निर्माण के क्रम में गूगल शीट में सेंसर से डाटा प्रकाशित करने के लिए पाइथन कार्यक्रम विकसित किए गए थे और उष्णकटिबंधीय मिट्टी (QUEFTS) मॉडल की उर्वरता के मात्रात्मक मूल्यांकन का उपयोग करकेAICRIP के दीर्घकालिक मिट्टी उर्वरता प्रयोगात्मक डाटा के साथ पोषक तत्व आवश्यकता मॉड्यूल को माननीय किया गया था।

कृषि अभियांत्रिकी

1.0 एचपी विद्युत तीन चरण मोटर और का उपयोग करके एक मिट्टी की पुड्लिंग मशीन बनाई गई थी। ड्रम में पुड्लिंग के लिए विशेष रुप से डिजाइन किए टूल के साथ खड़े हो।

कृषि रसायन

न्यूट्रल सिलिका जिसकी तैयारी के बारे में पहले बताया गया था, का परीक्षण (बीज आईसीआर पी के तहत) उनके नियंत्रण के लिए अलग-अलग सांद्रण वाले भंडारण कीड़ों पर किया गया।

भंडारण कीट के नियंत्रण के लिए तटस्थ सिलिका 1500 पीपीएम सबसे उपयुक्त पाया गया हाइड्रोजेल आधारित धीमी गति से रिलीज होने वाले यूरिया में नाइट्रोजन की मात्रा 41.02% सब सुधारने के लिए पद्धति विकसित की गई।

फसल सुरक्षा

कीट विज्ञान

नीलगिरी का तेल और कीटनाशक डाईनोट फ्यूरान 20% एसजी संयुक्त क्रिया प्रदर्शित करने के लिए पाया गया ब्राउन प्लांट हॉपर के खिलाफ।

आवश्यक तेलों के धीमी गति से निकलने वाले केक फॉर्मूलेशन पीले तना छेदक और दानेदार पक्षियों के खिलाफ क्षेत्र की परिस्थितियों में प्रभावी थे इस तरह, यह फॉर्मूलेशन चोर किए गए अनाज के कीट कम अनाज बॉर्डर के खिलाफ अत्यधिक प्रभावी थे।

तीन जीनोटाइप एलडी 24, खाओ पाह माव, और सुरक्षा को चावल के लिए प्रतिरोधी पाया गया।

जड़ गांठ नेमाटोड सामान्य रोपाई (NTP) प्रणाली की तुलना में वैकल्पिक गीलापन और सुखाने प्रणाली (AWD) में कुल सूत्रकृमि प्रचुरता अधिक थी हालांकि, चावल जड़ सूत्रक्रमी Hirschanniella एसपीपी की बहुतायत NTP सिस्टम की तुलना में AWD सिस्टम में कम था एरोबिक खेती में धान के पुआल के साथ मल्चिंग और स्वस्थानी हरी खाद में लोबिया और शाकनाशी के साथ पौधे परजीवी नेमाटोड को दबा दिया।

एंटोमोपथोजेनिक नेमाटोड हेट्र हैपेटाइटिस इंडिका और स्टेरनेमा ग्लौसरी से अलग किए गए सिंबायोटिक बैक्टीरिया फोटोरहैसंन ल्युमिनसेंस और ज़ेनोरहीबड्स नेमैटोफिला ने डुअल कल्चर प्लेटो में फंगल रोगजनक राइजोक्टोनिआ सोलानी और फुसेरियम के विकास को रोक दिया।

कल्टीवर टीकेएम 6, तना छेदक के प्रति प्रतिरोधी होने के अलावा परजीवी भर्ती के लिए अनुकूल रासायनिक पारिस्थितिकी भी थी पैरासाइटोइड ट्राईकोग्रामा जपोनिकम ने स्वस्थ् पौधों की तुलना में स्टेम बोरर से प्रभावित पौधों को प्राथमिकता दी, जिसमें बीपीटी 5204 की ओर काफी अधिक प्राथमिकता थी, इसके बाद वाईट्यूब ओल्फेक्टोमीटर परक में पीबी 1 था।

रस पैदा करने वाले फूल वाले पौधों की परिस्थिति ने ही 44.97 प्रतिशत परजीविता में योगदान दिया परजीविता (18.19) प्रतिशत में उल्लेखनीय वृद्धि मिथाइल सेलिसीलेट अनुप्रयोग के संयोजन और बांधों के साथ अमृत उत्पादक फूलों के पौधों को प्रदान करने से देखी गई एक नया कीटनाशक अणु, ME5382 2% GR @ 150g/ ai प्रति हेक्टेयर परिणाम स्वरूप येलो स्टेम बोरर संक्रमण द्वारा मृत हृदय निर्माण में उच्चतम कमी (72.58%) हुई. सफेद बालियों के संबंध में क्लोरेनट्रानिलिप्रोयेल 0.4% जीआर + थिआमेथोक्साम 1.00% जीआर को दो बार लागू किया गया, फसल वृद्धि के वानस्पतिक और प्रजनन चरणों मैं नियंत्रण पर 66.84% की कमी के साथ बेहतर पाया गया

तेलंगाना, आंध्र प्रदेश और कर्नाटक से नौ शेत्र की आबादी में ब्राउन प्लांट हॉपर के लिए पाइमेट्रोजिन की विषाक्तता की निगरानी की गई प्रतिरोध अनुपात वारंगल (10.5 से 15.1) > मारुटेरु (6.2 से 6.8)> रायचूर (3.4) > नलगोंडा (1.1 से1.6) के क्रम में थे।

बीपीएच प्रतिरोधी उत्परिवर्त, एनएच 4631 ने रक्षात्मक जीनो की अत्यधिक महत्वपूर्ण अभिव्यक्ति दिखाई और इसकी प्रकाश संश्लेषण दक्षता बीपीएच संक्रमण से प्रतिकूल रूप से प्रभावित हुई।

पित मिस प्रतिरोध के लिए जर्मप्लास्म लाइनों की स्क्रीनिंग ने एचआर + प्रतिक्रिया के साथ प्रतिरोधी लाइनों, जेजीएल 11727 और सुकराधिन1 और एचआर प्रतिक्रिया पोस्ट बायो टाइप 1 संक्रमण के साथ सी यार 2615-1 और जे जी एल 11470 की पहचान की RP5588, RP5587, SM 92 और इसकी व्युत्पन्न लाइनRP6112-MS-MR-41, RP 4919 पर नवजात लार्वा के साथ पीले तने के छेदक के लिए कट स्टेम परख, SASYASREE मेजबान सयंत्र प्रतिरोध के घटक के रूप में प्रति जीवाणु साबित हुआ

कार्यकारी सारांश

1.0 के नुक्सान स्रोत के साथ 26 बी आई एल को चावल की पत्ती फोल्डर के प्रतिरोधी के रूप में पहचाना गया एलो स्टेम बोरर और लीफ फोल्डर के धीमी गति से निकलने वाले फेरोमोन फॉर्मूलेशन को उच्च मोथ कैच वाले सामान्य फॉर्मूलेशन की तुलना में प्रभावी पाया गया।

प्लांट पैथोलॉजी

3539 में से 799 लाइने ब्लास्ट के खिलाफ प्रतिरोधी के रूप में पाई गई राइजोस्फेरिस मिट्टी के एक कवक (ट्राइकोडर्मा स्पिरिलम TAIK) और तीन जीवाणु विरोधी (बेसिलस सेरस IIRR, बेसिलस ज़ियामेनेसिस बेसिलस सबलिटिस IIRR) ने पत्ती विस्फोट रोगजनक के खिलाफ 64.71 से 72.22% तक पौधों की वृद्धि को बढ़ावा देने वाली गतिविधि के साथ उच्च प्रतिशत प्रतिरोध दिखाया।

1121 प्रविष्टियों में से 113 को बैक्टीरियल ब्लाइट के खिलाफ प्रतिरोधी स्रोतों के रूप में पहचाना गया प्रतिरोधी के एक नए स्रोत के साथ 14 प्रतिरोध प्रविष्टियों की पहचान की गई तेलंगाना और तमिलनाडु के BB स्थानिक क्षेत्रों में *Xa21+xa13+xa5+Xa38* जीनो के साथ शामिल DRR धान 53 के BB प्रतिरोध का प्रदर्शन किया गया सिप्रोफ्लोक्सासिन और क्लोरेनफेनिकाल ने ग्लासहाउस परिस्थितियों में जू की रोग गंभीरता को कम करने में अच्छा प्रदर्शन किया पंजाब, हरियाणा, उत्तराखंड और कर्नाटक से 270 शीत ब्लाइट नमूने एकत्र किए गए R. Solani और *R. oryzae sativae/ R. oryzae* के लगभग 300 आइसोलेट को 40C पर बनाए रखा जा रहा है एक प्रमुख घटक विश्लेषण (पीसीए) ने 32 आइसोलेट को जिनोमिक डाटा के आधार पर अलग-अलग समूहों में विभाजित किया गया 2014 की प्रविष्टियों में शीत ब्लाइट के खिलाफ 139 सहिष्णु लाइनों की पहचान की गई, जिन्हें परिस्थितियों में कृत्रिम रूप से जांच गया था।

क्रोमोसोम11 में ISM/WZK RILs आबादी के पांच प्रमुख शीथ ब्लाइट क्यूटीएल की पहचान की गई और एसएनपी ज़ीनोटीपिंग के माध्यम से सहिष्णुता से जुड़े एक प्रमुख क्यूटीएल की पहचान क्रोमोसोम 3 में की गई।

म्यान के खिलाफ दो बार कवकनाशी ड्रोन उपयोग 15 दिनों के अंतराल पर झुलसा रोग में 54% रोग नियंत्रण दर्ज किया गया।

आलू सुक्रोज में यू, वीरेन प्योर कल्चर के 200 आइसोलेट को 40 C पर बनाए रखा जा रहा है।

आईआईआरआर की कृत्रिम फाल्स स्मट स्क्रीनिंग सुविधा का उपयोग करते हुए 957 प्रविष्टियों की जांच की गई और100 विभिन्न प्रविष्टियों को फाल्स स्मट के प्रति सहिष्णु के रूप में पहचाना गया अट्ठासी यू वेरेंसिसोलेटस की आणविक परिवर्तनशीलता ने अनुवांशिक परिवर्तनशीलता के अस्तित्व का खुलासा किया और भौगोलिक दूरी के आधार पर कोई विशिष्ट समूहन नहीं था।

बाइपोलरिस ओरेजा के 30 आइसोलेट पश्चिम बंगाल और तेलंगाना राज्यों में एकत्र किए गए थे और बाइपोलैरिस के कुल 50 आइसोलेट को शुद्ध कल्चर के रूप में बनाए रखा जा रहा है।

1550 प्रविष्टियों की ब्राउन स्पॉट रोग और 52 प्रविष्टियों की कृत्रिम रूप से जांच की गई प्रतिरोधी/ मध्यम प्रतिरोधी के रूप में दर्ज किया गया।

पुष्पगुच्छ और पत्ती आवरण के बीच बीज में शीत रोड रोगजनक इनोकुलम को गुना करने से उच्च रोग घटना होती है तना सड़न रोग के कृत्रिम प्रेरण के लिए टाइफा लीफ बीट विधि आशा जनक थी।

राज्य के विभिन्न जिलों से के 84 नमूने एकत्र किए गए थे जिनमें से 38 को पृथक किया गया था और पृथक एस एच आर 79 की विषाणु के रूप में पहचान की गई थी।

पांच अलग-अलग सांद्रण पर तना सड़न रोग जनक के विरुद्ध इन विट्रो मैं 12 अनु का परीक्षण किया गया मैनकोज़ेब 63%+ कार्बेंडाजिम 12% डब्ल्यूपी और टैबू कोना जोल 250 इसी ने सभी परीक्षण किए गए सांद्रण ऊपर अवरोध दिखाया।

स्क्रीन की गई 1749 लाइनों में से 77 प्रविष्टियों को कृत्रिम रूप से प्रतिरोधी के रूप में पहचाना गया चावल वायरस रोग के खिलाफ जांच की गई।

अंबाला, यमुनानगर, करनाल, कुरुक्षेत्र, पंचकूला, सोनीपत, कैथल, पानीपत और जींद जिलो मैं चावल का बोना रोग देखा गया रोग की घटना 2 से 10% तक भिन्न थी।

संभावित एसपीपी स्टेम रोट रोग जनक के खिलाफ पहचान की गई और अनुक्रम और अनुक्रम NCBI जीन बैंक डेटाबेस (पुतिदा PIK 1 एचएसएन नंबर स्टैंड रोड स्क्लेरोटियम हाइड्रो फिल्म एक्सेस नंबर मैं जमा किए गए ट्राइकोडरमा स्पेशल हम बेसिलस सिउड़ो म दिनों

से याद कर रहा है आपको झारे नहीं आ रही कहां गएना स्कूटी डा सोमनाथ एसपी के जारी फाइटोहार्मोस पृथक की पहचान की गई और मात्रा निर्धारित की गई तीनों बायो एजेंट में प्रमुख हार्मोन IAA का पता चला था।

प्रौद्योगिकी और परीक्षण का हस्तांतरण

मध्य प्रदेश के 10 गांव को कवर करने वाले 200 चावल किसानों के साथ जलवायु परिवर्तन और चावल की खेती पर किए गए एक खोजपूर्ण अध्ययन ने दतिया जिले में किसानों की अनुकूल क्षमताओं के आधार पर उनकी अनुकूलन रणनीतियों का दस्तावेजी करण किया स्मार्ट गांव परियोजना के हिस्से के रूप में जैविक संशोधनों और नियमित निगरानी के तहत किसान 24 क्विंटल/ एकड़ फसल पाकर बहुत खुश थे पाइथन सॉफ्टवेयर - आधारित सांप और सीढ़ी का खेल किसानों के बीच अच्छी कृषि पद्धतियों (GAP) का प्रसार करने के लिए डिजाइन और विकसित किया गया।

एफपीओ हित धारकों की आवश्यकता के आकलन के आधार पर, सदस्य किसानों की विस्तार और सलाहकार सेवा आवश्यकताओं को पूरा करने के लिए चयनित एफपीओ के लिए विस्तार और सलाहकार सेवा मॉड्यूल को अनुकूलित और विकसित किया गया था।

बेहतर चावल उत्पादन तकनीक पर आर्थिक और ऊर्जा दक्षता अध्ययन पता चला कि नियंत्रण भूखंडों की तुलना में उच्च लाभ से लागत अनुपात के साथ प्रदर्शन भूखंडों के तहत चावल का उत्पादन अधिक लाभदायक था आईपी प्रौद्योगिकियों के ऑन फॉर्म अंगी करण और प्रभाव विश्लेषण अध्ययन के तहत, मिट्टी परीक्षण आधारित पोषक तत्व प्रबंधन और आवश्यक तेलों सहित स्थानीय रूप से अपनाने योग्य आईपीएम घाटकोपर प्रशिक्षित किसानों पर हस्तक्षेप, जिसके परिणाम स्वरूप महत्वपूर्ण आईपीए म प्रथाओं को अपनाया गया, उच्च उपज और उच्च उपज के लिए अग्रणी और रासायनिक स्प्रे की संख्या कम कर दी एम मॉडल विकसित करने के लिए सर्च आधारित बायसी एनएमटी करनैल विधियों का उपयोग किया गया था पारंपरिक रिज प्रतिगमन और मॉडल के साथ करनैल आधारित बायसीएल मॉडल की तुलना करने पर, गौ सीयन करनैल विधि ने बेहतर प्रदर्शन किया पारंपरिक बायसीएल रिज और जी बी ए ल यू पी मॉडल के बिना इंटरेक्शन वाले मॉडल से बेहतर प्रदर्शन किया।

कंप्यूटर अनुप्रयोग

एफ ए ओ मिट्टी ग्रिड सी मिट्टी की मिट्टी, रेप थोक घनत्व और कार्बनिक कार्बन पर मिट्टी की परतें डाउनलोड की गई इन परतो को संसाधित किया गया और अन्य मापदंडों के साथ मिट्टी की मिट्टी की परत एक परत से मिला दिया गया मिट्टी के मापदंड को चावल डीएसएस के साथ उपयोग करने के लिए प्राप्त किया गया।

All India Coordinated Research Project on Rice (AICRPR)

Crop Improvement

- A total of 61 varieties including 4 Hybrids and 57 varieties for different ecologies have been released by both central and state varietal release committees (Central-28; state-33) during 2022.
- Forty eight varietal trials and four hybrid trials were conducted in 944 experiments (810 varietal and 134 hybrid rice) at 123 locations (45 funded, 78 voluntary centres) in 28 states and 2 union territories across seven zones of the country during 2021.
- The trials were constituted with 1492 entries (1392 varietal and 100 hybrid rice) including 189 checks, 21 promising lines were identified including 3 hybrids.
- A total of 36 proposals including 32 varieties and 4 hybrids were considered by Varietal Identification Committee (VIC) and 34 entries including 31 varieties and 1 hybrid were identified.
- A total of 4449.06 quintals of Breeder seed was produced against a DAC indent of 3598.67 quintals involving 305 rice varieties from 49 centres across the country.

Crop Production

Agronomy

- A total of 245 were experiments were conducted at 45 locations consisting of evaluation of 132 promising cultivars belonging to 18 groups for their response to integrated nutrient management at 50 and 100% recommended dose of fertilizer (RDF).
- In addition, six trials on cultural management, four trials each on weed management and three in rice based cropping systems and climate resilient agriculture were taken up.
- Most of the trials were collaborative trials with Soil science (2), Entomology (2) and Pathology (2) while all nutrient management trials were in collaboration with Plant Breeding to develop cost effective cultivars and technologies in rice and rice based cropping systems.

Soil Science

- A total of eight trials were conducted in 18 locations representing typical soil and crop systems and important rice growing regions.
- In the 33rd year of study on long term soil fertility management in RBCS, the treatment RDF + FYM resulted in maximum grain yield at all 3 locations and significantly superior to RDF at Mandya during *kharif*. FYM alone treatment was on par to RDF during *kharif* at Mandya.
- Soil quality index calculated from pooled data of soil parameters indicated variations in the quality and health of soils across farmer's categories.
- Zinc uptake both in grain and straw was high in genotype MTU 1001 (1513 and 3795 g ha^{-1}, respectively) in sodic soils when nano Zn formulation was tested.
- The acid tolerant genotypes Shreyas, Uma, ARRH-7576 and Sharboni were found promising and application of NPK (RD) + Silixol spray recorded significantly higher grain yield.
- The results showed that the crop residues can be applied to substitute a part of the recommended nitrogen without any yield penalty.
- The varieties, ARRH7576, Varadhan, CNN5 and CNN3 recorded the maximum yields and nitrogen use efficiency at most of the locations.
- The software, Nutrient Expert based fertiliser application showed differential responses; insignificant responses in Maruteru-*Rabi* and significant effects in Maruteru-*Kharif* in both grain and straw yields and uptake of elements.
- In organic rice cultivation, 50% N (FYM) + 50% N (Green manure/Green Leaf Manure) was significantly superior to other treatments in terms of grain yield and yield parameters at Khudwani and at Chinsurah most of the soil properties improved with 100% N (FYM) organic treatments compared to other treatments.

Plant Physiology

- Physiological studies under AICRPR were constituted in six trials at eight funded centres, two ICAR institutions and six voluntary centres.

- Silicon application increased mean grain yield by 5% and the best performing entries were 27P63, DRR Dhan-48, Sahabhagadhan and US-312.
- The genotypes IL-19072, IL-19081, IL-19082, IL-19132 and WGL-14 were identified as relatively drought tolerant genotypes suitable for rainfed cultivation based on grain yield.
- Under heat stress, genotypes IET29943, IET29946, IET22946, 29947, 29948, IET29949, IET29952, IET29956 and IET29958 performed better with higher yield and stability.
- CR-2862-IC-10 was found to be tolerant to multiple abiotic stresses (Anaerobic germination, salinity and osmotic), IET-27051, CR-2862-IC-10 and Dular were tolerant to AG and osmotic stresses; AC43037, CR-3818-IC-225, CR-2862-IC-10 were tolerant to salinity and osmotic stresses.
- AC43025, Dular, NPS17 and NPS18 showed more than 70% survival under 14 days of complete submergence and may be used as potential donors for improving submergence tolerance trait.
- Based on grain yield, amongst the tested entries IET28276 and IET29031 show relative tolerance to low light stress.

Crop Protection

Entomology

- Seven major trials involving 268 experiments were conducted at 38 locations spread over 21 states and 2 Union territories.
- Evaluation of 1562 entries against 13 major insect pests in 182 valid tests resulted in identification of 80 entries as promising against various insect pests.
- Aganni (*Gm8*), INRC 3021 (*Gm8*), W1263 (*Gm1*) and Kavya (*Gm1*) were found promising against gall midge. The donors with *Gm8* and *Gm1* gene and INRC 17470 (new donor) confer resistance to gall midge.
- Aganni (*Gm8*) holds promise at Jagityal, Ragolu and Warangal against gall midge when through single female progeny.
- PTB 33 (*bph2*+*Bph3*+*Bph32*+unknown factors), RP 2068-18-3-5 (*Bph33*(t)), Swarnalatha (*Bph 6*), T12 (*bph7* gene), Rathu Heenati (*Bph3*+*Bph17*), ASD 7 (*bph2*), Babawee (*bph 4*), IR 36 (*bph2*) and IR 64 (*Bph1*+), Chinasaba (*bph8*) and Milyang 63 were found promising against planthopper.
- The brown planthopper population at Gangavathi was more virulent than IIRR-Rajendranagar, Coimbatore and Ludhiana populations.
- Field evaluation of granular insecticides against gall midge revealed that seed treatment with thiamethoxam followed by application of fipronil 3% GR at 20-25 days after transplanting in the main field was most effective with significantly lower per cent silver shoots.
- Combination of neemazal, neem oil and triflumezopyrim treatment was found to effective against brown planthopper.
- The incidence of pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to SRI, aerobic rice and semi dry rice methods.
- The slow release pheromone blends of yellow stem borer, rice leaf folder and multispecies pheromone blend of leaf folder and yellow stem borer were found effective.
- Water management along with ecological engineering significantly reduced planthopper population compared to farmers' practice. The benefit cost was also significantly higher with ecological engineering and water management.
- Bio intensive pest management tactics were effective in suppressing insect pest damage with higher natural enemy population and higher yields.
- Grain yields were significantly high in IPM implemented plots due to effective management of insect pests, diseases and weeds resulting in high gross returns. Overall, benefit to cost ratios of IPM plots were superior to that of 'Farmers' Practices' due to better yields and lower input costs.
- Monitoring of insect pests by light traps revealed that yellow stem borer, leaf folder and planthopper continues to be the most important pests across the locations.

Plant Pathology

- 15 trials were conducted at 50 AICRPR locations on Host plant resistance, field monitoring of virulence of major rice pathogens and disease management.
- 74 entries were found as moderately resistant to two to four diseases across the tested locations of 1449 entries were evaluated.
- Field monitoring of virulence of *Pyricularia grisea* revealed a change in the pathogen virulence.
- Differentials possessing single bacterial blight resistance genes like *Xa1, Xa3, Xa4, xa5, Xa7, xa8, Xa10, Xa11* and *Xa14* were susceptible at most of the locations.
- The incidence of leaf blast was found to be more in the late sown crops when compared to the early and normal sown crops. Incidence of sheath blight and Bakanae, was found to be more in the early sown crop and incidence of sheath rot was more in late sown crops.
- Fungicides kitazin 48% EC (1.0 ml/L) and isoprothiolane 40% EC (1.5 ml/L) were effective against the leaf blast. Isoprothiolane 40% EC (1.5 ml/L) was effective against neck blast and Thifluzamide 24% SC (0.8 g/L) and difenoconazole 25% EC (0.5 ml/L) effective against sheath blight. Difenoconazole 25% EC (0.5 ml/L) was effective in reducing sheath rot and brown spot. Tebuconazole 25.9% EC (1.5 ml/L) showed broad spectrum activity against sheath blight, sheath rot, brown spot and blast.
- Seed treatment with carbendazim @2g/kg and a spray of 0.4 g/L of trifloxystrobin 25%+ tebuconazole 50% most effectively decreased the severity of major rice diseases. Across the locations, seed treatment and spraying of bio-control agent at 15-20 DAT (10 g/L) along with one spray of propiconazole (1 g/L) at the booting was effective against leaf, neck blast, sheath blight and sheath rot.
- IPM practices reduced incidence of leaf blast, neck blast, sheath blight, false smut and bacterial blight diseases.
- A disease index of 33.3-62.6% caused a yield reduction of 17.8-48.1% for leaf blast; 38.8-67.2% caused a yield reduction of 23-51% for Sheath blight and 56-83% caused a yield reduction of 11-25% for BB.
- Puddled direct seeded method was found promising in reducing neck blast and sheath rot diseases and manual transplanting reduced grain discolouration and sheath rot but increased sheath blight. In Chinsurah, manual transplanting has showed maximum sheath blight incidence when compared to puddled direct seeded plants.

Production Oriented Survey

- Survey was conducted in 98 districts of 14 states.
- Hybrid rice varieties occupied a significant area in states like Uttar Pradesh, Haryana, Gujarat and Bihar and its area is increasing in states like Karnataka and Maharashtra.
- The intensity of bacterial blight was severe in Andhra Pradesh and Telangana while blast, brown spot and grain discolouration was more in Jammu and Kashmir.
- Insect pests such as, stem borer, leaf folder and panicle mite were very widespread in Telangana State and bloodworm problem was noticed in Cauvery command area

AICRIP Experimental Database –http://www.AICRIP-intranet.in

- During this year above 75% of centres uploaded data through AICRPR Intranet. Analysis modules of state and zonal reports of plant breeding and hybrid rice were refined as per the new proceedings of 57th ARGM.

Lead Research

Crop Improvement

Plant Breeding

- DRR Dhan 65 (IET No. 27641) a high yielding low phosphorus tolerant variety released for cultivation in Andhra Pradesh, Telangana, Chhattisgarh and Punjab.
- Germplasm comprising of landraces were evaluated and two genotypes GM-3 (Binnidhan)

and GM-86 (Selection from Maharashtra) was identified to have BPH resistance along with high zinc content (>25PPM) and used as donors in breeding programme.

- 16-141, Sw-22-01, Sw-22, Sw-22-07 and RP6252-BV/RIL-BV228 and NSR -101 were found promising in two station trials.
- DRR Dhan 54, DRR Dhan 47, Jaya, Rasi, DRR Dhan 39, Improved Samba Mahsuri, DRR Dhan 50 and DRR Dhan 60 were identified superior donors for yield.
- A novel gene tentatively designated as WBPH13(t) on Chromosome 2 at a 0.53Mb region flanking SNP marker C2_24136056 and SSR marker RM13606 from a RIL mapping population derived from Swarna/ Sinnasivappu.
- Genotypes with high grain protein content was identified *viz.,* JAK16, JAK47, JAK75, JAK686, JAK713). Highest lysine, methionine, cysteine contents were identified through amino acid profiling in JAK16 (5.61 g/100g protein), JAK686 (9.52 g/100g protein) and JAK 686(8.49 g/100g protein) respectively.
- Promising introgression lines for weed competitiveness *viz.,* IL 40-2, IL 179-2, IL 48, IL 143, IL 23-2, IL 80 and IL 80-2 were identified in BC1F7 population derived from IR64*1/*Oryza glaberrima* and further backcrossed with IR64 to develop F_2 populations. Genotypes Khao Hlan On (KHO), D14 (NIL possessing AG QTLs) were identified for anaerobic germination.
- MAGIC populations involving parents with desirable traits such as heat tolerance, seedling and reproductive salinity tolerance, nutrient use efficiency, flood tolerance and yield enhancing genes *Gn1, SCM2* and *OsSPL14* and standardized the phenotyping methodology for reproductive salinity tolerance were developed.
- Advanced breeding lines *viz.,* JBB 5952, 5960, 5962, 5964, 5966, 5967, 5973 were identified with high grain number (320-472) during *kharif* 2022.
- Promising low P tolerant genotypes 16-302, PN 42-16, F5 MSAC 23-31, 16-518 out of 350 germplasm lines were identified. Rasi x Improved Samba Mahsuri populations was phenotyped at low P and normal conditions.
- 101 coloured rice germplasm were collected and were characterized for agro-morphological and yield related traits and 15 crosses were made using selected speciality rices.
- *Os03go103400* which encodes GRAS transcription factor was identified as the causative gene for grain weight increase with a PVE of 48% in Swarna/ *Oryza nivara* back cross introgression population.
- Promising donors *viz.,* RP Bio 4918-224, RP Bio 4918-228-1 with tolerance to gall midge, RP Bio 4918-269 and RP Bio 4918-230 with multiple pest resistance and NPS19-1, NPS56-2, NPS58-1 and NPK77-3 with bacterial blight resistance from Swarna/*O. nivara* and RP Bio 491- NSR10 and RP Bio 491- NSR88 with tolerance to stemborer from KMR3/ *O. rufipogon* lines were identified.
- New crosses were attempted and advanced breeding lines were evaluated for aroma related traits using Ketkijoha, TCVM-1, GAR1, Jeerabattis, BRRI Dhan75, Pusa Basmathi 1121, Dhanguri, HUR 4-3.

Hybrid Rice

- 17 hybrids (central releases-16; state releases-1) were released and notified by CSCCSN&RV for commercial cultivation in different zones.
- Seven hybrids *viz.,* IIRRH 150, IIRRH 151, IIRRH 152, IIRRH 153 (IHRT-E); IIRRH 148, IIRRH-154 (IHRT-ME); IIRRH 154 (IHRT-M) were nominated to AICRPR trials.
- The two best hybrids PUSA 5A X IJD13 and PUSA 5A X IJD13 were identified.
- DRRH 4 (IET 27937), worlds first public bred aerobic hybrid was released and notified (S.O. 4065(E). dt 31st Aug, 2022).
- DRR Dhan 64 [IET 28358 (RP 5599-212-56-3-1)], an early maturing (115-120 days) and N use efficient rice variety (S.O. 4065(E). dt 31st Aug, 2022.) with multiple disease resistance was released.
- RP6338-9 (INGR22065) an improved heat tolerant restorer and RP5593-83-12-3-1 (INGR22102) a sodic/acidic/aerobic adapted restorer line was

registered with Plant Germplasm Registration Committee (PGRC), ICAR -NBPGR.

- The improved restorer lines with multiple stress (BLB, blast, sheath blight, BPH, GM & drought, salinity, low P) resistance/tolerance were genotyped with the help of SNP markers and lines having multiple stress tolerance genes were identified.
- 350 test crosses were evaluated and identified 65 maintainers which includes TCP 3901, 3905, 3912, 3916, 3921, 3922, 3924, 3927, 3959, 3966, 3970, 3971, 3972, 3974, 3980, 3981, 3984, 3987.

Biotechnology

- A set of genetically divergent restorers were identified from the recombinant inbred lines derived from a cross between parents of the elite rice hybrid KRH2 with the help of markers. Genetically diverse high and low yielding RILs were crossed with the female parent of KRH2, i.e. IR58025A, to test their fertility restoration ability and heterosis in the hybrids. Novel hybrids derived from the high yielding RILs, namely RIL-1, RIL-12 revealed significant positive standard heterosis for total grain yield/ plant over the checks. RILs, which had higher proportion of KMR3R genome were observed to show significantly higher heterosis than KRH2. A strong correlation was observed between the SNP score and yield heterosis of the novel hybrid.
- DRR Dhan 66, a high-yielding, long-slender grain type rice variety, highly tolerant to low soil phosphorus conditions, was developed, released and notified through CVRC. It can grow and yield normally even at 40% application of the recommended dose of phosphatic fertilizers. DRR Dhan 66 is a NIL of the mega-variety, MTU1010, possessing the major QTL associated with tolerance to low soil phosphorus, *Pup1.*
- In collaboration with PJTSAU and ANGRAU, WGL1487, a high-yielding, long-slender grain type rice variety, which is highly tolerant to low soil phosphorus conditions was developed and released through CVRC. WGL1487 is a NIL of the popular variety of Andhra Pradesh, MTU1121 and possesses *Pup1.*
- Identified, fine-mapped, cloned and characterized a major bacterial blight resistance gene, *Xa48t* located on Chr. 11 from an introgression line of *O. officinalis.*
- A breeding line, IET 30261 derived from the cross, MTU1121*2/ Swarna possessing low nitrogen stress, showed promise in Low nitrogen trial (LNT) trial of AICRPR and was promoted to second year of testing.
- A breeding line in the genetic background of the mega-rice variety, improved Samba Mahsuri, IET 30084, possessing the yield enhancing genes, *Gn1a* and *OsSPL14* has been promoted to AVT1-MS in Zone VI. Another breeding line of Improved Samba Mahsuri possessing the yield enhancing genes has been promoted to AVT1-MS in overall basis and also in Zone III and Zone VI.
- Genome wide association study (GWAS) of Rice Diversity Panel 1 comprising 188 genotypes using 5.2M SNP data identified marker-trait associations for grain filling % total (GFTOT) on chromosome 3. Candidate genes underlying the QTLs within in the linkage disequilibrium (LD) of 205kb were explored for GFTOT. The candidate gene *LOC_OS3g62720* was found to be involved in seed development stages.
- A novel chitinase *OS10G0416500* was cloned from Tetep and over-expressed in Taipei309. The over-expression transgenic lines showed significant reduction of sheath blight diseases.
- An integrated approach of combining linkage mapping, QTL seq and RNA-seq for complete panicle emergence (CPE) using the BPT 5204 EMS mutant line CPE 109 and wild type parent BPT 5204 revealed the genomic regions 5.45 Mb and 3.06 Mb on chromosomes 4 and 12 respectively, 12-12 SNP marker and AP2/ethylene-responsive element binding protein as a candidate gene governing CPE. The mutant lines *viz.*, SM92, SM74, SM72 and SM48 were found to be promising for yellow stem borer resistance; mutant derived line SP-M_MS-70 (with zero score) was found to be tolerant to brown planthopper. Twenty Samba Mahsuri mutant lines and their derivatives are in the national trials of AICRPR.

- Long non-coding RNA sequencing has been executed using the Illumina NovaSeq 6000 chemistry in the mutant line having high seedling vigor, robust root system architecture TI-128, flooding adapted mega variety, BPT-5204 and aerobic adapted variety, CR Dhan 202.

Crop Production

Agronomy

- Among the systems of cultivation, mechanised SRI method required lowest amount of water (11.61% and 13.21% less of mean applied water than drum seeding and normal transplanting respectively). DRR Dhan 43 recorded higher water productivity as well as WUE as compared to other cultivars.

- DRR Dhan 43 (long and bold grain type) or NLR-34449 (fine grain type) cultivars of rice were promising under SRI or drum seeding method of sowing with alternate wetting and drying irrigation system for higher yield and economic returns.

- The weed population and weed biomass were recorded lower in the treatments of Pyrazosulfuron ethyl 70% WDG @21g a.i./ha fb Penoxsulam+ cyhalofop butyl @150 g a.i./ha at 25-30 DAS; followed by Pyrazosulfuron ethyl 70% WDG @21g a.i./ha fb Triafamone 20% + Ethoxysulfuron 10% WG @67.5 g a.i./ha at 25-30 DAS.

- Pooled analysis revealed that the conventionally tilled rice–maize system resulted in a similar system productivity as that of the conservation agriculture (CA) during the study period. The cost–benefit analysis revealed that transplanted rice and conventionally tilled maize fetched higher net returns of Rs. 1,11,074 and Rs. 1,01,658/ha, respectively, over the direct-wet seeded rice and CA.

- The CA-based rice–maize system resulted in a significantly higher very labile (0.194%) and labile (0.196%) carbon concentration at a 0-5 cm depth of soil compared to those under the conventional system.

- DRR Dhan 42 produced significantly higher grain yield (6.49 t/ha) than MTU 3626 (6.08 t/ha) and IIRRH 124 (6.15 t/ha).

Soil Science

- High Nitrogen Use Efficiency (NUE) rice varieties identified were BV1704, Nidhi, Tella Hamsa, PSV 344, PSV 181 and PUP 221. Out of 190 BAAP entries tested, the top five entries based on grain yield at N-50 level were: 39-BAAP-81(CHHOLA BORO (2) G1); 126- BAAP-199 (DULA AUS IRGC 49180-1); 180- BAAP-266 (DHALI BORO 105-2 IRGC 29314-1); 133- BAAP-210 (JATI AUS IRGC 34940-1) and 8-BAAP-13 (SADUCHO). Improved N sources such as N-(n-Butyl) thiophosphoric triamide (NBPT) and Allicin recorded a yield increase over NCU and NUE was significantly higher with NBPT1000 ppm.

- Methane emission decreased by more than 40 per cent in SRI and by 49 and 54 per cent in AWD at 5 and 10 cm, respectively, as compared to NTP. N_2O-N emission was higher by 28 per cent in SRI and 33 and 47 per cent in AWD at 5 and 10 cm, respectively, over NTP. AWD and SRI methods lowered the global warming potential due to lower methane emissions.

- Multi-date MODIS Terra data spanning over six water years starting from 2016-17 was used to create Time Series Analysis using TIMESAT. Twelve first approximation digital soil themes were generated by interpolation techniques from the soil health cards pertaining to Telangana State after the curation of about 112000 soil health cards.

- 1400 samples were collected from Maheshwaram, Kadthal, Kandukur and Amangal Mandal in the Rangareddy district of Telangana state to develop soil nutrient maps. The major area of the soil tested in the study area was sandy (4034 acres), followed by Loamy (884 acres) and Clay (398 acres) and the major colour of the soil is red followed by brown.

- The metabolome of the Amycolatopsis orientalis IIRRACT9, a rare actinomycete genus was studied, to identify bioactive metabolites. Bioactive compounds identified in the culture supernatant included antibacterial, antifungal and antihelmentic metabolites. Gibberellins and siderophores with the potential for plant growth promotion were also produced by the isolate. In addition, antitumor and antiviral metabolites were also detected in the metabolome.

- 35 nitrogen fixing bacteria were isolated on N- free media and 12 unique morphotypes were purified and evaluated for nitrogenase activity through Acetylene Reducing Assay (ARA) and 3 potential phosphorus solubilising (PSB) microbes were isolated. Deposited PSB cultures in the National Agriculturally Important Microbial Culture Collection (NAIMCC), ICAR-NBAIM, Mau. The Illumina MiSeq based 16S rRNA gene amplicon metagenomics analysis of rice rhizosphere soil was carried out.
- Two sprays of ZnSO4 registered the highest grain yield (4.59 t/ha) followed by nano ZnO @ 250 mg L-1 (4.39 t/ha). Significant improvement in Zn content (35.1 mg/kg) in straw was observed with the application of nano ZnO @ 150 mg/ kg followed by 0.5% ZnSO4 (26.9 mg/kg). Increasing concentrations of nano ZnO to 500 mg/L has registered a higher SOD (25.7 U/min/g wt), CAT (87.3 H_2O_2 reduced/min/g wt) and POX (2.7 µmol tetra guaicol formed/min/g wt), respectively compared to lower concentrations.
- Application of 40 kg P in combination with phosphorus solubilizing bacteria (PSB) resulted in the highest number of tillers/m^2 (442), panicles/ m^2 (405), grain yield (5.7 t/ha) and straw yield (7.7 t/ha) as compared to the other treatments. Application of coated phosphorus fertilizers registered higher agronomic efficiency than their respective uncoated treatments.

Plant Physiology

- Silicon application under water stress situation improved tolerance to abiotic stresses.
- Based on preliminary observations few genotypes such as Blackgora, E MOOM, IRGC-132252, IC-438644, IC-124667, IC-124667, IC-44975, ADAYSEL, RASI, BAKAL, VANAPRAVA were found to be highly tolerant to heat stress at reproductive stage having spikelet fertility more than 80%.
- Accelerated ageing treatment appears promising, to follow the ageing related changes in rice grain in less time in comparison with natural ageing.

Computer Applications

- In continuation to fabricating weather sensors, Python programs were developed to publish the data from sensors in Google Sheets and Nutrient requirement module was validated with long term soil fertility experimental data of AICRPR using Quantitative evaluation of the fertility of tropical soils (QUEFTS) model.
- Soil layers on soil clay, sand, bulk density and organic carbon from FAO soil grids (https://soilgrids.org) were downloaded. These layers were processed and soil clay layer along with other parameters were merged into one layer and soil parameters were derived to use with Rice DSS.

Agricultural Engineering

- A soil puddling machine was fabricated using 1.0 hp electrical 3 phase motor and stand with a specially designed tool for puddling in a drum

Agricultural Chemicals

- Neutral silica, the preparation of which was reported earlier, tested (under Seed AICRP) on storage insects with different concentrations for their control. Neutral silica @ 1500 ppm was found most suitable for control of storage pest.
- Methodology developed for improving nitrogen content to 41.02% in hydrogel based slow releasing urea.
- At 100% RDN, in comparison of neem coated urea, urea coated with hydrophobic silica has grain yield advantage of 1867 kg/ha, straw yield advantage of 1167 kg/ha and has advantage in number of productive tillers by 17/m2.

Crop Protection

Entomology

- Eucalyptus oil and insecticide dinotefuran 20% SG found to exhibit joint action against brown planthopper.
- Slow releasing cake formulations of essential oils were effective against yellow stem borer

and granivorous birds under field conditions. Similarly, these formulations were highly effective against stored grain pest, lesser grain borer.

- Three genotypes, LD24, Khao Pahk Maw and Suraksha were found resistant to rice root knot nematode.
- The total nematode abundance was more in alternate wetting and drying system (AWD) compared to the normal transplanting (NTP) system. However, the abundance of rice root nematode *Hirschmanniella spp.* was less in AWD system compared to the NTP System. In aerobic cultivation mulching with paddy straw and in situ green manuring with cowpea and herbicide application suppressed plant parasitic nematodes.
- Symbiotic bacteria *Photorhandus luminescence* and *Xenorhabdus nematophila* isolated from *entomopathogenic* nematodes *Heterorhabditis indica* and *Steinernema glaseri* respectively, inhibited the growth of fungal pathogens *Rhizoctonia solani* and *Fusarium* in dual culture plates.
- Cultivar TKM 6, in addition to being resistant to stem borer also had a favourable chemical ecology for parasitoids recruitment. The parasitoid *Trichogramma japonicum* preferred stem borer infested plants over healthy plants with a significantly higher preference towards BPT 5204 followed by PB 1 in Y- tube olfactometer assays.
- Presence of nectar producing flowering plants border alone contributed to 44.97 per cent parasitism. A significant increase in parasitism (18.19%) was observed by combining methyl salicylate application and providing nectar producing flowering plants along the bunds.
- A new insecticide molecule, ME5382 2% GR @150 g a.i. per ha. resulted in highest reduction (72.58%) in dead hearts formation by yellow stem borer infestation. With respect to white ears, chlorantraniliprole 0.4% GR + thiamethoxam 1.00% GR applied twice, at vegetative and reproductive stages of the crop growth was found superior with 66.84 per cent reduction over control.
- Toxicity of pymetrozine to brown planthopper was monitored in nine field populations from Telangana, Andhra Pradesh and Karnataka. Resistance ratios were in the order of Warangal (10.4 to 15.1) > Maruteru (6.2 to 6.8) > Raichur (3.4) > Nalgonda (1.1 to 1.6).
- The BPH resistant mutant, NH 4631 showed highly significant expression of the defensive genes and its photosynthetic efficiency was not adversely affected by BPH infestation.
- Screening of germplasm lines for gall midge resistance identified the resistant lines, JGL 11727 and Sukaradidhan1 with HR+ reaction and CR 2615-1 and JGL 11470 with HR-reaction post biotype 1 infestation.
- Cut stem assay for yellow stem borer with neonate larvae on RP5588, RP5587, SM92 and its derived line RP6112-MS-M-R-41, RP4919, Sasyasree proved antibiosis as the component of host plant resistance.
- 26 BILs were identified as resistant to rice leaf folder with a damage score of 1.0.
- Slow release pheromone formulations of yellow stem borer and leaf folder were found effective compared to normal formulations with higher moth catches.

Plant Pathology

- 799 out of 3539 lines were found as resistant against blast.
- One fungal (*Trichoderma asperellum* TAIK) and three bacterial antagonists (*Bacillus cereus* IIRR, *Bacillus xiamenensis* IIRR, *Bacillus subtilis* IIRR) from rhizospheric soil showed higher per cent antagonism against leaf blast pathogen ranging from 64.71 to 72.22% coupled with plant growth promoting activity.
- 113 out of 1121 entries were identified as resistant sources against bacterial blight. 14 resistance entries were identified, with a novel source of resistance.
- BB resistance of DRR Dhan 53 incorporated with *Xa21+xa13+xa5+Xa38* genes was demonstrated in the BB endemic areas of Telangana and Tamil Nadu.

- Ciprofloxacin and chloramphenicol performed well in reducing the disease severity of *Xoo* under glasshouse conditions.
- 270 sheath blight samples were collected from Punjab, Haryana, Uttarakhand and Karnataka. Around 300 isolates of *R. solani* and *R. oryzae sativae / R. oryzae* are being maintained at 4 °C.
- A principal component analysis (PCA) divided 32 *Rhizoctonia* isolates into three different groups based on genomic data.
- 139 tolerant lines against sheath blight were identified from 2014 entries screened artificially under field conditions.
- Five major sheath blight QTLs were identified from the ISM / WZK RILs population in chromosome 11 and through SNP genotyping a major QTL associated with tolerance, was identified in chromosome 3.
- Drone application of fungicide *azoxystrobin+ difenoconazole* twice against sheath blight at 15 days interval recorded 54% disease control.
- 200 isolates of *U. virens* pure culture are being maintained at 4 °C in Potato sucrose agar slants.
- 957 entries were screened using the artificial false smut screening facility of IIRR and 100 different entries were identified as tolerant against false smut.
- Molecular variability of fifty eight *U. virens* isolates revealed the existence of genetic variability and there was no specific grouping based on the geographical distance.
- 30 isolates of *Bipolaris oryzae* were collected from the states of West Bengal and Telangana and a total of 50 isolates of *Bipolaris oryzae* are being maintained as pure cultures.
- 1550 entries were screened artificially against brown spot disease and 52 entries were recorded as resistant/moderately resistant.
- Placing of sheath rot pathogen inoculum multiplied in seed between panicle and leaf sheath gave higher disease incidence. Typha leaf bit method was promising for artificial induction of stem rot disease.
- 84 samples of *S. oryzae* were collected from different districts of Telangana state, out of which 38 were isolated and isolate SHR 79 was identified as virulent.
- 12 molecules were tested in-vitro against stem rot pathogen at five different concentrations. mancozeb 63% + carbendazim 12% WP and tebuconazole 250 EC showed the maximum inhibition at all the tested concentrations.
- 77 entries out of 1749 lines screened were identified as resistant when artificially screened against rice tungro virus disease.
- The rice dwarf disease was observed in Ambala, Yamunanagar, Karnal, Kurukshetra, Panchkula, Sonepat, Kaithal, Panipat and Jind districts. The disease incidence was varied from 2 to 10%.
- Potential *Pseudomonas spp.* against stem rot pathogen was identified and sequenced and sequences were submitted to NCBI GenBank database (*Pseudomonas putida* - PIK 1 Accession No: ON778610, Stem rot – *Sclerotium hydrophilum* –SHPS 1 Accession No: OP480227).
- Phytohormones released from *Trichoderma asperellum* TAIK 1, *Bacillus cabrialesii* BIK3, *Pseudomonas putida* PIK1, *Pseudomonas sp.* isolate PF14 were identified and quantified. The major hormone IAA was detected in all three bioagents.

Transfer of Technology and Training

- An exploratory study on climate change and rice farming conducted with 200 rice farmers covering 10 villages of Madhya Pradesh documented the farmer's adaptation strategies based on their adaptive capacities, in Datiya district.
- As part of SMART village project, through organic amendments and under regular monitoring, farmers were very happy to harvest 24 q/acre. Python software-based snakes and ladders game was designed and developed to disseminate Good agricultural practices (GAP) among farmers.
- Based on need assessment of FPO stakeholders, Extension and Advisory Services modules were customized and developed for selected FPOs to cater the extension and advisory service needs of the member farmers.

- Economic and Energy efficiency study on improved rice production technology revealed that the production of rice under demonstration plots was more profitable with a higher benefit-to-cost ratio compared to that of the control plots.
- Under On-Farm Adoption of IPM Technologies and impact analysis studies, interventions on trained farmers on locally adoptable IPM components including soil test based nutrient management and essential oils that resulted in the increased adoption of important IPM practices, higher yield and leading to higher yield and reduced number of chemical sprays.
- Stochastic search-based Bayesian MT kernel methods were used to develop MTME models. On comparing the Kernel based Bayesian models with the conventional Ridge regression and GBLUP MT models, Gaussian kernel method outperformed conventional Bayesian Ridge and GBLUP MT models. The MTME models performed better than models with without G*E Interactions.

Introduction

Genesis

Mandate

Organizational Structure

Infrastructure

Linkages

Staff & Budget

Introduction

Genesis

The All India Coordinated Rice Improvement Project (AICRPR) was established in 1965 at Hyderabad, with the responsibility to organize multi-disciplinary, multi-location testing and develop suitable varietal and production technologies. AICRPR capitalized upon the available research infrastructure in different states of India and successfully introduced a national perspective in technology development and testing. AICRPR 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, AICRPR was started with 22 centres (19 main and 3 testing centres) with 7 zonal centres and 12 regional centres. During the fifth five-year plan (1974-79) the main and sub centres were classified as single cropped (24) and double cropped (21) centres. Except Pondicherry and Varanasi which were fully funded by the ICAR, the rest of the centres were financed in the ratio of 75:25 with State Agricultural Universities (SAUs – 25%) or 50:50 per cent basis with State Departments of Agriculture (SDAs – 50%). During VI plan period (1980-85), 8 more sub centres were sanctioned raising the total to 53. There was a total of 61 centres including 8 subject related special centres. In the VII plan period (1985-89) the number of centres was reduced to 50 (18 main and 32 sub centres. During the eighth plan (1992-97) there were 51 approved centres of which six centres were withdrawn and Karnal centre was merged with Kaul in the IX plan period (1997-2002). The total number of centres during X plan (2002-2007) increased to 46 with the approval of Kanpur and Nagina centres and to 47 during XI plan (2007-2012) with the addition of Navsari in southern Gujarat in western India. Two centres were dropped in XII plan due to poor performance. The Institute (AICRPR) has evolved into an efficient and successful program of partnership in rice research bringing together more than 300 rice researchers from 45 funded and over 100 voluntary research centres.

The Organisation

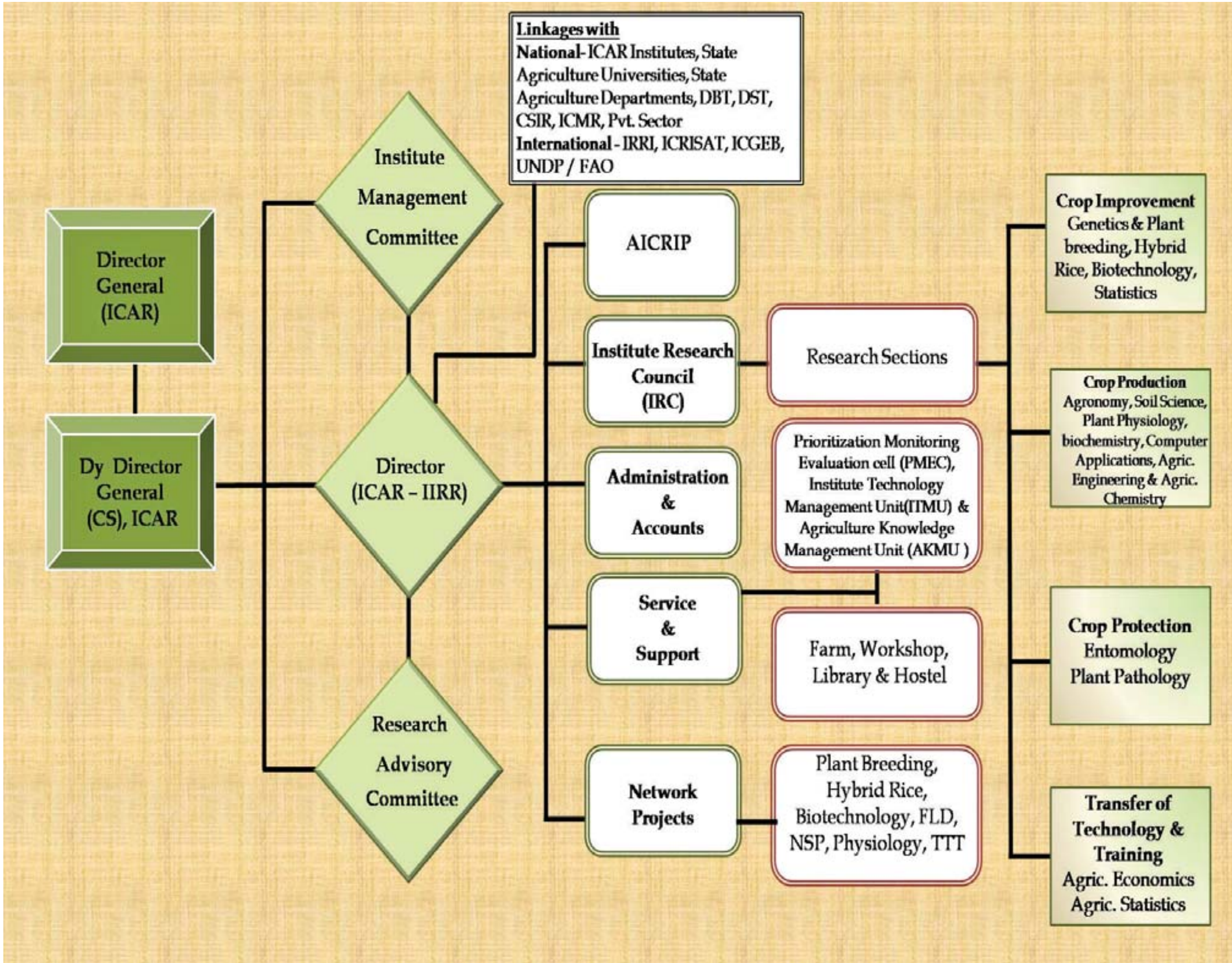
IIRR is an important constituent institute of ICAR under direct supervision of the Deputy Director General for Crop Sciences. The detailed organizational setup of the Institute is provided in the organogram. For fulfilling its mandate effectively, IIRR is organized into four sections and ten units along with centralized service wings and administration. AICRPR activities are integrated into the mandate with senior most scientists of each discipline acting as the PIs of the programme. There are 45 funded and more than 100 voluntary centres 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).

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

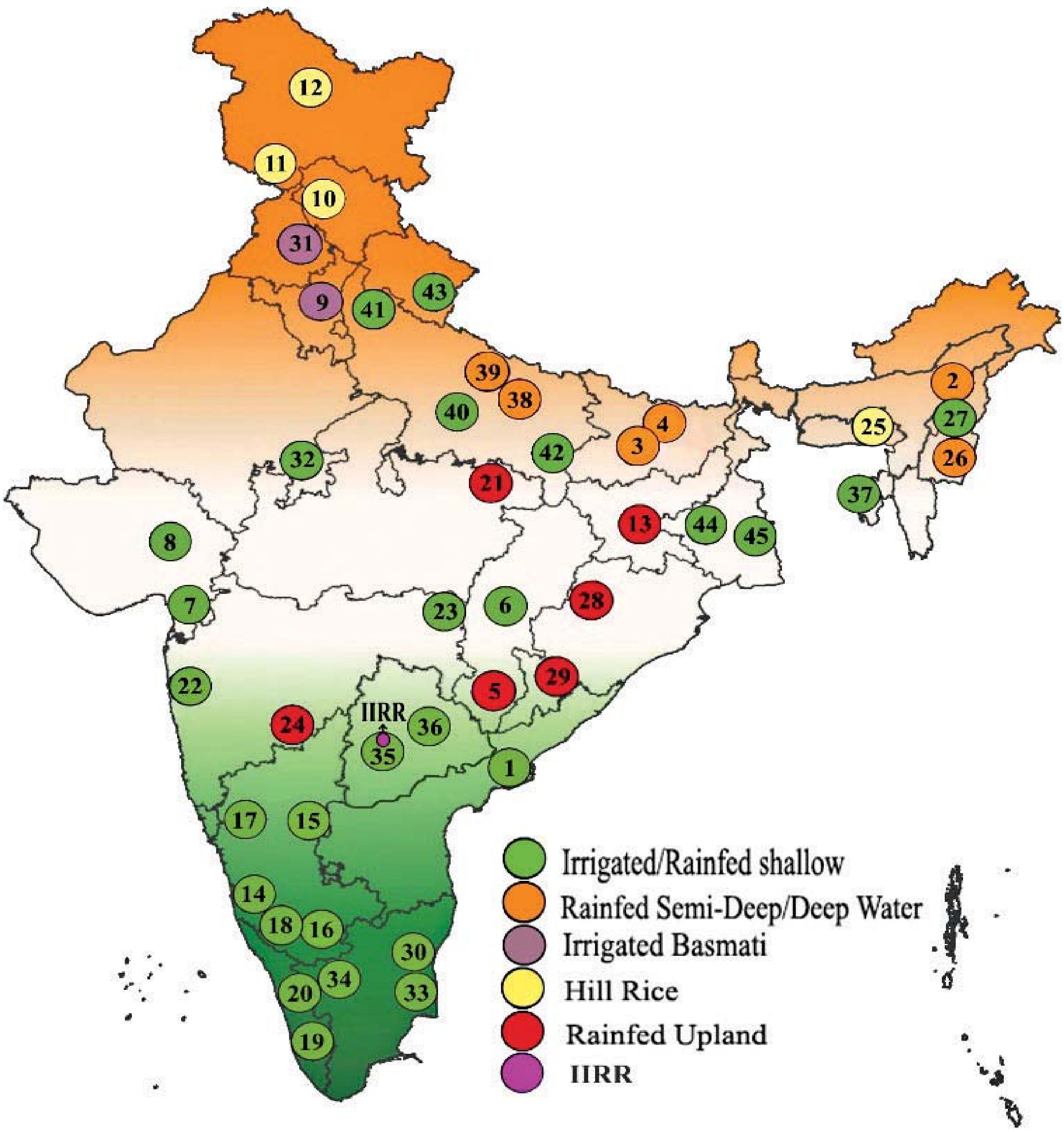
Dissemination of technologies, capacity building and establishing linkages



Organogram of the ICAR-IIRR

AICRPR - Funded Centres

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



All India Coordinated Research Project on Rice (AICRPR)

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 germplasms for resistance against pests and diseases, net-houses, growth chambers, screening nursery beds, containment transgenic poly-houses and heat tunnels. Field facilities include 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, warehouses and limited cold storage facilities. A centrally air-conditioned auditorium with a seating capacity of 350, seminar halls, guest house, hostel facilities and a canteen, have been established for imparting training and to disseminate information using the latest multi-media and ICT tools. The Central library of the institute is 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. AICRPR has 45 funded centres affiliated to State Agricultural Universities and Departments of Agriculture of 27 states and 2 Union territories, besides five ICAR institutes. About 90-100 voluntary centres are also 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, Hyderabad, NBAIR (Bengaluru), NBPGR, New Delhi (ICAR); PPV&FRA, New Delhi, IICT (CSIR), NIN (ICMR), Hyderabad, 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, Osmania University, University of Hyderabad, Jawaharlal Nehru Technological University, Yogi Vemana University, Kakatiya University, University of Agricultural Sciences, Bangalore, Acharya Nagarjuna University, Sanskriti 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

As on 31st March, 2022

S. No.	Category	Sanctioned	Filled	Vacant
1	Director	1	1	0
2	Scientists	66	65	1
3	Administration	36	19	17
4	Technical	42	30	12
5	Supporting Grade	47	43	04
	Total	**192**	158	34

The Budget (2021-22)

(Rupees in lakhs) As on 31st March, 2022

Item	2021-22	
	Outlay	Expenditure
IIRR, Hyderabad	4397.30	4396.72
AICRP on Rice, Hyderabad	3894.59	3894.50

Introduction

Research Achievements

Coordinated Research

Crop Improvement

New Varieties and Hybrids released

Crop Production

Agronomy

Soil Science

Plant Physiology

Crop Protection

Entomology

Pathology

All India Coordinated Research Project on Rice (AICRPR)

Crop Improvement

Coordinated varietal testing

ICAR-IIRR coordinated and conducted trials in collaboration with ICAR-NRRI and ICAR-IARI under Irrigated ecology, rainfed ecology and basmati trials respectively. A total of 48 trials (44 varietal trials and 4 hybrid rice trials) were conducted in 944 experiments (810 varietal and 134 hybrid rice) at 123 locations (45 funded, 78 voluntary centres) in 28 states and 2 Union Territories across seven zones of the country during 2021. Hybrid rice experiments were conducted by 10 private seed companies. The 48 trials were constituted with 1492 entries (1392 varietal and 100 hybrid rice) including 189 checks.

Breeder seed production of 305 rice varieties was organized at 49 locations as per the DAC indents. ICAR-IIRR also evaluated 59 candidate varieties, 65 Farmers Varieties and 2 extant varieties (VCKs) for DUS testing. Additionally, the strong partnership with IRRI, Philippines provides access to global elite rice germplasm with the exchange of breeding lines through "The International Network for Genetic Evaluation of Rice (INGER)".

In the irrigated ecology, of the 707 test entries evaluated in IVT trials in the 1st year of testing of which 190 were promoted to 2nd year of testing. Entries in 2nd year of testing were 203 and of them 86 were promoted to 3rd year of testing. In all, 21 entries were found promising in various irrigated trials (Appendix I)

New Varieties and Hybrids released

During the year 2022, a total of 61 rice varieties were released by Central Sub Committee on Crop Standards, Notification and Release of Varieties (CSCCSN & RV) and State Varietal Release Committee (SVRC). Among these CVRC released 26 varieties and 2 hybrids and the SVRC released 29 varieties and 2 hybrids. Among the 32 varieties and 4 hybrids proposals submitted to Variety Identification Committee; 31 varieties and 1 hybrid were identified for release in different states.

Rice Varieties Released during 2022 (CVRC)

S. No	Variety Name	IET No	Designation	Cross Combination	DFF	Eco-Sys	GT	Yield (t/ha)	Pests/ Disease reaction	Recommended State
A	CVRC									
1	ADT 56	27920	AD 16028	WGL 14377/ MTU 5	90	IRE	LB	4.92	R-RTD; MR- BLB, SB, LF	CH, MH, MP, BI, JH & WB
2	***AZ 8433 DT (Hybrid)***	28160	HRI 202	-	101	IRM	MS	6.72	R-BPH, MR-BLB	HR, PU, UP, BI, JH, OD, MP, CH, TS, AP, TN & KA
3	CR Dhan 321	28354	CR 4073-1339-3-5-1-1-3	IET 22296/RR 2-6	90	IRE	MS	6.48	MR-BS, T-SB, LF	OD, BI, JH, WB, UP, TR, AS, CH, MH
4	CR Dhan 314	27263	CR 4113-3-2-1	CR 3724-1/TJ 171-1 (CR 2688-6-7)	110	IRM	LB	6.44	R-LF; MR-SB	OD & BI
5	CR Dhan 414	27051	CR 2851-S-1-B-4-1-4-1-1	Gayatri/SR 26B	113	Coastal Saline	MS	4.22	R-LF; MR-SB	OD, WB, AP
6	ICAR NEH NICRA-Boro Dhan 1	26435	TRC 2016-14	Pyzum/Sambha Mahasuri	126	Boro	LS	6.43		TR, AS, WB

S. No	Variety Name	IET No	Designation	Cross Combination	DFF	Eco-Sys	GT	Yield (t/ha)	Pests/ Disease reaction	Recommended State
7	ICAR NEH NICRA Hill Rice 2022-2	28230	TRC PSM -1720-B-B-5-1	Pyzum/BPT 5204	91	Upland Hills	SB	3.05		HP, MA
8	KKL (R) 2	28791	KR 16024	ADT 46*3/ Swarna Sub 1	105	IRM	LS	6.80		TN, PD
9	Rajendranagar Vari-1	27077	RNR 11718	MTU 1010/NLR 34449	105	Saline Alkaline	MS	7.78	MR-BLB, SB, BPH, WBPH, LF	KA, PD
10	Telangana Rice 5	28746	RNR 28362	Bhadrakali/NSN 20894 (HKR 05-22)	105	IRM	MS	5.31	MR-BS, T-SB, LF	UP, OD
11	Telangana Rice 6	28332	KNM 7048	KPS 3219/KNM 118	90	IRE	LB	5.72	MR-Bl	OD, WB, CH, MH
12	Telangana Rice 7	28343	KNM 6965	MTU 1010/KNM 118	90	IRE	LS	4.92	MR-Bl	CH, MH
13	Telangana Vari 8 (WGL-1487)	28818	RP 6317-S35-BC_2F_4-49-25-6-21	MTU 1121*1/ Swarna	99	Low P	MS	4.02	R-BPH; MR-Bl	AP, TS
14	DRR Dhan 64	28358	RP 5599-212-56-3-1	MTU 1010/KMR 3R	90	IRE	LS	5.33	MR-Bl, WBPH	BI, WB
15	DRR Dhan 65	27641	RP Bio-4919-B-B-NSR 86	KMR 3/ *O. rufipogon*	110	LOW P	SB	6.00	T-Bl, BLB	TS, AP, KA, CH, JH, MH
16	DRR Dhan 66	28066	RP 5973-13-1-6-67-12-57	MTU 1010*2/ Swarna	87	LOW P	LS	5.03	MR-Bl	AP, TS
17	DRR Dhan 67 (BRRI Dhan 84)		BR7831	BRRI Dhan 29/ IR 68144//BRRI Dhan 28/// BR 11	110	BORO	LS	6.00		AS, WB, TR
18	DRR Dhan 68 (BRRI Dhan 99)		HHZ5-DT20-DT2-DT1 (GSR IR1-5-D20-D2-D1)	Huang-Hua-Zhan/OM 1723	105	BORO	LS	6.56		AS, WB, TR
19	DRR Dhan 69 (BRRI Dhan 100)		BR 8631-12-3-5-P2	BR 7166-5B-5/ BG 305//BRRI Dhan 29	118	BORO	LS	6.85		AS, WB, TR
20	Sabour Heera Dhan	27538	BRR 2110	AD 12173-Sel (Improve white Ponni/Kalajoha)	120	RSL	MS	4.59	MR- Bl, BLB, ShBl, BS	KA, AP
21	***DRRH 4 (Hybrid)***	27937	IIRRH 124		94	Aerob	LB	5.03	MR-SB	PU, OD, CH, TR, GU
22	Pusa Basmati 1882	28788	Pusa 1882-12-111-20	Pusa Basmati 1/Nagina 22// Pusa Basmati 1*3	101	MAS(Drt)	LS	4.68		UP, DL, UK, HR, PU, J&k
23	Pusa Samba 1853	28014	Pusa 1853-12-288	Pusa 1850-5-18/ Pusa 1701-10-5-8	100	MAS (Bl)	MS	3.97	R- Bl, BLB	AP, TS
24	Swarna Purvi Dhan 3	28329	RCPR 60-IR 97073-26-1-1-3	IR10L146/ IR10L137	87	IRE	LS	5.53	MR- BLB, ShBl, BS	HR, RJ, BI, UP, CH, MH
25	MTU Rice 1273	26790	MTU Rice 1273	MTU 1010/FL 478//*3 MTU 1010	87	IRE	LS	5.31	MR-Bl, BS	CH, MH, GU
26	MTU Rice 1293	28010	MTU Rice 1293	MTU 1010/FL 478//*3 MTU 1010	88	MAS (CS)	LS	3.44	MR-Bl, BS	AP, TS
27	MTU Rice 1310	27686	MTU Rice 1310	MTU 1075/CR 3598-1-4-2-1	110	IRM	MS	7.49	MR-SB, LF	AP, TS, TN, KA
28	MTU Rice 1321	28757	MTU Rice 1321	MTU 5249/IR 72	110	IRM	MS	6.94	MR-Bl, ShBl	TS, TN, KA, PD

Rice Varieties Released during 2022 (SVRC)

S. No	Variety Name	IET No	Designation	Cross Combination	DFF	Eco-Sys	GT	Yield (t/ha)	Pests/Disease reaction	Recom-mended State
1	Uttar Samir	26453	PUR-B-36	Annada/Gontra Bidhan-1	122	Boro	SB	5.88	R-BLB, BS	WB
2	Uttar Sugandhi	24616	UBKVRA -2	Selection from *Kalo Nunia*	120	ASG	MS	3.68	MR- Bl, BS	WB
3	GR 20 (Navsari Kamod)	27797	NVSR 407	IET-19347/GAR-1	92	ASG	SS	5.66	MR-BLB, SB, LF; T-BPH	GU
4	Gujarat Rice 21 (Vatrak)	28733	NWGR 15022	GR11/IR-60	96	IRME	MS	4.67	MR-Bl, BLB, SB, BPH, LF	GU
5	GAR 22 (Swagat)	29278	NWGR 8001	GR3/NWGR 97011	99	IRME	LS	5.61	R-Bl, SB, BPH, LF; MR- BLB	GU
6	Haccha (Aaudpu Dhan 04)	26344	AAUDR 9304-14-4-1	CRM 53/IR64	76	RUP	LS	3.06	R-Bl; MR-SB	AS
7	Langpi (AAUDPU Dhan 05)	27688	TTBDR 205-2-1	IET 17684/RANJIT	111	IM	MS	5.32	R- Bl, ShBl	AS
8	Diyung (AAUDPU Dhan 06)	27680	TTBDR 103-4-4	Malbhog/Bahadur	111	IM	MS	6.23	MR-SB, LF	AS
9	AAU-TTB-Dhan 40 (Dholi)	26848	TTB-AAU-TTB-DHAN-40	Ranjit/Swarna Sub-1//Ranjit	105	IM	MS	4.71	MR-Bl, BLB, ShBl; T-SB	AS
10	Surma Dhan (AAU KMJ Dhan 46)	28296	CN 1758-2-TTB7	CN 1216/CN 1131-4-1-4	113	SDW	MS	4.53	R-BLB, BS	AS
11	Kamesh (CR Dhan 415)	22097	CRR 624-207-B-1-B	Apo/IR 64	96	IRME	SB	5.00	R-Bl; MR-BS, SB, LF	JK
12	Pramod (CR Dhan 103)	22020	CRR 451-1-B-2-1	Vandana/IR 64	68	RUP	LS	3.30	R-Bl, BS	JK
13	Unnat Vandana (CR Dhan 107)	26337	CRR 747-12-3-B	Vandana*4/C101A51//IR84984-83-15-862-B	81	RUP	LS	3.31	R-Bl	JK
14	VL Dhan 70	26593	VL 32094	VL Dhan 85/VOHP 3102	95	Medim Hills	ELS	3.98	R- BS, SB, LF	UK
15	RC Maniphou 15	26583	RCM 36	Moirangphou/Lawagin	114	IRL	SB	7.10	R-Bl	MA
16	RC Maniphou 16	27495	RCM 37	RCM 10/RCM9	112	IRL	LB	5.50	T-Bl	MA
17	RC Maniphou 14	25841	RCM 33	IR 64 / Phougak	101	IRM	LS	7.43	R-Bl, BS; T-ShBl	MA
18	Lalkada Gold (GNR 9)	28699	NVSR-2756	IR28 / Lalkada	81	Biofort	LS	4.20	MR-SB, LF	GU
19	Sahyadri Brahma	29830	BMR-MS-1-2-1	IR-8/PTB20	105	IRM	MB	5.76	T-ShBl, SB, GM	KA
20	Sahyadri Kempumukthi	29855	Sahyadri Kempumukthi	Jyothi / KPR-1	95	IRME	MB	5.99	R-Bl; T-SB, LF	KA
21	Shalimar Sugandh 1	26558	SKUA 494	Selection Pusa Sugandha-3	96	Early Hills	LS	6.38	T-Bl	J&K
22	CO 55	27873	CB 15714	ADT 43/GEB 24	89	IRE	SS	6.95	R-Bl; MR-RTD, BS	TN
23	ADT 57	25569	AD 09219	ADT (R) 45/ ACK 03002	84	IRE	MS	6.50	R-Bl; MR-RTD, ShBl, BS, BPH, GM; T-SB, LF	TN
24	TRY 5	26068	TR 09030	Mutant of TRY 2	75	RUP	LS	4.06	MR- Bl, BS	TN
25	TKM 15	26645	TM 12077	TKM (R) 12 / IET 21620	88	RUP	MS	4.00	MR- Bl, BS, SB	TN
26	Punjab Basmati 7	29672	RYT 3677	BAS 386/IET 17948//BAS 386*2///PUSA BAS 1121	97	SCR	LS	4.86	R-ShBl, BS, SB	PU
27	CR Dhan 310	24780	CR 2829-PLN-37	ARC10075 (HP-2)/Naveen	97	Biofort	MS	4.82	MR- SB, GM, LF	AS
28	CR Dhan 311 (Mukul)	24772	CR 2829-PLN-100	HP-2/ Naveen	95	Biofort	LB	4.38	MR-SB, GM; T-BLB, RTD, BS, LF	AS
29	Maudamani (CR Dhan 307)	20925	CR2 599	Dandi/Naveen//Dandi	105	IRM	SB	8.12	MR-SB, WBPH,GM, LF; T-BS	AS

S. No	Variety Name	IET No	Designation	Cross Combination	DFF	Eco-Sys	GT	Yield (t/ha)	Pests/Disease reaction	Recom-mended State
30	CR Dhan 801	25667	IR96322-34-223-B-1-1-1-CR3955-2	IR8189-B-B-195/2*Swarna-Sub1//IR91659-54-35	112	MAS (Sub)	SB	4.82	R-SB, LF; MR-BLB, RTD	AS
31	CR Dhan 802 (Subhas)	25673	CR 3925-22-7	Swarna-Sub1*4 / IR81896-B-B-195	110	MAS (Sub)	SB	2.27	R-SB, LF; MR-BLB, RTD	AS
32	JKRH 3333 (Hybrid)	**20759**	**JKRH 3333**							AS
33	S-4001 (NK 14722) (Hybrid)		**NK 14722**							AS

Hybrid Rice

The total area planted under hybrid rice has reached 3.5 million ha during the year 2020 and more than 80% of the total hybrid rice area is in the states of Uttar Pradesh, Jharkhand, Bihar, Chhattisgarh, Madhya Pradesh, Odisha and Haryana. So far, 133 hybrids have been released in the country for commercial cultivation.

Initial Hybrid Rice Trials

During *kharif* 2021, totally 81 hybrids were evaluated in four hybrid rice trials *viz.,* IHRT-E, IHRT-ME, IHRT-M, IHRT-MS, in different locations representing North, East, Northeast, Central, West and South zones of the country. CD @ 5% is considered as a criterion for promotion of entries. The Promising hybrids identified in different hybrid rice trials (2021) is provided in appendix II.

Monitoring of AICRPR trials during 2022

Monitoring of AICRPR trials was conducted during *kharif* 2022, Eighteen (18) Multidisciplinary teams comprising of Scientists from IIRR, IARI, NRRI in collaboration with State Agricultural Universities & State Department of Agriculture monitored the performance of trials at 85 cooperating centers in seven rice zones across the country.

DUS tests in Rice

The DUS testing of 88 test samples was conducted at the specialized DUS block at our Ramachandrapuram Farm, ICRISAT campus during *kharif* 2022. The samples included 30 first year samples (Typical/ Farmer's varieties) and 58 second year samples (Candidate hybrids, F_1's from Shimoga and Typical). These were tested in replicated trials along with checks like PA6129, US 312, Tellahamsa, BPT 5204, CO 51, Anjali, RP Bio 226, MTU 1075, MTU 1153, atnd CR Dhan 201. Additionally, we tested another 26 DUS samples which were not tested during 2021. The trials were sown (30-06-2022; 06-07-2022) and planted (10-08-2022; 17-08-2022) on two different dates as per the plot availability. Among the 1st year samples, seven recorded very poor germination (1-5%) and two 2223-4 and 22RF6 did not germinate; whereas, among the 2nd year samples, 2122H22, 2122N1 and 2122-34 recorded poor germination. The DUS tests were carried out as per statutory requirement of the PPV & FR Act, 2001 and the recorded data was submitted to the authority in time in the specified format. The monitoring of

Monitoring at Bikramganj

Monitoring at Bilaspur

DUS trials was conducted on 06-12-2022 by a team comprising of Dr BC Patra, PS, NRRI, Cuttack; and Dr T Srinivas, PS, ANGRAU, Guntur.

Monitoring team of DUS test at RC Puram Farm

National seed project and Breeder Seed Production

Breeder seed production of 305 rice varieties was organized at 49 locations as per the DAC indents. Breeder seed Production of DRR Dhan42, DRR Dhan48, DRR Dhan49, DRR Dhan53, DRR Dhan55, DRR Dhan56, DRR Dhan60 and DRR Dhan62 at ICAR-IIRR along with other varieties indented.

Monitoring of seed production plots

Crop Production

Agronomy

Nutrient Management Trials

A total of 132 AVT-2 entries belonging to 18 categories were evaluated at different locations under two levels of nutrient application, *i.e.*, 50 and 100% of the recommended dose of nutrients along with standard and local cultivars to identify stable and efficient genotypes. Vivek Dhan-86 and tested cultures IET 28200, IET 28329. IET 28358. IET 28396. IET 28302 and aerobic culture, IET 26178 was found to be promising with higher grain yield were found to be promising based on grain yield efficiency index across the locations.

Trial results compiled for six locations to identify N efficient cultivars revealed that IET 29583, IET 29584, IET 29577, IET 30261, IET 28084, IET 30275 and IET 29564 were high yielding with high nitrogen use efficiency cultivars. The genotypes G1 (CR 4333-181-1-2-1), G2 (CR 4333-35-2-2-1), G4 (CR 4332-184-2-2-1) and G5 (CR 4332-37-2-1-1), 1815 and 1823 with no or low phytotoxicity to weedicides tested have contributed to higher crop growth and grain yield.

Cultural Management Trials

Mechanical transplanting of JGL 24423 variety in delayed condition resulted the highest grain yield (7.09 t/ha). Among varieties, JGL 24423 (6.52 t/ha) performed better than other varieties. In Mandya, improved local system (drum seeding) resulted the highest grain yield (5.18 t/ha). Among weed control methods, application of pre + post-emergence of herbicide resulted the highest grain yield (5.23 t/ha). However, cost of cultivation was less in mechanical weeding (Rs. 52720/-) compared to pre + post emergence herbicide application (Rs. 57278/-). The lowest cost of cultivation was recorded in broadcasting of seeds and manual weeding once (Rs. 36,539/-). In Ghaghraghat, NDR 2065 variety applied with 150% of RDF (N-P2O5-K2O 180-90-60 kg/ha) resulted in the highest grain yield (5.97 t/ha). Farmers' application dose ((N-P2O5-K2O 100-50-0 kg/ha) resulted in the lowest grain yield (2.86 t/ha). In Raipur, Devbhog resulted in the highest grain yield under best state organic management practices (50% N through vermicompost + green manuring in situ + PSB + Azotobacter + cow urine spray twice @ 30%) with yield of 4.83 t/ha. In Titabar also the highest grain yield was recorded under state recommended organic practices (4.30 t/ha). Mechanical transplanting method on puddled soil (crop management methods same as for puddled transplanted rice) resulted the highest grain yield (4.95 t/ha) followed by direct wet seeding in puddled soil (4.60 t/ha). However, the cost of cultivation was lower in direct dry seeding (mechanical) (Rs. 40,598/ha).

Weed Management Trials

The grain yield loss due to weeds ranged from 14.68% at Rewa to as severe as 75.24% at Jagdalpur, depending on the weed intensity and weed flora distribution during the critical period of crop growth. The mean grain yield across the locations varied from 2.39 t/ha at Chatha to 5.41 t/ha at Puducherry. In general, the incidence of pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to other methods. Incidence of dead hearts was significantly high in wet DSR (10.95%) as compared to other methods. The cost of weed management under chemical weed control ranged from Rs 1200 at Ludhiana to 7871 per hectare at Mandya. Cost of weed management under weed free condition varied from Rs. 5,400/- at Rewa to 12,600/- per hectare at Ludhiana. In Zone I-Hilly Regions, the dry weed biomass was lower in IPM implemented fields by 5.67 and 50.08% respectively. The mean grain yield advantage was 38% in IPM adopted plots.

Rice Based Cropping Systems

The system productivity analysis (*kharif* and *rabi*) indicated the superiority of transplanting at Vadgaon (8.77 t/ha), Titabar (6.33 t/ha) and ARI-Rajendranagar (8.31 t/ha). Aerobic rice yielded higher system productivity at Karjat (8.57 t/ha) based on the REY. Rice residue incorporation (30 cm height) was found to be superior at all three locations with higher REY values at Vadagaon, Karjat, Titabar and ARI-Rajendranagar. Among crop establishment methods, transplanting exhibited significant higher values for growth and yield attributes at Vadgaon, Titabar, Ghagraghat and Karjat. The REY of the system productivity indicated superiority of the residue application at all four locations (Vadagaon, Karjat, Titabar and ARI-Rajendranagar) indicating the superiority of residue incorporation (6%-17% higher grain yield with residue incorporation).

Soil Science

Long term soil fertility management in rice based cropping system

The long-term soil fertility management in RBCS (rice based cropping systems) is in the 33rd year of study. Combined use of RDF + FYM yielded maximum grain yield at Mandya, Maruteru and Titabar. The treatment with FYM alone was on par to RDF in *kharif* at Mandya. Nutrient omission (NPK, Zn and S) and reduction of NPK to 50% resulted in yield reduction at all three centres and in both seasons. Over a period of 33 years, RDF recorded slightly positive growth rate in productivity at Maruteru; more positive growth rate at Titabar and negative growth rate at Mandya. Supplementary dose of FYM along with RDF recorded positive growth rate in productivity with 67, 62 and 60 kg/ha/yr at Maruteru, Titabar and Mandya, respectively, compared to RDF where growth rate varied from -61 kg/ha/yr at Mandya to 33 kg/ha/yr at Titabar.

Soil quality and productivity assessment for bridging the yield gap in farmers' fields

Assessment for bridging the yield gap was conducted in farmers' fields at selected centres - Chinsurah, Titabar, Pantnagar, Kanpur, Kaul, Moncompu and Ludhiana to record the variability in soil nutrient supply, its relationship with rice yields at current recommended fertilizer practices. Sharp variations in mean grain yields were recorded, from 2.38 to 5.0 t/ha at Chinsurah, 2.48 to 3.43 t/ ha at Titabar, 4.76 to 6.59 t/ha at Kanpur, 2.4 t to 4.32 t/ ha at Moncompu, 2.9 to 3.21 t/ha at Ludhiana, 3.79 to 4.67 t/ha at Karaikal and 4.39 to 5.94 t/ha at Pantnagar, respectively. The highest level of yield gap of 84% was recorded at Kaul, followed 52% at Chinsurah, 44% at Moncompu, 28% at Titabar and Kanpur, 26% at Pantnagar and 17% at Ludhiana.

Screening of Germplasm for Soil Sodicity

The trial on management of zinc nutrition in sodic soil using nano Zn formulation was conducted at three locations with different genotypes. MTU 1001 registered the highest grain yield of 5.26 and 6.07 t ha-1 at Ludhiana and Mandya, respectively. At Faizabad, DRR DHAN 48 performed well with a grain yield of 4.20 t/ha, straw yield of 5.24 t/ha, respectively. Out of four genotypes, MTU 1001 had the highest Zn uptake (grain, straw and total) at Ludhiana.

Screening of rice genotypes for tolerance to soil acidity

In a study on "Management of Acid soils", five genotypes were evaluated with three different treatments at three locations. Application of NPK (RDF) + Silixol spray recorded significantly higher grain yields (4.40 t/ha) at Moncompu. Whereas, NPK + Rice husk ash followed by Dolomite application recorded significantly higher grain yield (5.57 t/ha) at Dumka. The varieties, which outperformed, include Shreyas (4.40 t/ha) and Uma (4.33 t/ha) at Moncompu, ARRH - 7576 (4.16 t/ha) and Uma (4.15 t/ ha) at Titabar and Sharboni (4.42 t/ha) at Dumka.

Residue management in rice based cropping systems

The trial on residue management was conducted at eight centres. The results showed that the crop residues can be used to substitute a part of the recommended nitrogen without yield penalty. The crop residue treatments were at par with each other in terms of nutrient uptake and also maintained higher nutrient use efficiencies over RDF. Post-harvest soil nutrient status was not influenced much by residue treatments, which were at par with each other.

Screening of rice germplasm for Nitrogen use efficiency (NUE)

In a study on "Screening of rice germplasm for NUE", ten genotypes were evaluated with three nitrogen levels at seven locations. The results indicated that grain yield was significantly higher at 100% RDN and the increase was in the range of 9-40% over 50% RDN and 13-110% over no N application. The mean maximum yield was recorded by ARRH7576 (4.34 t/ ha) followed by Varadhan (4.32 t/ha), CNN5 (4.30 t/ ha) and CNN3 (4.14 t/ha). Maximum agronomic efficiency and physiological efficiency was recorded by ARRH7576 and maximum recovery efficiency was recorded by Varadhan, CNN3 and MTU 1010.

Yield maximization of rice in different zones

The yield maximization trial was conducted in Karaikal and Maruteru. Specific focus was on fertilizer schedule as per Nutrient Expert, which is assumed to be site-specific fertilizer management which showed differential responses; insignificant responses in Maruteru-*rabi* and significant effects in Maruteru-*kharif* in both grain and straw yields and uptake of elements. Similarly, additional treatment (RDF + Eco Agra Spray) had significant effects on grain, straw and uptake of elements differing from some treatments. However, it was on par with the fertilizer schedule as per Nutrient Expert ultimately highlighting the site-specific management.

Enhancing productivity of Organic Rice cultivation

The second year of study on "Enhancing Productivity of Organic Rice cultivation", showed positive response to the 50% N (FYM) + 50% N (Green manure/Green Leaf Manure and 150% N (FYM) and was significantly superior to other treatments in terms of grain yield and yield parameters at Khudwani and Moncompu, respectively, but the inorganic RDF gave higher grain yield at Chinsurah and Kaul centres. At Chinsurah most of the soil properties improved with 100% N through organic (FYM) treatment compared to other treatments.

Plant Physiology and Biochemistry

Physiological studies under All India Co-ordinated Rice Improvement Program were conducted at eight funded centres (Coimbatore, Maruteru, Pantnagar, Pattambi, Rewa, Raipur, Karjat and Titabar), two ICAR institutions (IIRR Hyderabad and NRRI Cuttack) and six voluntary centres (RARS Chinsurah, NDUAT Faizabad, PJNAR Karaikal, IGKV Raipur and BAU Ranchi).

In view of the importance of silicon in on improving abiotic stress tolerance, a trial was conducted with ten entries at eleven locations with four treatments and eight genotypes consisting of hybrid and high yielding varieties. The results revealed that there was an increase in biomass, leaf area index, stem weight, grain number per panicle, 1000 grain weight, harvest index and grain yield when silicon granules were applied (0.08% orthosilicic acid) @5kg/acre at active tillering and flowering stages. Overall, there was a 5% increase in yield in silicon applied plots. The best performing entries were 27P63, DRR Dhan-48, Sahabhagadhan and US-312.

A trial was conducted to study the drought tolerance traits of rice varieties with 36 introgression lines from Krishna Hamsa background under rainfed and irrigated conditions at 5 locations. Based on yield and statistical analysis genotypes IL-19072, IL-19081, IL-19082, IL-19132 and WGL-14 have a higher yield and a lower variation and could be identified as relatively drought tolerant genotypes suitable for rainfed cultivation.

A trial was conducted with 25 entries from IVT-E-TP breeding trial at 7 locations to study the drought tolerance traits of rice varieties. IET29943, IET29946, IET22946, 29947, 29948, IET29949, IET29952, IET29956 and 29958 produced relatively higher yield under heat stress condition and also, they show stability in performance as assessed by Shukla's stability variance and Kang's" statistic.

Screening of 25 rice accessions for multiple abiotic stress tolerance was conducted at 7 locations. All the genotypes including tolerant checks recorded reduction in key physiological traits. CR-2862-IC-10 was tolerant to all the abiotic stresses (AG, salinity and osmotic), while IET-27051, CR-2862-IC-10, Dular were found tolerant to both AG and osmotic stresses; three genotypes, AC43037, CR-3818-IC-225, CR-2862-IC-10 were tolerant to salinity and osmotic stresses.

A trial for submergence tolerance in rice was conducted at four different locations. The survival rate was found to be highest in the tolerant check Swarna-SUB1, while susceptible check Naveen showed only 15% survival. Based on survival %, AC43025, Dular, NPS17 and NPS18 were highly tolerant; AC43037, Black Gora, Mahulata, Gurjari and Pani Kekua were tolerant (60-70%) while NPS71, Ampaki Bora, MianSali and Boga Amona were moderately (55-60%) These genotypes may be used as potential donors for improving submergence tolerance.

The trial to screen genotypes for low light tolerance was conducted at 7 locations with 15 AVT entries including Swarnaprabha as check. Results indicated low light stress resulted in significant loss in yield up to 54%. Amongst the 21 entries tested only IET28276 and IET29031 show relative tolerance to low light stress.

Crop Protection

Entomology

All India Coordinated Entomology Programme during *kharif* 2021 was conducted with seven major trials encompassing various aspects of rice entomology at 38 locations spread over 21 states and 2 Union territories. Evaluation of 1562 entries (1324 pre-breeding lines, 100 hybrids, two varieties, 13 germplasm accessions and 121 check varieties) against 13 major insect pests in 182 valid tests (48 greenhouse reactions and 134 field reactions) resulted in identification of 80 entries as promising against various insect pests. In Gall midge biotype trial, Aganni (*Gm8*), INRC 3021 (*Gm8*), W1263 (*Gm1*) and Kavya (*Gm1*) were found promising. The results suggest that donors with *Gm8* and *Gm1* gene and INRC 17470 (new donor) confer resistance to gall midge. Gall midge population monitoring through single female progeny tests revealed that Aganni *(Gm8)* holds promise at Jagityal, Ragolu and Warangal. Low virulence against W1263 *(Gm1)* was observed at Gangavathi, Pattambi and Warangal. Among the 17 gene differentials evaluated in planthopper special screening trial, PTB 33 (*bph2*+*Bph3*+*Bph32*+unknown factors), RP 2068-18-3-5 (*Bph33(t)*), Swarnalatha (*Bph* 6), T12 (*bph7* gene), Rathu Heenati (*Bph3*+*Bph17*), ASD 7 (*bph2*), Babawee (*bph 4*), IR 36 (*bph2*) and IR 64 (*Bph1*+), Chinasaba (*bph8*) and Milyang 63 were found promising.

Planthopper population monitoring trial revealed that brown planthopper population at Gangavathi was more virulent than IIRR-Rajendranagar, Coimbatore and Ludhiana populations with higher fecundity, nymphal hatching and percentage of brachypterous adults and lower male population.

Field evaluation of granular insecticides against gall midge across 13 locations revealed that seed treatment with thiamethoxam followed by application of fipronil 3% GR at 20-25 DAT in the main field was most effective with significantly lower per cent silver shoots (6.34%). Evaluation of insecticide-botanicals modules revealed that all insecticides module was found to be superior in reducing stem borer, gal midge, white backed planthopper, leaf folder and green leafhopper damage compared to other insecticide-botanical modules. Combination of neemazal, neem oil and triflumezopyrim treatment was found to effective against brown planthopper. All insecticides module recorded highest yield of 4581.7 kg/ha with 44.2% increase over control followed by treatment with applications of neemazal, neem oil and triflumezopyrim with 4071 kg/ha yield (25.3% increase over control).

In general, the incidence of pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to SRI, aerobic rice and semi dry rice methods.

The slow release pheromone blends of yellow stem borer, rice leaf folder and multispecies pheromone blend of leaf folder and yellow stem borer were found effective.

Water management along with ecological engineering significantly reduced planthopper population at Warangal (4.26/hill) compared to farmers' practice (8.03/hill) while increasing natural enemy populations and yields. At Warangal, the benefit cost was also significantly higher with ecological engineering and water management (1.67) compared to Farmers' practice (1.28). Bio intensive pest management tactics were effective in suppressing insect pest damage with higher natural enemy population and higher yields. Grain yields were significantly high in IPM implemented plots due to effective management of insect pests, diseases and weeds resulting in high gross returns. Overall, benefit to cost ratios of IPM plots were superior to that of 'Farmers' Practices' due to better yields and lower input costs.

Monitoring of insect pests by light traps revealed that yellow stem borer, leaf folder and planthopper continues to be the most important pests in terms of numbers as well as spread across the locations. Gall midge continues to be an endemic pest. However, case worm, white stem borer, pink stem borer, black bug, gundhi bug and zigzag leaf hopper showed an increase in the spread and intensity of incidence posing concern for future.

Plant Pathology

In the year 2021, 15 trials were conducted at 50 AICRPR locations on Host plant resistance, field monitoring of virulence of major rice pathogens and disease management. With respect to host plant resistance, 1449 entries were evaluated under various screening nurseries. Among the tested entries, 74 entries found moderately resistant against two to four diseases. A few promising entries were listed in the Table.

Multiple disease resistant/tolerant lines identified across the different screening nurseries during *kharif* 2021

Name of the Screening Nursery	No of Multiple disease resistant/ tolerant entries	IET #/ Designations	Resistant/ Tolerant against
NSN-1	15	30253	LB, NB, BS
		28366	SHB, SHR
		28508	NB, BB
NSN-2	6	29838	NB, LB, BB
NSN-H	9	28907& 29651	NB, ShB
		28196	NB, BS
NHSN	23	29753	LB, NB, ShB, BS, BB, ShR
		29721	LB, NB, ShB, BB
		29747	LB, NB, ShR
DSN	21	RP-Bio Patho-4	LB, NB, ShR
		RP-Bio Patho -5	LB, BB, NB
		RNR 28400	LB, NB, RTD

35 cultivars at 27 locations were used for field monitoring of virulence of *Pyricularia grisea*. Tetep and Raminad str-3 were resistant but, Tetep was susceptible at Cuttack, Gaghraghat. Similarly, the susceptible check Co-39 recorded resistance reaction at Gerua, Mugad and Wangbal indicating a shift in the pathogen population. Cluster analysis revealed that the reaction pattern was grouped into eight major groups at 65 percent similarity coefficient.

Monitoring the virulence of bacterial blight (BB) pathogen, *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) was conducted at 24 locations with 28 near isogenic lines

(IRBB lines) possessing different BB resistant genes in the genetic background of IR 24. Differentials possessing single bacterial blight resistance genes like *Xa1, Xa3, Xa4, xa5, Xa7, xa8, Xa10, Xa11* and *Xa14* were susceptible at most of the locations. BB resistance gene *xa13* was susceptible in 8 locations while *Xa21* was susceptible in 11 locations. Based on their virulence, the isolates were grouped into high, moderate and low virulence groups.

Leaf blast was more in the late sown crops. The highest incidence of BB was observed in the early and normal sown crops at Maruteru. Incidence of sheath blight was more in the early sown crops. Maruteru had the highest percent disease severity of sheath blight in the early sown crop. In Moncompu, the severity of sheath blight was more in late sown crop while Kaul reported the incidence of Bakanae, in the early sown crop. In Nawagam, sheath rot incidence was more in late sown crops.

The fungicidal molecules difenoconazole 25% EC, isoprothiolane 40% EC, kasugamycin 3% SL, kitazin 48% EC, propineb 70% WP, tebuconazole 25.9% EC and thifluzamide 24% SC were evaluated at 31 locations. Kitazin 48% EC (1.0 ml/L) and isoprothiolane 40% EC (1.5 ml/L) were effective against leaf blast and Isoprothiolane 40% EC (1.5 ml/L) alone was effective against neck blast. Thifluzamide 24% SC (0.8g/L) and difenoconazole 25% EC (0.5 ml/L) was effective in reducing sheath blight. Difenoconazole 25% EC (0.5 ml/L) was identified as a best molecule to reduce sheath rot and brown spot diseases. Tebuconazole 25.9% EC (1.5 ml/L) showed broad spectrum activity against sheath blight, sheath rot, brown spot and blast.

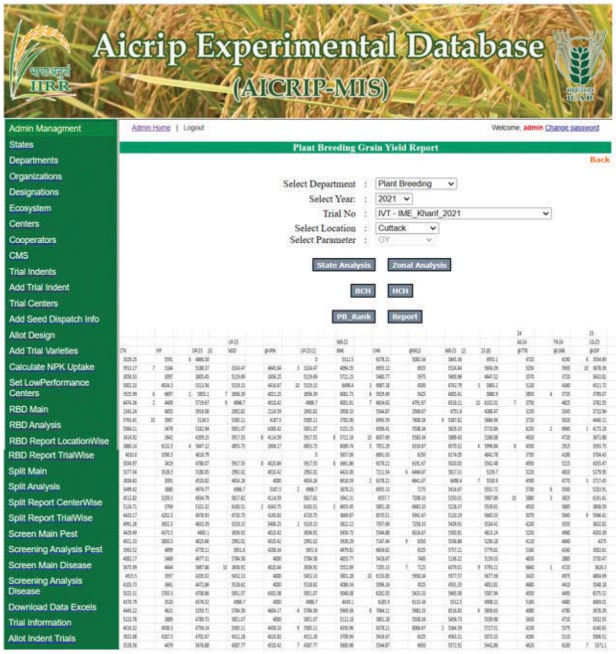
An integrated disease management trial was conducted at 14 locations. The bioagent, *Trichoderma asperellum strain* TAIK1 was supplied from IIRR. Seed treatment with carbendazim @2g/kg of seeds plus a spray of 0.4g/L of trifloxystrobin 25%+ tebuconazole 50% effectively decreased disease severity of major rice diseases. However, seed treatment and spraying of bio-control agent at 15-20 DAT (10 g/L) along with one spray of propiconazole (1 g/L) at the booting stage performed well against leaf blast, neck blast, sheath blight and sheath rot.

The IPM trial was conducted at 5 different zones - Northern zone (Pantnagar, Kaul); Eastern zone (Chiplima, Masodha); North-eastern zone (Titabar); Western zone (Karjat, Nawagam, Sakkoli) and Southern zone (Rajendrnagar, Mandya). The disease progress of leaf and neck blast was significantly lower where IPM practices were followed. Similarly, the IPM practices performed well against Sheath blight at six test locations. The bacterial blight disease severity was reduced due to adoption of IPM practices at all the five locations, compared to farmer's practices.

The trial on yield losses was conducted at 11 locations on leaf blast, sheath blight and bacterial blight. Leaf blast per cent disease index of 62.6, 45.3 and 33.3 caused a yield reduction of 48.1, 31.0 and 17.8. Sheath blight percent disease index of 67.2, 43.7 and 38.8 caused a yield reduction of 51, 35 and 23. Similarly, the BB per cent disease index of 83.5, 65.5 and 56.0 resulted in the grain yield reduction of 25.2, 17.3 and 11.15. A trial was conducted on different establishment methods and cropping system on rice diseases at 3 locations. In Rajendranagar, puddled direct seeded method was found as promising in reducing neck blast and sheath rot; manual transplanting was effective against grain discolouration. The manual transplanting method increased sheath blight disease severity in Chinsurah, while the same method reduced sheath rot severity at Karjat.

Production Oriented Survey (POS)

POS was conducted in 98 districts of 14 states by 16 AICRP-Rice centres. The southwest monsoon rainfall during June to September was been normal (96 -104% of LPA) over Northwest India (96%) and central India (104%). Seasonal rainfall was below normal over East and Northeast India (88%) and above normal over South Peninsula India (111%). Extremely severe cyclonic storms like 'Tauktae' over Arabian sea; 'Yaas' over Bay of Bengal during May; 'Gulab' in September, over Bay of Bengal and 'Jaad' during December caused major disruptions across the country. Hybrid rice varieties occupied a significant area in states like Uttar Pradesh, Haryana, Gujarat and Bihar and its area is increasing in states like Karnataka and Maharashtra. Among the diseases, leaf blast, neck blast, brown spot, sheath blight, false smut, grain discoloration and bacterial blight were widespread whereas intensity of BB was severe in Andhra Pradesh and Telangana regions. The intensity of the diseases like blast, brown spot and grain discolouration was more in Jammu and Kashmir. Among the insect pests, stem borer, leaf folder and panicle mite were very widespread in Telangana State and bloodworm problem was noticed in Cauvery command area.



AICRIP Experimental Database: http://www.AICRIP-intranet.in

Many centers have uploaded data through AICRPR-Intranet. Analysis modules of state and zonal reports of plant breeding and hybrid rice were refined as per the new proceedings of 57th ARGM like CD@5% is considered as criteria for promotion of entries, elimination of locations with CV not in range of 5-20%, F-value not significant etc.

Research Achievements

Lead Research

GEQ - Genetic enhancement of quality for domestic & export purpose

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

IPM - Integrated pest management

HRI - Host-plant resistance against insect pests and its management

HRP - Host-plant resistance against pathogens and its management

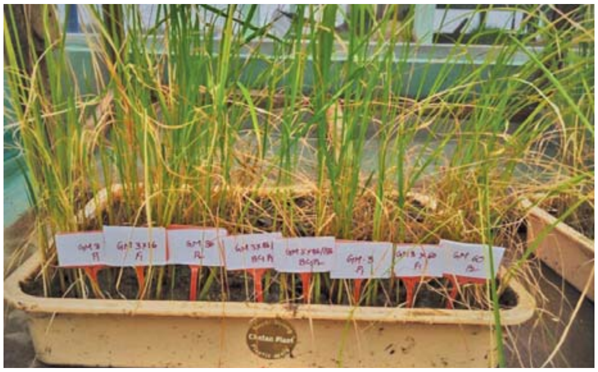
TTI - Training, transfer of technology and impact analysis

GEQ-Genetic enhancement of quality for domestic and export purpose

GEQ/CI/BR/8: Enhancing nutritional quality of rice through bio-fortification

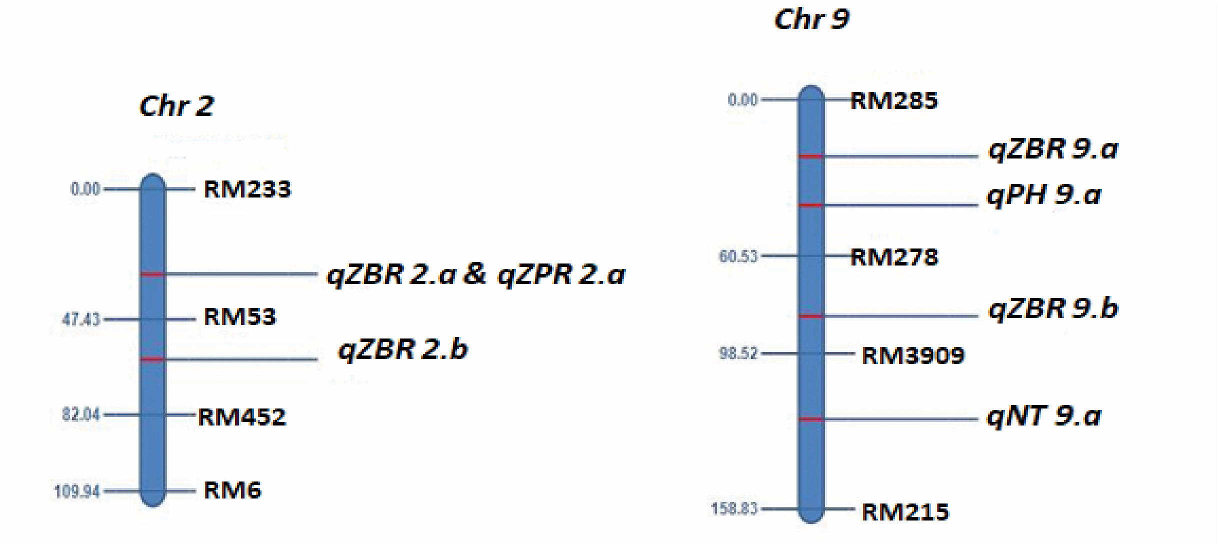
Among the genotypes studied, GM-3 and GM-86 had recorded higher zinc content along with BPH resistance (score 1) and hence were identified as promising genotypes for BPH resistance along with high zinc content (>25.0 ppm in brown rice). GM-3 is an early duration, tall genotype with grain yield on par with the checks. GM-86 is of medium duration, tall with grain yield on par to the checks, namely BM 71 and TN1. Four parents were selected for the crossing program in which two parents (GM-3 (Binnidhan) GM-86 (Selection from Maharashtra) for BPH resistance along with high zinc content (>25 ppm) and two parents GM-60 (Selection from Madhya Pradesh) and GM-96 (Selection from Kerala) for susceptibility to BPH and low zinc content.

Field View of high Zinc genotype GM-86 with BPH tolerance



BPH screening under Lab conditions

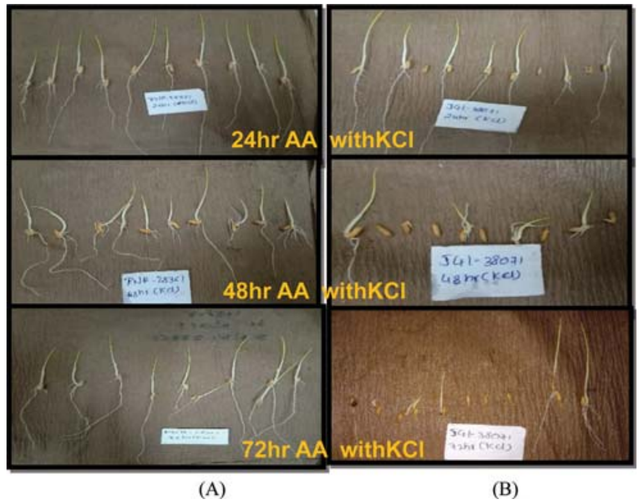
A RIL population developed from the high-yielding rice variety MTU1010 and the high-zinc rice variety Ranbir Basmati was deployed to identify the QTLs associated with grain zinc (Zn) content. A total of 185 reported Zn associated SSR markers were surveyed for the parental polymorphism resulting in the identification of 38 polymorphic SSRs. Selective genotyping was done in 12 high Zn lines (35 to 45 ppm) and 12 low Zn lines (9 to 14 ppm) using 38 polymorphic SSRs and extended to 306 RILs. Consistent QTLs for grain Zn polished (*qZPR.2. a*) and Zn brown (*qZBR.2. a*) were identified on chromosome 2. On chromosome 9, two minor QTLs for grain Zn brown (*qZBR.9. a* and *qZBR.9. b*) were identified among the other QTLs.



QTLs identified in MTU1010/ Ranbir Basmati population grain zinc content

GEQ/CI/BR/26: Investigation into the role of major metabolites on rice grain quality

In accelerated ageing (AA) experiment on 10 advanced lines, changes in percentage of germination, vigour index, starch content and amylase activities were observed. AA appeared to be promising to study the changes in rice grain in less time as compared to natural ageing. Among the 98 Sambha Mashuri (SM) mutants, 44 were low GI (≤55), 52 were medium GI (55-69) and only two were high GI (≥70) and their panicles were collected for expression analysis. The range of total bran oil was 0.62 g to 2.46 g in 33 genotypes.



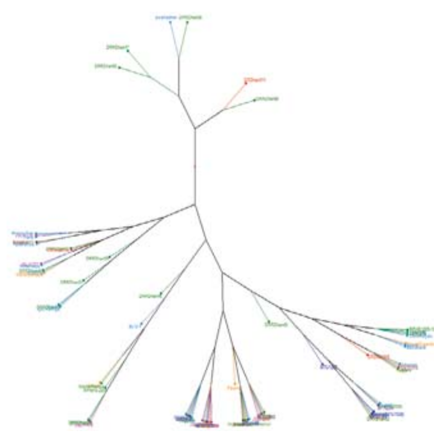
Variation in germination in (A) RNR28361 and (B) JGL38071 under accelerated ageing treatment

GEY-Genetic enhancement of yield and stress tolerance

GEY/CI/ BR/26: Breeding for high yielding water use efficient short duration rice hybrids & varieties

Crosses were effected between 10 selected parents using half diallel. (MTU 1010, Prasanna (early), Rasi, Pooja, DRR Dhan 44, 42 (Drt), 50 (Drt+sub), DRR 45, 48 (Zn), MTU 1081 (HY, low shat), BPT 5204, WGL 14 (GT), ISM (BB), Tetep (BL), Akshayadhan, Swarna, 4 lines with strong culm). During selection and generation advancement 23 F_2 Populations and 8 F_3 selections were raised and selection exercised. These selections will be carried further for critical evaluation for high yielding and short duration characters along with other morphological characters. A total of 80 (IIRON) and 72 (IURON) lines were evaluated in field in 2 replications and selections were made from INGER Lines for duration yield and finally the top 10 high yielding lines were retained in each set for critical evaluation. Experiment was conducted with 270 entries from the Project Accelerated Genetic Gain in Rice-Irrigated Ecology and the 15 selections with medium slender grain type were made to assess them critically for water use efficiency and high yield. In the mutant lines developed using mutagenic treatment in six aromatic short grain and local cultivars for developing their yield and quality characters. Few (14) individual plants have been selected and will be advanced for critical evaluation during ensuing crop season.

Promising variety - DRR Dhan 50



Cluster Diagram showing different groups of varieties based on yield related genes

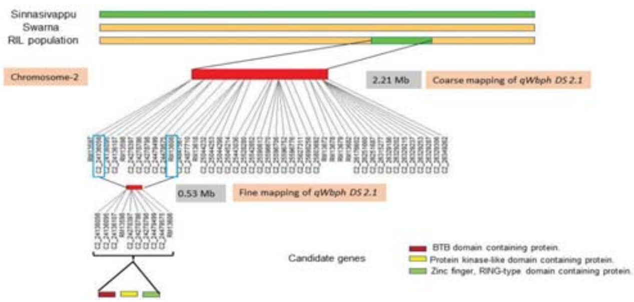

Experiments conducted at ICRISAT farm and Promising entries in the station trials

GEY/CI/BR/31: Breeding for high yielding, medium to late maturing rice varieties with tolerance to biotic stresses and good grain quality

24 elite genotypes were identified out of 96 genotypes/varieties evaluated *viz.*, MTU 1121, JGL 11727, Sampada, JGL11470, DRR Dhan54, MTU1224, Binadhan 11, KMP 149, Jarava, DRR Dhan 47, Swarnadhan, MAS 26, Jaya, Akshaydhan, JGL 18047, Rasi, MTU 1010, MTU 1155, DRR Dhan 39, Salivahana, Improved Samba Mashuri, Binadhan 17, DRR Dhan 50 and DRR Dhan 60. These genotypes will be utilized in crossing of elite x elite genotypes for breeding high yielding, medium to late maturing rice varieties with tolerance to biotic stresses and good grain quality. Significant variability was observed in ANOVA for various yield contributing traits among the genotypes. Grain yield had significant negative correlation with days to flowering and days to maturity; and significant positive correlation with plant height, number of productive tillers, panicle length and 1000 grain weight. Number of productive tillers had significant negative correlation with panicle length, CT1, CT2 and 1000 grain weight. Days to flowering has significant negative correlation with plant height, CT2, 1000 grain weight and grain yield. 10 crosses were promoted to F_2 generation and 30 crosses were attempted between elite x elite genotypes. 82 cultivars genotyped using 4 functional gene markers linked to yield *viz.*, GN-1a-indel-3, SPL-14-12, TGW6-1d and SPIKE-01. Diversity analysis showed only 2 major clusters with 76 genotypes into one cluster and 6 genotypes in second cluster showing a very minimum diversity in popular cultivars with respect to yield genes.

GEY/CI/ BR/16: Traditional and molecular approaches for breeding improved rice varieties with resistance to planthoppers

A RIL mapping population (n = 140) derived from Swarna, susceptible to white backed planthopper (WBPH) and Sinnasivappu (AC No. 15444), a landrace resistant to WBPH was screened along with parents and checks (MO1- Resistant and TN1- Susceptible) against WBPH during seedling stage following Standard Seedbox Screening Test (Heinrichs *et al.*, 1985). Phenotypic data on damage scores showed segregation ratio of 1R:1S in RILs which fits with chi square test of goodness of fit suggesting a single dominant gene. The RILs were subjected to Genotyping by sequencing and constructed a high-density linkage map with 3620 SNP loci spanning a map distance of 22547.9cM. QTL analysis using SNP marker data and phenotypic data detected a major QTL, *qWbph DS 2.1* which occupied 2.21 Mb region on Chr #2 flanked by SNP markers C2-24136056 and C2-26349262 explaining 13.5% phenotypic variation. Further fine mapping of QTL with polymorphic SSR markers underlying *qWbph DS 2.1* narrowed down the region from 2.21Mb to 0.53Mb delimited by SNP marker C2_24136056 and SSR marker RM13606.



Fine mapping and identification of candidate genes underlying WBPH resistance locus qWbph DS2.1

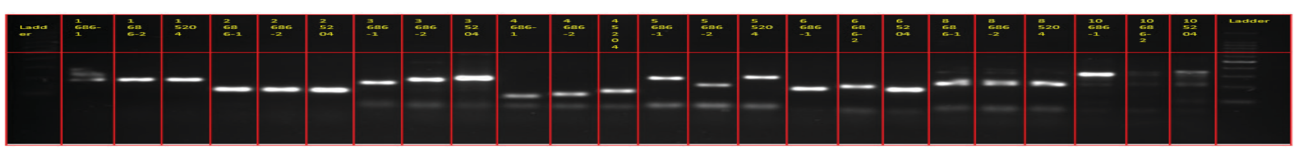
Since no reported genes for WBPH resistance were identified within fine mapped 0.53 Mb region, the identified new gene is tentatively designated as *WBPH13(t)*. The tightly linked flanking markers of SNP and SSR could be used for marker-assisted introgression of *WBPH13(t)* into genetic background of WBPH susceptible elite varieties. In silico analysis revealed three annotated genes, encoding *BTB domain containing protein*, *Protein kinase-like domain containing protein* and *Zinc finger, RING-type domain containing protein* having key biological functions regulating the plant's defence against biotic stresses.

GEY/CI/BR/9: Development of Rice Cultivars with High Grain Protein Content (GPC) and Quality Traits

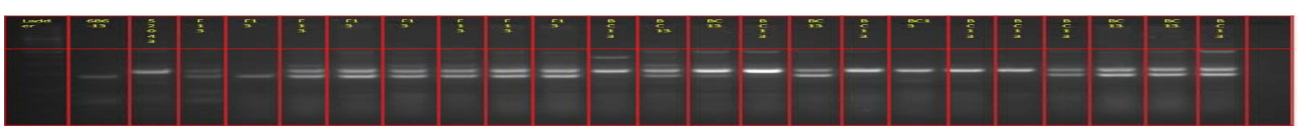
Morpho-physiological and nutritional quality evaluation of 147 lines was completed during 2022. Grain protein content exhibited a range of 5.44 – 13.44% among the 147 lines. The amylose content exhibited a wide variation of 8.94 – 29.12%. Based on these results, five high grain protein content lines (HGPC: JAK 16, JAK 47, JAK 75, JAK 686, JAK 713) and five low grain protein content lines (LGPC; JAK 46, JAK 145, JAK 354, JAK 390, JAK 392) were identified.

The average lysine content was higher in the high protein lines (4.043 g/100 g protein) compared to the low protein lines (2.958 g/100 g protein). The highest and lowest lysine content of 5.61 g/100g protein and 1.70 g/100g protein was in JAK 16 and JAK 145 respectively.

Methionine content also exhibited similar trend with higher average content in high protein lines (6.898 g/100g protein) in comparison to the low protein lines (5.028 g/100g protein). The highest and lowest methionine content of 9.52 g/100g protein and 2.84 g/100g protein was in JAK 686 and JAK 390 respectively. JAK 686 and JAK 390 had the highest (8.49 g/100g protein) and lowest quantity (3.04 g/100g protein) of cysteine respectively. Mapping QTLs for Grain Protein Content in rice was also carried out.



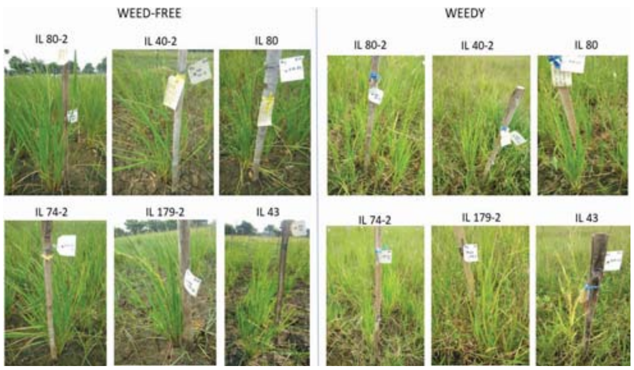
Parental polymorphism studies using SSR markers



Confirmatory studies of true F1s by using polymorphic SSR markers (RM 493 & RM 562)

GEY/CI/BR/22: Genetic Improvement of Direct Seeded Rice Traits Using Elite Varieties and Wild Species

In order to identify the genomic regions associated with weed competitiveness 190 lines of BC_1F_7 population derived from IR64*1/*Oryza glaberrima* were phenotyped under weedy and weed free condition with four checks- IR64, Sahbhagidhan, Sabita, DRR Dhan 44 and Brown gora. Weed competitive traits namely germination %, seedling length, shoot fresh weight, shoot dry weight, leaf dry weight, number of tillers, number of leaves, weed parameters, days to 50% flowering were recorded. The study revealed IL 80-2, IL 80, IL74-2, IL 40-2 and IL 179-2 to have higher seedling length and dry weight at 15 DAS and 30 DAS. *Cyanadon dactylon* was found to be most dominant with a summed dominance ratio (SDR) of 39.04, followed by *Cypress rotundus* (SDR = 19.06) and *Echinochloa colona* (SDR= 9.41). The lines KA 34, KA 74-2 and KA 40-2 were found to have comparatively high values than others lines in almost all traits. Anaerobic germination (AG) experiment carried out using IR64 (sensitive), Khao Hlan On (KHO), D 14 (NIL possessing AG QTLs) and germplasm (D20) received from ARS, Maruteru, Andhra Pradesh, showed KHO and its NIL (D14) were promising donors for anaerobic germination tolerance. These were crossed with Samba Mahsuri, DRR Dhan 44 and DRR Dhan 60. In order to transfer DSR traits, early seedling vigour traits and weed competitiveness into elite rice cultivars, crosses namely, DRR Dhan 44 × Brown Gora, DRR Dhan 44 × Sabita, Samba Mahsuri × Brown Gora, Samba Mahsuri × Sabita were effected in the current season. NIL of Pusa 44 possessing AHAS mutant allele conferring herbicide tolerance was crossed with DRR Dhan 44 and DRR Dhan 60 and F_1s seeds were harvested. Validation of AHAS mutant allele was carried out using SSR marker RM 6844.

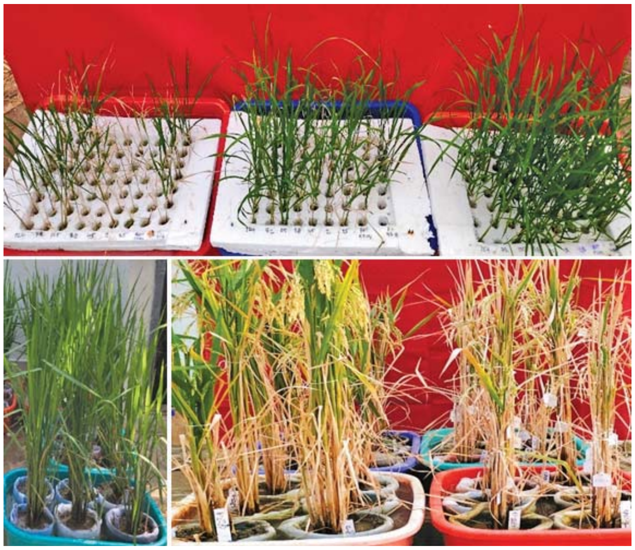


Performance of promising introgression lines in weedy and weed free conditions in direct seeded rice

GEY/CI/ BR/27: Novel Genetic approaches for development of Climate Smart Rice Varieties

Diverse germplasm lines identified for heat tolerance consecutively for two years were utilized in hybridization. The F_2 population is generated utilizing the promising donors namely Nerica L44 and Giza 178. Populations involving reproductive stage tolerance donor- Sadri was utilized in the generation of breeding material for salinity tolerance at reproductive stage in the genetic background of RP 6354, Jaya and MTU 1153. A total of 48 crosses involving diverse parents for yield, quality, heat, cold salinity tolerance, anaerobic germination, strong culm, nutrient use efficiency and quality were raised and F_2 populations were collected.

The phenotyping methodology for reproductive salinity tolerance was standardized. About 100 genotypes were phenotyped with different EC levels of EC 6 dSm^{-1}, EC 8 dSm^{-1} and EC 12 dSm^{-1} and identified the tolerant genotypes based on SES score at seedling stage and tolerance as well as yield components at reproductive stage. Populations involving reproductive stage tolerance donor- Sadri was utilized in the generation of breeding material for salinity tolerance at reproductive stage in the genetic background of RP 6354, Jaya and MTU 1153. The two-way intercrosses generated were evaluated. Approximately 207 entries of breeding material in advanced generation F_9 and F_{10} generation from 35 cross combinations were evaluated and 55 promising fixed lines and 25 bulks were selected for evaluation in preliminary yield trials. Thirty entries of advanced generation fixed lines were evaluated in station trial and identified 12 promising lines for further evaluation and multilocation testing.



Screening for salinity tolerance at seedling and reproductive stage

GEY/CI/ BR/25: Broadening the genetic base of indica rice and modify plant type by introgressing traits from Tropical japonica

Entries in AICRPR testing: Seven entries promoted and are in second year of testing (IETs 29834, 29859 and 29287 in AVT1-IM; IETs 30245 and 30241 in AVT1-LPT; IET 29219 in AVT1-IME and IET 30116 in AVT1-MS). About 14 high yielding lines were nominated in wet season, nine in *boro* and five in dry season trials of AICRPR 2022-23 testing.

Promising line K21B-26-29

Promising line No. 4432

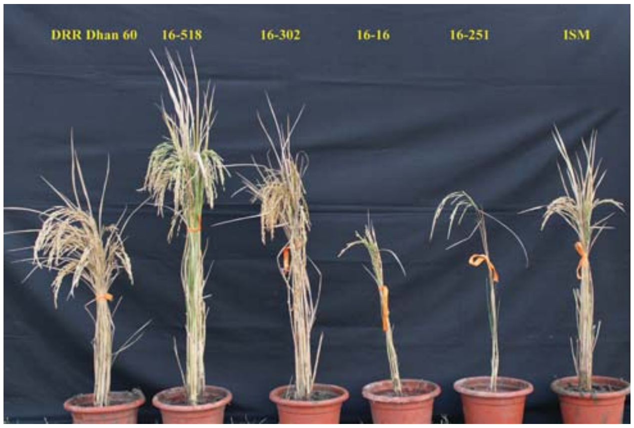
Two bi-parental mapping population for strong culm (SC) trait from the cross of Swarna/IRGC 39111 (250) and Samba Mahsuri/IRGC 10658 (189) were advanced to F_6 and F_4 generations respectively. Another population for GWAS-Association Mapping (AM) Panel was constituted with 192 genotypes.

Advanced breeding lines JBB 5952, 5960, 5962, 5964, 5966, 5967, 5973 were found to have high GN (320-472) during *kharif* 2022. Grain number in the bi-parental mapping population from the cross of DRR Dhan 48/Moudamani (612) in F_2 generation varied from 29-323 fitting in a normal distribution curve. Selections in segregating generations: Based on foreground selection with superior haplotype based SNP markers, 17 BC_2F_3 plants and 19 BC_1F_3 plants (DRR Dhan 48/NX3533) were marker positive for the trait grain yield.

An observation yield trial (OYT), a preliminary yield trial (PYT) and a multi environment trial (MET) were conducted. The test entries in all the trials comprised selections from *indica*/tropical *japonica* crosses and marker assisted multi-parent derived multiple stress tolerance ILs. In the IM group, four entries (JB 204, JBB 677-1-3, JB01802-6 and IL-19002 recorded yield advantage of 10.96 to 15.9% over NDR 359. Two entries IL-19053 and IL-19030 in the IME group, six entries *viz.,* JBB 678-2, 686-1, 672-2, 684-3, 673-3 and 660-3 in the IM group, JB L-277 in late duration and IL-19180 in the MS group outperformed best checks (IME-MTU 1010, IM-NDR 359, L-Swarna and MS-DRR Dhan 53) with respective duration/ grain type. MET experiments were conducted with eight test entries and one check in six environments. Significant G X E interactions were observed. G9 (JBB 1325) is the ideal genotype followed by G7 (JBB 680-4) and G1 (JBB 689-1). G8 (JBB 674-1) followed by G7 (JBB 680-4), G6 (JBB 683-1) and G1 (JBB 689-1) are the generally adapted genotypes Mean performance of the genotypes across the environments varied from 7979 kg/ha (G9-JBB 1325) to 3850 kg/ha (Swarna). All the eight test genotypes recorded mean grain yield of more than 6 t/ha with an average of 6877 kg/ha.

GEY/BR/24: Breeding high yielding rice cultivars tolerant to low soil phosphorus and nitrogen

A total of 350 germplasm lines were screened. The plants were nourished with basal application of N and K, followed by top dressing with N at maximum tillering stage without the application of phosphatic fertilizer. The soil P levels were monitored during transplanting, maximum tillering and grain maturity stages. The genotypes exhibited a vast amount of variability for the yield attributing traits under low soil P conditions. The values for plant yield ranged from 3 g (F5 MSAC 29-18) to 74 g (16-518) with a general mean of 26.34 g in low P conditions. The roots were sampled from low Phosphorous plot at maximum tillering stage and Root dry weight (RDW), Shoot dry weight (SDW), Shoot length (SL), Root length (RL), SFW (Shoot Fresh Weight), RFW (Root Fresh Weight), Root volume (RV) were recorded.



Genotypes evaluated under low P conditions for yield

Performance of genotypes for shoot and root traits under low P

190 RILs along with parents (Rasi and Improved samba mashuri) were screened under very low soil P plot (Available P<2 Kg ha^{-1}) and normal soil P conditions (available P>18 Kg ha^{-1}). Days to fifty percent flowering increased in the low soil P condition in the RIL population. The plant height and productive tillers of the RILs drastically decreased in the low soil P in comparison to the normal soil P. There is also a considerable reduction in the flag leaf length, flag leaf width, root length, shoot length, root volume and panicle length. The shoot length and the root length showed a significant variation among the RILs both in low and normal soil P conditions and exhibited decline in the length of the root and shoot of the plant and a significant decrease in grain yield.

GEY/CI/ BR/28: Genetic Enhancement of Specialty Rices of India

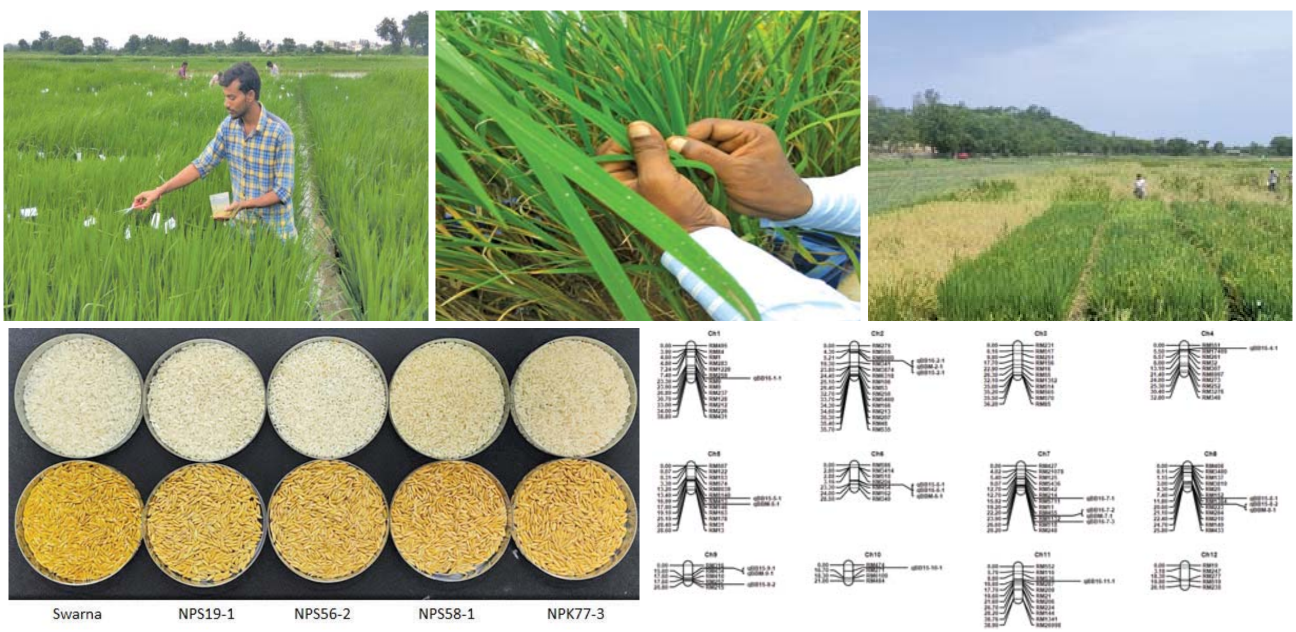
A total of 101 coloured rice germplasm were collected from various sources, characterized for agro-morphological and yield related traits in the field. 15 crosses were made using selected speciality rices with different donors having favourable genes/ QTLs. 6 introgression lines homozygous for bacterial leaf blight, blast resistance and yield enhancing genes in the genetic background of Swarna; 8 introgression lines similar to recurrent parent (MTU1010) and homozygous for yield enhancing genes and 16 introgression lines in the genetic background of MTU1121 with tolerance to phosphorous, bacterial leaf blight and blast resistance were evaluated. Backcross derived lines in the genetic background of Jaya (30 BC_2F_1 and 6 BC_1F_3) were also evaluated. A total of 118 crosses were made, 250 advanced populations were generated and 48 station trial entries were evaluated. 1583 germplasm consisting of lines collected from different states of India, IRRI Philippines, green super rice lines, INGER lines were evaluated and maintained. Total of 572 donor lines identified in AICRPR screening were also maintained.

Coloured rice germplasm screening

GEY/CI/BR/30: Breeding high yielding stress tolerant rice varieties using interspecific wild introgression lines derived from *Oryza nivara* and *Oryza rufipogon*

Low P tolerant variety DRR Dhan 65 was identified as promising climate smart variety with both biotic and abiotic stress tolerance by CVRC and notified and released for Andhra Pradesh, Telangana, Chhattisgarh and Punjab. 290 BC_2F_{10} materials derived from *viz*., Swarna / *O. nivara* IRGC81848, Swarna / *O. nivara* IRGC81832 and KMR3 / *O. rufipogon* WR120 were characterised for yield traits. 60 crosses were developed for generation of mapping populations and selection of improved lines from wild, landraces and elite cultivars having high yield and seedling vigour. Five introgression lines entered in AICRPR trials were promoted to AVT1. Two secondary F_2 mapping populations were developed to fine map grain weight based on QTL mapping in Swarna/ *O. nivara* IRGC81848 and Swarna / *O. nivara* IRGC81832 for 3 years.

Phenotyping carried out using 516 F_2 derived from Swarna x NPK61 and further genotyping by sequencing data using 22 high grain weight and 22 low grain weight genotypes showed *Os03go103400* which encodes GRAS transcription factor could be the causative gene for QTL *qTGW3.1* (RM231-RM16-RM251) with a PVE of 48%. Novel QTLs for bacterial blight resistance, *qBB-10-1* and *qBB-12-1* were identified as candidate genomic regions for further fine mapping and can be utilized for enhancing BB resistance in elite rice genotypes. Novel QTLs for false smut resistance were identified in chromosome 4, 6, 7, 10, 11 and 12 using 1 K SNP genotyping and phenotyping from 3 years' data. Genotypes NPS3, NPS8, NPS13, NPS21, NPS25, NPS99 were found to show tolerance to infection with low number of smut balls. Among 100 germplasm tested, HWR – 42, Danteshwari, Sampada, C.G. Zn Rice-2, HWR – 36, Vasumati, Anjali and PTB62 showed high *Fe* content ranging from 12.6-10.1ppm and Zinco Rice M S, Trimbe C.G., Dubraj Mutant-1, Shymala, Kasturi, IGKV R2, Durgeshwari, C.G. Zn Rice-2 and Danteshwari showed high *Zn* content ranging from 30.8 -25ppm.

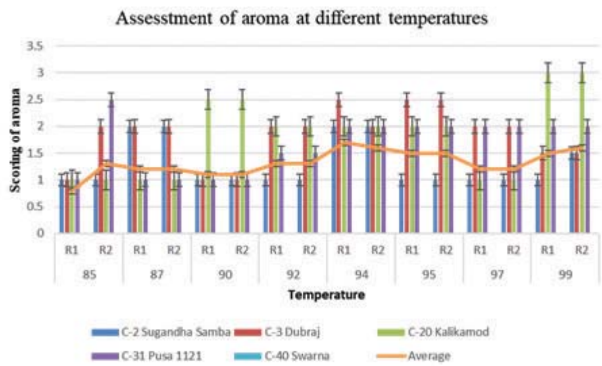


Novel QTLs for bacterial blight resistance identified from Swarna/ ***Oryza nivara*** BILs

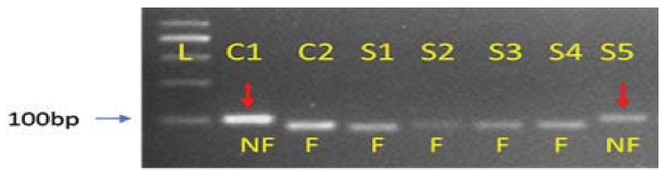
GEY/CI/ BR/10 Breaking the yield plateau in native aromatic short and medium grain rice through classical and molecular breeding

New crosses were attempted using Ketkijoha, TCVM-1, GAR1, Jeerabattis, BRRI Dhan 75, Pusa Basmathi 1121, Dhanguri, HUR 4-3. Advanced breeding lines were evaluated for morphological traits. Four lines *viz., SRB-2202-7-14*-Q1, SRB-2202-7-26-Q7, SRB-2202-7-35-Q11, SRB-2202-7-41-Q29 were identified to have good yield, grain quality and with moderate aroma with grain type varying from medium slender to short bold. New modified methodology of identification of aroma using PCR tube method was standardized.

The method is of high relevance when large number of limited amounts of sample needs to be evaluated in lesser time period and in a cost-effective manner with low man power. Five samples of aromatic and nonaromatic rices *viz*., Sugandha Samba (S1), Dubraj (S2), Kalikamod (S3), Pusa Basmathi 1121 (S4) and Swarna (S5) along with C1 (BPT 5204) and C2 (Shobini) as negative and positive checks respectively were analysed for presence or absence of aroma and also the intensity of aroma with different treatments of temperature, time period, grain number, type of plant sample. The method was validated against advanced breeding lines and aromatic lines using KOH method and molecular marker *BADEX7-5* which identifies 8bps deletion in exon 7 of Chromosome 8S. The results of the method showed collinear results with KOH method and with molecular marker *BADEX7-5*. The method which will be re-evaluated further.



Assessment of aroma over a temperature scale



Amplification pattern of BADEX7-5 in fragrant (F) and non-fragrant (NF) rices

Hybrid Rice

GEY/CI/HY/13: Development and evaluation of three-line hybrids with better grain quality and resistance to major pests and diseases

Seven hybrids *viz*., IIRRH 150, IIRRH 151, IIRRH 152, IIRRH 153 (IHRT-E); IIRRH 148, IIRRH-154 (IHRT-ME); IIRRH 154 (IHRT-M) were nominated to AICRPR trials. Of the 106 promising lines developed from *indica* (Parental lines) and tropical *japonica* crosses, based on molecular screening results, 13 genotypes with both Rf_3 and Rf_4 were selected and test crossed with four CMS lines. A total of 52 hybrids were developed by crossing 13 genotypes with four CMS lines namely IR68897A, IR79156A, APMS6A and PUSA5A in L X T fashion. The resulting 52 hybrids along with 17 parents and 8 checks were evaluated for 14 yield and yield related traits for combining ability and heterosis studies. Among testers, PUSA5A was identified as good general combiner for majority of the yield and yield related traits. Among lines, IJD28 for single plant yield and biomass; IJD38 for productive tillers, total number of tillers, panicle exsertion ratio, pollen fertility and spikelet fertility per cent; IJD13 for panicle length, panicle exsertion ratio and thousand grain weight; IJD4 for thousand grain weight; IJD30 for pollen fertility, spikelet fertility and biomass were identified as good general combiners. The two best hybrids were identified based on sca and gca effects and mean performance PUSA 5A X IJD13 for panicle length, spikelet fertility, single plant yield, biomass and per day productivity and PUSA5A X IJD75 for days to 50% flowering, single plant yield, harvest index and per day productivity.

GEY/CI/HY/15: Genetic enhancement of parental lines suitable for aerobic and tolerance to salinity conditions through conventional and molecular approaches

DRRH 4 (IET 27937) world's first aerobic hybrid, (S.O. 4065(E). dt 31st Aug, 2022) and DRR Dhan 64 [IET 28358 (RP 5599-212-56-3-1)], an early maturing (115-120 days) and N use efficient rice variety (S.O. 4065(E). dt 31st Aug, 2022.) were released and notified. The hybrid IIRRH-115 (IET 27847) was promoted in AVT1-CSTVT trial and will be evaluated in AVT 2 of CSTVT trial. APMS6B possessing BB and PuP1 introgression lines was converted into new CMS line. Parental lines namely RP6338-9 and RP5593-83-12-3-1 (MTP-1)/IET26168 for high temperature and sodic conditions respectively were registered with NBPGR. Identified parental lines and hybrids for heat tolerance with different staggered sowing and two BILs derived from KMR3/N22 namely RP6338-24 and RP 6338-155 under high temperature stress with high Zinc content (>30ppm). Based on station trial evaluation, the new hybrid combinations namely PSV 6363, PSV 3401, PSV 5733, PSV 4581 and PSV 8172 were included in station hybrid trial for evaluation. New hybrids included in seed production trials namely APMS6A/PSV7272, APMS 6A/NPVR 11, APMS6A/PSV 4564, APMS6A/PSV3366 for nominations for AICRPR in aerobic and salinity trials respectively. MABB derived restorer lines namely RP 6340-NPVR-32 & RP 63340-NPVR 1 possessing drought tolerant QTLs (*qDTY12.1, qDTY2.3, qDTY1.1* and *qDTY6.1*), RP 6341-VTCP 56, RP 6341-VTCP45 possessing Saltol, RP 6342-MB44 and RP 6342-TCP2 possessing SUB1 and RP 6343-BP10-5 with *Xa21, Xa38* + *Pup1* in the background of APMS6B were promising introgressed lines and will be registered as novel genetic stock with tolerance to different abiotic stresses and also utilized in development of hybrids for unfavourable ecologies.

GEY/CI/HY/: Development and evaluation of biotic stress-resistant restorers and their hybrids for yield and grain quality traits by conventional and molecular approaches in rice

The improved restorer lines with multiple stress resistance/tolerance were genotyped with the help of SNP markers and lines having multiple stress tolerance genes were identified. A total 752 lines were genotyped using low density 10 SNP panel for the genes *viz., Pi-ta, Xa-21, DTY 3.1, Rf4*, Saltol, *DTY-2_2, DTY3-2, NAS3_2, Pi54* and IR 36 ms (male sterility). The results were utilized in selecting restorer lines for developing experimental rice hybrids for heterosis and grain quality analysis. Potential restorers with biotic and abiotic stress resistance/tolerance were utilized in three-line hybrid rice breeding and experimental rice hybrids were developed and evaluated in the multi locations. A total of 20 R X R crosses for targeting traits *viz.*, yield, multiple stress tolerance and grain quality were taken up. 760 improved restorer lines were genotyped with 1K RiCA mid-density SNP genotyping panel consisting of roughly 800 genome-wide markers, 22 quality-control markers and up to 200 trait markers, distinguishing 87 high-value genes and QTLs. The high-yielding, low P tolerance (LPT) genotype RP5964-82 (IET 28821) derived from the partial restorer improvement program is under final year of testing in the AICRPR AVT-2 LPT trial. The improved restorer lines with blast resistance genes *viz., Pi9, Pi54* and *Pi54+Pi9* were evaluated in the disease screening nursery. The lines RP 6617-58 (PRS 58), RP 6617-59 (PRS 59) and RP 6619 (PRS 17) were derived from RP 5933-1-19-2 R X *O. minuta (Pi9)*. The line RP 6618 (PRS 50) was derived from the cross RP 5933-1-19-2 R X Tetep (*Pi54*). By utilizing hidden genes from wild species *viz., O. rufipogon* and *O. nivara*, development of pre-breeding lines for improving hybrid rice parental lines for genetic diversity and out crossing, biotic and abiotic stress tolerances are under progress.

GEY/CI/HY/16 - Genetic improvement of maintainer for biotic stress and yield enhancing genes

There were 350 test crosses evaluated in test cross nursery during 2022 and identified 65 maintainers which includes TCP 3901, 3905, 3912, 3916, 3921, 3922, 3924, 3927, 3959, 3966, 3970, 3971, 3972, 3974, 3980, 3981, 3984, 3987, 3988, 3990, 3994, 4007, 4033, 4034, 4035, 4054, 4057, 4081, 4095, 4097, 4099, 4104, 4105, 4106, 4110, 4124, 4136, 4137, 4139, 4141, 4142, 4155, 4162, 4163, 4165, 4166, 4169, 4170, 4173, 4180, 4194, 4205, 4208, 4209, 4210, 4211, 4212, 4213, 4214, 4224, 4225, 4228, 4338, 4344, 4348, 4349. The genetically improved for out crossing ability (stigma exsertion), bacterial leaf blight, blast, elongation of upper internode (eui) and low phosphorous tolerance promising maintainers were converting into CMS lines and which are in different back crosses in different maintainer line back ground includes IR 58025B, IR 79156B and APMS-6B. Based on previous season morphological and molecular data, there were 24 plants were grown from plant to progenies row and visual selection was imposed on BC_3F_2 population.

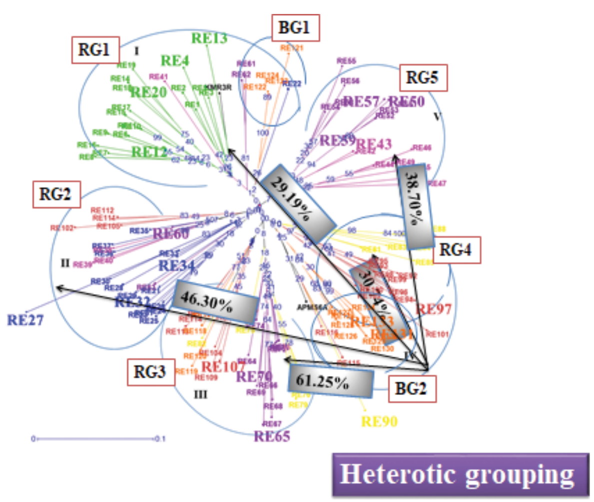
GEY/CI/HY/14 - Establishment and validation of heterotic gene pools in hybrid rice

16 R lines from the clusters (1, 2, 3, 4 and 5) formed based on molecular genetic distance (SSR Based) and

two CMS lines (APMS6A and IR59156A, from cluster 4) were selected and the test crosses were attempted in LXT mating fashion. The generated 32 hybrids were evaluated. Significant differences among all the crosses for all the nine traits were observed. Nine yield traits were recorded for all the hybrids, parents and along with the six checks. Based on combing ability analysis, among lines, APMS6B was identified as a best combiner for PT and UFG and IR79156B was identified as a best combiner for majority of the traits. Best combiners among testers were identified based on significant General Combining Ability. Among 32 evaluated hybrids, 19 hybrids were identified with significant positive standard heterosis over six checks for single plant yield. Correlation between hybrid grain yield, molecular genetic distance, specific combining ability, mid parent grain yield and better parent grain yield was studied. Significant positive association was observed between HGY and SCA. All the marker group combinations have shown positive average standard heterosis. Among 5 group combinations, RG3 (Restorer Group 3) X BG2 (Maintainer Group 2) group combination has given higher heterosis average over the best check (Gontrabidhan-3) for grain yield. For the development of standard heterotic groups and to correlate with SSR/SNP based grouping and Morphological trait-based grouping, the available parental lines along with few promising varietal and hybrid checks were subjected to high throughput genotyping (IKRICA SNP Genotyping through INTERTEK). From the clusters generated based on SSR and SNP genotyping and morphological characterization, 24 R lines and three CMS lines (APMS6A, IR79156A and CRMS32A) were selected and generated 72 hybrids in LXT mating fashion. All the marker group combinations have shown positive average standard heterosis, among 5 group combinations, RG3 (Restorer Group 3) X BG2 (Maintainer Group 2) group combination has given higher heterosis average over the best check (Gontrabidhan-3) for grain yield.

Marker group combination wise average Hybrid Grain Yield (HGY), Molecular Genetic Distance (MGD), Specific Combining Ability (SCA) and Standard Heterosis (SH)

Marker group Combination	AVG HGY (g)	MGD	SCA	Yield Advantage (%)					
				Gontrabidhan (15.33 g)	NDR359 (10.53 g.)	CO-51 (14.03 g)	US314 (14.30 g)	US312 (9.03 g.)	HRI174 (13.40 g.)
RG1 X BG2	19.80	0.24	-0.93	29.19	88.01	41.11	38.44	119.24	47.74
RG2 X BG2	21.03	0.25	3.47	46.30	95.72	46.89	44.12	128.23	53.80
RG3 X BG2	22.10	0.26	1.74	61.25	109.90	57.54	54.57	144.78	64.95
RG4 X BG2	20.98	0.23	-3.274	30.74	90.27	42.80	40.11	121.87	49.52
RG5 X BG2	18.85	0.22	0.83	38.70	101.8	51.50	48.60	135.30	58.60



Marker group combination wise average heterosis

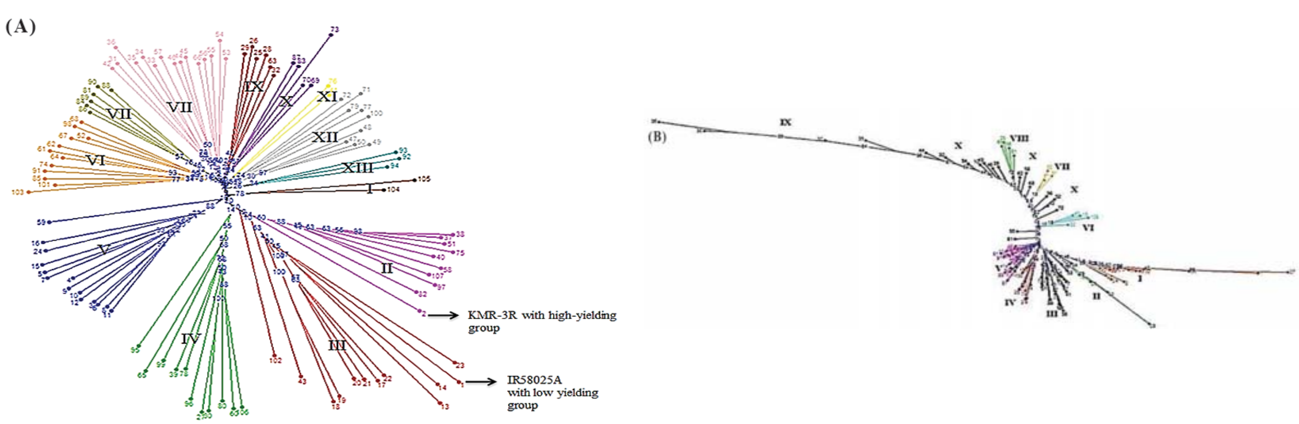
ABR-Application of biotechnology tools for rice improvement

ABR/CI/BT/17: Application of genomic, transcriptomic and proteomic tools for understanding and improvement of yield heterosis in rice hybrids

Divergent restorers for development of heterotic hybrids, were identified from recombinant inbred lines (RILs) derived from KRH-2. The genetic diversity and fertility restoration loci (*Rf*) based population structure was assessed using a combination of expressed sequence tag (EST)-derived and genomic simple sequence repeat (SSR) markers. Most of the high yielding RILs were observed to possess the major fertility restorer genes, *Rf3*-*Rf4,* while the low yielding RILs had only the *Rf3* locus. Selected genetically diverse high and low yielding RILs were test crossed with the female parent IR58025A, to test their fertility restoration ability and heterosis in hybrids. Novel hybrids derived from the test-crosses between high yielding RILs, namely RIL-1, RIL-12 with IR58025A, demonstrated significant positive standard heterosis for total grain yield/plant over varietal checks Akshayadhan, Varadhan and hybrid check KRH-2. Likewise, the hybrid derived from the lowest yielding RIL-24 (IR58025A/RIL-24), was observed to be significantly positively heterotic over the checks. Agro-morphological evaluation of these better-yielding novel test-cross derived hybrids demonstrated their statistical significance ($p < 0.05$) for the traits *viz*., total grain yield per plant, panicle weight, productive tillers, 1,000 grain weight, filled grains per panicle. The assessment of parental genome recovery of IR58025A and KMR-3R among the selected high-low yielding RILs with 126 genomic and EST-derived SSRs demonstrated higher proportion of KMR-3R's genome in high-yielding RILs. at least by 10%. Further, single nucleotide polymorphism (SNP) genotyping of high and low yielding RILs identified signature allelic changes which contributed for conspicuous yield differences among them. A strong correlation was observed between the SNP score and YLD of the novel hybrid, supporting the hypothesis that higher the number of significant SNPs in RIL, higher is the magnitude of standard heterosis in novel hybrids, corroborating the test cross data.

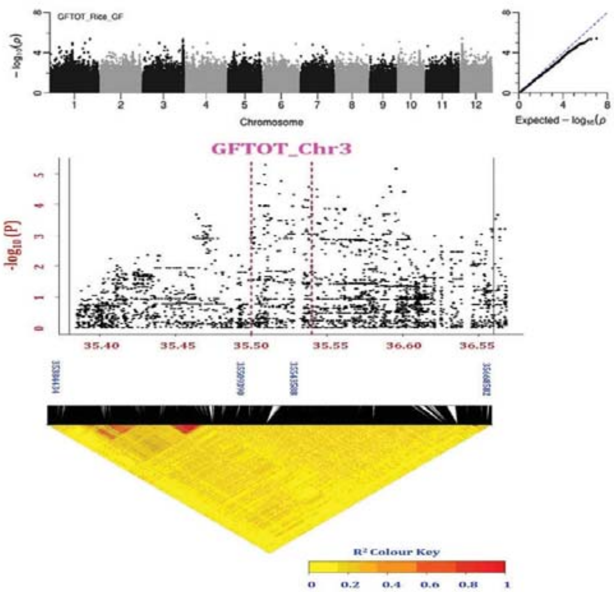
ABR/CI/BT/6: Identification of genes for grain filling in rice (*Oryza sativa*)

A set of 188 rice accessions from the Rice Diversity Panel 1 (RDP1) was evaluated at two environments for their panicle architecture, 13 promising genotypes with ≥ 50 grains on lower secondary (GLS) of the panicle were identified. Genome-wide association mapping using 5.2 M SNP dataset has identified marker trait associations for different panicle traits, especially for spikelets total (STOT) on chromosome 6, grains total (GTOT) on chromosome 4 and grain filling % total (GFTOT) on chromosome 3 and 12. Novel significant QTL was identified for grains secondary (GS) on chromosome 4 at 5.98 Mb. Candidate genes underlying the QTLs within in the linkage disequilibrium (LD) of 205kb were explored



Cluster diagrams based on molecular and morphological data using weighted neighbour joining (NJ) method. **A**. Radial tree showing the molecular clustering of parents, IR58025A, KMR-3R and 105 KRH-2 derived RILs into 13 clusters. **B**. Weighted neighbour joining (NJ) tree showing morphological clustering of KRH-2 derived 105 RILs in 10 clusters.

for three traits STOT, GTOT and GFTOT. For GFTOT, the candidate gene *LOC_OS3g62720* (35.494 to 35.497Mb/35,494058 to 35,497784), harbouring 23 SNPs, was found to be associated with high expression in the reproductive tissues, especially in pistil (RGAP database). Of 23 SNPs, three were non-synonymous at 35,496,399bp (A/G polymorphism), 35,497,210bp (G/A polymorphism,) and 35,497,424bp (G/A polymorphism) with amino acid substitutions from Ile(I) to Met (M); Met (M) to Ile (I) and Arg(R) to His(H). Three haplotype groups, haplotype A (n=81), haplotype B (n=19) and haplotype C (n=16) were formed and significant association was observed for both GFTOT. Haplotype A (GFTOT 71.7%) was found to be superior group than haplotype B (GFTOT 63.9%) and C (GFTOT 71.3%).



Local Manhattan plot (top) and LD heat map (bottom) of QTL on chromosome 3 for grain filling total (GFTOT)

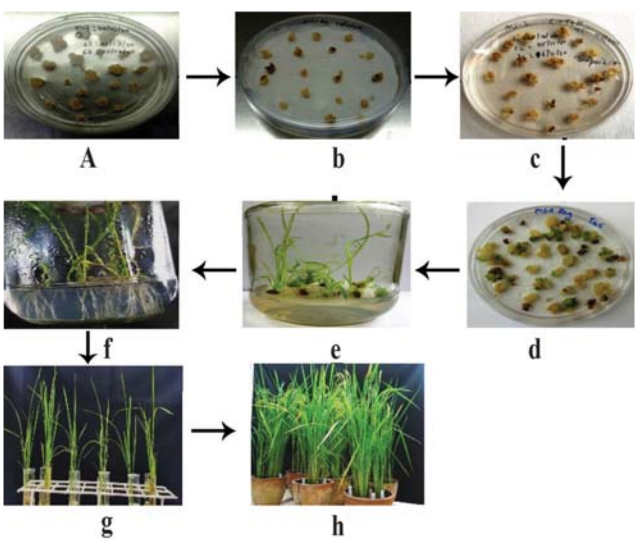
ABR/CI/BT/17: Transcriptomics and cloning candidate gene *OS10G0416500* for sheath blight resistance

A promising candidate gene *OS10G0416500* encoding a novel chitinase was identified for sheath blight disease resistance using whole-genome transcriptome and qRT-PCR analysis previously. *Os10g0416500* (named as *Oschib1*) is a PR-8 protein (Class III chitinase1), a Glycohydrolase18 (GH18) class member. It is having only one exon without any intronic region. The Tetep allele of this gene was amplified using RT-PCR. The complete gene was cloned into pENTR vector and then subcloned into plant transformation vector pGWB5 using Gateway cloning. Then the plasmids were sent for sequencing to check the orientation of the cloned gene. After all these confirmations, the plasmid pGWB5: *Oschib1* was mobilized to the *Agrobacterium* LBA4404 strain. The embryogenic calli were produced from Taipei309 rice seeds with MS modified media. Round and globular compact embryogenic calli were co-cultivated with *Agrobacterium* (LBA4404) harbouring pGWB5: *Oschib1* for 48 hrs in the dark. After three rounds of selection, the calli was shifted to regeneration media for shoots induction and then in rooting media for roots development. The plantlets with roots were later transferred to Yoshidha media for hardening and later transferred to biosafety glass house for hardening in soil. The plants were raised for three months and the putative T_0 plants were analyzed for PCR confirmations. PCR confirmations were done using primers specific to *Oschib1* gene, 35S promoter, hygromycin (*hyg* or *hpt*) and green fluorescent protein (gfp). Fifteen plants showed positive PCR bands with all primer combinations in T_0. The transformation efficiency was 9.09%. Further, these 15 plants were selected for segregation analysis.

Hundred seeds from each of the 15 transgenic lines (T_1) obtained from putative transformants (T_0) were germinated on the ½ strength MS basal medium containing 35 mg/l hygromycin. Out of 15 lines (T_1), only 10 lines showed monogenic Mendelian segregation with a ratio of ~3 hygromycin resistant: ~ 1 susceptible, indicating these are single-copy T-DNA integration transformants and considered as homozygous for *hpt* gene. After segregation analysis, again PCR confirmation was done in T_1 transgenic lines. Among the 10 monogenic lines, 3 lines obtained from three independent batch of transformation were selected for further evaluation based on the transgene expression. The transgene relative expression levels were up-regulated in RS-NT1-65-3, RS-NT1-69-1 and RS-NT1-144-1 with 5.63, 4.85 and 7.45-fold respectively, when compared with non-transgenic plants.

Detached leaf bioassay was adapted to screen the transgenic plants against sheath blight pathogen *R.*

solani. The transgenic lines RS-NT$_1$-65-3, RS-NT$_1$-69-1 and RS-NT$_1$-144-1 showed significantly lower disease symptoms than non-transformed plants. The size of the lesions on the leaves RS-NT$_1$-65-3, RS-NT$_1$-69-1 and RS-NT$_1$-144-1 was found to be lesser than the non-transgenic control. The non-transgenic control plants showed larger yellow infected lesions, which turned brown after four days of infection. These plants were screened for sheath blight resistance with highly virulent *R. solani AG-1-IA*. After 6 days, the disease incidence was higher in control plants and the disease score was 7. The transgenic lines RS-NT$_1$-69-1and RS-NT$_1$-144-1 showed disease of 1.0. The transgenic lines showed significantly lower disease symptoms than non-transformed plants Symptoms appeared as oval-shaped, light-grey to dark brown lesions on the leaf sheath. In control the symptoms were present in higher portion of the sheath and many necrotic lesions were appeared in contrast to T$_1$ lines.

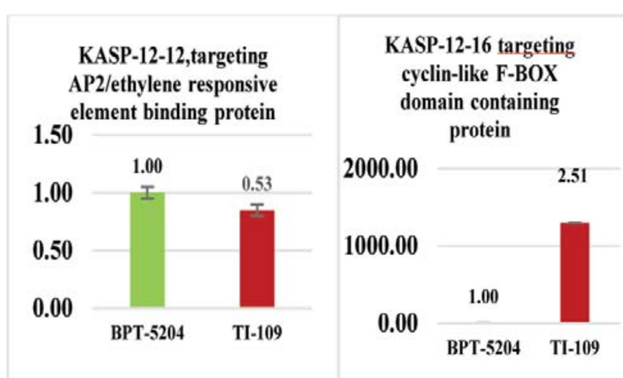


Schematic representation of rice callus (Taipei309) transformation with Agrobacterium mobilised chitinase gene from callus induction to hardening of plantlets. a) callus produced from seed b) co-cultivation of callus with Agrobacterium (LBA4404) c) Callus kept in selection media d) Regeneration of plantlets e) Shoot induction f) Root induction g) Plantlets in Yoshida media for hardening h) Hardening of rice plants in soil

ABR/CI/BT/16: Exploring the mutant resources for rice improvement

A total of 417 transcripts were up regulated and 367 were down regulated in the CPE-109 compared to the wild type. 21 differentially expressed genes (DEGs) were found in the four genomic regions identified through QTL-seq. 17 genes were up regulated and 4 genes were down regulated. Among the down regulated genes, *Os12g0126300* codes for AP2/ethylene responsive element binding protein was only present and rest 3 genes are hypothetical. Similarly, DEGs were also found in the four QTLs identified through linkage mapping**.** Transcriptome analysis also revealed that a number of transporters, plant hormone related functions, an auxin regulated protein - *Os07g0486500*, a GA3 regulated gene *Os06g0569900 (ent-kaurene synthase)*, two cytokinin related transcripts - *Os07g0486700* (cytokinin-O-glucosyltransferase2), *Os10g0479500* (cytokinin riboside 5′-monophosphate phosphoribo hydrolase) were upregulated and one ethylene biosynthetic gene ACC synthase (*Os01g0192900*) ethylene responsive factor-2 (*Os05g0497300*) and one cytokinin signalling pathway transcript (*Os04g0442300*) were down-regulated in the mutant.

The two SNPs KASP 12-12 (Chr12:1.26Mb) and KASP 12-16 (Chr12:1.51Mb), showed a tight association with CPE trait in the F$_2$ population (n=200). The marker KASP12-12 having mutation in AP2/ethylene responsive element binding protein (*Os12g0126300*) and KASP 12-16 marker having the mutation in F-box domain-containing protein (*Os12g0131400*) were validated with advanced breeding lines (BC1F6) (n=29), entire F$_2$ population (n=200) derived from the cross CPE-109 Vs BPT, other CPE mutant lines (n=12) and with other released rice varieties exhibiting complete panicle exertions. The marker KASP12-12 also showed linkage in the F$_2$ population derived from the mutant crossed with RPHR 1005 and hence is considered as a reliable marker for CPE trait.



Expression analysis of the genes, whose makers showed association

ABR/CI/BT/19: Elucidation of long non-coding RNAs and association of molecular markers for important root traits under aerobic condition

The long non-coding RNAs lncRNA) (>200 nucleotides, not encoding proteins) were expressed significantly under the aerobic condition in CR Dhan 202 and BPT 5204 in the previous study related to RNA-seq data of roots and shoots. To understand the differential expression and molecular mechanism of lncRNAs under aerobic condition, the roots of the earlier identified line having robust root system architecture, early vigor (TI-128) *viz*., BPT 5204 and CR Dhan 202 were sequenced for lncRNAs at the panicle initiation stage under controlled aerobic condition in three biological replications. The rRNA reads were depleted (rRNA removal using QIAseq FastSelect rRNA Plant Kit) and mRNA was enriched for lncRNA sequencing on Illumina NovaSeq 6000 platform. Thirty million reads emanated from each sample on average were aligned to the reference and the extracted non-coding RNAs (coding potential = 0) are being deployed for studying the differential expression of lncRNA in the three lines. The earlier identified SNPs have an index near to one and functional relevance to root-related traits from the MutMap QTL-seq data were validated using Kompetitive Allele Specific PCR (KASP) assays in the lines showing extreme phenotypes (root volume/ length in F_2 mapping population), North-eastern landraces, aerobic and anaerobic released varieties and BPT-5204 mutants showing high root length and volume. The KASP SNPs at 3243938th position C/T (Chrm 12 effected genes *OsACTPK6* act domain-containing protein kinase 6-actpk1 - *OsFbox646;* intergenic_ region) and 23181622nd position C/T (Chrm 2 effected genes, *Os02g0597000* Regulator of chromosome condensation, RCC1 domain-containing protein; downstream_gene_variant) significantly associated with the desired robust root phenotypes. These markers can be further deployed on a larger set of germplasm for association studies in relation to root system architecture, dry direct seeded establishment, aerobic rice adaptation-related traits in rice. The North-eastern lines showing the robust root system architecture and early vigour have been crossed with MTU 1010 and mapping populations have been developed for the validation of the earlier identified marker-trait associations for root traits.

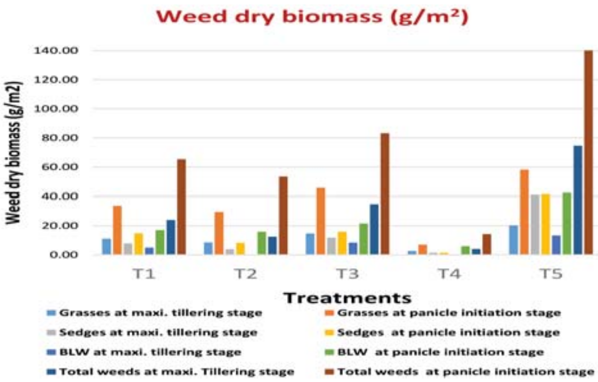
RUE - Enhancing resource and input use efficiency

RUE/CP/AG/11: Strategic research on enhancing water use efficiency and productivity in irrigated rice system

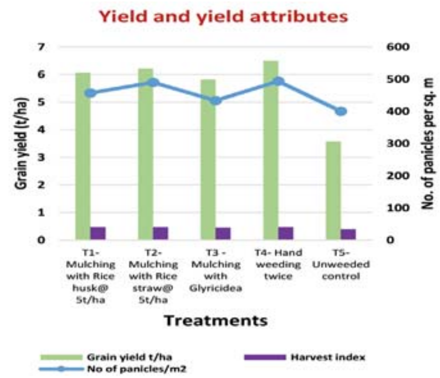
Iron coated seed found significantly promising over untreated in terms of yield attributes and seed treatment with *Trichoderma* species was on par with iron coated seed in three methods of cultivation. Under direct seeded rice, the performance of Fe coated seed was significant under 1-2 cm water level condition caused by unpredicted rains. Alternate wetting and drying (AWD) saved 15 per cent of total water requirement during crop growth period. Among the systems of cultivation, mechanised SRI method required the lowest amount of water (12.2% and 14.3% less of mean applied water than drum seeding and normal transplanting, respectively). Hydroponic nursery raised in trays was used for mechanised transplanting to test for its suitability for mechanized transplanting in SRI. The yields are on par (6.12 t/ha and 6.07 t/ha) in both the situations mat and hydroponic nursery. Hydroponic nursery was suitable for SRI without any yield reduction and makes it convenient for year round seedling production.

RUE/CP/AG/18 Development of Climate smart and economic weed management technologies for changing rice establishment systems

The weed flora recorded in the trial included *Echinochloa crusgalli*, *Cyperus difformis, Cyperus rotundus, Eclipta alba*. *Ammania baccifera, Marsilea quadrifoliaetc.* Weed population showed group wise dominance of Grasses-Sedges-Broad Leaf Weeds (BLW) at 30 DAT, Sedges-Grasses-BLW at 45 DAT and BLW-Grasses-Sedges at 60 DAT. With the objective of working out the feasibility of reducing chemical herbicide usage in weed control of aerobic rice system, the trial was conducted during *kharif* 2022 with five treatments and four replications in Randomized Block Design. *viz*., mulching with rice husk @ 5t/ha, mulching with rice straw @ 5t/ha, mulching with *Glyricedia*, hand weeding twice and unweeded control. The lowest weed population and weed biomass was recorded in the treatment mulching with rice straw @ 5t/ha. at maximum tillering and panicle initiation stages Mulching with rice husk @ 5t/ha was found to be 2nd in the order.



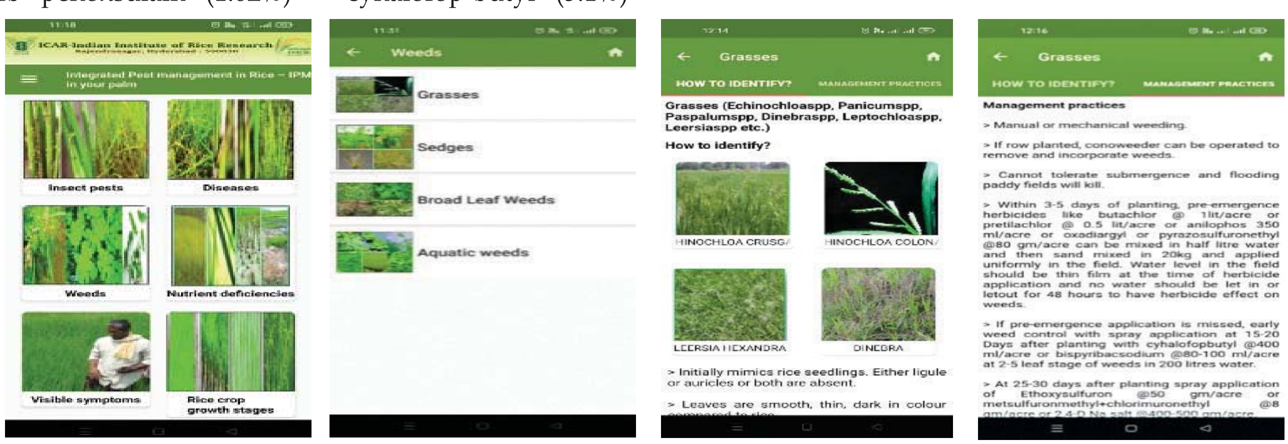
Weed dry biomass (g/m²)of sustainable weed management in aerobic rice system, *kharif*-2022



Yield and yield attributes of sustainable weed management in aerobic rice system, *kharif*-2022

Among the Post emergence herbicides/ combinations tested, pre-emergence herbicide pretilachlor 50 EC @ 500g a.i./ha was found superior over pyrazosulfuron ethyl 70% WDG @ 21g a.i./ha. The combination herbicide penoxsulam 1.02% + cyhalofop-butyl (5.1%) ready mix @ 150g a.i./ha, triafamone 20%+ ethoxysulfuron 10% WDG @ 67.5g a.i./ha, florpyrauxifen-benzyl (2%) + cyhalofop- butyl (10%) ready mix @ 150g a.i./ha recorded higher weed control efficiency, lower weed flora, lower weed density, lower weed dry biomass, higher crop growth parameters, yield attributes, grain yield kg/ha, straw yield kg/ha and comparable to hand weeding twice at 20 and 40 DAS. Sequential application of pretilachlor 50 EC @ 500 g a.i./ha as pre-emergence within 3 DAS fb penoxsulam (1.02%) + cyhalofop-butyl (5.1%) ready mix @ 150 g a.i./ha as post-emergence at 15- 20 DAS was identified as the economically feasible post-emergence herbicide combination for broad-spectrum weed control in wet direct seeded rice.

Content of Weed Management for development of Rice IPM App in English language- Farmers friendly Weed Management module of different rice establishment systems was generated and contributed for Rice IPM app English version. In this module from basic information of Pests, Weeds in Rice cultivation, Different groups of weeds, critical period of weed competition in different establishment methods, different control methods, chemical herbicides for effective weed control, Integrated Weed Management etc were provided when using the mobile App.



Weed management in rice with IPM mobile app

The farmers field monitoring in districts of Telangana, indicated a weed shift. Over the years, the grass weed (*Leptochloa*) is becoming major problem and the herbicides available with local dealers are not able to control it. Similarly, *Paspalum* spp., *Cyanotis* spp. are the difficult to control dominant weeds. In Nellore and Tirupati districts of Andhra pradesh, in direct sown rice, the farmers are facing similar weed.

Monitoring Weed shift in broadcast seeded DSR in Marlapadu Village, Telangana State

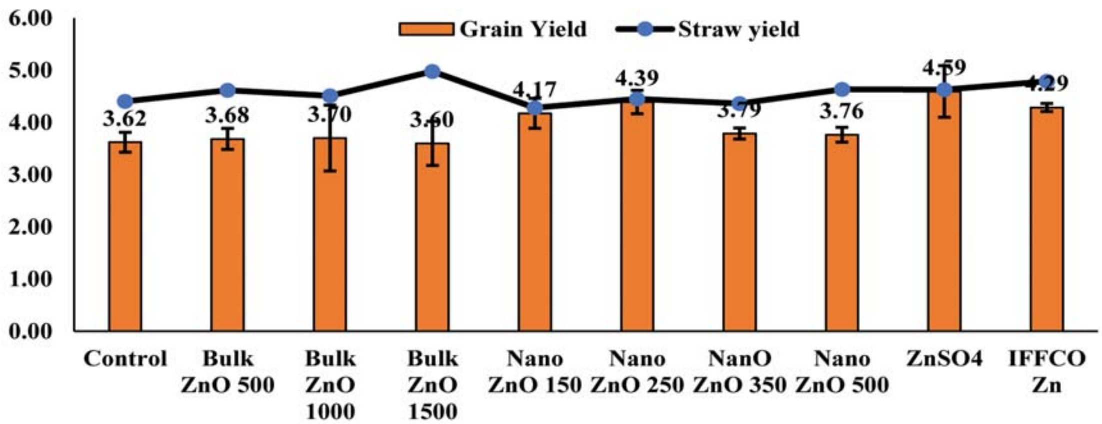
RUE/CP/SS/21: Exploiting soil legacy phosphorus and enhancing phosphorus use efficiency in irrigated rice

The study aims at utilization of soil legacy phosphorus as well as improving fertilizer phosphorus use efficiency. Field experiments were conducted to evaluate various phosphorus management strategies *viz*., addition of phosphorus solubilizing bacteria, addition of phosphorus activators (humic acid) and coating the fertilizer phosphorus for slow and gradual release. Treatments consisting graded levels of Phosphorus with humic acid and phosphorus solubilizing bacteria combinations along with coated phosphorus, were imposed in a randomized block design with improved Samba mahsuri. The results revealed that, application of 40 kg P in combination with Phosphorus solubilizing bacteria resulted in highest number of tillers m^{-2} (442), panicles m^{-2} (405), grain yield (5650 kg ha^{-1}) and straw yield (7693 kg ha^{-1}). Treatments supplemented with phosphorus solubilizing bacteria recorded the highest number of microbial population irrespective of the dose of phosphorus application. The yield improvement by the various management practices was to the tune of 2-18% over respective fertilizer dose control. Application of coated phosphorus fertilizers registered higher agronomic and recovery efficiency than their respective uncoated phosphorus treatments.

RUE/CP/SS/19: Evaluation of nano ZnO nanoparticles on performance of rice

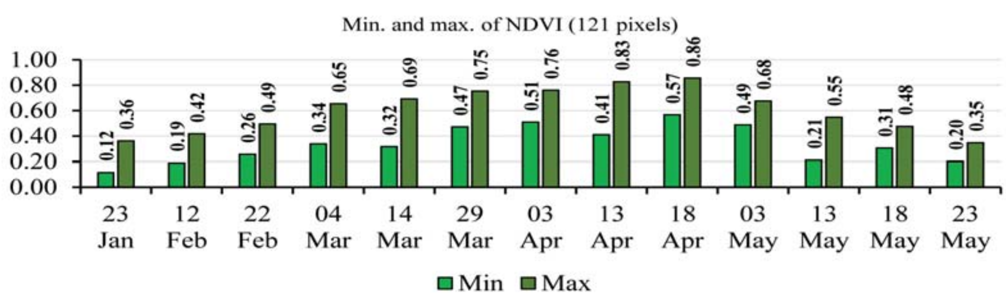
The field-level testing on nano ZnO was initiated during 2020 with two sprays of ZnO nanoparticles at 50, 100 and 150 mg/L, ZnO at 500, 1000 and 1500 mg/L and 0.5% $ZnSO_4$. Subsequently, it was suggested to use higher doses for the evaluation in the current year. The increased levels included the dose of nano ZnO *i.e.* 250, 350, 500 mg/L and IFFCO Zn. Results revealed that increasing concentrations of nano ZnO to 500 mg/L had registered a higher SOD (25.7 U/min/g), CAT (87.3 H_2O_2 reduced/ min/g), POX (2.7 µ mol tetra guaiacol formed/ min/g) and chlorophyll content (36.4 mg/L) as compared to lower concentrations. Significant improvement and higher Zn content (35.1 mg/kg) in straw were observed with the application of nano ZnO @ 150 mg/kg followed by 0.5% ZnSO4 (26.9 mg/kg) and IFFCO Zn (25.6 mg kg^{-1}). Two sprays of $ZnSO_4$ registered the highest grain yield (4.59 t/ ha), which was 27 per cent higher than the control plot (3.62 t/ha). The application of nano ZnO @ 150 and 250 mg/L has shown grain yield as 4.17 t/ha and 4.39 t/ha, respectively. Application of nano ZnO @ 150 mg/L significantly improved the Zn uptake in both straw (150 g/ha), grain (107 g/ha) and total uptake (257 g/ha).

Grain and straw yield (t/ha)

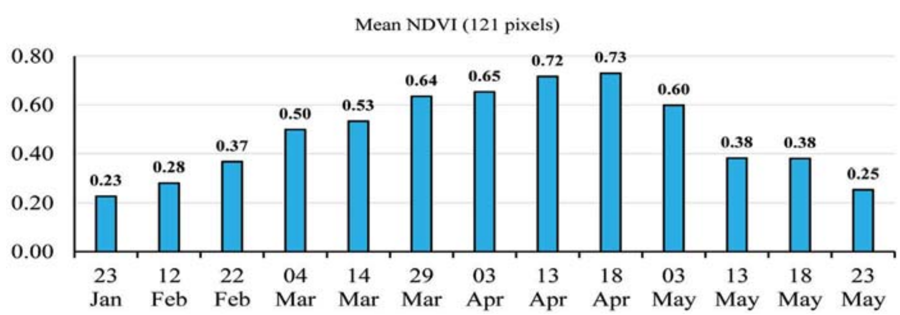


RUE/CP/SS/16: Study of rice vegetation in terms of crop stress to model the yield using NDVI

A stack of 276 NDVI images was created for six water years covering from 2016-17, for Time series analysis using a software, TIMESAT. An area of 30 acres in West Godavari was selected for phenology metrics of rice varieties. Data pertaining to about 112000 soil health cards in Telangana State issued under Model Village Programme from Department of Agriculture, Government of Telangana were obtained and curated to eliminate the duplicate and erratic entries for generation of various soil theme maps by interpolation. The soil themes included pH, EC, OC, N, P, K, S, Cu, Mn, Zn, Mn and B. Temporal study of NDVI and SAVI of a field grown with DRR Dhan 48 with Sentinel 2 data (10 m resolution) was done and the plot showed various stages from transplanting to harvest during *Rabi*. It is imperative that any rice field (with considerable area) can be monitored in near real time using free satellite data and processing software, SNAP (Sentinel Application Platform). The plot of minimum and maximum NDVI among 121 pixels and the mean NDVI of 121 pixels represented the dynamics in rice vegetation condition. A bell-shaped curve, typical of growth curve with certain deviations was seen. In fact, these deviations indicate aberrations in crop health and are important in forewarning about crop stress. (Minimum, maximum and mean NDVI of a rice field).



Minimum and maximum NDVI (121 pixels)



Mean NDVI (121 pixels)

SSP- Sustaining rice system productivity

SSP/CP/AG/15: Sustainable intensification of conservation agriculture practices in rice-maize system to enhance system productivity in Southern India

System productivity of conservation agriculture (CA) -based minimum tilled rice–maize was inferior during the first three years but was superior to the conventionally tilled method in the fourth and fifth year. Pooled analysis revealed that the conventionally tilled rice-maize system resulted in a similar system productivity as that of the CA during the study period. *Echinochloa crusgalli* (L.) Beauv., *Echinochloa colona* (L.) Link., *Cyperus esculentus* L., *Cyperus rotundus* L., and *Parthenium hysterophorus* were among the weed flora that appeared in the rice-maize system over time. Regardless of treatment, the total weed population rose as the years continued. The wet direct seeded rice-based plots had a larger overall weed population than the transplanted rice-based plots.

Location specific studies to identify the existence, magnitude and statistical significance of different types of extreme weather events and to understand the regional-level climate change in the Varanasi district of Uttar Pradesh during the period 1980-2018 using ETCCDI indices through RClimDex software. The annual mean maximum temperature, warm days, diurnal temperature range and monthly minimum of maximum temperature have decreased significantly by 0.029 ºC, 0.159 days, 0.032 ºC and 0.122 ºC per year, respectively whereas cool days and cold spell duration have increased significantly by 0.264 ºC and 0.372 days per year, respectively, indicating an increasing cooling effect over the study area. The increasing drought over the study area is evident as the number of rainy days and consecutive wet days have decreased significantly by 0.262 days and 0.058 days per year, respectively. This study stresses the development of adaptation strategies to overcome the adverse effects of extreme weather events over the Varanasi district.

Two-season field experiment was conducted to study the seed production and shattering pattern of barnyard grass (BYG) in response to its emergence and crop geometry. The experiment was laid out in a split-plot design with four replications. Increasing crop spacing by 10 cm in each row and column increased the seed production of BYG by 20%. The wider crop geometry also recorded significantly higher density (17.2%), dry matter production (39.6%), leaf length (11.6%) and panicle count (24.7%). Management techniques need to be developed to control escaped or late emerged BYG in order to prevent soil weed seedbank enrichment and to ensure sustainable weed management.

Temperature and precipitation are key elements in describing climate. We projected future climate of Odisha in three time slices *viz*., near (2011-2039), mid (2040-2069) and late (2070-2099) century using CMIP5 multi-model ensemble. The projection showed an increase in minimum and maximum temperature in Odisha under RCP4.5 and RCP8.5 scenarios. The western part of Odisha (Sambalpur) is expected to experience more warming, as the maximum and minimum temperatures are projected to increase more compared to other parts in all three-time slices and all the seasons. Under RCP4.5, annual rainfall is projected to increase by 0.8-4.0%, 0.4-3.6% and 3.0-6.0% during the near, mid and late-century respectively.

Trend in eight precipitation and ten temperature-related extreme weather events from 1980 to 2010 over an eastern Indian state, Odisha was carried out using RClimDex software. The scale and statistical significance values of trends for calculated indices were estimated using Mann–Kendall (MK) and linear regression test. In Khordha, the annual mean maximum temperature (mean T_{max}) and mean minimum temperature (mean T_{min}) showed a statistically significant (P=0.01%) increasing trend of 0.03 and 0.027 °C/year, respectively while in Keonjhar and Sambalpur the mean T_{max} showed an increasing trend and mean T_{min} showed a decreasing trend. All the eight precipitation indices showed a positive trend in Khordha, while in Keonjhar and Sambalpur majority of the precipitation related indices showed a negative trend.

SSP/CP/SS/11: Assessment of genotypic variability and improving nitrogen use efficiency (NUE) in irrigated rice

Nitrogen use efficiency of existing popular rice varieties were evaluated in field to identify efficient rice genotypes for their responsiveness and utilisation of soil and applied N. Main treatments included N-0, N-50 and N-100 kg/ha and 190 BAAP genotypes along with control genotype MTU1010 were evaluated as sub treatments in a split plot design with 2 replications. In another experiment to improve N use efficiency, different urease inhibitors and coated urea were evaluated at 20% reduced doses in comparison to 100% NCU. Twenty varieties selected based on their NUE (both high and low NUE) were subjected to germination studies. Out of 190 BAAP entries tested, top 5 entries at N-50 level based on grain yield were: 39-BAAP-81 (CHHOLA BORO (2) G1); 126- BAAP-199 (DULA AUS IRGC 49180-1); 180- BAAP-266 (DHALI BORO 105-2 IRGC 29314-1); 133- BAAP-210 (JATI AUS IRGC 34940-1) and 8-BAAP-13 (SADUCHO). Application of different sources of N along with coated materials indicated significant improvement in grain yield with urease inhibitors. NBPT 1000 ppm better performed with a yield of 4.58 t ha^{-1} (13% higher than 100% NCU) followed by Allicin 2000 ppm (4.43 t ha^{-1} with 9% yield increase over NCU). 6 High NUE out of 21 varieties (BV1704, Nidhi, Tellahamsa, PSV 344, PSV 181 and PUP 221) were selected, based on total length, total dry weight, SVI-1 and SVI-2. Mandya Vijaya, BPT 5204 and Mahsuri were the low NUE varieties. Low SVI of other cultivars is mainly due to lower germination %, root and shoot parameters. High NUE is thus associated with high root and shoot parameters and high seedling vigour.

Field evaluation of Nitrogen with different coated materials

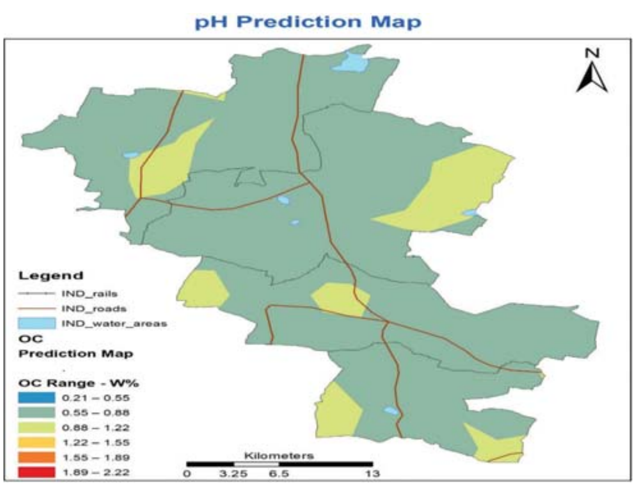
Sl. No.	Varieties	Total length (cm)	TDW (g)	SVI-1	SVI-2
High N use efficient varieties					
1	BV 1704	40.0	0.057	39.2	0.056
2	Nidhi	38.8	0.078	38.8	0.078
3	Tella Hamsa	36.7	0.095	35.9	0.093
4	PSV 344	33.9	0.063	33.9	0.063
5	PSV 181	33.7	0.057	33.7	0.057
6	PUP 221	28.3	0.054	28.3	0.054
Low N use efficient varieties					
1	Mandya Vijaya	20.1	0.009	20.1	0.009
2	BPT 5204	17.2	0.008	17.2	0.008
3	Mahsuri	23.1	0.010	23.1	0.010

SSP/CP/SS/18: Studies on soil organic carbon status, mapping and stocks in rice soils of India

Soil organic carbon (SOC) studies and its mapping in rice ecologies of India was done in a study in Maheshwaram, Kadthal, Kandukur and Amangal Mandals of Ranga Reddy district of Telangana state. Nearly 1400 samples were collected from the field adjacent to the Rythu Vedika. The major area of the soil tested in these areas is sandy (4034 acres), followed by Loamy (884 acres) and Clay (398 acres). The majority of soil belonged to red colour followed by brown. A soil nutrient map depicting the soil nutrient status and a base map depicting the layers of Mandal boundaries, roads, railway line and water bodies was developed. The nutrient maps developed are made available on the cloud too. Most of the soils tested were in the medium nutrient range and soil pH was recorded from 6 – 9.72 and soil organic carbon in the range of 0.21% to 2.33% (from heavy forestation).

Soil nutrient status in some districts of Telangana

Parameter	Unit	Range	
		Minimum	Maximum
pH	-	6.0	9.72
EC	ds/m	0.11	1.49
Organic Carbon	W%	0.21	2.33
Macro Nutrients			
Nitrogen	Kg/Ha	155	483
Phosphorus	Kg/Ha	8	148.69
Potassium	Kg/Ha	150	496
Micro Nutrients			
Boron	mg/Kg	0.11	1.25
Copper	mg/Kg	0.11	1.48
Iron	mg/Kg	4	18.75
Sulphur	mg/Kg	3.03	250.55
Zinc	mg/Kg	0.14	2.95



Soil organic carbon status map of Ranga Reddy district (Telangana)

SSP/CP/SS/19: Prospecting endophytic actinobacteria of rice for sustainable rice production

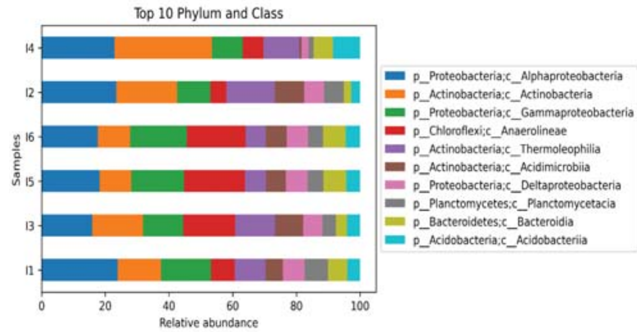
The culture supernatant of endophytic plant growth-promoting filamentous actinobacterium (Fig.), *Amycolatopsis orientalis* IIRRACT9 (NCBI accession No. OP107016) grown in ISP2 medium was extracted with methanol and electrospray ionization. (ESI)–MS analysis was performed to identify the metabolites. Of the 1844 metabolites identified, several metabolites exhibited diverse biological activities. Antibacterial compounds such as Bacitracin and Vancomycin, Nocardicin and Tobramycin; antifungal metabolites like blasticidin, candicidin and Fengycin were identified in the culture supernatant. Avermectin and albendazole with antihelmintic properties and beauvericin with insecticidal properties were also produced by the actinobacterium. Daunorubicin, Mithramycin, Bleomycin B2 and Valinomycin present in the culture supernatant are potent antitumor and antiviral agents.

Colony morphology and aerial mycelium of *A. orientalis* IIRRACT9

The plant growth-promoting ability of the isolate could be attributed to the presence of plant growth hormones gibberellin A20 and gibberellin A1 and the production of siderophores like deferoxamine and deferoxamine.

SSP/CP/SS/15: Microbial population dynamics in different rice establishment methods in relation to nutritional availability and acquisition

The soil samples were collected from farmer's field and IIRR research farm cultivated with different rice establishment methods to isolate potential nitrogen fixing and phosphorus solubilising microbes. A total of 35 nitrogen fixing bacteria were isolated on N- free media and 12 unique morphotypes were purified and evaluated for nitrogenase activity through Acetylene Reducing Assay (ARA) and 3 potential phosphorus solubilising microbes (PSB) were isolated. Six potential PSB cultures *Citrobacter amalonaticus* IIRRPSB1, *Bacillus* sp. IIRRPSB6, *Bacillus pumilus* IIRRPSB10, *Bacillus sp.* IIRRPSB13, *Citrobacter amalonaticus* IIRRPSB4 and *Citrobacter amalonaticus* IIRRPSB6 were deposited in the National Agriculturally Important Microbial Culture Collection (NAIMCC), ICAR-NBAIM, Mau. The Illumina MiSeq based 16S rRNA gene amplicon metagenomic analysis of rice rhizosphere soil was carried out for different rice establishment methods including flooded, AWD and aerobic cultivation. Illumina MiSeq method of sequencing revealed various Phyla, with major Phyla belonging to the Proteobacteria, Acidobacteria, Actinobacteria and Bacteroidetes using UniFrac-weighted PCoA plots of bacterial communities. Further more, KEGG pathway enrichment analysis revealed the nitrogen, phosphorus and potassium metabolism pathways in all soil samples of rice establishment methods.



Bacterial community structure at the phylum level

CCR-Assessing and managing crop response to climate change

CCR/CP/ PP/12: Role of Silicon in inducing abiotic stress tolerance in rice

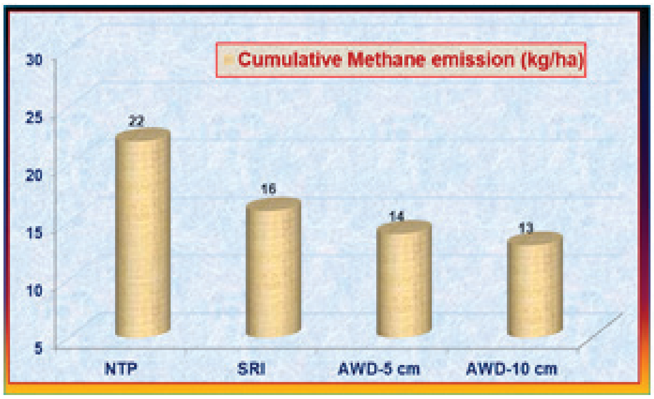
An experiment was laid out with 7 hybrids and a high yielding variety with 4 treatments and 3 replications in a split plot design. Drought stress was imposed for 25 days after anthesis. The results revealed that silicon application improved chlorophyll content, leaf area index, harvest index and number of grains per panicle and yield and its attributes. Overall 10% increase in yield and 18% increase in biomass was recorded as compared with control plots. Application of silicon during drought stress could improve tolerance to abiotic stresses.

CCR/CP/PP/13: Deciphering physiological basis of heat stress tolerance in rice

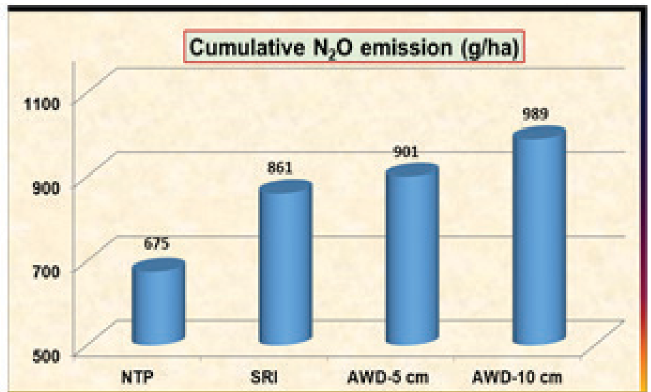
Phenotyping of rice germplasm for physiological traits related to heat stress tolerance was taken up in *kharif* season of 2022 at Rajendranagar farm of ICAR-IIRR, Hyderabad. About 450 rice germplasm were sown in augmented block design with two treatments. One set of germplasm was characterized under normal conditions without heat stress as control and another set was transplanted under heat stress in Heat Tunnel. Based on preliminary observations such as spikelet fertility among 450 genotypes a few were identified as highly tolerant to heat stress at reproductive stage having spikelet fertility more than 80% *viz.*, Blackgora, E MOOM, IRGC 132252, IC 44975, ADAYSEL, RASI, BAKAL, VANAPRAVA, IRGC 127466 and IRGC 128373. Some genotypes were identified as tolerant with spikelet fertility ranging from 61 to 80% *viz.*, IC 282803, Kalinga-1, IC 426049, BAM 4477, BIJULI BATI, DERAWA, HIRA and IRGC 117271 etc.

CCR/CP/SS/17: Studies on emission of greenhouse gases (GHGs) from rice soils and their mitigation

Four planting/water management methods *viz.*, conventional transplanted (NTP), system of rice intensification (SRI) and alternate wetting and drying (AWD) at 5 cm and 10 cm depletion of ponded water, with five replications were studied for their impact on greenhouse gas emissions. The test variety grown was DRR Dhan 42. The different establishment/ planting methods significantly impacted both the greenhouse gas *i.e.*, methane and nitrous oxide emissions throughout the crop growth period. The seasonal integrated flux (SIF) for methane was the highest in NTP method (22.36 kg/ha) followed by SRI (15.55 kg/ha) and AWD resulted in lower flux values of 14.21 and 12.65 kg/ha with irrigation at 5 cm and 10 cm depletion of ponded water, respectively. Methane emissions decreased by more than 40 per cent in SRI and by 49 and 54 per cent in AWD at 5 and 10 cm, respectively as compared to NTP. The higher methane emissions under conventional NTP method were due to the depletion of oxygen under submerged condition leading to conducive anaerobic or reduced atmosphere throughout the crop growth season. The seasonal integrated fluxes of N_2O-N were the least in NTP (0.675 kg/ha) as compared to SRI (0.861 kg/ha) and AWD methods (0.901 and 0.989 kg/ha). N_2O-N emissions were higher by 28 per cent in SRI and 33 and 47 per cent in AWD at 5 and 10 cm, respectively over NTP. Carbon Equivalent Emissions (CEE) significantly varied with different establishment techniques. The CEE was the highest under NTP (207 kg C / ha) due to higher methane emissions during the entire crop growth period. Lowest CEE was under AWD at 5 and 10 cm (170 & 167 kg C / ha). Carbon Efficiency Ratio (CER) was the lowest in NTP method (11.7) and highest in (15.2) SRI. The CER of conventional method was 23 per cent lower than SRI method, which shows that the latter is more efficient. SRI and AWD methods lowered the Global Warming Potential due to lower methane emissions as compared to the conventional NTP method. The highest grain yield was recorded in SRI method (5569 kg ha^{-1}) and the water productivity ranged from the lowest of 3.03 kg ha mm^{-1} in NTP to 5.20, 4.13 and 3.20 kg ha mm^{-1} in SRI and AWD at 5 and 10 cm depletion respectively.



CME of different crop establishment methods

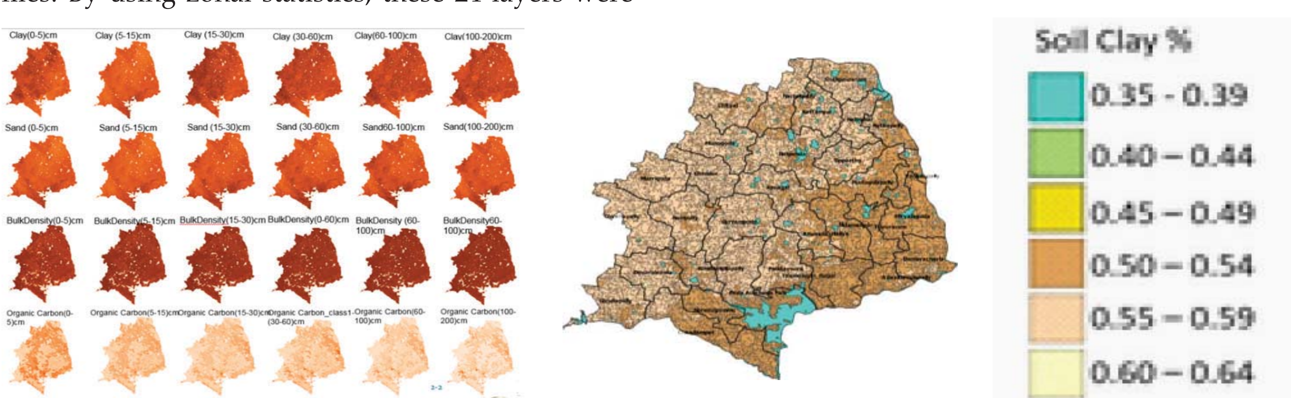


CNE of different crop establishment method

Computer Applications in Agriculture

Smart precision models and Mobile Apps for real time advisories on Rice Crop Management

Soil layers of clay (CL), sand (SND), bulk density (BLD), Organic Carbon (ORDRC) (2-7 layers for the corresponding sowing dates during 2019 i.e. 4x6 layers=24 layers) were downloaded from FAO Soil Grids Portal (https://soilgrids.org). These layers were processed, reclassified and converted to shape files. By using zonal statistics, these 24 layers were merged into Soil clay layer with 24 attributes. Soil clay layer was classified into 6 classes (Fig. 1). Soil parameters required for Rice DSS were derived using these 24 parameters. Mandal wise weather data was collected from Telangana Portal (https://data.telangana.gov.in/). Thiessen polygons were generated for these mandals. Further, soil layer data will be validated with observed data and overlaid with weather data to use with Rice DSS for estimating polygon wise rice yield.



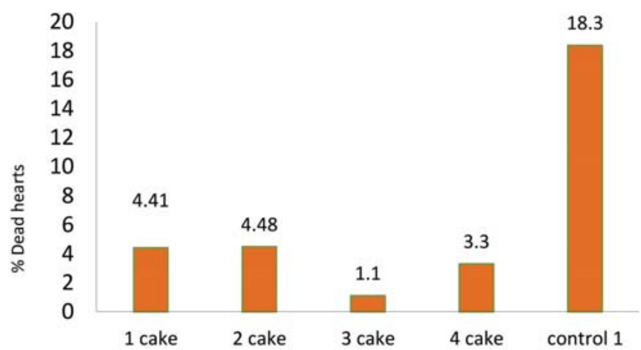
Soil clay layer generated by merging soil layers of clay (CL) sand (SND), bulk density (BLD), Organic Carbon (ORDRC) downloaded from FAO soil grids

IPM - Integrated pest management

IPM/CPT/ENT/21: Botanicals for sustainable management of major pests of Rice

The joint efficacy of insecticide dinotefuran 20 SG and eucalyptus oil at various concentrations against brown plant hopper, *Nilaparvata lugens* was studied in the laboratory. All combinations resulted in higher mortality as compared to insecticide or eucalyptus oil alone indicating a synergistic action.

Efficacy of slow releasing essential oil cakes against rice pests was evaluated in farmers' fields in Nagasanipalli, Vanaparthi District. The cakes were installed at 4 doses (1,2,3 and 4 Nos./ 25 m^2) with 3 replications in a randomized block design. There was considerable reduction of dead hearts incidence (1.1-4.8%) in all the doses of cake as compared to control 18.37% in control.



Effect of slow releasing essential oil cakes on stem borer damage

Efficacy of slow releasing essential oil cakes against the lesser grain borer, *Rhizopertha dominica* infesting rice grain was evaluated under laboratory conditions by releasing 20 adults per 25 g of grain. Four doses of cake (100 mg, 200 mg, 300 mg, 400 mg) and untreated control were the treatments. After 3 days of release more than 85% mortality was observed in all the treatments as compared to the control treatment (6.25%). Treatment with 200 mg dose was most effective with highest mortality (93.75%) of the beetle. Evaluation of slow releasing essential oil cakes for control of grain eating birds in rice fields was conducted at grain maturity stage of rice crop in farm. *Munias*, which come in groups damage rice grain at milky stage. Slow releasing essential oil cakes were installed 1 m above canopy level @ 1cake/25-30 m^2. Observations were recorded during evening hours (5-6 pm) for one hour for 3 days. No birds have visited the treated plots as compared to 494 birds on average visiting the untreated plots.

Effect of slow releasing essential oil cakes on visiting of granivorous birds

Date	Total no visited (No)		Total time (min.)
	Untreated	Treated	
18/4/22	523	0.0	24
19/4/22	440	0.0	21
21/4/22	520	0.0	22
Mean	494.3	0.0	22.3

IPM/CPT/ENT/27: Investigations on Nematodes of Importance to Rice Cultivation

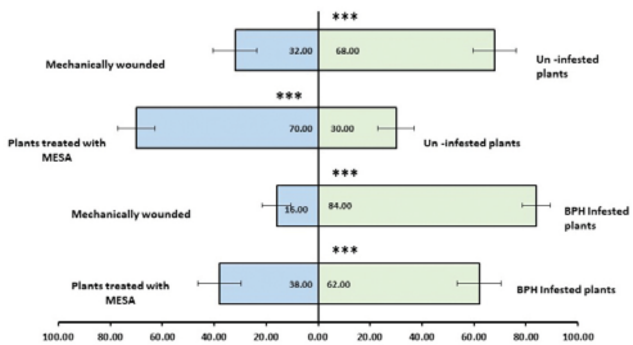
A sick plot facility for rice root-knot nematode, *M. graminicola* is being developed at IIRR farm for carrying out field experiments. Highly susceptible rice cv. TN1 was raised in this plot to build up nematode population in soil. The nematode population development was monitored periodically. The incidence of root galls was 69.44% and number of root galls/plant ranged from 0-27. Nematode population density was 28 J2/100 cc soil. Efforts are also being made to augment the nematode population in soil by transplanting artificially infected seedlings. Screening of 25 rice genotypes for resistance to rice root-knot nematode, *M. graminicola* in pot culture experiments revealed that three genotypes ((LD24, Khao Pahk Maw and Suraksha) were resistant and two genotypes (DRR Dhan 41 and DRR Dhan 55) were moderately resistant to the nematode on the basis of Relative Root Gall Index (RRGI) and Relative Reproduction Index (RRPI). Soil samples from rice under different water and labour saving management systems were analysed for nematode population. Rice root nematode, *Hirschmanniella* spp. was the most predominant nematode (>60%) in experimental plots. The total nematode abundance in alternate Wetting and drying system (AWD) was more as compared to normal transplanted fields. However, the abundance of rice root nematode.

Hirschmanniella spp. was less in AWD system. Field experiments on weed management in aerobic rice revealed that mulching with paddy straw and *in situ* green-manuring with cowpea and herbicide application suppressed the population of plant parasitic nematode population. Plant and soil samples received from farmers' fields showing poor plant growth from Damarakunta village, Telangana in Direct Seeded (DSR) rice of cultivars MTU 1010 and MTU 1153 were found severely infected with rice root-knot nematode.

In-vitro nematicidal activity of culture filtrates of eight endophytic bacteria *Paenibacillus sonchi (isolate IIRR-BNF1)* recorded highest nematode mortality. Symbiotic bacteria *Photorhandus luminescence* and *Xenorhabdus nematophila* isolated from entomopathogenic nematodes *Heterorhabditis indica* and *Steinernema glaseri* respectively, inhibited the growth of fungal pathogens *Rhizoctonia solani* and *Fusarium* in dual culture plates. Pure cultures of entomopathogenic nematode isolates and cultures of their insect hosts (*Galleria mellonella* and *Corcyra cephalonica*) are being maintained in the laboratory and cultures of plant parasitic nematode *M. graminicola* are being maintained in the glasshouse.

IPM/CPT/ENT/30: Enhancing biological control of rice pests through Chemical ecology

Five varieties and one hybrid with varying resistance to pests *viz.*, BPT 5204, DRRH3, PB 1, TKM 6, W1263 and TN 1 were evaluated for pest damage versus per cent egg parasitisation. The per cent dead hearts ranged from 7.9 -12.63 and the lowest damage was observed in TKM 6. The white ear damage caused by stem borer was statistically on par in all lines assessed. However, egg parasitisation ranging from 65.48 – 81.08 per cent among the varieties, was significantly higher in TKM 6. This indicated that TKM 6, in addition to first level of resistance to stem borer also had a chemical ecology that is favourable for recruiting the parasitoids. In *rabi* 45 lines were evaluated in field and six lines in lab for attraction to parasitoids, *Anagrus*, *Oligosita*, *Bracon* and *Trichogramma japonicum*. The parasitoid *T. japonicum* preferred stem borer infested plants over healthy plants with a significantly higher preference towards BPT 5204 followed by PB 1 in Y- tube olfactometer assays. A field experiment was also conducted to evaluate the combined effect of exogenously applied signal molecule, methyl salicylate (MESA) @100mg/l and a flowering border of marigold, *Tagetes erecta* on parasitism by egg parasitoids of brown planthopper, *Nilaparvata lugens*. Mean per cent parasitism on BPH eggs by two egg parasitoids namely, *Anagrus* sp. and *Oligosita* sp. were significantly different and was highest on BPH pre-baited plants with MESA near flowering border (63.16%) while parasitism in other treatments were, BPH pre-baited plants without MESA near flowering border (44.97%), BPH pre-baited plants with MESA without flowering border (34.65%) and BPH pre-baited plants without MESA and without flowering border (15.52%). Presence of nectar producing flowering border alone contributed to 44.97 per cent parasitism. A significant increase of 18.19% of parasitism was observed by combining MESA application in rice field with nectar producing flowering bund crop.



Y-tube olfactometer response of the parasitic wasp, ***Oligosita sp.*** *to* elicitor and/or infestation by brown planthopper on variety TN 1 (Chi squared goodness of fit was used to determine whether the overall distribution of the parasitoids over the two odour sources deviated from 50:50) (H0: μ =0.5)

IPM/CPT/ENT/28: Bioefficacy and toxicological studies of Insecticides against insect pests of rice

A new insecticide molecule, ME5382 2% GR was evaluated under field conditions. ME5382 2% GR @ 150 g a.i. per ha resulted in highest reduction (72.58%) in dead hearts, followed by ME5382 2% GR @125 g. a.i. per ha (59.53%). With respect to white ears, chlorantraniliprole 0.4% GR + thiamethoxam 1% GR applied twice, at vegetative and reproductive stages of the crop growth was found superior with 66.84 per cent reduction over control. Similarly, one application of ME5382 2% GR @ 150 g a.i. per ha at vegetative stage was best against brown planthopper with highest reduction in population (53.13%) as compared to the untreated control. No phytotoxicity symptoms were observed in rice due to the application of ME5382 25 GR at a higher dose of 300 g *a.i.* per ha. Grain yield was significantly higher (6681.8 kg/ha), with a 26 per cent increase over control in the treatment ME5382 2% GR @ 150 g a.i. per ha as compared to the untreated control (5304.8 kg/ha). Brown planthopper population is being maintained under glass house conditions without exposure to insecticides. On the other hand, by exposure to sub lethal doses of pymetrozine, resistant population is being developed. At the end of sixth generation up to 34.5-fold resistance to pymetrozine was observed. Toxicity of pymetrozine to brown planthopper was monitored in nine field populations of brown planthopper from the states of Telangana, Andhra Pradesh and Karnataka. Resistance ratio was in the order of Warangal (10.4 to 15.1)>Maruteru (6.2 to 6.8)>Raichur (3.4)>Nalgonda (1.1 to 1.6).

HRI - Host plant resistance against insect pests and their 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

Two hundred and one EMS mutant lines of Nagina 22 were evaluated for resistance to brown planthopper and white backed planthopper. Mechanisms of resistance and expression analysis of defence responsive genes were also studied in the selected resistant mutants. Out of these thirty-one mutants were resistant to brown planthopper, forty-four mutants were resistant to white backed planthopper and twenty-one mutants were resistant to both the planthoppers. The planthoppers probed more number of times, fed less and excreted less honeydew on the resistant mutants. The nymphal survival was lowest, nymphal duration was longest and growth index was lowest on the resistant mutants. The resistant mutants survived more number of days when exposed to planthopper nymphs and took more days to wilt. In gene expression studies, the defence genes and genes responsible for photosynthesis and chlorophyll synthesis were upregulated in the resistant mutants compared to the susceptible mutant. Brown planthopper infested wild type showed high level of defensive nature towards the planthopper infestation. The brown planthopper resistant mutant, NH 4631 showed highly significant expression of these defensive genes and its photosynthetic efficiency was not adversely affected by the insect infestation. The identified mutants with known mechanisms of resistance can be used as donors for developing planthopper resistant varieties

HRI/CPT/ENT/31: Understanding the interaction of internal feeders–stem borers and gall midge with rice for their management

A relook at the maintenance protocol of gall midge in the greenhouse conditions revealed that number of days taken by the insects to emerge from the galls in an infested tray varied from 23.2 ± 0.18 to 25.80± 0.73 days. From a single infested tray with galls, the days of emergence of adults varied from 1-5 days, though the sex ratio was highly variable. An initial release of four mated females per 660 seedlings per tray in 32nd standard week had given the maximum growth rate of 0.89 with a favorable sex ratio and multiplication ratio of 9.56 at 27±2 °C. Gall development in infested seedlings is suppressed if plants are infested by brown planthopper in the early stages of infestation. NPS56, SKL 07-8-720-63-147-182-276, RP 179-3-9-1 and W1263, though resistant to gall midge were highly susceptible to stem rot. TN1 was also susceptible to stem rot. Screening of germplasm lines to gall midge, identified the resistant lines, JGL 11727 and Sukaradidhan1 (HR^{+} reaction); CR 2615-1 and JGL 11470 (HR^{-} reaction) after gall midge infestation for biotype 1.

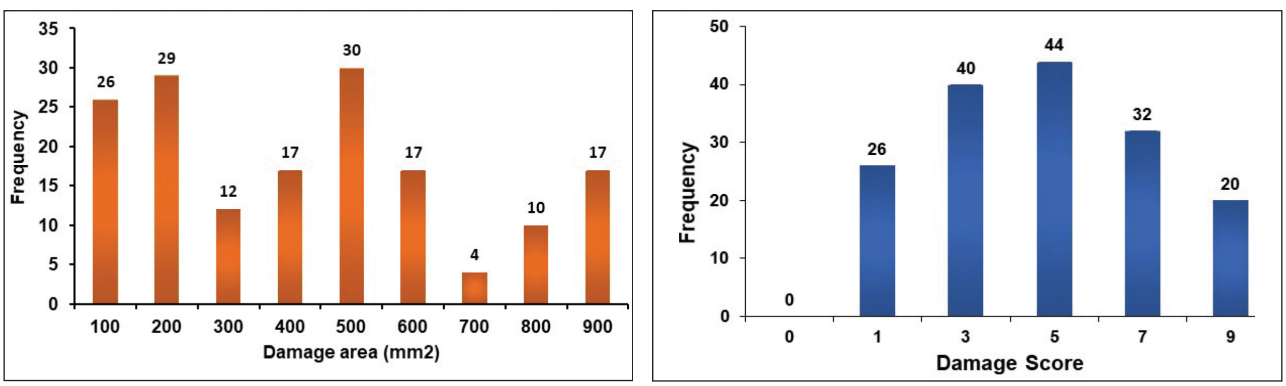
With respect to yellow stem borer, germplasm lines NND2, NND4, NND5, NND6, HWR20, HWR17; breeding lines RP5588, NSP10, NSR88, SM92 and its derived line RP6112-MS-M-R-41, Sasyasree and RP 2068-18-3-5 exhibited recovery resistance when infested at vegetative phase with neonate larvae despite high dead heart damage (DS 5-7 SES scale) as compared to susceptible check. Cut stem assay with neonate larvae on RP5588, RP5587, SM92 and its derived line RP6112-MS-M-R-41, RP4919, Sasyasree proved antibiosis as one other mechanism in these lines.

Mortality of neonate larvae in RP6112-MS-M

HRI/CPT/ENT/27: Assessment of host plant resistance to leaf folder and semio-chemical approaches for the management of insect pests of rice

Phenotyping of C2 population (162 BILs) of two stable backcross alien introgression lines 166s and 14s derived from Swarna / *Oryza nivara* IRGC81848 was done for the second year using rapid field screening method. Feeding by third instar larva for 48 hrs was scored on a scale of 0 to 9. Damage area varied from 43.3 to 879.1 mm^2. Based on the damage score, 26 BILs were identified as resistant to rice leaf folder with a damage score of 1.0. Around 40 BILs were identified as moderately resistant with a damage score of 3.0. Among the morphological parameters, leaf length ranged between 27.5 and 45.2 cm while leaf width varied from 1.0 to 1.5 cm. The correlation between leaf width and damage area was positive and significant (r = 0.4587) while it was negative and significant with respect to leaf length (-0.4421).

Behavioural and bio-efficacy studies on pheromone blends of rice pests in the field revealed that higher catches of adult moths were observed in traps with the slow release formulation compared to traps with normal formulation. During 2022, the incidence of yellow stem borer and leaf folder was low to moderate. Adult catches varied from 0 to 12 in traps with yellow stem borer normal lures, while they ranged between 6 and 23 in traps with slow-release formulation. Similarly, very few adults were observed in traps with leaf folder normal formulation (0-4) compared to traps with slow release formulation (4-7).



Phenotyping of C2 population for leaf folder resistance using rapid field screening method

Dr. TR Sharma, DDG (Crop Sciences) observing the catches in the slow release pheromone traps

HRP - Host-plant resistance against pathogens and its management

HRP/CPT/PATH/15: Assessment of host plant resistance for rice blast disease and its management

A total of 3539 lines belong to different categories *viz.*, advanced breeding lines, near-isogenic lines, marker-assisted introgression lines, wild introgression lines, 3K rice genome panel, aerobic breeding lines with *Pi* 54 gene, improved restorer lines in the back ground of Samba mahsuri and Swarna, mutant lines of Samba mahsuri and selected lines of AICRPR etc., were evaluated in the Uniform Blast Nursery under artificial inoculation with the virulent blast isolate. The data was recorded when the score on the susceptible line reached to 9 on SES scale. 799 lines were found resistant.

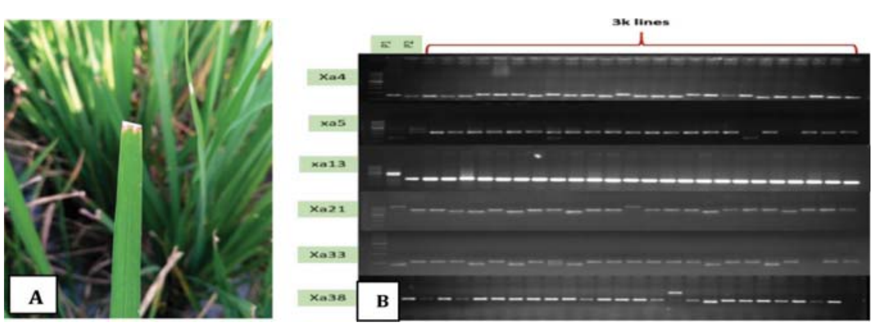
The potential rhizosphere microflora from native rhizosphere soil samples were isolated from three different agro-climatic zones of Telangana. A total of 15 fungal and 13 bacterial isolates were tested for their antagonistic activity. The per cent mycelia inhibition ranged from 0.98% to 76.67%. Four isolates *viz.*, one fungal (*Trichoderma asperellum* TAIK) and three bacterial antagonists (*Bacillus cereus* IIRR, *Bacillus xiamenensis* IIRR, *Bacillus subtilis* IIRR) from rhizospheric soil exhibited higher per cent antagonism ranging from 64.71 to 72.22% coupled with plant growth promoting activity. Field studies revealed significant improvement in the seedlings treated with *T. asperellum* + three foliar sprays of neem oil at 40, 60 DAT. The same treatment recorded 83.36 cm plant height, 10.40 number of panicles and 8583.33 kg/ha yield.

Artificial Screening of different genotypes against Leaf blast under UBN

Disease reaction in the resistant and susceptible entries – *kharif* 2022

HRP/CPT/PATH/13: Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice

Thousand hundred and twenty lines (1020) were artificially screened either in the glass house or in the field with multiple *Xoo* isolates. Among them, 113 entries were identified as resistant sources. The identified genotypes were checked for the presence of known BB resistance genes (*Xa4*, *xa5*, *xa13*, *Xa21*, *Xa33* and *Xa38*). Around 14 resistance entries were identified, which will serve as a novel source of resistance.



A - Promising 3k panel entry showing high level of BB resistance, K' 2022; B-Genotyping of selected 3k panel entries for major BB resistance genes; P1: Positive check (IRBB4 for *Xa4*; ISM for *xa5, xa13* and *Xa21;* FBR-1-15 for *Xa33* and DRR Dhan 53 for *Xa38*; P2: negative check (BPT 5204)

Reaction of selected NSN-2020 lines to multiple isolates of *Xanthomonas oryzae* pv. *oryzae*

NSN Lines	IET #	Average disease score									
		IX 020	PNT-09-1	RPR-09-1	SVP-10-10	ADT	CHN/J	Kaul-09-1-2	LUD-09-1-1	AND-09-3	GRKPR
N1-20-19	28014 (R)	1 (0.5)	1 (1.3)	1 (0.6)	1 (0.4)	1 (0.6)	1 (1.3)	1 (0.5)	1 (0.4)	1 (0.9)	1 (0.5)
N2-20-29	29353	3 (3.0)	3 (2.6)	3 (2.9)	1 (0.7)	1 (0.6)	5	1 (1.9)	1 (0.9)	1 (0.2)	1 (0.4)
N2-20-31	28503	3 (1.8)	7	7	7	3 (2.9)	7	7	7	1 (0.7)	1 (0.4)
N2-20-36	29492	1 (0.7)	1 (0.5)	1 (1.7)	1 (0.7)	1 (0.6)	1 (0.4)	1 (1.0)	1 (0.5)	1 (0.7)	1 (0.3)
TN1		9	9	9	9	9	9	9	9	9	9
ISM		1 (0.4)	1.67 (1.6)	3 (3.5)	3 (4.6)	1 (0.6)	5 (4.5)	1 (0.6)	3	1 (1.6)	1 (0.7)

(Figures in parentheses indicate average lesion length)

DRR Dhan 53 seeds were distributed to 60 selected farmers in BB endemic areas of Kalleru and Thallada blocks of Khammam, Telangana and Tamil Nadu. There was a severe incidence of bacterial blight on Samba Mahsuri while BB resistant DRR Dhan 53 was free from bacterial blight.

Sixteen common antibiotics, *viz*., spectinomycin, carbenicillin, sulphafurazole, novobiocin, tetracycline, chloramphenicol, chlorotetracycline, amphicillin, cefotaxime, cloxacillin, gentamycin, neomycin, trimethoprim, lincomycin and vancomycin were tested against *Xoo* under *in-vitro* conditions. Fourteen antibiotics showed varied degree of *Xoo* growth suppression with diameter of inhibition zone ranging from 18 mm to 54 mm. Ciprofloxacin and chloramphenicol had the strongest effects against *Xoo*. Under glasshouse conditions, chloramphenicol significantly reduced the disease severity.

HRP/CPT/PATH/22: Population dynamics of rice sheath blight pathogen and sustainable disease management

Diagnostic survey was made in Punjab, Haryana, Uttrakhand and Karnataka and collected 290 disease samples, of which 60 were isolated, characterized through ITS sequencing. ITS sequences were submitted to NCBI *Genbank*. So far, around 300 isolates of *R. solani* and 25 isolates of *R. oryzae sativae* / *R. oryzae* were characterized and preserved for long term storage. 32 isolates *of R. solani* were characterized by genome sequencing. Principal component analysis based on the genomic distance divided the isolates into three different groups and a subgroup of admixture between group I and group II, suggesting natural hybridization among the isolates. Around 2000 entries belonging to different categories were screened artificially under field conditions. Out of which 139 tolerant lines were identified.

Details of different genotypes screened artificially for sheath blight tolerance

Genotype Details	Number of identified tolerant lines/Name of the Few Tolerant lines
AICRPR promising entries (Slow blighting Entries) (150 lines)	35(22272, 23642, 24518, Varsadhan, Savitri, VL Dhan-82, Vikramarya, Shalivahana, Sarala, Sufheer, Gayatri, Indravati, VL Dhan-85 and Purnendu)
Germplasm (subset of IRRI, 3K panel (263 lines)	44 (3/5 disease score)
Different Screening AICRPR Entries (1331 lines)	30(28366, 29343, 29000, 29485, VP-R36, VPD9, WGL 1246, VP-R25, DB6, VP-R262, VP-R78, VPD10, VPD5 and VP-R134)
AICRPR Multilocational Testing of RILs (Wazuhophek/ISM)	13(R25, R36, R78, R109, R134, R-158, R-186, R-210, R-243, R-256, R-260, R-261, R-262).

A- Different species of *Rhizoctonia sp.*; B-sheath blight tolerant lines

Research Achievements

Five major sheath blight QTLs were identified from the ISM / WZK RILs population (*OsSBQTL1.1, OsQTL4.1, OsQTL6.1, OsQTL11.1* and *OsQTL11.2* in chromosome 11 through fine mapping. Three sheath blight tolerant lines *viz.* R36T, R47T and R158T identified based on phenotyping and genotyping from this population.

Five highly tolerant RILs derived from the cross ISM / WZK, *viz.*, R-38, R-47, R-158, R-36 and R- 124 (with qShbltol3.1) crossed with recurrent varieties, Swarna, MTU100 and DRR-Dhan53.

Fungicide azoxystrobin + difenconazole was applied twice against sheath blight by drone with 15-day interval. Bio-efficacy of test molecule by drone was about 54% disease control over 62% in power sprayer.

HRP/CPT/PATH/23: Variability in *Ustialginoidea virens* and management of false smut disease

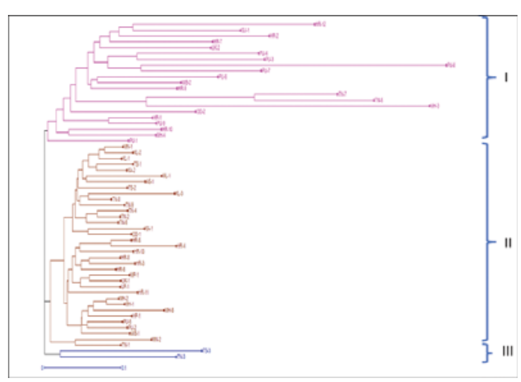
Forty-five false smut infected samples were collected from States *viz.*, Telangana, Andhra Pradesh, Chhattisgarh, West Bengal. Isolation was completed and around 200 isolates of *U. virens* pure culture are being maintained at 4 °C in Potato sucrose agar slants. Long term preservation of sixty isolates of *U. virens* was done on filter paper and the isolates were stored at -20 °C.

A highly reproducible artificial screening technique with artificial sprinkler and green shade net conditions was adopted for genotype screening. During *kharif* 2022, around 707 different lines *viz.*, germplasms, mutant lines, wild introgression lines, land races and two mapping populations (250 numbers) were screened artificially. *U. virens* was multiplied in rice leaf extract broth and potato sucrose broth. Germinated conidia were inoculated and data was recorded 15 to 20 days after inoculation. For each genotype, more than 5 panicles were artificially inoculated. Data on percentage disease infection and number of infected spikelets/ panicle were recorded. Maximum of 45 smut balls were recorded in the susceptible genotypes. Among the different genotypes screened, around 100 lines were identified as tolerant genotypes which will be confirmed further.

Fifty (50) ISSR primers (UBC series from 801 to 850) were screened to study the molecular variability in 58 isolates of *U. virens* collected from different rice-growing geographical regions. Among the tested Primers UBC 812 and UBC 809 recorded maximum heterozygosity. A dendrogram was generated and all the 58 *U. virens* isolates were grouped into three major clusters *viz.*, Cluster I (21 *U. virens* isolates); Cluster II (35) and Cluster III (2). The isolates showed genetic variations and no specific grouping based on the geographical distance.

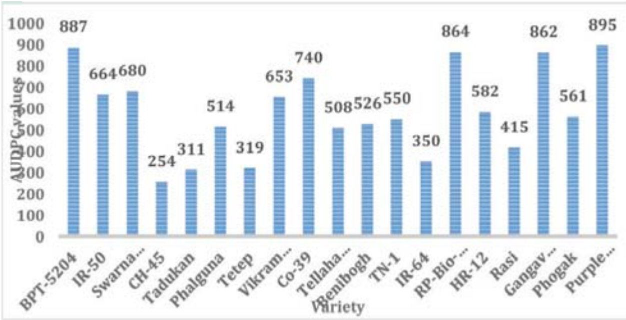
HRP/CPT/ PATH/24: Survey, host plant resistance to brown spot disease of rice and its management

In *kharif* 2022, brown spot diseased samples (30) were collected from West Bengal. The brown spot severity was high at Rupnarayanpur, Salboni, Sadishta, Bangabandh and Mohanchok villages. Diseased samples were also collected from Warangal, Karimnagar, Nizamabad and Jagtial districts of Telangana. The severity of brown spot varied from low to moderate in fields of different districts visited in Telangana state. Total of 50 isolates of *Bipolaris oryzae* are being maintained as pure cultures at IIRR.



A & B: Artificial screening of different genotypes against false smut at IIRR under field conditions, C &D: Expression of false smut disease in the susceptible genotypes E: Identified false smut tolerant genotype: Cluster analysis of 58 *U. virens* isolates based on molecular profiling with ISSR primers

Out of 793 AICRPR lines of NSN-1, NSN-H, NHSN and DSN screened under artificial inoculation conditions for brown spot resistance and 19 lines showed moderate resistance with score of 4. Out of 282 lines screened (NLR34449 x ISM; *O. rufipogon* x Samba Mahsuri) for three consecutive seasons both during *kharif* and *rabi* 2021 and *kharif* 2022, ten lines showed high level of resistance with disease score of less than 3. Out of 475 lines of wild rice introgressed lines 23 were found as resistant/moderately resistant, which will be confirmed further.



AUDPC of brownspot disease for different varieties/cultivars

Ten isolates *B. oryzae* subjected to pathogenic variability under glass house conditions. IIRR isolate was identified as more virulent (DSI 64.24%).

During *kharif* 2021 and 2022**,** 19 popular varieties were studied for disease development. The disease progression took around 30-35 days to attain maximum severity on highly susceptible varieties. AUDPC was computed based on the disease severity at different intervals and the values were *viz*., 895 (Purple Putti), 887 (BPT 5204), 864 (RP-Bio-226) and 862 (Gangavathi sona) and three genotypes were identified as highly susceptible; while CH-45, Tetep, Tadukan and Rasi found as moderately resistant varieties. Apparent rate of infection was more during the initial period of progression of the disease; while decreased during middle of the progression cycle and again slight increase was seen when disease progressed towards its terminal severity.

HRP/CPT/ PATH/25: Investigations on Sheath rot and Stem rot diseases of Rice

Among the different screening methods tested, placing of pathogen inoculum (multiplied in seed) between panicle and leaf sheath found as the best with higher disease incidence compared to other methods. Three different inoculation methods were tested for stem rot pathogen, out of which Typha leaf bit method was promising in artificial induction of the disease.

Eighty-four (84) sheath rot infected samples were collected from different districts of Telangana state *viz*., Nalgonda, Suryapet, Nirmal, Nizamabad, Medak Rangareddy, Medak, Mahabubnagar, Jagtial, Karimnagar, Siddipet, Warangal and Nagarkurnool. Thirty-eight isolates of *S. oryzae* were isolated, purified and pathogenicity of all 38 isolates was proved in the susceptible cultivar TN-1. Among all the isolates, isolate SHR 79 from Lingala village of Nagar Kurnool district showed 60% PDI, followed by isolate SHR 6 from Jalalpur village of Nalgonda district (59.3% PDI).

Twelve fungicide molecules were tested *in-vitro* against stem rot pathogen at different concentrations. Mancozeb 63% + Carbendizm 12% WP and Tebuconazole 250EC effective under *in-vitro* conditions at all the concentrations. *Tricyclozole* 70% WP showed the least efficiency in controlling the *S. oryzae* under *in-vitro* conditions.

Based on the results of *in-vitro* studies, Tebuconazole was selected for field management studies along with bio-control agents and organic amendments. The combination of seed treatment with *Bacillus*, soil application of Karanja cake and foliar spray of Tebuconazole (T7) is the best combination for the control of stem rot disease as it is showing 74% disease reduction over control.

In-vitro effect of fungicide molecules on radial growth of mycelium of stem rot fungus

Research Achievements

Bio-intensive management practices for management of stem rot pathogen

Treatments	Per cent disease incidence (PDI)*		AUDPC (Units^2)	% disease reduction over control
	At 60 days of crop age	At 75 days of crop age		
T1	13.73 (21.75)	26.82 (31.19)	642.12	20.97
T2	16.02 (23.59)	28.47 (32.25)	729.61	16.09
T3	7.98 (16.41)	14.53 (22.40)	657.40	57.19
T4	12.54 (20.74)	24.46 (29.64)	583.60	27.91
T5	5.97 (14.14)	12.72 (20.89)	516.20	62.52
T6	6.01 (14.20)	12.45 (20.66)	601.84	63.32
T7	5.11 (13.06)	8.74 (17.20)	467.61	74.23
T8: Control	20.76 (27.10)	33.93 (35.63)	942.58	
C.D (0.05)	1.68	1.63		
C.V.	10.24	5.08	3.56	

HRP/CPT/PATH/14: Assessment of host plant resistance and development of diagnostic tools for rice tungro disease

Host Plant Resistance: Thousand four hundred and forty-nine lines (1449) were screened artificially by forced feeding insect transmission method against rice tungro virus disease and 60 entries were identified as resistant with the score 3. Out of 300 number of 3K Indica rice panel screened, 17 lines showed high level of resistance with a disease score of 1-3.

Survey on Southern rice black-streaked dwarf virus: During *kharif* 2022 in the states of Northern India, plants remain stunted with reduced tillering and poor root development. Scientists from ICAR-IIRR, Pathologists and Entomologists of RRS, Kaul (Haryana) and PAU, Ludhiana and state agriculture department and KVK, surveyed the affected fields in Haryana and Punjab. The intensity of the disease has been categorized as severe (>50%), moderate (25–50%), low (11–25%), or trace (<10%). For each of the categories, fields were identified and extent of disease incidence was recorded. The overall mean dwarf disease incidence was calculated. The main symptoms of rice dwarf disease are stunting and appearance of white chlorotic specks on its foliage. The height of the plant is restricted to 1/2 - 1/3rd as compared to normal plants. These plants have shallow roots and can be uprooted easily. It is observed across almost all rice varieties, basmati and non-basmati. However, the symptoms are more prominent in early sown paddy crops.

In Haryana, dwarf disease was mainly observed in Ambala, Yamunanagar, Karnal, Kurukshetra, Panchkula, Sonepat, Kaithal, Panipat and Jind districts and about 1.24 lakh acres were affected with dwarf disease. In the fields where the disease was recorded, the infected plants varied from 2 to 10 per cent.

In Panipat, up to 20 per cent incidence was recorded. Fields in Karnal and Yamunaganagar district had higher incidence of dwarf disease (10-15%) with yellowing symptoms. Insect like WBPH, BPH population was also observed in fields affected by dwarf disease. In some isolated fields, up to 80% incidence of rice dwarf disease was observed.

Severe incidence of Southern rice black-streaked dwarf virus disease in Punjab and Haryana

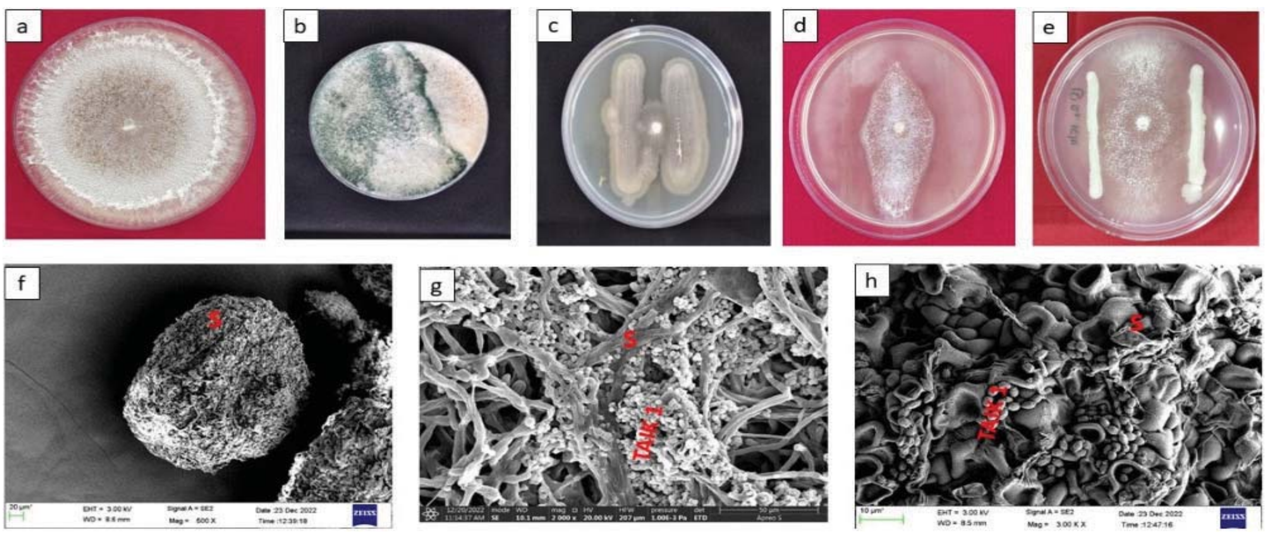
In Punjab, both basmati and non-basmati fields were severely affected, especially in Ludhiana, Patiala, Fatehgarh Sahib, Ropar, Mohali, Hoshiarpur, Pathankot and Gurdaspur. Ludhiana has been reported dwarf disease in paddy over 3,500 hectares, accounting for 1.35 per cent of the total area under paddy.

HRP/CPT/ PATH/20: A consortia approach to the biological management of diseases in rice Biological control

Potential *Pseudomonas* spp. against stem rot pathogen were identified and confirmed using specific primers and sequenced. The nucleotide sequences were submitted to NCBI GenBank database (*Pseudomonas putida* - PIK 1 Accession No: ON778610, Stem rot – *Sclerotium hydrophilum* –SHPS 1 Accession No: OP480227)

Phytohormones IAA, GA, Cytokinin, ABA, SA were analyzed from the bioagents *viz*., *Trichoderma asperellum* strain TAIK 1, *Bacillus cabrialesii* strain BIK3, *P. putida* strain PIK1, *Pseudomonas* sp. isolate PF14 using LC-MS. Among the major phytohormones detected IAA was released by all the 4 bioagents. Whereas GA was found to be released by TAIK 1, BIK 3, PIK 1 and PF 14. While the Salicylic acid and ABA was released by TAIK 1. Similarly, Zeatin was released and detected in BIK 3.

This potential bioagents were studied for their antagonistic properties under *in-vitro* conditions using dual plate culture technique. Results revealed that TAIK 1 showed maximum inhibition of the growth of the *S. hydrophylum*, followed by PIK 1. Samples of BCA and pathogen interaction were studied using SEM. Studies revealed the presence of the colonization of bioagents above the pathogen mycelia and *Trichoderma* conidia over the sclerotial bodies in stem rot pathogen.



a) Control stem rot pathogen; b) interaction of TAIK 1 + Stem rot; c) Interaction of BIK 3 + Stem rot; d) interaction of PIK1 + Stem rot; e) interaction of PF 14 with stem rot; f) SEM image of stem rot sclerotia; g) SEM image shows interaction of TAIK 1+ Stem rot mycelia; h) stem rot sclerotia surface (S) infected and colonized by TAIK 1 conidia

Stem rot pathogen inoculation process and effect of selected biocontrol agents under glass house conditions: Seeds of stem rot susceptible variety TN1 seeds were treated with bioagents suspension (@ 10 ml/kg seed) and grown on nursery trays. Bioagents were applied to the soil @10 ml/kg of soil having approximately 2.5 × 10^8 CFU and seedlings transplanted. Stem rot pathogen was inoculated 45 DAT maximum tillering stage. The selected biocontrol agents effectively reduced the disease severity.

TTI - Training, Transfer of Technology and Impact Analysis

TT1/TTT/EXT/15: Climate change and rice farming: Farmers perception and Adaptation Strategies

An exploratory study on climate change and rice farming was designed to elicit the farmers' perception and adaptation strategies in Datiya district of Madhya Pradesh under the Bundelkhand region intersecting Madhya Pradesh and Uttar Pradesh. Information was collected from 200 rice farmers covering 10 villages under the KVK operational jurisdiction where in the climate change challenges are very severe and the mitigation measures were implemented through NICRA project.

Documentation of farmers' Adaptation Capacities (AC) revealed that farmers having high AC deployed usage of drought tolerant rice varieties, changing planting dates, use of chemical or organic fertilizers, early maturing rice varieties and formal irrigation system. However, there are some adaptation strategies where farmers have moderate AC such as the farming near water bodies (0.59), farming on fallowed land (0.52), crop rotation (0.45), mixed cropping (0.42) and mono cropping (0.42). The respondents having low AC tried to improve irrigation, make farm ponds in rice farms and increase use of water and soil conservation techniques. The average AC of the respondents is 0.54. This implies that on an average, farmers in the study area have moderate capacity to adapt to climate change. Hence, farmers need to be empowered to increase their AC.

Degree of Adaptive capacity of farmers

Adaptation Strategies	Adaptive Capacities	Rank	Degree of Adaptive Capacities
1. Drought Tolerant varieties	0.83	1	High Adaptive capacity
2. Planting dates	0.82	2	High Adaptive capacity
3. Use of chemical /Organic Fertilizers	0.71	3	High Adaptive capacity
4. Early maturing varieties	0.71	4	High Adaptive capacity
5. Formal Irrigation	0.69	5	High Adaptive capacity
6. Farming near water bodies	0.59	6	Moderate Adaptive capacity
7. Farming on fallow land	0.52	7	Moderate Adaptive capacity
8. Crop rotation	0.45	8	Moderate Adaptive capacity
9. Mixed cropping	0.42	9	Moderate Adaptive capacity
10. Improved irrigation	0.31	10	Low Adaptive capacity
11. Constructing farm ponds	0.30	11	Low Adaptive capacity
12. Use of soil and water conservation measure	0.29	12	Low Adaptive capacity

TTT/EXT/16: Smart village strategy for accelerated rice technology transfer

The COM-B model, Capability (C), Opportunity (O) and Motivation (M) as three key factors capable of changing behaviour (B) was used to undertake behaviour change interventions for the dissemination of seed smart, technology smart, water-smart, nutrient-smart practices and weather-smart, activities in the selected villages. This model ensures the sustainability of learned behaviour and provides a basis for designing interventions aimed at behaviour change.

For soil smart interventions, a team of IIRR scientists visited the farmers' fields and identified the problem of salinity by on-farm testing of the soils and later with laboratory analysis as severe inland salinity and salinity induced damage of the crop. Considering the resource availability, soil amendment with cow dung slurry was suggested as remedy to be applied immediately on the top soils and the crop started showing good results after a gap of 2-3 days. Through organic amendments and under regular monitoring, crop recovered and farmers were very happy to harvest 24 q/acre.

Under the Nutrition Smart interventions, demonstrations on high zinc rice variety, DRR DHAN 48 were taken up in Manchal village of Ranga Reddy district, Telangana. About 22% of the farmers retained the grain for own consumption and rated it to be good in taste, evaluated to be non-lodging and tolerant to blast disease. Seed production of DRR Dhan 48 was taken up in 3.5 acres in Aroor village of Ranga Reddy district Telangana and sold @ Rs. 26/kg. Horizontal spread of the technology is very encouraging as farmers' after initial hesitation came forward for cultivating this variety. The farmers rated the taste as good and a systematic consumer acceptability study is to be undertaken.

Dissemination of Good Agricultural Practices (GAP) among farmers was attempted in a fun way, through the traditional snakes and ladders game that was designed and developed using Python open source software for easy installation in desktops/Laptops and demonstrated to farmers. Further this game will be converted to mobile app for easy reach to farmers.

Nutri-rice crunchy snacks preparation from IIRR rice varieties was kick-started with all-time favorite snack. Murukku was prepared from rice flour of ISM (Low GI) and DRR DHAN 48 (high zinc). The crunchy snack was relished by all the consumers. A range of traditional and nutritionally enriched snacks are in the offing. The long-term plan is to promote the products under the name - NutriRice with a tagline "nutritious and delicious".

TTI/TTT/EXT/14: Innovations in group-based extension approaches: Accelerating rice technology transfer through farmer-based organizations

FPO based intervention matrix comprising of demonstrations of IIRR technologies, seed production of IIRR varieties, need-based information sharing (through social media and whiteboards), Rice Check Meeting, exposure visits to IIRR & other FPCs were specifically designed and undertaken. An effort was being made to disseminate sequential rice messages to the farmers during the cropping season and the level of relevance was analysed from the 120 farmer members that identified key information parameters like new varietal technologies, seed availability, latest management practices, land management, pest & disease, nutrient management as more relevant. Based on the finding that 69% of FPOs felt exclusive extension professional/team is essential to cater the extension and advisory services for the needy farmers, extension module is being designed.

Interaction with CEO and Extension specialist of Yazali FPO, Guntur

TTI/TTT/ECON/4: Economic, Energy and Sensitivity Analysis of selected Rice Production Technologies

The demonstrations on improved rice production technology were organized in the Wanaparthy, Nagarkurnool, Yadadri, Bhuvanagiri and Ranga Reddy districts of Telangana state of India. The biofortified varieties assume great significance to achieve nutrition security. Hence, the zinc biofortified rice variety, DRR Dhan 48 was demonstrated in the 142 farmer fields and the economic impact of these demonstrations was assessed with the 'difference in difference' approach. The results revealed that the production of rice under demonstration plots was more profitable with a higher benefit-to-cost ratio (B:C; 1.9) compared to that of the control plots (1.4). The independent two-sample t-test revealed that the productivity in the control plots was not statistically different from that of the demonstration's plots (p = 0.112) before the project was implemented. However, with the intervention in the form of the demonstration of improved rice production technology, the productivity differed significantly (p = 0.000) for the control and the demonstration plots for the intervention year. The results of the difference in differences estimator revealed that there was a positive impact of demonstrations on the yield of the beneficiaries. The mean productivity of demonstration plots and control plots were 5.52 t/ha and 4.5 t/ha, respectively. The farmers had an additional yield advantage of 22.6% over the control plots. The results indicated that the adoption of an improved package of practices would enable harnessing higher productivity levels and bridging the yield gaps in similar agroecosystems. Also, the results suggest the practical significance of the popularization of biofortified rice varieties for food and nutritional security.

TTI/TTT/EXT/17: On-Farm Adoption of IPM Technologies and impact analysis

Varietal demonstration was carried out in three villages *viz.,* Kanchiraopalle (Mandal-Pebbair), Annaram and Dondaipalle (Mandal-Pangal) with nine varieties (DRR Dhan 48, 49, 50, 53, 55, 59, 60, 62 and 64). Each variety was planted in around 500 square metres area in the demonstration field, which facilitated the local farmers to have firsthand perception about the performance of the variety in their area. The IPM strategies were adopted by 78 farmers spread over six villages (Mallepally, Jammapuram, Rainpally, Chikkapally, Dondaipally and Kanchiraopally) planted with DRR Dhan 50 (50 acres) and DRR Dhan 51 (28 acres). The strategies such as clipping of leaf tips, leaving alleyways, judicious use of fertilizers were adopted by farmers.

Essential oils were validated in farmers' fields for the management of BPH (*kharif*) and stem borer (*rabi*). The results revealed that all the oils *viz.,* eucalyptus, lemon grass, citronella and camphor were effective in reducing the BPH population along with the standard check Pymetrozyne whereas eucalyptus oil reduced the population of Mirid bug but not spiders, however Pymetrozyne was inhibiting the population of both Mirid bug and spider. All other oils were safer to both the natural enemy's population. In *rabi* season the installation of essential oil cakes @ 1, 2 and 3 cakes per 5 square metres proved to be effective in reducing the dead heart damage compared to the untreated control.

TTI/TTT/STAT 4: Statistical modelling and soft computing approaches for genomic selection in Rice

For the reported period the MTME model was developed for rice SNP RDP data sets. Phenotypic data on 268 genotypes over three environments (nitrogen Low, Nitrogen 50 and Nitrogen 100) for three traits; Plant Height (PH), Number of Tillers (NT) and Single Plant Yield (SPY) with 31601 SNPs were considered. The SNP data were converted into numerical form and then VanRaden Genomic Relationships matrix as exogenous variables in developing regression based MTME GP models. In this period, stochastic search based Bayesian MT kernel methods were used to develop MTME models. Four Kernels *viz.,* linear, Gaussian, polynomial and sigmoid kernels were used to develop MTME models by incorporating G*E Interactions. The Kernel based Bayesian models were compared with the conventional Ridge regression and GBLUP MT models and results show that, in general, the Gaussian kernel method outperformed conventional Bayesian Ridge and GBLUP MT models. The MTME models performed better than classical models.

Institutional Activities

Transferable Technologies & Genetic Stocks

DRR Dhan 64 (IET 28358): It is an early maturing rice variety (115-120 days) with nitrogen use efficiency (S.O. 4065(E). dt 31st Aug, 2022). It is suitable for irrigated ecosystems of Bihar and West Bengal (Zone III). It has multiple disease resistance with moderate resistance to leaf blast and neck blast, resistance to gall midge and rice thrips and moderate resistance to plant hoppers and whorl maggot. It has long slender grains with head rice recovery of 66.8%, gel consistency of 62 mm and amylose content 22.5%.

DRR Dhan 64, early maturing, N use efficient rice variety with multiple disease resistance

DRR Dhan 65 (IET 27641) a high yielding low phosphorus tolerant variety developed from wild introgression lines showed promising yield performance over the checks across four years under various recommended doses of fertilizer P. It has desirable grain quality characteristics and short bold (SB) grain type. It showed multiple biotic and abiotic stress tolerance especially heat stress tolerance and tolerance to leaf blast, neck blast, sheath blight and plant hoppers. It is notified and released for Andhra Pradesh, Telangana, Karnataka, Chhattisgarh, Jharkhand and Maharashtra.

DRR Dhan 65, A high yielding low phosphorous tolerant variety

DRRH 4 (IET 27937): This is the world's first public bred aerobic hybrid, was released and notified (S.O. 4065(E). dt 31 August, 2022) for Northern Zone (Zone II), North-eastern Zone (Zone IV), Central Zone (Zone V) and Western Zone (Zone VI) and aerobic ecologies of Punjab, Odisha, Chhattisgarh, Tripura and Gujarat. It is moderately resistant to the diseases leaf blast and neck blast and to insect pests- gall midge, rice stem borer and whorl maggot. It possesses long bold grains, with head rice recovery of 62.8%, gel consistency 30 mm and amylose content 24.6%.

DRRH 4 world's first public bred aerobic hybrid

- **DRR Dhan 66 (IET 28066)** is a low soil P tolerant long duration variety developed with introgression of QTL '*Pup1*'. It is derived through marker assisted selection (MAS) in the background of 'MTU 1010' (Cottondora sannalu) which is widely cultivated across Telangana and Andhra Pradesh and quite popular among farmers. It has long slender grains released and notified for Andhra Pradesh and Telangana.
- **DRR Dhan 67 (BRRI Dhan 84)** is zinc rich variety developed through pure line selection and has been released for cultivation in the *boro* areas of **Assam, West Bengal and Tripura.** It has long slender grains with long maturity duration with average yield of 6.0 to 6.5 tons/ha. It contains 25.5% amylose, 8.3% protein and high zinc 27.6 mg/kg.
- **DRR Dhan 68 (BRRI Dhan 99)** is a pure line selection and salt-tolerant variety released for cultivation in the boro season in **Assam, West Bengal and Tripura.** It has long slender grains with long maturity duration with average yield of 5.35 tons/ha under salinity. In favorable conditions, it can produce up to 7.1 tons/ha.
- **DRR Dhan 69 (BRRI Dhan 100)** is zinc rich variety developed through pure line selection and released for cultivation in the boro areas of **Assam, West Bengal and Tripura**. It has long slender grains with long maturity duration with 26.8% amylose and 7.8% protein. This is a zinc-rich variety with 25.7 ppm zinc content.

Genetic Stocks:

National identity	Donor identity	INGR_No	Pedigree	Novel unique features
IC426273	Chittimuth-yalu	INGR22064	Landrace	*Possess grain Zn (>24 ppm) content in polished rice. Possess unique aroma and grain type-aromatic short grain (ASG).*
IC643971	RP6338-9	INGR22065	KMR-3R*2// Nagina22	*Higher grain yield than Nagina22 (Tolerant parent) and KMR3 (Susceptible parent) under high temperature stress (> 5 °C) and ambient temperature. Heat-tolerant in terms of stable yield across varied temperature locations (Based on stability variance and rankings). Heat tolerant in terms of increased Coefficient of non-photochemical Quenching (qN) trait under high temperature stress.*
IC645776	RP6252-BV/ RIL/1705	INGR22067	BPT5204 × Vardhan	*Stable grain yield under low nitrogen (N) and 50% of the recommended N (N-50) inputs across tested field locations under AICRPR. High Nitrogen Use Efficiency (NUE), Physiological Efficiency (PE) and Recovery Efficiency (RE) under N-50 input. High Grain yield than Vardhan*
	Moirang-Phou Khokngangbi	INGR22101		*Approved: Resistant to leaf blast (2-3 score). Stable resistance consequently for 4 years (2015, 2016, 2017 and 2018) for blast pathogen with score 2-3 Mid-early duration with long bold (LB) grain type along with early seedling vigour traits.*
IC645772	RP5593-83-12-3-1 (MTP-1)/ IET26168	INGR22102	MTU1010 × Nagina22	*High nutrient (NPK) uptake and high grain yield than tolerant check and recurrent parent under native sodic soil conditions (without gypsum amendment) (pH 8.5 –10.0) across field locations under AICRPR. Testing Tolerance to acidic soils (pH 4.3 – 5.2) in terms of stable grain yield and toxicity score (3.67). Adaptability and high grain yield under direct seeded aerobic ecosystems over three years of AICRPR testing.*

National identity	Donor identity	INGR_No	Pedigree	Novel unique features
IC646825	CPE-109, TI-109, CPE-9, IET-29340	INGR22103	Selection of Samba Mahsuri EMS mutant	*Complete panicle emergence in elite genetic background of Samba Mahsuri.*
IC646826	MSM-139/ IET-27994	INGR22104	Selection of Samba Mahsuri EMS mutant	*Tolerance to leaf folder in elite genetic background of Samba Mahsuri.*
IC646827	IL-3, DRR-BL-295-2	INGR22105	PR114 / *O. nivara* (105410)/ / 3*PR114	*Excellent resistance for leaf and neck blast. Present in the elite genetic background of PR114. Tolerance for sheath blight.*
IC626285	NH787 (RP Bio 5477-NH787)	INGR22106	Nagina 22	*Tolerant to low soil Phosphorus. NH787 (EMS mutant of Nagina 22) exhibited higher root biomass, number of tillers and grain yield than Nagina 22 under low phosphorus soil conditions. NH787 shows higher photosynthetic rate, pollen fertility and the activities of antioxidant enzymes in low phosphorus soil. Stable high yielding mutant with complete panicle filling with no unfilled spikelets/panicle in both normal and low P conditions. Seed hull is darker than N22.*

- **CRISPR/Cas based multiplex genome editing of indica rice cultivar for yield improvement**

  CRISPR/Cas technology utilized to edit the cytokinin oxidase (*OsCKX2)* gene of rice controlling the grain number in order to increase the yield of Samba Mahsuri. Guide RNAs for two different exons of *OsCKX2* were designed and a CRISPR/Cas construct was developed to produce guide RNAs and Cas protein. The genome-editing construct was stably expressed in Samba Mahsuri by using Agrobacterium-mediated genetic transformation. The gRNAs showed 100% editing efficiency with ~95% biallelic mutations in T0 generation. The genome-edited T0 lines showed 200 to 496 grains/ panicle in comparison to ~150 grains/panicle in wild-type or non-edited Samba Mahsuri plants under glasshouse conditions. Further, phenotypic evaluation of selected T1 lines showed desired characters like strong culm and early maturity contributed by new allele of *OsCKX2.*

- Phosphate Solubilizing Bacterial (PSB) culture, *Citrobacter amalonaticus* IIRRPSB1 and *Bacillus sp.* IIRRPSB6 were deposited with the accession numbers NAIMCC-B-03141 and NAIMCC-B-03137, respectively, in the National Agriculturally Important Microbial Culture Collection (NAIMCC), ICAR-NBAIM, Mau.

- Draft Genome Sequence of *Paenibacillus sonchi* IIRRBNF1, a nitrogen-fixing, a rice-rhizospheric, endospore-forming, gram-positive and plant growth-promoting bacterium isolated from rice rhizosphere is available.

- Generated the whole genome sequence data for biocontrol agents *viz.* bacteria and fungi PRJNA744701- BIK2- *Bacillus velenzensis,* PRJNA735062- BIK3- *Bacillus cabrialesii,* PRJNA744714- BIK4- *Bacillus paralicheniformis,* PRJNA727916- TAIK1-*Trichoderma asperellum,* PRJNA735060- TAIK4- *Trichoderma asperellum,* PRJNA745529- TAIK5- *Trichoderma asperellum.*

- A potential broad-spectrum antifungal effector protein, Bg_9562 derived from the bacteria *Burkholderia gladioli* strain NGJ1 (efficient at 35 °C and 45 °C and ineffective either at high acidic pH (3.0) or alkaline pH (9.5) conditions) was found to be effective against *Rhizoctonia solani*.

- Identified new wavelength for the estimation of amylose content in rice. At this wavelength, amylopectin interference is negligible and is useful to give amylose content close to the actual values. This wavelength is good for our country where intermediate to high amylose rice varieties are generally consumed.

- Commercialized a completely automated and portable soil testing technology Krishi RASTAA (Rapid Automated Soil Testing with Agronomy Advisory).

NCBI Submissions

- BioProject ID: PRJNA851222 for STRONG CULM MutMap QTL-seq data (Strong culm mutant line TI-17 and wild-type BPT 5204).
- SRA data: PRJNA846116 for MutMap QTL-Seq analysis of rice samples for root length and root volume (TI-128 and BPT-5204).
- BioProject accession ID: PRJNA916352 for complete panicle exertion (CPE 110).

Human Resource Development

Eight training programs were organized and overall, 768 stakeholders were trained on improved rice production technologies and other identified interventions to enhance yield and profitability.

Trainings Organized during 2022

S. No.	Name of Training	Sponsored By	Date	Number of Participants
1.	Online Training Program on "Advanced Statistical Techniques for Data Analysis using R"	SARR, Hyderabad & ICAR-IIRR	3 -15 January	480
2.	Virtual Users Training cum Workshop on AICRPR Intranet Functionalities (www.AICRPR-intranet.in)	ICAR-IIRR	15-17 February	160
3.	Exposure Visit cum Training of Farmers from Valsad ATMA, Gujrat	ATMA, Valsad, Gujarat	9-11 March	21
4.	DST-SERB High-End workshop statistical and Machine Leaving Techniques for Agricultural Systems Modelling and Forecasting Using R	DST-SERB	18 -30 July	30
5.	Training on Water Management Aerobic Rice and Direct Seeded Rice for ITC Officials	ITC	27- 29 September	30
6.	Training to Agri-Polytechnic Students on Rice Cultivation	State Department	11 November	31
7.	Training Programme for FPO Members of Maharashtra	Natural Farms and Agro Products Producer Company Limited	29 November	9
8.	Exposure Visit Cum One Day Training Programme for Farmers of Jabalpur	NFSM, Madhya Pradesh	27 December	7

Off campus Training

- An off-campus training program on 'Improved rice production technology' was organized at Cheruvu Jammulapalem, Bapatla Mandal, Guntur district of Andhra Pradesh on 10 October, 2022. Scientists from various disciplines of IIRR explained about the use of Rice mobile app developed by ICAR-IIRR, diagnosis of the pests and diseases to take up timely crop protection measures and for profitable rice production.
- An ICT-based training program on 'Integrated Pest Management in Rice', was organised on 28 December, 2022 at Avancha (V), Thimmajipet (Mandal), Nagarkurnool district, Telangana.

- On 11 October 2022, under ICAR-IIRR-SCSP, a training program was organized at Etheru village of Bapatla mandal of Andhra Pradesh. The importance of Integrated nutrient management in rice was demonstrated with the use of Leaf Color

Charts developed by ICAR-IIRR. The importance of Integrated nutrient management in rice and use of leaf colour charts developed by ICAR-IIRR was explained and demonstrated. The LCCs were distributed to the farmers. About 25 farmers attended the program.

Trainings attended by IIRR staff in 2022

Scientist	Programme name	Organizers	Duration
Sruthi K. Suvarna Rani Ch Manasa V	Advanced Statistical Techniques for Data Analysis using R	ICAR-IIRR	3 - 15 January
Vijayakumar S	Online Training Programme on Recent advances in electronic devices, artificial intelligence and machine learning for precision agriculture	ICAR-Central institute of agricultural engineering, Bhopal	1-21 February
Santosha Rathod	21 days online training program on Analytical Techniques for Decision Making in Agriculture	ICAR-NIAP, New Delhi	5-25 February
Amtul Waris	Faculty Development Program: Research in Social Sciences: Contemporary Trends, Perspectives and Pedagogy	JNU, New Delhi and Galgotias, University, UP	7 - 13 February
Fiyaz RA Gireesh C, Divya B	Virtual User's Training cum Workshop on AICRPR Intranet functionalities	ICAR-Indian Institute of Rice Research, Hyderabad	15-17 February
Vijayakumar S	Online Training Programme on Recent Advances in Organic Farming Research	ICAR-NAARM, Hyderabad	22-26 February
Santosha Rathod	Five days online training program on Smart Farming: application of AI, Robotics, IOT & Cloud Computing	Centre for Agricultural Marketing Intelligence under NAHEP-CAAST International Agri-Business Management Institute, Anand Agricultural University Anand	28 February - 4 March

Scientist	Programme name	Organizers	Duration
Sundaram RM Prakasam V. Kalyani B	Genome Editing for Crop Improvement: Potential and Policy	PJTSAU	6 March
Santosha Rathod Nirmala B	10 days National FDP (Online) on Understanding Research and Statistical Analysis Using SPSS	IIIT, Tiruchirappalli	07-16 March
S Vijayakumar	DST-NGP summer school (Level 2) on Geospatial Science and Technology Applications in Agriculture	Department of Remote Sensing and GIS, Tamil Nadu Agricultural University	11 - 31 May
Prakasam V.	Establishing a Danish-Indian partnership on Smart Plant Protection (SPP)	ICRISAT	16-20 May
Fiyaz RA	IRRI-NARES Rice Breeding Advancement Meeting	IRRI-South Asia Hub, ICRISAT	12-13 May
Revathi P	Speed breeding: progress &prospects in crop improvement	IRRI South Asia Regional Centre, Varanasi, India	4-5 July
Sundaram R.M.	Executive Development training course	ICAR-NAARM	4-9, July
Vijayakumar S Manasa V	Online training on 'Irrigation Systems and Advancements	National Institute of Plant Health Management, Hyderabad	19-21 July
Revathi P	Breeding Program Modernization: Partnership-Driven Research for Food Secure Future	Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, India	14-18 October
Padma Kumari, A. P.	Analysis of Multi-Environment Trials (Online Mode)	ICAR-NAARM, Hyderabad	3-8 November
Suvarna Rani Ch	New Crop Breeding Technologies	International Rice Research Institute South Asia Hub, ICRISAT, Hyderabad	21 November - 11 December
Chitra Shanker Aravind J Bandeppa S	NABL Laboratory assessor's training course (accreditation criteria ISO/IEC 17025:2017)	NABL, Gurgaon	19-23 December

Academic Linkages

MOUs were signed for academic collaboration and exchange of students of M.Sc and Ph.D with Sanskriti University, Mathura, Uttar Pradesh; Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh; and University of Agricultural & Horticultural Sciences, Shivamogga.

Intellectual Property Management/ Commercialization of Technologies

A Memorandum of Agreement (MOA) signed on 8th February, 2022 between Association for Innovation Development of Entrepreneurship in Agriculture (a-IDEA), Technology Business Incubator of ICAR - National Academy of Agricultural Research Management (ICAR-NAARM) and ICAR-IIRR under the Incubation programme of a-IDEA.

- ICAR-IIRR, Hyderabad and VYOMIK, Hyderabad, signed a memorandum of understanding (MOU) on 27 June, 2022 to undertake research on the evaluation of various applications of drones. The research activities include the development of Standard Operating Protocols (SOPs) in rice cultivation practices such as direct seeding using the drone, efficacy evaluation of drone-based pesticides (herbicide, insecticide, fungicide) and fertilizer (nano or liquid fertilizers) sprays. The drone-based applications will also be considered for supplementary pollination in hybrid rice using UAVs and mapping of biotic and abiotic stress.

- A memorandum of understanding (MoU) was signed between ICAR-IIRR and Krishitantra for the joint initiative of KRSHIRASTAA, Joint Patent filing and other revenue sharing over device sales.
- A publication book entitled "Innovative technologies and services available @ ICAR - Indian Institute of Rice Research" prepared by ITMU, IIRR is available for public private partnerships.

- A lecture on Intellectual property rights "Understanding protection of plant varieties and commercialization process" was presented by Dr A.S. Hari Prasad, Principal Scientist (Hybrid Rice) & Chairman, ITMU, for Ph.D Scholars of Department of Agricultural Extension, PJTSAU-College of Agriculture, Rajendranagar at ICAR-IIRR, Hyderabad on 25.08.2022.
- Dr A.S. Hari Prasad, Principal Scientist (Hybrid Rice) & Chairman, ITMU participated in the meeting "Inception Workshop on State Biodiversity Strategy and Action Plan (SBSAP) 2022-2032 for Telangana State" organized by Telangana State Biodiversity Board, Hyderabad on 22.11.2022.

Industry Meet

IIRR - Industry Meet 2022 was organized on 10.11.2022 with a theme of 'Display of IIRR Technologies & Services', to display technologies which are in the take off stage for commercialization and to discuss the essential abiding steps of MOA and MTA and the services that IIRR can offer to the private sector to support their R&D activities.

Around 50 representatives of 20 private seed companies participated in the display of varieties/ hybrids/ genetic stocks/ pesticide formulations/ soil testing kits/ value added products/ farm machinery etc. Dr D.K. Yadava, ADG (Seeds), ICAR, New Delhi was the Chief Guest and participated virtually.

He addressed the participants and highlighted the Council's initiative for further strengthening the public-private partnerships in research activities which will lead to the development of high yielding genotypes with value added traits.

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 revenue. A profit of Rs. 4.97 lakhs was generated for the financial year 2022.

Externally funded projects

Twenty-Five new externally funded projects have been sanctioned during 2022 (Appendix 5) with a budget outlay of 714 lakhs. A total of 37 externally funded projects are currently being handled at the Institute (Appendix 6).

Awards and Recognitions

- ✓ Dr. B. Nirmala, Senior Scientist (Agri. Economics) received the Raithu Nestham Award- 2022 from Shri. M. Venkaiah Naidu, former Hon'ble Vice President of India on 20th November, 2022 at Swarna Bharat Trust, Muchintal, Hyderabad, during the Raithu Nestham Foundation's 18th Annual Award Ceremony in the presence of about 500 farmers from Andhra Pradesh and Telangana.
- ✓ Dr Fiyaz R A received Fellow of SAWBAR for the year 2022 by Society for Advancement of Wheat and Barley Research, Karnal, India.
- ✓ Dr LV Subba Rao received SARR Fellow Award at the International Conference on System of Crop Intensification (ICSCI 2022), ICAR-IIRR, Hyderabad during 12-14 December, 2022.
- ✓ Dr Divya Balakrishnan received First SARR Young Scientist Award at the International Conference on System of Crop Intensification (ICSCI 2022), ICAR-IIRR, Hyderabad during 12-14 December, 2022.

- ✓ Dr K. Sruthi, Scientist received Neelamraju Ganga Prasad Rao and N Kamala Gold Medal during the 8th foundation day (03.09.2022) of PJTSAU for having secured the highest overall grade point average (9.46 OGPA) in Ph.D. (Agriculture) in the major field of Genetics and Plant breeding.

- ✓ Dr Brajendra received the Distinguished Scientist Award from SSDA, MEERUT during ICAAAS-2022 held at HPU, Shimla and HP during 12-14 June, 2022.
- ✓ Dr Brajendra received the Outstanding Soil Scientist Award, by PKVSS, Patna, Bihar, at KNIPSS, Sultanpur, UP during DISHA-2022 from 11-12 June, 2022.
- ✓ Dr Brajendra received the Outstanding Achievement Award by SAID society, Ranchi, Jhrakhand during the NC FNSSA during 15-16th April 2022 at Hyderabad, India.
- ✓ Dr Brajendra received the Innovative Soil Extension Award by Science and Technology Society for Integrated Rural Improvement (S&T SIRI) Thorrur, Mahabubabad during National Conference on Digital and Organic Interventions Towards Sustainable Agriculture Horticulture and Animal Husbandry held at ICAR-IIRR, Hyderabad from 15-16 October, 2022.
- ✓ Dr M Sheshu Madhav was selected as Academic editor of PLOS ONE, BMC plant Biology, Annals of Genetics.
- ✓ Dr M Sheshu Madhav was selected as Fellow of Royal Society of Biology (RSB), London.
- ✓ Dr P Revathi nominated as editorial board member of "Electronic Journal of Plant Breeding" for the year 2022-2023 by Indian Society of Plant Breeders (ISPB).
- ✓ Dr Revathi P was selected as Editorial Board Member of International Journal of Phytology Research during the year 2022.
- ✓ Dr Fiyaz RA was nominated as the Associate Editor of the Journal of Cereal Research published by Society for Advancement of Wheat and Barley Research.
- ✓ Dr M Sheshu Madhav was selected as Executive Member of Academic council of Koti Women's college (Osmania University) and Board of studies (BOS) of Department of Botany at Kakatiya University.
- ✓ Best oral presentation was awarded to Dr Fiyaz RA on the topic 'Status of Geographical Indications of Rice in India' during the National Conference on "Intellectual Property Rights in Agriculture: Opportunities and Challenges (IPRAOC-2022)" held at Veer Kunwar Singh College of Agriculture, Dumraon (Buxar), on 07–08 April, 2022.
- ✓ Best oral presentation was awarded to Dr Fiyaz RA 'Community upliftment through Geographical Indications' during the 5th National Conference and webinar on Doubling Farmers Income for Sustainable and Harmonious Agriculture DISHA 2022 on 11-12 June, 2022 organized by KNIPSS, Sultanpur, UP in association with GAPS, Dhanbad, Jharkhand and PKVSS, Patna, Bihar.
- ✓ Best Oral presentation award to Dr. V. Prakasam, Priyanka, C., Sundaram, R.M., Rekha, G., Gopaljee Jha, Vikraman, M., Kannan, C., Laha, G.S. and Prasad, M.S. 2022. "Understanding ecological diversity of sheath blight pathogen *Rhizoctonia solani* from various rice-ecosystem in India through phenotyping and whole genome sequencing (WGS)"in IPSCONF2022 held at SKNAU, Jobner-Jaipur, Rajasthan, India. p43
- ✓ Best Poster Presentation was awarded to "Introgression of broad-spectrum blast resistance gene *Pi2* into maintainer line of DRR 9A CMS line by marker assisted selection in rice" authored by Arun Kumar Singh, P. Revathi, M. Srinivas Prasad, A.S. Hari Prasad, P. Senguttuvel, K.B. Kembaraju, K. Sruthi and R.M. Sundaram in IPSCONF2022

held at SKNAU, Jobner-Jaipur, Rajasthan, India by IPS (Indian Phytopathological Society) 8th International Conference during March 23-26, 2022.

- ✓ Best Poster Presentation was awarded to Dr C Gireesh (Senior Scientist) for "*Oryza glaberrima* – A potential donor for improving the *Oryza sativa*" In: Tending Mendel's Garden for a Perpetual and Bountiful Harvest: Symposium Commemorating Birth Bicentenary of Gregor Johann Mendel (MENDELSYM), July 19-21, 2022, ICAR-IARI, New Delhi, India.
- ✓ Best Poster Presentation was awarded to "Characterization of wild introgression lines from *Oryza nivara* and *Oryza rufipogon* for detection of grain size QTLs" authored by Divya Balakrishnan, Rao YV, Malathi S, Krishnamraju A, Kavitha B, LV Subba Rao, Sarla N. 2022, In: Tending Mendel's Garden for a Perpetual and Bountiful Harvest: Symposium Commemorating Birth Bicentenary of Gregor Johann Mendel (MENDELSYM), July 19-21, 2022, ICAR-IARI, New Delhi, India.
- ✓ Best Poster Presentation was awarded to G. Padmavathi, B. Umakanth, V. Jhansi lakshmi, M. Sheshu madhav, L.V. Subba rao and R.M. Sundaram for the paper "Identification of a novel gene, Wbph13(t), governing resistance to white-backed planthopper by QTL analysis using SNP markers in Sinnasivappu, a landrace of rice" at the International Conference on System of Crop Intensification for Climate-Smart livelihood and Nutritional Security in Theme 2: Breeding Cultivars, Land Races, Ideotypes, Management Practices, Pest and Disease Dynamics of SCI held at ICAR-IIRR, Hyderabad during 12-14 December 2022, ICSCI 2022/T2/47: pp 82-84.
- ✓ Best Poster Presentation was awarded to Bharali V, Bitra B, Thati S, Yadla S, Jukanti AK (2022) "From Mendelian Genetics to Modern Genomics". In: National Symposium - Remembering Gregor Johann Mendel on his Bicentennial Birth Year (From Scratch to Factor to Gene to Genome), G.B. Pant University of Agriculture & Technology, Pantnagar, May 5-6, 2022.
- ✓ Best poster award for the poster "Evaluation of nitrogen sources for improving productivity and nitrogen use efficiency by Surekha, K., Rao, D.V.K.N., Kumar, R.M., Neeraja, C.N., Manasa, V., Gobinath, R., Brajendra and Sundaram, R.M. in the International conference on "System Crop Intensification (ICSCI 2022) for Climate Smart, Livelihood and Nutritional Security'' held during 12-14th December.

ICAR – IIRR, Hyderabad, Annual Awards for Best Research Paper, 2022

Category	Name of the publication	Authors
Crop Improvement	Mapping of QTLs for Yield Traits Using $F_{2:3:4}$ Populations Derived from Two Alien Introgression Lines Reveals qTGW8.1 as a Consistent QTL for Grain Weight from *Oryza nivara*. *Front. Plant Sci.* 2022. 13:790221. doi:0.3389/fpls.2022.790221	Beerelli K, Divya Balakrishnan, Addanki KR, Surapaneni M, Rao Yadavalli V and Neelamraju S
Crop Improvement	Multiparent-Derived, Marker-Assisted Introgression Lines of the Elite Indian Rice Cultivar, 'Krishna Hamsa' Show Resistance against Bacterial Blight and Blast and Tolerance to Drought. *Plants*, 11, 622. https://doi.org/10.3390/plants11050622	Badri Jyothi, Lakshmidevi, G., Jai Vidhya, L.R.K., Prasad, M.S., Laha, G.S., Jhansi Lakshmi, V., Subhakara Rao, I., Revathi P., Balakrishnan, D., Vishnu Priya, Y.V., Arvind Kumar, J., Singh, U. M., Singh, V.K., Kumar, A., Ram, T., Subba Rao, L.V. and Sundaram, R.M.
Crop Production	Sustainable Intensification of a Rice–Maize System through Conservation Agriculture to Enhance System Productivity in Southern India" published in Plants Journal	Tuti, M. D., Rapolu, M.K., Sreedevi, B., Bandumula, N., Kuchi, S., Bandeppa, S., Saha, S., Parmar, B., Santosha Rathod., Ondrasek, G. and Sundaram, R. M.
Crop Production	Improving Yield and Nitrogen Use Efficiency using Polymer Coated Urea in Two Crop Establishment Methods of Rice (*Oryza sativa* L.) Under Vertisol	Surekha, K., Gobinath and Manasa, V.

Category	Name of the publication	Authors
Crop Protection	Climate-Based Modeling and Prediction of Rice Gall Midge Populations Using Count Time Series and Machine Learning Approaches" in Agronomy Journal.	Santosha Rathod, Yerram S, Arya P, Katti G, Rani J, Padmakumari AP, Somasekhar N, Padmavathi C, Ondrasek G, Amudan S, Malathi S, Rao NM, Karthikeyan K, Mandawi N, Muthuraman P, Sundaram RM.
Crop Protection	Performance of Novel Antimicrobial Protein Bg_9562 and In Silico Predictions on Its Properties with Reference to Its Antimicrobial Efficiency against Rhizoctonia solani. Antibiotics (Basel). 8;11(3):363. doi: 10.3390/antibiotics11030363. PMID: 35326826; PMCID: PMC8944631.	Pranathi, K., Rekha, G., Kalyani, M., Divya, M., Gopalje, J., Vellaisamy, P., Priyanka, C., Hajira, S., Maruthi, P., Sundaram, R.M. and Kannan Chinnaswami.
Social Science	An Economic Evaluation of Improved Rice Production Technology in Telangana State, India" in Agriculture Journal	Bandumula, N.; Santosha Rathod.; Ondrasek, G.; Pillai, M.P.; Sundaram, R.M.
Social Science	Modelling and Forecasting of Rice Prices in India during the COVID-19 Lockdown Using Machine Learning Approaches" in Agronomy Journal.	Santosha Rathod, Chitikela G, Bandumula N, Ondrasek G, Ravichandran S, Sundaram RM

ICAR – IIRR, Hyderabad, Annual Awards for Best Researcher, 2022

Category	Award	Scientist
Crop Improvement	Best Young Scientist	Dr Fiyaz RA
Crop Production	Best Scientist	Dr Brajendra
Crop Production	Best Young Scientist	Dr V. Manasa
Crop Protection	Best Scientist	Dr V Prakasam
Social Sciences	Best Scientist	Dr B Nirmala
Social Sciences	Best Young Scientist	Dr Santosha Rathod

Copyrights

Copyright applications were submitted for software package IIRRSTAT (Diary no. 19300/2022-CO/SW) and IIRR Seed Portal (Diary No. 19316/2022-CO/SW).

Patents

Patent applications were submitted for

- Anhydrous Skin Cleansing and Moisturizing composition: Appl. No. 202241006257 dated 5 February 2022.
- Anhydrous Natural Pain Relief Composition for Topical Application: Appl. No 202241011157 dated 02 March 2022.
- Natural Skin Care Composition and Preparation thereof: 202241034696 dated 17 June 2022.
- BioDCM-NPs – (IIT-K, ICAR-IIRR and HCU) - Patent Application No. 202111061106A dated 07 January 2022.

Databases

- ITS sequences of *Pseudomonas* spp. (*Pseudomonas putida* - PIK 1 Accession No: ON778610, Stem rot (*Sclerotium hydrophilum* –SHPS 1 Accession No: OP480227), False smut (*Ustilaginoidea virens* - ON782056 & OP480796) were submitted to NCBI GenBank database.
- Six Microbial cultures were submitted to NBIAM, Mau (One fungal (*Trichoderma asperellum* TAIK); 3 bacterial antagonists (*Bacillus cereus* IIRR, *Bacillus xiamenensis* IIRR, *Bacillus subtilis* IIRR), 2 blast culture- *Pyricularia oryzae* POIIRR 31 & 41).
- Six potential Phosphate Solubilizing Bacterial cultures *Citrobacter amalonaticus* IIRRPSB1, *Bacillus* sp. IIRRPSB6, *Bacillus pumilus* IIRRPSB10, *Bacillus* sp. IIRRPSB13, *Citrobacter amalonaticus* IIRRPSB4 and *Citrobacter ramalonaticus* IIRRPSB6 were deposited in the National Agriculturally Important Microbial Culture Collection (NAIMCC), ICAR-NBAIM, Mau.

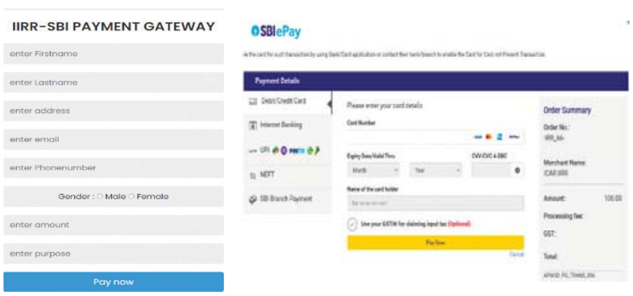
Portals/Websites/Mobile Apps

Rice IPM Mobile App in Hindi Language

The content of IPM app in Telugu language was translated to English and Hindi languages and app was developed in Hindi and further it will be translated to other local languages to reach farmers in different rice growing regions.

IIRR- SBI payment gateway (https://icar-iirr.org/statebank/register1.php)

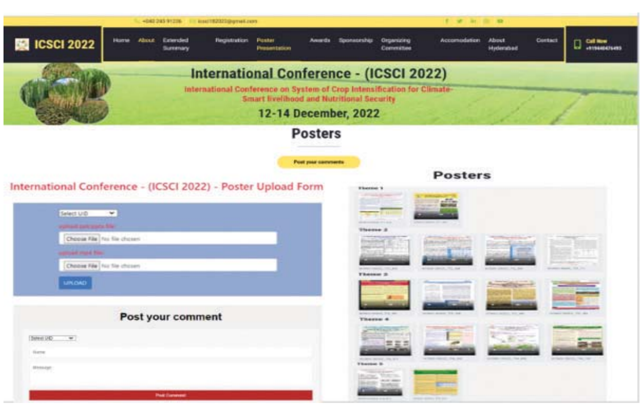
SBI payment gateway was designed using PHP language with MYSQL as backend and integrated with IIRR website to facilitate online payments to IIRR. User has to register with basic details to pay online through IIRR SBI Payment Gateway.



New Websites

Two websites were designed and hosted

- ✓ Website for Society for advancement of rice research
- ✓ Website for International conference on System of Crop Intensification (ICSCI 2022) for Climate – Smart Livelihood and Nutritional Security



https://sarr.co.in/icsci2022/

Deputations

Dr P Senguttuvel, Senior Scientist, ICAR-IIRR attending HRDC Annual Meeting at IRRI, Philippines during 21-23rd September 2022

Dr. V. Prakasam, Senior Scientist was deputed to University of Copenhagen to attend "Establishing a Danish-Indian partnership on Smart Plant Protection (SPP)" from November 28 to December, 02 2022, at University of Copenhagen, Denmark.

Dr R M Sundaram, Director, IIRR deputed to Bangladesh to represent the country for the CORRA meeting at BRRI, Bangladesh during 29-30 November, 2022.

Dr S Vijayakumar, Scientist (Agronomy) was deputed to participate in the 3rd International Weed Science Congress held in Bangkok, Thailand during 4-9th December, 2022.

Workshops/ Institutional Meetings and Significant Events

Annual Hill Rice group Meeting

The 9th Annual Hill Rice Research Group Meeting was held on 28th February, 2022 at ICAR-IIRR, Hyderabad in virtual mode under the chairmanship of Dr. TR Sharma, DDG (Crop Science), ICAR and co-chaired by Dr. RK Singh, ADG (FFC), ICAR. After remarks of Dr. RM Sundaram, Director (ICAR-IIRR), Dr. LV Subba Rao presented the action taken report of 2020 workshop and results of AICRPR *kharif* 2021 of Hill ecology. Dr. TR Sharma in his introductory remarks emphasised on the importance of collection and submission of high-quality data of the trials from all the funded and voluntary centres. Dr. RK Singh briefed about diverse rice ecologies in India and urged the co-operators to ensure the supply of quality rice seeds to farmers in Hill zones. Various cooperating centres under Hill ecology presented progress made during 2021.

Second Meeting of the Expert Committee on Revisiting the AICRPR Guidelines

The second meeting of the expert committee on revisiting some of the AICRPR guidelines for evaluation of entries was held on virtual mode on 10th March, 2022 under the chairmanship of Dr JP Tandon, Former ADG (F&FC), ICAR, New Delhi. Drs LV Subba Rao, PI-AICRPR and AVSR Swamy, Principal Scientist, Plant Breeding, ICAR-IIRR made a brief presentation on the existing guidelines and flagged the issues of concern. Dr Santosha Rathod gave inputs on statistical analysis of AICIRP data. The committee discussed on minimum number of locations with acceptable quality of data required for promotions, monitoring of ACIRIP trials, norms for promotion and grain quality concerns in basmati and non-basmati trials.

57th Annual Rice Group Meeting (ARGM)

The 57th ARGM was held during 25-27th April, 2022 in Hybrid mode under the chairmanship of Dr TR Sharma, DDG (Crop Science), ICAR and co-chaired by Dr RK Singh, ADG (FFC), ICAR. Dr RM Sundaram, Director, ICAR-IIRR welcomed the dignitaries and delegates of AICRPR, QRT, RAC, IRRI and private seed industries and presented Director's report, of the research highlights of AICRPR and ICAR-IIRR. Dr. T.R. Sharma, DDG (CS), ICAR lauded the efforts of ICAR-IIRR and congratulated the Director, IIRR and his team. He emphasized the importance of the use of modern, cutting-edge technologies, including Genomics and Precision agriculture, in the development of varieties with high productivity, suitable for different ecosystems and a rapidly changing climate. Dr. T. Mohapatra, Secretary, Department of Agriculture Research and Education (DARE) and Director General, ICAR, stressed the importance of development of multi-stress tolerant varieties and popularization and adoption of varieties. He also suggested that pest and pathogen evolution needs to be studied to identify reasons for the emergence of pest/pathogens despite cultivating resistant varieties.

Varietal Identification Committee Meeting

The Varietal Identification Committee Meeting-2022 Varietal Identification Committee (VIC) Meeting on virtual mode was held on 27th April, 2022 under the chairmanship of Dr. T.R. Sharma, DDG (Crop Science), ICAR. There were a total of 36 proposals including 32 varietal entries and 4 hybrid entries. All the 36 proposals were critically examined for their performance with respect to on overall, zonal and state basis over the years, their reaction to biotic/abiotic stresses, performance in agronomic trials and quality features, etc. The committee emphasized that if the superior performance of an entry is limited a single state in a particular zone, such entries may be considered by the respective SVRCs.

Research Advisory Committee Meeting

The Research Advisory Committee (RAC) Meeting of ICAR-Indian Institute of Rice Research, Hyderabad was held on 28th June, 2022 in hybrid mode under the Chairmanship of Dr. B. Mishra Ex-VC, SKUAS&T, Jammu & Ex-PD, ICAR-DRR, Hyderabad and ICAR-DWR, Karnal. A brief presentation on the activities and research achievements of the institute, during 2021-22, was made by Dr. R.M. Sundaram, Director and detailed presentations by the respective heads of sections. The Chairman, Dr. B. Mishra appreciated the presentation and welcomed all the members of RAC. Dr. K.K. Jena congratulated the outstanding research work being done at IIRR. Dr. Sheshashayee praised the progress of research work and specified the excellent progress on genome editing and biofortification work. Dr. R.K. Singh, ADG (CC & FFC) congratulated the scientists for commendable research work and publications. He applauded the genome editing research work done at IIRR and suggested to develop programs for development of climate smart varieties and increasing the productivity of rainfed rice. Dr. Padmini Swain, Director, ICAR-NRRI congratulated the IIRR for excellent work. Dr. B. Mishra stressed on managing the soil health which in turn determines the health of water, humans and animals. He also raised concern over the average productivity of rice in India which is significantly lesser than the international productivity.

Institute Research Council (IRC) Meeting

The Institute Research Council (IRC) Meeting was organized on 6th, 8th, 10-12th, 16th, 22-23 August, 2022 (8 days) for the year 2021-22. All the scientists presented their progress and achievements in detail

along with their future course of work to the IRC members. New project proposals were presented for approval by the IRC. Dr. R.M. Sundaram, Director and Chairman (IRC) appreciated the efforts of the scientists in effectively conducting research projects. Various researchable issues regarding the ongoing IRC projects and suggestions for the next year's experiments were thoroughly discussed by all the scientists during 8 days' deliberations.

Institute Biosafety Committee (IBSC) meeting

The 20th IBSC meeting of ICAR-IIRR was held in hybrid mode on August 5, 2022, with the newly constituted Institute Biosafety Committee (IBSC) members.: Dr R.M. Sundaram, Director, ICAR-IIRR & Chairman; Dr D. Balakrishnan, DBT Nominee & Principal Scientist, ICAR-IIMR, Hyderabad; Dr K. Ulaganathan, Expert Member & Professor, CPMB, Osmania University, Hyderabad; Dr K. Gopinath, Expert Member & Professor, University of Hyderabad; Dr Nuzhath Fatima, Medical Officer, ICAR-1IRR, Hyderabad; Dr C.N. Neeraja, Principal Scientist and Head, Biotechnology, ICAR-IIRR; Dr A.P. Padmakumari, Principal Scientist (Entomology), ICAR-IIRR, Internal Member; Dr D. Krishnaveni, Principal Scientist (Plant Pathology), ICAR-IIRR, Internal Member; Dr S.K. Mangrauthia, Sr. Scientist (Biotechnology), ICAR-IIRR, Internal Member; Dr Kalyani M. Barbadikar, Scientist (Biotechnology), lCAR-llRR, Internal Member. All the members actively participated in the meeting. Dr R.M. Sundaram, Director IIRR welcomed the members. Dr S.K. Mangrauthia presented the status and progress related to IIRR-IBSC. He updated the progress made during the last year and emphasized the need for biosafety measures involved therein. The experts gave their inputs for better operation and management of transgenic and genome-edited products.

Annual Review Meeting of CRP Biofortification

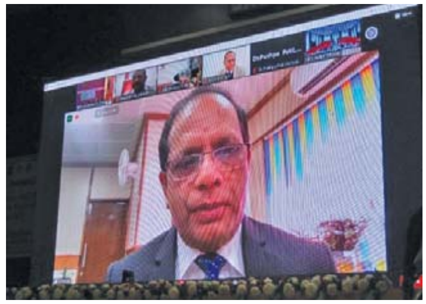
A review meeting of CRP Biofortification was held during 20th-21st May, 2022 in virtual mode. Dr. C.N. Neeraja, Principal Scientist, ICAR-IIRR welcomed Dr. D.K. Yadava ADG Seeds, delegates and participants from centers on Rice, Wheat, Maize, Pearl Millet, Sorghum and Small Millets. Dr. R.M. Sundaram, Director, ICAR-IIRR presented opening remarks and briefed the project outlines. A total of 31 scientists presented research work progress across the centers. Discussions were made and the critical research points were discussed as per the agenda of the meeting.

Institute Management Committee Meeting

The Institute Management Committee Meeting was conducted on 14th June, 2022. Dr. R.M. Sundaram made a brief presentation on the research achievements. Shri Shitanshu Kumar presented the agenda to the committee. Several proposals were approved by IMC and the proceedings were submitted to council for approval.

International Conference on System of Crop Intensification (ICSCI 2022)

ICAR-IIRR in association with the Society for Advancement of Rice Research (SARR) organized the International Conference on System of Crop Intensification (ICSCI 2022) for Climate - Smart Livelihood and Nutritional Security in hybrid mode during 12-14 December, 2022. The inaugural session of the International Conference - ICSCI 2022 was


chaired by Dr. Himanshu Pathak, Secretary, DARE & DG, ICAR with Dr. SK Pradhan, ADG (FFC) as co-chair. Dr. Alapati Satyanarayana, Former Director of Extension, ANGRAU, was the Chief guest for the session. Guests of Honour include Dr. DK Yadava, ADG (Seeds), ICAR; Dr. AK Singh, Director, ICAR-IARI; Dr. R. Jagdeeshwar, Director of Research, PJTSAU; Dr. Francesco Carnevale Zampaolo, Program Director, SRI-2030, UK; Dr. Abha Mishra, Former Director, ACISAI, Thailand. Dr. Himanshu Pathak, Secretary DARE & DG, ICAR, New Delhi welcomed the delegates. He pointed out several challenges in sustainable rice production like degrading soil quality and issues of greenhouse gases and mentioned that technologies like SRI and SCI can address several of these issues. He also mentioned that location-specific modification of SCI is needed to upscale the technology. Several publications related to rice cultivation were released during the inaugural session of the conference.

Five technical sessions were conducted during the conference. Each session included the presentation of lead talks by the experts, oral presentations, lightning talks and poster presentations. A total of 209 participants including delegates from 16 Countries, *i.e.,* USA, UK, Philippines, Germany, Italy, New Zealand, Netherlands, Japan, Iran, Nepal, Bangladesh, Vietnam, Tanzania and India took part in the conference. Besides researchers and students, about 150 farmers also participated in this conference.

Extension activities

Farmers Day

ICAR-Indian Institute of Rice Research celebrated its Farmers day on 28 October, 2022 in the Rajendranagar premises. About 350 farmers from Telangana, Andhra Pradesh, Karnataka and Odisha took active part in the event and visiting farmers were exposed to improved rice production technologies to help them break the yield barrier in Irrigated Ecosystem. A seed sale counter was made available for farmers to purchase improved HYV of ICAR-IIRR for the ensuing *rabi* season. Overall 15 exhibition stalls were installed to benefit the farmers.

Tribal sub –Plan Activities

Over 3200 tribal farm families of Andhra Pradesh (650), Assam (500) Chhattisgarh (300), Jharkhand (300), Jammu and Kashmir (280) Karnataka (300), Kerala (250), Odisha (320) and Telangana (600) were benefitted with cafeteria of rice related technologies. The targeted farm household were given improved rice varieties and other critical inputs capable to breaking the yield barriers. The inputs include metal plough, neem coated urea, micro nutrients, herbicides, neem oil, sprayers, tarpaulins, rodenticide, water pipes, zinc sulphate, pheromone traps, gunny bags

and storage bins. By imparting the subject matter training about the technical know-how and do-how of rice cultivation, the extension gaps were minimized along with technological gaps. The yield increase was observed minimum of 16% in Jharkhand and maximum of 24% in Telangana and Andhra Pradesh. The major tribal groups covered under this scheme are Baiga, Bhil, Korba, Lambadas, Chenjus, Kurumbas, Kattunaikans Oron, Santhal, Todas and Siddhis and Yerukula.

IIRR-SC SP Activities

Seeds of ICAR-IIRR varieties were provided to 360 beneficiary farmers of Telangana. Drying sheets, sprayers, pheromone traps and lures, drum seeders, cono-weeders, herbicides, insecticides and fungicides were provided to the beneficiaries. A total of 4,504 demonstrations were organized during 2022 under ICAR-IIRR-SCSP. These demonstrations were organised in collaboration with SKUAST, Jammu, RARS, Maruteru, ANGRAU, TNAU, Coimbatore, Annamalai University, PJTSAU, Telangana, RRS, Chinsura, West Bengal, PANJANCOA, Puducherry, IGKV, Raipur, Chattisgarh, RRS, Nagina, BHU, Uttar Pradesh, KVKs of Rastakuntubai, Vizianagaram, RASS, Andhra Pradesh, GRI, Dindigul, Needamangalam, Thiruvarur, Tamil Nadu, Chamarajnagar, Karnataka, YFA-KVK, Wanaparthy, Medak, Durgapur, Amaravathi, Maharashtra and Sadanandapuram, Kerala. Twelve training programs on various aspects of rice production technologies were organised in Telangana and Andhra Pradesh under SCSP. The SC rice farmers were trained on Integrated Nutrient Management, Integrated Pest Management, Integrated Weed Management, preparation of vermi-compost and water saving technologies and Cyber Security.





Activities under IIRR SC SP

Other Institutional Activities

PM- Kisan Samman Nidhi program

An interaction was organized at ICAR-IIRR, Hyderabad to create awareness about the PM- Kisan Samman Nidhi program and the Release of 10th installment under PM-Kisan and release of equity grant to FPOs on 1st January, 2022. It was live streamed for the staff and students, farm workers and farmers in the IIRR Seminar Hall by the coordinator of the program Dr Amtul Waris.

National Girl Child Day

As mandated by Government of India, Ministry of Women & Child Development and ICAR, an event to celebrate **National Girl Child Day** was organized on January 24, 2022 that was enthusiastically attended by Research Scholars, Technical Assistants, Skilled Workers and Scientists of the institute.

National Girl Child Day celebrations at IIRR

World Pulses Day

The World Pulses Day was celebrated on 10th February, 2022 at ICAR-IIRR. As mandated by ICAR a Kisan Ghoshti and discussion forum on "Pulses to empower youth in achieving sustainable agri food systems" was organized on the occasion of World Pulses Day at ICAR-IIRR.

Brainstorming Session on "Rice and Water"

Brainstorming session on "Rice and Water" was held on 11th February, 2022. 175 rice researchers, R&D personnel and progressive farmers participated in the session. It focussed on sustainable rice production through novel water-saving technologies and practices.

Automatic Weather Station (AWS) inaugurated

New Automatic Weather Station (AWS) at Department of Plant Pathology, ICAR-IIRR, Hyderabad, established under DST-ICRISAT collaborative project on Centre of Excellence on Climate Change Research for Plant Protection: Pest and Disease Management was Inaugurated on 25.02.2022 by Dr. R M Sundaram, Director, ICAR-IIRR, Hyderabad and Dr. Mamta Sharma, Project Co-ordinator, Deputy Regional Director-Asia, ICRISAT, Hyderabad.

Inauguration of Automatic Weather Station at IIRR Rajendranagar Farm

Nutririce crunchy snacks from ICAR-IIRR rice varieties

The long-standing desire to taste and enjoy the fruits of hard labour of developing rice varieties of ICAR-IIRR took shape in the form of preparation of traditional recipes from two ICAR-IIRR rice varieties (Improved Samba Mahsuri and DRR Dhan 48). The all-time favourite snack ***murukku*** was prepared from rice flour of ISM (Low glycemic index) and DRR Dhan 48 (high zinc). The crunchy snack was relished by all the consumers.

The edible products have been conceptualized by Dr RM Sundaram, Director, IIRR and Dr Amtul Waris. The logo was artistically designed by Dr S Arun Kumar with the apt tagline penned by Dr Santosha Rathod. A range of traditional and nutritionally enriched snacks are in the offing. The long-term plan is to promote the products under the brand name NutriRice *nutritious and delicious*.

International Women's Day

"International Women's Day'' was celebrated on 8th March, 2022 by the ICAR-Indian Institute of Rice Research. The UN designated theme "**Gender equality today for a sustainable tomorrow**" was very aptly deliberated upon by the Director, ICAR-IIRR, Dr RM Sundaram. The significance of acknowledging the contributions of women by dedicating a special day was elaborated upon by Dr B Jhansi Rani, the senior most woman scientist and head Entomology. The power of mentoring and coaching to help younger colleagues navigate their careers was deliberated upon by the coordinator of the program Dr Amtul Waris. The emcee, Dr B Nirmala ensured the smooth conduct of the program. A song depicting the important roles from housekeeping to heads of sections being played by women personnel of the institute was composed and melodiously rendered by Drs B Sailaja, K Surekha and team.

International Women's Day was celebrated on March 8, 2022

International Day of Yoga

International Day of Yoga (IDY) celebrated on 21st June 2022. Ms. Deepti Mantri, Founder, YOGASHALA-The path of Transformation (Hyderabad) engaged all staff in a session on Yoga - a boon for a stress-free, healthy workforce.

AI based monitoring of Pest and Disease for Rice Crop

A meeting on "**AI based monitoring of Pest and Disease for Rice Crop**" was organised on May 11, 2022 at IIRR. Scientists from Purdue University- USA, IARI and NRRI and IIRR participated in this meeting and discussed about the current status of research in above area and future collaborative program.

ICAR organized Mega farmers -PM interaction Meeting

ICAR- IIRR mobilized 550 farmers from five districts and actively participated in the mega farmers -PM interaction meeting organized by ICAR on May 31, 2022 across the country and hosted by ICAR- CRIDA, Hyderabad.

The Har Ghar Tiranga Mahotsav

The *Har Ghar Tiranga* Mahotsav was celebrated from 13th to 15th August. National flags were distributed to all the employees and students of the Institute and were asked to hoist the flag and pin the flags online. Information posters were put up on the flag code and all precautions were taken to maintain the dignity of the National Flag.

Inauguration of Soil Testing Laboratory

As a part of *Azadi Ka Amrith Mahotsav,* Director, Dr. R M Sundaram inaugurated the Soil Testing Laboratory at the Institute for providing agro-advisory services to rice farmers. Soil testing services extended to the adopted farmers' fields in Mahboobnagar, Telangana. Three hundred soil health cards were distributed and an agro-advisory service camp was organized in the Maheshwaram Mandal, Ranga Reddy district.

National campaign on ''Balanced use of fertilizers''

Under the "Azadi Ka Amrit Mahotsav a national campaign on ''Balanced use of fertilizers'' was organized for farmers (47) of Japala Village, Manchal Mandal of Ranga Reddy District, Telangana. INM for soil health and environmental protection was deliberated, use of LCC for judicious use of fertilizers, Soil analysis for use of right fertilizers at right time, place and rate, Appropriate Cropping systems for nutrient use efficiency, Use of bio-control agents and Digital tools for INM were practically demonstrated by TEAM IIRR. The farmers were motivated to follow a balanced use of fertilizers to save the precious soil and environment.

National campaign on ''Balanced use of fertilizers''

Workshop on "effective use of nano-fertilisers in agriculture"

A one-day workshop on ***"Effective use of nano-fertilisers in agriculture"*** was jointly organised by ICAR-Indian Institute of Rice Research and Coromandel International Private Ltd, Hyderabad on 01-09-2022 at Radisson Blu Plaza, Banjara Hills, Hyderabad. The focus of this workshop was to understand the mechanisms and enable the use of nano-materials/fertilisers for the sustainable production of crops. Delegates from Coromandel including Mr. Sameer Goel, MD, Coromandel Private Ltd., Mr. Shankar Subramanian, President (Fertilisers), Dr. Subbarao (Former Director, ICAR-IISS) and Scientists of ICAR-IIRR namely, Drs. Mahender Kumar, MBB Prasad Babu, P. Muthuraman, Brajendra, Gobinath and V. Manasa participated in this workshop.

Subject matter specialists from other institutes *viz.*, Dr. Manoj Srivastava (IARI), Dr. S.S. Mukopadhyay (PAU), Dr. TNVKV. Prasad (ANGRAU), Dr. Rahul Kumar (UoH) and Dr. Elanchezhian (ICAR-IISS) presented their work. This was followed by a panel discussion on the current relevance and scope of nano-fertilisers in Agriculture.

One day awareness programme on application of Rice IPM

ICAR-IIRR and Seva Spurthi Foundation jointly organized a programme on Rice IPM at Motakonduru Mandal, Yadadri district, Telangana on 21 June, 2022.

One day awareness programme on application of drone technology

ICAR-IIRR Scientists in association with Seva Spoorthi foundation organised one day awareness programme on Sustainable rice production and application of drone technology in agriculture on 5th September, 2022 at Muddamguda village, Shabad mandal, Ranga Reddy District of Telangana. Mr. Ratnakar, Manager, Seva spoorthi foundation, Mr. Charan, Vyomic drones, representatives from state agricultural department, village sarpanch and around 40 farmers participated in the meeting.

Cybersecurity awareness program

As a part of Cyber Jaagrookta Divas Annual Day Celebrations, ICAR-IIRR in association with Pranadhara Foundation, Bapatla organised Cybersecurity Awareness Program through ABCs of information security campaign in Cheruvu Jammula Palem village, Bapatla, Andhra Pradesh on 10.10.2022. Dr. B. Sailaja, Principal Scientist (Computer Applns.) briefed on Cyber safety tips and Dos and Don'ts of using mobiles and computers. Drs. B. Nirmala, Senior Scientist (Economics) and D. Krishnaveni, Principal Scientist (Pathology), ICAR-IIRR, Sri Pundarikakshudu and Sri Kiran Prakash from Pranadhara Foundation, Mrs. Vijaya Nirmala, DDA, FTC, Mrs. Lakshmi, ADA, Bapatla actively participated in the program. About 30 progressive farmers attended this program.

Vigilance Awareness Week

Vigilance Awareness Week was celebrated at ICAR-Indian Institute of Rice Research, Hyderabad from 31 October to 6 November, 2022. The theme of this was "Corruption free India for a developed Nation"- "भ्रष्टाचार मुक्त भारत - विकसित भारत". The main aim of Vigilance awareness week is to encourage all the stakeholders to collectively participate in preventing corruption in public life. Several awareness programs were organized during this week.

Pradhan Mantri Kisan Samman Sammelan-2022

ICAR-IIRR participated in *Pradhan Mantri Kisan Samman Sammelan* -2022 on October 17, 2022 and organized an interactive session with farmers on rice cultivation and felicitated the farmers. ICAR-IIRR participated virtually in the Global Launch of Mission Life by the Hon'ble Prime Minister of India on 20th October, 2022.

Constitution Day

ICAR-IIRR celebrated Constitution Day on 25th November, 2022. Dr D. Subrahmanyam, Director (I/C), Administered the Constitution Day pledge to all the staff of the Institute.

World Soil Day

ICAR-Indian Institute of Rice Research celebrated the World Soil Day 2022 on the 5th of December. The program was attended by farmers and staff of ICRA-IIRR. Dr. K Surekha, Head, Soil Science Section, welcomed and addressed the gathering. Mr. Sandeep Kondaji, CEO and his team demonstrated soil testing using the indigenous machine – KRSHIRASTAA More than 50 soil health cards were distributed to the beneficiary farmers by Dr. R M Sundaram, Director, IIRR. A Memorandum of Understanding (MoU) was signed between ICAR-IIRR and Krishitantra for the joint initiative of Krishirastaa.

Swachta Pakhwada

ICAR-IIRR organized Swachta Pakhwada during 16-31 December, 2022. Various Swatchta activities were organized around the Institute campus and in the farm during this program.

Sports and Games

IIRR Wins Laurels at ICAR South Zone Sports Meet - 2022

Zonal Sports Meet of 26 ICAR Institutes of South India organized by ICAR-National Academy of Agricultural Research Management, Hyderabad during November 2022. ICAR-IIRR stood overall 3rd with 45 points among 26 institutes with 4 gold 2 silver and 2 bronze medals.

ICAR-IIRR Celebrated Foundation day

The 8th Foundation Day of the institute was celebrated on 21 December, 2022 at Dr SVS Shastry Auditorium. Dr A Vishnu Vardhan Reddy, Vice Chancellor, ANGRAU was the Chief Guest of the event while Dr S K Pradhan, ADG (FFC), ICAR, Dr R Jagadeeshwar Director of Research, PJTSAU and Dr M Sheshu Madhav, Director, Central Tobacco Research Institute were the guests of honour. Selected staff members of ICAR-IIRR were awarded for their contributions.

Official Language Implementation Committee Meeting

राजभाषा कार्यान्वयन गतिविधियां

संसदीय राजभाषा समिति के द्वारा संस्थान का राजभाषा कार्यान्वयन निरीक्षण

संसदीय राजभाषा समिति की दूसरी उप-समिति के द्वारा 18 जून, 2022 को भाकृअनुप-भारतीय चावल अनुसंधान संस्थान, हैदराबाद की राजभाषा कार्यान्वयन गतिविधियों का निरीक्षण किया गया। निरीक्षण के दौरान समिति की ओर से माननीय सांसद एवं बैठक के अध्यक्ष श्री प्रदीप टम्टा जी एवं अन्य पदाधिकारीगण श्री धर्मराज खटीक, डॉ. रामेश्वर लाल मीना, श्री मनोज कुमार, श्री मो. आरीफ, श्री अनिल कुमार उपस्थित थे। श्री प्रदीप टम्टा जी ने संस्थान के राजभाषा कार्यान्वयन कार्यों की समीक्षा की तथा संस्थान के द्वारा राजभाषा कार्यान्वयन के लिए निर्धारित लक्ष्यों

की प्राप्ति की सराहना की तथा उनमें और सुधार हेतु सुझाव दिए। संस्थान की ओर से डॉ. रामन मीनाक्षी सुंदरम, निदेशक, भाचाअनुसं ने बैठक के प्रारंभ में सदस्यों का स्वागत किया तथा संस्थान की अनुसंधान एवं विकास गतिविधियों पर प्रस्तुतीकरण दिया। इसके अलावा भारतीय कृषि अनुसंधान परिषद की ओर से डॉ. आर के सिंह, सहायक महानिदेशक (व्यावसायीक फसलें), श्रीमती सीमा चोपड़ा, निदेशक (राजभाषा) एवं श्री मनोज कुमार, मुख्य तकनीकी अधिकारी (राजभाषा) तथा संस्थान की ओर से डॉ. सतेन्द्र कुमार मंगरौठिया, वरिष्ठ वैज्ञानिक, श्री शीतांशु कुमार, मुख्य प्रशासनिक अधिकारी एवं डॉ. महेश कुमार, सहायक मुख्य तकनीकी अधिकारी (राजभाषा), भाकअनुसं एवं प्रभारी, हिंदी कक्ष, भाचाअनुसं ने उक्त बैठक में भाग लिया। श्रीमती वनिता एवं श्री नवनीत कुमार ने उक्त निरीक्षण हेतु अपेक्षित कार्यों में सहयोग प्रदान किया। बैठक के अंत में डॉ. आर के सिंह द्वारा माननीय सांसद एवं अन्य पदाधिकारीगण के प्रति आभार व्यक्त किया गया तथा राजभाषा कार्यान्वन में प्रगति हेतु दिए गए सुझावों हेतु हार्दिक धन्यवाद ज्ञापित किया गया।

हिंदी चेतना मास समारोह

भाकृअनुप - भारतीय चावल अनुसंधान संस्थान, हैदराबाद में 14 सितंबर से 13 अक्तूबर, 2022 के दौरान आयोजित हिंदी चेतना मास समारोह का उद्घाटन श्री अमीत शाह, माननीय केंद्रीय गृह एवं सहकारिता मंत्री, भारत सरकार के द्वारा सूरत में हिंदी दिवस एवं द्वितीय अखिल भारतीय राजभाषा सम्मेलन के दौरान संपन्न हुआ। डॉ. महेश कुमार, सहायक मुख्य तकनीकी अधिकारी (राजभाषा), भाकअनुसं एवं प्रभारी, हिंदी कक्ष, भारतीय चावल अनुसंधान संस्थान ने उक्त सम्मेलन में संस्थान के प्रतिनिधि के रूप में भाग लिया।

डॉ. आर एम सुंदरम, निदेशक, भारतीय चावल अनुसंधान संस्थान ने औपचारिक रूप से दीप प्रज्ज्वलित करके संस्थान में हिंदी चेतना मास समारोह के शुभारंभ की घोषणा की। इस अवसर पर डॉ. महेश कुमार ने समारोह में उपस्थित लोगों का स्वागत किया तथा हिंदी दिवस एवं हिंदी के फैलते साम्राज्य पर प्रकाश डाला। श्री शीतांशु कुमार, मुख्य प्रशासनिक अधिकारी, भाचाअनुसं ने हिंदी दिवस का महत्व बताते हुए हिंदी चेतना मास के दौरान आयोजित की जा रही विभिन्न प्रतियोगिताओं के संबंध में विस्तृत जानकारी प्रदान की।

अक्तूबर 19, 2022 को संस्थान में जारी हिंदी चेतना मास समारोह के पुरस्कार वितरण कार्यक्रम का आयोजन किया गया। उक्त चेतना मास के अंतर्गत हिंदी में विभिन्न प्रतियोगिताओं का आयोजन किया गया, जिनमें वैज्ञानिक, तकनीकी, प्रशासनिक तथा अनुसंधान सहायक, शोध छात्रों आदि ने बड़े-ही उत्साह एवं उमंग के साथ भाग लिया। समारोह का शुभारंभ भारतीय कृषि अनुसंधान परिषद् गान से हुआ। श्रीमती वनिता, प्रवर श्रेणी लिपिक ने समारोह में उपस्थित लोगों का स्वागत किया। डॉ. महेश कुमार ने पिछले वर्ष के दौरान संस्थान में संपन्न राजभाषा कार्यान्वयन संबंधी कार्यों पर प्रतिवेदन एवं हिंदी चेतना मास समारोह के दौरान आयोजित कार्यक्रमों पर प्रतिवेदन प्रस्तुत किया। उन्होंने उक्त समारोह को सफल बनाने के लिए संस्थान में कार्यरत सभी अधिकारियों एवं कर्मचारियों के प्रति आभार व्यक्त किया।

इस अवसर पर डॉ. आर एम सुंदरम, निदेशक, भाचाअनुसं ने हिंदी चेतना मास के दौरान आयोजित प्रतियोगिताओं के विजेताओं को नकद पुरस्कार तथा प्रमाण-पत्र तथा प्रतियोगिताओं के आयोजकों/निर्णायकों को स्मृति चिह्न भी प्रदान किए। इस अवसर पर संस्थान में हिंदी में अधिकाधिक कार्य करने वाले अधिकारियों एवं कर्मचारियों को भी नकद पुरस्कारों से सम्मानित किया गया।

डॉ. सुंदरम ने अपने संबोधन में बताया कि इस तरह के समारोह केवल मनोरंजन व पुरस्कार तक ही सीमित नहीं होने चाहिए, संस्थान में हमेशा हिंदी की उतरोत्तर वृद्धि होते रहनी चाहिए। हमारे देश की अखंडता में हिंदी का अत्यधिक योगदान है और उसे नकारा नहीं जा सकता है, इसके साथ ही स्थानीय भाषाओं का भी अपना महत्व है। इसके अलावा उन्होंने बताया कि हमारा संस्थान भारत सरकार की त्रिभाषी नीति का अनुपालन कर रहा है। इसके साथ ही उन्होंने संस्थान में राजभाषा कार्यान्वयन की प्रगति हेतु आधुनिक टुलों के उपयोग की अपील की। अंत में श्री शीतांशु कुमार, मुख्य प्रशासनिक अधिकारी के द्वारा धन्यवाद ज्ञापन एवं समारोह को सफल बनाने हेतु आयोजकों, निर्णायकों, सहभागियों के प्रति आभार प्रकट करने के पश्चात सामूहिक रूप से राष्ट्रगान के बाद समारोह का समापन हुआ। संस्थान में संपन्न पूरे हिंदी चेतना मास समारोह के कार्यक्रमों का संचालन एवं समन्वय डॉ. आर एम सुंदरम के दिशा-निर्देश में श्री शीतांशु कुमार, डॉ. महेश कुमार तथा श्रीमती वनिता के द्वारा किया गया।

हिंदी कार्यशालाएं

भाकृअनुप - भारतीय चावल अनुसंधान संस्थान, हैदराबाद में आलोच्य अवधि के दौरान विविध भाकृअनुप सहोदर संस्थान के संयुक्त तत्वावधान में ऑनलाइल तीन हिंदी कार्यशालाओं का आयोजन किया गया। जिसमें संस्थान के कार्मिकों ने भाग लेकर लाभ उठाया। उक्त कार्यशालाओं का समन्वय एवं संचालन डॉ. रामन मीनाक्षी सुंदरम, निदेशक, भाचाअनुसं के दिशा-निर्देश में श्री शीतांशु कुमार, मुख्य प्रशासनिक अधिकारी, डॉ. महेश कुमार, सहायक मुख्य तकनीकी अधिकारी (राजभाषा), भाकृअनुसं एवं प्रभारी, हिंदी कक्ष, भाचाअनुसं तथा श्रीमती वनिता, प्र.श्रे.लि. के द्वारा किया गया।

संस्थान में संपन्न अन्य प्रमुख राजभाषा कार्यान्वयन गतिविधियाँ

राजभाषा संबंधी बैठकों, सम्मेलनों आदि में सहभागिता: राजभाषा के संबंध में विभिन्न विभागों/संस्थानों द्वारा आयोजित बैठकों, सम्मेलनों आदि जैसे – नराकास-2 की बैठक, क्षेत्रीय राजभाषा सम्मेलन, हिंदी कार्यशाला में संस्थान की सहभागिता।

संस्थान की गतिविधियां पत्र-पत्रिकाओं की सुर्खियों में: "हिंदी मिलाप", "स्वतंत्र वार्ता", "शुभ लाभ", "राजभाषा आलोक" आदि ने संस्थान में समय-समय पर संपन्न राजभाषा कार्यान्वयन संबंधी गतिविधियों एवं लेख, संदेश आदि को अपने-अपने पत्र-पत्रिकाओं में स्थान दिया।

राकास की तिमाही बैठकें: प्रत्येक तिमाही में राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन किया गया। बैठकों में राजभाषा कार्यान्वयन में हुई प्रगति की समीक्षा तथा उसके कार्यान्वयन में तेजी लाने हेतु चर्चाएं की गईं।

हिंदी रोस्टर: संस्थान में कार्यरत अधिकारियों तथा कर्मचारियों के हिंदी ज्ञान संबंधी आँकड़ों का संकलन करके तैयार किए गए हिंदी रोस्टर का समय-समय अद्यतन किया गया।

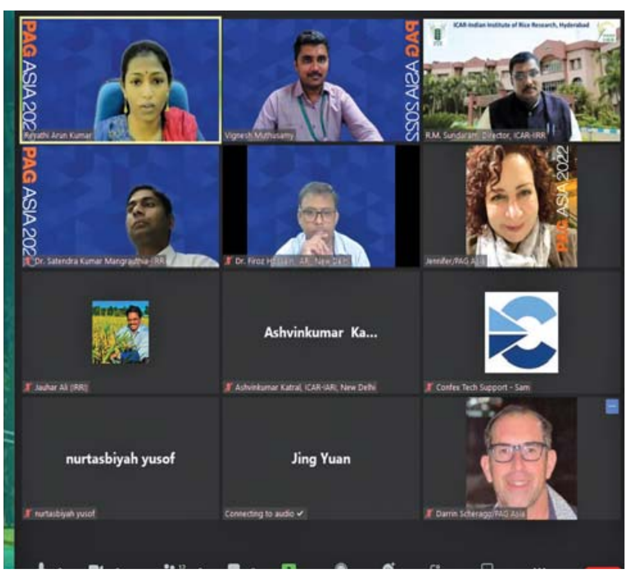
Azad ki Amrut Mahotsav -Talks and webinars organized by ICAR- IIRR and Society for advancement of Rice Research 2022

S. No.	Speaker	Title of the talk	Date
1.	Dr Jitender Giri Scientist V NIPGR	Low P tolerance in rice: mechanisms and way forward	22 January
2.	Dr Akshay Kumar Biswal, Scientist, CYMMYT, Mexico	A workshop on writing manuscripts with Mendeley	31 January
3.	Dr Sheshsayee, Prof. Plant Physiology, UAS, Bengaluru	Developing rice cultivars for water saving cultivation: a physiological perspective	19 February
4.	Dr PS Brahmanand, Prinicpal Scientist, IIWM, Odisha	Ideology of Swami Vivekananda: Motivational Force for ensuring fruitful result of Science and technology and establishing welfare society	26 March
5.	Dr Nese Sreenivasulu, Research Unit Leader – Consumer driven Grain Quality and Nutrition, IRRI, The Philippines	Rice Value addition for future road map of India	28 March

S. No.	Speaker	Title of the talk	Date
6.	Dr P. V. Vara Prasad Director, Sustainable Intensification Innovation Lab, Distinguished Professor, Crop Ecophysiology, Kansas State University, Manhattan, USA	Crop Responses to Key Climate Change Factors and Need for Systems Research	18 May
7.	Dr Tapan Kumar Mondal Principal scientist, ICAR-NIPB, New Delhi	*Oryza coarctata*: a potential source of stress tolerance genes"	30 June
8.	Dr S. Shobana Senior Scientist & Head, Department of Diabetes Food Technology, Madras Diabetes Research Foundation	Food and Nutrition Research in relevance to Diabetes	01 July
9.	Dr CR Mehta Director, CIAE, Bhopal.	Sustainable mechanization for Rice production"	26 July
10.	Dr NK Krishna Kumar, Former DDG (Horticulture)	Agrobiodiversity, Ecosystem services for Sustainable Agriculture	3 September
11.	Dr Niranjan Baisakh Assoc. Prof. Lousiana State University Agricultural Centre, USA	Integrated approaches towards development of rice varieties for alternative irrigation systems	09 November
12.	Dr VP Singh, Retd Professor, ICAR-IARI	IARI interface with rice industry	11 November
13.	Dr BP Malli Karjuna Swamy	Development of Healthier rice to achieve global nutritional security	15 November

Workshop on Modern Crop Breeding in Hybrid Crops for Global Food and Nutritional Security

Organized a workshop on "Modern Crop Breeding in Hybrid Crops for Global Food and Nutritional Security" in the International Plant & Animal Genome Conference PAG Asia 2022, held as a virtual conference from June 22nd to 24th, 2022. As a part of the workshop, lectures by eminent scientists engaged in the research area of genomics-assisted breeding in hybrid rice and maize crops were delivered to the global audience.



RTI Activities

Totally 4 queries and one appeal were received through RTI portal and answers were uploaded within the stipulated time. Quarterly and Annually RTI returns were submitted in CIS and RTIMIS portals

Annual Transparency Audit document (self-appraisal) was prepared

Distinguished Visitors

Dr Vibha Ahuja, Chief General Manager, Biotech Consortium India, Delhi visited ICAR-IIRR on 06.05.2022 and a meeting was held with Scientists regarding the rice genome editing programme at ICAR-IIRR.

Dr Hans Bhardwaj, Head, Rice Breeding Innovations, International Rice Research Institute, Philippines visited ICAR-IIRR on 27.05.2022 and interacted with scientists. Dr. Shoba Venkatanagappa, Senior

Scientist II, Head, INGER & MERiT Global Networks of crop improvement and Dr. Swati Nayak, South Asia Lead-Seed Systems & Product Management from International Rice Research Institute visited ICAR-IIRR on 06 June, 2022. Dr. Shoba Venkatanagappa briefly presented the Seed Equal seed systems initiative by One CG to crop improvement scientists, ICAR-IIRR. Dr. Swati Nayak informed regarding the SeEDQUAL program for delivering genetic gains to the stakeholders.

Mr. G P Sharma, Director Finance, ICAR visited IIRR on 9th July, 2022 and interacted with senior staff

ICAR-IIRR in association with SARR felicitated Dr. V. Praveen Rao, Former Vice Chancellor, PJTSAU for his outstanding contributions to the agricultural research and farming sector on 4th August, 2022

Dr. R C Chaudary, Former Global Co-ordinator, INGER and Chairman of PDRF, Gorakhpur visited the Institute and delivered a talk on "Journey of Kalanamak-an aromatic rice variety" on 26th August, 2022

Dr. D.K. Yadava, ADG (Seeds), ICAR visited the research farm of ICAR-IIRR, Rajendranagar and interacted with scientists regarding the material developed under CRP-Biofortification, CRP-Hybrid Rice and CRP-Molecular Breeding and addressed the staff on 24.9.2022

Dr. Seema Jaggi, ADG (Education), visited IIRR and participated in the interactive session on "Refinement of *statistical methodologies for AICRPR*" on July 30, 2022

Dr. A.R. Pathak, Former VC, Junagadh Agricultural University and Dr. A.K. Singh, Former DDG, NRM, Former VC, RVSKVV and Former Director, IARI visited ICAR-IIRR on 29 September, 2022.

Dr. A.R. Pathak, Former VC, Junagadh Agricultural University and Dr. A.K. Singh, Former DDG, NRM, Former VC, RVSKVV, and Former Director, IARI visited ICAR-IIRR on 29 September, 2022. Dr. R M Sundaram, Director along with his team of scientists took them on a field visit to the IIRR research farm and briefed them regarding the ongoing research experiments. Dr. A.R Pathak appreciated the progress made in phenotyping facilities for nutrient management and biotic/abiotic stress management.

Dr. H K Chaudhary, Vice chancellor, CSKHPKVV and his team including Dr. S. P. Dixit, Director of Research, Dr. Vinod Sharma, Assoc. Director, HAREC Bajaura, Dr. Pankaj Sood, Principal Scientist-cum-Programme Coordinator, Krishi Vigyan Kendra Mandi at Sundernagar and Shri Ram Saran Sharma, Section Officer, Office of Vice Chancellor of the University visited ICAR-IIRR, Hyderabad and interacted with the Scientists on 1st October, 2022.

Personnel and Staff

Scientific Staff

Name	Designation
Dr. R.M. Sundaram	Director
Plant Breeding	
Dr. L.V. Subba Rao	Principal Scientist
Dr. AVSR Swamy	Principal Scientist
Dr. S.V. Sai Prasad	Principal Scientist
Dr. G. Padmavathi	Principal Scientist
Dr. J. Aravind Kumar	Principal Scientist
Dr. Gireesh. C	Senior Scientist
Dr. Suneetha Kota	Senior Scientist
Dr. Jyoth Badri	Senior Scientist
Dr. M.S. Anantha	Senior Scientist
Dr. R. Abdul Fiyaz	Senior Scientist
Dr. Divya Balakrishnan	Senior Scientist
Dr. Suvarna Rani .C	Scientist
Hybrid Rice	
Dr. A.S. Hari Prasad	Principal Scientist
Dr. P. Senguttuvel	Senior Scientist
Dr. P. Revathi	Senior Scientist
Dr. Kemparaju K.B	Senior Scientist
Dr. K. Shruti	Scientist
Biotechnology	
Dr. C.N. Neeraja	Principal Scientist
Dr. M Seshu Madhav	Principal Scientist (Appointed as Director, CTRI, Rajahmundry)
Dr. S.K. Mangrauthia	Senior Scientist
Dr. Kalyani Kulkarni	Scientist
Agronomy	
Dr. R. Mahendra Kumar	Principal Scientist
Dr. B. Sreedevi	Principal Scientist
Dr. Mangaldeep Tuti	Senior Scientist
Dr. Aarti Singh	Scientist (Transferred to DSR, Mau, UP)
Dr. S. Vijaya Kumar	Scientist
Soil Science	
Dr. K. Surekha	Principal Scientist
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
Dr. R. Gobinath	Scientist
Dr. V. Manasa	Scientist

Name	Designation
Physiology & Biochemistry	
Dr. D. Subrahmanyam	Principal Scientist (Superannuated on Nov 2022)
Dr. P. Raghuveer Rao	Principal Scientist
Dr. D. Sanjeeva Rao	Scientist
Dr. Akshay Sakhare	Scientist
Agricultural Engineering	
Dr. Vidhan Singh	Principal Scientist
Agricultural Chemicals	
Dr. M.M. Azam	Principal Scientist
Computer Applications	
Dr. B. Sailaja	Principal Scientist
Entomology	
Dr. B. Jhansi Rani	Principal Scientist
Dr. V. Jhansilakshmi	Principal Scientist
Dr. N. Somashekar	Principal Scientist
Dr. A.P. PadmaKumari	Principal Scientist
Dr. Chitra Shanker	Principal Scientist
Dr. Ch. Padmavathi	Principal Scientist
Dr. Y. Sridhar	Principal Scientist
Mr. S. Chavan	Scientist
Plant Pathology	
Dr. M. Sreenivas Prasad	Principal Scientist
Dr. G.S. Laha	Principal Scientist
Dr. D. Krishnaveni	Principal Scientist
Dr. C. Kannan	Principal Scientist
Dr. Ladha Lakshmi	Senior Scientist
Dr.V. Prakasam	Senior Scientist
Dr. K. Basavaraj	Scientist
Mr. S. Jasudas Gompa	Scientist
Transfer of Technology & Training	
Dr. P. Muthuraman	Principal Scientist
Dr. Amtul Waris	Principal Scientist
Dr. Shaik N. Meera	Principal Scientist
Dr. P. Jeya Kumar	Principal Scientist
Dr. PA Lakshmi Prasanna	Senior Scientist
Dr. B. Nirmala	Senior Scientist
Dr. S. Arun Kumar	Senior Scientist
Dr. Santosha Rathod	Scientist
Emeritus Scientist	
Dr. P. Ananda Kumar	

Technical Staff

Dr. M.N. Arun	Chief Technical Officer
C. Sadanandam	Assistant Chief Technical Officer
Srinivasan Amudhan	Assistant Chief Technical Officer
Chirutkar Prakash	Assistant Chief Technical Officer
Uddaraju Chaitanya	Assistant Chief Technical Officer
M. Ezra	Assistant Chief Technical Officer
U. Pullaiah	Assistant Chief Technical Officer
K. Padmaja	Senior Technical Officer
M. Vijay Kumar	Senior Technical Officer
Mohd. Tahseen	Technical Officer
Emkolla Nagarjuna	Technical Officer
Mohd. Sadath Ali	Technical Officer
K. Ramulu	Technical Officer
Dr. Y. Roseswara Rao	Technical Officer
Kova Shravan Kumar	Technical Officer
Tupakula Venkaiah	Technical Officer
C. Muralidhar Reddy	Technical Officer
K. Janardhan	Technical Officer (Driver)
T. Narender Prasad	Technical Officer, superannuated on 30th April, 2022
P. Chandrakanth	Senior Technical Assistant
K.H. Devadas	Senior Technical Assistant
Koteswara Rao Potla	Senior Technical Assistant
K. Narasimha	Senior Technical Assistant (Driver)
M. Chandrakumar	Senior Technician
S. Vijay Kumar	Senior Technician
A. Ramesh	Senior Technician (Driver)
D. Srinivasa Rao	Technician
V. Srinivas	Technician
R. Sathemaiah	Technician
S. Yadaiah	Technician

Administrative Staff

Shri Shitanshu Kumar	Chief Administrative Officer (Joined on 30th March, 2022)
K. Srinivasa Rao	Finance & Accounts Officer
Smt. O. Suneeta	Principal Private Secretary (Joined Institute on 4th August, 2022)
K. Kousalya	Asst. Administrative Officer (Superannuated on 31st January, 2022)
Sudha Nair	Asst. Administrative Officer
P. Lakshmi	Asst. Administrative Officer
B. Vidyanath	Asst. Administrative Officer
R. Udaya Kumar	Private Secretary
Aparna Das	Private Secretary
Bommakanti Ramesh	Private Secretary
S. Hemalatha	Personal Assistant
Sandiri Rama Murthy	Personal Assistant
Ashfaq Ali	Personal Assistant
Uppalapati Rama	Assistant
K. Sudhavalli Tayaru	Assistant (Superannuated on 30th June, 2022)
Shaik Ahmed Hussain	Assistant
Bharath Raju	Assistant
K. Mallikarjunudu	Assistant
Vanitha	UDC (Upper Division Clerk)
Kota Jashwanth	UDC (Upper Division Clerk)
S. Rekha Rani	UDC (Upper Division Clerk)
Navneet Kumar	Stenographer Gr, III
Chander	Skilled Supporting Staff (SSS)
M. Anthamma	Skilled Supporting Staff (SSS)
B. Susheela	Skilled Supporting Staff (SSS)
Ahmed Ullah Khan	Skilled Supporting Staff (SSS)
V. Golu Naik	Skilled Supporting Staff (SSS)

Casual Labour regularised to Skilled Support staff

S. No.	Name
1.	Smt. V. Sukrutha
2.	Sri. B. Swamy
3.	Smt. G. Sivamma
4.	Smt. G. Vajramani
5.	Sri. I. Bikashpathi
6.	Smt. B. Balamma
7.	Sri. G. Sailu *(Superannuated in October, 2022)*
8.	Smt. B. Sugunamma
9.	Smt. V. Pentamma *(Superannuated in October, 2022)*
10.	Smt. R. Kistamma
11.	Smt. D. Buchamma
12.	Smt. Ch. Swaroopa
13.	Smt. K. Durgamma
14.	Sri. M. Ramesh
15.	Smt. P. Bharthamma *(Superannuated in October, 2022)*
16.	Smt. A. Sathamma

S. No.	Name
17.	Smt. K. Yadamma
18.	Smt. B. Sakkubai
19.	Smt. V. Chandramma *(Superannuated in October, 2022)*
20.	Smt. P. Pushpa
21.	Smt. B. Saroja *(Superannuated in October, 2022)*
22.	Smt. K. Manamma *(Superannuated in October, 2022)*
23.	Sri. G. Venkatesh
24.	Smt. M. Govindamma
25.	Smt. R. Amrutha
26.	Smt. D. Padmamma
27.	Smt. M. Anjamma *(Superannuated in October, 2022)*
28.	Smt. D. Laxmamma
29.	Smt. M. Narasamma
30.	Smt. M. Laxmamma
31.	Smt. R. Parvathamma
32.	Smt. D. Kalavathi *(Superannuated in October, 2022)*
33.	Smt. K. Laxmi *(Superannuated in October, 2022)*
34.	Smt. D. Balamani
35.	Smt. S. Pochamma *(Superannuated in October, 2022)*
36.	Sri. M. Yadaiah
37.	Smt. R. Channamma
38.	Smt. M. Laxmi

Mr Shitanshu Kumar joined as Chief Administrative Officer at ICAR-IIRR on 30^{th} Mar, 2022

Ten Skilled Supporting Staff (SSS) superannuated on 31^{st} October, 2022

Dr. D. Subrahmanyam, Principal Scientist, Crop Physiology, superannuated on 30^{th} November, 2022

Publications

Papers in Research Journals

Ajay B. C., Fiyaz R. A., Bera S. K., Kumar N., Gangadhar K., Kona P., Rani K., Radhakrishnan T. 2022. Higher Order AMMI (HO-AMMI) analysis: A novel stability model to study genotype-location interactions. *Indian J. Genet. Plant Breed.*, 82(1): 25-30. http://krishi.icar.gov.in/jspui/handle/123456789/76285.

Akula, M., Bandumula, N., and Rathod, S. 2022. Rice production in Telangana: growth, instability and decomposition analysis. *ORYZA* 59(2), 232–240. http://krishi.icar.gov.in/jspui/handle/123456789/76241.

Aleena D., Padma V., Rekha G., Dilip Kumar Thota, Punniakotti Elumalai, Kousik Muppavarapu, Laxmi Prasanna Butam, Swapnil Ravindra Kulkarni, Pragya Sinha, Harika Gunukula, Ravindra Ramarao Kale, Ayyappa Dass Muralidhara, Hajira Shaik, Anila Miriyala, Pranathi Karnati, Mastanbee Shaik, Laha Gouri Shankar, Srinivas Prasad Madamsetty, Balachandran Sena, Gireesh Channappa, Anantha Madhavenkatapura Siddaih, Venkata Subba Rao Lella, Ratna Babu Didla, Lal Ahamed Mohammad, Venkata Ramana Jagarlamudi, Vijay Gopal Avula & Raman Meenakshi Sundaram, 2022. Improvement of bacterial blight resistance of the popular variety, Nellore Mahsuri (NLR34449) through marker-assisted breeding. *Journal of Genetics*. 101, 7.

Aleena Francis, Srayan Ghosh, Kriti Tyagi, Prakasam, V., Mamta Rani, Nagendra Pratap Singh, Amrita Pradhan, Sundaram, R.M., Priyanka, C., Laha, G.S., Kannan, C., Prasad, M.S., Debasis Chattopadhyay and Gopaljee Jha, 2022. Genome duplication and transposon-mediated gene alteration shape the pathogenicity of *Rhizoctonia solani* AG1-IA. *BMC Biology* http://krishi.icar.gov.in/jspui/handle/123456789/76325.

Amit Saha, KN Singh, Mrinmoy Ray, Santosha Rathod, Makrand Dhyani. 2022. Fuzzy rule–based weighted space–time autoregressive moving average models for temperature forecasting. *Theor Appl Climatol.*, 150, 1321–1335. http://krishi.icar.gov.in/jspui/handle/123456789/74704.

Amtul Waris, Battu Jangaiah and Jana Harish (2022) Constraints Faced by Farmers due to COVID-19 Disruptions on Agricultural Activities in Nalgonda District of Telangana, India. *International Journal of Environment and Climate Change* 12(10): 688-695, 2022 http://krishi.icar.gov.in/jspui/handle/123456789/76087.

Amtul Waris and S. Arun Kumar (2022) Local Food Systems and Farmers' Markets-an Exploratory Study. *Asian Journal of Agricultural Extension, Economics & Sociology*, 40(12), 60-67. http://krishi.icar.gov.in/jspui/handle/123456789/76088.

Anand, A., Pinninti, M., Tripathi, A., Mangrauthia, S.K. and Sanan-Mishra, N., 2022. Coordinated action of RTBV and RTSV proteins suppress host RNA silencing machinery. *Microorganisms*, *10*(2), p. 197.

Anila, M., Giri, A. and Sundaram, R. M., 2022. Evaluation of recombinant inbred lines for low soil phosphorous tolerance derived from Rasi - a low soil phosphorous tolerant variety. *Electronic Journal of Plant Breeding*, 13(3):1-10.https://doi.org/10.37992/2022.1303.102 http://krishi.icar.gov.in/jspui/handle/123456789/76398.

Anjali, K. M., V. Jhansilakshmi, S. K. Mangrauthia, S. J. Rahman, S. Akanksha and R. M. Sundaram. 2022. N22 mutants resistant to rice planthoppers BPH and WBPH. *Journal of Experimental zoology, India*, 25(2): 2093-2098. http://krishi.icar.gov.in/jspui/handle/123456789/76397.

Anupama Dhawande, V Jhansi Lakshmi and LV Subba Rao. 2022. Non-preference mechanism of resistance in rice germplasm accessions to White-backed planthopper *Sogatella furcifera* (Horvath). *Indian Journal of Ecology*, 49(3): 809-815. http://krishi.icar.gov.in/jspui/handle/123456789/76396.

Anusha Ch., Uma Maheswari T., Damodar Raju Ch., Malathi S., Om Prakash S. and A. P. Padmakumari. 2022. Identification of new sources of resistance to rice gall midge biotypes prevailing in Telangana, *India. J. Exp. Zool. India* 25, (1) 793- 803. ISSN 0972-003025.793, eISSN 0976-1780. http://krishi.icar.gov.in/jspui/handle/1234567 89/75000 http://krishi.icar.gov.in/jspui/handle/1234567 89/75000.

Aravind Balaji A, Arumugam Pillai M, Shoba D, Aiyanathan EA, Sathwik B, Rapaka Percy VS, Madhuri M, Bharath Kumar M, Dileep Kumar GD, Kasarla Chaithanya and R Abdul Fiyaz. 2022. Genetic variability studies in traditional rice landraces of India. *The Pharma Innovation Journal* SP-11(9): 2953-2956. http://krishi.icar.gov.in/jspui/handle/123456789/76394

Asik, D., Bhattacharyya, R., Chaudhary, V.P., Sharma, C., C Prasad Nath, C., Kumar, S.N., Parmar, B., 2022. Impact of long-term residue burning versus retention on soil organic carbon sequestration under a rice-wheat cropping system, *Soil and Tillage Research*, 221: 105421 http://krishi.icar.gov.in/jspui/handle/123456789/76392.

Ayyappa Dass M., M. Anila, R. R. Kale, S. Pragya, M. S. Anantha, N. P. Mandal, H. Surekha Rani, Smita C. Pawar, A. Roja Rani, A. Srinivas, S. Prasanth and R. M. Sundaram. 2022. Evaluation of Rice Recombinant Inbred Lines Developed from the Cross Rasi × Improved Samba Mahsuri for Drought Tolerance. 2022. *International Journal of Environment and Climate Change*. Volume 12 (12): 1537-1546. DOI: 10.9734/IJECC/2022/v12i121597 v12i121597 http://krishi.icar.gov.in/jspui/handle/123456789/76291.

Babithraj GG, Saida ND, Fiyaz AR, Azam MM, Reddy NS and Balaji NB. 2022. Genetic parameters of selected rice (*Oryza sativa* l.) Germplasm for yield and yield traits. *J. Res. PJTSAU* 50(1): 108 -111. http://krishi.icar.gov.in/jspui/handle/123456789/76297.

Babithraj GG, Saida ND, Fiyaz AR, Azam MM, Reddy NS and Balaji NB. 2022. Phenotypic Correlation Between Morphological and Yield Related Traits of Rice (*Oryza sativa* L.). *International Journal of Agriculture, Environment and Biotechnology*. 15(Special Issue): 515-520. http://krishi.icar.gov.in/jspui/handle/123456789/76289.

Badri Jyothi, Lakshmidevi, G., JaiVidhya, L.R.K., Prasad, M.S., Laha, G.S., Jhansi Lakshmi, V., Subhakara Rao, I., Revadi, P., Balakrishnan, D., Vishnu Priya, Y.V., Arvind Kumar, J., Singh, U. M., Singh, V.K., Kumar, A., Ram, T., Subba Rao, L.V. and Sundaram, R.M. 2022. Multiparent-Derived, Marker-Assisted Introgression Lines of the Elite Indian Rice Cultivar, 'Krishna Hamsa' Show Resistance against Bacterial Blight and Blast and Tolerance to Drought. *Plants*, 11, 622. http://krishi.icar.gov.in/jspui/handle/123456789/76284.

Bandeppa, S., Phule, A.S., Barbadikar, K.M., Govindannagari, R., Kavuru, V.P.B., Mandal, P.K., Sundaram, R.M. and Chandran, L.P., 2022. Draft Genome Sequence of *Paenibacillus sonchi* IIRRBNF1, a Nitrogen-Fixing and Plant Growth-Promoting Bacterium Isolated from Rice Rhizosphere. *Microbiology Resource Announcements*, *11*(5), pp.00126-22. http://krishi.icar.gov.in/jspui/handle/123456789/76288.

Bandeppa, S., Phule, A.S., Rajani, G., Babu, K.V., Barbadikar, K.M., Babu, M.B.B., Mandal, P.K., Sundaram, R.M. and Latha, P.C., 2022. Effect of nitrogen-fixing bacteria on germination, seedling vigour and growth of two rice (*Oryza sativa* L.) Cultivars. *International Journal of Plant & Soil Science*, *34*(16), pp.94-106. http://krishi.icar.gov.in/jspui/handle/123456789/76287.

Bandumula, N.; Santosha Rathod.; Ondrasek, G.; Pillai, M.P.; Sundaram, R.M. 2022. An Economic Evaluation of Improved Rice Production Technology in Telangana State, India. *Agriculture*, *12*, 1387. http://krishi.icar.gov.in/jspui/handle/123456789/76230.

Barrera, W. B., Bej, S., Suman, K., Malathi, S., Sundaram, R. M. and Neeraja, C. N., 2022. Promising rice genotypes with enhanced root growth and HMA transporter gene expression under zinc deficient conditions. *Journal of plant biochemistry and Biotechnology*. http://krishi.icar.gov.in/jspui/handle/123456789/76290.

Basavaraj P. S., C. Gireesh, Muralidhara B, C. A. Manoj, V. G. Ishwaryalakshmi, P. Senguttuvel, R. M. Sundaram, L. V. Subbarao and M. S. Anantha. 2022. Genetic analysis of introgression lines of *Oryza rufipogon* for improvement of low phosphorous tolerance in indica rice. *Indian Journal of Genetics and Plant Breeding*., 82(2): 135-142. http://krishi.icar.gov.in/jspui/handle/123456789/76298.

Basavaraja, T., Manjunatha, L., Chandora, R., Singh, M., Rathod, S., Dubey, V., Kanishka R. C. Singh F., Singh, N.P. 202). Assessment of phenotypic diversity and multi-locational screening against bean common mosaic virus (BCMV) disease resistance in dry bean (*Phaseolus vulgaris* L.) germplasm. *Plant Genetic Resources*, 1-8. doi:10.1017/S1479262122000144. http://krishi.icar.gov.in/jspui/handle/123456789/76229.

Beerelli K, Balakrishnan, D, Addanki KR, Surapaneni M, Rao Yadavalli V and Neelamraju S. 2022. Mapping of QTLs for Yield Traits Using F2:3:4 Populations Derived from Two Alien Introgression Lines reveals *qTGW8.1* as a Consistent QTL for Grain Weight from *Oryza nivara*. *Front. Plant Sci.* 13:790221. doi: 10.3389/fpls.2022.790221 http://krishi.icar.gov.in/jspui/handle/123456789/76301.

Bhanusree, D., Srinivasachary, D., Nirmala, B., Supriya, K., Naik, B. B., Rathod, S., Brajendra, Reddy, B. N. K., and Bellamkonda, J. 2022. Application of the CERES-Rice Model for Rice Yield Gap Analysis. International *Journal of Environment and Climate Change*, *12*(11): 3471-3478. http://krishi.icar.gov.in/jspui/handle/123456789/76233.

Bollinedi, H., Neeraja, C.N., Chattopadhyay, K., Chandel, G., Shashidhar, H.E., Prakash, J., Singh, A.K., Voleti, S.R. and Sundaram, R.M., 2022. Karuppunel: A promising donor for high zinc content in rice (*Oryza sativa*) grain. *Indian Journal of Agricultural Sciences*, 92(10): 1247–1252. http://krishi.icar.gov.in/jspui/handle/123456789/76313.

Brajendra, P., Vishwakarma, A., Padbhushan, R., Kumar, A., Kumar, R., Kumari, R., Kumar Yadav, B., Giri, S.P., Kaviraj, M. and Kumar, U., 2022. Hedge and Alder-Based Agroforestry Systems: Potential Interventions to Carbon Sequestration and Better Crop Productivity in Indian Sub-Himalayas. *Frontiers in Environmental Science* 10:858948. http://krishi.icar.gov.in/jspui/handle/123456789/76312.

Chaitanya, Anitha, G. and Shanker, C., 2022. Comparing pest abundance and diversity among various organic regimes of rice. *Journal of Entomological Research*, 46(1): 32-39. http://krishi.icar.gov.in/jspui/handle/123456789/76374.

Chandrasekar, A., Mamta, Kumari., Navaneetha Krishnan, J., Suresh, S., Gnanam, R., Sundaram, R. M. and Kumaravadivel, N., 2022. Marker-assisted introgression of bacterial blight resistance gene *xa13* into improved CO43. *Euphytica*, 218:118. http://krishi.icar.gov.in/jspui/handle/123456789/76311.

Chavan S.N., De Kesel J., Desmedt W., Degroote E., Singh R.R., Nguyen G.T., Demeestere K., De Meyer T. and Kyndt T. 2022. Dehydroascorbate induces plant resistance in rice against root-knot nematode *Meloidogyne graminicola*. *Molecular Plant Pathology*. 29(3): 1303-1319. http://krishi.icar.gov.in/jspui/handle/123456789/76310.

Chitra Shanker and Jhansi Rani Billa. 2022. Conserving Floral and Faunal Diversity of Rice Paddies, *Indian J. Plant Genet. Resour*. 35(3): 393–396. http://krishi.icar.gov.in/jspui/handle/123456789/76086.

Deepak K. Sinha, Ayushi Gupta, A. P. Padmakumari, J. S. Bentur and Suresh Nair. 2022 Infestation of Rice by Gall Midge Influences Density and Diversity of *Pseudomonas* and *Wolbachia* in the Host Plant Microbiome, *Current genomics*. 23(2): 126 – 136. http://krishi.icar.gov.in/jspui/handle/123456789/76308.

Desmedt W., Kudjordjie E.N., Chavan S.N., Zhang J., Li R., Yang B., Nicolaisen M., Mori M., Peters R.J., Vanholme B., Vestergård M. and Kyndt T. 2022. Rice diterpenoid phytoalexins are involved in defence against parasitic nematodes and shape rhizosphere nematode communities. *New Phytologist*, 235(3): 1231-1245. http://krishi.icar.gov.in/jspui/handle/123456789/76375.

Desmedt, W., Kudjordjie, E. N., Chavan, S. N., Desmet, S., Nicolaisen, M., Vanholme, B., Vestergård M. and Kyndt T. 2022. Distinct chemical resistance-inducing stimuli result in common transcriptional, metabolic, and nematode community signatures in rice root and rhizosphere. *Journal of Experimental Botany*, 73(22): 7564-7581. http://krishi.icar.gov.in/jspui/handle/123456789/76307.

Devanna, B.N., Jain, P., Solanke, A.U., Das, A., Thakur, S., Singh, P.K., Kumari, M., Dubey, H., Jaswal, R., Pawar, D. and Kapoor, R., 2022. Understanding the dynamics of blast resistance in rice-*Magnaporthe oryzae* interactions. *Journal of Fungi*, 8(6): 584. http://krishi.icar.gov.in/jspui/handle/123456789/76306.

Balakrishnan D., Laha, G. S., Arra, Y., Surapaneni, M., Beerelli, K., Ladhalakshmi, D., Srinivas Prasad, M., Subba Rao, L. V., Sundaram, R. M., and Neelamraju, S., 2022. Identification of novel major and minor quantitative trait loci associated with bacterial blight resistance in rice from *Oryza nivara*-derived wild introgression lines. *Plant Breeding*, 141 (6): 756-770 http://krishi.icar.gov.in/jspui/handle/123456789/76305.

Fiyaz A.R., D. Shivani, K. Chaithanya, K. Mounika, M. Chiranjeevi, G. S. Laha, B. C. Viraktamath, L. V. Subba Rao, R. M. Sundaram, 2022. Genetic Improvement of Rice for Bacterial Blight Resistance: Present Status and Future Prospects. *Rice Science*, 9(2): 118-132. http://krishi.icar.gov.in/jspui/handle/123456789/76303.

Gangambika AS, Padmasri A, Parimala K. and Azam MM. 2022. Effect of Seed Moisture on Incidence of Pulse Beetle, *Callosobruchus chinensis* (L.) infestation in Popular Pigeonpea Cultivars Grown in Telangana. *Biological Forum – An International Journal*, 14(3): 510-514.

Gobinath, R., Datta, S.P., Singh, R.D., Datta, S.C., and Manasa, V., 2022. Synthesis and characterization of ZnO nanoparticles – comparison of acetate (precursor) based methods, *Inorganic and Nano-Metal Chemistry*, 52(2):185-194. DOI: 10.1080/24701556.2021.1891099. http://krishi.icar.gov.in/jspui/handle/123456789/7.

Gorantla Nagamani, KN Yamini, Ch V Durga Rani, A.P. Padmakumari, R Shravan Kumar, C Anjali and RM Sundaram. 2022. Screening of F3 lines of rice against gall midge resistance in rice. *The Pharma Innovation Journal*, 11(7): 3000-3004.

Gorlapalli, A., Supriya Kallakuri, Pagadala Damodaram Sreekanth, Rahul Patil, Nirmala Bandumula, Gabrijel Ondrasek, Meena Admala, Channappa Gireesh, Anantha M S, Brajendra Parmar, Brahamdeo Kumar Yadav, R M Sundaram and Santosha Rathod. 2022. Characterization and Prediction of Water Stress Using Time Series and Artificial Intelligence Models. *Sustainability*, 14, 6690. https://doi.org/10.3390/su14116690. http://krishi.icar.gov.in/jspui/handle/123456789/76226.

Goud CA, Satturu V, Malipatil R, Viswanath A, Semalaiyappan J, Kudapa H, Santosha Rathod, Rathore A, Govindaraj M, Thirunavukkarasu N. Identification of iron and zinc responsive genes in pearl millet using genome-wide RNA-sequencing approach. *Frontiers in*

Publications

Nutrition, 9:884381. http://krishi.icar.gov.in/jspui/handle/123456789/76232.

Ishwarya Lakshmi, V.G., Sreedhar, M., Jhansi Lakshmi, V., Gireesh, C., Rathod, S., Bohar, R., Deshpande, S., Laavanya, R., Kiranmayee, K.N.S., Siddi, S. and Vanisri, S., 2022. Development and Validation of Diagnostic KASP Markers for Brown Planthopper Resistance in Rice. *Frontiers in Genetics*, 13:1619. http://krishi.icar.gov.in/jspui/handle/123456789/71264.

Jaldhani, V., Neeraja, C.N., Sanjeeva Rao D., Aravind Kumar J., Siromani, N., Beulah, P., Nagaraju, P., Manasa, Y., Rao, P.R., Subrahmanyam, D., Sudhakar, P., Krishna Priya, A., and Senguttuvel, P., 2022. Grain and cooking quality analysis in heat-tolerant QTL introgressed restorer of hybrid rice. *Journal of Rice Research*, 14(2): 12-17. http://krishi.icar.gov.in/jspui/handle/123456789/76391.

Jamaloddin M., Durga Rani C.V, Swathi G, Anuradha C., Vanisri S, Rajan CPD, *et al.*, 2020. Marker Assisted Gene Pyramiding (MAGP) for bacterial blight and blast resistance into mega rice variety "Tellahamsa". *PLoS ONE*, 15(6), e0234088. http://krishi.icar.gov.in/jspui/handle/123456789/76329.

Jasmine, C., Shivani, D., Senguttuvel, P. and Naik, D.S., 2022. Genetic variability and association studies in maintainer and restorer lines of rice [*Oryza sativa* (L.)]. *The Pharma Innovation Journal*, 11(1): 569-76. http://krishi.icar.gov.in/jspui/handle/123456789/76330.

Jayaramulu, K., Kemparaju, K.B., Sruthi, K., Sheshu Madhav, M., Hariprasad, A.S., Beulah, P. Revathi, P. and Senguttuvel, P., 2022. Parental Polymorphic Marker Survey and Genetic Diversity Studies among the Popular Maintainer Lines of Hybrid Rice (*Oryza sativa* L.) for Stigma Exsertion Trait. *International Journal of Plant & Soil Science*. 34(1): 94-104.

Jyostna, B., Meena, A., Rathod, S., Tuti, M. D., Kallakuri, S., Bhanusree, D., & Reddy, B. N. K. 2022. Trend Analysis of Rainfall in Telangana State (India) Using Advanced Statistical Approaches. *International Journal of Environment and Climate Change*, *12*(11), 3404–3412. http://krishi.icar.gov.in/jspui/handle/123456789/76215.

Kakarla Lavanya, Suman K, Abdul R Fiyaz, M Chiranjeevi, R Surender, A Krishna Satya, P Sudhakar and L. V. Subba Rao. 2022. Phenotypic assessment of rice landraces for genetic variability and diversity studies under heat stress. *Oryza* 59(1): 31-38.http://krishi.icar.gov.in/jspui/handle/123456789/76332.

Karingu, S., Bandumula, N., Reddy, D. S., & Meena, A. (2022). Resource Use Efficiency in Paddy Cultivation: A Comparative Study of Telangana Sona and Chintu Varieties in Nalgonda District of Telangana State of India. *Asian Journal of Agricultural Extension, Economics & Sociology*, *40*(11), 237-243. http://krishi.icar.gov.in/jspui/handle/123456789/76334.

Kavitha, G., Reddi Sekhar, M., Sundaram, R.M., Seshu Madhav, M., Beulah, P., Nagaraju, P., Mohan Reddy, D., Reddy, V.L.N., Kalyani, M.B., Sudhakar, P. and Senguttuvel, P., 2022. Marker assisted backcross breeding to develop the drought tolerant version of IR58025B, a popular maintainer line of hybrid rice. *Oryza*, 59 (4): 418-429. http://krishi.icar.gov.in/jspui/handle/123456789/76333.

Kiranmayee, B., Kemparaju, K.B., Sundaram, R.M., Damodar Raju, Ch., Balram, M., Hari Prasad, A.S., Senguttuvel, P., Revathi, P., Sruthi, K., Gireesh, C., Anantha, M.S., Abdul Fiyaz, R., Nagaraju, P., Beulah, P. and Manasa, Y., 2022. Genetic diversity analysis of maintainer lines using SSR markers in rice (*Oryza sativa* L.). *Oryza* 59 (4): 393-399. DOI.

Kranthi Kumar Dhande, Sharma Rama, Santosha Rathod, 2022. Ramasubramanian V, Ranjan Kumar Nalini. Forecasting future prospects of fish and paddy production in Andhra Pradesh using VAR model. *Journal of Experimental Zoology India*. 25(1). 891-896. http://krishi.icar.gov.in/jspui/handle/123456789/76222.

Kulkarni, S.R., Balachandran, S.M., Fiyaz, R.A. Balakrishnan D, Sruthi K, Ulaganathan K, Hari Prasad A.S. Sundaram RM. 2022. Assessment of heterotic potential and combining ability of novel iso-cytoplasmic restorer lines derived from an elite rice hybrid, KRH-2, for the development of superior rice hybrids. *Euphytica* 218, 60 (2022). http://krishi.icar.gov.in/jspui/handle/123456789/76320.

Kumam, Y., Rajadurai, G., Kumar, K.K., Varanavasiappan, S., Reddy, M.K., Krishnaveni, D., Mangrauthia, S.K., Raveendran, M., Arul, L., Kokiladevi, E. and Sudhakar, D., 2022. Genome editing of indica rice ASD16 for imparting resistance against rice tungro disease. *Journal of Plant Biochemistry and Biotechnology*, 31: 880–893. http://krishi.icar.gov.in/jspui/handle/123456789/76318.

Kumar TV, Pramod P Aradwad, Pranita Jaiswal, Santosha Rathod, PK Sahoo, Indra Mani. 2022. Development and evaluation of a battery operated ginger (*Zingiber officinale*) washer for small and marginal farmers. *Indian Journal of Agricultural Sciences* 92(9): 1071–1075. http://krishi.icar.gov.in/jspui/handle/123456789/76228.

Kumar, B., Rakshit, S., Kumar, S., Singh, B. K., Lahkar, C., Jha, A. K., Kumar, K., Kumar, P., Choudhary, M., Singh, S.B., Amalraj, J. J., Prakashet, B., Khulbe, R., Kamboj, M. C., Neeraja, C. N. and Hossain, F., 2022. Genetic diversity, population structure and linkage disequilibrium analyses in tropical maize using genotyping by sequencing. *Plants,* 11:799.

Kumar, R.R., Rai, G.K., Kota, S., Watts, A., Sakhare, A., Kumar, S., Goswami, S., Kapoor, N., Babu, P., Mishra, G.P., Kumar, S.N., Chinnusamy, V., and Divya Praveen, S. 2022. Fascinating Dynamics of Silicon in alleviation of heat stress Induced oxidative damage in plants. *Plant Growth Regulation*, http://krishi.icar.gov.in/jspui/handle/123456789/76335.

Ladhalakshmi, D., Yugander, A., Laha, G.S., Vijayasamundeeswari, A., Basavaraj, K., Balakrishnan D., Preeti, Bhaskar, M., Aparna, M.D., and Prasad, M.S., 2022. Assessing the molecular variability in *Ustilaginoidea virens*, the rice false smut pathogen with ISSR markers. *Journal of Rice Research*, 15(1): 51-57. http://krishi.icar.gov.in/jspui/handle/123456789/76390.

Lakshmi Soujanya P, J C Sekhar, S B Suby, AP Padmakumari, S Divya, M Lava Kumar Reddy, SL Jat and Sujay Rakshit. 2022. Life-history and life-table parameters of fall armyworm (*Spodoptera frugiperda*) for maize (*Zea mays*) in tropical Indian condition. *Indian Journal of Agricultural Sciences* 92(6): 785–8. http://krishi.icar.gov.in/jspui/handle123456789/75538.

Madhusudan, N., Beulah, P., Jaldhani, V., Nagaraju, P., Manasa, Y., Sundaram, R. M., Laha, G. S., Anantha, M.S., Barbadikar, K.M., Gireesh, C., HariPrasad, A.S., Sheshu Madhav, M., Gobinath, R., Yugander, A., Kemparaju, K.B., Neerja, C.N., Brajendra, P., Tuti, M.D., Mahendra Kumar, R., Radha Krishna, K.V. and Senguttuvel, P., 2022. Stacking of Pup1 QTL for low soil phosphorus tolerance and bacterial blight resistance genes in the background of APMS6B, the maintainer line of rice hybrid DRRH-3. *Euphytica*, 218:37.

Mahesh, G., Ramesh, T., Reddy, N., Meena, A., Rathod, S., Fiyaz, R. A., Badri, J., Rao, L. V. S., Sundaram, R. M. and Jukanti, A. K., 2022. Genetic variability, heritability, genetic advance and path coefficients for grain protein content, quality traits and grain yield in rice (*Oryza sativa* L.) germplasm lines. *The Pharma Innovation Journal,* 11, pp.1836-1839. http://krishi.icar.gov.in/jspui/handle/123456789/76359.

Nagaraju, P., Beulah, P., Jaldhani, V., Manasa, Y., Madhusudan, N., Sundaram, R.M., Hariprasad, A.S., Sruthi, K., Sheshu Madhav, M., Kota, S. and Kalyani, M.B., 2022. Assessment of reproductive stage drought tolerance using stress indices in improved restorer lines of KMR-3R in rice. *Cereal Research Communications*,1-14. http://krishi.icar.gov.in/jspui/handle/123456789/76357.

Nagaraju, P., Beulah, P., Manasa, Y., Jaldhani, V., Madhusudan, N., Sundaram, R.M., Hari Prasad, A.S., Revathi, P., Kemparaju, K.B., Sruthi, K., Srinivas, A., Prashant, S., Someswar Rao, S., Sheshu Madhav, M., and Senguttuvel, P. 2022. Evaluation of improved drought-tolerant parental lines of KMR3R for fertility restoration by molecular analysis. *Journal of Rice Research*, 14(2): 1-7. http://krishi.icar.gov.in/jspui/handle/123456789/76354.

Nagendra Reddy, B, Jhansi Lakshmi, V and Umamaheswari, T. 2022. Insecticide resistance monitoring in the field populations of brown planthopper, *Nilaparvata lugens* (Stål) in Andhra Pradesh, India. *Journal of Experimental zoology India*. 25(2): 2099-2016. http://krishi.icar.gov.in/jspui/handle/123456789/76376.

Naseerunnisa M, Kuna A, Sarkar S, Azam MM, Prasanna KL. 2022. Effect of Germination on the Physical and Functional Properties of Brown Rice Flours. *Asian Journal of Dairy and Food Research*, 41(3): 335-340. http://krishi.icar.gov.in/jspui/handle/123456789/76350.

Neeraja, C. N., Hossain, F., Hariprasanna, K., Ram, S., Satyavathi, C. T., Longvah, T., Raghu, P., Voleti, S. R. and Sundaram, R. M., 2022. Towards nutrition security of India with biofortified cereal varieties. *Current Science*, *123*(3), pp.271. http://krishi.icar.gov.in/jspui/handle/123456789/76349.

Ondrasek G., Davor Romić, Vjekoslav Tanaskovik, Radovan Savić, Santosha Rathod, Jelena Horvatinec, Zed Rengel. Humates mitigate Cd uptake in the absence of NaCl salinity, but combined application of humates and NaCl enhances Cd mobility & phyto-accumulation. *Science of The Total Environment*, 847: 157649. http://krishi.icar.gov.in/jspui/handle/123456789/76235.

Ondrasek, G., Santosha Rathod., Manohara, K. K., Gireesh, C., Anantha, M. S., Sakhare, A. S., Parmar, B., Yadav, B. K., Bandumula, N., Raihan, F., Zielińska-Chmielewska, A., Meriño-Gergichevich, C., Reyes-Díaz, M., Khan, A., Panfilova, O., Seguel Fuentealba, A., Romero, S.M., Nabil, B., Wan, C., Shepherd, J., Horvatinec, J. 2022. Salt Stress in Plants and Mitigation Approaches. *Plants*, *11*, 717. http://krishi.icar.gov.in/jspui/handle/123456789/76224.

Padbhushan, R., Kumar, U., Sharma, S., Rana, D.S., Kumar, R., Kohli, A., Kumari, P., Brajendra, P., Kaviraj, M., Sinha, A.K., Annapurna, K., and Gupta, V.V.S.R., 2022. Impact of Land-Use Changes on Soil Properties and Carbon Pools in India: A Meta-analysis. *Frontiers in Environmental Science*. 9:794866. doi: 10.3389/fenvs. 2021.794866. http://krishi.icar.gov.in/jspui/handle/123456789/76337.

Padmashree, R., Nakul, D. M., Barbadikar, K. M., Phule, A., Honnappa, Senguttuvel, Maganti, M.S., Anantha M. S., Balakrishnan D., Gireesh, C., Manasa, V., and Lokesha, R., 2022. Phenotypic evaluation of seedling vigour-related traits in a set of rice lines, *Journal of Rice Research*, 15(1): 1-7. http://krishi.icar.gov.in/jspui/handle/123456789/76368.

Padmavathi Ch and Padmaja PG. 2022. Insect Resistance in Field Crops. *Indian Journal of Entomology*, 84: 1 - 28. http://krishi.icar.gov.in/jspui/handle/123456789/76356.

Patil, R., Nagaraj, D. M., Polisgowdar, B. S., and Santosha Rathod. (2022). Forecasting potential evapotranspiration for Raichur district using seasonal ARIMA model. *MAUSAM*, 73(2), 433–440. http://krishi.icar.gov.in/jspui/handle/123456789/76227.

Pranathi, K., Rekha, G., Kalyani Barbadikar, Divya Mishra, Gopaljee Jha, Vellaisamy Prakasham, Priyanka Chilumula, Hajira Shaik, Maruthi Pesari, Raman Meenakshi Sundaram, and Kannan Chinnaswami., 2022. Performance of Novel Antimicrobial Protein Bg_9562 and In Silico Predictions on Its Properties with Reference to Its Antimicrobial Efficiency against *Rhizoctonia solani*. *Antibiotics*, 11, 363. http://krishi.icar.gov.in/jspui/handle/123456789/76386.

Prasanna, G., Eswari, K.B., Senguttuvel, P., Reddy, S.N., Sundaram, R.M., Beulah, P., Veerendra, J., 2022. Studies on genetic divergence and screening of parental lines for *Rf3* and *Rf4* genes through molecular markers in hybrid rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding*, 13(4): 1170-9. http://krishi.icar.gov.in/jspui/handle/123456789/76353

Raj K. Gautam, Sapna Langyan, Vimla Devi, S., Rakesh Singh, Semwal, D.P., Sharik Ali, Mangat, G.S., Sutapa Sarkar, Torit Baran Bagchi, Somnath Roy, Senguttuvel, P., Bhuvaneswari, S., Chetia, S., Kuldeep Tripathi, Harish, G.D., Ashok Kumar and Kuldeep Singh, 2022. Genetic resources of sticky rice in India: status and prospects. *Genetic Resources and Crop Evolution*, 70(1): 95-106. http://krishi.icar.gov.in/jspui/handle/123456789/76351.

Rao, D.V.K.N., 2022. Soils and soil-plant interrelationships have multidimensional data: multi-variate statistics are needed for better learning. *Academia Letters-Article*, 5042. http://krishi.icar.gov.in/jspui/handle/123456789/76379.

Rao, D.V.K.N., Rao, G.S., Rathod, S. and Surekha, K., 2022. Development of Digital Soil Theme Maps using Soil Health Cards by Geostatistical Methods. *Journal of the Indian Society of Soil Science*, 70(4), pp. 446-455. http://krishi.icar.gov.in/jspui/handle/123456789/76234.

Rao, S. B. N., Suman, K., Neeraja, C. N., Sundaram, R. M., Nalina, M., Chandrasekharaih, M., Parthipan, S. and Soren, N. M., 2022. Nutritional evaluation of different rice (*Oryza sativa*) straw of bio-fortified varieties, bio-fortified breeding lines and breeding lines. *Indian Journal of Animal Sciences*, 92, pp.390–393. http://krishi.icar.gov.in/jspui/handle/123456789/76343.

Rathod, S., Gayatri, C., Nirmala, B., Ondrasek, G., Ravichandran, S. and Sundaram RM., 2022. Modeling and Forecasting of Rice Prices in India during the COVID-19 Lockdown Using Machine Learning Approaches. *Agronomy*, 12: 2133. http://krishi.icar.gov.in/jspui/handle/123456789/76343.

Rathod, S., Sridhar, Y., Arya, P., Katti, G., Jhansi Rani, B., Padmakumari, A.P., Somasekhar, N., Padmavathi, Ch., Ondrasek, G., Amudan, S., Malathi, S., Mallikarjuna Rao, N., Karthikeyan, K., Mandawi, N., Muthuraman, P. and Sundaram, R.M. (2022). Climate-Based Modeling and Prediction of Rice Gall Midge Populations Using Count Time Series and Machine Learning Approaches. *Agronomy* 2022, 12, 22. http://krishi.icar.gov.in/jspui/handle/123456789/71196.

Ray, M., Ramasubramanian, V., Singh, K. N., Santosha Rathod, and Shekhawat, R. 2022. Technology Forecasting for Envisioning *Bt* Technology Scenario in Indian Agriculture. 2022. *Agricultural Research*, http://krishi.icar.gov.in/jspui/handle/123456789/69930.

Reddy, B. N. K., Rathod, S., Kallakuri, S., Sridhar, Y., Admala, M., Malathi, S., Pandit, P., & Jyostna, B. 2022. Modelling the Relationship between Weather Variables and Rice Yellow Stem Borer Population: A Count Data Modelling Approach. *International Journal of Environment and Climate Change*, *12*(11), 3623–3632. http://krishi.icar.gov.in/jspui/handle/123456789/76223.

Rekha, G., Abhilash Kumar, V., Gokulan, C.G., Koushik, M.B.V.N., Laxmi Prasanna, B., Kulkarni, S., Aleena, D., Harika, G., Hajira, S.K., Pranathi, K., Punniakoti, E., Kale, R.R., Dilip Kumar, T., Ayyappa, D., Anila, M., Sinha, P., Manohara, K.K., Padmavathi, G., Subba Rao, L. V., Laha, G. S., Prasad, M.S., Fiyaz, R.A., Suneetha, K., Balachandran, S.M., Patel, H.K., Sonti, R.V., Senguttuvel, P. and Sundaram, R.M., 2022. DRR Dhan 58, a Seedling Stage Salinity Tolerant NIL of Improved Samba Mahsuri Shows Superior Performance in Multi-location Trials. Rice, 15:45. http://krishi.icar.gov.in/jspui/handle/123456789/76369.

Sahoo, S., Mukhopadhyay, P., Sinha, A.K., Bhattacharya, P.M., Rakesh, S., Kumar, R., Padbhushan, R., Singh,B., Brajendra, P., Vishwakarma, A., Kumar, A., Yadav, B.K., Bhushan, S., Kumar, A., Kaviraj, M., and Kumar, U,. 2022. Yield, nitrogen-use efficiency, and distribution of nitrate nitrogen in the soil profile as influenced by irrigation and fertilizer nitrogen levels under zero-till wheat in the eastern Indo-Gangetic plains of India. *Frontiers in Environmental Science.* 10:970017. http://krishi.icar.gov.in/jspui/handle/123456789/76363.

Saini, M.R., Chandran, L.P., Barbadikar, K.M., Sevanthi, A.M.V., Chawla, G., Kaushik. M., Mulani, E., Phule, A.S., Govindannagari, R., Sonth, B., Sinha, S.K., Sundaram, R.M., and Mandal, P.K., 2022. Understanding plant–microbe interaction of rice and soybean with two contrasting diazotrophic bacteria through comparative transcriptome analysis. *Frontier in Plant Science.* 13:939395. http://krishi.icar.gov.in/jspui/handle/123456789/76361.

Sanjeeva Rao D., R. Ananthan, T. Longvah, J. Aravind Kumar, V. Ravindra Babu and R. M. Sundaram.2022. Low GI rice for rice consumers suffering from diabetes mellitus. *Current Science* 122(3): 238-239. http://krishi.icar.gov.in/jspui/handle/123456789/76372.

Saravanan, T.G., Loganathan, A., Gobinath, R., Rohini, K.V. and Krishnaveni, G., 2022. Bioleaching of Heavy Metals by Streptomyces avermitilis – BBA4 Isolate from Coal Mine Soil of Tamil Nadu. *Current Microbiology*, 79-303.

Sevanayak, D., Vadithe, T., Dikshit, N., Usha, T. N., SaidaNaik, V., Ronda, V., Manasa, V., and Bandeppa, S., 2022. Effect of elevated co_2 and temperature on physiological and biochemical changes in forage crops – A review, Forage Research, 48(1), pp. 22-27. http://krishi.icar.gov.in/jspui/handle/123456789/76367.

Sravani, B. Ch. Anuradha, R. M. Sundaram, K. Supriya, N. Gandhi, and R. Abdul Fiyaz. 2022. Genetic Variability, Heritability and Genetic Advance in 3K Rice (*Oryza sativa* L.) Genotypes. *International Journal of Environment and Climate Change*, 12(11): 2259-2265. http://krishi.icar.gov.in/jspui/handle/123456789/76364.

Sreedevi, B., Singh, A., Ram, T., Singh, S., Srivastava, A.K., Singh, U.S., Kumar, R.M., 2022. Assessing the Performance of Drought-Tolerant Rice Varieties under Varied Nitrogen Doses. *Current Journal of Applied Science and Technology* 41(6): 21-35. http://krishi.icar.gov.in/jspui/handle/123456789/76366.

Srija, A., Latha, P. C., Tejashree, M., Reddy, K. P. C., Triveni, S., Bandeppa, S., Phule, A. S., and Venkatanna, B., 2022. Identification and in vitro Evaluation of Environmental Stress Resilient Plant Growth Promoting Rhizobacterial Consortia for Rice (*Oryza sativa* L.). *International Journal of Environment and Climate Change*, 12(11), 3340-3354. http://krishi.icar.gov.in/jspui/handle/123456789/76371.

Srikanth, B., Subrahmanyam, D., Narender Reddy, S., Jaldhani, V., Neeraja, C. N., Sanjeeva Rao, D. and Supriya, K., 2022. Effect of graded levels of Nitrogen application on yield and yield attributes in different rice varieties. *International Journal of Environment and Climate Change*, 12(11): 153-167. http://krishi.icar.gov.in/jspui/handle/123456789/76370.

Sudha Rani, J. S., Sreedevi, B., Vani, K. P., Latha, P.C., Venkata Ramana, M., Surendrababu, P., and Naganjali, K., 2022. Effect of Organic and Inorganic Sources of Nutrients on Yield Attributes and Yield of Maize in Aerobic Rice- Zero Till Maize Cropping System Under Sandy Clay Loam Soils in Southern Telangana Agro-Climatic Zone. *International Journal of Environment and Climate Change* 12(10): 449-461. http://krishi.icar.gov.in/jspui/handle/123456789/76352.

Sunny Rao A., A.P. Padmakumari and Gajendra Chandrarkar. 2022. Parasite on Asian rice gall midge - *Orseolia oryzae* (Wood-Mason) in light trap collection. Insect environment, 25(2): 322-323. http://krishi.icar.gov.in/jspui/handle/123456789/76084.

Thube H.S., Pandian R.T.P., Babu M., Joseph Rajkumar A., Mhatre P.H., Santhosh Kumar P., Nirmal Kumar B.J., Hegde V. and Chavan S.N. 2022. Evaluation of a native isolate of *Metarhizium anisopliae* (Metschn.) Sorokin TMBMA1 against tea mosquito bug, *Helopeltis theivora* infesting cocoa (*Theobroma cacao* L.). *Biological Control* 179: 1-9. http://krishi.icar.gov.in/jspui/handle/123456789/76347.

Thummala, S.R., Guttikonda, H., Tiwari, S., Ramanan, R., Baisakh, N., Neelamraju, S. and Mangrauthia, S.K., 2022. Whole-Genome Sequencing of KMR3 and *Oryza rufipogon*-Derived Introgression Line IL50-13 (Chinsurah

Nona 2/Gosaba 6) Identifies Candidate Genes for High Yield and Salinity Tolerance in Rice. *Frontiers in Plant Science*, *13:* 810373.

Tuti, M. D., Kumar, R. M., Sreedevi, B., Nirmala, B., Senguttuvel, P. and Sundaram, R. M., 2022. Energy Dynamics of Aerobic Rice Cultivation in India. *International Journal of Environment and Climate Change* 12(11): 1454-1460. http://krishi.icar.gov.in/jspui/handle/123456789/76345.

Tuti, M. D., Mahender Kumar, R., Sreedevi, B., Nirmala, B., Surekha, K., Bandeppa, S., Saha, S., Brajendra, P., Rathod, S., Ondrasek, G. and Sundaram, R. M., 2022. Sustainable Intensification of a Rice–Maize System through Conservation Agriculture to Enhance System Productivity in Southern India. *Plants,* 11: 1229. http://krishi.icar.gov.in/jspui/handle/123456789/76225.

Umakanth, B., Vishalakshi, B., Sathish Kumar, P., Rama Devi, S.J.S., Bhadana, V.P., Senguttuvel, P., Kumar, S., Sharma, S.K., Sharma, P.K., Prasad, M.S and Madhav, M.S., 2017. Diverse Rice Landraces of North-East India Enables the Identification of Novel Genetic Resources for Magnaporthe Resistance. *Frontiers in Plant Sciences*, 8:1500. doi:10.3389/fpls.2017.01500 http://krishi.icar.gov.in/jspui/handle/123456789/76344.

Uttam, G. A., Suman, K., Jaldhani, V., Babu, P. M., Rao, D. S., Sundaram, R. M. and Neeraja, C. N., 2022. Identification of Genomic Regions Associated with High Grain Zn Content in Polished Rice Using Genotyping-by-Sequencing (GBS). *Plants,* 12(1): 144. https://doi.org/10.3390/plants12010144.

Vijayakumar, S., Kumar, R.M., Choudhary, A.K., Deiveegan, M., Tuti, M.D., Sreedevi, B. and Sundaram, R.M. 2022. Artificial Intelligence (AI) and its Application in Agriculture. *Chronicle of Bioresource Management,* 6(1): 25-031. http://krishi.icar.gov.in/jspui/handle/123456789/70181.

Vijayakumari, M., Pillai, M.A., Senguttuvel, P., Saravanan, S., Sheela, J., 2022. Assessment of genetic variability and correlation studies in direct seeded aerobic rice ecosystem. *The Pharma Innovation Journal*, 11(8): 398-403. http://krishi.icar.gov.in/jspui/handle/123456789/76362.

Yadavalli, V.R., Balakrishnan, D., Surapaneni, M, Addanki K, Mesapogu S, Beerelli K, Desiraju S, Voleti SR Neelamraju S. 202). Mapping QTLs for yield and photosynthesis-related traits in three consecutive backcross populations of *Oryza sativa* cultivar Cottondora Sannalu (MTU1010) and *Oryza rufipogon*. Planta 256: 71.

Yugander, A., Ershad, M., Muthuraman, P.P., Prakasam, V., Ladhalakshmi, D., Sheshu Madhav, M., Srinivas Prasad, M., Sundaram, R.M. and Laha, G.S., 2022. Understanding the variability of rice bacterial blight pathogen, *Xanthomonas oryzae* pv. *oryzae* in Andhra Pradesh, India. *Journal of Basic Microbiology*, 62(2): 185-196. http://krishi.icar.gov.in/jspui/handle/123456789/76360.

Yugandhar, P., Veronica, N., Subrahmanyam, D., Brajendra, P., Nagalakshmi, S., Srivastava, A., Voleti, S. R., Sarla, N, Sundaram, R. M., Sevanthi A.M., A. K. Singh, A.K., and Mangrauthia S.K., 2022. Revealing the effect of seed phosphorus concentration on seedling vigour and growth of rice using mutagenesis approach. *Scientific Reports*, 12:1203. http://krishi.icar.gov.in/jspui/handle/123456789/76336.

Conference abstracts/ Extended summaries

Amtul Waris, Jyothi Badri, R Abdul Fiyaz, SV Sai Prasad, Ch Padmavathi, R Mahender Kumar and RM Sundaram. 2022. International Conference on System of Crop Intensification (ICSCI 2022) for Climate Smart Livelihood and Nutritional Security: Souvenir. 12-14 Dec, 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, pp60.

Andrew Ashley, P. Muthuraman, B. Nirmala and P. Jayakumar. 2022. Type II Diabetes in India: An Anthropological Perspective. ICSCI 2022/T5/06 pp 571 *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Balakrishnan D., Sunanda T, Kavitha B, Arun Kumar, Sai Theja D, Magudeeswari P, Pranay G, Anantha MS, Subba Rao LV, Sundaram RM, Sarla N. 2022. Low phosphorus tolerance in advanced introgression lines from wild accessions of *Oryza* spp Genotypic variability of Recombinant inbred lines from interspecific crosses for widening the genetic base of *Oryza* spp. ICSCI 2022/T2/29 pp 70, *In:* Extended Summaries. 12-14 Dec, 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Balakrishnan D., D. Subrahmaniyam, Jyothi Badri, G Padmavathi, D Ladha Lakshmi, C. Gireesh, P. Revathi, B. Kalyani, Ch. Suvarna, LV Subba Rao, RM Sundaram and N Sarla. 2022. 166 (P-166) pp 55, *In:* Extended Summaries. 1st National Conference on Plant Genetic Resources Management. National Agricultural Science Centre (NASC), Pusa Campus, New Delhi, 22-24 November 2022, p 199.

Balakrishnan D., Rao YV, Malathi S, Krishnamraju A, Kavitha B, LV Subba Rao, Sarla N. 2022. Characterization of wild introgression lines from *Oryza nivara* and *Oryza rufipogon* for detection of grain size QTLs. MS1215. pp 115. *In:* Tending Mendel's Garden for a Perpetual and Bountiful Harvest: Symposium Commemorating Birth Bicentenary of Gregor Johann Mendel (MENDELSYM), July 19-21, 2022, ICAR-IARI, New Delhi, India. P246.

Bharali V, Bitra B, Thati S, Yadla S, Jukanti AK. 2022. From Mendelian Genetics to Modern Genomics. Pg 127-128. *In:* Souvenir cum abstracts of the National Symposium - Remembering Gregor Johann Mendel on his Bicentennial Birth Year - From Scratch to Factor to Gene to Genome, G.B. Pant University of Agriculture & Technology, Pantnagar, May 5-6, 2022.

Bhargavi, Suneetha Yadla, Jukanti AK, Sreenivasulu KN, Violina B, Nagaraju P, Srinivas T. 2022. Effect of climate change in rice production (*Oryza sativa* L.): Production and quality. Theme 1, PP-1-3, In: Abstracts of the Annual Post Graduate Student's National Conference (APGSNC-2022) on Climate Resilient and Eco-friendly strategies towards sustainable agriculture and Food Security. Agricultural College, Bapatla, AP, May 6-7, 2022.

Dayala Sai Theja, Divya Balakrishnan, Sonali Kar and LV Subba Rao. 2022. Landraces and wild introgression lines as source of novel traits for climate smart rice varieties. 302 (P-302) pp 161, *In:* Extended Summaries. 1st National Conference on Plant Genetic Resources Management. National Agricultural Science Centre (NASC), Pusa Campus, New Delhi, 22-24 November, 2022, p 199.

De Silva N.P. S, Balakrishnan D., V.G. Shankar, Jyothi B, Senguttuvel P, Ladhalakshmi D, Gireesh C, Kalyani MB, Sruthi K, Suvarna C, G Padmavathi, LV Subbarao, N Sarla. 2022. Genotypic variability of Recombinant inbred lines from interspecific crosses for widening the genetic base of *Oryza* spp. ICSCI 2022/T2/30 pp 72, *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Jhansi lakshmi, V., K. M. Anjali, S. K. Mangrautia, S. Akanksha and R. M. Sundaram. 2022. Resistance of N22 mutants to rice planthoppers ICSCI 2022/T2/62 151 *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Ladhalakshmi D., M. Bhaskar, Preeti, P. Koteshwar, Balakrishnan D., G. S. Laha, M. S. Prasad and R. M Sundaram. 2022. Identification of tolerant genotype for rice false smut disease through artificial inoculation and parental polymorphism survey using SSR Markers. ICSCI 2022/T2/51 pp 124, In: Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Mahesh G, Ramesh T, Jukanti AK. 2022. Evaluation of rice germplasm lines for high mineral content. Pg 76 *In:* Souvenir cum abstracts of the National Symposium - Remembering Gregor Johann Mendel on his Bicentennial Birth Year - From Scratch to Factor to Gene to Genome, G.B. Pant University of Agriculture & Technology, Pantnagar, May 5-6, 2022.

Padmakumari, A. P. 2022. Survey and molecular characterization of pink stem borer, *Sesamia inferens* (Walker) in rice-based cropping systems of Andhra Pradesh, Poster 69. Extended Summary # 133 *In:* Souvenir and Extended Summaries: 3rd National Symposium Entomology 2022: Innovation and Entrepreneurship, 8-10 December 2022, Hyderabad, India.

Padmashree R, Kalyani M Barbadikar, Honnappa, Nakul Magar, Balakrishnan D., Lokesha R., Chanappa Gireesh, Anantha M. Siddaiah, Sheshu Madhav Maganti. 2022. Assessment of multiple tolerance indices to identify rice lines suitable for aerobic rice. ICSCI 2022/T2/104. International Conference on System of Crop Intensification (ICSCI 2022) for Climate-Smart Livelihood and Nutritional Security during 12-14 December, 2022.

Padmavathi G., B. Umakanth, V. Jhansi lakshmi, M. Sheshu Madhav, L.V. Subba Rao and R.M. Sundaram. 2022. Identification of a novel gene, Wbph13(t), governing resistance to white-backed planthopper by QTL analysis using SNP markers in Sinnasivappu, a landrace of rice. ICSCI 2022/T2/47 pp 116, In: Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Padmavathi, G. B. Umakanth, V. Jhansi lakshmi, M. Sheshu Madhav, L.V. Subba Rao and R.M. Sundaram. Identification of a novel gene, Wbph13(t), governing resistance to white-backed planthopper by QTL analysis using SNP markers in Sinnasivappu, a landrace of rice. ICSCI 2022/T2/47 p82-84, *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Prabhakar M, V Jhansi Lakshmi, Ch Padmavathi, KA Gopinath, U Sai Sravan, M Thirupathi and YG Prasad. 2022. Detecting Brown Plant Hopper Damage in Rice using Hyperspectral Radiometry, ICSCI 2022/T2/75 pp 177 *In*: Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Pradeep Goud Ayeella, Madhavilatha Kommana, Vamshi P, Sumeeth C, Ganesh Ch, Sravan M, Prashanth Varma E, Sandeep K, Nakul D Magar, Kalyani M Barbadikar, Jhansi Lakshmi and K, Sheshu Madhav M. 2022. Identification of resistant Samba Mahsuri mutants and mutant derivatives against Brown plant hopper, *Nilaparvata lugens* ICSCI 2022/T2/76 pp180, In: Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Prakasam, V., Priyanka, C., Sundaram, R.M., Rekha, G., Gopaljee Jha, Vikraman, M., Kannan, C., Laha, G.S. and Prasad, M.S. 2022. "Understanding ecological diversity of sheath blight pathogen *Rhizoctonia solani* from various rice-ecosystem in India through phenotyping and whole genome sequencing (WGS)". IPSCONF2022 held at SKNAU, Jobner-Jaipur, Rajasthan, India. P 43.

Prakasam, V., Priyanka, C., Akanksha Srivastava, Mangrauthia, S. K., Vikraman, M., Manoj, V.M., Laha, G.S., Srinivas Prasad, M., and Sundaram, R.M. 2022. Evaluation of rice N22 EMS mutant lines tolerance against sheath blight disease under field conditions. MS1205. pp115. *In:* Tending Mendel's Garden for a Perpetual and Bountiful Harvest: Symposium Commemorating Birth Bicentenary of Gregor Johann Mendel (MENDELSYM), July 19-21, 2022, ICAR-IARI, New Delhi, India. P112.

Rao, D.V.K.N., Surekha, K., Aruna, L., and Sundaram, R.M., 2022. Space based observations for monitoring a multi-locational trial under All India Coordinated Research Project on Rice. ICSCI 2022/T5/01 p 561, In: Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Sailaja B., Ch. Padmavathi, D. Krishnaveni, B. Sreedevi, Santosha Rathod, M Srinivas Prasad, R. Mahender Kumar, D. Subrahmanyam, S. Gayatri, R. Nagarjuna Kumar and R.M. Sundaram. Aavishkar- an AI based Mobile App for Rice Pest Detection. 2022. In Souvenir & Abstracts of 73rd Annual Conference of ISAS on "Statistics and Machine Learning for Big Data Analytics" organized by Indian Society of Agricultural Statistics in Collaboration with Division of Agricultural Statistics SKUAST-K, Shalimar, J&K-India during 14 -16 November, 2022. P.50.

Sailaja B., S. Gayathri, D. Subrahmanyam, K. Surekha, Santosha Rathod, Ch. Padmavathi, G.S. Laha, M.S. Prasad, R. Nagarjuna Kumar and R.M. Sundaram. Smart Precision models for Sustainable Rice Production. 2022. In Extended Summaries of the International Conference on System of Crop Intensification for Climate-Smart livelihood and Nutritional Security (ICSCI 2022) organised in hybrid mode at ICAR-IIRR, Hyderabad during 12-14 December, 2022. P 535-539.

Sailaja B., S. Gayathri, D. Subrahmanyam, K. Surekha, Santosha Rathod, R. Nagarjuna Kumar and R.M. Sundaram. Smart Precision Models for Rice Yield Estimation. In Souvenir & Abstracts of 73rd Annual Conference of ISAS on "Statistics and Machine Learning for Big Data Analytics" organized by Indian Society of Agricultural Statistics in Collaboration with Division of Agricultural Statistics SKUAST-K, Shalimar, J&K-India during 14 -16 November, 2022. P 25.

Sarao P. S. and V Jhansi Lakshmi. 2022. Monitoring of Virulence of *Nilaparvata lugens* Using Gene Differentials ICSCI 2022/T2/59 pp 143, *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Senguttuvel P, Hariprasad AS, Sundaram RM, Revathi P, Kemparaju KB, Sruthi K, Sadath Ali, Koteshwara Rao, Beulah P, Nagaraju P, Veerendra J, Gireesh C, Anantha MS, Suneetha Kota, Mahender Kumar RM, Sreedevi B, Sheshu Madhav M, Muthuraman P, Nirmala B, Gobinath R, SubbaRao LV, Aravind Kumar J, AVSR Swamy, Sai Prasad SV, Padmavathi G, Laha GS, Amtul Waris, Somasekhar N, Kannan C and MS Prasad. 2022. DRRH-4, the first Public bred Aerobic and High-yielding hybrid for water limited conditions. ICSCI 2022/T3/76 p 461-462 *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Somasekhar, N Soil nematode community, organic matter, nutrient status, and crop productivity in rice under a long-term System of Rice Intensification (SRI). Poster presented in International Conference on System of Crop Intensification for Climate Smart Livelihood and Nutritional security Society for Advancement of Rice Research, ICAR-IIRR, Hyderabad. 12-14 December, 2022. ICSCI 2022/T3/107, pg 519.

Sreenivasulu S., V. Divya, T. Ramu Kumar and B. Nirmala. 2022. Performance of tractor drawn seed drill for direct seeding in paddy. Extended Summaries - International Conference on System of Crop Intensification (ICSCI

2022) for Climate-Smart Livelihood and Nutritional Security, 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, –556-558.

Sruthi K., K.B. Eswari, Ch. Damodhar Raju, M. Sheshu Madhav, A. Dhandapani, M. Bala Satya Sree, K. Srikrishna Latha, P.Koteswararao, M. Sadath Ali, Balakrishnan D., P. Senguttuvel, P. Revathi, K.B. Kemparaju, Ch. Suvarna Rani, M.B. Kalyani, R.M. Sundaram and A.S. Hari Prasad. 2022. Genetic diversity of indica tropical japonica derived lines in rice. ICSCI 2022/T2/10 pp 32, *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Sruthi K, K B Eswari, Ch Damodhar Raju, M Sheshu Madhav, A Dhandapani, M Bala Satya Sree, K Srikrishna Latha, P Koteswararao, M Sadath Ali, Divya Balakrishnan, P Senguttuvel, P Revathi, K B Kemparaju, R. M Sundaram, A S Hari Prasad. 2022. Exploitation of tropical japonica germplasm for heterosis breeding. MS1139. Pg no: 175 *In:* Book of Abstracts of the symposium on Tending Mendel's Garden for a Perpetual and Bountiful Harvest at ICAR-IARI, New Delhi from 19-21 July, 2022. Pp 246.

Supriya Puram, Manish Solanki, Balakrishnan, M., Prakasam, V., Soam, S.K., Sundaram, R.M., and Mangrauthia K. Satendra. 2022. Identification and expression analysis of long Noncoding RNAs induced during *R. solani* infection in rice. Proceedings S7VO-05, APBNS 2022.

Umakanth B., G. Padmavathi, Balakrishnan D., K. Chattopadhyay, Girish Chandel, Santosh Rathod, G Shiva Prasad, B. Krishna veni, P.S. Virk, L.V. Subba Rao and R.M. Sundaram. 2022. Identification of stable biofortified rice genotypes through G×E analysis. ICSCI 2022/T2/38 p 94 *In:* Extended Summaries. 12-14 Dec 2022, Society for Advancement of Rice Research, Rajendranagar, Hyderabad-500030, India, p 571.

Books Edited

Amtul Waris, Kiran Singh, Mala Kumari, Anamika Jamwal, Bishnu Deo Singh and K Saikanth. (2022). Women in Agriculture. Parmar Publications ISBN- 978-93-921932-1-8 pp 165.

Amtul Waris, Ajay Kumar, Shashikant and K Saikanth (2022) Mass media trends in promoting agri innovations. Parmar Publications: ISBN- 978-93-921932-2-9.pp 158.

Brajendra, Surekha, K., Nageswara Rao D.V.K., Prasad Babu, M.B.B., Latha, P.C., Mahender Kumar, R., Manasa, V., Tuti, M. D., Gobinath, R., Bandeppa, S., and Ghose. T.J., 2022. Soil Health Management Strategies in Rice Based Cropping Systems. ICAR - Indian Institute of Rice Research, Hyderabad, pp: 118.

Kalyan K.M., Laha, G.S., Arup Kumar M., Srinivas Prasad, M., Ramanathan, A., Rao, G.P., Krishnaveni, D., Matiyar Rahaman Khan, Manas Kumar Bag, Bishnu Maya B., Prakasam, V., 2022. Rice Diseases Compendium, Published by Indian Phytopathological Society, New Delhi (ISBN Number: 978-81-953723-5-5).

Singh, S.P., Brajendra., Singh, M., Singh, P.B., Rana, R., Bhati, H. P., Nayak, H., Pankaj Sharma, P., Singh, B., Satish Chand Gaur, S. C., Tamburne, B.V., Netrapal Malik, Butola, J.S., Vinay Kumar. 2022. Innovative and Current Advances in Agriculture and Allied Sciences, Published by Astha Foundation.

Book chapters

Aglawe, S.B., Magar, N.D., Dhawane, Y., Bhamare, D., Shah, P., Devi, S.R., Kumar, S.J. and Barbadikar, K.M., 2022. Genome Editing Crops in Food and Futuristic Crops. In Recent Advances in Food Biotechnology (pp. 401-445). Singapore: Springer Nature Singapore.

Akshay S. Sakhare, Suneetha Kota, Santosh Rathod, Brajendra Parmar and Viswanathan Chinnusamy. 2022. Genome-Wide Association Study: Approaches, Applicability and Challenges. *In:* Genotyping by Sequencing for Crop Improvement, First Edition. Edited by Humira *et al*. 2022, published by John Wiley & Sons Ltd. Published 2022, pp 80-111.

Arun, M. N, Kumar, R. M., Nori, S, Sreedevi, B, Padmavathi, G, Revathi, P, Pathak N, Srinivas, D, & Sundaram, R. M. (2022). Bio stimulant Properties of Marine Bioactive Extracts in Plants: Incrimination toward Sustainable Crop Production in Rice. In (Ed.), Marine Ecosystems - Biodiversity, Ecosystem Services and Human Impacts. https://doi.org/10.5772/intechopen.108640.

Beerelli K, Balakrishnan D, Addanki KR, Surapaneni M, Rao Yadavalli V and Neelamraju S. 2022. Mapping of QTLs for Yield Traits Using F2:3:4 Populations Derived from Two Alien Introgression Lines Reveals qTGW8.1 as a Consistent QTL for Grain Weight from *Oryza nivara*. *Front. Plant Sci.* 13:790221. doi: 10.3389/fpls.2022.790221 In Koide, Y., Matsubara, K., Tao, D., McNally, K. L., eds. (2022). Reproductive Barriers and Gene Introgression in Rice Species, Volume II. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88976-840-0.

Chitra Shanker 2022. Insect Pests *vis-à-vis* Soil Health: Implications on Integrated Pest and Nutrient Management. In Evolving Concepts of Integrated Pest

Publications

Management (Eds.) Rabindra Prasad, Munna Yadav, Suday Prasad, Amarendra Kumar, P Jeya Kumar), Parmar Publications, India, pp 85-99. http://krishi.icar.gov.in/jspui/handle/123456789/76100.

Dharmesh, V., Singh, A. N., Kalubarme, M. H., Saroha, G. P., Ritesh Sharma, and Brajendra. (2022). Varietal Discrimination, Acreage Estimation and Yield Prediction of Basmati Aromatic Rice in North-Western India Using Satellite Data: Springer Nature Switzerland AG 2022 163 K. P. Vadrevu *et al.* (eds.), Remote Sensing of Agriculture and Land Cover/Land Use Changes in South and Southeast Asian Countries, https://doi.org/10.1007/978-3-030-92365-5_9.

Jaldhani, V., Rao, D.S., Beulah, P., Nagaraju, P., Suneetha, K., Veronica, N., Kondamudi, R., Sundaram, R.M., Madhav, M.S., Neeraja, C.N. and Rao, P.R., 2022. Drought and heat stress combination in a changing climate. In Climate change and crop stress (pp. 33-70). Academic Press.

Magar, N. D., Shah, P., Harish, K., Bosamia, T. C., Barbadikar, K. M., Shukla, Y. M., Phule, A., Zala, H. N., Madhav, M. S., Mangrauthia, S. K. and Neeraja, C. N., 2022. Gene expression and transcriptome sequencing: basics, analysis, advances. in gene expression. *IntechOpen*.

Melekote Nagabhushan Arun, Rapolu Mahender Kumar, Banugu Sreedevi, Guntlpalli Padmavathi, Pallakonda Revathi, Neha Pathak, Dayyala Srinivas and Boya Venkatanna. The rising threat of invasive plant species in agriculture. 2022. Gabrijel Ondresek (Ed). *In:* Resource management in Agroecosystems. Intech Open. ISBN 978-1-83768-421-2.

Melekote Nagabhushan Arun, Shibara Shankarahebbar, Bhuprakash, Thulasiram Senthivel, Anil Kumar Nair, Guntupalli Padmavathi, Pratima Pandey Aarti Singh. 2022. Seed priming: the way forward to mitigate abiotic stress in crops. Pp 173-203. Mirza Hasanuzzaman (Ed). *In:* Plant Stress Physiology - Perspective in Agriculture. Intech open. ISBN: 978-1-83969-865 -5

Melekote Nagabhushan Arun,Rapolu Mahender Kumar, Banugu Sreedevi, Guntupalli Padmavathi, Pallakonda Revathi, Neha Pathak,Dayyala Srinivas and Raman Meenakshi Sundaram. 2022. Impact of Zinc nano fertilizer for enhancing rice productivity. Min Huang (Ed). *In:* Rice crops - productivity and Sustainability. Intech Open. ISBN: 978 -1- 83768 -102 -0

Nakul D. Magar, Priya Shah, K. Harish, Tejas C. Bosamia, Kalyani M. Barbadikar, Yogesh M. Shukla, Amol Phule, Harshvardhan N. Zala, Maganti Sheshu Madhav, Satendra Kumar Mangrauthia, Chirravuri Naga Neeraja and Raman Meenakshi Sundaram and Sundaram RM (2022). Gene Expression and Transcriptome Sequencing: Basics, Analysis, Advances. *In:* Fumiaki Uchiumi (Ed.), Gene Expression. IntechOpen. https://doi.org/10.5772/intechopen.105929.

Neeraja, CN and Suman K (2023). Molecular mechanisms leading to grain Zn accumulation in rice. In Genetic Engineering and Genome Editing for Zinc Biofortification of Rice published by Elsevier. ISBN: 9780323854061.

Prasad, J.S. and Somasekhar, N. (2022). The unseen rice root nematode problem in irrigated rice. *In: Integrated Nematode Management: State-of-the-art and visions for the future* ((eds. R.A. Sikora, J. Desaeger and L. P. G. Molendijk). CAB International, 2022. Pp. 61-65.

Raghurami Reddy, M., Acaso, J.T., Alakonya, A.E., Mangrauthia, S.K., Sundaram, R.M., Balachandran, S.M. and Biswa, A.K., 2022. Accelerating cereal breeding for disease resistance through genome editing. In: Zhao, K., Mishra, R., Joshi, R.K. (eds) Genome Editing Technologies for Crop Improvement. *Springer*, Singapore, pp. 323–347. https://doi.org/10.1007/978-981-19-0600-8_15.

Reddy MR, Acaso JT, Alakonya AE, Mangrauthia SK, Sundaram RM, Balachandran SM and Biswal AK (2022). Accelerating Cereal Breeding for Disease Resistance Through Genome Editing. *In*: Zhao, K., Mishra, R., Joshi, R.K. (eds) Genome Editing Technologies for Crop Improvement. Springer, Singapore. https://doi.org/10.1007/978-981-19-0600-8_15M. Print ISBN #: 978-981-19-0599-5; Online ISBN #: 978-981-19-0600-8.

Santosha Rathod, Arun Kumar S, Nirmala B, Mahender Kumar R, Muthuraman P and Sundaram R M (Eds) (2022). Training E manual: Online Training Program on "Advanced Statistical Techniques for Data Analysis using R" 03rd to 15th January, 2022. Indian Institute of Rice Research, Rajendranagar, Hyderabad pp. 487.

Srinivas Prasad, M., Jasudasu, G.S., Basavaraj, K., Krishnaveni, D., Prakasam, V., Ladhalakshmi, D., Kannan, C., and Laha, G.S., 2022. Varinashinchu Tegullu- Yajamanya Paddathulu. *In:* (Eds) LV Subba Rao *et al.*, Raithu Samkshemam dishaga maruthunna vathavarananiki anuvaina varisagu. Bulletin no. 118/2022. pp 160.

Suman K, Neeraja CN, Madhubabu P, Rathod S, Bej S, Jadhav KP, Kumar JA, Chaitanya U, Pawar SC, Rani SH, Subbarao LV and Voleti SR (2022). Identification of promising rils for high grain zinc through genotype

× environment analysis and stable grain zinc qtl using SSRs and SNPs in Rice (*Oryza sativa* L.) in Nutrient Interactions in Plants. Lausanne: Frontiers Media SA. In Romera, F. J., Rodriguez- Celma, J., Pérez-Vicente, R., Lan, P., eds. (2022). Lausanne: Frontiers Media SA.doi:10.3389/978-2-88974-046-8.

Suvarna Rani Chimmili, Sruthi Kanneboina, Prashanthkumar S. Hanjagi, P. S. Basavaraj, Akshay S. Sakhare, P. Senguttuvel, T. Sudhir Kumar and Suneetha Kota. 2022. Integrating Advanced Molecular, Genomic, and Speed Breeding Methods for Genetic Improvement of Stress Tolerance in Rice. *In:* Next-Generation Plant Breeding Approaches for Stress Resilience in Cereal Crops. Mallikarjuna, M.G., Nayaka S.C. and Kaul.T. by Springer, pp 263-284.

Technical bulletins

Barbadikar KM, Mangrauthia SK, Madhav MS, Magar ND, Anila M, Ayyappa M, Rekha G, Suman K, Suneel, Hajira SK, Phule AS, Kousik MBVN, Punniakoti E, Syamaladevi DP, Subba Rao LV, Hari Prasad AS, Ananda Kumar P, Sarla N, Balachandran SM, Neeraja CN and Sundaram RM. (2022). Steps to Strides: Biotechnological Advances at ICAR-IIRR. ICAR-Indian Institute of Rice Research, Hyderabad 500030, India. pp 132. ISBN-978-81-948904-8-5.

Hariprasad, D. Subrahmanyam, R.M. Kumar, K. Surekha, B. Jhansi Rani, M.S. Prasad, D. Krishnaveni, M. Sudha Madhuri and S. Gayatri. 2022. AICRPR Experimental Database Portal (www.AICRPR-intranet.in). Technical Bulletin No: 114/2022. ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad-500 030, Telangana State, India. pp. 63, ISBN No: 978-81-948904-4-7.

Jhansi Lakshmi V., Ch Padmavathi, AP Padmakumari, B Jhansi Rani, Chitra Shanker and Y Sreedhar. 2018. Varinasinchu cheedapurugulu- samagra yajamanya paddhathulu. Pp 40-56. In LV Subba rao, Jyothi Badri, AS Hariprasad, K Sruthi, MS Prasad, Ch. Padmavathi, B Nirmala, Ch. Padmavathi, SG Jesudas, K Basavaraju, K Surekha, B sreedevi, V Manasa, Amtul Waris and RM Sundaram. Raithu sankshemam disagaa maarutunna vathaavaranaaniki anuvaina varisaagu ICAR-IIRR Bulletin No. 118/2022. Pages 160.

Madhav MS, Satyanarayana J, Hari Prasad AS, Subba Rao LV, Srinivas Prasad M, Jhansi Rani B, Mahender Kumar R, Muthuraman P, Neeraja CN, Surekha K, Azam MM, Vidhan Singh T, Brajendra, Jhansi Lakshmi V, Aravind Kumar J, Fiyaz RA, Lakshmi Prasanna PA, Kannan C, Chaithanya U and Sundaram RM. (2022). Innovative technologies and services available @ ICAR-Indian Institute of Rice Research. ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad - 500 030, Telangana State, India, pp 96. ISNB: 978-81-948904-7-8.

Padmavathi Ch, GS Laha, B Sailaja, P Prashanth, T Dilip, S Gayatri, R Naganna, V Jhansi Lakshmi, AP Padmakumari, C Shanker, Y Sridhar, D Ladha Lakshmi, V Prakasam, D Krishnaveni, M Srinivas Prasad, B Jhansi Rani, G Katti, RM Sundaram. (2022). Changing Scenario of Rice Insect Pests in India: Spatio Temporal Analysis from Production Oriented Survey (ISBN-978-81-948904-6-1) ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad-500030, Telangana State, India, 114pp.

Sailaja B., R.M. Sundaram, S. Arun Kumar, Santosha Rathod, L.V. Subba Rao, A.S. Hari Prasad, D. Subrahmanyam, Mahender Kumar, K. Surekha, Jhansi Rani, M. Srinivas Prasad, Raghuveer Rao, B. Sreedevi, M.B.B. Prasad Babu, V. Jhansi Lakshmi, A.P. Padma Kumari, Ch. Padmavathi, P. Senguttuvel, C. Gireesh, R. Abdul Fiyaz, Balakrishnan D., K. Sruthi, R. Gobinath, V. Manasa, Akshay S. Sakhare, Basava Raj, Satyaswara Jasudasu Gompa, S. Amudhan, M. Sudha Madhuri and S. Gayatri. Manual for Virtual User's Training cum Workshop on AICRPR Intranet functionalities (http://www.AICRPR-intranet.in). 2022. Indian Institute of Rice Research (ICAR), Rajendranagar, Hyderabad – 500 030, TN., India. pp. 55.

Sharma TR, Gupta S, Roy AK, Bakshi Ram, Kar CS, Yadava, Kar G, Singh GP. Pradeep Kumar, Venugopalan MV, Singh RK, Sundaram RM, Mitra S, Jha SK, Satpathu, Sujaya Rakshit, Tonapi VA and Prasad YG (2002). Achievements in Field Crops in Independent India. Achievements in Field Crops in Independent Indi. *In:* Pathak H, Mishra JP and Mohapatra T (eds.) Indian Agriculture after Independence. Indian Council of Agricultural Research, New Delhi-110 001, pp 426. ISBN: 978-81-7164-256-4.

Sheshu Madhav M., J. Satyanarayana, A.S. Hari Prashad, L.V. Subba Rao, M. Srinivas Prashad, B. Jhansi Rani, R. Mahender Kumar, P. Muthuraman, C.N. Neeraja, K. Surekha, M.M. Azam, T. Vidhan Singh, Brajendra, V. Jhansi Lakshmi, J. Arvind Kumar, R. Abdul Fiyaz, P.A. Lakshmi Prasanna, C. Kannan, U. Chaitanya and R.M. Sundaram. 2022. Innovative technologies and services available @ ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad-500030, Telangana State, India. pp. 96. ICAR-IIRR Publication No. 113/2022.

Subba Rao, L.V., Jyoti Bhadri, Hariprasad, A.S., Sruthi, K., Prasad, M.S., Padmavathi, Ch., Jasudasu, G.S., Basavaraj, K., Surekha, K., Sridevi, B., Manasa, V., Amtul warris, and Sundaram. R.M., 2022. Raithu Samkshemam dishaga maruthunna vathavarananiki anuvaina varisagu. Bulletin no. 118/2022. Pp1-160. (Telugu)

Surekha K., Amtul Waris, V Jhansi Lakshmi, K Sruthi and K Padmaja. 2022. *Vathaavaranamlo vastunna marpulu-vari saagulo paatinchavalasina melakuvalu*. Pp 89-93. In LV Subba Rao, Jyothi Badri, AS Hariprasad, K Sruthi, MS Prasad, Ch. Padmavathi, B Nirmala, Ch. Padmavathi, SG Jesudas, K Basavaraju, K Surekha, B sreedevi, V Manasa, Amtul Waris and RM Sundaram. *Raithu sankshemam disagaa maarutunna vathaavaranaaniki anuvaina varisaagu* ICAR-IIRR Bulletin No. 118/2022. Pages 160.

Surekha K., V Jhansi Lakshmi, V Manasa and K Padmaja. 2022. Sendriya vari saagu. Pp 94-101. In LV Subba Rao, Jyothi Badri, AS Hariprasad, K Sruthi, MS Prasad, Ch. Padmavathi, B Nirmala, Ch. Padmavathi, SG Jesudas, K Basavaraju, K Surekha, B sreedevi, V Manasa, Amtul Waris and RM Sundaram. *Raithu sankshemam disagaa maarutunna vathaavaranaaniki anuvaina varisaagu* ICAR-IIRR Bulletin No. 118/2022. Pages 160.

Technical/popular articles

Akula M., N. Bandumula and Santosha Rathod. (2022). Farmer's Investment Support Scheme (Rythu Bandhu) of Telangana: An Overview *Food and Scientific Reports*, 3(1): 40-43.

Akula, M., Bandumula, N. and Rathod, S. 2022. The Government Schemes for Financial Assistance and Support to Farmers for Income Augmentation. *Food and Scientific Reports*, 3(11): 45 -52.

Amtul Waris and Jana Harish (2022) Vermicompost preparation. Raithu Nestham 17(10)47-49.

Amtul Waris (2022) Gender Sensitive Climate Information Services and Products. Agriculture & E Food Newsletter, 4 (10)110-114.

Balakrishnan D, Jyothi Badri, Shruthi Kanneboina, Bharamappanavara Muralidhara and Santosha Rathod. 2022. Genotype by Environment Interaction and Stability Analysis using GGE and AMMI Analysis. Training Manual Online Training Program on "Advanced Statistical Techniques for Data Analysis using R" (03-15 January, 2022). 250-266p Indian Institute of Rice Research, Rajendranagar, Hyderabad pp. 487.

Bandeppa, Amol. S. Phule., Latha, P. C., Manasa, V., Gobinath, R., Vijaya Kumar, S. and Samdhan, Bagul. 2022, Phosphate Solubilizing Microbes and Their Role in Sustainable Agriculture, *Biomolecule Reports*, 6(4): 1-3.

Basavaraj, K., Jasudasu, G.S., Prakasam, V., Ladhalakshmi, D., Kannan, C., Krishnaveni, D., Laha, G.S., Gireesh, C. and Srinivas Prasad, M., 2022. Development of artificial mass screening technique for brown spot disease under field condition. *IIRR Newsletter*, 20 (1), pp5-6.

Bhanusree D, Nirmala B, Rathod S, Sriramulu T, Jyotsna B, Muthuraman P. Rice Yield Gaps in India and Strategies to Narrow the Gaps CBM [Internet]. 28 Dec. 2022 [cited 8 Feb. 2022]; 6(1): 119-121. Available from: http://www.pphouse.org/cbm-article-details.php?cbm_article=79.

Bhanusree D, Nirmala B, Rathod S, Sriramulu T, Jyotsna B, Muthuraman P. 2022. Rice Yield Gaps in India and Strategies to Narrow the Gaps *Chronicle of Bioresource Management*; 6(1): 119-121.

Nirmala B, Rathod S, Sriramulu T, Muthuraman P. 2022. Impact of SCSP Demonstrations on Good Agricultural Practices in Rice Cultivation. *Chronicle of Bioresource Management*. 6(1): 122-124.

Nirmala B. 2022. Adhunika paddhatulato laabhasaati vari saagu. In (*Ed.*). L.V. Subba Rao, Jyothi Badri, A.S. Hari Prasad, K. Shruthi, M.S. Prasad, Ch. Padmavathi, S.G. Jesudasu, K. Basavaraju, K. Surekha, B. Sreedevi, V. Manasa, Amtul Waris and R.M. Sundaram. *Rythu sankshema dishaga maarutunna vaatavaranaaniki anuvaina vari saagu*. Bulletin No. 118/2022 p. 143-145.

Sailaja B., LV Subba Rao, AVSR Swamy, AS Hari Prasad, R Abdul Fiyaz, S Arun Kumar, U Chaithanya, S Gayathri and RM Sundaram. 2022. Barathiya Vari Parishodana Samstha (IIRR) Vari Vittana Portal (https://www.iirr-seedportal.in) (Telugu). In LV Subbarao *et al.* 2022. *Raithu sanskemum disaga Maruthunna Vatavarananiki anuvaina vari saagu*. Bulletin Number 118/2022. Pp160. 115-121.

Sailaja B., Santosha Rathod, S. Gayatri and R. Nagarjuna Kumar. Classification and Regression Trees (CART). 2022. In Training Manual of SERB sponsored High End Workshop (Physical mode) on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R (under the KARYASHALA Scheme) organised by ICAR-IIRR during 18-30 July, 2022. Pp 184-192.

Sailaja B., Santosha Rathod, S. Gayatri and R. Nagarjuna Kumar. Geospatial Crop Modelling. 2022. In Training Manual of SERB sponsored High End Workshop

(Physical mode) on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R (under the KARYASHALA Scheme) organised by ICAR-IIRR during 18-30 July, 2022. Pp 376-386.

Sailaja B., Santosha Rathod, S. Gayatri and R. Nagarjuna Kumar. Random Forest Algorithm. 2022. In Training Manual of SERB sponsored High End Workshop (Physical mode) on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R (under the KARYASHALA Scheme) organised by ICAR-IIRR during 18 -30 July, 2022. Pp 193-197.

Sailaja B., Santosha Rathod, S. Gayatri and R. Nagarjuna Kumar. Supervised and Unsupervised Classification in Remote sensing. 2022. In Training Manual of SERB sponsored High End Workshop (Physical mode) on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R (under the KARYASHALA Scheme) organised by ICAR-IIRR during 18 -30 July, 2022. Pp 344-356.

Somasekhar N. (2022). Nematode menace in rice and integrated nematode management methods. *In:* LV Subba Rao, Jyothi Badri, AS Hari Prasad, K Sruthi, MS Prasad, CH Padmavathi, SJ Jesudas, K Basavaraj, K Surekha, B. Sreedevi, V. Manasa, Amtul waris and RM Sunadaram (eds) "Rice cultivation in the context of changing climate" IIRR Bulletin No 118/2022. Pp 160. (in Telugu).

Subba Rao LV, Jyothi Badri, G Padmavathi, K Sruthi, Aravind Kumar, C Gireesh, K Suneetha, MS Anantha, RA Fiyaz, Balakrishnan D., Suvarna Ch, AVSR Swamy, SV Sai Prasad, AS Hari Prasad, P Senguttuvel, P Revathi, KB Kemparaju, CN Neeraja, M Seshumadhav, SK Mangruthia, Kalyani K. and RM Sundaram. 2022. Vari Parishodana Samstha roopandinchina noothana vari vangadalu (Telugu). In LV Subbarao *et al.* 2022. *Raithu sanskemum disaga Maruthunna Vatavarananiki anuvaina vari saagu*. Bulletin Number 118/2022. Pp160. 2-23.

Sundaram RM, Jena KK, Kim S, Senguttuvel P, Abdul Fiyaz R, Subba Rao LV, Suneetha K, Jyothi Badri, Padmavathi G, Neeraja C N, Mangrauthia SK, Madhav MS, Kalyani K Barbadikar, Subramanyam D, Raghuveer Rao P, Punniakotti E, Kousik M B V N, Chaitra K, Dilip T, Rekha G, Hajira SK, Masthani SK, Vivek G, Jyothi K, Ayyappa DM, Anila M, Backiyalakshmi C. and Pragya Sinha. 2022. Marker assisted introgression of yield enhancing genes into the background of elite Indian rice varieties. *IIRR Newsletter*, 20(1): 2-4.

Surekha K, Amtul Waris, V Jhansilakshmi, K Sruthi and K Padmaja. 2022. Climate change -Management practices to be followed in rice. 2022. Popular article in Telugu. In: *Raithu Nestam Magazine*. March 2022. 17(6): 45-46.

Suvarna Rani Ch, Anantha MS, Padmavathi G, Aravind Kumar J, Gireesh C, Jyothi Badri, Suneetha K, Abdul Fiyaz R, Balakrishnan D., Subba Rao LV and Sundaram RM. 2022. Molecular and morphological characterisation of aroma in scented aromatic short grain rice lines *ICAR-IIRR Newsletter* 20(1): 3-4.

Tuti Mangal Deep, R. Mahender Kumar, B. Sreedevi, B. Nirmala and R. M. Sundaram. (2022). Rice based cropping systems for enhancing productivity of food grains in India. *Food and Scientific Reports*. 3(23): 42-46.

Vijayakumar S, Gobinath R, Jesudas Gompa S, Surekha K, Kumar RM and Sundaram RM. (2022). Management of micro-nutrient deficiency and toxicity in rice. *Indian Farming* 72: 11-14.

Vijayakumar S, Hanuma M, Sai Charam B, Kumar RM and Sundaram RM. (2022). Drone application in rice cultivation: Experiences from ICAR-IIRR trails. *Indian Farming* 72: 03-06.

Vijayakumar, S., Gobinath, R., Arun Kumar, S., Bandeppa, S. Jasudas, Gompa, Basavaraj, K., Prakasam, V. and Manasa, V. 2022. Interventions to Achieve the Untapped Potential of Conservation Agriculture in India. *Chronicle of Bioresource Management*, 6(2): 049- 053.

Vijayakumar, S., Gobinath, R., Arun Kumar, S., Bandeppa, S., Jasudas Gompa, S., Basavaraj, K., Prakasam, V., and Vakada Manasa. 2022. Interventions to Achieve the Untapped Potential of Conservation Agriculture in India. *Chronicle of Bioresource Management*, 6(2), pp 49-53.

Vijayakumar, S., Gobinath, R., Jesudas, Gompa., Surekha, K., Kumar, R. M. and Sundaram, R. M. 2022. Management of micro-nutrient deficiency and toxicity in rice. *Indian Farming*, 72(04): 11-14.

Vijayakumar, S., Karunakaran, V., Gobinath, R., Basavaraj, K., Raghavendra Goud, B., Naseeruddin Sha., Manasa, V. and Aravindan, S. 2022. Sustainable Rice Production in India Through Efficient Water Saving Techniques. *Chronicle of Bioresource Resource Management*, 6(1): 032-038.

Lectures/ Lead and invited talks in symposia/ workshops/ training courses

Scientist	Topic	Programme Name	Organizers	Duration	Remarks Oral/lead /poster
R.M. Sundaram	Making Samba Mahsuri Climate change resilient through molecular breeding	National Conference on Empowerment of Rural Youth with Novel Agricultural Technologies organized by at College of Agriculture	Andhra Agricultural Union and ANGRAU Bapatla	28 January	Dr. M.V. Reddy Memorial Lecture
Kalyani M Barbadikar	Transcriptomic data analysis	Training programme Advanced Statistical Techniques for Data Analysis using R	ICAR-Indian Institute of Rice Research	11 January	Invited Lecture
Chitra Shanker	Non-pesticidal interventions for nutritional, ecological and monetary benefits in rice	International Conference on Recent Trends in Smart & Sustainable Agriculture for Food Security	Lovely Professional University, Phagwara, Punjab	21-22 January	Keynote
R.M. Sundaram	Technological Interventions in Rice	FPO interaction meeting	ICAR-IIOR, Hyderabad	22 February	Invited talk
Somasekhar N	Production protocols for microbial Biopesticides	Production protocols for microbial Bio-pesticides	National Institute of Plant Health Management, Hyderabad.	22-25 February	Lecture
Somasekhar N	Field diagnosis and management of plant parasitic nematodes	Field diagnosis and management of plant parasitic nematodes	National Institute of Plant Health Management, Hyderabad	March, 2022	Lecture
R.M. Sundaram	Development of Climate change resilient rice varieties through molecular breeding	Training course on Biotechnological tools	PJTSAU, Hyderabad	22 March	Lecture
Revathi P	Development of blast resistance restorers by introgression of broad-spectrum resistance genes *Pi54* & *Pi9* by marker assisted selection in rice	IPSCONF2022	Indian Phytopathological Society at SKNAU, Jobner-Jaipur, Rajasthan	March 23-26	Oral
Revathi P	Pre-breeding to enhance the yield potential of hybrid rice parental lines	International symposium on advances in plant biotechnology and nutritional security	ICAR-National Institute for Plant Biotechnology New Delhi-110012, India	April 28-30, 2022	Oral
Chavan, S. N.	Dehydroascorbate activates induced resistance in rice against root-knot nematode *Meloidogyne graminicola*	7th International Congress of Nematology	Society of Nematologists, New Mexico, USA	1-6 May	Oral
R.M. Sundaram	Genome editing for crop improvement: Potential and Policy	Workshop on Genome editing for crop improvement	BCIL and PJTSAU	6 May	Keynote lecture

Scientist	Topic	Programme Name	Organizers	Duration	Remarks Oral/lead /poster
Senguttuvel P	Yield stability and performance evaluation of heat tolerance potential in QTL introgressed rice restorer, KMR-3	6th Australasian Plant Breeding Conference	University of Queensland, Australia	9-12 May	Oral
R.M. Sundaram	Interaction between rice and its friendly microbes and pathogens reveals dynamic relationship	International workshop on "Plant and microbiome synergies	ICGEB, New Delhi	9 May	Keynote lecture
R.M. Sundaram	Development of Climate resilient rice varieties through molecular breeding	National Symposium on "Self-reliant Coastal Agriculture	ICAR-CCARI, Goa	12 May	Lead lecture
Chitra Shanker	Molecules to ecosystems - recent trends in chemical Ecology for combating biotic stresses in a changing climate	International Conference on Advances in Agriculture Technology and Allied Sciences,	Centurion University of Technology and Management, Odisha and Association of Rice Research Workers, NRRI, Cuttack	4-5 June	Keynote
R.M. Sundaram	Application of genomic tools for improvement of yield heterosis in rice hybrids	The Plant and Animal Genome Conference 2022	PAG ASIA	24 June	Invited talk
R.M. Sundaram	Development of climate resilient rice varieties	Orientation training course	ICAR-NAARM	30 June	Lecture
Rao, D.V.K.N.	Temporal observation of NDVI and SAVI of rice derived from Sentinel 2 bands	National Seminar on Sustainable Food Production Systems for Self-reliant and Climate Resilient Agriculture	UAS, Dharwad	16-18 June	Oral
Senguttuvel P	Physiological evaluation of backcrossed inbred lines of rice for seedling stage salinity tolerance	2nd International conference on integrative biology and applied genetics	Osmania University, Hyderabad	20-22 July	Oral
Senguttuvel P	Population structure, Genetic diversity and Molecular marker –trait association analysis for fertility restoration and abiotic stress tolerance in landraces of rice	2nd International conference on integrative biology and applied genetics	Osmania University, Hyderabad	20-22 July	Oral
Sailaja B	Classification and Regression Trees (CART)	Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R	ICAR-IIRR	18-30 July	Lecture

Scientist	Topic	Programme Name	Organizers	Duration	Remarks Oral/lead /poster
Sailaja B	Supervised and Unsupervised Classification in Remote sensing	Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R	ICAR-IIRR	18-30 July	Lecture
Sailaja B	Random Forest Algorithm	Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R	ICAR-IIRR	18-30 July	Lecture
Sailaja B	Geospatial Crop Modelling	SERB sponsored High-End Workshop on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R	ICAR-IIRR	18-30 July	Lead Lecture
R.M. Sundaram	Biofortified released rice varieties in India-Status and Progress	Workshop entitled Biofortified rice-way forward	IGKV, Raipur and ICAR-IIRR	17 August	Invited Talk
Satendra Kumar Mangrauthia	Stress tolerance - Frontiers in Biochemistry and Bioinformatics	Conference on 'Biotechnology trends and future prospects'	UAS, GKVK	14 Sep	Lead lecture
Chavan, S. N.	Dehydroascorbate: A novel resistance-inducing stimulus against root-knot nematode Meloidogyne	1st International Symposium on Sustainable Agriculture Biostimulants and Biopesticides	Ghent University, Belgium	20-22 September	Oral
Satendra Kumar Mangrauthia	Recent Advancement in Genetic Engineering and Genome Editing	National Symposium on "Emerging Innovations in Plant Molecules for Achieving Food and Nutritional Security"	Navsari Agricultural University (NAU), Navsari	22-23 September, 2022	Lead lecture
R.M. Sundaram	Breeding for nutrient use efficiency in Rice	National Seminar on "Harnessing the Potential of Panchabhutas (tatvas) for Sustainable Climate Resilient Rainfed Agriculture	ICAR-CRIDA, Hyderabad	28 September	Lead lecture
Brajendra	Role of soil in sustainable agriculture	Sustainable living through sustainable agriculture	Heartfullness Education Trust, Hyderabad	21 October	Lecture
R.M. Sundaram	Development of climate resilient rice varieties through application of biotechnological tools	Council for Partnership on Rice Research in Asia (CORRA)	Bangladesh Rice Research Institute, Ghazipur	29-30 Nov	Invited talk

Scientist	Topic	Programme Name	Organizers	Duration	Remarks Oral/lead /poster
Sridhar Y.	Impact of climate change on Insect pests with special reference to Rice"	Climate Change: Changing pest & Disease Scenarios in India - Present Status, Challenges & their Management Strategies Entomology-Hyderabad	Professor Jayashanker Telangana State Agricultural University and National Institute of Agricultural Extension Management, Hyderabad	14-16 November	Lecture
Sailaja B.	Aavishkar- an AI based Mobile App for Rice Pest Detection	73rd Annual Conference of ISAS on "Statistics and Machine Learning for Big Data Analytics"	Indian Society of Agricultural Statistics in Collaboration with Division of Agricultural Statistics SKUAST-K, Shalimar, J&K	14-16 November	Invited talk
Sailaja B.	Smart Precision Models for Rice Yield Estimation	73rd Annual Conference of ISAS on "Statistics and Machine Learning for Big Data Analytics"	Indian Society of Agricultural Statistics in Collaboration SKUAST-K, Shalimar, J&K-India	14-16 November	Oral
Rao, D.V.K.N.	Coarse fragments dilute exploitable soil volume - Consequent adjustments are required for soil fertility management	86th Annual Convention of Indian Society of Soil Science	MPKV, Rahuri	15-18 November	Oral
Brajendra	The role of soil health management in sustainable agriculture	Sustainable living through sustainable agriculture	Heartfullness Education Trust, Hyderabad	6 December	Lecture
R.M. Sundaram	Marker assisted selection in rice product development	Training course on New Crop Breeding Technologies	ICRISAT	7 December	Lecture
Padmavathi Ch.	Insect resistance in field crops	3rd National Symposium Entomology 2022: Innovation and Entrepreneurship, Entomology-Hyderabad	Professor Jayashanker Telangana State Agricultural University, Entomological Society of India, Plant Protection Association of India, Agri Biotech Foundation, Hyderabad	8-10 December	Invited talk
Sailaja B	Smart Precision models for Rice Crop Management	National Workshop on SMART IF	ICAR-CTCRI, Thiruvanantha-puram, Kerala	15-17 December	Lecture

Scientist	Topic	Programme Name	Organizers	Duration	Remarks Oral/lead /poster
Sridhar Y	Feeding behaviour of pymetrozine resistant and susceptible brown planthopper (*Nilaparvata Lugens*) strains to pymetrozine	3rd National Symposium Entomology 2022: Innovation and Entrepreneurship Entomology-Hyderabad	Professor Jayashanker Telangana State Agricultural University, Entomological Society of India, Plant Protection Association of India, Agri Biotech Foundation, Hyderabad	8-10 December	Oral
Rao, D.V.K.N.,	Space based observations for monitoring a multi-locational trial under All India Coordinated Research Project on Rice	System of Crop Intensification (ICSCU 2022) for Climate-Smart Livelihood and Nutritional Security	ICAR-Indian Institute of Rice Research, Hyderabad	12-14 December	Oral
Padmavathi Ch.	Impact of rice cultivation methods on insect pest incidence and their management	International Conference on System of Crop Intensification for Climate Smart Livelihood and Nutritional security	Society for Advancement of Rice Research, ICAR-IIRR, Hyderabad	12-14 December	Lead talk
Sailaja B.	Smart Precision models for Sustainable Rice Production	International Conference on System of Crop Intensification for Climate-Smart livelihood and Nutritional Security (ICSCI 2022)	ICAR-IIRR, Hyderabad	12-14 December	Lightening talk
Chitra Shanker	Harnessing functional diversity and ecosystem services in ephemeral ecosystems - a case of Rice crop	7th National Conference on Biological Control	Society for Biocontrol Advancement, Bengaluru	15-17 December	Lead talk

Appendix-1

Promising Entries In Varietal Trials, *Kharif* 2021

S. No.	IET No.	Designation	Cross Combination	Source Trial	Yield (Kg/ha)	FD (days)	GT	Promising for
1	28343	KNM 6965	MTU 1010 / KNM 118	AVT 2 – E TP	5576	89	LS	Suitable for irrigated ecology in Haryana & Maharashtra
2	26790	MTU 1273	MTU 1010 / FL478 // *3 MTU 1010	AVT 2 – E TP	5389	89	LS	Suitable for irrigated ecology in Chhattisgarh, Maharashtra Gujarat
3	28356	KNM 7073	KNM 606 / KNM 118	AVT 2 – E TP	5096	89	LS	Suitable for irrigated ecology in Odisha
4	28354	CR 4073-1339-3-5-1-1-3	IET 22296 / RR 2-6	AVT 2 – E TP	5275	90	MS	Suitable for irrigated ecology in Odisha, Bihar & Assam
5	28332	KNM 7048	KPS 3219 / KNM 118	AVT 2 – E TP	5821	88	LB	Suitable for irrigated ecology in Bihar, West Bengal, Maharashtra, Chhattisgarh, Gujarat
6	28329	RCPR 60-IR 97073-26-1-1-3	IR10L146 / IR10L137	AVT 2 – E TP	5175	89	LS	Suitable for irrigated ecology in Bihar and Chhattisgarh
7	28160	HRI-202 (Hybrid)	-	AVT 1 - IM	6321	102	MS	Suitable for irrigated ecology in Haryana, Odisha, Chhattisgarh and Karnataka
8	28171	RNE-0122 (Hybrid)		AVT 1 – IM	6055	102	MS	Suitable for irrigated ecology in Telangana
9	27900	MTU-1276 (MTU 2578-56-1)	MTU 1156 / MT U 1081	AVT 1 - IM	5803	110	LB	Suitable for irrigated ecology in Tamil Nadu
10	28200	TRC BN-1311-B-B-43-11-1	Bhalum 3 / Naveen	AVT 1 – E (H)	4738	102	SB	Promising for Himachal Pradesh, Uttarakhand
11	28230	TRC PSM-1720-B-B-5-1	Pyzum / BPT 5204	IVT – U (H)	2893	97	SB	Promising for Himachal Pradesh, Manipur
12	28508	CR 2830-48-1	Swarna / ARC10075	AVT 1 - LATE	5391	113	SB	Promising for Chhattisgarh and Maharashtra
13	28730	KPS-6262	BPT 5204 / MTU 1010	AVT 1 - MS	5404	105	MS	Promising for Telangana
14	28757	MTU 1321 (MTU 2284-103-1-7)	MTU 5249 / IR 72	AVT 1 - MS	5652	110	MS	Promising for Chhattisgarh Gujarat and Odisha
15	27823	CSR MAGIC 157	Fedearroz 50 / SHZ-2 // PSBRc 82 / PSBRc 158 //// IR 77298-14-1-2-10 / IR 4630-22-2-5-1-3 // IR 45427-2B-2-2B-1-1 / Samba Mahsuri + Sub 1	AVT 1 – AL&ISTVT	AL-2983 IS-3087	AL-92 IS-108	LB	Suitable for saline and alkaline in Haryana
16	28606	CSRM1-7	IR 71730-51-2 / NSIC RC 106	AVT 1 – AL&ISTVT	AL-2896 IS- 3445	AL-79 IS-90	LS	Suitable for saline and alkaline in Haryana
17	28608	CSR 449S-13	CSR30 / CSR36	AVT 1 – AL&ISTVT	AL-3037 IS- 3046	AL-88 IS-99	LS	Suitable for saline and alkaline in Haryana

Appendices

S. No.	IET No.	Designation	Cross Combination	Source Trial	Yield (Kg/ha)	FD (days)	GT	Promising for
18	27847	IIRRH 115 (Hybrid)	-	IVT - CSTVT	3666	105	LB	Promising for Gujarat & Odisha
19	28066	RP 5973-13-1-6-67-129-57	MTU 1010*2 / Swarna	NIL (IME & IM)	AP-4655 TS-5685	AP-90 TS-98	MS	Promising for Andhra Pradesh & Telangana
20	28065	RP 5972-13-1-6-67-129-266	MTU 1010*2 / Vandana	NIL (IME & IM)	4655	101	SB	Promising for Andhra Pradesh
21	28818	RP 6317-S35-BC2F4-49-25-621	MTU 1121 * 2 / Swarna	NIL (IME & IM)	6483	96	LS	Promising for Andhra Pradesh

Appendix-2

Promising hybrids identified in different hybrid rice trials *kharif* 2021

Name of the Hybrid	IET No.	DFF	Promising in
IHRT-E			
UPLRH-180842	29690	91	Overall
UPLRH-181325	29694	90	Overall
HRI-214	29689	88	Overall
IHRT-ME			
PHI 21105	29736	92	Overall
PHI 21104	29734	97	Overall
RNC-0457	29738	96	Overall
IHRT-M			
HRI-211	29743	100	Overall
HRI-209	29741	97	Overall
PHI-20108	29753	97	Overall
IHRT-MS			
CRHR-154	29763	103	Zone III

Appendix-3

Centre-wise breeder seed production during *kharif*, 2021 (as per DAC indent) (Quantity in Quintals)

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
1	CRURRS, Hazaribagh (NRRI, Cuttack)	Abhishek (IET-17868) (RR-272-829)	0.05	1.92	1.87
		SAHBHAGI (Sahbhagi Dhan IET-19576)	75.65	167.70	92.05
		Total	**75.70**	**169.62**	**93.92**
2	TNRRI, Aduthurai (TNAU, Coimbatore)	ADT-37	1.10	1.10	0.00
		ADT-39	1.10	1.10	0.00
		ADT-45	0.10	0.10	0.00
		ADT (R)-46	0.10	0.10	0.00
		ADT-51 (IET-23617)	1.85	1.85	0.00
		ADT-53 (IET-23955)	0.95	0.95	0.00
		Total	**5.20**	**5.20**	**0.00**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
3	RRS, Chinsurah (Govt. of WB)	Ajit	7.60	5.00	-2.60
		Muktashree (IET-21845)	2.70	1.95	-0.75
		Rajdeep (CN 1039-9) (IET-17713)	0.65	1.70	1.05
		Sabita (IET-8970)	2.00	2.48	0.48
		Sukumar (IET-21261)	5.80	0.00	-5.80
		Shatabdi (IET-4786)	28.20	5.59	-22.61
		Sujala (CNR-2) (IET-20235)	1.10	1.60	0.50
		Bidhan Suruchi (IET-25701)	3.10	0.00	-3.10
		Chinsurah Nona - 2 (Gosaba- 6) (IET-21943)	1.00	1.28	0.28
		Chinsurah Rice (IET-19140) (CNI 383-5-11) (Kaushalya)	1.00	1.00	0.00
		CN1272-55-105 (IET- 19886) (Kanak)	0.50	2.50	2.00
		Khitish (IET-4094)	3.00	3.90	0.90
		BNKR-1 (Dhiren) (IET-20760) (PY-84) (IET-19848)	3.20	1.85	-1.35
		Total	**59.85**	**28.85**	**-31.00**
4	ANGRAU, Guntur	Amara (MTU-1064)	5.60	5.60	0.00
		Bharani (NLR-30491)	1.00	1.00	0.00
		BPT 5204	42.80	42.80	0.00
		BPT-3291 (Sonamasuri)	4.00	4.00	0.00
		Chandra (IET-23409) (MTU-1153)	86.90	86.90	0.00
		Cottondora Sannalu (MTU-1010)	164.60	164.60	0.00
		Maruteru Sannalu (MTU-1006, IET-14348)	1.00	1.00	0.00
		MTU 1001 (Vijetha)	55.30	55.30	0.00
		MTU 1075 (IET-18482)	8.50	8.55	0.05
		Varam (MTU-1190)	1.50	1.50	0.00
		MTU-1223	17.80	17.80	0.00
		MTU-1239	16.70	16.70	0.00
		MTU 1140 (Bheema)	11.10	11.10	0.00
		MTU 1156 (Tarangini)	103.50	103.50	0.00
		MTU-1061	6.20	6.20	0.00
		MTU-1121 (Sri Dhruthi)	32.85	32.85	0.00
		Ksheera (MTU-1172)	1.70	1.70	0.00
		MTU-1210	9.00	9.00	0.00
		MTU-1224	8.50	8.50	0.00
		MTU-1262	7.50	7.50	0.00
		MTU-7029	130.80	130.80	0.00
		Nellore Dhyanyarasi (NLR-3354)	1.00	1.00	0.00
		NLR-4001	1.00	1.00	0.00
		NDLR-7	2.10	2.10	0.00
		Nellore Mahsuri (NLR-34449)	7.10	7.10	0.00
		Pardhiva (NLR-33892)	1.00	1.00	0.00
		RGL-2537	9.00	9.00	0.00
		Total	**738.05**	**738.10**	**0.05**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
5	NRRI, Cuttack	Ankit	9.20	9.20	0.00
		Annada	1.50	1.50	0.00
		CR Dhan 201 (IET-21924)	0.65	0.65	0.00
		CR Dhan 202 (IET-21917	0.80	0.80	0.00
		CR Dhan 300 (CR2301-5) (IET-19816)	0.30	0.30	0.00
		CR Dhan 303 (CR 2649-7) (IET-21589	0.10	0.10	0.00
		CR Dhan 304 (IET-22117)	0.40	0.40	0.00
		CR Dhan 305 (IET-21287	7.69	7.70	0.01
		CR Dhan 306	1.00	1.00	0.00
		CR Dhan 315	3.00	3.00	0.00
		CR Dhan 311 (MUKUL)	25.51	25.60	0.09
		CR Dhan 401 (REETA) (IET-19969)	0.50	0.00	-0.50
		CR Dhan 505 (IET-21719)	0.20	1.00	0.80
		CR Dhan 510 (IET-23895)	0.60	0.70	0.10
		CR Dhan 511	0.60	0.80	0.20
		CR Dhan 601 (IET-18558)	4.60	4.60	0.00
		CR Dhan 701 (IET-20852) (CRHR32)	0.02	0.02	0.00
		ÇR Dhan 800 (SWARNA-MAS)	25.00	26.40	1.40
		CR Dhan 801 (IET-25667)	5.05	11.20	6.15
		CR Dhan 802 (Subhar)	11.50	4.55	-6.95
		CR Dhan-203	16.15	16.15	0.00
		CR Dhan-307	2.10	0.80	-1.30
		CR Dhan-309	1.00	1.00	0.00
		CR Dhan-310	70.60	70.60	0.00
		CR Dhan-407	0.30	1.60	1.30
		CR Dhan-409	1.50	9.50	8.00
		CR Dhan-508	1.70	3.00	1.30
		CR Sugandh Dhan 907 (IET-21044) (CR2616- 3- 3-3-1)	10.00	0.25	-9.75
		CR-1009	2.00	3.00	1.00
		CR-1009 SUB-1	49.75	39.00	-10.75
		CR Dhan-102 (IET-26121)	1.52	1.60	0.08
		CR Dhan-210 (IET-23449)	1.50	1.50	0.00
		CR Dhan-308 (IET-25523)	1.50	1.50	0.00
		CR Dhan 312 CR 3808-13 (IET-25997)	1.50	4.00	2.50
		CR Dhan 602 (IET-26692)	3.55	3.60	0.05
		Geetanjali (CRM-2007-1) (IET-17276)	1.00	1.00	0.00
		Luna Sampad (IET-19470)	1.50	0.15	-1.35
		Luna Suwarna (IET-18697)	1.50	0.15	-1.35
		Luni Sree	0.50	0.80	0.30
		Naveen (CR-749-20-2) (IET-14461)	4.20	4.20	0.00
		Pooja (IET-12241)	0.10	48.40	48.30
		Samba Sub-1 (IET 21248)	23.30	4.06	-19.24
		CR Sugandh Dhan-908 (IET-23189)	1.92	2.00	0.08
		Swarana-Sub 1 (CR2539-1) IET-20266	79.50	78.00	-1.50
		Varshadhan (CRLC-899) (IET-16481)	1.50	4.50	3.00
		Improved Lalat	17.35	9.28	-8.07
		Total	**395.26**	**409.16**	**13.90**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
6	OUAT, Bhubaneswar	Ashuthosh	1.50	1.50	0.00
		Gobinda (OR 2324-8)	1.50	1.50	0.00
		Hasanta	4.70	4.70	0.00
		Kalachampa	45.00	28.00	-17.00
		Lalat (IET-9947)	1.00	1.00	0.00
		Mandakini (OR 2077-4) (IET 17847)	6.20	6.20	0.00
		Mrunalini (OR 1898-18) (IET 18649)	3.00	3.00	0.00
		Parijat (IET-2684)	1.00	1.00	0.00
		Pradeep (IET 20923)	0.10	0.10	0.00
		Pratibha (OR 2172-7) (IET 21582)	1.50	1.50	0.00
		Pratikshya (ORS 201-5) (IET-15191)	19.10	19.10	0.00
		Rani Dhan (IET-19148)	4.00	4.00	0.00
		Total	**88.60**	**71.60**	**-17.00**
7	RARS, Pattambi	Athira (PBT-51)	0.30	1.00	0.70
		Jyothi	10.50	23.21	12.71
		Total	**10.80**	**24.21**	**13.41**
8	PRDF Gorakhpur, Uttar Pradesh	KN3 (Kalanamak)	0.10	0.10	0.00
		Total	**0.10**	**0.10**	**0.00**
9	IGKV, Raipur	Bhadshabhhog Selection-1	25.40	26.60	1.20
		CG Madhuraj Dhan-55	30.00	46.20	16.20
		Chhattisgarh Devbhog	30.00	42.90	12.90
		Chhattisgarh Zinc Rice -1	30.00	32.10	2.10
		Chhattisgarh Zinc Rice-2	30.00	31.20	1.20
		DUBRAJ SELECTION-1	30.50	39.90	9.40
		IGKVR-1 (IET 19569)	63.30	73.50	10.20
		IGKVR-2 (IET 19795)	10.00	12.00	2.00
		Indira Aerobic- 1 (R1570-2649-1-1546-1) (IET 21686)	50.00	58.20	8.20
		Indira Barani Dhan-1 (RF-17-38-70) (IET 21205)	22.00	25.20	3.20
		IR-36	2.60	17.10	14.50
		IR-64	33.10	45.60	12.50
		Mahamaya (IET-10749)	80.00	96.60	16.60
		Maheswari (IGRKVR- 1244) (R 12244-1246-1-605-1) (IET 19796)	15.00	15.00	0.00
		Samaridhi (R-2384)	1.20	0.00	-1.20
		Tarun Bhog Selection-1	30.00	45.20	15.20
		Trombey Chattisgarh Dubraj Mutent-1	30.00	37.20	7.20
		Vishnubhog Selection- 1	25.20	39.60	14.40
		Zinco Rice MS	50.00	63.30	13.30
		Total	**588.30**	**747.40**	**159.10**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
10	IIRR, Hyderabad	Kasturi (IET-8580)	5.00	3.20	-1.80
		BRRIDhan-69	0.10	0.50	0.40
		BRRI Dhan-75 (HUA 565)	4.20	5.00	0.80
		BINA Dhan-10	0.30	0.00	-0.30
		BINA Dhan-11 (Cinerang Sub-1)	31.70	23.50	-8.20
		BINA Dhan-8	0.10	0.00	-0.10
		BINA Dhan-17	9.90	5.40	-4.50
		DRR Dhan 50 (IET 25671) (Drt Tolerent)	21.00	22.00	1.00
		DRR Dhan-45 (IET 23832)	12.20	13.00	0.80
		DRR Dhan-53	11.00	9.00	-2.00
		DRR Dhan-39 (Jagjeevan (IET-19487) RP-4631-46-6- 5-1-1-1)	11.05	7.00	-4.05
		DRR Dhan-42 (IR-64 Drt-1) (RP 5208 - IR-87707-445-B-B)	123.74	125.00	1.26
		DRR Dhan-43	11.20	6.90	-4.30
		DRR Dhan-44	41.20	25.00	-16.20
		DRR Dhan-46	5.70	4.50	-1.20
		DRR Dhan-48	1.20	1.50	0.30
		DRR Dhan-49	0.10	0.50	0.40
		DRR Dhan-51	20.00	20.00	0.00
		DRR Dhan-56	1.50	0.00	-1.50
		Improved Samba Mahsuri	1.00	2.00	1.00
		Jaya	14.65	15.00	0.35
		Total	**326.84**	**289.00**	**-37.84**
11	RARS, Titabar (AAU, Jorhat)	Bahadur Sub-1	15.32	16.30	0.98
		Kanaklata (TTB-103-3- 1) (MGD-103)	0.60	1.20	0.60
		Ranjeet (IET - 12554)	1.70	6.70	5.00
		Ranjit Sub -1	32.40	34.50	2.10
		Disang [Dehangi) (IC-574471)]	2.00	4.80	2.80
		Luit	2.00	5.00	3.00
		Total	**54.02**	**68.50**	**14.48**
12	ARS, Kaul (CCSHAU, Hisar)	Basmati-370	11.50	11.50	0.00
		HKR-127 (HKR-95-222)	4.64	5.00	0.36
		HKR-47	0.43	1.00	0.57
		HKR-48	0.10	0.10	0.00
		Total	**16.67**	**17.60**	**0.93**
13	MPKV, Rahuri (ARS, Rathnagiri)	Bhogavati	0.60	2.90	2.30
		Total	**0.60**	**2.90**	**2.30**
14	BAU, Ranchi	Birsa Vikas Dhan-111 (IET-19848) (PY - 84)	2.10	2.50	0.40
		Birsa Vikas Dhan-203	2.10	3.25	1.15
		Birsa Vikas Sugandha-1 (IET-18941)	5.00	5.50	0.50
		Total	**9.20**	**11.25**	**2.05**
15	ZARS, Mandya (UAS, Bangalore)	BR-2655	0.70	4.00	3.30
		Total	**0.70**	**4.00**	**3.30**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
16	TNAU, Coimbatore	CO 51	33.23	33.23	0.00
		Rice VGD 1	0.10	0.10	0.00
		TM-07278	0.10	0.10	0.00
		TKM 13	0.30	0.30	0.00
		Total	**33.73**	**33.73**	**0.00**
17	CSSRI, Karnal	CSR 56 (IET24537)	2.00	2.45	0.45
		CSR 60 (IET 25378)	5.00	5.60	0.60
		CSR-30	0.08	2.70	2.62
		CSR-36 (Naina) (IET- 17340)	1.00	1.23	0.23
		CSR-43	1.90	2.80	0.90
		Total	**9.98**	**14.78**	**4.80**
18	RRS, Bankura	Dhruba (IET-20761)	4.05	4.05	0.00
		Pushpa (IET 17509)	2.35	1.05	-1.30
		Sampriti (BNKR-B12) (IET-21987)	2.00	2.10	0.10
		Total	**8.40**	**7.20**	**-1.20**
19	PJTSAU, Hyderabad	Erra Mallelu (WGL-20471)	1.00	1.50	0.50
		JGL-1798	0.40	1.00	0.60
		JGL-18047 (Bathukamma)	9.02	10.00	0.98
		JGL-24423	5.00	10.00	5.00
		JGL-17004	1.20	1.20	0.00
		JGL-11727	0.90	1.00	0.10
		JGL 11118 (Anjana)	1.30	1.30	0.00
		KNM-118	28.90	30.00	1.10
		RNR-15048 (Telangana Sona)	43.30	50.00	6.70
		Krishna (RNR-2458)	0.10	0.20	0.10
		Shobhini (RNR-2354) (IET-21260)	0.30	0.50	0.20
		Sugandha Samba (RNR-2465)	0.02	0.10	0.08
		Somnath (WGL-347)	0.10	0.50	0.40
		Tellahamsa	1.00	1.00	0.00
		Telangana Vari-1 (IET25330) (WGL-739)	1.10	1.50	0.40
		WGL-915	1.50	2.00	0.50
		Total	**95.14**	**111.80**	**16.66**
20	UAS, Raichur (ARS, Gangavati)	Gangavati Sona (GGV-05- 01)	0.70	2.50	1.80
		GNV-1089	0.75	1.75	1.00
		Gangavati Ageti (IET-19251)	0.75	1.25	0.50
		Total	**2.20**	**5.50**	**3.30**
21	AAU, Anand (GAU, Nawagam)	GAR-1 (IET 21276)	2.10	1.50	-0.60
		GAR-14	0.50	0.50	0.00
		Mahisagar (IET 22100)	0.50	0.50	0.00
		Total	**3.10**	**2.50**	**-0.60**
22	Chatha J & K (SKUAST, Jammu)	GIZA-14	6.00	1.50	-4.50
		SJR-5 (IET-19972)	15.00	1.50	-13.50
		Total	**21.00**	**3.00**	**-18.00**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
23	ICAR RC NEH Tripura Centre	Gomati Dhan TRC-2005-1 (TRC-05-8-4-42-8-3-7) IET 21512	0.10	0.10	0.00
		Tripura Hakuchuk-2	0.50	0.50	0.00
		Tripura Hakuchuk-1	0.50	0.50	0.00
		TRC 2008-1 (IET22167) Tripura Jala	0.10	0.10	0.00
		Tripura Khara 2 (IET 22835)	0.20	0.20	0.00
		Total	**1.40**	**1.40**	**0.00**
24	BCKV, Nadia	Gontra Bidhan-1 (IET 17430)	6.20	21.30	15.10
		Gontra Bindhan-3 (IET 22752)	20.25	22.10	1.85
		Total	**26.45**	**43.40**	**16.95**
25	RWRS, Malan (CSKHPKV, Palampur)	HPR 2143	10.00	11.50	1.50
		HPR-2656	15.00	16.50	1.50
		HPR-2795	10.00	15.45	5.45
		HPR-2880	10.00	15.00	5.00
		Sukha Dhan-5	0.10	1.00	0.90
		Total	**45.10**	**59.45**	**14.35**
26	BHU, Varanasi	HUR-917	2.50	14.00	11.50
		Total	**2.50**	**14.00**	**11.50**
27	ARS, Mugad	IET- 24451	0.25	0.00	-0.25
		KMD-2 (Abhilash)	0.75	2.00	1.25
		Intan	0.50	2.00	1.50
		Total	**1.50**	**4.00**	**2.50**
28	IARI-RS, Karnal	Improved Pusa Basmati-1 (IET - 18990) (PUSA 1460-01-32-6-7-67)	0.10	0.10	0.00
		Pusa Basmati-1(IET 10364)	0.08	10.00	9.92
		Pusa Basmati 1637 (IET 24570)	14.68	14.68	0.00
		Pusa Basmati 1728	6.00	9.00	3.00
		Pusa Basmati-1718 (IET 24565)	62.03	26.00	-36.03
		Pusa Basmati-6 (PUSA 1401) (IET - 18005)	21.22	22.00	0.78
		Pusa Basmati 1692 (IET 26995)	20.98	22.00	1.02
		Pusa-44	0.08	0.08	0.00
		Total	**125.17**	**103.86**	**-21.31**
29	IARI, New Delhi	Pusa-2511	0.05	0.00	-0.05
		Pusa Sugandh-5 (IET - 17021)	15.00	0.00	-15.00
		Total	**15.05**	**0.00**	**-15.05**
30	JNKVV, Jabalpur	Improved Chinnor	7.60	13.50	5.90
		Improved Jeera Shankar	13.10	18.00	4.90
		JR-767	16.50	27.82	11.32
		JR-81	45.00	128.48	83.48
		JR-206	34.00	90.00	56.00
		JRB-1	25.00	90.00	65.00
		Kranti (R-2022)	0.60	50.00	49.40
		Rashmi(JR-201)	7.50	6.21	-1.29
		Total	**149.30**	**424.01**	**274.71**
31	ARS, Vadagon (MPKV, Rahuri)	Indrayani (IET - 12897)	24.00	70.00	46.00
		Total	**24.00**	**70.00**	**46.00**

Appendices

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
32	NDUAT, Faizabad	IR-64 Sub-1 (IET - 21247)	9.50	1.50	-8.00
		Narendra Dhan-97	0.05	28.00	27.95
		Sarjoo-52	1.10	160.40	159.30
		NDR 9930111	3.00	1.80	-1.20
		Total	**13.65**	**191.70**	**178.05**
33	Khudwani, J & K (SKUAST, Srinagar)	K 39	3.00	3.00	0.00
		K-448	3.00	3.00	0.00
		Shalimar Rice -2	3.60	3.60	0.00
		Total	**9.60**	**9.60**	**0.00**
34	UAHS, Shivamogga, Karnataka	KKP-5 (IET - 24250)	2.10	2.10	0.00
		KHP-11	0.25	0.25	0.00
		KHP-13	0.50	0.50	0.00
		KPR-1	0.25	0.25	0.00
		Sahyadri Megha	1.25	1.00	-0.25
		Sahyadri Panchamuk	0.50	0.50	0.00
		Tunga (IET-13901)	5.85	5.85	0.00
		Total	**10.70**	**10.45**	**-0.25**
35	RARS, Karjat (BSKKV, Dapoli)	Karjat-3	3.50	4.50	1.00
		Karjat-5	1.20	1.65	0.45
		Karjat-7	2.00	5.00	3.00
		Karjat-8	0.92	1.50	0.58
		Karjat-9	1.00	2.00	1.00
		Total	**8.62**	**14.65**	**6.03**
36	Arundhutinagar, Tripura	Khowai TRC-2005-3 (TRC- 05-2-6-4-39-3-6) IET 21564	0.10	0.00	-0.10
		Total	**0.10**	**0.00**	**-0.10**
37	RRS, Moncompu (KAU, Thrissur)	MO 21 (Pratiksha)	1.00	4.35	3.35
		Bhadra (MO-4)	2.75	2.75	0.00
		Uma (MO-16)	27.25	28.00	0.75
		Total	**31.00**	**35.10**	**4.10**
38	GBPUAT, Pantnagar	Pant Dhan-18 (IET17920) (UPRI 99-1)	1.00	6.00	5.00
		Pant Dhan-24	11.20	40.00	28.80
		Pant Dhan-26	0.30	6.00	5.70
		Total	**12.50**	**52.00**	**39.50**
39	ARS, Sindewahi (PDKV, Akola)	PDKV Tilak (SYE-503-78- 34-2)	1.60	20.00	18.40
		PKV HMT	43.20	43.20	0.00
		PKV Kisan	1.60	10.00	8.40
		Sakoli-9	0.30	15.00	14.70
		Total	**46.70**	**88.20**	**41.50**
40	PAU, Ludhiana	PR 121	39.29	45.00	5.71
		PR 122	14.58	15.00	0.42
		PR 127	4.94	5.00	0.06
		PR-113	3.38	6.00	2.62
		PR-114	0.72	4.00	3.28
		PR-124	3.84	6.00	2.16
		PR-126	55.14	60.00	4.86
		PR-128	0.44	3.00	2.56
		PR-129	0.28	3.00	2.72
		Punjab Basmati 4	0.04	0.10	0.06
		Punjab Basmati 5	0.04	0.10	0.06
		Total	**122.69**	**147.20**	**24.51**

S. No.	Centre Name	Variety	Allocation (q)	Production (q)	Surplus/ deficit (q)
41	BEDF, New Delhi	Pusa - 1121 (Pusa Sugandh-4)	12.12	0.00	-12.12
		Pusa Basmati-1509 (IET 21960) (Pusa 1509-03-3-9-5)	106.23	0.00	-106.23
		Total	**118.35**	**0.00**	**-118.35**
42	RPCAU, Pusa	Rajendra Bhagvati	14.95	27.00	12.05
		Rajendra Kasturi	13.00	12.16	-0.84
		Rajendra Sweta	20.95	20.70	-0.25
		Rajendra Neelam	30.00	29.88	-0.12
		Rajshree (TCA-80-4) (IET 7970)	0.05	5.00	4.95
		Total	**78.95**	**94.74**	**15.79**
43	ARS, Shirgoan (BSKKV, Dapoli)	Ratnagiri-6	1.00	2.00	1.00
		Ratnagiri-7	0.60	1.00	0.40
		RTN-5	2.00	2.50	0.50
		RTN-8	0.30	2.00	1.70
		Total	**3.90**	**7.50**	**3.60**
44	BAU, Sabour	Sabour Shree (RAU 724- 48-33) (IET 18878)	60.60	78.00	17.40
		Sabour Deep	35.00	40.00	5.00
		Sabour Harshit Dhan (IET-25342)	0.10	8.00	7.90
		Sabour Sampann	20.00	25.00	5.00
		Sabour Surbhit	10.00	14.00	4.00
		Total	**125.70**	**165.00**	**39.30**
45	ICAR RCER Patna, Bihar	Swarna Samridhi	15.00	35.40	20.40
		Swarna Shakti Dhan (IET-25640)	10.00	24.90	14.90
		Swarna Shreya	24.50	38.50	14.00
		Total	**49.50**	**98.80**	**49.30**
46	SHIATS, Prayagraj	Shiats Dhan -1 (AAIR 2) (IET-20928)	2.50	0.00	-2.50
		Shiats Dhan 5	2.00	0.00	-2.00
		Shiats Dhan-4	12.00	0.00	-12.00
		Total	**16.50**	**0.00**	**-16.50**
47	ZARS, Mandya (UAS, Bangalore)	Thanu	2.10	4.00	1.90
		Total	**2.10**	**4.00**	**1.90**
48	UBKV, Pundibari	Uttar Sona (UBKVR-1) (IET-24171)	2.70	18.00	15.30
		Uttar Lakshmi (UBKVR-15) (IET 24173)	2.10	12.00	9.90
		Total	**4.80**	**30.00**	**25.20**
49	VPKAS, Almora	VL Dhan 157 (VL 31611) (IET 22292)	2.50	1.00	-1.50
		VL Dhan 68 (VL 31611) (IET 22283)	3.00	3.00	0.00
		VL Dhan 85 (IET-16455) (VL-3613)	0.60	1.50	0.90
		VL 88	3.00	5.50	2.50
		Total	**9.10**	**11.00**	**1.90**
		Total (A)	**3598.37**	**4446.06**	**847.69**

Hybrids/Parental lines

S. No.	Centre Name	Hybrid/Parental Lines	Allocation(q)	Production (q)	Surplus/ deficit (q)
1	UAS, Bengaluru	KRH 2 A-line	0.10	**0.50**	**0.40**
		KRH 2 B-line	0.10	**0.50**	**0.40**
		KRH 2 R-line	0.10	**2.00**	**1.90**
		TOTAL (B)	**0.30**	**3.00**	**2.70**
	Grand Total		**3598.67**	**4449.06**	**850.39**

Appendix 4

List of Institute Research Projects 2022

Project Code	Project Title	Pi	Co-Pis
CROP IMPROVEMENT			
PLANT BREEDING			
GEQ/CI/ BR/8	Enhancing nutritional quality of rice through bio-fortification	Dr L V Subba Rao	Dr G Padmavathi, Dr CN Neeraja Dr J Aravind Kumar, Dr AVSR Swamy Dr T Longvah (NIN)
GEY/CI/BR/26	Breeding for high yielding short duration and water use efficient rice hybrids and varieties	Dr AVSR Swamy	Dr R M Sundaram, Dr M Seshu Madhav Dr R Mahender Kumar Dr P Senguttuvel, Dr Jyothi Badri Dr R Abdul Fiyaz, Dr D Subrahmanyam
GEY/CI/BR/31	Breeding for high yielding, medium to late maturing rice varieties with tolerance to biotic stresses and good grain quality Breeding for high yielding, medium to late maturing rice varieties with tolerance to biotic stresses and good grain quality	Dr S V Sai Prasad	Dr AVSR Swamy Dr J Arvind Kumar Dr M. Srinivas Prasad Dr V Jhansi Lakshmi
GEY/CI/ BR/16	Traditional and molecular approaches for breeding improved rice varieties with resistance to planthoppers	Dr G Padmavathi	Dr V Jhansi Lakshmi, Dr M Sheshu Madhav, Dr C Gireesh, Dr ADVSLP Ananda Kumar (APRRI, Maruteru)
GEQ/CI/ BR/9	Development of Rice Cultivars with High Grain Protein Content and Quality Traits	Dr J Aravind Kumar	Dr LV Subba Rao, Dr D Subramanyam Dr R Abdul Fiyaz, Dr Jyoti Badri Dr Ch Suvarna Rani
GEY/CI/BR/29	Genetic Improvement of Direct Seeded Rice Traits Using Elite Varieties and Wild Species	Dr C Gireesh	Dr R M Sundaram, Dr L V Subba Rao Dr Sheshu Madhav, Dr M S Anantha Dr B Divya, Dr P Senguttuvel Dr R Mahendra Kumar, Dr B Sreedevi Dr K Basavaraj, Dr K B Kemparaju
GEY/CI/ BR/27	Novel Genetic approaches for development of Climate Smart Rice Varieties	Dr Suneetha Kota	Dr G Padamavathi, Dr P Senguttuvel Dr C Gireesh, Dr R M Sundaram Dr Santosha Rathod, Dr Akshay S. Sakhare Dr Brajendra, Dr M D Tuti Dr S K Mangrauthia, Dr Viswanathan C Dr Girija Rani, Dr Krishnamurthy SL Dr Manohar K K
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	Dr LV Subba Rao, Dr Divya Balakrishnan Dr J Aravind Kumar, Dr P Revathi Dr P Raghuveer Rao, Dr V Prakasam Dr Ch Padmavathi, Dr B Sreedevi Dr Ch Suvarna Rani

Appendices

Project Code	Project Title	Pi	Co-Pis
GEY/CI/ BR/24	Breeding high yielding rice cultivars tolerant to low phosphorus and nitrogen	Dr M S Anantha	Dr C Gireesh, Dr R M Sundaram Dr P Senguttuvel, Dr R Mahender Kumar Dr K Surekha, Dr Brajendra Dr Raghuveer Rao, Dr P C Latha Dr Aarthi Singh, Dr Ch Suvarna Rani
GEY/CI/ BR/28	Genetic Enhancement of Speciality Rices of India	Dr R Abdul Fiyaz	Dr R M Sundaram, Dr J Aravind Kumar Dr MM Azam, Dr K Basavaraj Dr LV Subba Rao, Dr Suvarna Rani Ch
GEY/CI/BR/30	Breeding high yielding stress tolerant rice varieties using interspecific wild introgression lines derived from *Oryza nivara* and *Oryza rufipogon*	Dr Divya Balakrishnan	Dr G Padmavathi, Dr Jyothi B Dr C Gireesh, Dr Ladha Lakshmi Dr M B Kalyani
GEQ/CI/ BR/10	Breaking the yield plateau in native aromatic short and medium grain rice through classical and molecular breeding	Dr Suvarna Rani Chimmili	Dr LV Subba Rao, Dr G Padmavathi Dr M Sheshu Madhav Dr J Aravind Kumar, Dr Jyothi Badri Dr Divya Balakrishnan, Dr M S Anantha Dr C Gireesh
HYBRID RICE			
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	Dr P Senguttuvel, Dr P Revathi Dr KB Kemparaju, Dr K Sruthi Dr RM Sundaram
GEY/CI/HY/15	Genetic enhancement of hybrid rice parental lines suitable for aerobic and tolerance to salinity conditions through conventional and molecular approaches	Dr P Senguttuvel	Dr AS HariPrasad, Dr RM Sundaram Dr P Revathi, Dr KB Kemparaju Dr K Sruthi, Dr Sheshu Madhav Dr B Sreedevi, Dr K Suneetha Dr C Gireesh, Dr MS Anantha Dr G Padmavathi, Dr Mahender Kumar Dr R Gopinath, Dr N Somasekhar Dr D Subrahmanyam
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	Dr K Sruthi, Dr S K Mangrauthia Dr Jyothi Badri, Dr Divya Balakrishnan Dr M. Srinivas Prasad Dr V Jhansi lakshmi
GEY/CI/HY/16	Genetic improvement of maintainer lines for biotic stress and yield enhancing genes	Dr K B Kemparaju	Dr Sruthi K, Dr AS Hari Prasad Dr P Senguttuvel, Dr R Abdul Fiyaz Dr M Sheshu Madhav
GEY/CI/HY/14	Establishment and validation of heterotic gene pools in hybrid rice	Dr K Sruthi	Dr AS Hari Prasad, Dr P Senguttuvel Dr P Revathi, Dr B Kemparaju Dr R M Sundaram

Project Code	Project Title	Pi	Co-Pis
BIOTECHNOLOGY			
ABR/CI/BT/6	Identification of genes for grain filling in rice (*Oryza sativa* L.)	Dr CN Neeraja	Dr L V Subba Rao, Dr M Sheshu Madhav Dr D Sanjeeva Rao, Dr Kalyani M B
ABR/CI/BT/17	Application of genomic, transcriptomic and proteomic tools for understanding and improvement of yield heterosis in rice hybrids	Dr R M Sundaram	Dr C N Neeraja, Dr A S Hariprasad Dr K Sruthi, Dr P Senguttuvel Dr S K Mangrauthia, Dr Kalyani M B Mr P Koteshwara, Dr T M Gireesha
ABR/CI/BT/16	Exploring the mutant resources for rice improvement	Dr M Sheshu Madhav	Dr R M Sundaram, Dr Kalyani MB Dr D Sanjeeva Rao, Dr B Sreedevi Dr P Senguttuvel, Dr LV Subba Rao Dr C Gireesh, Dr AP Padma kumari Dr Jhansi Lakshmi, Dr Ch Padmavathi Dr Y Sridhar, Dr GS Laha Dr MS Prasad, Dr Ladha Lakshmi
ABR/CI/BT/18	Genomics and genome editing approaches for abiotic stress tolerance (low P and heat), biotic stress tolerance (sheath blight and bacterial blight) and yield improvement of rice	Dr S K Mangrauthia	Dr R M Sundaram, Dr C N Neeraja Dr G S Laha, Dr Brajendra Dr P Revathi, Dr Akshay Sakhare Dr V Prakasam
ABR/CI/BT/19	Elucidation of long non-coding RNAs and association of molecular markers for important root traits under aerobic condition	Dr Kalyani M Barbadikar	Dr. M. Seshu Madhav, Dr S K Mangrauthia Dr C N Neeraja, Dr R M Sundaram Dr P Senguttuvel
CROP PRODUCTION DIVISION			
AGRONOMY			
RUE/CP/AG/14	Strategic research on enhancing water Use efficiency and productivity in irrigated rice system	Dr R Mahender Kumar	Dr K Surekha, Dr B Sreedevi Dr Ch Padmavthi, Dr M. Srinivas Prasad Dr V Prakasham, Dr N. Somashekhar Dr B Nirmala, Dr Amtul Waris Dr AVS Swamy, Dr Senguttuvel P Dr C. Kannan, Dr Vidhan Singh T Dr Y Sreedhar, Dr Bandeppa Dr MBB Prasad Babu, Dr DVK Nageswar Rao Dr K Srinivas (CRIDA), Pranaadhara – A. P
RUE/CP/AG/13	Development of Climate smart and economic weed management technologies for changing rice establishment systems	Dr B Sreedevi	Dr Mahender Kumar Dr N Somasekhar Dr P Senguttuvel Dr M D Tuti

Appendices

Project Code	Project Title	Pi	Co-Pis
SSP/CP/AG/15	Sustainable intensification of conservation agriculture practices in rice-maize system to enhance system productivity in Southern India	Dr Mangal Deep Tuti	Dr R Mahender Kumar, Dr B Sreedevi Dr S Vijayakumar, Dr B Nirmala Dr Bandeppa
RUE/CP/AG/ 18	Precision farming technologies to increase the resilience of rice production under changing climate scenarios	Dr S Vijayakumar	Dr B Sailaja, Dr R M Kumar Dr D V K Nageswara Rao, Dr B. Sreedevi Dr M D Tuti, Dr R Gobinath Dr M B B Prasad Babu Dr Santosha Rathod Dr S Pazhanivelan Dr N S Sudarmanian
SOIL SCIENCE			
SSP/CP/SS/11	Assessment of Genotypic variability in nitrogen use efficiency and improving NUE in irrigated rice	Dr K Surekha	Dr D V K Nageswara Rao Dr V Manasa Dr R Gobinath, Dr R M Kumar Dr C N Neeraja, Dr M M Azam
CCR/CP/ SS/17	Studies on emission of greenhouse gases (GHGs) from rice soils and their mitigation	Dr M B B. Prasad Babu	Dr R Mahender Kumar, Dr PC Latha Dr Brajendra
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	Dr K Surekha, Dr R Mahender Kumar Dr B Sridevi, Dr Ch Padmavati Dr V Prakasam, Dr Santosha Rathod
SSP/CP/SS/18	Studies on Soil Organic Carbon Status, Mapping and stocks in Rice Soils of India	Dr Brajendra	Dr B Sailaja Dr MBB Prasad Babu Dr P Muthuraman
SSP/CP/SS/19	Prospecting endophytic actinobacteria of rice for sustainable rice production	Dr PC Latha	Dr Bandeppa Dr MBB Prasad Babu
SSP/CP/SS/15	Microbial population dynamics in different rice establishment method in relation to nutritional availability and acquisition	Dr Bandeppa	Dr P C Latha, Dr K Surekha Dr M D Tuti, Dr Kalyani M B
RUE/CP/SS/19	Evaluation of ZnO nanoparticles on performance of rice	Dr Gobinath, R	Dr Manasa, Dr K Surekha Dr PC Latha, Dr S Vijayakumar
RUE/CP/SS/21	Exploiting legacy phosphorus and enhancing phosphorus use efficiency in irrigated rice	Dr V Manasa	Dr R Gobinath, Dr K Surekha Dr P C Latha, Dr Bandeppa Dr M D Tuti, Dr M M Azam
PLANT PHYSIOLOGY			
CCR/CP/PP/11	Evaluation of genotypic variability in leaf photosynthetic efficiency and its associated factors in rice	Dr. D Subrahmanyam	
CCR/CP/PP/12	Role of Silicon in inducing abiotic stress tolerance in rice	Dr P Raghuveer Rao	Dr M M Azam, Dr D Sanjeeva Rao Dr M D Tuti

Project Code	Project Title	Pi	Co-Pis
CCR/CP/PP/13	Deciphering physiological basis of heat stress tolerance in rice	Dr Akshay S. Sakhare	Dr P Raghuveer Rao, Dr Sanjeev Rao Dr Suneetha Kota, Dr P Senguttuvel Dr Kalyani M B, Dr Brajendra Dr M D Tuti
GEQ/CP/PP/1	Selective biochemical and molecular analysis of natural and accelerated ageing in rice	Dr D Sanjeeva Rao	Dr P Raghuveer Rao, Dr M Sheshu Madhav Dr P Senguttuvel, Dr J Arvind Kumar Dr AVSR Swamy
AGRICULTURAL ENGINEERING			
RUE/CP/ENG/6	Selective mechanization in rice cultivation	Dr T Vidhan Singh	Dr R Mahender Kumar Dr B Nirmala
COMPUTER APPLICATIONS			
TTI/CP/CA/5	Smart precision models and Mobile Apps for real time advisories on Rice crop Management	Dr B Sailaja	Dr D Subrahmanyam Dr K Surekha, Dr Ch Padmavathi Dr Brajendra, Dr Santosha Rathod
AGRICULTURAL CHEMICALS			
RUE/CP/AC/1	Post-Harvest Treatment of Rice and Rice By-Products for Health Benefits and on-farm application	Dr M.M. Azam	Dr P C Latha, Dr R Mahendra Kumar Dr Amtul Waris, Dr T Vidhan Singh Dr D Sanjeeva Rao, Dr R. Abdul Fiyaz Dr AP Padmakumari, Dr MS Prasad Dr GS Laha, Dr V Prakasam Dr K Surekha, Dr V Manasa Dr Aparna Kuna
CROP PROTECTION			
IPM/CPT/ENT/21	Botanicals for sustainable management of major pests of rice	Dr B Jhansi Rani	Dr Chitra Shanker, Dr M M Azam Dr M Srinivasa Prasad
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	Dr D Sanjeeva Rao Dr Y Sreedhar
IPM/ CPT/ ENT/29	Studies on Plant Nematode Interactions in Diverse Rice Phytobiomes	Dr N Somasekhar	Dr P Senguttuvel Dr PC Latha Dr Sanjeeva Rao
HRI/ CPT/ ENT/23	Understanding the interaction of internal feeders – stem borers and gall midge with rice for their management	Dr A P Padmakumari	Dr Y Sreedhar, Dr D Subramanyam Dr K Suneetha, Dr R M Sundaram Dr M Seshu Madhav
IPM/CPT/ENT/30	Enhancing biological control of rice pests through Chemical ecology	Dr Chitra Shanker	Dr B Jhansi Rani, Dr M Azzam Dr Ch Padmavathi Dr N Somasekhar, Dr C Kannan

Project Code	Project Title	Pi	Co-Pis
HRI/CPT/ENT/ 27	HPR to rice leaf folder and Semiochemical approaches for the management of insect pests of rice	Dr Ch Padmavathi	Dr Y Sridhar Dr Divya Balakrishnan Dr MM Azam
IPM/CPT/ ENT/28	Bio efficacy and toxicological studies of insecticides against insect pests of rice.	Dr Y Sridhar	Dr V Jhansi Lakshmi Dr A P Padma Kumari, Dr Chitra Shanker Dr Ch Padmavathi
IPM/CPT/ENT/ 25	Development of Entomopathogenic Nematodes (EPN) for Biointensive Integrated Pest Management in Rice	Mr Satish N Chavan	Dr N Somasekhar Dr A P Padmakumari Dr C Kannan
PLANT PATHOLOGY			
HRP/CPT/ PATH/15	Assessment of host plant resistance to rice blast disease and its management	Dr M S Prasad	Dr V Prakasam, Dr M S Madhav Dr Divya Balakrishnan Dr Basavaraj, Dr G S Jasudasu
HRP/CPT/ PATH/13	Assessment of resistant sources and monitoring of pathogen virulence in bacterial leaf blight of rice	Dr G S Laha	Dr D. Krishnaveni Dr D Ladhalakshmi, Dr R M Sundaram Dr S K Mangrauthia
HRP/CPT/ PATH/14	Assessment of host plant resistance and development of diagnostic tools for rice tungro virus disease	Dr D Krishnaveni	Dr GS Laha, Dr C N Neeraja Dr Chitra Shanker, Dr S K Mangrauthia Dr D Ladhalakshmi
HRP/CPT/ PATH/20	Bioformulations of antagonistic microbes for disease management in rice	Dr C Kannan	Dr V Prakasam Dr Chitra Shanker Dr P C Latha Dr P Senguttuvel
HRP/CPT/ PATH/23	Variability in *Ustialginoidea virens* and management of false smut disease	Dr D Ladhalakshmi	Dr G S Laha, Dr D. Krishnaveni Dr C Kannan, Dr V Prakasam Dr K Basavaraj Dr Divya Balakrishnan, Dr Sanjeeva Rao
HRP/ CPT/ PATH/22	Population dynamics of Rhizoctonia solani and sustainable management of rice sheath blight disease	Dr V Prakasam	Dr M S Prasad, Dr G S Laha Dr D Ladhalakshmi Dr Jyothi Badri
HRP/CPT/ PATH/24	Survey, host plant resistance to brown spot disease of rice and its management	Dr K Basavaraj	Dr M Srinivas Prasad, Dr G S Laha Dr D Ladhalakshmi, Dr V Prakasam Dr G S Jasudasu, Dr C Gireesh Dr Divya Balakrishnan
HRP/CPT/ PATH/25	Host plant resistance and Characterization of pathogens of Sheath rot and Stem rot diseases of Rice	Dr G S Jasudasu	Dr G S Laha, Dr M Srinivas Prasad Dr V Prakasam, Dr K Basavaraj Dr D Ladhalakshmi, Dr D Krishnaveni
TRANSFER OF TECHNOLOGY & TRAINING			
TTI/TTT/ EXT/15	Climate change and rice farming: Farmers perception and adaptation strategies	Dr P Muthuraman	Dr Shaik N Meera, Dr S Arun Kumar Dr P Jeyakumar, Dr Brajendra

Appendices

Project Code	Project Title	Pi	Co-Pis
TTI/TTT/ EXT/12	Smart village(s) strategy for accelerated rice technology transfer	Dr Amtul Waris	Dr P Muthuraman, Dr Shaik N Meera Dr P Jeykumar, Dr PA Lakshmi Prasanna Dr B Nirmala, Dr S Arun Kumar Dr S Rathod, Dr K Surekha Dr C N Neeraja, Dr Chitra Shanker Dr Jyothi Badri, Dr Jhansi Lakshmi
TTI/TTT/ EXT/18	Impact Acceleration with Digital Extension Ecosystem for Rice Farmers	Dr S N Meera	Dr Arun Kumar S Dr Santosha Rathod
TTI/TTT/ EXT/13	On-Farm Adoption of IPM Technologies and impact analysis	Dr P Jeyakumar	Dr Ch Padmavathi, Dr P Muthuraman Dr Amtul Waris, Dr S Arun Kumar Dr Santosha Rathod
TTI/TTT/ ECON/3	IPR - Competition interaction in rice seed sector – Emerging scenario-implications for enhancing quality seed use.	Dr P A Lakshmi Prasanna	Dr L V Subba Rao, Dr A S Hari Prasad Dr Amtul Waris, Dr S N Meera Dr B Nirmala Dr S Arun Kumar
TTI/TTT/ ECON/4	Economics, Energy and Sensitivity Analysis of selected Rice production technologies	Dr B. Nirmala	Dr P Muthuraman, Dr Amtul Waris Dr R Mahender Kumar Dr A S Hari Prasad, Dr T Vidhan Singh Dr P Senguttuvelu
TTI/TTT/ EXT/14	Innovations in group-based extension approaches: Accelerating rice technology transfer through farmer-based organisations	Dr S. Arun Kumar	Dr S N Meera, Dr Amtul Waris Dr P Jeya Kumar, Dr P Muthuraman Dr PA Lakshmi Prasanna, Dr LV Subba Rao
TTI/TTT/ STAT/4	Statistical modeling and soft computing approaches for genomic selection in Rice	Dr Santosha Rathod	Dr C N Neeraja, Dr R M Sundaram Dr C Gireesh Dr P Senguttuvel

Appendix 5

Newly Sanctioned Externally Funded Projects During 2022

S. No.	Title	Principal Investigator	Funding Agency	Duration	Budget Sanctioned (Lakhs)
1	Evaluating IoT enabled AWD system for reducing GHG emissions and enhancing sustainability of rice production.	Dr Mahender Kumar	CULTVATE	2022-23	16.26
2	SERB-National Post Doctoral Fellowship to Dr Anil Arjun Hake under mentorship of Dr Sheshu Madhav	Dr Sheshu Madhav	SERB	2022-24	22.37
3	Genomic selection for development of rice genotypes tolerant to low phosphorous.	Dr Anantha MS	SERB	2022-25	35.54
4	Nanoscale Zeolite-Zinc-Carbo-Mycolizers (Zin Carbolyzers) to improve productivity of rice	Dr Kannan C	DBT	2022-25	67.85
5	Evaluation of nano Urea spray in irrigated rice	Dr R Gobinath	Coramandel	2022-24	12.67
6	Identification of SNP haplotype associated with starch synthesizing genes for assessing the cooking quality of rice- Samba Mahsuri mutant lines	Dr Sheshu Madhav/ Dr Shiromani WOS	DST-WOS-A	2022-25	22.13
7	KARYASHALA on Statistical and Machine Learning Techniques for Agricultural Systems Modeling and Forecasting using R	Dr Santhosha Rathod	SERB	2022-23	5.00
8	Evaluation of NBPT (N-Butyl-Thiophosporic Triamide) combined with urea on productivity and nitrogen use efficiency in irrigated rice	Dr Surekha	Balaji Amines Ltd	2022-23	3.65
9	Evaluation of microbial consortiumAG/MB/PTO5.01/02 (Organica Biotech) on productivity and quality parameters of wet direct seeded rice	Dr Mahender Kumar	Organica Biotech Pvt. Ltd	2022-24	8.50
10	Enrichment of iron and calcium in the grains of rice (*Oryza sativa* .L) by Bio fortification using micron sized nutrient particles	Dr AVSR Swamy	Biofac Inputs Private Limited	2022-24	13.50
11	Evaluation of N-CARB in irrigated rice	Dr Brajendra	Nutralytica Research Private Ltd	2022-23	3.58
12	Deciphering and deploying low phosphorus tolerance and nitrogen use efficiency in rice using targeted genomics approach	Dr C N Neeraja	NASF	2022-25	69.44
13	Response of Poly 4 (Di Hydrate Polyhalite) fertilizer on growth, Yield and Soil health of irrigated rice crop.	Dr Surekha & Dr Gobinath	M/s Sirius Minerals Pvt. Ltd	2022-24	12.95
14	Bioefficacy of "ME5382 2% GR" against insect pests of paddy	Dr Y Sridhar	UPL Ltd	2022-24	5.95
15	Resistance Monitoring Study for Rice Sheath blight Pathogen (Rhizoctonia solani) against azoxystrobin fungicide	Dr Prakasam	Syngenta India Ltd	2022-24	23.91

S. No.	Title	Principal Investigator	Funding Agency	Dura-tion	Budget Sanctioned (Lakhs)
16	Evaluation of CSIR-NBRI Bioformulations	Dr C Kannan	CSIR-NBRI	2022-23	3.54
17	Evaluation of Nano Bio Tech Capsule in Irrigated Rice - Krishna Agro Bio Products	Dr P C Latha	Krishna Agro Bio Products	2022-24	3.54
18	Allele mining for the epigenetic regulator NGR5 and other yield-associated genes (GRF4) and their modulation using multiple genomic and molecular approaches to enhance rice yield under low nitrogen conditions	Dr S K Mangrauthia	NASF	2022-25	44.15
19	CRISPR Crop Network: Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing	Dr S K Mangrauthia	NASF	2022-25	49.50
20	Evaluation and Validation of ALDOR in irrigated rice for enhancing yield and nutrient use efficiency	Dr Mahender Kumar/ Vijay Kumar	M/s Sirius Minerals Pvt. Ltd.	2022-23	15.24
21	Evaluation of TERI Nano Urea in irrigated rice	Dr Manasa	TERI-Deakin Nano biotechnology center	2022-24	5.31
22	Identification and characterization of fungal effectors and host factors in rice-false smut pathosystem	Dr Ladha Lakshmi	NASF	2022-25	236.91
23	Evaluation of isotianil 120 G/L + Trifloxystrobin 100G/L SC on rice crop against bacterial leaf blight, leaf blast and dirty panicle.	Dr G S Laha	Bayer Crop Science Ltd.	2022-24	11.33
24	Evaluation of propineb 70% WG on rice crop against leaf blast and brown spot.	Dr Jesudasu Gompa	Bayer Crop Science Ltd.	2022-24	8.50
25	Evaluation of Penflufen 240 g/l fs (Emesto Prime) against sheath blight of rice.	Dr V Prakasam	Bayer Crop Science Ltd.	2022-24	12.74
	Total				**~ 714.04**

Appendix 6

Ongoing Externally Funded Projects 2022

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
1.	ICAR-Consortia Research Platform on Molecular Breeding in crops	RM Sundaram (PI) LV Subba Rao R Abdul Fiyaz C Gireesh MS Anantha P Senguttuvel MS Madhav MS Prasad GS Laha AP Padmakumari V Jhansi Lakshmi	ICAR	2017-22	68.32	The popular, bacterial blight resistant (possessing the resistance genes *Xa21, xa13* & *xa5*), high-yielding, fine-grain variety, Improved Samba Mahsuri has been improved for its resistance against blast (*Pi2* + *Pi54*) and BPH (*Bph33*), tolerance to salinity (*Saltol*) and low soil phosphorus (*Pup1*). Transfer of gall midge resistance genes (*Gm4* + *Gm8*) has been recently completed. Two varieties, *viz.*, DRR Dhan 58 and DRR Dhan 60 have been developed in the genetic background of Improved Samba Mahsuri and possessing *Saltol* and *Pup1*, respectively have been developed and released by CVRC.
2.	ICAR Plan - Sub-project IV: Molecular genetic analysis of resistance/tolerance to different stresses in rice, wheat, chickpea and mustard including sheath blight complex genomics	G S Laha (PI) R M Sundaram V Prakasam Jyothi Badri D Ladhalakshmi Divya Balakrishnan	ICAR	2017-22	125.00	**Sheath blight:** Out of 217 entries screened artificially, 100 entries showed tolerance to sheath blight. About 30 germplasm with highly tolerant to sheath blight RILs population (177) of IR 64 X Gumdhan (F_8) and 342 RILs of ISM and Phougak (F_5) were screened. Crosses were made between DRR Dhan 48 and four donors (IET 27118, 22272, 25157 & 24518) identified from repeated screening since 2013. From two crosses, DRR Dhan 48/ IET 28305 and DRR Dhan 52/IRGC 132408, F_2 populations were screened and selected 235 and 20 single plants respectively with sheath blight tolerance. **False smut:** Mapping population of 200 lines from F_3 generation developed from the crosses HWR36 (NPT x *O. longistamina*)/Samba Mahsuri (100 lines) and HWR42 (NPT x *O. officinalis)* were screened by injection method of inoculation. Among them, lines *viz* 182, 184, 185, 190, 587, 588 and 596 showed tolerant reactions.

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
3.	Imparting sheath blight resistance in rice (A DBT flagship project)	RM Sundaram (PI) C Kannan V Prakasam GS Laha	DBT	2019-22	108.00	Five major sheath blight QTLs were identified from the ISM / WZK RILs population (*OsSBQTL1.1, OsQTL4.1, OsQTL6.1, OsQTL11.1*, and *OsQTL11.2 OsSBQTL1.1, OsQTL4.1, OsQTL6.1, OsQTL11.1* and *OsQTL11.2*) in chromosome 11 (LOD > 26%) from the Indian land race, Wazuhophek. *R. solani* isolates (n = 32) were characterized. All 32 isolates were genome sequenced with 350 x throughput to produce 700.853 Gb sequence data. 5,046,121 SNPs were obtained by physically mapping the reads on the presently assembled BRS1 genome. A principal component analysis (PCA) based on the genomic distance divided the isolates into three different groups and a subgroup of admixture between group I and group II, suggesting natural hybridization among the isolates.
4.	Development of climate resilient lines of the bacterial blight resistant and low glycemic index rice variety, Improved Samba Mahsuri	RM Sundaram (PI) GS Laha LV Subba Rao MS Prasad MS Madhav R Abdul Fiyaz P Senguttuvel	CSIR (Under FTT Scheme)	2019-22	86.26	The elite rice variety, Improved Samba Mahsuri has fortified with genes/QTLs conferring resistance against bacterial blight and blast along with drought and submergence tolerance QTLs
5.	Mainstreaming rice landraces diversity in varietal development through genome wide association studies: A model for large-scale utilization of genebank collections of rice	C N Neeraja (PI) L V Subba Rao (PI) C Gireesh M S Anantha D Ladha Lakshmi A Fiyaz	DBT Net work	2020-25	143.36	Out of 500 genotypes evaluated under low phosphorus field plot during *kharif* 2022, 19 accessions were identified to be promising for tiller number, yield and phenotyping scoring. Four landraces have not shown Pup1 allele, thus F1s were generated with ISM. Out of 457 genotypes evaluated during *kharif* 2022 for false smut under artificial field inoculation, fourteen lines showed tolerant reaction. Crosses generated between the three identified tolerant genotypes with the susceptible genotype BPT 5204.
6.	Breeding for High Zinc Rice	C N Neeraja (PI) L V Subba Rao M S Anantha	IRRI	2020-22	7.45	Out of 294 (AYT early/late, PYT and OYT) advanced breeding lines evaluated, four lines were found to be promising for their grain Zn. Out of 408 Heat Magic lines evaluated two lines were found to be promising based on phenotype and grain Zn.
7.	CRP- Biofortification in selected crops for nutritional security	C N Neeraja (PI) RM Sundaram S K Mangrauthia M B Kalyani LV Subba Rao Amtul Waris K Surekha J Aravind kumar D Sanjeev Rao K Sruthi U Chaitanya	ICAR	2021-26	575	Eight biofortified breeding lines were given for AICRPR 2022 nominations for IVT-biofortification trials. Four major QTLs with high phenotypic variance and 27 minor QTLs were identified for different quality traits in PR116/Ranbir Basmati F8 RIL mapping population using SSR markers. From Genotyping-by-Sequencing in MTU1010/Ranbir Basmati RIL population, two candidate genes *Os06g0705700, Os06g0706100* were identified at *qZnPR.6.2* and higher expression levels for Zn was observed in Ranbir Basmati compared to MTU1010. RNA-Seq analysis of six critical tissues in Karuppunel (high Zn and Fe) and MTU1010 (low Zn and Fe) identified significant differential expressed transcripts (DETs).

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
8.	Targeting *Pup1* independent mechanisms for improving low soil phosphorus tolerance and use-efficiency in rice	S K Mangrauthia (PI) RM Sundaram MS Anantha	DBT	2021-24	130.00	Detailed phenotyping of the two RIL mapping populations (Rasi/ ISM and Wazuhophek/ISM) was done under low soil phosphorus (P) and normal soil P conditions.
9.	Harnessing haplotype diversity of genes controlling yield, stress tolerance and resource use efficiency traits in rice for accelerating genetic gains	C Gireesh (PI) Kalyani MB MS Anantha	ICAR-NASF	2020-23	250.85	A total of 282 accessions of the Indian Subset of the 3k panel were characterized for yield related traits. Haplotype analysis of seed related traits were carried out.
10.	CSIR-FBR Phase-II: Toward product development in rice using mutants that have traits of agronomic importance	M Sheshu Madhav (PI) Kalyani M B	CSIR	2021-23	60. 00	Four yellow stem borer tolerant promising mutant lines (SM92, SM74, SM72 & SM48); three sheath blight promising mutants (SM93, SB8 & SB6) have been deployed for developing mapping populations. One mutant line derivative (SP-M-MS-70 derived from TI140 X BPT-5204 showed an immune response with a '0' score against brown planthopper (Biotype 4) using the standard seed-box technique in ICAR-IIRR glass house and is being further characterized.
11.	ICAR-Plan Scheme: Incentivizing Research in Agriculture Project: Genetic modifications to improve biological nitrogen fixation for augmenting nitrogen needs of cereals.	RM Sundaram (PI) P C Latha M.B.B. Prasad Babu Kalyani M B Bandeppa	ICAR	2021-26	63.20	Dual transcriptome analysis revealed that transcripts related to metabolic pathways and biosynthesis of secondary metabolites were significantly enriched in rice roots (cv. BPT 5204) in response to *Gluconacetobacter diazotrophicus* than *Bradyrhizobium japonicum* at 240 hours post-inoculation while *B. japonicum* expressed higher number of transcripts and effectors of T4SS and T6SS secretion systems and compared to *G. diazotrophicus*. Formulations of *Paenibacillus sonchi* were observed to improve crop growth and yield under different nitrogen levels
12.	Application of next generation breeding, genotyping and digitalization approaches for improving the genetic gain in India for staple crops	L V Subbarao (PI) P Revathi Abdul Fiyaz	ICAR-BMGF collaborative project	2021-22	5139.37	A total of 20 different varieties are selected which are released for cultivation in different years. These selected varietal entries are evaluated at 25 locations across India. This is the second year of the ERA trial. This data will be utilized for estimating the genetic gain of rice in India.

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
13.	CRP on Hybrid Technology (Rice)	A S Hari Prasad (PI) P Senguttuvel P Revathi KB Kemparaju K Sruthi	ICAR	2015-26	23.00	Seven promising hybrids were nominated in AICRPR IHRT trials. Fifty promising genotypes were identified from the available breeding materials. Through the barrier isolation method, 40 new hybrids were produced and the seed will be used for preliminary evaluation in station trials.
14.	Centrally sponsored scheme of PPVFRA under sub-mission on seeds and planting material-DUS Tests in Rice	L V Subba Rao (PI) J Aravind Kumar Jyothi Badri	PPV&FRA	2008 Long term	13.00	DUS testing included 30 and 58 entries in first (Typical/Farmer's varieties), and second year (Candidate hybrids, F1's from Shimoga, and Typical) respectively. Another 26 entries which were not tested during 2021 were also evaluated for DUS traits. Among the first-year entries, seven recorded very poor germination (1-5%), and two (2223-4 and 22RF6) did not germinate; whereas, among the 2nd year entries, 2122H22, 2122N1 and 2122-34 recorded poor germination. The DUS tests were carried out as per statutory requirement of the PPV & FR Act, 2001 and the recorded data was submitted to the authority in time in the specified format.
15.	AICRP on seeds (Mega Seed Project. & National Seed Project.	L V Subba Rao (PI) R Abdul Fiyaz AVSR Swamy U. Chaitanya	ICAR	2006 Long term	8.0/year	Breeder seed production of rice varieties and parental lines of rice hybrids as per the DAC indents was organized at 44 centers across the country, involving 320 varieties and parental lines of 4 rice hybrids. At IIRR centre, 27 varieties and 3 hybrid parental lines were included in breeder seed production with a total production of 519.70 quintals against the target of 289.17 quintals.
16.	ICAR-IRRI Seed dissemination and production of nucleus & breeder seed of stress tolerant varieties.	L V Subba Rao (PI) R Abdul Fiyaz	IRRI	2017-22	5.80	Drought tolerant varieties such as DRR Dhan 42, DRR Dhan 44, DRR Dhan 46 and DRR Dhan 50; Heat tolerant varieties DRR Dhan 47 and DRR Dhan 52 seeds were produced and supplied to different farmers for field demonstration and frequent monitoring was taken up.
17.	Accelerated Genetic Gain in Rice-Irrigated Ecology (AGGRi-Alliance)	AVSR Swamy (PI) J Aravind Kumar AP Padma kumari D Ladha Lakshmi	IRRI	2020-24	30.00	Experiment was conducted with 270 entries *i.e.* Advanced Breeding Lines selected and supplied by IRRI in two replications during the Wet season of 2022. Data was recorded for the characters of yield and other morphological characters. 15 selections which are of medium slender grain type, were made, to assess them critically for water use efficiency and high yield.

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
18.	From QTL to Variety: Genomics-Assisted Introgression and Field evaluation of rice Varieties with Genes/QTLs for yield under Drought, Flood and Salt Stress	G Padmavathi (PI) Jyothi Badri GS Laha V Jhansi Lakshmi S K Mangrauthia	DBT	2018-22	71.95	Two drought yield QTLs, *qDTY1.1* and *qDTY2.2* were pyramided into the genetic background of DRR Dhan 50 (*qDTY2.1* + *qDTY3.1*) through marker assisted breeding to enhance grain yield under reproductive stage drought stress. After genotyping BC_2F_3 lines with foreground selection markers (RM 324 for *qDTY 2.1*, RM 16030 for *qDTY 3.1*, RM 11943 & RM 431 for *qDTY 1.1* and RM 279 for *qDTY 2.2*) a set of 19 pyramided lines were selected possessing 3 QTLs (*qDTYs 3.1+2.1+2.2*), 17 lines with another new set of 3 QTLs (*qDTYs 3.1+2.1+1.1*) and 5 pyramided lines with all 4 QTLs (*qDTYs. 3.1+2.1+1.1+2.2*) with 85 to 88% genome recovery of DRR Dhan 50
19.	Global rice Array	G Padmavathi (PI)	IRRI	2017-22	0.83	Evaluated 50 Antenna panel genotypes and detected two promising alkaline tolerant entries namely IR84984-83-15-481-8 (3300 Kg/ha) and NSIC RC 240 (3021 Kg/ha) compared to alkaline tolerant check, CSR 36 (2850 Kg/ha) under high alkaline stress (EC; 1.9 dSm-1 and pH: 9.8-10.4 at ARS, Kampasagar, Hyderabad.
20.	DST – SERB Project: Mapping Genomic Regions Associated with Bacterial Leaf Blight Resistance Derived from *Oryza glaberrima*	C Gireesh (PI) RM Sundaram GS Laha MS Anantha	DST SERB	2021-24	27.57	BC1F7 population was phenotyped for bacterial leaf blight resistance using IX-020 isolate during *Kharif*, 2022. Genotyping of mapping population (n=187) was done using genotyping by sequencing (GBS) to identify the polymorphic markers between the parents. QTL analysis is being carried out to identify the genomic region associated with bacterial blight resistance derived from O. glaberrima
21.	Genomic selection for development of rice genotypes tolerant to low soil Phosphorus	MS Anantha (PI)	DST SERB	2021-24	38.75	A total of 350 germplasm lines (Genomic selection panel) were screened under low soil P plot during *Kharif*-2022. The genotypes exhibited a vast amount of variability for all the yield attributing traits under low soil P conditions. Grain yield per plant varied from 1 g per plant to 24.6 g per plant. The roots were sampled from low Phosphorus plot at maximum tillering stage and root related observations like Root dry weight, Shoot dry weight, Shoot length, Root length, Shoot Fresh Weight, Root Fresh Weight, Root volume were recorded.

Appendices

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
22.	Marker-assisted introgression of genes associated with yield enhancement and resistance against bacterial blight and blast diseases into an elite rice variety, 'Jaya'	R Abdul Fiyaz (PI) RM Sundaram GS Laha J Aravind Kumar, LV Subba Rao Basavaraj K	DST-SERB	2020-23	36.96	This involves introgression of one yield enhancing gene 'Gna1' (grain number per panicle) and two biotic stress resistant genes Xa21 (Bacterial leaf blight resistance) and *Pi54* (Blast resistance). The recurrent parent used is 'Jaya' and donor parent is an 'Isogenic line of MTU 1010 containing genes '*Xa21+Pi54+Gn1a*'. Of the total 50 F1 plants, 15 true F1 plants were confirmed using the functional marker PTA248. All the true F_1 hybrids were used in crossing programmes to produce BC1F1 seeds. A total of 34 BC_1F_1 seeds were produced. Foreground and background selection were done and promising introgression lines were selected to cross with recurrent parent to generate BC_2F_1 seeds during *kharif* 2022.
23.	Exploring Chromosome Segment Substitution Lines from interspecific crosses to decipher the genetics of grain weight and earliness	Divya Balakrishnan (PI) N Sarla	DBT	2019-23	43.00	Various wild introgression lines were studied for grain weight and earliness across generations. Fine mapping of *QTL qTGW3.1* in Swarna / *Oryza nivara* using genotyping by sequencing revealed *Os03go103400* which encodes GRAS transcription factor is one of the causative gene for grain weight with a PVE of 48%.
24.	Molecular tagging of genes related to early seedling vigour using landraces and wild introgression lines to develop climate smart rice varieties	Divya Balakrishnan (PI) LV Subbarao	DST SERB	2021-24	36.00	Morphological and molecular characterization of seedling vigour of cultivars and landraces were carried out along with yield. New crosses were made between high seedling vigour lines with those of high yield to develop advance mapping populations.
25.	DST-ICRISAT Center of Excellence on Climate Change Research for Plant Protection (CoE-CCRPP): Pest and disease management for climate change adaptation (PI)	V Prakasam (PI) M S Prasad G S Laha Ch Padmavathi, Chitra Shanker S K Mangrauthia M S Madhav D Subrahmanyam P Muthuraman	DST-GOI	2018-23	87.96	Impact of elevated CO2 and temperature on rice sheath blight differentials were studied under CO2 and temperature gradient tunnel in ICRISAT. Observed the high level of variation in physiological and pathological parameters among the treatments and rice sheath blight differentials. Inoculation was standardized under the CO2 growth chamber. Response of six monogenic resistant lines to blast were tested against eCO2 under open top chamber. Initiation of rice blast was fast and severe at 700 ppm in HR-12 and BL-25. To know the impact of climate change on Rice and Brown Planthopper (BPH), studies were conducted under CTGT and ambient conditions with 18 differentials. There is significant variation in the reaction of BPH to the differentials under both conditions.
26.	IRRI – India Sub project: Insect-Pest and Disease Forecasting and Decision Support Systems in rice.	Ch Padmavathi (PI) B Sailaja Santosha Rathod	IRRI	2021-23	5.70	A "Rice pest pheno-forecasting portal" was developed with interfaces with details on Insect Pests, Diseases and Weeds, Thermal maps, Forecast maps and other details of the project. AI-based temperature prediction was made with NASA POWER data and IMD gridded data as historical data sources. AI & ML models used include i) Long Short-Term Memory (LSTM); ii) Artificial Neural Network (ANN); iii) Autoregressive Integrated Moving Average (ARIMA); and iv) Random Forest (RF) model.

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
27.	Development of superior haplotype based near isogenic lines (Haplo-NILs) for enhanced genetic gain in rice"	Jyothi Badri (PI) Aravind Jukanti V Prakasam V Jhansi Lakshmi MS Prasad A P Padma kumari	DBT	2020-23	117.90	Trait characterization: With DRR Dhan 48 as common parent, bi-parental mapping populations for grain number (DRR Dhan 48/ Moudamani-279) and panicle length (DRR Dhan48/ Anfuzhan-300 and DRR Dhan 48/ADT12-169) are in segregating generations. Superior Haplo-NIL development: For the traits panicle length 39 BC_2F_3 plants from the cross of DRR Dhan 48/ADT12 and for the trait grain yield, 17 BC_2F_3 and 19 BC_1F_3 plants from the cross of DRR Dhan 48/NX3533 were selected combining the results of genotyping with superior haplotype based foreground markers and phenotyping for the target traits.
28.	South Asian Nitrogen Hub (SANH) Work Package (WP) 2.1b	D Subrahmanyam C N Neeraja	UKRI	2020-24	88.00	18 rice varieties were tested under 4 nitrogen doses (0-low N, 50, 100 and 150 kg N/ha) and IR-64, Vasumathi, Vikramarya, Varadhan and Indira with N50 has recorded relatively higher grain yield.
29.	AICRP – Biocontrol	Chitra Shanker (PI) C Kannan	ICAR	2017-21	4.00	BIPM demonstrations were taken up at Miriyalguda, Nalgonda and Manchal, Ibrahimpatnam, Ranga Reddy. Population of natural enemies of rice pests were significantly higher in bio intensive pest management modules as compared to farmers practice with insecticide application. The economics of crop production of various treatments indicated that, the BIPM 2 with *Bacillus cabrialesii* BIK3 treatment gave the maximum benefit with a BC ratio of 1.94
30.	Direct Seeded Rice Consortium (DSRC)	Mahender Kumar R	IRRI	2020-22	6.50	Total mechanization of Dry DSR in collaboration with NGO reduced the cost of cultivation by Rs 5-7000 per acre. In puddled direct sown rice, post emergence application of Penoxsulam 2.67% OD@ 25 and 30 g *a.i*/ha at 3-5 leaf stage of weeds is effective in broad spectrum weed control. The survey report on weed shift in the changed system of establishment from Transplanted to Direct Sowing, showed dominance of *Leptochloa*, and *Paspalum* among grasses; *Scirpus* in Sedges, *Alternanthera, Cyanotis, Caesulia*, among BroadLeaf Weeds

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
31.	Increasing the Health potential in rice by lowering glycaemic index response in high yielding lines (Low GI Rice)	Aravind Kumar J	IRRI	2020-22	4.50	Seed multiplication of two low glycemic index (GI) lines (IRRI 162 and IRRI 147) supplied by IRRI was taken up at IIRR during *Rabi* 2022. These lines would be nominated for multi-location testing. Further, these two lines have been incorporated into the quality breeding program and crossing was initiated. Two crosses involving IRRI 162 were successful *i.e.* ISM X IRRI 162 and DRR Dhan 53 X IRRI 162; would help in identification of lines with BLB tolerance and low GI. We have also crossed IRRI 162 with a high grain protein lines i.e., JAK 686-1 to identify lines with high grain protein and low GI.
32.	Biofortification of rice (Harvest Plus)	G Padmavathi (PI) LV Subba Rao	CIAT, Columbia & IFPRI, USA	2018-22	80.00	Evaluated HPMET- Set 2 during *Kharif*, 2022 at RC Puram farm, Hyderabad with 34 elite entries developed and shared among the partner centres including checks (Yield: Samba Mahsuri; Micro Nutrient checks: DRR Dhan 45, 48 and 49) in 5m^2 plots. At ICAR-IIRR, Hyderabad, in the early duration group (≤100 days flowering duration), two entries namely CR Dhan 310 (IET 24780) with 97 days flowering duration and 4933 Kg/ha yield outperformed the check, IR 64 by 9.8% yield gain. The 2nd entry NVSR 522 (99 days) with mean yield 4778 Kg/ha also recorded 6.4% yield gain over the check IR 64. In the medium and late duration group (> 100 days flowering duration), CSR HZR 17-8 (110 days) yielded 4661 Kg/ha with 10% yield superiority over, Samba mahsuri check. Zinc estimation in test entries is in progress
33.	Characterization and understanding the genetics of resistance of *Ustilaginoidea virens* and Identification of false smut disease tolerant sources in rice	D Ladha lakshmi (PI)	SERB	2019-22	33.30	Survey was made in the false smut-infected rice fields of Telangana and Tamil Nadu. Disease incidence was varied from 86.90% to 90% along with 7.27% and 11.73% spikelet infection. In the molecular variability study with ISSR primers, 60 isolates were grouped into two major clusters I and II and exhibited genetic variability and clustered across geographical variations. In the virulence study, Raigad isolate recorded maximum inhibition and was found as virulent. Around 700 genotypes were screened under field conditions using the standardized method of artificial inoculation. Maximum Percentage of disease incidence was 72% and maximum of 25 smut balls/panicles were recorded. Among the screened lines, germplasm line 200 (IC334233) was identified as a tolerant donor for false smut disease. Crosses were made with Samba Masuri (BPT-5204). Eight hundred forty-eight SSR markers from the Gramene database were used to screen for the polymorphism between parental lines. Out of 848 markers, only 88 SSR markers were found to be polymorphic.

S. No.	Title	Investigators	Funding source	Duration	Budget in lakh Rs.	Brief Progress of work
34.	Evaluation of BAS 750-02-F400 g/l SC (Mefentrifluconazole 400 g/l SC) against sheath blight and grain discoloration of rice"	V Prakasam (PI) M S Prasad K Basavaraj G S Jasudasu M Surendran (Moncompu) Ramanathan, (TNRRI, Aduthurai)	BASF India	2018-22	17.00	Identified Mefentrifluconazole 400 g/l SC 3.5 and 4 ml/l is effective in reducing the sheath blight in the field at three locations, Hyderabad, Moncompu (Kerala), Aduthurai (Tamil Nadu) compared to other treatments. There is no phytotoxicity among the treatments of test molecule.
35.	Bioefficacy of 'ME5382 2% GR' against insect pests of paddy	B Jhansi Rani Y Sridhar	United Phosphorus Limited.	2021-22	5.95	One application of ME5382 2% GR at vegetative stage @150 g a.i. per ha resulted in lower dead hearts (73%), white ears (51%) and brown planthopper population (53%) with significant yield increase (26%) over control.
36.	IRRI-India Frontiers in Rice Science-New Science-Sub project 1: Resource re-mobilization during grain filling under drought"	Jyothi Badri (PI) D Subrahmanyam	IRRI	2021-22	3.79	Stem carbohydrate remobilization of high-harvest index lines was compared with drought tolerant varieties. Under drought stress, highest resource remobilization % was recorded in DRR Dhan 54 (56.29%), RIL 14 (55.22%) and RIL 15 (50.86%). Under irrigated conditions- resource remobilization % > 50% was recorded in five released varieties (IR 64, DRR Dhan 47, Swarna Shreya, DRR Dhan 54 and Swarna Shakti Dhan) and two RILs (RIL Nos. 9 and 16)
37.	Collaborative project with PJTSAU Marker assisted pyramiding of BPH resistant genes into "Telangana Sona", a popular rice variety of Telangana using candidate gene and SSR based markers	V Jhansi Lakshmi	DST-SERB	2021-24	11.50	BC_2F_2 population of the cross RNR15048X10-3 was phenotyped for brown planthopper resistance in the greenhouse by using modified mass tillering screening technique in *kharif* 2022.

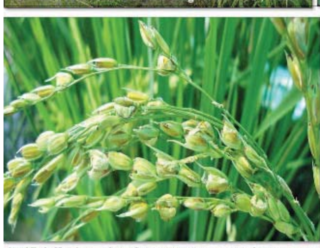
Completed Projects

DST- SERB Project Characterization and understanding the genetics of resistance of *Ustilaginoidea virens* and Identification of false smut disease tolerant sources in rice (PI- Dr D Ladhalakshmi):

Survey was made in the false smut-infected rice fields of Telangana and Tamil Nadu. At Khammam district of Telangana (2019), very high disease incidence ranged from 73.11% to 86.90% was recorded with 7.27% spikelet infection. In Sivagangai district of Tamil Nadu (2020) around 60 – 65 acres belonging to Kannagudi block were severely affected by false smut disease. Disease incidence 90% of infected tiller/panicle and 11.73% infected spikelet/panicle was recorded in BPT5204. Sixty *Ustilaginoidea virens* isolates collected from different states of India and around 29 ISSR primers were selected for studying the molecular variability. The results revealed that all the sixty isolates were grouped into two major clusters I and II. Cluster I contain 29 isolates of *U. virens* and Cluster II contains 31 isolates. Results revealed that the collected isolates exhibited genetic variability and they clustered across the geographical variations. Around 11 identified susceptible hosts and 3 *U. virens* isolates were used for pathogenic variability study. Among the tested isolates, Raigod isolate recorded maximum inhibition and found as virulent one. Around 700 genotypes (consisting of Germplasm lines, wild introgression lines and NSN- 1 entries) were screened under field conditions using the standardized method of artificial inoculation. Maximum Percentage of disease incidence was 72% and maximum of 25 smut balls/ panicle were recorded. Among the screened lines, germplasm line 200 (IC334233) was identified as tolerant donor for false smut disease. The identified tolerant germplasm IC 334233 was crossed with Samba Masuri (BPT-5204), high yielding susceptible to disease to produce the F1 hybrids. Eight hundred forty-eight SSR markers from the Gramene database were used to screen for the polymorphism between parental lines i.e., BPT-5204 and IC 334233. Out of 848 markers, only 88 SSR markers were found to be polymorphic. These markers were distributed across the 12 rice chromosomes.

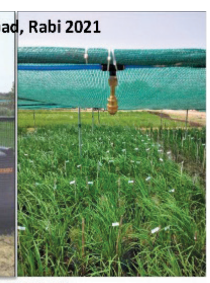

Field view of the artificial screening of false smut, K -2020


Under field conditions, artificially inoculated Genotypes expressed symptom – *Kharif* 2020


Artificially inoculated genotype expressing symptom


False smut tolerant line - Germplasm No. IC282421

Artificial screening facility created at ICAR-IIRR, Hyderabad, Rabi 2021




Artificial screening of different genotypes, Rabi 2021

Acknowledgements

Constant motivation, encouragement, support and guidance received from Dr. T. Mohapatra, former Secretary, DARE and Director General, ICAR; Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR; Dr. T.R. Sharma, DDG (CS); Dr. R.K. Singh, ADG (CC); Dr. D.K. Yadava, ADG (Seed) and Dr. S.K. Pradhan, ADG (FFC) are gratefully acknowledged. We are thankful to all the Vice-Chancellors, Directors of Research and other concerned officers of the State Agricultural Universities and Directors of State Department of Agriculture for their support and cooperation in implementing the AICRPR. Appreciation is extended to the all the scientists of the headquarters and cooperating centers for the successful implementation of research activities which are reflected in the Annual Report and also to the administrative and technical support from the headquarters and cooperating centers. We also acknowledge the efforts of Project staff A Pradeep Goud, Mastani and Vamshi Poloju in compiling the publications and providing the Krishi portal links. We thank all the scientists of IIRR for their contribution to Annual Report, Administrative, Technical staff; for their assistance in compilation of the report.

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agresearch with a human touch

भारत 2023 INDIA

आज़ादी का अमृत महोत्सव

भाकृअनुप-भारतीय चावल अनुसंधान संस्थान
ICAR-Indian Institute of Rice Research
Rajendranagar, Hyderabad - 500 030