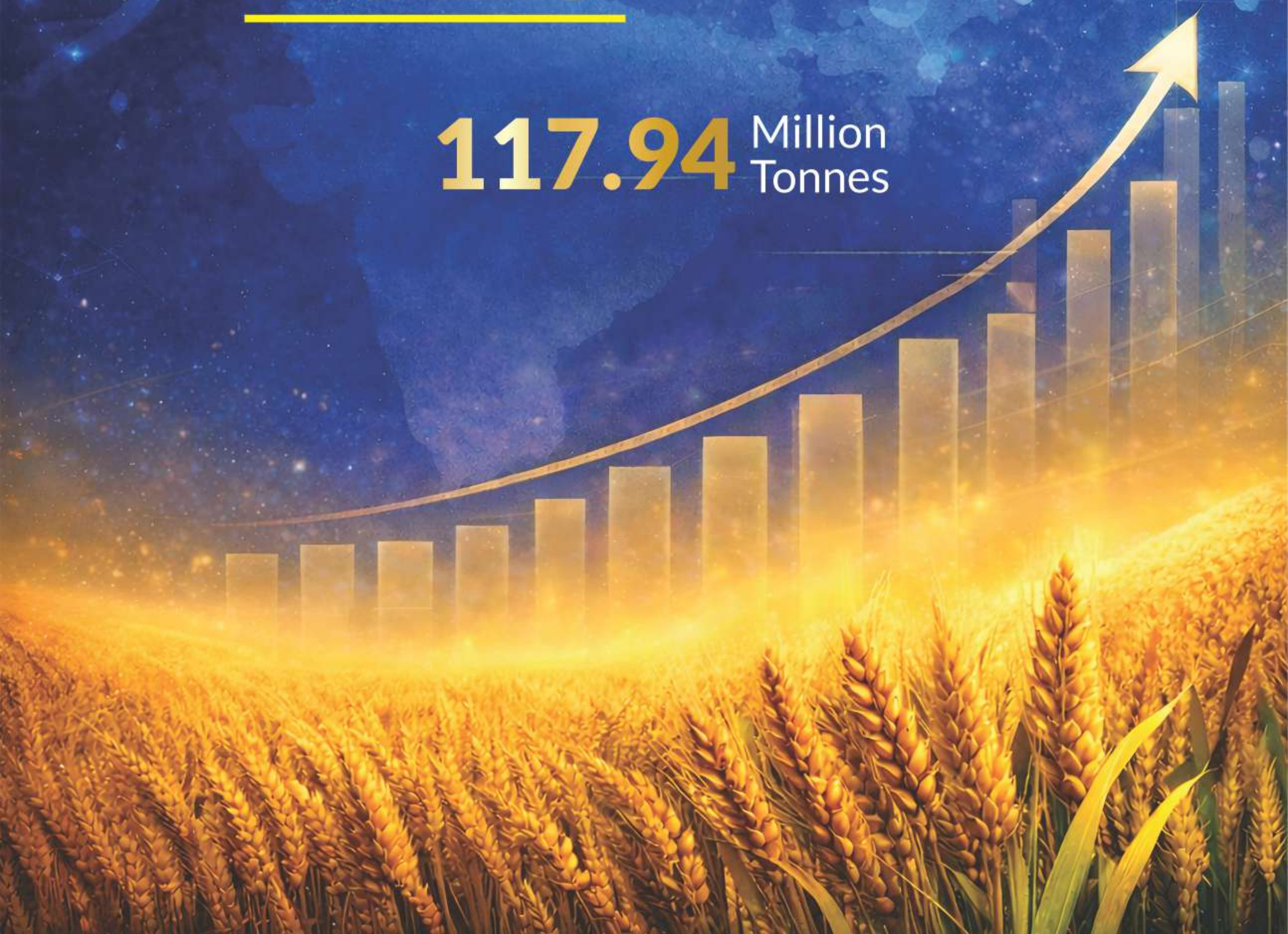
वार्षिक प्रतिवेदन

ANNUAL REPORT

2025



ICAR

भारतीय कृषि अनुसंधान परिषद

Indian Institute of Wheat & Barley Research

Karnal, Haryana

MANDATE

- Basic and strategic research on wheat and barley to improve productivity and quality.
- Coordination and development of improved crop production and protection technologies for sustainable production.
- Providing genetic diversity and accelerate the breeding cycle through off season facilities.
- Surveillance and forewarning for management of rust diseases.
- Dissemination of improved technologies, capacity building and development of linkages.

THE MISSION

Ensuring food and nutritional security by enhancing the productivity and profitability of wheat and barley on an ecologically, socially and economically sustainable basis and making India the world leader in climate smart wheat system production.

वार्षिक प्रतिवेदन

ANNUAL REPORT 2025

भा.कृ.अनु.प.–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान

करनाल–132001, भारत

ICAR-Indian Institute of Wheat and Barley Research

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भा.कृ.अनु.प.–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान
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डॉ. रतन तिवारी
निदेशक
Dr. Ratan Tiwari
DIRECTOR

PREFACE

It is a privilege to place before you the Annual Report of the ICAR–Indian Institute of Wheat and Barley Research (IIWBR) for the year 2025. The report highlights the Institute's major achievements, ongoing research initiatives, and developmental activities aimed at strengthening wheat and barley production and ensuring food and nutritional security in India.

As a premier institute of the Indian Council of Agricultural Research (ICAR), IIWBR continues to address the challenges faced by wheat and barley farmers through cutting-edge research, innovative technologies, and sustainable agricultural practices. Our scientists have made significant advances in developing high-yielding, disease-resistant, biofortified, and climate-resilient varieties, along with improvements in crop management and post-harvest technologies. These collective efforts contributed to India achieving a record wheat production of 117.94 million tonnes and barley production of 1.92 million tonnes during 2024–25.

ICAR–IIWBR successfully organized the 64th All India Wheat and Barley Workers' Meet from 25-27 August 2025 at Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (MP). The Varietal Identification Committee identified 24 wheat and 5 barley varieties for different production environments across the country. During 2025, the Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, recommended the release and notification of 14 wheat and 3 barley varieties for different production conditions.

ICAR-IIWBR has produced 5833.25 q of breeder seed and 3249.51q of TL seed of 15 wheat varieties. Furthermore, efforts were made to strengthen the Public–Private Partnership (PPP) approach, with more than 180 seed firms signing Memoranda of Agreement with ICAR–IIWBR to reinforce the seed chain system for dissemination of ICAR-IIWBR varieties.

I take this opportunity to express my sincere gratitude and heartfelt thanks to Dr. M. L. Jat, Secretary, DARE and Director General (ICAR); Dr. D. K. Yadava, Deputy Director General (Crop Science); Dr. S. K. Pradhan, Assistant Director General (F&FC); and Dr. P. L. Gautam, Chairman, RAC, along with all the members of the RAC, for their invaluable guidance and constructive suggestions in the effective implementation of various research programmes. Through strong collaborative initiatives with national and international institutions, ICAR–IIWBR has further strengthened its role in delivering science-based solutions for the advancement of wheat and barley.

I extend my sincere gratitude to our cooperators from State Agricultural Universities, research partners, and other stakeholders for their continued support and valuable inputs. I also place on record my deep appreciation for the dedication and commitment of our scientists, technical staff, and administrative personnel, whose tireless efforts have been instrumental in the Institute's achievements."

This report is expected to serve as a valuable reference for researchers, policymakers, and all stakeholders involved in the wheat and barley sectors.

Jai Jawan, Jai Kisan, Jai Vigyan, Jai Anusandhan

RTiwari

(Ratan Tiwari)

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कार्यकारी सारांश

फसल सुधार

- वर्ष 2024–25 के दौरान गेहूँ का उत्पादन 117.94 मिलियन टन दर्ज किया गया, जो कि 2020–21 में हुए गेहूँ उत्पादन 109.52 मिलियन टन की तुलना मे उल्लेखनीयं रुप से अधिक है।
- वर्ष 2025 के दौरान, कृषि फसलों के लिए फसल मानक, अधिसूचना और किस्मों की संस्करण पर केंद्रीय उप–समिति ने विभिन्न उत्पादन स्थितियों एवं राज्यों के लिए 13 चपाती गेहूँ किस्मों (12 केंद्रीय रूप से जारीः पीबीडब्ल्यू891, एचआई1669, एचआई1674, एनआईएडब्ल्यू4114, लोक79, एकेएडब्ल्यू5100, जीडब्ल्यू543, डीबीडब्ल्यू386, डीबीडब्ल्यू443, एनडब्ल्यू2222, एचडी3428, डब्ल्यूएच1306; और राज्य द्वारा जारीः राजेंद्र गेहूँ 4) को अधिसूचना संख्या 2128(ई) दिनांक 13.05.2025 के माध्यम से जारी और अधिसूचित किया।
- भारतीय गेहूँ एवं जौ अनुसंधान संस्थान की दो किस्मों को विभिन्न गेहूँ उगाने वाले क्षेत्रों में खेती के लिए अधिसूचित किया गया है जिसमें पहली, डीबीडब्ल्यू386 (करण खुशबू) उत्तर पूर्वी मैदानी क्षेत्र की सिंचित समय पर बोई गई स्थितियों के लिए और दूसरी, डीबीडब्ल्यू443 (करण सान्वी) प्रायद्वीपीय क्षेत्र में सिंचित समय पर बोई गई स्थितियों के लिए है।
- चपाती–गेहूँ की तीन किस्में डीबीडब्ल्यू325, डीबीडब्ल्यू326 और डीबीडब्ल्यू445 को किस्म पहचान समिति द्वारा क्रमशः केंद्रीय क्षेत्र की सिंचित देर से बुआई स्थितियों, प्रायद्वीपीय क्षेत्र की सिंचित देर से बुआई स्थितियों और केंद्रीय क्षेत्र की सिंचित अगेती बुआई स्थितियों के तहत जारी करने के लिए पहचान की गयी है।
- वर्ष 2025 के दौरान, गेहूँ के दो आनुवंशिक संभार जीडब्ल्यू557 रोग प्रतिरोधक क्षमता के लिए और यूएएसडी22–5 गर्मी और सूखे के प्रति सहनशीलता के लिए पंजीकृत किए गए। भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल की आनुवंशिक संसाधन इकाई इन पंजीकृत आनुवंशिक संभार के बीजों को गुणन करती है और देश भर के प्रजनकों को गेहूँ सुधार में इस्तेमाल के लिए उपलब्ध करवाती है।
- भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, की पाँच चपाती–गेहूँ प्रविष्टियां, जिनका नाम डीबीडब्ल्यू465, डीबीडब्ल्यू466, डीबीडब्ल्यू467, डीबीडब्ल्यू458 और डीबीडब्ल्यू509 है, को उनकी बेहतर गुणवत्ता और पैदावार के आधार पर विभिन्न क्षेत्रों के लिए एवीटी में परीक्षण के अंतिम वर्ष के लिए पदोन्नत किया गया है।
- इस वर्ष के दौरान, गेहूँ जननद्रव्य की कुल 346 लाइनों को विभिन्न स्रोतों से पंजीकृत किया गया और शोध कार्यक्रम में इस्तेमाल के लिए विभिन्न मांगकर्ताओं को गेहूँ के 905 एक्सेसन्स भेजे गये है।
- वर्तमान में, संस्थान के मध्यम अवधि भंडार मॉड्यूल (4°C और 30% आरएच) में गेहूँ के लगभग 18500 एक्सेसन्स संग्रहित किए गये हैं एवं 10000 से ज़्यादा एक्सेसन्स को दालंग मैदान, हिमाचल प्रदेश में प्राकृतिक परिस्थितियों में सुरक्षित प्रतिरुप के तौर पर संरक्षित किया गया है।
- इस वर्ष के दौरान, संरक्षित जननद्रव्य से कुल 585 गेहूँ एक्सेसन्स (353 चपाती गेहूँ, 154 डाइकोकम, 20 ड्यूरम, 14 टर्जिडम, 12 पोलोनिकम, 13 ट्यूरानिकम एक्सेसन्स, 11 कार्थलिकम, 1 कॉम्पैक्टम एवं 1 ट्रिटिकेल का एक्सेसन्स) का मूल्यांकन गेहूँ के लिए डीयूएस परीक्षण दिशानिर्देश के अनुसार आठ लक्षणों के लिए किया गया।
- इस वर्ष के दौरान, दो चपाती गेहूँ की किस्में, करण शिवांगी (डीबीडब्ल्यू359) और (करण बोल्ड) डीबीडब्ल्यू377 को पीपीवी एवं एफआरए, नई दिल्ली द्वारा मौजूदा श्रेणी के तहत पंजीकरण संख्या आरईजी/2024/0441 और आरईजी/2024/442 के तहत पंजीकृत किया गया है।
- गेहूँ की दो किस्में डीबीडब्ल्यू386 और डीबीडब्ल्यू443 के पंजीकरण के लिए आवेदन पीपीवी एवं एफआरए, नई दिल्ली में मौजूदा श्रेणी के तहत पंजीकरण के लिए जमा की गयी है।
- नाइट्रोजन–कुशल (बीएनआई–मुनाल) और व्युत्पन्न जनक मुनाल गेहूँ जीनोटाइप के लिए चार नाइट्रोजन स्तरों (0% , 50% , 75% , और 100% अनुशंसित मात्रा) में जीन अभिव्यक्ति स्वरुप को उजागर करने के लिए एक तुलनात्मक ट्रांसक्रिप्टोमिक विश्लेषण किया गया, जिसमें पांच यूनिजीन (तीन अप–रेगुलेटेड और दो डाउन–रेगुलेटेड) की पहचान की गई, जो सभी नाइट्रोजन स्तरों पर लगातार व्यक्त किए गए थे। अप–रेगुलेटेड यूनिजीन के आगे के विश्लेषण में एनआरपीए जीन (नाइट्रोजन विनियमन में शामिल), टेट्रा–ट्राइकोपेप्टाइड रिपीट–युक्त प्रोटीन (पीपीआर), और साइटोकइनिन डिहाइड्रोजनेज 2 से संबंध पाए गए।
- 165 जंगली गेहूँ एक्सेसन्स का मूल्यांकन तनाव सहनशीलता के लिए किया गया। *ए. टॉस्ची* एक्सेसन्स नंबर 3806, 3753, 9803 सूखे के तनाव के प्रति सहनशील पाए गये, जबकि एक्सेसन्स नंबर 3753 और 9803 गर्मी के तनाव के प्रति सहनशील पाये गये। एई. पेरेग्रीना एक्सेसन्स नंबर 102, 103 गर्मी और सूखे के तनाव के प्रति सहनशील पाये गये।
- पांच अंतर्ग्रहण लाइनें, जिनका नाम एचटीडब्ल्यू 2312 (डीबीडब्ल्यू39/*एई. स्पेल्टोइड्स*), एचटीडब्ल्यू 2304 (*एई. टौस्ची*/4'एचडी2967), एचटीडब्ल्यू2309 (पीबीडब्ल्यू698/ *टीएच. बेस्साराबिकम*), एचटीडब्ल्यू2305 (एसवाईएन224/3' डब्ल्यूएच1105), एचटीडब्ल्यू2307 (*एई. कॉम्पेक्टम*/के1213/2' डब्ल्यूएच1105) है, स्क्रीनिंग नर्सरी में गर्मी (एचएसआई<1) और सूखा सहनशीलता (डीएसआई <1) के लिए आशाजनक पायी गयी।
- 90 जीनोटाइपस का मूल्यांकन उच्च जस्ता, लौह तत्व एवं प्रोटीन की मात्रा के लिए किया गया और दो लाइनें बीएफकेडब्ल्यू101 और बीएफकेडब्ल्यू103 में >50 पीपीएम जस्ता और >55 पीपीएम लौह तत्व पाया गया और दो लाइनों में >15% प्रोटीन पायी गयी।
- भा.कृ.अनु.प – राष्ट्रीय डेयरी अनुसंधान संस्थान करनाल, भा.कृ. अनु.प – भारतीय कृषि प्रणाली अनुसंधान संस्थान एवं भा.कृ.अनु. प–केंद्रीय आलू अनुसंधान संस्थान– क्षेत्रीय स्टेशन, मोदीपुरम के साथ अंतर–संस्थागत सहयोग के तहत, भा.कृ.अनु.प – भारतीय

गेहूँ एवं जौ अनुसंधान संस्थान ने 15 गेहूँ की किस्मों जैसे डीबीडब्ल्यू327, डीबीडब्ल्यू377, डीबीडब्ल्यू303, डीबीडब्ल्यू187, डीबीडब्ल्यू222, डीबीडब्ल्यू359, डीबीडब्ल्यू370, डीबीडब्ल्यू371 और डीबीडब्ल्यू372 का 5833.25 क्विंटल प्रजनक बीज और 3249.51 क्विंटल टीएल बीज का उत्पादन किया, जबकि वर्ष 2025 के दौरान बीज और अनुसंधान फार्म, (भा.कृ.अनु.प – भारतीय गेहूँ एवं जौ अनुसंधान संस्थान), हिसार में 06 जौ की किस्मों का कुल 300.39 क्विंटल बीज उत्पादित किया गया।

- संस्थान की रिवॉल्विंग फंड योजना के तहत गेहूँ के न्यूक्लियस/प्रजन्नक एवं टीएल बीजों की बिक्री से कुल 7.54 करोड रुपये की राशि प्राप्त हुई।
- भा.कृ.अनु.प – भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल ने हाल की गेहूँ की किस्मों जैसे डीबीडब्ल्यू327, डीबीडब्ल्यू377, डीबीडब्ल्यू303, डीबीडब्ल्यू187, डीबीडब्ल्यू222 आदि के टीएल बीज को सभी गेहूँ उगाने वाले राज्यों के किसानों को पंजीकरण करने एवं वितरित करने के लिए भारतीय गेहूँ एवं जौ अनुसंधान संस्थान सीड पोर्टल को पदोन्नति किया गया है।
- एक द्वि–अभिभावकीय मैपिंग आबादी का 35के एसएनपी सरणी विश्लेषण किया गया और क्रोमोसोम 3बी, 3डी, और 6बी पर प्रमुख क्यूटीएल पछेती बुआई और अचानक उष्मा के तनाव की स्थितियों में अनाज की उपज, दानों की संख्या, और हजार दानों के भार से जुड़े थे। इन स्थिर क्षेत्रों से जुड़े एसएनपी को केएएसपी मार्करों में परिवर्तित किया गया और तीन स्वतंत्र आबादी में पुष्टि किया गया, जिससे उनकी विश्वसनीयता की पुष्टि हुई।
- सूखे के तनाव के तहत क्यूआरटी पीसीआर का उपयोग करके सूखे के प्रति प्रतिक्रियाशील जीन (डीआरईबी2ए, एपीएक्स1, सीएटी1, टीएसीवाईपी707ए1, एसएएमएस1, एचएसपी17.8 और डीएचएन) अभिव्यक्ति पर बैक्टीरियल इनोक्यूलेशन के प्रभाव का अध्ययन किया गया। जीन डीआरईबी2ए, सीएटी1, एपीएक्स1, एसएएमएस1 और एचएसपी17.8 ने बिना इनोक्यूलेशन वाले सूखे के तनाव वाले गेहूँ के पौधों में अप–रेगुलेशन दिखाया, जबकि बैक्टीरियल–इनोक्यूलेटेड तनाव वाले पौधों ने कम ट्रांसक्रिप्ट संचय प्रदर्शित किया, जो सूखे के तनाव की स्थितियों में सूखे के प्रति प्रतिक्रियाशील जीन के विनियमन में एंडोफाइटिक बैक्टीरिया की भूमिका को दर्शाता है।
- ग्यारह संभावित एंडोफाइटिक बैक्टीरिया की उपस्थिति में डीआरईबी2ए (डीहाइड्रेशन–रिस्पॉन्सिव एलिमेंट बाइंडिंग प्रोटीन), सीएटी1 (कैटलेज), डीएचएन(डीहाइड्रिन), टीएसीवाईपी707ए1 (साइटोक्रोम पी450 मोनोऑक्सीजिनेज 707ए1) और एपीएक्स1 (एस्कॉर्बेट पेरोक्सीडेज), एचएसपी17.8 (हीट शॉक प्रोटीन) और एसएएमएस1 (एस–एडेनोसिल–मेथियोनीन सिंथेटेज़) जीन की अभिव्यक्ति विश्लेषण का अध्ययन किया गया।
- सूखे के तनाव में नकारात्मक नियंत्रण सीडलिंग में सकारात्मक नियंत्रण सीडलिंग की तुलना में एपीएक्स1, डीआरईबी2ए, सीएटी1 और डीएचएनजीन काफी ज्यादा उच्च विनियमित हुए थे।
- एमएस1–एडिटेड पौधों के अनुवांशिक डीएनए के टी7 एंडोन्यूक्लिज़ एसे ने नियत्रंण की तुलना में बदले हुए क्लीवेज बैंड पैटर्न दिखाए, जो लक्षित स्थान पर सीआरआईएसपीआर / टीएएलईएन / जेडएफएन–प्रेरित इंडेल्स की मौजूदगी का संकेत देते हैं, जिसकी आगे क्रम से पुष्टि की जाएगी।
- गेहूँ में रियल–टाइम पीसीआर का उपयोग करके अलग–अलग संश्लेषक और आत्मसात्करण दरों वाले जीनोटाइप में सात प्रमुख सी4 संश्लेषक जीन का विश्लेषण किया गया, जिसमें उच्च प्रर्दशन जीनोटाइप में टीएएसपीएटी और टीएपीईपीसी की काफी ज्यादा अभिव्यक्ति सामने आई। इन जीनों को गेहूँ में संश्लेषक दक्षता बढ़ाने के लिए आगे की अनुवांशिक इंजीनियरिंग और अनुवांशिक संपादन के लिए संभावित दर–सीमित उम्मीदवारों के रूप में पहचाना गया है।

फसल सुरक्षा

- 300 गेहूं जर्मप्लाज्म लाइनों में से जो स्ट्राइप रस्ट, लीफ रस्ट और लीफ ब्लाइट के खिलाफ मूल्यांकन की गईं, केवल पांच जीनोटाइप अर्थात् इसी1175030, इसी1175031, इसी1175177, इसी1175196, और इसी1175246 को सभी तीन रोगों के खिलाफ प्रतिरोधी पाया गया।
- *ट्राइकोडरमा हार्जियानम* गेहूँ की रस्ट़ रोग को नियंत्रित करने में सबसे प्रभावी साबित हुआ, जिससे रोग की गंभीरता 10एमएस तक कम हो गई।
- 51 *बाइपोलारिस सोरोकिनियाना* के अलग–अलग नमूनों में संरचनात्मक, रोगजनक और आणविक विविधता का मूल्यांकन किया गया, जिसमें बीएस–3 को सबसे अधिक विषाणुता के रूप में पहचाना गया।
- महत्वपूर्ण एमटीएस में से 60 की पहचान की गई, जिनमें से 33 नए थे, जो स्पॉट ब्लॉच प्रतिरोध के लिए प्रमुख लक्षणों (एयुडीपीसी, आईपी, एलएल, और एलबी) में शामिल हैं।
- कुल 132 एक्वापोरिन जीनों को पहचाना और वर्णित किया गया, जिनमें संरक्षित प्रतिरूपों को तनाव अनुकूलन के लिए महत्वपूर्ण के रूप में पहचाना गया।
- फ्यूजेरियम हेड ब्लाइट (एफएचबी) अलगावों को रूपात्मक, रोगजनक और आणविक विश्लेषणों के माध्यम से विशिष्ट किया गया, जिससे आठ फ्यूजेरियम प्रजातियों का पता चला जिनकी वृद्धि पैटर्न और रोगजनकता विविध थी, विशेष रूप से एफ. सरेअलिस, एफ. कल्मोरम, और एफ. इनकार्नेटम सबसे आक्रामक पाई गईं।
- डब्लूआरआईएसटी (गेहूं जंग सूचना और निगरानी ट्रैकर), एक इंटरैक्टिव विजुअलाइजेशन प्लेटफॉर्म जो गूगल लाकर स्टूडियो में विकसित किया गया है, स्थानिक और कालिक प्रवृत्तियों और दीर्घकालिक रोग गतिकी की खोज करने में सक्षम बनाता है।

संसाधन प्रबंधन

- संरक्षण कृषि के अंतर्गत मक्का–सरसों–मूंग और मक्का–गेहूँ–मूंग जैसे फसल विविधीकरण विकल्प पारंपरिक कृषि की तुलना में अधिक उत्पादक और लाभदायक थे।
- मक्का–गेहूँ–मूँग प्रणाली में दीर्घकालीन जुताई के प्रयोग से पता

चला कि पोषक तत्व प्रबंधन तरीको में अनुशंसित एनपीके + 10 टन/हैक्टर देसी खाद के प्रयोग से गेहूँ फसल की उपज अधिकतम प्राप्त हुई। पारंपरिक जुताई (सीटी) की तुलना में शून्य जुताई आधारित विकल्पों में मक्का की उत्पादकता अधिक प्राप्त हुई।

- सीधी बोई गई धान (डीएसआर) की तुलना में मचाई कर रोपित धान की उपज अधिक प्राप्त हुई, जबकि सीधी बोई गई धान (डीएसआर) के बाद बिना जुताई और अवशेष रखने की स्थिति में बोए गए गेहूँ की उपज में वृद्धि हुई।
- एकीकृत पोषक प्रबंधन जिसमें रासायनिक उर्वरकों एनपीके 150:60:40 कि.ग्र./है. की संस्तुत मात्रा के साथ 15 टन/हैक्टर देसी खाद का अनुप्रयोग उच्चतम उपज वाला पाया गया, इसके बाद अनुशंसित एनपीके+हरी खाद का स्थान रहा। पूर्ण नियंत्रण उर्वरक रहित की तुलना में अकेले पी, के या पीके के एकमात्र उपयोग से गेहूँ की उत्पादकता में कोई वृद्धि नहीं देखी गयी।
- गेहूँ की उच्च उपज वाली किस्मों (एचडी 2967, डीबीडब्ल्यू 187, डीबीडब्ल्यू 222 और डीबीडब्ल्यू 303) के जैविक उत्पादन में गोबर की खाद के 30 टन प्रति हैक्टर के अनुप्रयोग में उत्पादकता अनुशंसित रासायनिक उर्वरकों (एनपीके 150:60:40 कि.ग्रा./है.) की तुलना में काफी कम रही।
- प्राकृतिक खेती पद्धति में मक्का–जौ और धान–गेहूँ फसल प्रणालियों में मक्का, गेहूँ, धान और जौ की उपज पारंपरिक पद्धति की तुलना में काफी कम पायी गई।
- गेहूँ में विभिन्न प्रकार के खरपतवारों को नियंत्रित करने के लिए बिजाई के 35 दिन बाद बिक्सलोजोन + मेट्रिब्यूजिन का प्रीमिक्स संयोजन 900 (750 + 150) ग्राम हेक्टेयर की मात्रा बहुत प्रभावी पाया गया।
- धान–गेहूँ फसल प्रणाली में दोहरी बिना जुताई प्रणाली के कारण जंगली पालक (*रूमेक्स डेंटेटस)* और *मेडिकैगो डेंटिकुलाटा* की अधिक समस्याएं देखी गयी। जंगली जई का प्रकोप धान–गेहूँ प्रणाली की तुलना में मक्का–गेहूँ प्रणाली में अधिक देखा गया। इसके अलावा जीरो जुताई गेहूँ में पारम्परिक जुताई गेहूँ की तुलना में जंगली जई का प्रकोप कम पाया गया।
- मेटसल्फ्यूरोन प्रतिरोधी जगंली पालक (रूमक्स डटेंटेस) और बथुआ (*चिनोपोडियम एल्बम*) के नियत्रंण के लिए हैलोक्सिफेन् + फ्लूरोक्सीपायर, पेंडीमैथलिन, 2, 4–डी और कारफेंट्राजोन प्रभावी पाए गए।
- बहुशाकनाशी प्रतिरोधी *फ्लैरिस माइनर, एविना लुडोविसियाना* और *पॉलीपोगोन मोनस्पेलिएन्सिस* (क्लोडिनाफॉप, पिनोक्साडेन और सल्फोसल्फ्यूरॉन के खिलाफ) खरपतवारों के नियंत्रण के लिए खरपतवारनाशी पायरोक्सासल्फोन, बिक्सलोजोन + मेट्रिब्यूजिन और एक्लोनिफेन + डिफ्लुफेनिकन प्रभावी पाए गए।
- जौ में विविध प्रकार के चौड़ी पत्ती वाले खरपतवार वनस्पतियों के नियंत्रण के लिए हेलॉक्सिफेन +फ्लूरोक्सिपायर 200.6 (6.1 + 194.5) और मेटसल्फ्यूरॉन+कारफेंट्राजोन (4 + 20) ग्राम/हेक्टेयर को प्रभावी पाया गया।
- क्लोर्मेक्वेट क्लोराइड (लिहोसीन) का 0.2 प्रतिशत और टेबुकोनाजोल (फोलिकर 430 एससी) का 0.1 प्रतिशत व्यावसायिक उत्पाद मात्रा का टैंक मिश्रण के रूप में प्रथम नोड और ध्वज पत्ती अवस्था पर दो पर्णीय छिड़काव करने से जौ की उपज में उल्लेखनीय सुधार हुआ।
- 100 प्रतिशत वाष्पीकरण सिंचाई स्तर की तुलना में 80 प्रतिशत वाष्पीकरण सिंचाई स्तर पर गेहूँ के जीनोटाईपों की जल उत्पादकता में उल्लेखनीय वृद्धि देखी गई। जीनोटाइप एलबीपी 2023–8 और डीबीडब्ल्यू 466 को जल दक्ष और अधिक उपज देने वाले जीनोटाइप के रूप में पहचाना गया, जिनकी जल उत्पादकता क्रमशः 3.0–3.05 किलोग्राम/मी^{3} और उपज 68.7–69.8 क्विंटल/हेक्टेयर के बीच पायी गई।

गुणवत्ता एवं मूलभूत विज्ञान

- वर्ष 2025–26 की फसल अवधि के लिए, गेहूं के (सीआरपी) जैव संवर्धन पर किए जा रहे कार्य के तहत, बेहतर उपज, उच्च लौह अयस्क, जस्ता और प्रोटीन के आधार पर, एक प्रविष्टि को क्यूसीडब्ल्यूबीएन और दूसरी को स्टेशन परीक्षण के लिए भेजा गया है।
- विभिन्न पीढ़ियों में, सीआरपी बायोफोर्टिफिकेशन के तहत लौह की मात्रा 29.9 से 61.4 पीपीएम तक और जस्ता की मात्रा 21.6–45.1 पीपीएम तक रही।
- एफ4, एफ5 और एफ6 पीढ़ियों के लिए ≤30 मिलीलीटर या कम अवसादन मात्रा वाली प्रविष्टियों की संख्या क्रमशः 6, 7 और 13 थी।
- पृथक किस्मों, स्थिर किस्मों, एवीटी और जारी किस्मों (62 भिन्न जीनोटाइपों का एक समूह) में स्टार्च की मात्रा शुष्क भार के आधार पर 46.0 से 70.3 ग्राम/100 ग्राम तक थी (औसत 58.2%)।
- यूएएस, धारवाड़ द्वारा विकसित टी. डाइकोकम की 25 आरआईएल लाइनों का ग्लाइसेमिक इंडेक्स 38.3 से 64.3 (औसत 50.8) तक था, जो ग्लाइसेमिक इंडेक्स में व्यापक भिन्नता दर्शाता है।
- सूक्ष्म परीक्षण के लिए निर्धारण गुणांक (R^2) 0.84 पाया गया, जबकि सहसंबंध गुणांक (R) 0.92 था। इससे यह सिद्ध होता है कि अवसादन आयतन की गणना के लिए 1 ग्राम सूक्ष्म परीक्षण का प्रभावी ढंग से उपयोग किया जा सकता है (82 नमूनों के परीक्षण आधार पर)।
- गेहूं के विविध जीनोटाइप्स से प्राप्त व्हीटग्रास जूस का तुलनात्मक पोषक–औषधीय विश्लेषण किया गया, जिसमें फाइटोकेमिकल्स, एंटीऑक्सीडेंट क्षमता तथा स्वास्थ्यवर्धक उपयोगों हेतु पोषण गुणवत्ता का आकलन किया गया।
- गेहूं में फाइटेज जीन का इन–सिलिको विश्लेषण एवं विविधता अध्ययन कर संरक्षित डोमेन्स, विकासात्मक संबंधों तथा पोषण गुणवत्ता सुधार की संभावनाओं का मूल्यांकन किया गया।
- स्वस्थ खानपान को बढ़ावा देने के उद्देश्य से गेहूं के दलिया का उत्पादन करने के लिए ड्यूरम गेहूं की विभिन्न किस्मों का उपयोग किया गया और उनके भौतिक–रासायनिक, खाना पकाने और संवेदी गुणों का मूल्यांकन किया गया।

- चने के आटे और रागी के आटे से फोर्टिफाइड शुगर स्नैप कुकीज के संवेदी समग्र स्वीकार्यता स्कोर में भंडारण से संबंधित परिवर्तनों का आकलन किया गया।

जौ सुधार

- छिलका–रहित जौ की किस्म डीडब्ल्यूआरबी 223 को वर्ष 2025 में एनडब्ल्यूपीजेड में खेती हेतु जारी एवं अधिसूचित किया गया। यह किस्म उच्च उपज (42.96 क्विंटल हेक्टेयर), पीली रतुआ रोग के प्रति प्रभावी प्रतिरोध, तथा उत्कृष्ट पोषण गुणों–प्रोटीन (11.7%), β–ग्लूकान (6.0%), जिंक (47.8 पीपीएम) एवं आयरन (43.7 पीपीएम) से युक्त है।
- 64 वीं अखिल भारतीय गेहूँ एवं जौ अनुसंधान कार्यकर्ता बैठक में किस्म पहचान समिति द्वारा तीन प्रविष्टियों–डीडब्ल्यूआरबी 244; (छिलका–रहित जौ) डीडब्ल्यूआरबी 235 एवं डीडब्ल्यूआरबी 238 (माल्ट जौ) की पहचान की गई।
- दो प्रविष्टियाँ–डी–डब्ल्यू–आर–बी 2318; द्वि–उद्देशीय जौ तथा डी–डब्ल्यू–आर–बी 2312 (माल्ट जौ) को एन–डब्ल्यू–पी–जेड में ए–वी–टी– ।। हेतु पदोन्नत किया गया।
- छिलका–रहित जौ की दो प्रविष्टियाँ (डी–डब्ल्यू–आर–बी 2408 एवं डी–डब्ल्यू–आर–बी 2410) को एन–ई–पी–जेड में ए–वी–टी–I (2025–26) हेतु पदोन्नत किया गया। इसके अतिरिक्त, डीडब्ल्यूआरबी 2407 डीडब्ल्यूआरबी 2410 एवं डीडब्ल्यूआरबी 2425 को मध्य क्षेत्र में परीक्षण हेतु पदोन्नत किया गया।
- 109 जौ जर्मप्लाज्म लाइनों के मूल्यांकन में 8 जीनोटाइप धारीदार रतुआ रोग के प्रति पूर्णतः प्रतिरोधी पाए गए। स्पॉट ब्लॉच रोग के विरुद्ध कोई भी पूर्ण प्रतिरोधी जीनोटाइप नहीं पाया गया, हालांकि तीन जीनोटाइप मध्यम स्तर पर प्रतिरोधी दर्ज किए गए।
- पीला रतुआ–संवेदनशील किस्म 'ज्योति' पर किए गए प्रयोगों में पीला रतुआ की तीव्रता एवं उपज के बीच मजबूत नकारात्मक सहसंबंध पाया गया। 100S रोग तीव्रता की स्थिति में अधिकतम 74.83% उपज हानि दर्ज की गई, जिससे रतुआ रोग प्रबंधन के आर्थिक महत्व को स्पष्ट रूप से रेखांकित किया गया।
- नौ राज्यों से एकत्रित 27 आइसोलेट्स के अध्ययन में रूपात्मक, संवर्धनीय एवं रोगजनक स्तर पर व्यापक विविधता पाई गई। एसएसआर मार्कर विश्लेषण से यह स्पष्ट हुआ कि कुल आनुवंशिक विविधता का 76% समष्टि के भीतर तथा 24% समष्टियों के बीच विद्यमान है, जो रोगजनक की उच्च अनुकूलन क्षमता तथा सतत उत्क्रांति की संभावनाओं को स्पष्ट रूप से दर्शाता है।

सामाजिक विज्ञान

- रबी फसल 2024–25 के दौरान, भारत में आठ राज्यों/केंद्र शासित प्रदेशों, हिमाचल प्रदेश, उत्तर प्रदेश, बिहार, जम्मू और कश्मीर, पंजाब, हरियाणा, राजस्थान एवं मध्य प्रदेश, के 38 समन्वयक केंद्रों को 140 हैक्टर जौ के अग्रिम पंक्ति प्रदर्शन आवंटित किए गए थे। इनमें से, 38 केंद्रों द्वारा 139.6 हैक्टर जौ के अग्रिम पंक्ति प्रदर्शन आयोजित किए गए, इनसे 403 किसानों के 146.20 हैक्टर क्षेत्रफल को कवर किया गया। जौ की उन्नत किस्मों का प्रदर्शन उत्पादन की समग्र सिफारिशों (सिंचाई प्रबंधन, पोषक तत्व प्रबंधन, खरपतवार नियंत्रण, बीज उपचार आदि) के साथ किया गया।
- उत्तरी पर्वतीय क्षेत्र में उन्नत किस्मों के कारण क्षेत्रीय औसत उपज में वृद्धि दर सबसे अधिक (43.00%) देखी गई, इसके बाद उत्तर पूर्वी मैदानी क्षेत्र (32.87%), मध्य क्षेत्र (30.16%) एवं उत्तर पश्चिमी मैदानी क्षेत्र (20.94%) में दर्ज की गई।
- उत्तरी पर्वतीय क्षेत्र के शिमला केन्द्र पर बीएचएस 400 (27.75 कुंतल/हैक्टर), उत्तर पूर्वी मैदानी क्षेत्र के गोरखपुर–2 केन्द्र पर आरडी 2907 (42.75 कुंतल/हैक्टर), उत्तर पश्चिमी मैदानी क्षेत्र के दुर्गापुरा, जयपुर केन्द्र पर आरडी 2907 (73.43 कुंतल/हैक्टर) तथा मध्य क्षेत्र के विदिशा केन्द्र पर आरडी 2899 (46.75 कुंतल/हैक्टर) उच्चतम औसत उपज देने वाली किस्में थीं।
- किसानों के खेतों में अग्रिम पंक्ति प्रदर्शन कार्यक्रम के तहत जौ की उन्नत किस्मों के प्रदर्शनों में प्रति हैक्टर औसत लाभ लगभग 70741 रुपये प्राप्त हुआ। प्रदर्शनों के माध्यम से पंजाब में प्रति रुपये निवेश पर उच्चतम आमदनी 3.67 रुपये प्राप्त हुई। अग्रिम पंक्ति प्रदर्शन और जाँचक प्लॉट के बीच लाभ का अंतर रुपये 23659 (उत्तर प्रदेश) से लेकर 82668 रुपये (केन्द्र शासित प्रदेश जम्मू और कश्मीर) तक देखा गया। जौ उगाने वाले क्षेत्रों में प्रति रुपया निवेश पर सबसे अधिक रिटर्न उत्तर पश्चिमी मैदानी क्षेत्र (₹3.22) में दर्ज किया गया, इसके बाद मध्य क्षेत्र (₹2.81) तथा उत्तरी पहाड़ी क्षेत्र (₹2.45) में देखा गया।
- सभी क्षेत्रों की समग्र बाधाओं के विश्लेषण से पता चलता है कि आवकों की उच्च कीमत, जल स्तर में गिरावट एवं मंडूसी (फैलेरिस माइनर) देश की सबसे गम्भीर बाधाएँ थीं। श्रमिकों की अनुपलब्धता, भूमि की छोटी जोत, असमय वर्षा, जौ अनाज की कम कीमत, नहर सिंचाई जल सुविधा का अभाव, शाकनाशियों/कीटनाशकों की खराब गुणवत्ता एवं विभिन्न विभागों द्वारा आयोजित एक्सपोजर यात्राओं में कम भागीदारी को देश में जौ उत्पादन एवं उत्पादकता को प्रभावित करने वाली प्रमुख बाधाओं के रूप में पहचाना गया।
- एससीएसपी कार्यक्रम के तहत, किसानों के खेत में प्रदर्शन का आकलन करने के लिए फसल सत्र 2024–25 के दौरान गेहूँ की उन्नत किस्मों डीबीडब्ल्यू 187, डीबीडब्ल्यू 332, डीबीडब्ल्यू 370, डीबीडब्ल्यू 371 एवं डीबीडब्ल्यू 372 के 560 प्रदर्शन आयोजित किए गए। यह प्रदर्शन कृषि विज्ञान केन्द्रों के माध्यम से पंजाब (18), हरियाणा (4), राजस्थान (2), जम्मू और कश्मीर (1), हिमाचल प्रदेश (1) एवं आरएलबीसीएयू, झांसी (1) में आयोजित किए गए, जिसमें अनुसूचित जाति (एससी) कैटेगरी के 560 किसानों की कुल 560 एकड़ ज़मीन को शामिल किया गया था।
- रबी फसल सत्र 2024–25 के दौरान, 11 कृषि विज्ञान केंद्रों द्वारा 440 हैक्टर क्षेत्र में 1100 समूह प्रदर्शन आयोजित किए गए, जिससे 1053 किसान लाभान्वित हुए। फसल सत्र के दौरान, किसानों को विभिन्न अंतर–कृषि क्रियाओं पर समय–समय पर परामर्श प्रदान करके मार्गदर्शन किया गया। सभी प्रदर्शनों में, पूर्णिया (बिहार) में अधिकतम उपज वृद्धि (11.60%) दर्ज की गई। प्रदर्शित क्षेत्रों में सबसे अधिक प्रति हैक्टर लाभ पंजाब के मोगा

(₹48951) जिले में देखा गया, इसके बाद राजस्थान के धौलपुर (₹44935) जिले में दर्ज किया गया।

- फसल सत्र 2024–25 के दौरान 26 कृषि विज्ञान केंद्रों, अखिल भारतीय समन्वित गेहूँ एवं जौ सुधार परियोजना के 12 केंद्रों और अन्य सहयोगी संस्थानों के माध्यम से गेहूँ एवं जौ की तकनीकों का प्रसार किया गया। स्थानीय बाधाओं के बावजूद प्रदर्शनों ने बेहतर प्रदर्शन किया और उपज के अंतर को कम करके अंगीकरण को बढ़ावा दिया। एससीएसपी, टीएसपी एवं समूह प्रदर्शनों और अग्रिम पंक्ति प्रदर्शनों जैसे कार्यक्रमों के माध्यम से किसानों को हाल ही में अनुमोदित गेहूँ एवं जौ की किस्मों के बीज एवं अन्य आवक प्राप्त हुए। किसानों, हितधारकों एवं विस्तार कार्यकर्त्ताओं को प्रक्षेत्र दिवस, जागरूकता कार्यक्रम एवं संवादात्मक सत्रों के माध्यम से बेहतर तकनीकों के बारे में जागरूक करने के लिए शामिल किया गया।

क्षेत्रीय केन्द्र, फ्लावरडेल, शिमला

- फसल वर्ष 2024–25 के दौरान भारत एवं पड़ोसी देशों के प्रमुख गेहूँ–जौ उत्पादक क्षेत्रों में रतुआ रोगों की व्यापक निगरानी, रोगजनक पहचान तथा प्रबंधन–उन्मुख अनुसंधान किया गया।
- क्षेत्रीय निगरानी से गेहूँ के तीनों रतुआ रोग–पत्ती, धारीदार एवं तना रतुआ की उपस्थिति की पुष्टि हुई। पत्ती रतुआ सर्वाधिक तीव्र पाया गया, जबकि इस मौसम में यूजी 99 वंशावली अथवा गेहूँ ब्लास्ट की कोई घटना नहीं देखी गई।
- 14 राज्यों एवं नेपाल से एकत्रित 1293 रतुआ नमूनों के विश्लेषण में धारीदार रतुआ की 11, तना रतुआ की 7 तथा पत्ती रतुआ की 31 प्रजातियाँ पहचानी गई। 46एस119, 47एस103,110एस119, एवं 77–9, 52–4 प्रमुख प्रजातियाँ रहीं।
- 2400 से अधिक गेहूँ एवं जौ लाइनों (204 गेहूँ एवीटी तथा 254 जौ एनबीडीएसएन / ईबीडीएसएन प्रविष्टियाँ) की स्क्रीनिंग से कई प्रतिरोधी स्रोत पहचाने गए, जिनमें एमएसीएस 4147 तीनों रतुआ रोगों के प्रति प्रतिरोधी पाई गई।
- रतुआ प्रतिरोधी जीनों के विश्लेषण में वाईआर2, एसआर2, एसआर7, एवं एलआर13 प्रमुख पाए गए तथा वाईआर9 / एलआर26 / एसआर31, एलआर24 / एसआर24, वाईआर18 / एलआर34 / एसआर55, वाईआर17 / एलआर37 / एसआर38 एवं एसआर2 जीन समूहों की आणविक पुष्टि हुई।
- वयस्क पौधा प्रतिरोध अध्ययनों से कई एवीटी प्रविष्टियों में पौध अवस्था में संवेदनशीलता के बावजूद वयस्क अवस्था में स्थायी, प्रजाति–विशिष्ट प्रतिरोध स्पष्ट हुआ।
- जौ में, एनबीडीएसएन / ईबीडीएसएन की कोई भी प्रविष्टि तीनों रतुआ रोगों के प्रति पूर्ण प्रतिरोधी नहीं पाई गई। हालांकि, कई प्रविष्टियों ने एक या दो रतुआ रोगों के विरुद्ध प्रभावी प्रतिरोध दिखाया, तथा आरपीएच3 और आरपीएच19 प्रमुख पत्ती रतुआ प्रतिरोधी जीन पाए गए।
- गेहूँ एवं जौ में संकरण, जीन संयोजन एवं प्रजनन जनसंख्या विकास द्वारा रतुआ–प्रतिरोधी आनुवंशिक स्टॉक्स विकसित किए गए। साथ ही राष्ट्रीय एवं सार्क गेहूँ रोग निगरानी नर्सरी के माध्यम से क्षेत्रीय रोग जानकारी उपलब्ध कराई गई और 150 से अधिक रतुआ प्रजातियों का राष्ट्रीय भंडार संरक्षित किया गया।

क्षेत्रीय केंद्र, दालंग मैदान, लाहौल स्पीति

- ऑफ–सीजन 2025 के दौरान, 16 से 21 मई, 2025 तक आरएस दलंग मैदान में गेहूं और जौ की नर्सरी में शोध सामग्री बोई गई और सितंबर–अक्टूबर 2025 में इसकी कटाई की गई।
- शोध सामग्री में देश भर के विभिन्न संस्थानों के 45 सहयोगियों से प्राप्त गेहूं और जौ की 42000 से अधिक लाइने शामिल थीं।
- इस सीजन में विभिन्न केंद्रों द्वारा लगभग 14000 गेहूं की लाइनों की पीली रतुआ और फफूंदी रोग के लिए जांच की गई।
- इस सुविधा का उपयोग क्रॉसिंग, पीली रतुआ के नमूनों के संग्रह, गेहूं रोग निगरानी नर्सरी और जर्मप्लाज्म भंडारण के लिए भी किया गया।

बीज व अनुसन्धान प्रक्षेत्र, हिसार

- 2024–25 सीजन के दौरान, गेहूं (डीबीडब्लू303) और जौ की अलग–अलग किस्मों (डीडब्लूआरबी101, डीडब्लूआरबी123, डीडब्लूआरबी137, डीडब्लूआरबी160, डीडब्लूआरबी182 और डीडब्लूआरबी219) के 1099 क्विंटल ब्रीडर बीज का उत्पादन किया गया।
- एआईसीआरपी के तहत, 2024–25 के दौरान जौ एवीटी–एसएएल / एएलके का दो लवणीय वाले माहौल में ट्रायल किया गया। गेहूं (एनडब्लूपीजेड, एनईपीजेड, सीजेड, पीजेड–आरआई–टीएस) का एक स्टेशन ट्रायल किया गया, जिसमें 2 रेप्लिकेशन में 25 एंट्री थीं।
- कुल 105 रिलीज की गई किस्मों को मिट्टी की लवणीय सहनशीलता के लिए जाँचा गया और पांच किस्मों (के–508, पीएल419 और आरडी2552) ने लवणीय सहनशीलता को पुष्ट किया। जौ की किस्मों डीडब्लूआरबी137, डीडब्लूआरबी219 और डीडब्लूआरबी223 के म्यूटेशन ब्रीडिंग ट्रायल का एम2 पीढ़ी में चयन किया गया।

EXECUTIVE SUMMARY

CROP IMPROVEMENT

- Wheat production exhibited an increasing trend from 109.52 million tons in 2020-21 to 117.94 million tons in 2024-25, which is the highest wheat production recorded in the country.
- During the year 2025, the Central Sub-Committee on Crops Standards, Notification and Release of Varieties for Agricultural Crops released and notified 13 bread wheat varieties (12 Central released: PBW891, HI1669, HI1674, NIAW4114, Lok79, AKAW5100, GW543, DBW386, DBW443, NW2222, HD3428, WH1306; and one state released: Rajendra Genhu 4) for different production conditions and states vide notification number 2128(E) dated 13.05.2025.
- IIWBR wheat varieties were notified for cultivation in different wheat-growing zones: 1) DBW386 (Karan Khushboo) for irrigated timely sown conditions of North eastern Plains zone and 2) DBW443 (Karan Saanvi) for irrigated timely sown conditions in Peninsular Zone.
- Three bread-wheat varieties DBW325, DBW326 and DBW445 were identified by varietal identification committee for release under irrigated late sown conditions of Central zone, irrigated late sown conditions of Peninsular zone and irrigated early sown conditions of Central Zone, respectively.
- During 2025, two genetic stocks of wheat were registered; GW557 for disease resistance and UASD22-5 for heat and drought tolerance. The genetic resources unit of the IIWBR, Karnal multiplies the seeds of these registered genetic stocks and supplies to breeder across the country for use in wheat improvement
- Five AVT-II bread-wheat entries of IIWBR, Karnal namely, DBW465, DBW466, DBW467, DBW458 and DBW509 were promoted for the final year of testing in AVTs for various zones based on their superior quality and yield.
- During the period, a total of 346 wheat germplasm lines were procured from various sources and supplied 905 accessions of wheat to various indenters for utilization in the research programme.
- At present, around 18500 accessions of wheat are being stored in Medium term storage module at IIWBR, Karnal (4°C and 30% RH) and more than 10000 accessions are being conserved at Dalang Maidan, Himachal Pradesh under natural condition as safety duplicate.
- From conserved germplasm a total of 585 wheat accessions (353 Bread wheat, 154 *dicoccum*, 20 *durum*, 14 *turgidum*, 12 *polonicum*, 13 *turanicum* accessions, 11 *carthlicum*, and one accession each of *compactum* & *triticale*) were evaluated as per DUS testing guideline of wheat for eight traits.
- During the period, two bread wheat varieties namely Karan Shivangi (DBW359) and DBW377 (Karan Bold) were registered by the PPV&FRA, New Delhi under extant category vide registration number REG/2024/0441 and REG/2024/442, respectively.
- Registration application of two wheat varieties namely DBW386 and DBW443 has been submitted to PPV&FRA, New Delhi for registration under extant category.
- A comparative transcriptomic analysis was conducted for the nitrogen-efficient (BNI-Munal) and derivative parent Munal wheat genotypes to unravel the gene expression patterns across four nitrogen levels (0, 50, 75, and 100% recommended levels). The identified five unigenes (three up-regulated and two down-regulated) were consistently expressed across all nitrogen levels. Further analysis of up-regulated unigenes identified links to the *NrpA* gene (involved in nitrogen regulation), tetra-tricopeptide repeat-containing protein (PPR), and cytokinin dehydrogenase 2.
- 165 wild wheat accessions were evaluated for stress tolerance. *A. tauschii* accessions no. 3806, 3753, and 9803 were found tolerant to drought stress whereas accession no. 3753 and 9803 were found tolerant to heat stress. *Ae peregrina* accessions no. 102, 103 were observed tolerant to heat and drought stress.
- Five introgressed lines namely HTW 2312

(DBW39/*Ae. speltoides*), HTW 2304 (Ae. tauschii/4*HD2967), HTW2309 (PBW698/*Th. bessarabicum*), HTW2305 (SYN224/3*WH1105), HTW2307 (*Ae. compactum*/K1213/2*WH1105) were found promising for heat (HSI<1) and drought tolerance (DSI <1) in screening nursery.

- Ninety wheat genotypes were evaluated for grain zinc, Iron and protein contents and two genotypes BFKW101 and BFKW103 were identified with >50 ppm Zn and >55 ppm Fe.
- Under Inter-institutional collaborations with ICAR-NDRI Karnal, ICAR-IIFSR and ICAR-CPRI-RS, Modipuram, ICAR-IIWBR has produced 5833.25 q of breeder seed and 3249.51q of TL seed of 15 wheat *viz*., DBW 327, DBW 377, DBW303, DBW187, DBW222, DBW 359, DBW 370, DBW 371 and DBW 372 whereas total 300.39q seed of 06 barley varieties was produced at Seed and Research Farm, (ICAR-IIWBR), Hisar during 2025.
- Selling of nucleus/breeder and TL Seeds of wheat generated a total amount of Rs. 7.54 crores under the revolving fund scheme of the institute.
- ICAR-IIWBR, Karnal has upgraded IIWBR Seed Portal to register and distribute TL seed of recent wheat varieties *viz*., DBW 327, DBW 377, DBW 303, DBW 187, DBW222 *etc*. to the farmers in all the wheat growing states.
- A bi-parental mapping population was subjected to 35K SNP array analysis and prominent QTLs on chromosomes 3B, 3D, and 6B were associated with grain yield, grain number, and thousand grain weight under late-sown and sudden heat stress conditions. SNPs linked to these stable regions were converted into KASP markers and validated across three independent populations, confirming their reliability.
- Effect of bacterial inoculation on gene expression of drought responsive genes (*DREB2A, APX1, CAT1, TaCYP707A1, SAMS1, HSP17.8* and *DHN)* was studied under drought stress using qRT PCR. Genes *DREB2A, CAT1, APX1, SAMS1* and *HSP17.8* showed up-regulation in un-inoculated drought stress wheat plants, while bacterial-inoculated stressed plants displayed reduced transcript accumulation indicating role of endophytic bacteria in regulation of drought responsive genes under drought stress conditions.
- The expression analysis of *DREB2A* (dehydration-responsive element binding proteins), *CAT1* (catalase), *DHN* (dehydrins), *TaCYP707A1* (cytochrome P450 monooxygenase 707A1) and *APX1* (ascorbate peroxidase), *HSP17.8* (heat shock protein) and *SAMS1* (S-adenosyl-methionine synthetase) genes in presence of 11 of potential endophytic bacteria was studied.
- Genes *APX1, DREB2A, CAT1* and *DHN* were up-regulated significantly in negative control seedlings under drought stress compared to positive control seedlings
- The T7 endonuclease assay of genomic DNA from MS1-edited plants revealed altered cleavage band patterns compared to controls, indicating the presence of CRISPR/TALEN/ZFN-induced indels at target loci, which will be further confirmed by sequencing.
- Seven key C4 photosynthetic genes were analyzed in wheat using real-time PCR across genotypes with contrasting photosynthetic and assimilation rates, revealing significantly higher expression of *TaAspAT* and *TaPEPC* in high-performing genotypes. These genes were identified as potential rate-limiting candidates for further genetic engineering and genome editing to enhance photosynthetic efficiency in wheat.

CROP PROTECTION

- Out of 300 wheat germplasm lines evaluated against stripe rust, leaf rust, and leaf blight, only five genotypes *viz*., EC1175030, EC1175031, EC1175177, EC1175196, and EC1175246 were found resistant against all three diseases.
- *Trichoderma harzianum* proved most effective in managing wheat leaf rust, reducing disease severity to 10MS.
- Morphological, pathogenic, and molecular variations were assessed in 51 *Bipolaris sorokiniana* isolates, with Bs-3 identified as the most virulent.
- Sixty significant MTAs, including 33 novel ones, were identified for spot blotch resistance across key traits (AUDPC, IP, LL, and LB).

- Key genes (*TaEDS1, TaNPR1, TaNDR1*, sugar transporters) of Salicylic acid and sugar pathways were differentially expressed.
- A total of 132 aquaporin genes were characterized, with conserved motifs identified as key to stress adaptation.
- Fusarium head blight (FHB) isolates were characterized through morphological, pathogenic, and molecular analyses, revealing eight *Fusarium* species with diverse growth patterns and virulence, notably *F. cerealis*, *F. culmorum*, and *F. incarnatum* as the most aggressive.
- WRIST (Wheat Rust Information and Surveillance Tracker), an interactive visualization platform developed in Google Looker Studio, enables exploration of spatio-temporal trends and long-term disease dynamics.

RESOURCE MANAGEMENT

- Crop diversification options like maize-mustard-green gram and maize-wheat-green gram under conservation agriculture was more productive and profitable than conventional agriculture.
- A long-term tillage experiment in maize-wheat-green gram system indicated that among nutrient management, wheat grain yield was maximum with application of recommended NPK + 10 t/ha FYM. Maize productivity was higher in zero tillage-based options as compared to CT.
- Rice yield was higher under puddle transplanted conditions over direct seeded rice (DSR) whereas wheat yield improved when sown after DSR under no-till and residue retention conditions.
- Integrated nutrient management consisting of application of recommended doses of chemical fertilizers (NPK 150:60:40) with 15 t/ha FYM was found the highest yielder followed by recommended NPK + green manuring. Sole use of P, K or PK did not improve the wheat productivity compared to absolute control.
- In organic production of HYVs (HD 2967, DBW 187, DBW 222 and DBW 303) of wheat, the yield with 30 t FYM/ha application was significantly lower than recommended doses of chemical fertilizers (NPK 150:60:40).
- Grain yield of maize, wheat, rice and barley in maize-barley and rice-wheat cropping systems was reduced significantly under natural farming protocol over conventional practice.
- Premix combination of bixlozone + metribuzin at 900 (750+150) g/ha at 35 DAS was very effective for control of diverse weed flora in wheat.
- In rice-wheat system, double no-till system led to more problems of *Rumex dentatus* and *Medicago denticulata*. Wild oat infestation was observed higher in maize-wheat than in rice-wheat system. Also, wild oat infestation was less in ZT-wheat compared to CT-wheat.
- For control of metsulfuron resistant *Rumex dentatus* and *Chenopodium album*, halauxifen + fluroxypyr, aclonifen + diflufenican, pendimethalin, 2,4-D and carfentrazone, were found effective.
- For management of multiple herbicide resistant *P. minor*, *Avena ludoviciana* and *Polypogon monspeliensis* (against clodinafop, pinoxaden and sulfosulfuron) pyroxasulfone, bixlozone + metribuzin and aclonifen + diflufenican were found effective in wheat.
- Halauxifen + fluroxypyr 200.6 (6.1+194.5) and metsulfuron + carfentrazone 4 + 20 g/ha were found effective for control of diverse type of broadleaved weed flora in barley.
- Grain yield of barley improved significantly with two sprays of chlormequat chloride (Lihocin) @ 0.2% + tebuconazole (Folicur 430 SC) @ 0.1% of commercial product dose as tank mix at the first node and flag leaf.
- Significantly higher water productivity of wheat genotypes was observed with 80% ETc over 100% ETc irrigation level. Genotypes LBP2023-8 and DBW466 were identified as water efficient and top yielding genotype having water productivity in 3.0-3.05 kg/m^3 and yield in 68.7-69.8 q/ha range, respectively.

QUALITY & BASIC SCIENCES

- Under the work on CRP biofortification of wheat grain, one entry has been contributed to QCWBN while another one to station trial based on superior yield, high Fe, Zn, and protein for the cropping season 2025-26.

- Across generations, iron content ranged from 29.9 to 61.4 ppm while zinc content ranged from 21.6-45.1 ppm under CRP biofortification.
- Number of entries having sedimentation volume ≤30 ml was 6, 7 and 13 respectively for F4, F5 and F6 and advanced, respectively for NapHal carrying crosses.
- The starch content in segregating lines, fixed lines, AVTs and released varieties (a set 62 varied genotypes), ranged from 46.0 to 70.3 g/100 g on dry weight basis with an average of 58.2%.
- The glycemic index of 25 RIL lines of *T. dicoccum* developed by UAS, Dharwad ranged from 38.3 to 64.3 (average 50.8), showing wide variation in glycemic index.
- The coefficient of determination (R^2) for the micro-test was found to be 0.84 while correlation coefficient (R) was 0.92, demonstrating that 1 g micro-test can effectively be harnessed for sedimentation volume calculation (n=82).
- A comparative nutraceutical analysis of wheat grass juice from diverse wheat genotypes was conducted to assess phytochemicals, antioxidant potential, and nutritional quality for health-promoting applications.
- *In-silico* characterization and variability analysis of the phytase gene in wheat was performed to understand conserved domains, evolutionary relationships, and gene diversity for nutritional improvement.
- Various durum wheat varieties were used to produce wheat grits (*daliya*), and their physicochemical, cooking, and sensory properties were evaluated.
- Storage-related changes in the sensory overall acceptability score of sugar snap cookies fortified with chickpea flour and finger millet flour were assessed.

BARLEY IMPROVEMENT

- A hulless barley genotype DWRB 223 was released and notified in the year 2025 for its cultivation in NWPZ. This variety has desirable traits like high grain yield (42.96 q/ha), resistance to yellow rust disease and excellent combination of nutritional traits viz; protein (11.7%), β-glucan (6.0%), zinc (47.8 ppm) and iron (43.7 ppm).
- Three entries namely DWRB 244 (hulless barley), DWRB235 and DWRB238 (malt barley) were identified by VIC in the 64th All India Wheat and Barley Research Workers Meet, held at RVSKVV, Gwalior during August 25-27, 2025.
- Two entries DWRB2318 (dual purpose barley) and DWRB2312 (malt barley) were promoted to AVT-II in NWPZ.
- Two entries of hulless barley (DWRB 2408 and DWRB 2410) were promoted to the AVT-I- (2025-26) in NEPZ while three entries namely, DWRB 2407, DWRB 2410 and DWRB 2425 in CZ.
- Among 109 barley germplasm lines evaluated, 8 genotypes showed complete resistance to stripe rust (AUDPC = 0). Against spot blotch, no genotype was identified as resistant; however, three genotypes exhibited moderate resistance across locations.
- Field experiments on cultivar Jyoti demonstrated a strong negative correlation between stripe rust severity and yield. Maximum yield loss of 74.83% was recorded at 100S disease severity, highlighting the economic importance of rust management.
- Total 27 isolates collected from nine states showed wide morpho-cultural and pathogenic variability. Significant differences were observed in colony growth, colour, conidial size, and septation. SSR marker analysis revealed moderate genetic diversity, with 76% variation within populations and 24% among populations.

SOCIAL SCIENCES

- During the *rabi* crop season 2024-25, 140 hectares Barley Frontline Demonstrations (BFLDs) were allotted to 38 cooperating centers all over India in eight states/UT namely, Himachal Pradesh, Uttar Pradesh, Bihar, Jammu & Kashmir, Punjab, Haryana, Rajasthan, and Madhya Pradesh. Out of these, 139.6 ha BFLDs were conducted by 38 centers, covering 146.2 hectares area of 403 farmers. Improved barley varieties with complete package of practices (irrigation management, nutrient management, weed control, seed treatment *etc.*) were demonstrated.

- The yield gain due to improved varieties over regional mean yield was highest in NHZ (43.00%) followed by NEPZ (32.87%), CZ (30.16%) and NWPZ (20.94%).
- The varieties HBL 400 (27.75 q/ha) at Shimla centre (NHZ); RD 2907 (42.75 q/ha) at Gorakhpur-2 centre (NEPZ); RD 2907 (73.43 q/ha) at Durgapura Jaipur (NWPZ) and RD 2899 (46.75 q/ha) at Vidisha (CZ) were the highest average yielding.
- On an average, improved barley varieties demonstrated at the farmers' field under the FLD programme gave profit around ₹70741 per hectare. Punjab registered the highest returns per rupee of investment (₹3.67) through demonstrations. The difference in profit between FLD and check plots ranged from ₹23659 in Uttar Pradesh to ₹82668 in UT of J&K. The returns per rupee of investment across barley growing zones were highest in the NWPZ (₹3.22), followed by CZ (₹2.81) and NHZ (₹2.45).
- Overall analysis of constraints in different zones clearly indicated that high cost of inputs, decline in water table, and existence of *Phalaris minor* (Mandusi) were the most serious constraints in the country. Non-availability of labour, small land holding, untimely rain, and poor participation in exposure visits arranged by various departments, low price of barley grains, non-availability of seed of newly released varieties, lack of facility of canal irrigation water, were under serious category affecting barley production and productivity in the country.
- Under SCSP Programme, 560 varietal demonstrations of wheat varieties, DBW 187, DBW 332, DBW 370, DBW 371 and DBW 372 were organized during 2024-25 *rabi* crop season to assess their performance at farmers' field. The demonstrations were carried out through KVK of Punjab (18), Haryana (4), Rajasthan (2), UT of Jammu & Kashmir (1), HP (1), and RLBCAU Jhansi (1) covering a total of 560 acres area of 560 farmers of Scheduled Castes (SC) category.
- During the *rabi* crop season 2024-25, 1100 cluster demonstrations were conducted by 11 Krishi Vigyan Kendras covering 440 hectares area benefitting 1053 farmers. During the crop season, farmers were guided by providing timely advice on different intercultural operations. Among all the demonstrations, maximum yield gain (11.60%) was recorded in Purnea (Bihar). The profit per hectare in the demonstrated plots was highest in Moga, Punjab (₹48951), followed by Dholpur, Rajasthan (₹44935).
- During *rabi* crop season 2024–25, wheat and barley technologies were disseminated through 26 Krishi Vigyan Kendras (KVKs), 12 AICRP centres, and other partner institutions. Demonstrations tailored to local constraints showcased improved practices, bridging yield gaps and promoting adoption. Under programs like SCSP, TSP, Cluster Demonstrations and FLDs; farmers received seeds of recently released wheat and barley varieties and other inputs. Field days, awareness programmes and interactive sessions engaged farmers, neighbouring stakeholders, and extension agents in learning about superior technologies.

REGIONAL STATION, FLOWERDALE, SHIMLA

- In 2024–25, wheat and barley rust surveillance was conducted across India and neighbouring countries. All three wheat rusts (leaf, stripe, and stem) were recorded; leaf rust was most prevalent. No wheat blast or *Ug99* was detected.
- 1,293 rust samples were analyzed: stripe rust (11 pathotypes), stem rust (7), leaf rust (31). Key pathotypes included 46S119, 47S103, 110S119, 79G31, 40A, 40-3, 77-9, 52-4. Karnataka showed highest diversity.
- 2,400+ wheat and barley lines were screened for seedling resistance. Among 204 AVT wheat entries, MACS4147 was resistant to all rusts; others showed single/dual rust resistance.
- Key resistance genes identified: *Yr2* (stripe), *Sr2/Sr7b* (stem), *Lr13* (leaf); gene complexes *Yr9/Lr26/Sr31*, *Lr24/Sr24*, *Yr18/Lr34/Sr55*, *Yr17/Lr37/Sr38*, and *Sr2* were confirmed by markers.
- Adult plant resistance (APR) studies showed that several AVT lines had race-specific resistance at later stages despite seedling susceptibility, indicating durable resistance potential.
- In barley, no line resisted all rusts; some resisted two

rusts or all pathotypes of individual rusts. *Rph3* and *Rph19* were major leaf rust resistance genes.

- Progress was made in developing rust-resistant stocks via crossing, gene pyramiding, and segregating population advancement. National and SAARC nurseries provided regional disease intelligence, and a repository of 150+ rust pathotypes was maintained.

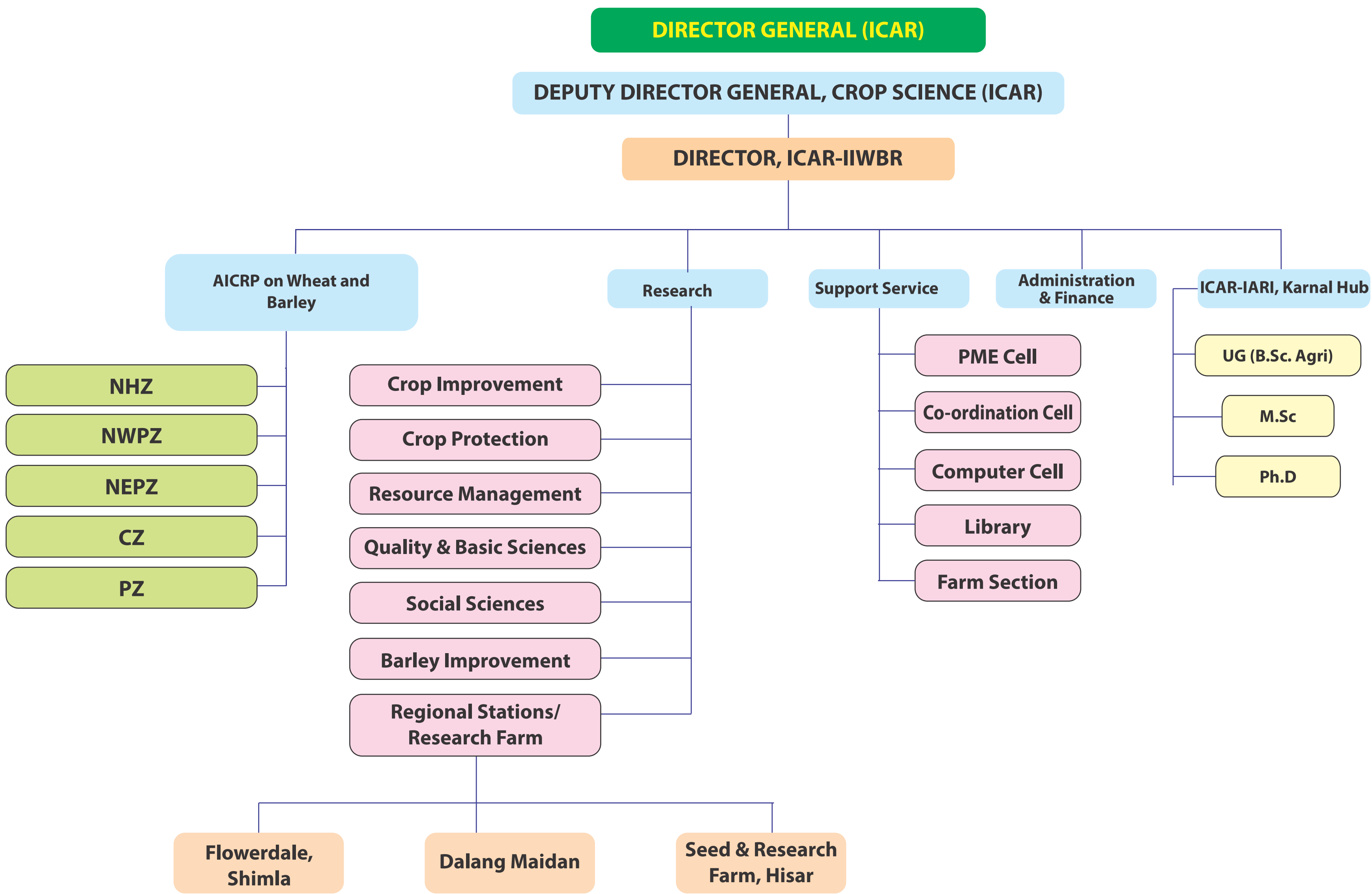
REGIONAL STATION, DALANG MAIDAN, LAHAUL & SPITI

- During the off-season 2025 summer nursery, wheat and barley research material was planted at RS Dalang Maidan during 16 - 21st May, 2025 and harvested in September-October 2025.
- The research material comprised of more than 42000 wheat and barley lines from 45 co-operators of different institutes across the country.
- This season around 14000 wheat lines were screened against yellow rust and powdery mildew by various centers.
- The facility was also utilized for crossing, the collection of yellow rust samples, wheat disease monitoring nursery, and germplasm storage.

SEED AND RESEARCH FARM, HISAR

- During the 2024-25 season, 1099 quintals of the breeder seed of different wheat (DBW303) and barley varieties (DWRB101, DWRB123, DWRB137, DWRB160, DWRB182 and DWRB219) was produced.
- Under the AICRP, Barley AVT-SAL/ALK was conducted during 2024-25 under two salinity environments. One station trial of wheat (NWPZ/NEPZ/CZ/PZ-RI-TS) with 25 entries in 2 replications was conducted.
- A total of 105 released varieties were evaluated for soil salinity tolerance and five varieties (K-508, PL419 and RD2552) validated salt tolerance. Selection in M2 generation of mutation breeding trial comprising of barley varieties DWRB137, DWRB219 and DWRB223, was conducted.

ORGANOGRAM


DIRECTOR GENERAL (ICAR)
DEPUTY DIRECTOR GENERAL, CROP SCIENCE (ICAR)
DIRECTOR, ICAR-IIWBR
AICRP on Wheat and Barley
NHZ
NWPZ
NEPZ
CZ
PZ
Research
Crop Improvement
Crop Protection
Resource Management
Quality & Basic Sciences
Social Sciences
Barley Improvement
Regional Stations/ Research Farm
Flowerdale, Shimla
Dalang Maidan
Seed & Research Farm, Hisar
Support Service
PME Cell
Co-ordination Cell
Computer Cell
Library
Farm Section
Administration & Finance
ICAR-IARI, Karnal Hub
UG (B.Sc. Agri)
M.Sc
Ph.D

1 INSTITUTE'S BACKGROUND AND MANDATE

Wheat research across the country has been funded and promoted by the Indian Council of Agricultural Research-ICAR (erstwhile Imperial Council of Agricultural Research) established in 1929 at New Delhi. Despite several thrusts, the realised breakthrough in yield was narrow during the early phase. An important milestone in the wheat improvement programme was created with the establishment of the 'All India Coordinated Wheat Improvement Project (AICWIP) in 1965 with its headquarters at Indian Agricultural Research Institute (IARI), New Delhi. Globally, it became one of the largest networks for a crop improvement programme which laid the foundation for Green Revolution in India. High yielding wheat varieties were made to spread widely across traditional wheat growing regions during this phase. The AICRP, hitherto, has contributed in the release of 540 high yielding wheat varieties comprising bread, durum and dicoccum wheat and around 106 high yielding barley varieties comprising feed, food, malt and dual purpose barley recommended for different agro-climatic zones of the country. The wide adoption of wheat varieties has begun with the earliest semi-dwarf varieties like Lerma Rojo, Sonora 64, Chhoti Lerma, Kalyansona and Sonalika. Some of the varieties became extremely popular and occupied large acreage. The project later was elevated to the status of Directorate of Wheat Research in 1978. The Directorate was shifted to the present location at Karnal in 1990 and was also assigned the responsibility of coordinating Barley Improvement Project. This arrangement continued during the VIII Five Year Plan. During the IX Five Year Plan, both barley and wheat projects were merged as “All India Wheat and Barley Improvement Project” in 1997 and this arrangement is being continued since then and now popularly known as the All India Coordinated Research Project (AICRP) on Wheat and Barley. The Directorate has been upgraded to Indian Institute of Wheat and Barley Research in 2014 and popularly tagged as ICAR-IIWBR, Karnal. It is a premier organization under the aegis of ICAR coordinating the multidisciplinary and multi-location testing of varieties in different AICRP centres', crop management and crop protection technologies across the diverse ecosystems for increasing and stabilizing the wheat production. The 29 funded centres located in different locations across the country support multidisciplinary research on wheat and barley. Each Centre also has its regional mandate depending upon the agro-climatic conditions as well as the prevalent diseases/pest situation in addition to the national / zonal requirements. Increased industrial demand has put barley crop as cash crop. Contractual farming and giving premium on better malt producing varieties has given a boost to cultivation of the crop in its niche area. In addition to the headquarters, IIWBR has two regional research stations, one at Flowerdale, Shimla (established in 1930), which serves as a national facility for monitoring wheat rust pathotypes, evaluating advanced generation material, postulating probable rust resistance genes in the test lines and act as a repository for maintenance of the wheat rust virulences. The another regional station at Dalang Maidan is located at an altitude of 10,000 feet with twelve hectares of land, of which six hectares is cultivable. The office cum laboratory and guest-house facilities has been created for the benefit of research workers. Facilities of this station are being utilized for advancing the generation, conservation of germplasm under natural conditions, making crosses during off-season and screening against yellow rust resistance by AICRP on wheat & barley centres. Another important milestone in the institute's history was the allotment of 200 acre land by the council at Hisar in 2012 for experiment and seed multiplication purposes.

MANDATE

The institute mandate is

- Basic and strategic research on wheat and barley to improve productivity and quality.
- Coordination and development of improved crop production and protection technologies for sustainable production.
- Providing genetic diversity and accelerate the breeding cycle through off season facilities.
- Surveillance and forewarning for management of rust diseases.
- Dissemination of improved technologies, capacity building development of linkages.

THE MISSION

Ensuring food and nutritional security by enhancing the productivity and profitability of wheat and barley on an ecologically, socially and economically sustainable basis and making India the world leader in climate smart wheat system production.

2 CROP IMPROVEMENT

Release of new wheat varieties for different zones/states

During the year 2025, the Central Sub-Committee on Crops Standards, Notification and Release of Varieties for Agricultural Crops released and notified the 13 bread wheat varieties (12 Central released: PBW891, HI1669, HI1674, NIAW4114, Lok79, AKAW5100, GW543, DBW386, DBW443, NW2222, HD3428, WH1306; and state released: Rajendra Genhu 4 for different production conditions and states vide notification number 2128(E) dated 13.05.2025 (Table 2.1).

New genetic stocks of wheat registered

During the year 2025, two genetic stocks of wheat were registered for traits like disease resistance and heat and drought tolerance. The genetic resources unit of the IIWBR, Karnal multiplies the seeds of these registered genetic stocks and supplies to breeder across the country for use in wheat improvement (Table 2.2).

Table 2.1. Wheat varieties released during 2024-25

SN	Variety name	Developed by	Zone/ state	Production condition	Grain yield (q/ha)		Special features
					Average	Pot.	
Central released							
1.	PBW 891	PAU, Ludhiana	PZ	IR, TS	50.7	80.7	Highly resistant to black rust (HS: 20S & ACI: 9.2) & brown rust (HS: 20S & ACI: 8.0). Good amount of protein content (12.6%) and grain iron content (41.5 ppm)
2.	HI 1669 (Pusa Wheat Kranti)	IARI Regional Station, Indore	CZ	IR, TS	59.2	82.7	Resistant to leaf rust (HS40S, ACI-9.3) and stem rust (HS10S, ACI-3.7). Good amount of zinc content (40.6 ppm) and tolerant to heat stress (HSI=0.85).
3.	HI1674	IARI Regional Station, Indore	CZ and PZ	IR, LS	50.3 (CZ), 46.0 (PZ)	82.7(CZ), 63.4(PZ)	High degree of resistance against brown rust (HS:15MS; ACI:5.8) and black rust (HS:20MS, ACI:2.7). Good amount of protein content (12.5%), grain zinc content (42.6ppm) and grain iron content (40.1 ppm) in PZ
4.	Phule Shashwat (NIAW 4114)	MPKV ARS, Niphad	PZ	IR, LS	47.9	70.2	Resistant against leaf rust (ACI-3.4) and stem rust (ACI-7.4) with good amount of protein content (12.7%).

SN	Variety name	Developed by	Zone/ state	Prod. condition	Grain yield (q/ha) Average	Pot.	Special features
5.	Lok-79 (Biofortified variety)	Lokbharti Gramvidyapith, Sanosara	PZ	IR, LS	45.1	69.7	Resistant to stem rust (ACI-3.1). Good amount of protein (12.9%), iron (44.4ppm) and zinc (42.3ppm) content
6.	AKAW5100 (Heat and drought tolerant)	PDKV, Akola	PZ	IR, TS	49.3	80.4	Resistant to black rust (ACI- 4.5) and brown rust (ACI-5.7). Rich in protein (12.7%) content. Heat and drought tolerant with HSI of 0.75 & DSI of 0.93
7.	GW543	SDAU, WRS, Vijapur	CZ	IR, ES	64.0	88.0	Resistant to leaf rust
8.	DBW 386 (Karan Khushboo)	ICAR-IIWBR, Karnal	NEPZ	IR, TS	52.0	70.6	Resistant to all the three rusts and wheat blast; Tolerant to heat stress with HSI of 0.67
9.	DBW443 (Karan Saanvi) (Biofortified variety)	ICAR-IIWBR, Karnal	PZ	IR, TS	49.2	77.6	Bio-fortified variety with good amount of protein (13.4%), iron (41.9ppm) and zinc (43.0ppm) content; better heat (HSI:0.85) and drought stress tolerance (DSI:0.89)
10.	NW2222	Nuziveedu seed Ltd.	PZ	IR, TS	52.0	77.3	Resistant to brown rust with tolerant to heat stress (HSI:0.85)
11.	HD 3428 (Pusa Surya)	ICAR-IARI, N. Delhi	NWPZ	IR, LS	51.2	77.2	High resistance to leaf (ACI-1.1) and stripe (ACI-12.2) rusts with good amount protein (12.2%), iron (41.1ppm) content; tolerant to heat (HSI0.67) & Drought (DSI:0.79) stress
12.	WH1306	CCS HAU, Hisar	PZ	IR, TS	50.4	72.8	Biofortified wheat variety with good amount of protein (12.4%), iron (40.8ppm) and zinc (40.5ppm)
State released							
Bread wheat							
1.	Rajendra Genhu 4	RPCAU, Pusa	Bihar	IR, TS	47.0	-	High iron content (43.0ppm)

Table 2.2. Genetic stocks registered during 2024-25

SN	Name of genotype	Registration number	Developing centre	Traits
1	GW 557 (J2020-07)	INGR24059	WRS, JAU, Junagadh,	Leaf and Stem rust resistance [Leaf rust score (ACI = 0.3-3.3); Stem rust score (ACI = 0.0-2.3)].
2	UASD 22-5	INGR24060	UAS, Dharwad	Tolerance to drought (DSI = 0.62) and heat stress (HSI = 0.73)

Varieties released by ICAR-IIWBR

DBW386 (Karan Khushboo)

DBW386 released for Timely sown, irrigated conditions of North Eastern Plains Zone vide gazette no. SO. 2128 (E) dated 13.5.2025. This variety is having an average and potential yield of 52.01q/ha and 70.6q/ha, respectively. It has resistance to wheat blast, and highly resistant to stripe (ACI 10), leaf (ACI 9.2) and stem rust (ACI 6.4) and insect pests. It is also highly tolerant to heat stress with Heat Susceptible Index (0.67) (Fig. 2.1).

DBW443 (Karan Saanvi)

Wheat variety DBW443 was released by the Central Sub-Committee on Crop Standards, Notification, and Release of Varieties, Ministry of Agriculture and Farmers Welfare, Government of India vide Gazette Notification No. S.O. 2128 (E) dated 13th May, 2025 for the irrigated timely sown conditions of Peninsular Zone. This variety is having an average and potential yield of 49.2 q/ha and 77.6 q/ha, respectively. It flowers in about 63 days and matures in about 109 days. DBW443 is an indigenously developed biofortified wheat genotype having higher protein (13.4%), grain zinc (43.0 ppm) and iron (41.9 ppm). This variety is having a thousand grains weight of 45g. It is resistant to wheat blast, leaf rust and brown rust diseases. DBW443 has shown low heat sensitivity index of (0.85) and drought sensitivity index (0.89) indicating better heat and drought stress tolerance. DBW443 has a hectoliter weight of 80.9 kg, sedimentation value (52.9 ml), high hardness index (82.7) and good chapati quality score (7.1/10) (Fig. 2.2).

Fig. 2.1. Field view of DBW386 at heading stage

Fig. 2.2. Field view of DBW443 at heading stage

Wheat varieties identified

DBW425: Wheat variety DBW425 (KACHU /SAUAL/4/ ATTILA*2/PBW65//PIHA/3/ATTILA /2*PASTOR) was selected from CIMMYT nursery 39th ESWYT. It was evaluated in NIVT 3B and AVT-IR-LS-CZ. In coordinated trials conducted over three years in various locations under late sown, irrigated condition of central zone, it recorded high mean yield (47.9q/ha) and established yield superiority over check varieties MP 4010 (15.1%), HD 2932 (6.2%), CG 1029 (6.7%) and HI 1634 (7.2%). DBW425 had the high frequency (17/30) of occurrence in the first non-significant group indicating its wider stability across the varied locations. It had high yield potential of 59.0 q/ha. DBW425 showed resistance to leaf (ACI- 8.4) and stem (ACI-14.3) rusts under artificial conditions. It showed high degree of adult plant resistance to the prominent races of leaf rust (77-5 & 104-2) and stem rust (40A & 11 in 2023-24 and 117-6 in 2024-25). DBW 425 recorded mean yield of 38.73 q/ha under different sowing dates with yield superiority of 3.72% over MP 4010 (37.29 q/ha), and 1.70% over HI 1634 (38.07 q/ha) (Fig. 2.3). It has more earheads than checks under late sown and comparable under very late sown conditions and has high 1000 grain weight than check varieties. DBW425 possesses better

Fig. 2.3. Field view of DBW425 at heading stage

quality attributes indicated by 80.2 kg/hl test weight and 12.3% protein, high chapati quality (7.5), bread quality (7.0). It has low phenol test value (3.6) than all the checks. Based on the yield and rust resistance, DBW425 was identified by varietal identification committee during 64th All India Wheat & Barley Research Workers' Meet held at RVSKVV, Gwalior on 26.8.2025.

DBW426

Wheat variety DBW426 was identified for irrigated late sown conditions of Peninsular zone comprising states of Maharashtra, Karnataka and Plains of Tamil Nadu by the Varietal Identification Committee during the 64th All India Wheat & Barley Research Workers' Meet held at RVSKVV, Gwalior from August 25-27, 2025 (Fig. 2.4). DBW426 is a triple bio-fortified wheat genotype having higher grain zinc (44.9 ppm) and iron (45.6 ppm) and protein (13.4%) content. DBW426 recorded high mean yield (44.7q/ha) and established yield superiority over check varieties Raj4083 (12.9%), HD2932 (10.9%), HI1633 (10.6%) and HD3090 (4.0%) (Fig. 2.4). It had a potential yield of 69.8 q/ha. It has recorded highest thousand grain weight of 45g. DBW426 has hectolitre weight of 77.8 kg, sedimentation value (55.3ml), good chapatti quality score (7.5/10), bread loaf volume (593 ml), biscuit spread factor of 8.7 and gluten index (89%). DBW426 is resistant to leaf and stem rust under natural and artificial conditions as evident from the lower ACI values. DBW426 has shown resistant to all the pathotypes of black and brown rust pathotypes in the seedling resistance test. Under APR studies, conducted for predominant race of brown rust *viz.*, 77-5, 77-9, 104-2 it had shown immune reaction. Gene postulation indicated gene combination *R* for black and brown rusts. The genotype has also shown resistance against Karnal bunt (avg. score 5.1).

DBW445

Wheat variety DBW445 was identified for irrigated Early Sown Condition of Central Zone (Madhya Pradesh, Chhattisgarh, Gujarat, Kota and Udaipur divisions of Rajasthan and Jhansi division of Uttar Pradesh) by the Varietal Identification Committee during the 64th All India Wheat & Barley Research Workers' Meet held at RVSKVV, Gwalior from August 25-27, 2025 (Fig. 2.5). It recorded superiority over all the check varieties DBW303 (8.4%), DBW377 (6.9%), GW322 (4.3%), DBW187 (3.6%) and DBW327 (3.5%). DBW445 also out yielded the qualifying varieties HD3463 (by 4.4%) and PBW906 (BY 1.5%). DBW445 recorded yield potential of 101.5 q/ha, and a high frequency (10/14) in the first non-significant group, over the years, indicating its stability across locations. Compared to the qualifying varieties, DBW445 has shown high heat and drought tolerance as indicated by lower HSI (0.93) and DSI (1.1) and minimum reduction in yield in both the stressed conditions. DBW445 is highly resistant to stem (black) and leaf (brown) rusts under natural and artificial conditions as evident from the lower ACI values. Under APR studies, conducted for predominant race of stem rust viz., 11, 117-6, 40A; and leaf rust viz., 77-5, 77-9, 104-2; it has shown high resistance at adult plant stage. DBW445 has soft textured grain with a low grain hardness index (50.9) and sedimentation value (48.7cc). It is having grain protein content of 12.0% indicated superior quality. Soft texture of grain has contributed to weaker gluten and hence better biscuit quality. DBW445 has a biscuit spread factor of 8.9.

Fig. 2.4. Field view of DBW426 at grain filling stage

Fig. 2.5. Field view of DBW445 at grain filling stage

Genetic Resources

Exchange: 346 wheat germplasm lines were acquired from various sources. The institute also supplied 905 accessions of wheat to various indenters for utilization in the research programme. This led to revenue generation of Rs. 87000/-.

Conservation: At present, around 18500 accessions of wheat are being stored in medium term storage module at IIWBR, Karnal (4°C and 30% RH) and more than 10000 accessions are being conserved at Dalang Maidan, HP under natural condition as safety duplicate.

Characterisation: A total of 585 wheat accessions (353 bread wheat, 154 *dicoccum*, 20 *durum*, 14 *turgidum*, 12 *polonicum*, 13 *turanicum* accessions, 11 *carthlicum*, and one accession each of *compactum* & *triticale* was evaluated as per DUS testing guideline of wheat. A wide range of variation was observed for days to heading (62-145 days); plant height (93.3-183.7 cm); flag leaf length (19.0-49.8 cm); spike length (5.5-22.3 cm); 1000 grain weight (8.62-61.98 g); spikelets/spike (16-42); grains/spike (20-89) and grain weight/spike (0.34-4.08 g). The promising accessions identified for various traits are given below:

Days to heading and maturity: During 2024-25, the accession PKD 242 (62 days) was earlier than check variety WR 544 (79 days).

Plant height: None of accession had plant height <90 cm. However seven accessions namely PI 185723 *(T. turgidum)* (175.3 cm), MG3521_UNIBO *(T. dic)* (175.3 cm), TRI4332 *(T.dic)* (176.7 cm), MG5390 *(T. dic)* (181.7 cm), MG15516/1 *(T. dic)* (182.7 cm), PI 341391 *(T. turgidum)* (183.7 cm) & TRI4467 *(T. dic)* (183.7 cm) recorded plant height more than 175 cm.

Spike length: Six accessions namely PKD 34 *(T. aes)* (16.2 cm), PKD 65 *(T. aes)* (16.3 cm), PKD 99 *(T. aes)* (16.4 cm), PI 210845 *(T. polo)* (18.5 cm), PI 352488 *(T. polo)* (20.5 cm) & PI 266846 *(T. polo)* (22.3 cm) had spike length greater than 16.0 cm.

Spikelets/spike: Eighteen accessions PI 366117 *(T. polo)* (36), PI 470984 *(T. dic)* (36), TRI4332 *(T. dic)* (36), IG46482 *(T.dic)* (36), MG5344/2 *(T. dic)* (36), MG5380/1/1 *(T.dic)* (36), MG5465 *(T. dic)* (36), MG5474 *(T. dic)* (36), MG15529 *(T. dic)* (36), MG5400/5 *(T. dic)* (36), Farvento *(T. dic)* (36), Lucanica *(T. dic)* (36), MG5293/1 *(T. dic)* (36), MG4360 *(T. dic)* (40), MG5333/1-FARVENTO *(T. dic)* (40), MG5344/3 *(T. dic)* (40), MG5447 *(T. dic)* (40) & MG5307 *(T. dic)* (42) had spikelets per spike more than or equal to 36.

Grains number/spike: Eight accessions namely PKD 121 *(T. aes)* (79), PKD 151 *(T. aes)* (79), PKD 81 *(T.aes)* (80), PKD 126 *(T. aes)* (81), PKD 182 *(T. aes)* (83), PKD 273 *(T. aes)* (83), PI 221423 *(T. turgidum)* (87) & MG3521/1 *(T. aes)* (89) had more than 78 grains per spike.

Grain weight/spike: Eight accessions PKD 229 *(T. aes)* (3.53g), PKD 296 *(T. aes)* (3.57g), PKD 129 *(T. aes)* (3.67g), PKD 74 *(T. aes)* (3.68g), PKD 267 *(T. aes)* (3.71g), PKD 81 *(T. aes)* (3.78g), PKD 182 *(T. aes)* (3.96g) & PKD 151 *(T. aes)* (4.08g) had grain weight/spike more than 3.50 g.

Thousand grain weight: During 2024-25, seven entries O.synthetic 53 *(T.aes)* (57.04g), PKD 164 *(T. aes)* (58.42g), PKD 136 *(T. aes)* (59.00g), O. synthetic 52 *(T. aes)* (59.29g), O. snthetic 43 *(T. aes)* (60.28g), O.synthetic 88 *(T. dic)* (60.33g) & O. synthetic 87 *(T.aes)* (61.98g) had thousand grain weight more than 57.00g.

Registration of varieties with PPV&FRA: Registration application of two wheat varieties namely DBW386 and DBW443 has been submitted to PPV&FRA, New Delhi for registration under extant category. Two bread wheat varieties namely Karan Shivangi (DBW359) and DBW377 (Karan Bold) were registered by the PPV&FRA, New Delhi under extant category vide registration number REG/2024/441 and REG/2024/442, respectively.

Performance of entries in NIVTs

One bread wheat entry DBW500 nominated by the genetic resources unit and tested in NIVT5A during 2024-25. It ranked second in the NEPZ with an average yield of 48.2 q/ha and promoted to AVT-RI-TS of NEPZ.

Performance of entries in AVTs

Two bread wheat entries nominated by the genetic resources unit and tested in different AVTs during 2024-254. Based on better yield performance and disease resistance in AVT, DBW 465 has been promoted to AVT-RI-TS of NWPZ (Table 2.3).

Table 2.3. Performance of entries in AVTs/ NIVTs

Name of Trial	Name of genotype/Check	Yield (q/ha) and Rank	Disease score (ACI) of tested genotype in PPSN	Remarks
AVT-IR-TS	DBW446	62.0 (8)	YR:8.9; LR(N):14.9	
NWPZ	DBW187(check)	65.7 (1)	LR(S):5.7;SR:12.9	-
NIVT5A	DBW465	48.4 (4)		Promoted to AVT-RI-TS-NWPZ
	NIAW3170/HI1612 (Checks)	47.10 (9)	-	

Breeding for NWPZ

Performance of DBW432 in AVT final year trials:

DBW432 was tested in AVT-RI-TS in final year in Central Zone and ranked sixth in the trial. An average of three years data DBW432 had yield superiority of 4.79% but due to high black rust score in final year could not be identified. Its performance in comparison to the checks are presented in Table 2.4

Performance of entries in AVT Ist year trials:

Two bread-wheat genotypes DBW457 & DBW509 were tested in AVT-IR-TS in Central Zone and ranked number sixteen & eight respectively in the trial. Based on its superiority in yield DBW509[B] was promoted to final year testing in 2025-26. In AVT-RI-TS-CZ trial, DBW469 & DBW470 were tested and ranked 8 & 15 respectively. In NWPZ, DBW467 was tested in AVT-RI-TS trial and ranked second, hence promoted to final year of testing in AVT (Table 2.5).

Table 2.4. Performance of DBW432 as compared to checks (Bread wheat) in AVT-RI-TS-CZ 2024-25

Variety	Yield q/ha	Rank	Rust response (ACI)			
			Black	Brown (South)	Brown (North)	Yellow rust
DBW432	42.7	6	31.56	7.13	10.7	5.9
DBW110 (C)	41.9	7	21.78	5.63	6.9	31.7
CG1040 (C)	40.6	9	29.56	12.25	15.0	35.6

Table 2.5. Performance of four AVT first year entries as compared to checks

Variety	Yield q/ha	Rank	Rust response (ACI)			
			Black	Brown (South)	Brown (North)	Yellow rust
AVT-IR-TS-CZ						
DBW457	52.8	16	20.0	6.95	7.88	9.23
DBW509[B]	54.4	8	14.44	9.63	11.0	13.92
GW322 (C)	51.8	19	21.78	7.50	14.0	43.38
MACS6768 (C)	52.6	17	13.58	5.40	3.00	54.77
AVT-RI-TS-CZ						
DBW469	40.9	8	20.44	2.93	12.75	15.14
DBW470	38.9	15	24.56	6.53	10.63	5..69
DBW110 (C)	41.9	7	21.78	5.63	6.9	31.7
CG1040 (C)	40.6	9	29.56	12.25	15.0	35.6
HI8627(d) (C)	37.7	19	8.69	1.10	1.5	8.2
HI8823(d) (C)	38.2	17	2.82	1.03	0.9	10.9
AVT-RI-TS-NWPZ						
DBW467	49.8	2	24.44	5.53	5.03	8.52
PBW644 (C)	45.0	16	22.22	12.50	11.50	27.31
NIAW3170	47.1	9	16.22	6.83	10.43	23.77
DBW296 (C)	48.2	5	20.53	2.05	0.93	3.03
HI1653 (C)	48.0	6	22.44	7.53	11.78	10.89
HD3086 (C)	46.0	14	41.11	16.78	28.85	4.89

Performance of entry DBW486 in NIVT trial:

From the NWPZ breeding programme bread wheat genotype DBW486 was evaluated in the multi-location National Initial Varietal Trials (NIVT) during the season 2024-25. Based on its superiority in yield DBW486 was promoted to AVT-1 for testing in crop season 2025-26 (Table 2.6).

Table 2.6. Performance of DBW486 tested in NIVT-1B during 2024-25

Genotype name	Yield (q/ha) (NWPZ)	Rank		Rust score ACI		
			Bl	Br-S	Br-N	YR
DBW486	69.2	2	32	9.15	4.3	9.08
DBW222 (C)	64.3	12	27.93	4.85	2.38	11.69
DBW187 (C)	59.9	26	25.33	5.63	7.35	5.54
DBW386 (C)	62.7	17	12.22	7.0	7.03	7.03
HD3086 (C)	64.2	13	37.47	16.88	33.25	9.6

Entries evaluated in station trials of IIWBR

A total of 23 entries of the breeding project were evaluated at two or more locations under various IIWBR station trials and RWP2359 & RWP2353 were promoted to NIVT-1A as DBW510 & DBW 514. RWP2264 promoted to NIVT1B as DBW519. RWP2245 promoted to NIVT 3A as DBW524. RWP2325 promoted to NIVT 5A as DBW530 while RWP2260 promoted to NIVT 6 as DBW537.

Performance QCWBN, SATSN and DHTSN

Five entries in DHTSN and one each in QCWBN and SATSN were tested during 2024-25. Genotype RWP2361 from DHTSN was identified as drought tolerant wheat genotype. Performance of DHTSN entries was superior for drought and heat tolerance as indicated by the data in Table 2.7.

Table 2.7. Performance of wheat genotypes tested in DHTSN during 2024-25

Genotype	GYI(g/plot)	GYD(g/plot)	DSI	YR%
RWP2209	655	439	0.99	32.9
RWP2249	701	450	1.08	35.9
RWP2268	671	432	1.07	35.6
RWP2295	738	471	1.09	36.2
RWP2361	644	503	0.66	22.0

Performance of wheat genotypes in IPPSN 2024-25

Screening of station trial entries of NWPZ breeding program for various wheat rust diseases under Initial Plant Pathological Screening Nursery (IPPSN 2024-25) for three rusts of wheat was conducted at more than 12 locations for each rust; yellow rust at sites Khudwani, Malan, Bajaura, Dhaulakuan, Almora, Jammu, Gurdaspur, Ludhiana, Karnal, Hisar, Delhi, Durgapura and Pantnagar; for brown rust (North): Jammu, Ludhiana, Karnal, Hisar, Delhi, Durgapura, Pantnagar, Kanpur, Ayodhya and Kalyani, brown rust (South) and stem rusts at Junagarh, Vijapur, Indore, Powarkheda, Niphad, Pune, Mahabaleshwar, Dharwad and Wellington. Table 2.8 presents wheat rust data average coefficients of infection (ACI) and highest score (HS) on 0-100 modified cobb scale from multilocation IPPSN 2024-25 for three rusts of wheat in 21 wheat entries.

Table 2.8. Rust data (average coefficient of infection- ACI and highest rust score-HS) of 21 wheat genotypes under IPPSN 2024-25

SN	Name of genotype	Stem rust		Leaf (South)		Leaf (North)		Stripe	
		ACI	HS	ACI	HS	ACI	HS	ACI	HS
1	RWP2359	4.74	20S	3.10	10S	11.86	40S	14.36	40S
2	RWP2264	12.11	40MS	4.38	10S	15.00	40S	11.35	40MS
3	RWP2286	4.03	20S	3.50	10S	12.29	20S	13.00	40S
4	RWP2291	4.11	10S	1.28	10S	7.14	20S	6.07	20S

SN	Name of genotype	Stem rust		Leaf (South)		Leaf (North)		Stripe	
		ACI	HS	ACI	HS	ACI	HS	ACI	HS
5	RWP2306	2.31	10S	3.15	20MS	0.57	10MR	2.36	10S
6	RWP2353	13.71	40S	1.50	10MR	0.00	0	13.91	40S
7	RWP2240	0.63	10MR	1.30	10MS	2.71	10S	9.55	30S
8	RWP2277	0.80	10R	4.13	20MS	11.14	20S	7.45	40MS
9	RWP2279	11.71	40MS	2.03	10MS	0.06	TMR	14.93	40S
10	RWP2332	6.57	10S	2.88	10MS	3.14	20S	5.31	20S
11	RWP2331	11.20	20S	2.55	20MS	4.00	20S	11.35	40MS
12	RWP2121	6.77	20S	1.065	10MS	2.71	5S	8.55	20S
13	RWP2245	3.06	10S	3.78	10S	7.29	20S	12.27	40MS
14	RWP2270	5.54	20S	3.78	20S	4.86	20S	5.91	10S
15	RWP2265	17.00	40S	0.65	5MR	1.49	10S	12.27	40S
16	RWP2293	0.31	10R	1.53	10MS	2.06	15MS	7.91	30MS
17	RWP2325	8.20	20MS	4.63	10S	6.43	20S	13.27	40MS
18	RWP2339	9.40	40MS	10.88	20S	10.00	20S	4.55	20MS
19	RWP2247	4.74	10S	2.75	10S	7.57	40S	17.27	60S
20	RWP2260	22.86	60S	8.50	20S	12.14	40S	7.09	20S
21	RWP2290	0.60	10MR	3.53	10S	5.71	40S	3.91	10S

Evaluation of advanced generation bulks:

A set of 242 advanced bulks and selections from international nurseries were evaluated as preliminary yield trials (PYTs) at IIWBR Karnal Main farm. The PYTs were conducted in three environments namely, timely sown irrigated condition, timely sown restricted irrigation and late sown irrigated conditions with augmented experimental designs. Six checks namely, DBW187, DBW296, DBW303, DBW316, PBW826, DBW327 were repeated six times in each PYT. Artificial rust epiphytotic were created for rust screening. There was sufficient build-up of yellow and brown rust on infector rows. The PYT genotypes were also evaluated for seedling rust resistance against brown and black rusts at ARI Pune. Selection criterion were applied based on the following traits: grain yield (Kg/ha), the phenological characters like days to heading at 75% flowering, days to physiological maturity and plant height, yield attributing traits like tiller number per meter row length, number of spikelets/spike, grain numbers per spike, 1000-kernel weight (TKW), physiological traits like NDVI, Canopy Temperature, heat sensitivity index, drought sensitivity index, resistance to rust diseases and foliar blight. Quality parameters like grain protein content (GPC), Zn and Fe content, hectolitre weight etc. For promotions to station trials four principal criteria were grain yield, 1000-grain weight, adult plant rust resistance and maturity duration.

Evaluation and generation advancement of segregating material:

Total 242 new combinations were made using elite lines and trait specific lines at Karnal and off-season nursery Dalang Maidan, HP. Utilization of diverse and novel rust resistance genes such as *YrCK*1, *Sr39, Sr65, Lr80,* Munal, being undertaken in wheat pre-breeding programme. Crosses such as *Lr80*/HD3437, *Lr80*/CHIPAK, *Lr80*/HD3437//DBW296, *Lr80*/CHIPAK//*Lr80*/DBW187/3/DBW318, *Lr80*/CHIPAK//*Lr80*/PBW703/3/DBW318, *Lr80*/CHIPAK// DBW296, *Lr80*//2*DBW303 are in F_5 & F_6 stage. Among breeding materials, a total of 105 F_1s, 293 F_2s populations, 112 F_3 populations, 57 F_4 populations were evaluated and selections were applied with SEL BULK method. A total of 40 F_5 populations with more than 400 head rows were evaluated for rust resistance, agronomic and quality traits. A total of 2187 lines including 185 F_1s, MAGIC and four bi-parental populations were evaluated and advanced at summer nursery Dalang Maidan. The 100 selections from F_5s lines were also evaluated (F_6) at summer nursery Dalang Maidan where screening for yellow rust resistance was done. In addition, 620 lines of eight parent MAGIC populations were evaluated both at Karnal and offseason nursery, Dalang Maidan. Selections were made for agronomic and disease resistance traits. A total of 17 selections were included for yield evaluation in the PYT 2025-26.

Evaluation for lodging tolerance:

A total of total 40 wheat genotypes were extensively evaluated for lodging tolerance. A replicated experiment was laid out for screening of 20 resistant wheat genotypes in second year. The material was subjected to both natural incidence and artificial lodging through a wind-blowing machine. Lodging was induced artificially through a specially designed wind tunnel with mist and high-speed air at milking and grain hardening stage. Data was recorded on height (cm), root depth (cm), stem width (mm), stem girth (mm), 1st, 2nd and 3rd internodes length (cm) and lodging score at vegetative and maturity stages.

Sharing of advanced bulks with cooperating centres:

A total 30 advanced bulks were shared with wheat breeders at ANDUAT, Ayodhya, CSAU&T, Kanpur and SKNAU (RARI), Durgapura. These advanced high yielding wheat lines were resistant to yellow rust and lodging. The selections from shared material were utilized by the breeders at CSAU&T, Kanpur and RARI, Durgapura for their station trial and crossing programme.

Breeding for NEPZ

Performance of entries in AVT trials:

During 2024-25, three wheat genotypes DBW448, DBW460 and DBW466 were tested in the timely sown, late sown and restricted irrigation timely sown advanced varietal trials, respectively in NWPZ. Based on the superiority in yield and resistance to diseases and grain quality traits in respective zones, genotype DBW466 was promoted to final year evaluation under restricted irrigation conditions of NWPZ (Table 2.9).

Table 2.9. Performance of entries in AVT trials

Trial	Entry	Yield (q/ha)	Rank	Rust: Yl	Rust: N Br	Any specific trait like blast, quality
AVT-IR-TS-NWPZ	DBW448	63.0	6	ACI-5.86; HS:20S	ACI-15.5; HS:40S	Protein: 11.2%, Fe: 40.9 ppm, Zn: 43.2 ppm
AVT-IR-LS-NWPZ	DBW460	51.6	9	ACI-9.38; HS:40S	ACI-7.38; HS:20S	Protein: 12.7%, Fe: 42.0 ppm, Zn: 40.2 ppm
AVT-RI-TS-NWPZ	DBW466	50.7	1	ACI-12.4; HS:40S	ACI-4.95; HS:20S	Protein: 12.0%, Fe: 41.5 ppm

Performance of entries in NIVT trials:

During 2024-25, eight genotypes were evaluated in different NIVTs, out of which DBW491 and DBW492 were promoted to next year of evaluation under different trials. Specific traits of the different genotypes are given below (Table 2.10).

Table 2.10. Performance of entries in NIVT trials

Trial	Entry	Yield (q/ha)		Rust	Any specific trait like blast, quality
		NWPZ	NEPZ		
NIVT-1A	DBW482	65.1	50.3	Br (ACI-3.9; HS10S) Yl(ACI-12.9; HS 40S)	-
NIVT-1B	DBW484	61.5	55.8	Br (ACI-9.9; HS 30S),Yl (ACI-5.52; HS20S)	Resistant to wheat blast (Score <10); Fe > 40 ppm
NIVT3A	DBW491	51.5	51.3	Br (ACI-7.5; HS 20S),Yl (ACI-2.9; HS20MS)	-
NIVT-3A	DBW492	55.0	48.9	Br (ACI-11.8; HS 30S),Yl (ACI-7.2; HS20S)	Protein: 12 %
NIVT5A	DBW498	53.7	45.2	Br (ACI-1.25; HS10MS), Yl (ACI-5.09; HS20S)	Fe> 40 ppm
		CZ	PZ		
NIVT-2	DBW489	56.3	51.9	Bl (ACI-23.1; HS 40S),Br (ACI-4.4; HS20MS)	Resistant to wheat blast (Score <10), Fe > 42 ppm, Zn: 43 ppm
NIVT-3B	DBW497	45.3	43.7	Bl (ACI-6.9; HS 20MS),Br (ACI-7.4; HS40MS)	Grain protein: 12.1%, Fe>47 ppm
		NWPZ	CZ		
NIVT-6	DBW504	79.0	65.3	Yl: (ACI-10.8; HS 40S),NBr (ACI-3.6; HS 20S), SBr (ACI-3.8; HS10S)Bl (ACI-20.0; HS60S)	Grain protein: 12.0%, Zn: 42 ppm

Performance of entries in common station trials (promotion to NIVTs):

During the crop season 2024-25, 20 wheat genotypes were contributed towards different IIWBR station trials which were conducted across different locations in different zones. Based on superior performance in yield coupled with disease resistance in station trials, eight wheat genotypes were contributed to different NIVTs *viz*., NIVT-1A: DBW511, NIVT1B: DBW516, DBW518, NIVT-2: DBW521, NIVT-3B: DBW528; NIVT5A: DBW532; NIVT-6: DBW535 and DBW539.

Evaluation of breeding materials in different generations:

During the crop season 2024-25, one hundred fifty five crosses were attempted including three/ four-way crosses. A total of 120 F_2, 190 F_3, 173 F_4, 105 F_5 and 190 F_6 populations with more than 850 progeny rows and 145 diverse selections were evaluated for yellow rust reaction. Based on visual selection for plant type and disease resistance selections were made in different filial generations. Generation advancement was undertaken at wheat summer nursery facility Dalang Maidan, HP during summer 2025 and 23 new crosses were also attempted.

Contributions for segregating stock nursery (SSN):

During crop season 2024-25, 15 F_2's were contributed towards segregating stocks nursery and selections were exercised by the co-operators. Similarly, 20 $F_{2/3}$'s were contributed during 2025-26 crop season (Table 2.11).

Table 2.11. Contributions for Segregating Stock Nursery (SSN)

S.No	Pedigree	S.No	Pedigree
1	K-1317/PBW725//PBW725	11	PBW712/HD3226//PBW780/3/NEDAT2107
2	PBW677/HD3086//PBW780	12	PBW725/KRL210//WH1105/3/PBW765
3	Dukula-4/HD3226//PBW677	13	PBW698/DBW222//PBW677/3/PBW763
4	PBW723/Frontana	14	HD3226/DBW252//PBW780
5	Dukula-4/PBW703//HD3226/3/PBW701	15	WB-02/DBW303//PBW701
6	DBW173/PBW725//PBW677	16	HD3226/DBW222//PBW780/3/PBW677
7	DBW90/DBW187//PBW763	17	PBW703/DBW173//PBW725
8	PBW725/DBW187//PBW677	18	PBW780/Dukula-4
9	K-1317/PBW763//PBW725/3/PBW763	19	HD3226/BHU-35//PBW701
10	PBW677/DBW246//PBW765	20	DBW296/PBW804//PBW677

Breeding for warmer areas

Germplasm submitted for registration as genetic stocks:

During the year 2024-25, 02 genotypes WAP2401, and WAP2404 were submitted to ICAR-NBPGR for registration as genetic stocks (Table 2.12).

Performance of entries in AVT trials:

During rabi, 2024-25, entry DBW422 was evaluated under AVT-LS-NWPZ second year trial, whereas DBW425 was evaluated under AVT-LS-CZ. The entry DBW422 ranked first in NWPZ with mean grain yield of 55.7 q/ha and the entry DBW425 ranked 2nd in CZ with mean grain yield of 48.1 q/ha. The yield and rank of the entries with the best checks are presented in Table 2.13.

Table 2.12. Submission of genotypes to be registered as genetic stocks

Entry	Pedigree	Trait
WAP2401	46IBWSN1059/ 22SAWYT335	Drought tolerance (DSI=0.66)
WAP2404	Selection from 29th SAWYT	Resistant to blast, leaf rust

Table 2.13. Details of the entries tested in AVT trials during 2024-25

Trial	Entry	Yield (q/ha)	Rank
AVT-IR-LS-NWPZ	DBW422	55.7	1
	JKW261 (C)	53.1	3
AVT-IR-LS-CZ	DBW425	48.1	2
	HD2931 (C)	46.6	4
AVT-IR-LS-NWPZ	DBW459	52.6	5
	JKW261 (C)	53.1	3

Performance of entries in NIVT trials:

During rabi, 2024-25, eight entries, namely DBW478, DBW480, DBW481, DBW487, DBW493, DBW499, DBW506 and DBW507 were evaluated under different NIVTs. Entries DBW487, DBW493, DBW499, and DBW507 were found promising and were promoted for AVT first year evaluation. Entries DBW493 and DBW499 were promoted for evaluation in two zones (Table 2.14).

Table 2.14. Details of the entries tested in NIVT trials during 2024-25

Trial	Entry	Yield (q/ha)	
		NWPZ	**NEPZ**
NIVT-1A	DBW478	62.1 (23)	50.8 (29)
	DBW480	66.1 (9)	52.3 (19)
	DBW481	62.6 (20)	51.1 (26)
NIVT-1B	DBW487	62.7 (18)	61.1 (1)
NIVT-3A	DBW493	54.4 (10)	47.2 (19)
NIVT-5A	DBW499	58.6 (1)	48.0 (4)
		NWPZ	**CZ**
NIVT-6	DBW506	78.7 (4)	63.9 (13)
	DBW507	78.5 (5)	70.9 (1)

**Rank with in parenthesis*

Performance of entries in common station trials (promotion to NIVTs, 2025-26):

Twenty-one entries were evaluated in IIWBR Station Trials (2024-25) and eight promising entries were promoted to the different NIVTs. The details of the genotypes are presented in the Table 2.15.

Table 2.15. Details of the entries promoted to NIVT (2025-26)

Entry	Trial Series	Promotion	NIVT code
WAP 2401	ST 1	NIVT 1B	DBW 517
WAP 2402	ST 1	NIVT 1A	DBW 512
WAP 2405	ST 1	NIVT 1A	DBW 515
WAP 2411	ST 3	NIVT 3B	DBW 527
WAP 2412	ST 3	NIVT 3A	DBW 525
WAP 2413	ST 3	NIVT 3A	DBW 526
WAP 2415	ST 4	NIVT 5A	DBW 531
WAP 2417	ST 4	NIVT 5B	DBW 533

Performance of entries in PYT trials:

During rabi, 2024-25, 129 entries (F6 and exotic) were evaluated with 05 checks, namely DBW222, DBW327, DBW371, DBW372, and PBW872. Twenty promising entries were contributed for IIWBR station trials (2025-26). One entry WAP 2522 was selected for contribution to Salinity/Alkalinity Tolerance Screening Nursery and WAP 2530 were contributed for QCWBN 2025-26.

Evaluation of breeding material in different generations

During rabi, 2024-25, a total of 557 breeding lines/progenies of different filial generations were grown. Out of which the selections were made on the basis of yield, rust resistance and grain traits. The details of the selected materials are given in the Table 2.16. A total of 195 crosses were attempted, out of which 123 F_1s

Table 2.16. Details of the breeding materials grown and selected during rabi, 2024-25

Generations	Evaluated lines	Selected lines/progenies
F_1	62	47
F_2	100	86
F_3	125	42
F_4	202	87
F_5	96	55
F_6	80	57
Total	**665**	**376**

were sent to Dalang Maidan (HP) for generation advancement at off-season nursery.

Contributions for Segregating Stock Nursery (SSN):

Harvested seed of 22 F_2 crosses grown during rabi, 2024-25 were supplied to coordinating centres through SSN for enriching diversity and strengthening breeding programs.

Wheat blast resistance:

During rabi, 2024-25, DBW507 was found completely resistant to wheat blast and the entries, DBW487, WAP2404, WAP2405, and WAP2408 also showed resistance for wheat blast (up to score 10.0). The entry DBW507 has been promoted to AVT-IR-ES-CZ whereas DBW 487 was promoted AVT-IR-TS-NEPZ. Further entry WAP2405 (DBW515) was promoted to NIVT 1B.

Performance of entries in DHTSN (2024-25):

Five entries namely, HTW 2401, HTW 2402, HTW 2403-01, HTW 2404, and HTW 2405 were evaluated for drought and heat tolerance in DHTSN at 8 locations. Two entries HTW 2401, and HTW 2403-01 were found to be drought tolerant and HTW 2404 as heat tolerant. HTW 2401 had better drought tolerance than the best check (WH 730, DSI = 0.81) (Table 2.17).

Table 2.17. Drought Sensitivity Index (DSI), Heat Sensitivity Index (HSI) and yield reduction (%) of genotypes along with checks in DHTSN

Genotype	DSI	YR%	HSI	YR%
HTW2401	0.66	21.7	1.18	26.8
HTW2402	1.11	36.9	1.03	23.4
HTW2403-01	0.99	32.9	1.18	26.8
HTW2404	1.06	35.1	0.99	22.6
HTW2405	1.11	36.7	1.22	27.8
DBW187(C)	0.99	32.8	1.19	27.1
DBW296(C)	1.18	39.2	0.96	22.0
DDW55(d) (C)	1.33	44.1	1.23	27.9
GW322(C)	0.94	31.0	1.01	22.9
NIAW3170 (C)	0.94	31.1	0.91	20.8
NIDW1149(d) (C)	1.45	48.0	1.17	26.6
RW5(C)	1.01	33.6	0.96	21.9
WH730(C)	0.81	26.9	0.69	15.8

DSI-Drought Sensitivity Index, HSI -Heat Sensitivity Index YR%-Yield reduction percentage

Experiments on heat and drought stresses:

During rabi, 2024-25 80 genotypes including three checks were evaluated under irrigated timely sown conditions and restricted irrigated late sown conditions The data was recorded for grain yield components and physiological traits and promising genotypes were identified (Table 2.18 and 2.19).

Table 2.18. Data for grain yield components and physiological traits

Trait	TSIR		LSRI	
	Range	Mean±SE	Range	Mean±SE
Heading	78.00–92.00	84.38±0.57	72.00 – 84.00	78.32 ± 0.33
Anthesis	84.00–96.00	89.82±0.48	78.00 – 88.00	83.06 ± 0.32
Plant Height	83.67–117.4	103.73±0.97		
NDVI (H)	0.68–0.80	0.74±0.05	0.70 – 0.79	0.75 ± 0.03
NDVI (A)			0.56 – 0.74	0.65 ± 0.05
CT (H)	20.00–25.30	22.49±0.20	17.50 – 23.60	20.41 ± 0.22
CT (A)			20.30 – 30.20	24.82 ± 0.38
Grain Yield (kg)	0.65–1.45	1.09±0.03	0.60 – 1.23	0.88 ± 0.02

Table 2.19. Promising genotypes tolerant to heat and drought stress

Genotype	Susceptibility index
KRL1-4/ DBW 110	-0.99
MACS-6696/RAJ 4037	-0.58
RW-5/ PHSL 1108	-0.22
CRS21/DBW264//MP-3495/MACS-6727	0.27
DBW-90/WB -2	0.42
DBW221 /HD 2967	0.45
DBW-107/PHSL 10	0.48
HI-1544/ MACS 6222	0.48
DBW129/ HD 2967	0.49
DBW-107/PHSL 10	0.51
PHSL 11/F1-161 (46 IBWSN 1284/46 IBWSN 1209)	0.54
HI-1605/WB 2	0.57
GW-463/ HD 2967	0.59
CRS21/DBW264//MP-3495/MACS-6727	0.72
DBW221 /HD 2967	0.80
22HRWYT47/CG1027//DBW 129/DBW-235	0.90
DBW221 /HD 2967	0.95

Rust SRT analysis:

A set of six wheat genotypes was screened against fourteen pathotypes of brown rust and six predominant pathotypes (110S119, 238S119, 46S119, 110S84, T, and P) of yellow rust to identify sources of effective resistance. None of the genotypes was found resistant to all the screened pathotypes of yellow rust while two genotypes conferred resistance to all the pathotypes of brown rust.

Breeding for Quality Improvement

Table 2.20. Performance of entries in AVT trials

Trial	Condition	Entry	Yield (q/ha)	Any specific trait like blast, quality	Remarks
NWPZ	IR-TS	DBW477	57.3	Highly Resistant against Yellow Rust	Proposed to VIC not identified
		DBW455	60.4	-	-
		DBW88(C)	58.6		
		PBW826(C)	65.7		
NEPZ	IR-LS	DBW458	42.0	Protein 12.0%; Fe 41.7 ppm	Promoted to AVT Final Year
		HI1621(C)	39.3		

Table 2.21. Performance of entries in NIVT trials

Trial	Entry	Yield (q/ha)		Rust	Any specific trait like blast, quality
		NWPZ	**NEPZ**		
NIVT3A	DBW494	51.2(23)	44.8(29)	Yl 0(0); Br 0(0)	
	DBW173©	51.6(19)	44.7(30)		
	HI1621©	50.9(24)	45.3(26)		
NIVT5A	DBW501	52.8(8)	45.7(11)	Yl 10MR(0.8), Br 0(0)	
	NIAW3170©	53.2(6)	45.6(12)	-	
	K1317©	49.5(18)	45.5(13)	-	
		CZ	**PZ**		
NIVT5B	DBW502	42.2(21)	34.9(12)	Bl(40S)	
	DBW503	44.9(9)	40.1(1)	tMR	PZ Protein 13.3%; Fe: 49.5 ppm, Zn :50.3 ppm, Promoted to AVT RI PZ
	DBW110©	45.9(3)	34.5(13)		
	HI1605©	45.1(8)	34.0(15)		

**Rank with in parenthesis*

Performance of entries in common station trials (promotion to NIVTs):

20 promising lines from PYTs have been contributed to IIWBR Station trial 2025-26. Six lines to station trial 1; 04 lines to ST-4 and ST5 and 03 lines to ST-2 and ST3 have been contributed for mulilocation evaluation and IPPSN 2025-26.

Table 2.22. Promotion of station trial entries to different NIVTs

SN	Entry	Trial	Pedigree
1	DBW520	NIVT2	7th STEMRRSN-6062/45th IBWSN-1196
2	DBW534	NIVT5B	TRAP#1/BOW/3/VEE/PJN//2*TUI/4/BAV92/RAYON/5/KACHU #1/6/TOBA97/PASTOR/3/T.DICOCCON PI94624/AE.SQUARROSA (409)//BCN/4/BL 1496/MILAN/3/CROC_1/AE.SQUARROSA (205)//KAUZ/7/SUP152*2/TECUE #1/8/QUAIU #1/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/4/QUA

Evaluation of breeding materials in different generations:

During the year 2025, a total of 62 new cross combinations were made for different quality traits in bread wheat. Targeted crosses have been attempted to improve grain protein content, high sedimentation value, high iron and zinc and high bread loaf volume in bread wheat. The details of different filial generation are given below (Table 2.23).

Table 2.23. Breeding material in different segregating and fixed generations

Filial Generation	Number of crosses/ families	Remarks	Number of plants/lines selected
F2	101	Selected Bulk	279
F3	350	SPS	596
F4	665	SPS	407
F5	103	SPS Carried out	83
F6	82	Bulk	78 lines selected for PYT

Transcriptome analysis for BNI:

A comparative transcriptomic analysis was conducted for the nitrogen-efficient (BNI-Munal) and derivative parent Munal wheat genotypes to unravel the gene expression patterns across four nitrogen levels (0%, 50%, 75%, and 100%). Analyzing the genes of BNI-enabled wheat helps to understand how they are expressed differently, which heavily influences BNI activity. Grain yield and 1000-grain weight were higher in BNI Munal than in Munal. All the other traits were similar in performance. Varying nitrogen dosages led to significant differences in gene expression patterns between the two genotypes. Genes related to binding and catalytic activity was prevalent among molecular functions, while genes corresponding to cellular anatomical entities dominated the cellular component category. Differential expression was observed in 371 genes at 0%N, 261 genes at 50%N, 303 genes at 75%N, and 736 genes at 100%N. Five unigenes (three up-regulated and two down-regulated) were consistently expressed across all nitrogen levels. Further analysis of up-regulated unigenes identified links to the NrpA gene (involved in nitrogen regulation), tetra-tricopeptide repeat-containing protein (PPR), and cytokinin dehydrogenase 2. Analysis of down-regulated genes pointed to associations with the *Triticum aestivum* 3BS-specific BAC library, which encodes the NPF (Nitrate and Peptide Transporter Family) and the *TaVRN* gene family (closely related to the *TaNUE1* gene). The five unigenes and one unigene highlighted in the Kyoto Encyclopedia of Genes and Genomes (KEGG) pathways were validated in Munal and BNI Munal.

Strategic research for improving biotic stress

- 163 new crosses were made during 2024-25 season. 77 crosses were sown as F_1 at Dalang Maidan during 2025 and further advanced.
- Traits targeted were yield components, yellow rust, KB resistance, protein content and abiotic stress tolerance.

- >3000 F_3, 945 F_5 and 251 F_6 progenies were planted and selected upon for superior plants during the main crop season 2024-25.
- One genotype DBW445, evaluated in SPL-HYPT trial during 2024-25, was identified for release during the 64th wheat workshop.
- DBW452 was also evaluated in AVT-IR-(NEPZ) but could not be promoted to next level.
- Out of six entries evaluated in different NIVTs during 2024-25, DBW495 has been promoted to AVT-LS in both NWPZ & NEPZ.
- 16 entries were contributed to IIWBR Station Trials during 2024-25, and three have been promoted to different NIVTs as: DBW523 (NIVT3A), DBW529 (NIVT5A) and DBW538 (NIVT6).
- 20 genotypes have been contributed for evaluation in IIWBR Station Trials during 2025-26.
- Four genotypes were contributed to various national nurseries 2025-26.

Breeding for early maturity and short duration wheat genotypes

During the season 2024-25, a set of 30 genotypes including checks were selected for early maturing. These genotypes were planted in a replicated trial with a plot size of 3.2m^2 each with spacing of 20 cm. The data recorded for the traits i.e., days to heading, days to anthesis, diseases, chlorophyll content, days to maturity, grain filling duration, TKW, Biomass, tillers/plant, Spkelets/spike, grain/spike and NDVI during the season. The overall mean for maturity days including checks was observed as 140 days and range was 140-148 days. The average grain yield of these genotypes was 1.82 kg/plot with prevailing biotic stress resistance. One hundred forty-three F_2 generations were planted and selections were made for target traits. Out of 143 F_2s planted, 43 F_2s were selected for early maturing; disease resistant during the season and sent further generation advancement in off-season 2025 at Dalang Maidan. The 105 new cross combinations were attempted during the season and sent to IIWBR-RS for generation advancement. The thirteen corrective crosses were made in off-season for the target traits. During crop season 2025-26, a set of fifteen selected genotypes were sown in abiotic stress management trial block for further testing.

A set of 6 entries contributed in station trial i.e., timely sown irrigated conditions, irrigated late sown and restricted irrigated conditions during 2024-25. Out of six genotypes, two genotypes were promoted in different NIVTs during 2025-26. The genotype DBW 513 (BWEM-1) was promoted in NIVT-1A and NIVT-1B; and genotype DBW 536 (BWEM-6) was contributed in NIVT-6 for the crop season 2025-26. A set of thirty-four selected genotypes were contributed in PYT, 2025-26 are as 14 genotypes for Irrigated Timely sown conditions, 06 genotypes contributed in Irrigated Late sown, and 14 genotypes for Restricted Irrigated conditions. In addition to that, A set of 25 advance bulks were contributed to CSAUAT, Kanpur, ANDUAT, Ayodhya and SKNAU, Jobner for evaluation of the performance.

Pre-Breeding

Promotion of entries to AVTs

Two *T. durum* genotypes, DDW 69 and DDW 71 were promoted to AVT final year during 2025-26. In addition, one genotype, DBW 522 (PBS 2024-6) was promoted in NIVT-3A during, 2025-26. Further, two *T. durum* genotypes, DDW72 (PBSD2025-1), DDW73 (PBSD2025-2) were contributed in NIVT-4 during 2025-26. Twenty-two genotypes, ST-1 (5), ST-2 (5), ST-3 (4), ST-4 (4), ST-5 (4) were contributed in Station trial, 2025-26.

Breeding material developed/evaluated:

- 165 accessions consisting of *Aegilops tauschii (DD)*, *Ae. peregrina (UUSS)*, *Triticum dicoccoides AABB)*, and synthetic hexaploid (AABBDD) were evaluated for abiotic stresses - heat, drought, and combined heat and drought stress. *A. tauschii* accessions no. 3806, 3753, 9803 were found tolerant to drought stress under ROS. The accessions no. 3753 and 9803 were found tolerant under late sown rainfed conditions. *Ae peregrina* accessions no. 102, 103 were observed tolerant under drought under ROS and heat and 103 was found tolerant for combined late sown and rainfed conditions.

- Genotypes were developed for higher grain Zn, the crosses namely; NEODUR x *T. bessarabicum)* (72.8ppm), *MACOUN x T. bessarabicum (56.9), Pavon-76 x Ae. Speltoides* (214008) (56.6), *CRESO x T. bessarabicum* (56.5), *(Ch. Spring x Ae. Mutica)* (2130012) (55.6), *Ch. Spring x S. anatolicum* (p208/142) (53.1), *KARIM x T. bessarabicum* (58ppm).
- Five introgressed lines namely HTW 2312 (DBW39/*Ae. speltoides*), HTW 2304 (Ae. tauschii/4*HD2967), HTW2309 (PBW698/*Th. bessarabicum*), HTW2305 (SYN224/3*WH1105), HTW2307 (*Ae. compactum*/K1213/2*WH1105) were found promising for heat (HSI<1) and drought tolerance (DSI <1) in screening nursery.
- Utilization of diverse and novel rust resistance genes such as *YrCK1*, *Sr39*, *Sr65*, *Lr80* were undertaken in wheat pre-breeding programme and developed novel crosses such as *Lr80*/HD3437, *Lr80*/CHIPAK, *Lr80*/HD3437//DBW296, *Lr80*/CHIPAK//*Lr80*/DBW187/3/ DBW318, *Lr80*/CHIPAK//*Lr80*/PBW703/3/DBW318, *Lr80*/CHIPAK//DBW296, Lr80//2* DBW303 for diversity for biotic stresses.
- Ten crosses involving synthetics namely Synthetic 67/PBW 502, Synthetic 400/PBW 502, Synthetic 107/*3DBW 17, Synthetic 26/*3PBW 502, Synth 88/PBW 343//UP 2425, Synthetic 207/*2PBW 502, Syn 14/PBW 502//Syn 59/DBW 16// DBW 16, Syn 98/PBW 343//Syn 59/DBW 16, Syn 206/DBW 17/DBW 17 and Syn 99/UP 2425/FLW21 were attempted and shared through Segregating Stock Nursery with the Cooperators for traits like soft wheat, heat tolerance, resistance, resistance and soft wheat etc.
- Synthetics were evaluated for various morphological traits and wide variations was reported for the trait such as days to heading (<90days): Synthetic-30 (89), Synthetic-70 (89), Synthetic-72 (90), Synthetic-32 (90); days to maturity (<135): Synthetic-72 (131), Synthetic-42 (131), Synthetic-55 (131), Synthetic-70 (132), Synthetic-29 (134), Synthetic-30 (134); plant height (100cm): Synthetic-50 (95.3cm), Synthetic-55 (95.7cm); ear length (>14cm): Synthetic-04 (16.8cm), Synthetic-38 (14.8cm), Synthetic-40 (14.7cm), Synthetic-68 (14.5cm), Synthetic-23 (14.2cm), Synthetic-39 (14.1cm); Thousand grain weight (>50gm): Synthetic-77 (62.5g), Synthetic-96 (54.9g), Synthetic-98 (53.3g), Synthetic-85 (53.3g), Synthetic-06 (52.4g), Synthetic-93 (51.3g); grain weight/spike (2.5gm): Synthetic-23 (3.37g), Synthetic-96 (2.69g), Synthetic-42 (2.65g), Synthetic-03 (2.57g), Synthetic-25 (2.51g), Synthetic-87 (2.51g); no. of grains/spike (>60): Synthetic-23 (70 grain/spike), Synthetic-39 (63 grain/spike), Synthetic-65(61 grain/spike).

During crop season, 2024-25 about 225 lines were analyzed for phenological and quality traits (Protein and beta carotene) and superior lines were identified. Data was recorded for phenological and physiological traits and disease incidence in 200 accessions of wild species *Ae.ovata, Ae. kotschyii, Ae. peregrina, Ae. speltoides Ae. tauschii, T. boeticum, T. dicoccoides*. A set of 213 new crosses involving non-conventional sources were attempted. One hundred fifty lines were analyzed for phenological and quality traits (Protein and beta carotene) and superior lines were identified. Ninety genotypes with higher Zinc, Iron and Protein contents were evaluated and selections were made out of that, two lines BFKW101 and BFKW103 were identified with >50 ppm Zn and >55 ppm Fe and two lines were with >15 % Protein content.

Seed production programme at ICAR-IIWBR, Karnal

Under Inter-institutional collaborations with ICAR-NDRI Karnal, ICAR-IIFSR and ICAR-CPRI-RS, Modipuram, ICAR-IIWBR has produced 5833.25 q of breeder seed and 3249.51q of TL seed of 15 wheat *viz*., DBW 327, DBW 377, DBW303, DBW187, DBW222, DBW 359, DBW 370, DBW 371 and DBW 372 whereas total 300.39q seed of 06 barley varieties was produced at Seed and Research Farm, (ICAR-IIWBR), Hisar during 2025. Selling of Nucleus/ Breeder and TL Seeds of wheat generated a total amount of Rs. 7.54 crores under the revolving fund scheme of the institute (Table 2.24).

Strengthening the seed chain through public and private partnership:-

In order to improve the seed access for ICAR-IIWBR Karnal recent varieties to the farmers, the institute has upscaled its seed production programme by involvement of the different public and private sector agencies. The institute is providing its breeder seed to different private seed growers 180 MOAs with different private seed companies during 2025, also supplied 3249.51q of TL seed under cluster demonstration, SCSP and TSP as well as directly to farmers through different ICAR institutes, State Agricultural Universities, KVKs and state government agencies for further seed multiplication and distribution of recent varieties to the farmers to meet their demands (Table 2.25). In total, 9082.76q of total seed was produced and sold for the further multiplication.

Table 2.24. Breeder seed (quintal) sale during 2024-2025

		Wheat			
S. No.	**Variety**	**BS Sale (q)**	**S. No.**	**Variety**	**BS Sale (q)**
1	DBW 370 (Karan Vaidehi)	45.20	9	DBW 377 (Karan Bold)	154.20
2	DBW 371 (Karan Vrindha)	532.60	10	DBW 316 (Karan Prema)	8.80
3	DBW 372 (Karan Vrindha)	561.70	11	DBW 359 (Karan Shivangi)	33.60
4	DBW 327 (Karan Shivani)	1433.00	12	JKW 261	7.40
5	DBW 332 (Karan Aditya)	21.20	13	DBW 173	0.70
6	DBW 303 (Karan Vaishnavi)	782.80	14	DBW 386 (Karan Khushboo)	119.60
7	DBW187 (Karan Vandana)	1246.00	15	DBW 443 (Karan Saanvi)	2.40
8	DBW222 (Karan Narendra)	654.80			
	Total				**5604.00**
		Barley			
S. No.	**Variety**	**BS Sale (q)**	**S. No.**	**Variety**	**BS Sale (q)**
1	DWRB 123	8.0	4	DWRB 137	134.40
2	DWRB 101	15.45	5	DWRB 219	7.20
3	DWRB 182	22.60	6	DWRB 223	41.60
			Total		**229.25**
			Grand Total (Wheat + Barley)		**5833.25**

Table 2.25. TL seed sale of different wheat and barley varieties (2025) to farmers and FLD's/ Cluster demonstration /SCSP/ TSP programmes

S. No.	Name of State	Total TL Seed (Quintals)	S. No.	Name of State	Total TL Seed (Quintals)
1	Haryana	2091.66	10	Arunachal Pradesh	25.00
2	Uttar Pradesh	353.60	11	Maharashtra	22.85
3	Rajasthan	209.95	12	Chhattisgarh	20.00
4	Bihar	110.90	13	Himachal Pradesh	3.90
5	Punjab	104.00	14	Delhi	2.30
6	Madhya Pradesh	96.10	15	Gujarat	0.50
7	West Bengal	90.50	16	Karnataka	0.10
8	Uttarakhand	66.05	17	Telangana	0.10
9	Jammu and Kashmir	52.00			
	Overall Total (Quintals)				**3249.51**

Technological interventions for efficient seed distribution:-

ICAR-IIWBR, Karnal has upgraded IIWBR Seed Portal to register and distribute TL seed of recent wheat varieties *viz*., DBW 327, DBW 377, DBW 303, DBW 187, DBW222 etc. for the farmers in all the wheat growing states (Fig. 2.6). The seed portal was designed and executed through IIWBR website during the September month. All the interested farmer were allowed to provide needful information including his/her name, village, mobile number, district and state, upload soft copy of Aadhar card, select the variety and quantity of seed to be purchased. After the farmer received an OTP on his/her mobile and then a message was sent to all such farmers that their demand of seed has been registered with the IIWBR. This facility was utilized by about 15976

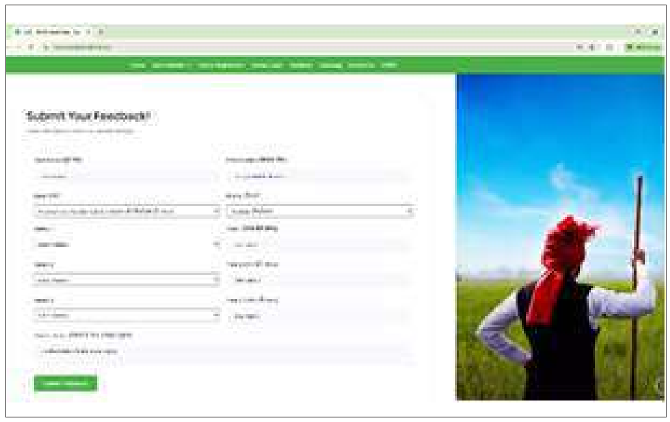


Fig. 2.6. Seed distribution and Unified Seed Software portal

farmers from different states like Haryana, Punjab, U.P., Bihar, MP and Rajasthan, who successfully registered on the portal during 15.09.2025 to 18.09.2025. The portal was closed after the successful registration of the farmers as per the seed availability. The farmers were then grouped into clusters as per their districts and states; accordingly, farmers were informed through bulk SMS

sent during 13th October to 18th October 2025 to come and collect the indented/ allotted seed on specific date and time. This way, IIWBR has distributed >2500q TL seed of wheat and barley varieties to the farmers during 13-18th October, 2025 (Fig. 2.7).

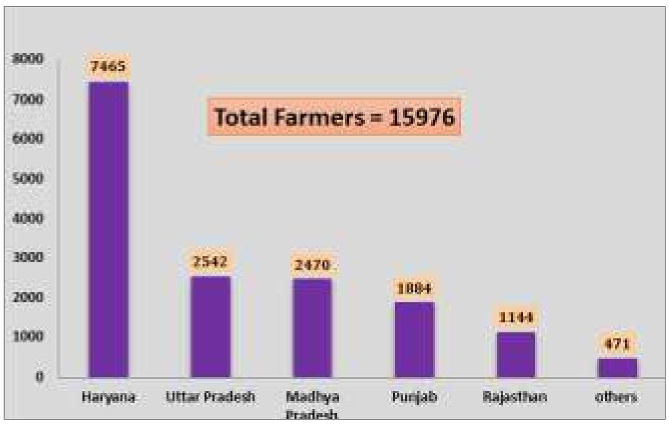


Fig. 2.7: Number of registered farmers for purchasing TL seed from different states during 2025-26.

IIWBR- Unified Seed Sale, Inventory and Finance Management Software:

During 2025, ICAR-IIWBR developed Unified Seed Software in order to address the challenges of distribution, inventory tracking, financial reconciliation, for breeder seed and TL Seed Sale, integration of transaction ids with bill, generating reports of variety wise sale, state wise number of farmers registered and actual number of farmers lifting the seed.

Software is equipped with generation of various reports i.e.

- Agency billing report,
- Farmers billing report,
- Sales report
- Breeder seed certificate
- Gate pass with date and quantity and variety name,
- Farmers wise variety report and
- Agency wise variety report
- State/ district wise report
- Audit report

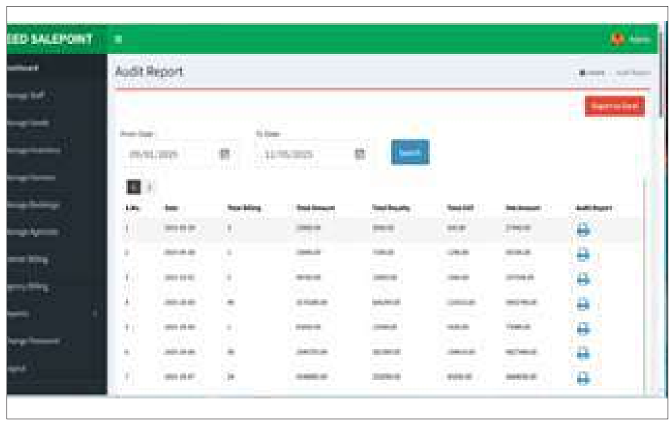


Fig. 2.8. View of seed sale and other features in Unified Seed Distribution portal.

These reports helped to understand the demand of the variety among farmers and indenting agencies, reconciliation of bills with finance department, state-wise number of farmers actually lifted the seeds which helped to plan the next year seed production programme.

Biotechnological and Physiological Interventions

Mapping of yield-related QTLs under terminal heat stress in wheat

Terminal heat stress during the reproductive stage significantly affects wheat productivity, particularly under late-sown conditions. To better understand yield losses under different heat stress patterns, a bi-parental wheat mapping population was evaluated across six environments representing both gradual and sudden terminal heat stress situations. Phenotypic data were recorded for key phenological, physiological, and grain yield–related traits. The experiments were conducted over two consecutive crop seasons under normal sowing, late sowing, and controlled sudden heat stress conditions (TCPF- Temperature-controlled phenotyping facility), thereby generating six distinct testing environments. Field trials were laid out in an alpha-lattice design with three replications at ICAR–IIWBR, Karnal, to ensure robust phenotypic evaluation. Substantial variation was observed for grain yield, grain number, and thousand grain weight across environments, indicating the presence of exploitable genetic variability. A genetic linkage map was constructed using the Wheat 35K SNP array, from which 1,464 informative markers were utilized for QTL analysis. In total, 46 QTLs associated with yield and its components were identified, explaining 4.2 to 23.4 percent of the phenotypic variation. Several QTLs showed consistent expression across environments, suggesting stable genetic control under heat stress. Nine such stable QTLs were detected on chromosomes 1A, 1B, 3B, 3D, 5A, and 6B. Prominent QTLs on chromosomes 3B, 3D, and 6B were associated with grain yield, grain number, and thousand grain weight under late-sown and sudden heat stress conditions. SNPs linked to these stable regions were converted into KASP markers and validated across three independent populations, confirming their reliability. Candidate gene analysis indicated the involvement of stress-responsive and metabolic pathways. The validated markers provide useful genomic resources for marker-assisted selection and support the development of heat-tolerant wheat varieties suited to the Indo-Gangetic Plains.

Gene expression studies of drought responsive genes

Effect of bacterial inoculation on gene expression of drought responsive genes (*DREB2A, APX1, CAT1, TaCYP707A1, SAMS1, HSP17.8* and *DHN*) was studied under drought stress using qRT PCR. Genes *DREB2A, CAT1, APX1, SAMS1* and *HSP17.8* showed up-regulation in un-inoculated drought stress wheat plants, while bacterial-inoculated stressed plants displayed reduced transcript accumulation indicating role of endophytic bacteria in regulation of drought responsive genes under drought stress conditions.

Drought stress responsive genes expression pattern in wheat (*Triticum aestivum* L.) in presence of potential endophytic bacteria

The expression analysis of *DREB2A* (dehydration-responsive element binding proteins), *CAT1* (catalase), *DHN* (dehydrins), *TaCYP707A1* (cytochrome P450 monooxygenase 707A1) and *APX1* (ascorbate peroxidase), *HSP17.8* (heat shock protein) and *SAMS1* (S-adenosyl-methionine synthetase) genes in presence of 11 endophytic bacteria (*Priestia megaterium, Priestia aryabhattai, Priestia megaterium, Priestia* sp., *Priestia megaterium, Bacillus pumilus, Bacillus subtilis, Bacillus safensis, Bacillus zhangzhouensis, Bacillus australimaris* and *Bacillus safensis*) along with positive and negative controls was performed using quantitative reverse transcriptase polymerase chain reaction (qRT-PCR). Total RNA was isolated from the leaf tissue of non-inoculated seedlings with water supply (positive control, PC), non-inoculated seedlings with drought induction (negative control, NC) and bacteria-inoculated seedlings subjected to 7 days of drought stress and 3 days of recovery, using RNeasy plant mini kit (QIAGEN, Hilden, Germany). Three independent samples of each treatment were used. Gene-specific primers for each gene were used for qRT-PCR. The results of the experiment were presented as the average of three replications.

The non-inoculated drought stressed seedlings (negative control, NC) and endophytic bacteria-

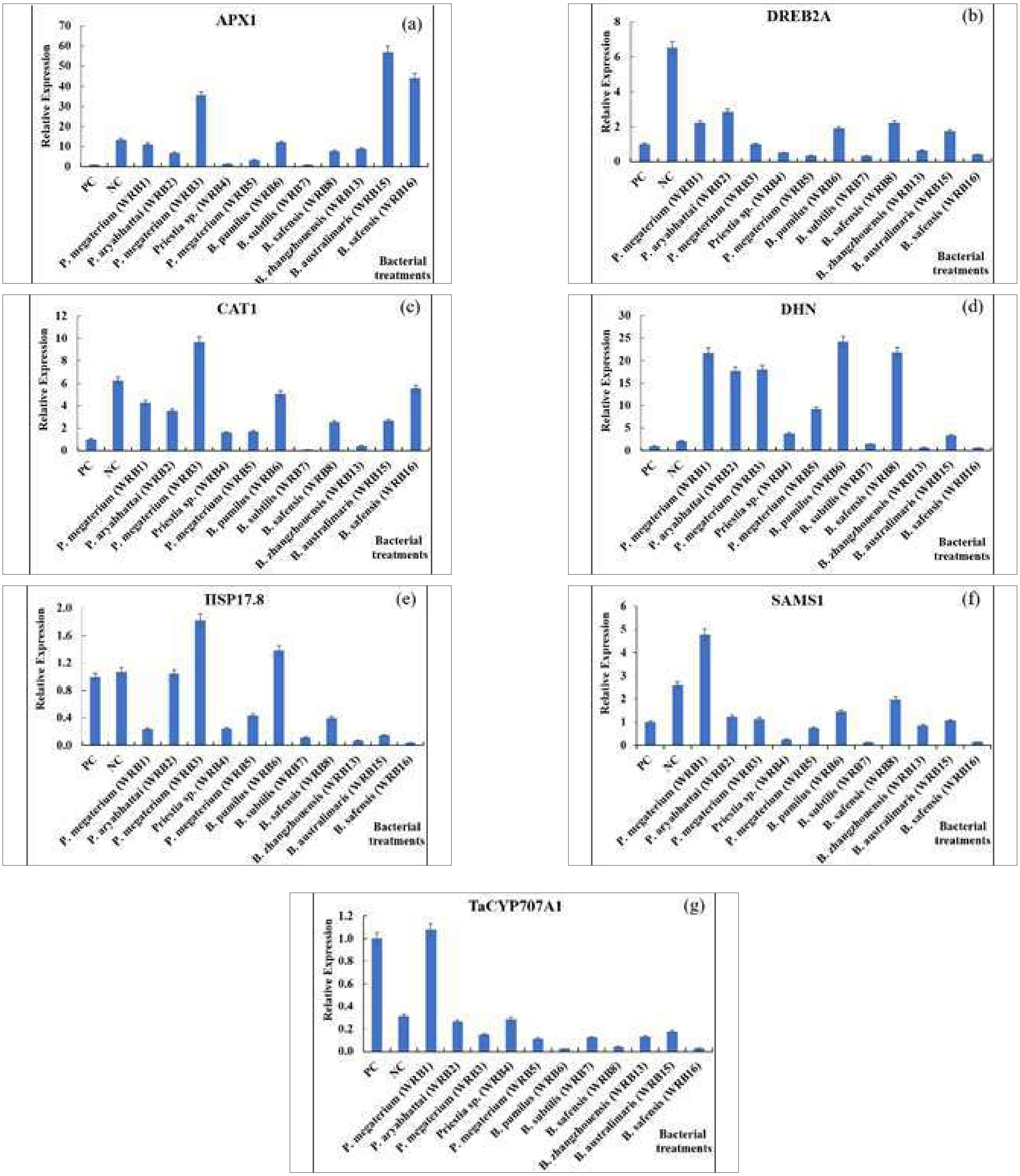


Fig. 2.9. Relative gene expression of APX1, DREB2A, CAT1, DHN, HSP17.8, SAMS1 and TaCYP707A1 in endophytic bacteria-inoculated wheat seedlings under drought stress. Error bars show the standard deviation of the mean values of three replicates. PC, positive control; NC, negative control

inoculated seedlings under drought stress (KDT-WRB1, KDT-WRB2, KDT-WRB3, KDT-WRB4, KDT-WRB5, KDT-WRB6, KDT-WRB7, KDT-WRB8, KDT-WRB13, KDT-WRB15, KDT-WRB16) were compared with non-inoculated seedlings with water supply (positive control, PC). Variable levels of expression for all the genes were recorded in non-inoculated and inoculated plants. Genes *APX1, DREB2A, CAT1* and *DHN* were up-regulated significantly in NC seedlings under drought stress compared to PC seedlings. The up-regulation was 13.4-, 6.5-, 6.2- and 2.0- fold, respectively for these genes. But in comparison to NC seedlings, all endophytic bacteria inoculated stressed seedlings were recorded with 1.4- to 12.4-fold repression of *APX1* gene except with KDT-WRB3, KDT-WRB15 and KDT-WRB16, which showed upregulation (Figure 2.9 a). A 3.7- to 6.2- fold repression of *DREB2A* gene was recorded after various endophytic bacteria treatments in stressed seedlings (Figure 2.9 b). Similarly, repression of *CAT1* gene (0.7- to 6.2-fold) was noticed in stressed seedlings after inoculation of different endophytic bacteria, except of KDT-WRB3 inoculated seedlings in comparison with NC seedlings (Figure 2.9 c). Inoculation with endophytic bacteria *viz*., KDT-WRB7, KDT-WRB13 and KDT-WRB16 repressed *DHN* gene expression by 0.5- to 1.4-fold in stressed seedlings compared to NC. However, in other bacteria inoculated seedlings, *DHN* transcript accumulation increased by 1.3- to 22.2-fold (Figure 2.9 d). The expression of *HSP17.8* gene was upregulated by 1.1-fold in NC seedlings relative to PC seedlings, but endophytic bacteria inoculation downregulated the expression by 0.03- to 1.03-fold (Figure 2.9 e). However, the*HSP17.8* gene showed upregulation of 0.75- to 0.31-fold in strain KDT-WRB3 and KDT-WRB6 inoculated seedlings. The transcript accumulation of *TaCYP707A1* gene in NC seedlings was repressed to 0.69-fold in comparison to PC seedlings. Inoculation of endophytic bacteria (excepting KDT-WRB1) in seedlings further repressed the expression of *TaCYP707A1* gene in almost all cases by 0.03- to 0.29-fold (Figure 2.9 f) in comparison to NC seedlings. Lastly, the expression of *SAMS1* gene in NC seedlings was upregulated by 2.59-fold relative to PC seedlings. In comparison to NC plants, the endophytic bacteria (except KDT-WRB1) inoculated seedlings were observed with reduced accumulation of transcript by 0.62- to 2.47-fold under drought stress while inoculation with KDT-WRB1 showed up-regulation by 2.20- fold (Fig. 2.9).

Standardization of T7 Endonuclease assay for detection of indels in MS1 edited plants:

The assay uses genomic DNA extracted from cells transfected with constructs expressing engineered nucleases such as Transcription activator-like effector nuclease (TALEN), Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas9, or Zinc-finger nuclease (ZFN). Following cleavage, genomic insertions or deletions (indels) are created by the cellular repair mechanisms. Loci where the gene-specific double-strand breaks occur are amplified by PCR. The PCR product is denatured and reannealed so that mismatches are generated as strands with an indel re-annealed to strands with no indel or a different indel. The mismatches are subsequently detected and cleaved by Detection Enzyme and then the resultant bands are analyzed by gel electrophoresis and band densitometry (Fig. 2.10). The Genomic DNA of MS1 edited plants were subjected to T7 endonuclease assay and observed variation in the band pattern between

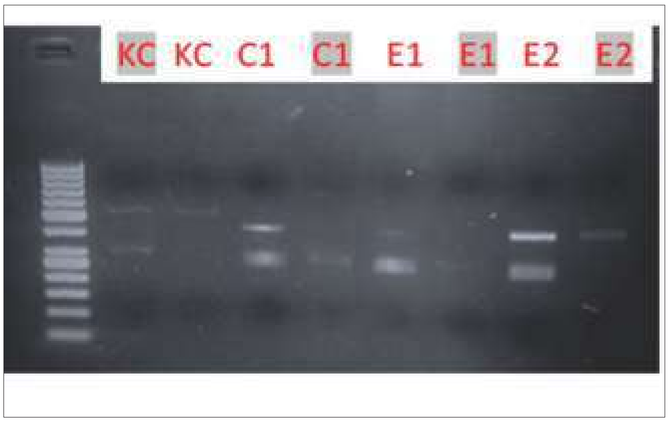
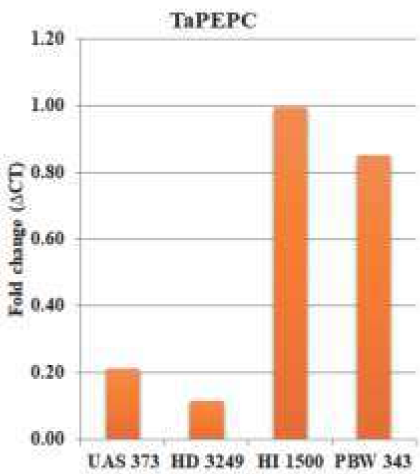


Fig. 2.10. PCR product after cleavage assay of *MS1* gene

control and edited plants after cleavage, indicating the possibility of presence of indels in the targeted gene of edited plants which will be further confirmed by sequencing.

Expression analysis of C4 Photosynthetic genes in wheat to identify the rate limiting gene

About seven key genes associated with C4 photosynthesis were shortlisted through review of literature and real time PCR primers were designed for the same. Further, the expression of these genes were studied in earlier identified photosynthetically contrast genotypes, DPW 621-50 (medium photosynthesis), EMS-98 (low photosynthesis) and M1043 (high photosynthesis). RNA was isolated from leaf tissues of DPW 621-50, M1043 and EMS-98 using TRIzol method (Invitrogen, UK) and cDNA was made using cDNA synthesis kit. The expression analysis of all shortlisted genes were done using SYBR Green dye in real time PCR (Agilent Real Time System, USA) with actin as internal control. The fold change expression of TaAspAT and TaPEPC genes were found to be significantly higher in high photosynthesis genotypes DPW-621-50, M1043 compared to low photosynthesis genotype EMS-98 compared to other genes. Further, *TaAspAT* and *TaPEPC* genes were used for expression validation in contrast hexaploid genotypes identified for assimilation. The genotypes UAS373, HD3249 were used as high assimilation genotypes and HI1500 and PBW343 were used as low assimilation rate genotypes. The expression analysis of shortlisted genes was found to be higher in high assimilation rate genotypes compared to other genotypes (Fig. 2.11). Thus, this identified *TaAspAT* and *TaPEPC* - C4 photosynthesis genes can be further explored are genetic engineering and genome editing studies in wheat to improve photosynthetic efficiency.



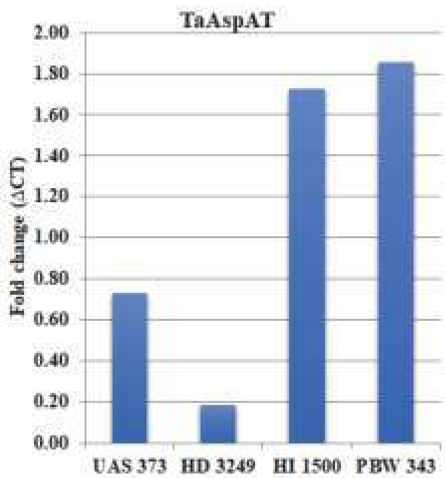


Fig. 2.11. Expression analysis of shortlisted genes in identified contrast genotypes for photosynthesis from physiological screening of released varieties

Characterization of released varieties for root traits

Root phenotyping focuses on assessing root system architecture (RSA) due to its critical role in resource acquisition. Root traits are increasingly valuable for breeding programs aimed at developing high-yielding, climate-resilient varieties. Considering the importance of root research, a study was conducted during rabi 2024–25 to evaluate the RSA of forty released wheat varieties from the North Hill Zone under controlled conditions. Plants were grown under controlled environment condition in pots for one month. After one-month plants were carefully uprooted, washed, and analyzed using WinRhizo software to quantify root traits like, length, surface area, diameter, volume, specific length, specific surface area, tissue mass density, and root-to-shoot ratio (Fig. 2.12). Contrasting genotypes for key root traits were identified. Root length showed a significant positive correlation with both root surface area and root volume.

Wheat variety HPW251 was recorded with maximum root length (30.66 cm), while HS375 was having minimum root length of 12.5cm. Highest Root surface area (mm^3) was recorded for HS1138-64 and lowest for VL421. Maximum root volume was recorded in HS507 and minimum in HS 562. Wheat variety HS375 showed maximum root shoot ratio while minimum root shoot ratio was recorded for 421 followed by VL804.

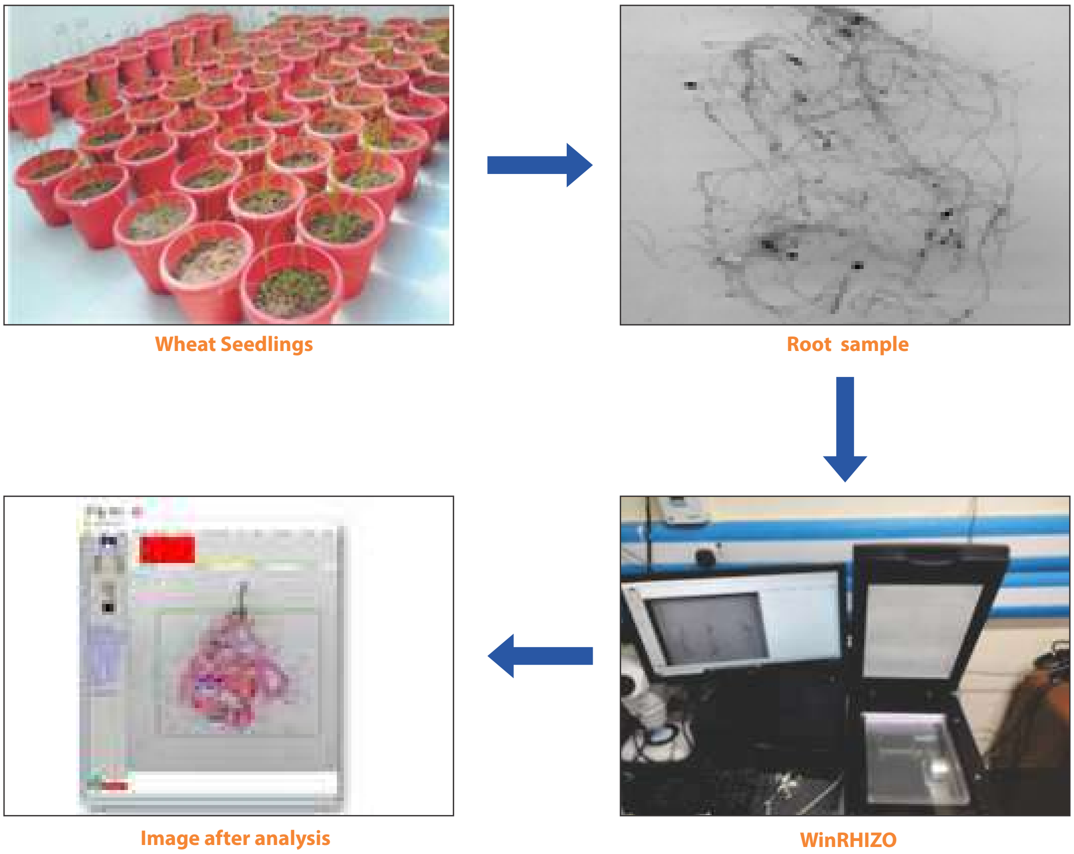


Fig. 2.12. Schematic diagram of analysis for Root system architecture (RSA) of wheat varieties sown under controlled condition a) One month old seedlings; b) Uprooted sample; c) WinRHIZO analysis for RSA; c) image capturing and data recording of root architecture traits

3 CROP PROTECTION

Evaluation of wheat germplasm against rusts and leaf blight: Out of 300 exotic durum wheat germplasm lines five genotypes *viz.,* EC1175030, EC1175031, EC1175177, EC1175196, and EC1175246 were found resistant against all three diseases *viz.,* leaf rust, stripe rust, and leaf blight with AUDPC score 0 to 50 and AUDPC score 0 to 100 for rusts and blight, respectively.

Biological control of leaf rust disease in wheat: Seven potential BCAs *viz.*, *Trichoderma harzianum*, *T. harzianum* M, *T. asperellum*, *Chaetomium globosum*, *Aspergillus niger*, *Pseudomonas fluorescens* and *Bacillus subtilis* were tested against leaf rust caused by *Puccinia triticina*in wheat. Among the treatments evaluated, *T. harzianum* was found most efficient against leaf rust restricting the disease level upto 10 MS on susceptible wheat genotype HD 3436 against untreated control (80S).

Morpho-cultural variability among spot blotch inciting *Bipolaris sorokiniana* isolates

Cultural variability: Total 51 isolates of *B. sorokiniana* were purified and evaluated for cultural variability on PDA medium. Radial growth differed significantly among isolates at all observation points. At 10 dai, colony diameter ranged from 25.0–84.5 mm, corresponding to growth rates of 2.50–8.45 mm/day. The fastest-growing isolates were Bs-9 (84.5 mm; 8.45 mm/day), whereas Bs-27 showed the slowest growth (Fig. 3.1). Colony colour varied from creamy white to black, with isolates distributed across five distinct colour categories (creamy white, light grey, grey, dark grey, black). Texture differentiated isolates into smooth (30 isolates) and rough classes (21 isolates). Most colonies were appressed, though 23 isolates produced raised growth. Colony margins were largely regular, while a subset exhibited irregular margins. Zonation occurred in a majority of isolates but was absent in 24 isolates across colour groups. Exudation was common, except in five isolates.

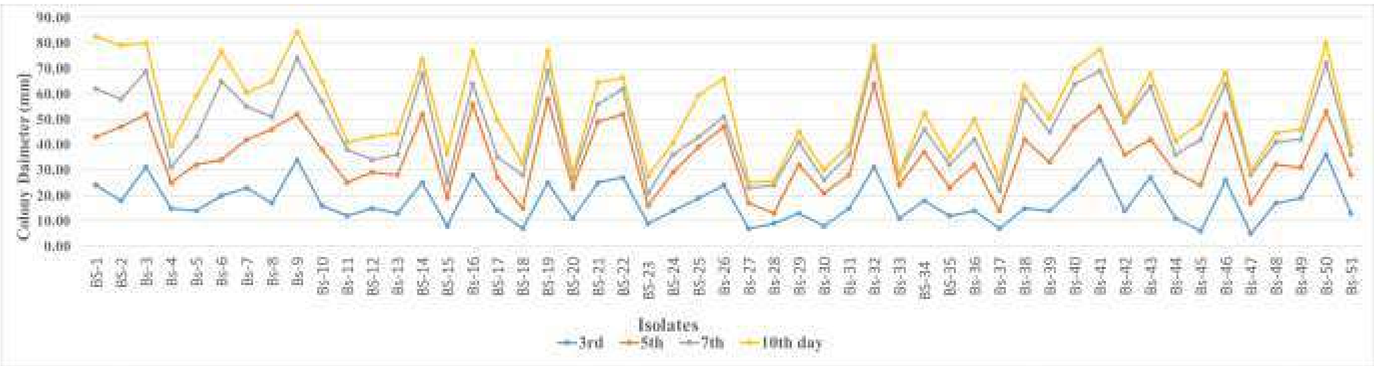


Fig. 3.1. Radial growth comparison of *B. sorokiniana* isolates at 3rd, 5th, 7th and 10th dai on PDA

Morphological variability: Morphological variability of total 51 *B. sorokiniana* isolates was determined using conidial length, conidial breadth and number of septa. Conidial length ranged from 42.37–72.02 µm and breadth from 14.61–25.18 µm, Bs-3 isolate produced the largest conidia (72.02 × 25.18 µm). The number of septa varied from 3 to 11, with mean septation values ranging from 4.2 to 7.4; isolates Bs-3, Bs-17, Bs-32, and Bs-44 showed the highest septation, whereas isolates Bs-12 and Bs-13 had the lowest. Conidia were typically brown to dark brown. Correlation analysis revealed strong positive associations among conidial length, conidial breadth, and septation (Fig. 3.2). Length was positively correlated with breadth (r = 0.72) and septation (r = 0.75), and breadth was positively correlated with septation (r = 0.66). Growth rate showed weaker positive associations with the same traits (Fig. 3.2a). Cluster analysis based on quantitative morpho-cultural variables resolved the isolates into five clusters. Cluster 1 comprised isolates with the smallest conidia and lowest septation, whereas Cluster 5 contained isolates with the largest conidia, highest septation and greater growth rates. The remaining clusters represented intermediate morphotypes. Principal component analysis supported these groupings. PC1 explained 63.1% of the total variation and was dominated by conidial length, breadth and septation, while PC2 accounted for 23.1% and was associated mainly with growth rate. The first two components together explained 86.2% of the overall variation, and the PCA ordination showed clear separation of clusters along these axes (Fig. 3.2b).

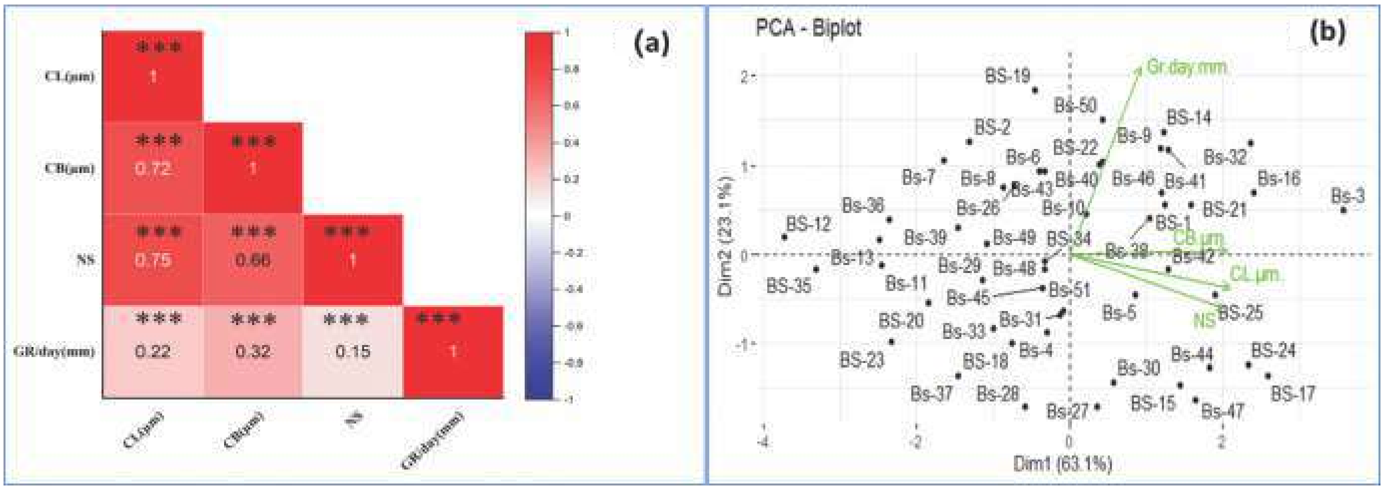


Fig. 3.2. Correlogram depicting correlation among various morpho-cultural traits (3.2a); PCA for different morpho-cultural traits (3.2b)

Molecular variability: Out of the 51 isolates studied for morpho-cultural and pathogenicity attributes, total of 48 *Bipolaris sorokiniana* isolates yielding high-quality genomic DNA were genotyped using 28 polymorphic simple sequence repeat (SSR) loci to assess molecular variability. The SSR primers, ranging from 18 to 26 bp in length and exhibiting melting temperatures between 59°C and 66°C, consistently produced clear amplicons across isolates, with most loci amplifying optimally at 59–60°C. Alleles were scored based on fragment-size homology, revealing 43 alleles in total, with individual loci exhibiting one or two alleles. Of the 28 markers, 15 were biallelic, while 13 were monomorphic, generating amplicons between 125 and 265 bp. All markers were polymorphic across the isolate set. Genetic diversity values ranged from 0.0408 (e.g., BS-28_1, BS-30_1, BS-35_1, BS-39_1, BS070) to 0.4991 (BS-28, BS-24), with a mean of 0.2984, while PIC values varied between 0.0400 and 0.3746 (mean = 0.2406), reflecting moderate informativeness of the SSR panel. Markers such as BS-24, BS-28, BS-11, and BS-39 exhibited the highest genetic diversity and PIC values, making them particularly informative for assessing population-level variation.

Population genetic analyses conducted using GenAlEx 6.5, PCoA, and DARwin consistently supported the presence of two genetically distinct lineages among the 48 *B. sorokiniana* isolates. AMOVA indicated that 29% of the total molecular variance was attributable to differences between the two subpopulations, whereas 71% resided within subpopulations (Fig. 3.3a), with both components highly significant (*PhiPT* = 0.295, *P* < 0.001; *Nm* = 1.195), reflecting moderate genetic differentiation and limited gene flow (Table 3.1). Genetic diversity indices further revealed higher allelic richness and heterozygosity in SP2 (*Na* = 11; *Ne* = 8.333; *I* = 2.238; *H* = 0.880; *uH* = 0.917) than in SP1 (*Na* = 8; *Ne* = 7.118; *I* = 2.011; *H* = 0.860; *uH* = 0.900), indicating greater genetic diversity within SP2. PCoA resolved the isolates into two clearly separated clusters (Fig. 3.3b; Table 3.1), with the first two axes explaining 33.41% of the total variation, in agreement with the STRUCTURE-based grouping. Similarly, the phylogenetic tree generated using the Weighted Neighbour-Joining method in DARwin 6 divided all isolates into two well-supported clades (Fig. 3.3c), fully consistent with the STRUCTURE and PCoA results.

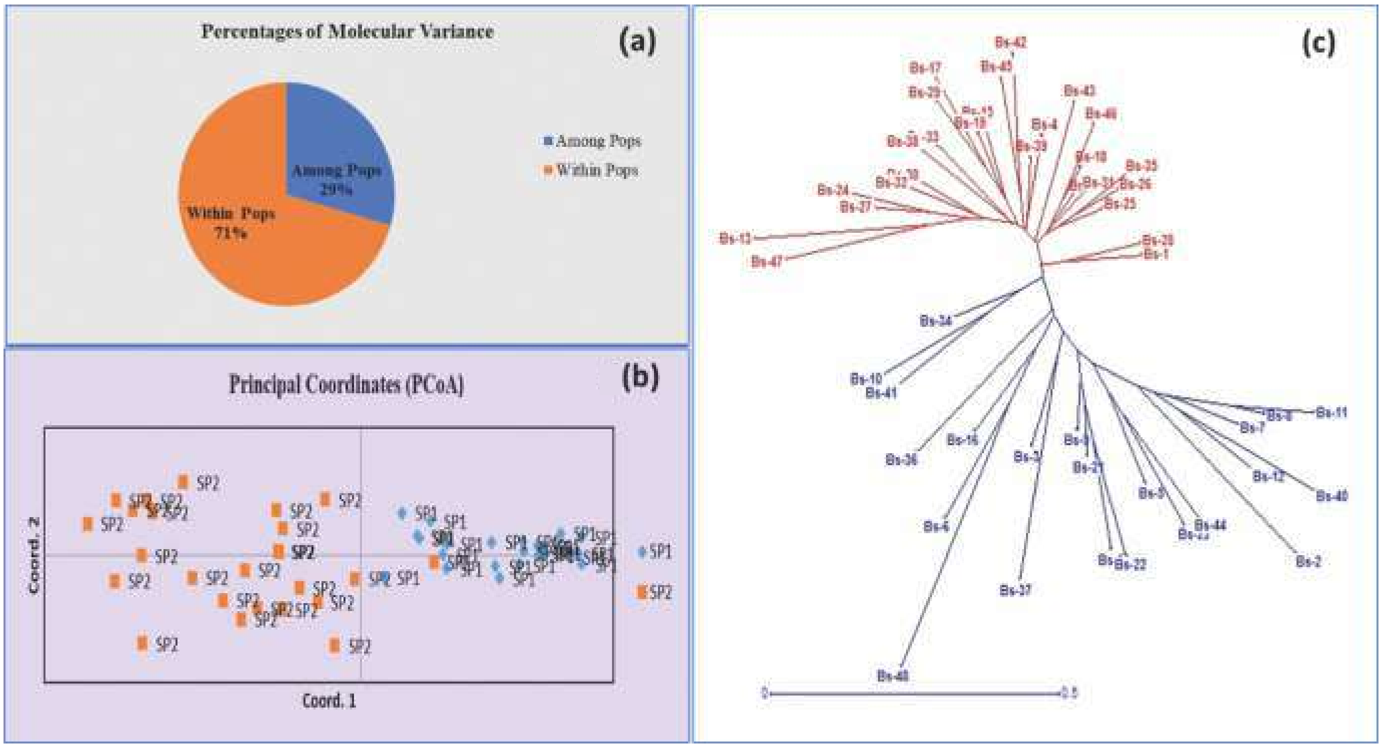


Fig. 3.3. Percentages of molecular variance in sub-populations of *B. sorokiniana* isolates (3.3a) Principal Coordinates Analyses (PCoA) of 48 *B. sorokiniana* isolates with different population subgrouping from STRUCTURE software as similarly revealed by GenALEx 6.5 software based on allelic data of 28 SSR loci (3.3b); The Phylogenetic tree diagram created using Darwin 6 software shows the clustering of 48 isolates of *B. sorokiniana* based on data from 28 SSR markers, using the Weighted Neighbors Joining method (3.3c)

Table 3.1. Subpopulations and grouping of isolates as per the results of structure

Subpopulation	Number	Isolates
SP1	23	Bs-2, Bs-3, Bs-5, Bs-6, Bs-7, Bs-8, Bs-9, Bs-10, Bs-11, Bs-12, Bs-13, Bs-16, Bs-20, Bs-21, Bs-22, Bs-23, Bs-24, Bs-37, Bs-40, Bs-41, Bs-44, Bs-47, Bs-48
SP2	25	Bs-1, Bs-4, Bs-14, Bs-15, Bs-17, Bs-18, Bs-19, Bs-25, Bs-26, Bs-27, Bs-28, Bs-29, Bs-30, Bs-31, Bs-32, Bs-33, Bs-34, Bs-35, Bs-36, Bs-38, Bs-39, Bs-42, Bs-43, Bs-45, Bs-46

Pathogenic variability among isolates of wheat spot blotch pathogen *Bipolaris sorokiniana:* Significant pathogenic variation was observed among the *B. sorokiniana* isolates across all disease-associated traits assessed on the susceptible cultivar Sonalika and the resistant cultivar Chirya-3. In Sonalika, incubation period ranged from 2.75–6.00 days, whereas in Chirya-3 it varied from 3.25–6.75 days, with isolates such as Bs-3, Bs-15, and Bs-5 showing the shortest incubation periods. Lesion dimensions were similarly variable: lesion length, spanned 1.95–5.05 mm and lesion size, 1.81–8.53 mm^2 in Sonalika, with Bs-3 consistently producing the largest lesions. Chirya-3 exhibited reduced lesion expansion (lesion length 1.23–2.40 mm, lesion size 1.16–2.88 mm^2), reflecting partial resistance. Infection frequency showed marked differentiation among isolates (Sonalika: 4.0–8.5 lesions/cm^2; Chirya-3: 1.25–3.75 lesions/cm^2), and lesion coverage ranged from 2.5–67.5% in Sonalika and 2.5–22.5% in Chirya-3, with Bs-3, Bs-21 and Bs-24 producing the highest lesion coverage values. Disease severity and percent disease index followed similar patterns: in Sonalika, disease severity ranged from 1.0–4.5 and percent disease index from 8.75–90.0, whereas in Chirya-3 disease severity ranged from 0.25–2.25 and percent disease index from 1.0–20.0. Across traits and hosts, Bs-3 was consistently among the most aggressive isolates, exhibiting the shortest incubation period, largest lesions, highest infection frequency and maximum lesion coverage, and the greatest disease severity and percent disease index. Correlation analysis revealed a strong negative relationship between incubation period and disease severity (*r* = –0.87), with incubation period also negatively correlated with lesion length, lesion breadth, lesion size, lesion coverage, and infection frequency. In contrast, disease severity showed highly significant positive correlations with all lesion-related traits (Fig. 3.4 a). Hierarchical clustering grouped isolates into five pathogenicity clusters. Cluster 1 comprised isolates with long incubation period and minimal lesion development, representing the least virulent group, whereas Cluster 5 (including Bs-3 isolate) displayed the shortest incubation period and highest lesion metrics, forming the most virulent group. Principal component analysis confirmed this structure, with PC1 (85.0%) dominated by lesion size, lesion breadth and infection frequency, while PC2 (7.1%) was associated primarily with lesion coverage and disease severity (Fig. 3.4b). The first two components together explained 92.1% of total variation, indicating strong covariation among pathogenicity traits (Fig. 3.4 b).

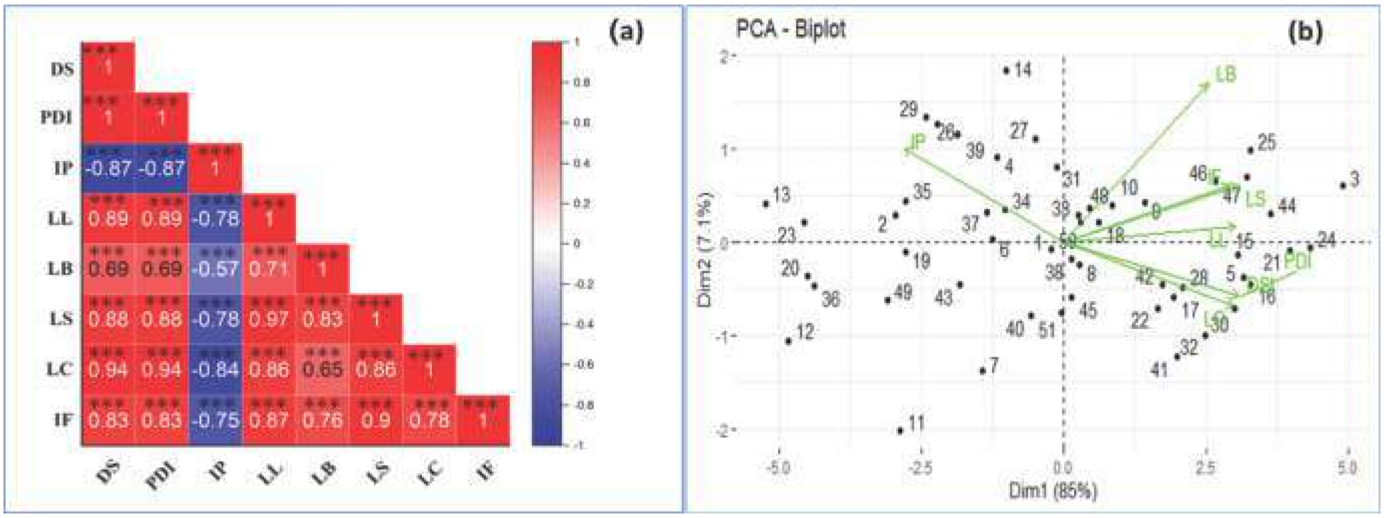


Fig. 3.4. Correlogram showing correlation among pathogenicity attributes (3.4a); Principal Component Analysis (PCA) on basis of pathogenicity attributes under study (3.4b)

Identification of genomic regions conferring resistance against spot blotch in a diverse genotypic panel of wheat employing GWAS approach: A genome-wide association study (GWAS) was conducted to identify genomic regions associated with resistance to spot blotch in wheat using a diverse panel of 403 genotypes evaluated under artificial inoculation at ICAR-IIWBR, Karnal and BHU, Varanasi during the *Rabi* seasons of 2022–23 and 2023–24. Phenotyping was performed for key disease-related traits including AUDPC, incubation period, lesion length, and lesion breadth across four environments. Genomic DNA was isolated using a modified CTAB method, quantified, and quality-checked prior to genotyping with the 35K Axiom® Wheat Breeder's SNP Array. After stringent quality filtering, 14,715 high-quality SNP markers from 391 genotypes were retained for analysis. Population structure was assessed using STRUCTURE and PCA, and kinship was estimated to account for relatedness among genotypes. Marker–trait associations were analyzed using the GAPIT package in R, testing multiple statistical models to minimize spurious associations. Farm CPU was identified as the best-fitting model based on Q–Q plot comparisons and was used for final GWAS analysis. Significant MTAs were declared at $p \leq 0.001$ across environments, and putative QTLs were defined based on linkage disequilibrium intervals. Significant SNPs were further subjected to in silico annotation to identify candidate genes associated with spot blotch resistance. Flanking regions were analyzed using EnsemblPlants, IWGSC RefSeq, and URGI databases, with functional annotation supported by BLAST and Blast2GO analyses. The identified genomic regions and candidate genes provide valuable insights into the genetic basis of spot blotch resistance and offer potential targets for marker-assisted breeding in wheat

In the germplasm panel of 391 genotypes used for GWAS, two subpopulations, SP1 and SP2 were observed on basis of structure (Fig. 3.5), all supported by PCA and Kinship matrix, based on unlinked SNP markers, natural adaptation, and selection history for traits of interest, SP1 was found to be more diverse than SP2 sub-population. During GWAS analysis total 306 MTAs were found to be significant in all traits over all the environments. In the case of AUDPC, total 74 MTAs were found significant, similarly in IP 57, LL 44 and LB 131 MTAs were found significant. Significant MTAs linked to candidate genes encode different types of functional proteins involved in various key pathways affecting the spot blotch resistance directly. 61 MTAs were found liked to NBS-LRR domain, MAP kinases, Peroxidases, calmodulin and calmodulin-binding proteins, UDP-Glycosyltransferase superfamily proteins, Protein_TIFY_3A, Ubiquitin proteins, RING_Finger_Protein, J-proteins (DnaJ proteins), cytochrome c oxidase, Chitinases etc. that govern resistance directly or indirectly. Annotated markers found within genes

Fig. 3.5. Structure population bar plot for 391 genotypes generated by Structure using the admixture model at K=2, each colour depicts an individual subpopulation SP1 (Red) and SP2 (Green), respectively.

TraesCS3D02G041900,LOC109741086, Traes CS3A02 G008000 and TraesCS2D02G001800 establishing direct resistance in plants. Total 33 MTAs were found to be novel MTAs among 306 MTAs. In case of AUDPC 3, IP 2, LL 8 and LB 20MTAs found to be novel. The significant SNP markers linked to the spot blotch and associated traits of spot blotch can be used to develop a Kompetitive Allele Specific PCR (KASP) assay and can be further used for Marker Assisted Selection.

Host–Pathogen Interaction

Wheat is the majorly cultivated cereal grain globally, playing a fundamental role in agriculture. Stripe rust, caused by *Puccinia striiformis* f. sp. *tritici* (*Pst*), is a catastrophic disease, poses significant challenges to wheat production worldwide and resistant cultivars are the most effective strategy against rust diseases. In plants, salicylic acid (SA) and sugar-mediated defense pathways are thought to offer durable, broad-spectrum resistance. In this study, to explore their roles in wheat during early stripe rust infection, time-course experiments analyzed the expression profiles of key regulator gene of SA (*TaEDS1*) and sugar (*TaHTP*) pathways in two wheat varieties PBW 343 (compatible) and FLW-3 (incompatible) with Pst pathotype 78S84 (Fig. 3.6).

Non-expressor of Pathogenesis-Related Genes 1 (NPR1)- functions downstream of the SA pathway and master regulator of systemic acquired resistance and modulates the expression of pathogenesis-related (PR) genes through SA-dependent signaling, conferring durable and broad-spectrum resistance. *TaNPR1* exhibited an early and strong induction at 24 hours post-inoculation in the resistant wheat line (FLW-3; incompatible) (Fig. 3.7), whereas its expression was weak and transient in the susceptible line (PBW 343; compatible). This pattern demonstrates that *TaNPR1* acts as a positive regulator of SA-mediated defense. Non-race specific Disease Resistance 1 (NDR1) - acts upstream in the salicylic acid (SA)-mediated defense signaling pathway and functions as a positive regulator of resistance. Its expression in the resistant line remained consistently low and delayed activation in the susceptible line suggests that *TaNDR1* is part of a feedback response attempting to compensate for pathogen establishment, rather than contributing to early effective resistance.

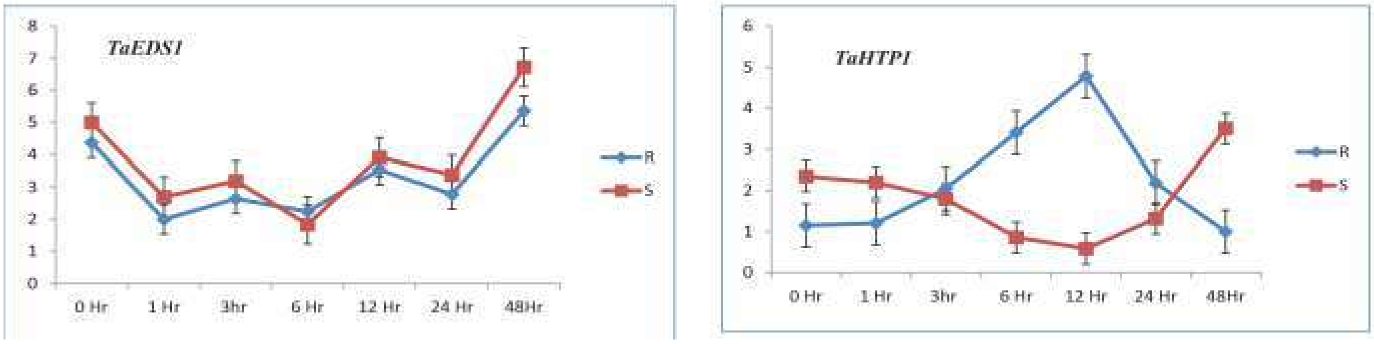


Fig. 3.6. Expression levels of SA pathway-related gene (*TaEDS1*) and sugar transporter genes (*TaHTP*) during compatible and incompatible interactions of wheat and leaf rust pathogen (R=Resistant; S=Susceptible)

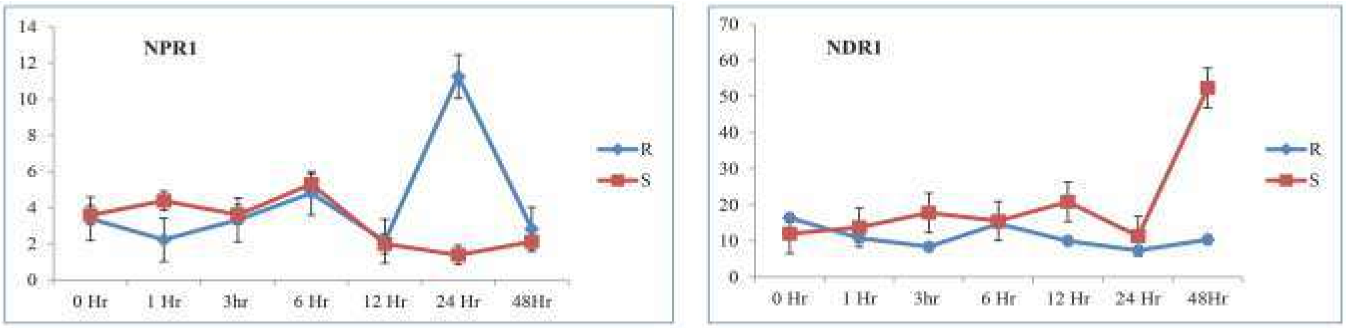


Fig. 3.7. Expression levels of SA pathway-related gene (*NPR1*) and (*NDR1*) during compatible and incompatible interactions of wheat and leaf rust pathogen

Molecular profiling of AVT lines with the help of robust molecular markers

- Wheat rust resistance genes (*Lr, Sr, Yr*) were identified using molecular markers in AVT material of 2024-25. DNA from all 204 AVT entries was isolated and DNA quality was checked on 1% agarose gel electrophoresis and quantified on nano drop. Robust molecular markers for several genes were applied on isolated DNA lines to ascertain additional rust resistance in these wheat lines (Fig. 3.8).
- Amplification of *Lr, Sr, Yr (Yr15; Lr24/Sr24; Lr19/Sr25; Yr18/Lr34/Sr57* and *Yr9/Lr26/Sr31)*
- AVT material screened for *Yr15; Lr24/Sr24; Lr19/Sr25; Yr18/Lr34/Sr57* and *Yr9/Lr26/Sr31* gene complex with molecular markers *GWM 11, Sr24#12, PSY1E1, csLV34, SCSS30.2* respectively.
- Presence of *Yr 15* :- 2, 12, 14,15, 16, 22, 24, 25, 36, 49, 54, 55, 79, 80, 90, 94, 99, 100, 104, 105, 108, 109, 123, 125, 142, 175,
- Presence of *Lr24/Sr24*:- line no. 13, 17, 19, 20, 28, 31, 32, 40, 41, 43, 110, 111, 113, 114, 116, 122, 125, 126, 160, 167, 174, 178, 180, 186, 187, 188
- Presence of *Lr19/Sr25* :- *NA*
- Presence of *Yr18/Lr34/Sr57* :- 32, 114, 126, 156, 163, 164, 179, 187, 189,
- Presence of *Yr9/Lr26/Sr31* :- 28, 41, 44, 80, 83, 85, 87, 89, 90, 92, 96, 107, 116, 119, 121, 122, 126, 132, 137, 138, 164, 179, 186, 188, 189,190

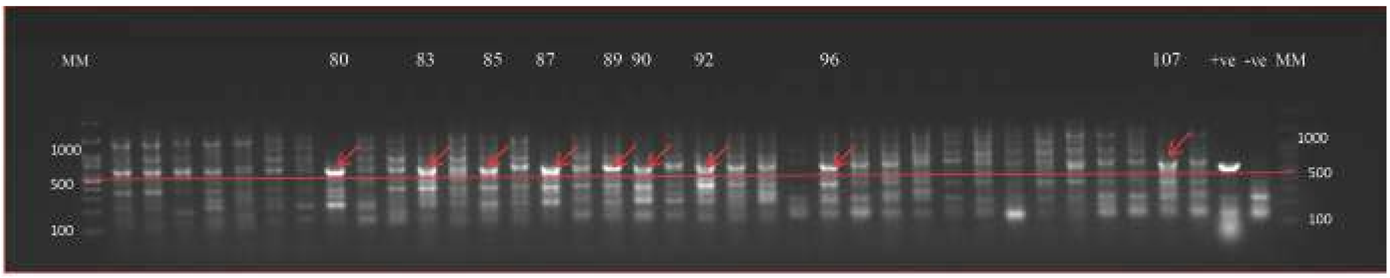


Fig. 3.8. Electrophoresis on 2.5 % agarose gel showing amplification profile of marker SCSS30.2 indicated the presence of *Yr9/Lr26/Sr31* gene complex. Lane 1(MM)- Gene Ruler 100 bp DNA ladder; Lane 2-37 - AVT line 1to 36, Lane 38(+ve)-Lr26 NIL as positive check for gene Lr26; Lane 39 (-ve)-LWH as negative check; Lane 40(MM)- Gene Ruler 100 bp DNA ladder

Genome Editing for Rust Resistance

TaNAC2, a nitrate transporter gene, was silenced to enhance tolerance to *Puccinia striiformis* by increasing H_2O_2 production and inhibiting hyphal development during early infection. Based on sequence retrieval (NCBI), BLAST analysis (Ensembl Plants), and CRISPR design tools, two guide RNAs targeting exonic regions were designed with high specificity and optimal GC content. Literature indicates no yield penalty from TaNAC2 manipulation. The validated gRNAs were: $gRNA_1$ (CCCTCTTCGGCACCCGCGAG) and $gRNA_2$ (AGTGCGACTGGGACTGCGAG).

Genome-wide Identification of Aquaporin Gene Family

Aquaporins (AQPs) are proteins found in cell membranes that help transport water and small non-water molecules across biological membranes. These proteins typically weigh between 26 and 30 kDa and play a key role in managing water movement and other essential molecules for plant growth and stress resistance. In plants, aquaporins are sorted into five main subfamilies based on their location within the cell and their sequence similarities. These are: plasma membrane intrinsic proteins (PIPs), tonoplast intrinsic proteins (TIPs), NOD26-like intrinsic proteins (NIPs), small basic intrinsic proteins (SIPs), and X intrinsic proteins (XIPs). In this study a genome-wide analysis of the aquaporin (AQP) gene family was carried out in wheat (*Triticum aestivum* L.) under biotic stress conditions. Aquaporin gene sequences were systematically retrieved from the Ensembl Plants database (IWGSC RefSeq v2.1) using BioMart, based on InterPro and Pfam domain identifiers associated with aquaporins. To enable comparative and phylogenetic analysis, aquaporin genes from *Oryza sativa* and *Arabidopsis thaliana* were also retrieved using the same approach, while aquaporin-related outgroup sequences (*AqpZ* and *GlpF*) were obtained from UniProt. Redundant transcript isoforms were removed to retain a single representative protein per gene, resulting in a final dataset of 132 wheat, 39 rice, and 37 *Arabidopsis* aquaporin genes (Fig. 3.9). Physicochemical properties of wheat aquaporin proteins were analyzed using the ExPASy ProtParam tool. Gene IDs were renamed based on aquaporin subfamily classification obtained from UniProt for improved visualization. Protein FASTA sequences from all species and outgroups were merged and aligned using MUSCLE, followed by phylogenetic tree construction using the Maximum Likelihood method in MEGA, with outgroups used for rooting.

The phylogenetic tree was visualized and annotated using iTOL with subfamily-based color coding. Additionally, conserved motifs among wheat aquaporins were identified using the MEME suite, revealing conserved structural patterns across the gene family. The dendrogram (Fig. 3.9) revealed clear phylogenetic structuring of wheat, rice and *Arabidopsis* aquaporin genes, indicating substantial sequence diversity within the gene family. Based on clustering patterns, the genes were grouped into four major phylogenetic groups, each represented by a distinct colour segment in the dendrogram. Genes within the same group showed high sequence similarity, suggesting shared evolutionary origin and possible functional relatedness. The presence of multiple sub-clusters within each major group indicates gene diversification, likely resulting from duplication events and subsequent functional divergence, which is characteristic of resistance (R) gene families in wheat.

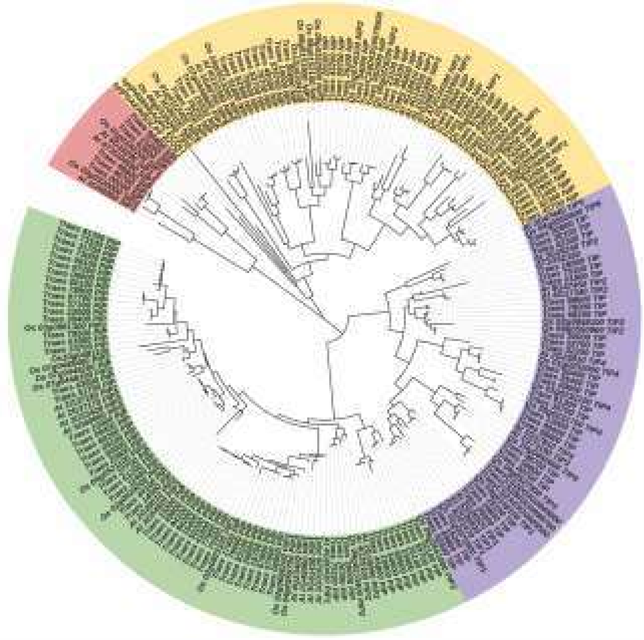


Fig. 3.9. Dendrogram revealed clear phylogenetic structuring of wheat, rice and *Arabidopsis aquaporin* genes

Molecular characterization of *Fusarium* species associated with wheat disease spike complex

The wheat spike disease complex, commonly referred to as Fusarium head blight (FHB), is among the most destructive diseases affecting wheat production across major wheat-growing regions of India. An initiative was undertaken to investigate the etiology of this disease complex. For this purpose, a large number of wheat spikes were collected from multiple FHB-affected regions, from which several Fusarium isolates were recovered. Based on morphological variability, ten distinct isolates were selected for detailed characterization. Morphological studies conducted on four culture media-potato dextrose agar (PDA), potato carrot agar (PCA), yeast malt agar (YMA), and synthetic complete dextrose agar (SCDA)-revealed substantial variation among isolates in colony colour, pigmentation, zonation, and growth rate. Mean radial growth across isolates ranged from 3.76 to 6.76 cm day^{-1}. SCDA supported the highest overall average growth (5.18 ± 0.04 cm day^{-1}), followed closely by YMA (5.17 ± 0.02 cm day^{-1}). PDA and PCA were superior for observing diagnostic macro- and microconidial features. Eight Fusarium species were identified: *Fusarium graminearum*, *F. culmorum*, *F. cerealis*, *F. incarnatum*, *F. proliferatum*, *F. annulatum*, *F. pernambucanum*, and *F. tanahbumbuense*. In vitro pathogenicity assays revealed symptom initiation as early as 4 days after inoculation, with disease severity at 7 days ranging from 34.0% to 88.2%. The highest disease severity was caused by *F. cerealis* (88.2 ± 2.14%), followed by *F. culmorum* (64.5 ± 2.36%) and *F. incarnatum* (56.2 ± 2.68%), indicating their high aggressiveness on wheat spikelets. Molecular confirmation using partial sequences of the translation elongation factor 1-α (TEF-1α) and Histone H3 genes grouped the ten isolates into eight well-supported phylogenetic clades, fully consistent with morphological identification (Fig. 3.10). The integration of growth parameters, pathogenicity data, and multilocus phylogenetic analyses highlights the diversity and differential virulence of eight different *Fusarium* species associated with wheat head blight across wheat-growing regions of India.

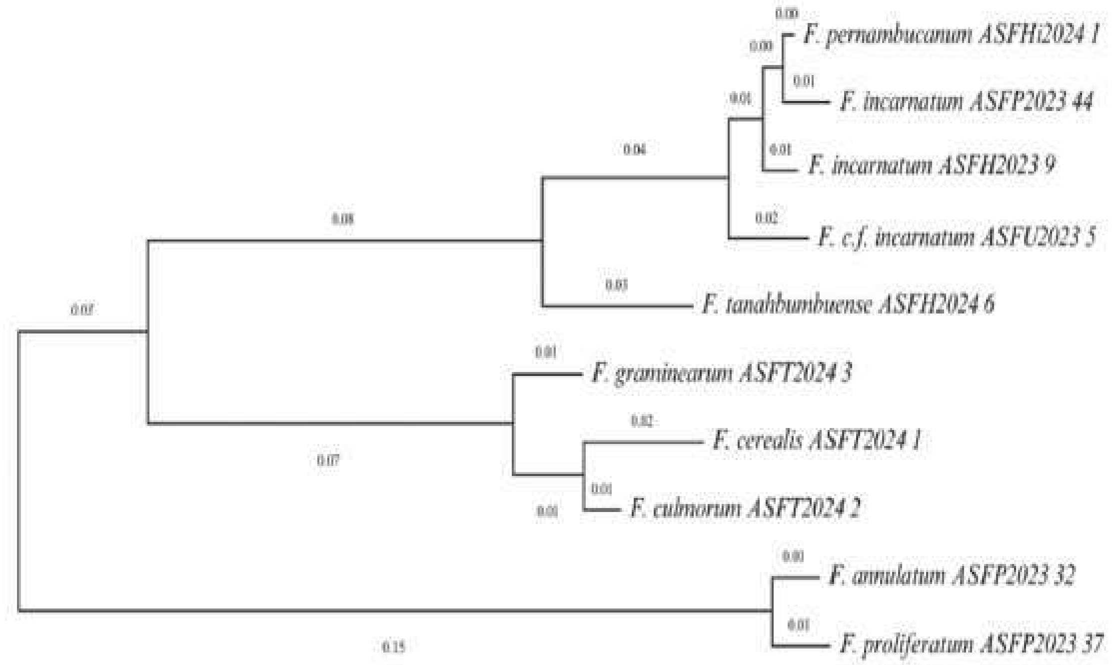


Fig. 3.10. Molecular identification of *Fusarium* species associated with spike blight disease complex using H3 and TEF genomic region.

Evaluation of synthetic wheat yellow rust resistance

Yellow rust (stripe rust), caused by *Puccinia striiformis* f. sp. *tritici*, is one of the most destructive diseases of wheat, particularly in cooler and humid wheat-growing regions. Frequent breakdown of race-specific resistance due to rapid pathogen evolution necessitates the identification of durable resistance sources. Synthetic wheats represent an important reservoir of novel alleles for adult plant resistance (APR) and slow-rusting traits. In this context, a study was planned to evaluate 86 synthetic wheat genotypes for their effectiveness against yellow rust. Analysis of variance revealed highly significant ($P \leq 0.05$) differences among genotypes for latent period (LP), lesion length (LL), final rust severity (FRS), average coefficient of infection (ACI), and area under the disease progress curve (AUDPC), confirming substantial genetic variability for resistance. Approximately 30% of the evaluated genotypes carried multiple known APR genes and/or putative novel slow-rusting genes. Latent period ranged from 10 to 20 days, with 22 genotypes exhibiting extended LP (16–20 days). These genotypes showed a significantly longer mean LP (18.1 days) compared with susceptible lines (11.3 days), indicating delayed disease development. Seven genotypes (O. Synthetic-32, O. Synthetic-46, O. Synthetic-49, O. Synthetic-65, O. Synthetic-85, O. Synthetic-86, and O. Synthetic-87) consistently expressed moderate resistance with significantly lower AUDPC values (<250) relative to susceptible checks (>650). Lesion length varied from 0 to 6.8 mm; three genotypes (O. Synthetic-01, O. Synthetic-50, and O. Synthetic-88) showed no visible lesions, while ten genotypes developed very small lesions (<2 mm), reflecting high levels of resistance. Based on AUDPC and ACI, field evaluations classified genotypes into resistant, slow-rusting, moderately susceptible, and susceptible groups. Resistant genotypes recorded significantly lower mean ACI (≤10) and AUDPC (≤200) than susceptible genotypes (ACI ≥40; AUDPC ≥700). Pearson's correlation analysis demonstrated strong positive associations between AUDPC and ACI ($r = 0.92$, $P \leq 0.01$) and between AUDPC and lesion length ($r = 0.76$, $P \leq 0.01$), highlighting the interdependence of disease components. Moderate negative correlations were observed between disease parameters and the number of resistance genes ($r = -0.48$ to -0.55), while LP showed a weak to moderate negative correlation with AUDPC ($r = -0.41$). Collectively, these results underscore the critical role of synthetic wheats as effective and durable sources of APR and slow-rusting resistance for yellow rust improvement in wheat breeding programs.

Development of WRIST (Wheat Rust Information and Surveillance Tracker) system

Effective disease surveillance requires a comprehensive understanding of pathogen population dynamics across space and time. This study applies spatio-temporal trend analysis to identify dominant wheat rust pathotypes and delineate high-risk regions for targeted disease management. Multi-year georeferenced datasets (2008–2025) encompassing more than 15 years of surveillance data on yellow (stripe), brown (leaf), and black (stem) rusts across multiple Indian states and selected international sites were integrated with molecular characterization data. Analytical tools were employed to map disease incidence patterns, detect hotspots, and assess pathotype dynamics. An interactive visualization platform, WRIST (Wheat Rust Information and Surveillance Tracker), developed using Google Looker Studio, facilitates exploration of spatio-temporal trends and long-term disease dynamics (Fig 3.11). It enables users to visualize the spatial distribution of wheat rust pathotypes by year and location. This integrated framework demonstrates how combining spatial analytics and temporal modeling can enhance early warning systems and promote precision disease management. Data processing and analyses were conducted using Jupyter Notebook and the Python programming language. In nutshell, the developed comprehensive surveillance approach not only strengthens understanding of wheat rust evolution but also provides a decision-support tool for wheat researchers and policymakers. The integration of long-term datasets with advanced analytics contributes to sustainable rust management strategies and improved resilience of wheat production systems.

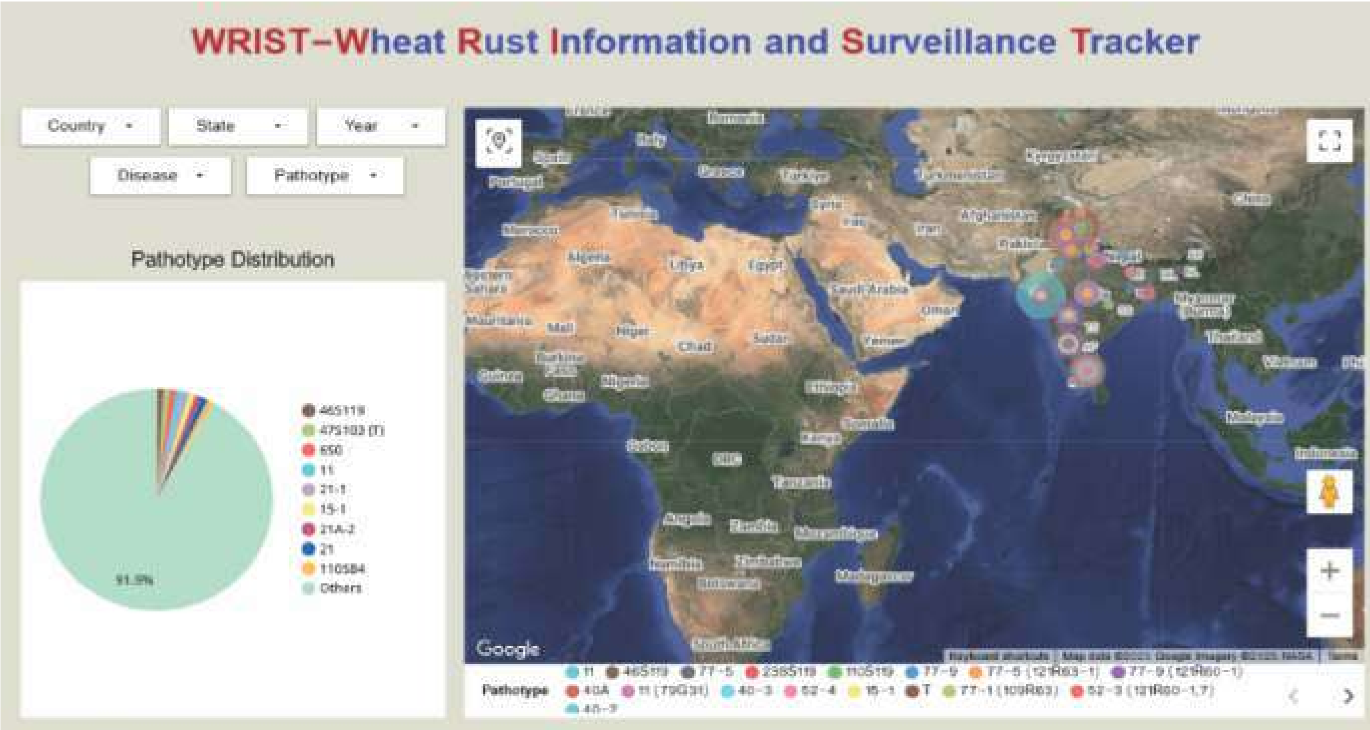


Fig. 3.11. WRIST for illustrating spatio-temporal trends and long-term dynamics of wheat rust diseases

4 RESOURCE MANAGEMENT

Diversification of rice-wheat system

The rice-wheat system in South Asia is crucial for sustenance, food security, and livelihoods. However, challenges like malnutrition, declining productivity, and resource degradation persist. Exploring alternative cropping systems is essential to address these issues and promote sustainability. Consequently, a field experiment was conducted to evaluate the potential of maize-based conservation agriculture (CA) compared to conventional agriculture (CT) in enhancing diversification, productivity, profitability, and sustainability in North-West India. Over a three-year average, the grain yield of maize, wheat, pea, mustard, and green gram under CA-based management practices surpassed that of CT-based management practices by 7.5%, 1.2%, 24.4%, 11.3%, and 30.3%, respectively (Fig. 4.1). Additionally, the wheat equivalent yield (WEY) of CA-based maize-wheat-green gram (MWG), maize-mustard-green gram (MMuG), maize-pea-wheat (MPW), and maize-wheat (MW) systems exhibited improvements of 11.4%, 2.1%, 0.8%, and 17.8%, respectively, over their corresponding CT-based cropping systems. Notably, mean of all maize based cropping systems under CA led to a substantial 35.4% increase in overall system productivity and an impressive 81.8% rise in profitability compared to the rice-wheat system (farmers' practice). While, average of all maize based cropping systems under CT also demonstrated significant enhancements, with a 26.0% gain in system productivity and a 49.8% rise in profitability over the farmers' practice.

Among the systems studied, the CA-based maize-wheat-green gram cropping system emerged as the most efficient production system, resulting in a notable 59.3% increase in wheat equivalent yield and a substantial 129.0% surge in economic profitability compared to the traditional farmers' practice. Our research emphasizes the potential of cropping systems like maize-wheat-green gram, maize-mustard-green gram, and maize-pea-wheat, employing conservation agriculture principles. These systems, particularly CA-based maize-wheat-green gram, introduce legumes and optimize practices to address challenges in the Indo-Gangetic Plains (IGP) of India. They significantly enhance the region's agricultural sustainability, offering scalable alternatives to the traditional rice-wheat system.

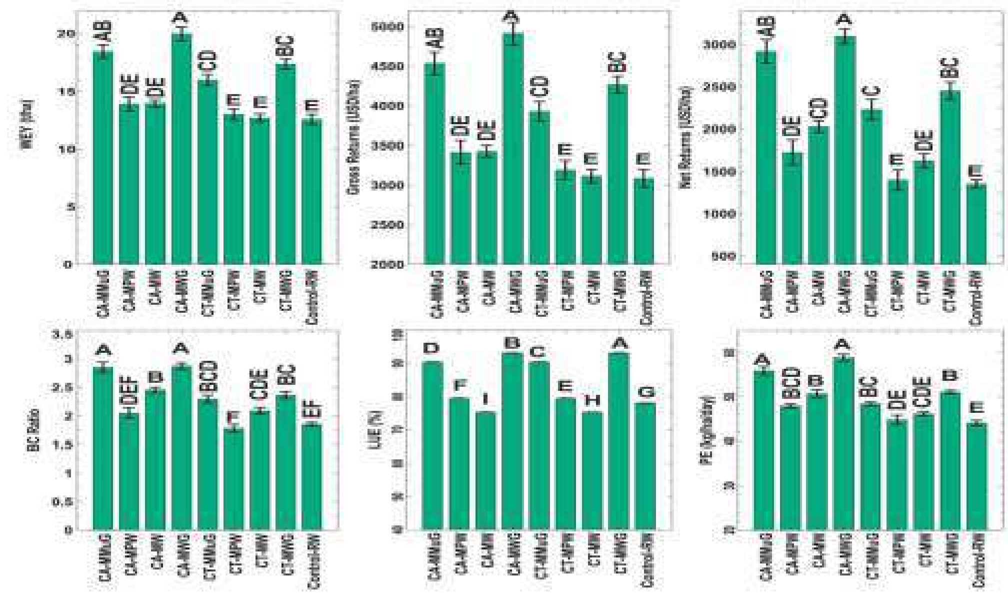


Fig. 4.1. Yield and economics of CA and CT based various cropping systems

Optimizing nitrogen use efficiency (NUE) and yield in wheat

A field experiment was conducted to evaluate the NUE of different wheat varieties under graded nitrogen doses. The study revealed that the variety PBW 826 demonstrated superior performance with application of 210 kg N/ha, exhibiting higher normalized difference vegetation index (NDVI) and chlorophyll content indices, along with lower flavonoid levels. PBW 826 also produced the highest biomass (14,506 kg/ha), grain yield (6,066 kg/ha), and straw yield, with a 17.5% and 20.3% increase in grain yield compared to other varieties. The NUE for PBW 826 was highest (38.1%) at 30 kg N/ha, While biomass, grain yield, and straw yield increased with nitrogen application up to 150 kg/ha, no significant differences were observed beyond this level. NUE metrics, including partial factor productivity and nitrogen harvest index, improved up to 150 kg N/ha but declined with further nitrogen enhancement. The study concludes that optimizing nitrogen levels up to 150 kg/ha enhances wheat productivity and efficiency, while excessive nitrogen application diminishes these benefits. Additionally, understanding the interaction between varieties and nitrogen levels for yield and NUE can help farmers select the best variety at the lowest nitrogen input, maximizing both profitability and sustainability.

Wheat and rice grain yield in rice-wheat cropping system due to different residue management practices

Wheat crop was sown after puddled and direct seeded rice under conventional tillage (no rice residue, burning of rice residue and rice residue incorporation) and zero till condition (no residue, anchored rice residue and full rice residue).

- Wheat grain yield was significantly higher under ZT + full rice residue condition over all three CT sown wheat treatments (residue removed, residue burned and residue incorporation) after puddlled transplanted rice (Fig. 4.2).
- Maximum wheat yield (6686 kg/ha) was obtained with zero-till + full rice residue condition after direct seeded rice.
- Maximum rice yield (4505 kg/ha) was obtained in puddled transplanted rice condition in treatment having zero-till wheat + full rice residue.
- Highest returns over variable cost (₹ 250794 per ha) and B:C (3.51) under rice-wheat cropping system was realized in direct seeded rice condition and zero-till sown wheat with full rice residue (Fig. 4.3).

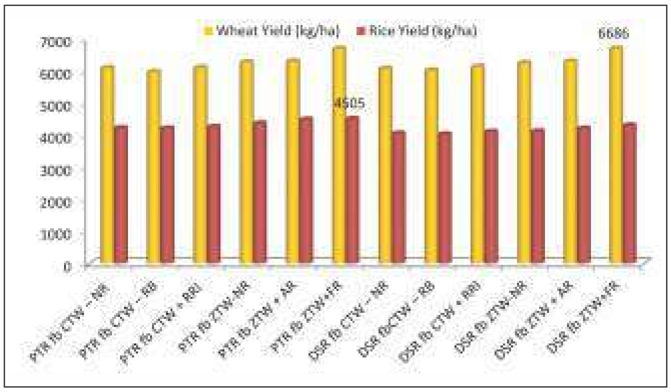


Fig. 4.2. Wheat and rice grain yield affected by different tillage and residue management practices. The abbreviations in fig are PTR: puddle transplanted rice; CTW: conventional tillage wheat; NR: no residue; RB: residue burning; RRI: rice residue incorporation; ZTW: zero tillage wheat; AR: anchored residue; FR: full residue; DSR: direct seeded rice

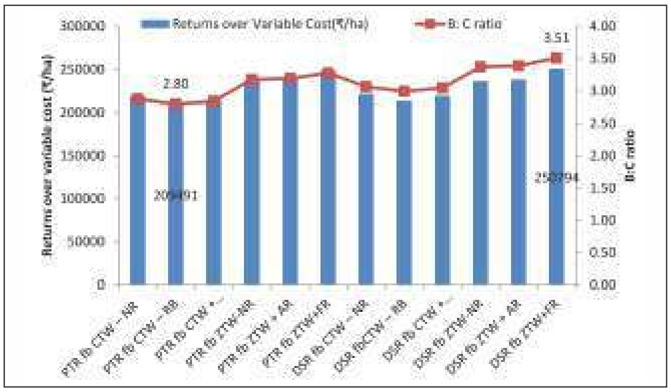


Fig. 4.3. Economics of different treatments in rice-wheat cropping system under different tillage and residue management practices. The abbreviations in fig are PTR: puddle transplanted rice; CTW: conventional tillage wheat; NR: no residue; RB: residue burning; RRI: rice residue incorporation; ZTW: zero tillage wheat; AR: anchored residue; FR: full residue; DSR: direct seeded rice

Natural farming

The experiment on natural farming in rice-wheat cropping system led to the following points:

- Grain yield of wheat was reduced significantly under natural farming protocol.
- Maximum wheat yield (6488 kg/ha) was obtained

under conventional tillage treatment having CT grown sesbania and puddled transplanted rice. Lower wheat yield (3312 kg/ha) was realized under natural farming protocol where wheat, rice (DSR) and green gram were sown in ZT + residue retention condition (Fig. 4.4).

- Grain yield of rice (2812 kg/ha) was also reduced significantly under natural farming protocol.
- Maximum rice yield (4622 kg/ha) was obtained under puddled transplanted rice condition after CT based green gram and wheat cultivation.
- The experiment on maize-barley cropping system in natural farming was also initiated and led to the following points:
- Grain yield of barley was reduced significantly under natural farming protocol.
- Maximum barley and maize yield (5022 and 7528 kg/ha, respectively) was obtained when barley (B), green gram (GG) and maize were sown under ZT condition with residue retention using recommended package of practices (RP). Under natural farming protocol, the maximum maize yield (4825 kg/ha) was realized when wheat and green gram sowing was done with ZT + residue retention (RR) condition (Fig. 4.5).

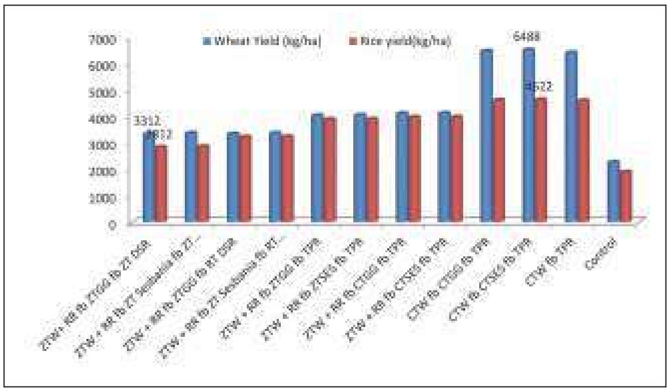


Fig. 4.4. Wheat and rice grain yield in rice-wheat cropping system under natural farming. The abbreviations in the fig are ZTW: zero tillage wheat; ZTGG: zero tillage green gram; DSR: direct seeded rice; ZTSES: zero tillage sesbania; CTW: conventional tillage wheat; CTGG: conventional tillage green gram; TPR: transplanted puddled rice

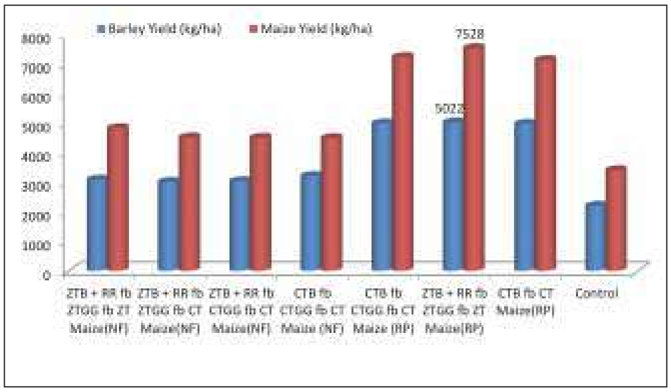


Fig. 4.5. Hullless barley and maize grain yield in barley-maize cropping system under natural farming

Popularization of natural farming

Trainings were imparted to more than 850 farmers on natural farming in collaboration with various KVKs of Punjab in Kapurthala, Nurmahal, SBS Nagar, Bahowal, Hoshiarpur, Kapurthala and Rupnagar.

Improving barley productivity through seed rate and growth regulators

Experiment was conducted using three seed rates (60, 80 and 100 kg/ha denoted as SR1, SR2 and SR3, respectively) and three foliar sprays of growth regulators {Tri-iodo benzoic acid (TIBA), 6-BAP, chlormequat chloride + tebuconazole) and mechanical drum rolling. The maximum grain yield (5383 kg/ha) was realized with two sprays as tank mix-chlormequat chloride (Lihocin) @ 0.2% + tebuconazole (Folicur 430 SC) @ 0.1% of commercial product dose at the first node and flag leaf as shown in Fig. 4.6.

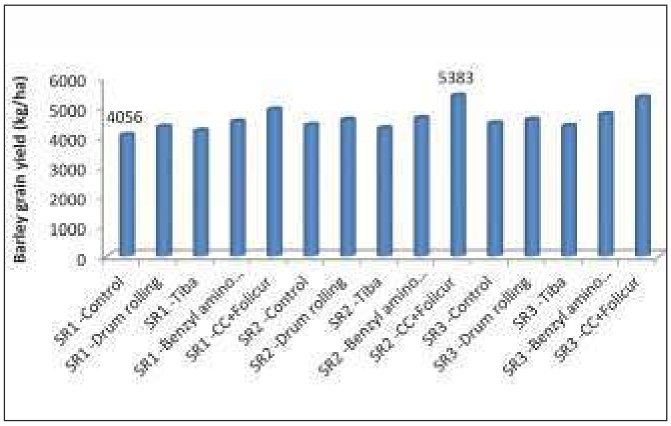


Fig. 4.6. Barley grain yield under different seed rates and growth regulators combination

Nutrient management

Integrated nutrient management in rice-wheat system

The long-term experiment consisting of seven nutrients management combinations [recommended NPK at the rate of 150:60:40 kg/ha N, P_2O_5 and K_2O, respectively (T_1), T_1 + FYM 15t/ha, T_1 + green manuring, Rec. N only, Rec. P only, Rec. K only and absolute control] was conducted in rice-wheat cropping system. The ninth-year results revealed that biomass and grain yield were significantly lower where only P or K were applied as compared to all other treatments, indicating the significance of nitrogen. The highest grain yield was recorded in treatment where all the major nutrients and FYM 15 t/ha were applied followed by the treatment in which all the major nutrients as well as green manuring were applied. These treatments were significantly higher than all other treatments except recommended NPK treatment. The application of recommended nitrogen alone brought significantly higher wheat productivity than recommended P and K alone or absolute control; however, the lowest yield was recorded where only P, K or no fertilizers (control) were applied, indicating the importance of nitrogen alone. The application of FYM or green manuring improved the organic carbon content significantly as compared to all other treatments.

Organics in high yielding varieties of wheat in rice-wheat cropping system

Organic production of high input responsive dwarf varieties of wheat is a matter of great concern and hence four newly released high yielding varieties (HYV) of wheat (HD 2967, DBW187, DBW222 and DBW 303) and five combinations of organic nutrient supply (control, farm yard manure (FYM) 10 t/ha, FYM 20 t/ha, FYM 30 t/ha and recommended doses of chemical fertilizers at the rate of 150:60:40 kg/ha N, P_2O_5 and K_2O, respectively, with two spray of nano urea and prilled urea at maximum tillering and heading stage thus having total 40 treatment combinations, were evaluated in split plot design. The fifth-year results revealed that application of FYM from 10 t/ha to 30 t/ha increased the grain yield of all the high yielding varieties of wheat significantly as compared to control (no organic or chemical fertilizer) treatment. However, the highest grain yield of all the high yielding varieties of wheat were recorded in the recommended NPK fertilizers treatment which was significantly higher than all the organic treatments including 30 t/ha FYM. Among the high yielding varieties, DBW 187 recorded the highest grain yield followed by DBW 222 and DBW 303 with recommended doses of NPK fertilizers (150:60:40). All the varieties performed similarly at all the organics levels and nano as well as prilled urea spray treatment. Prilled urea spray (3%) twice at maximum tillering and heading improved the productivity numerically than nano urea (1250 ml/ha) spray.

Conservation Agriculture (CA) in maize-wheat-green gram system

To evaluate the long-term effect of tillage, residue and nutrient management in maize-wheat-green gram system an experiment is in progress since *Kharif* 2015 involving combination of tillage and residue management {Zero tillage (ZT); ZT with residue retention (CA); Conventional tillage (CT) and CT + residue incorporation} in main plots and sub plots were having the four nutrient management options (Control; recommended N alone; recommended NPK; and recommended NPK + FYM 10 t/ha). The sowing was done using Happy Seeder. The results of the season 2024-25 showed that the effect of nutrient management, tillage and residue management and their interactions were non-significant. Among four nutrient management options, the minimum yield (22.63 q/ha) was recorded in unfertilized control plots (Fig. 4.7). The wheat grain yield recorded with application of recommended NPK + 10 t/ha FYM (66.73q/ha) was significantly better than therecommended N alone (39.43 q/ha) and recommended NPK (59.91 q/ha). These results indicate the superiority of integrated nutrient management in producing wheat yield. Observations were also recorded on soil temperature at 5 cm depth in the morning and in the afternoon on different dates.

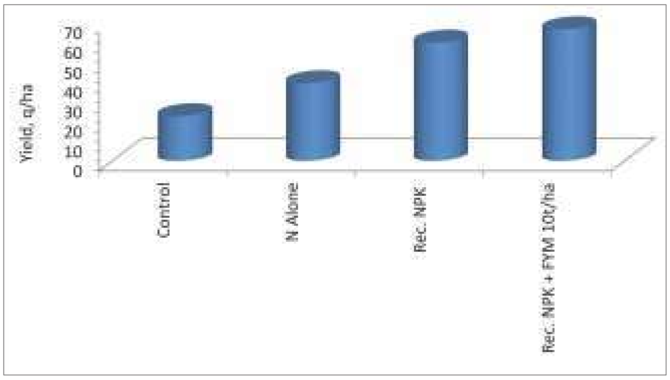


Fig 4.7. Nutrient management in wheat across tillage option in maize-wheat system

The morning temperatures were slightly higher in CA system where as the reverse was true in the afternoon. Among the treatments, the afternoon temperature in the control plots was higher than different nutrient management treatments.

Effect of tillage, residue and microbial consortia application on crop productivity

Field trials were conducted to study the effect of tillage, residue and microbial consortia application on crop productivity in rice-wheat system. The maximum wheat yield 55.68 q/ha was recorded with conventional tillage, which was similar to 55.18 q/ha with strip tillage (ST) as given in Fig. 4.8. The yield under zero-tillage was lesser (53.30 q/ha) over CT and ST tillage options. The effect of residue management options was non-significant but numerically higher yield (55.90 q/ha) was recorded with full residue + microbial consortia application over 53.39 q/ha with full residue and 54.86 q/ha with no residue. The effect of tillage and residue management in direct transplanted rice was non-significant (Fig. 4.9). However, numerically higher yield was reported under CT (44.65 q/ha) option over ZT (42.41 q/ha) and ST (43.32 q/ha). The mean yield of 42.47, 44.33 and 43.58 q/ha was observed for no residue (NR), full residue (FR) and full residue + microbial consortia (MC) application, respectively.

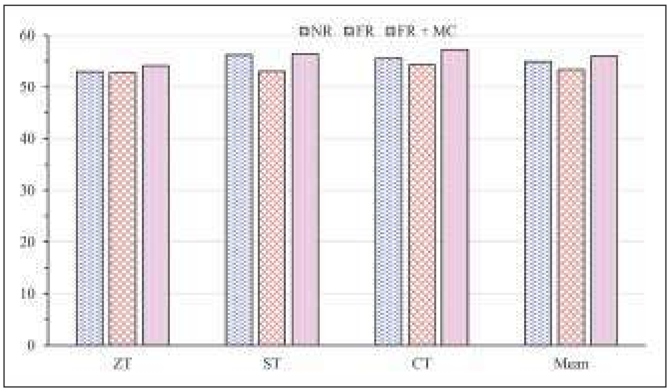


Fig. 4.8. Effect of tillage and residue management on wheat grain yield

Field demonstration on direct seeding of wheat under rice residue

Field demonstration on *in-situ* crop residue management in rice-wheat cropping system was conducted at farmer' field. In rice-wheat cropping system, wheat was directly sown under no-till conditions using Smart Seeder (Strip-till Drill) in the

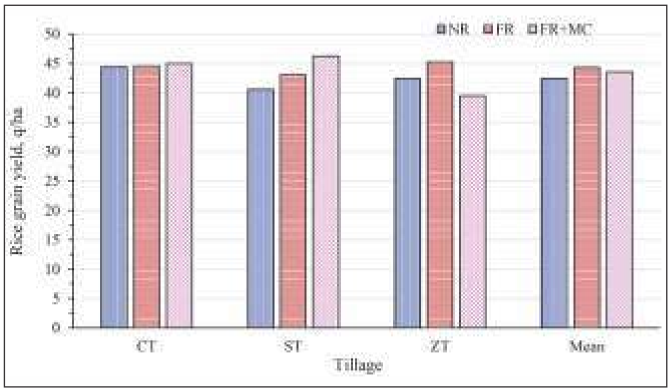


Fig. 4.9. Effect of tillage and residue management on rice grain yield

presence of rice residue at farmer' field of Taraori village in Karnal district (Fig. 4.10). After the field operation of mulcher on rice residue, the machine was effective in direct seeding of wheat in the presence of crop residue. Wheat can be directly seeded in rice by Smart Seeder after straw management system (SMS) fitted combine harvesting of rice or combine harvesting (without SMS unit) of rice followed by mulcher operation. It is always desirable to have the crop residue in anchored form as much as possible, leaving a lighter load of loose crop residue for uninterrupted and smooth seeding operation by CA machinery.

Fig. 4.10. Field demonstrations of Smart Seeder (Strip-till Drill) for direct sowing of wheat in rice residue

Weed management in wheat

The major findings of field and pot experiments conducted on evaluation of herbicides and herbicide mixtures against weeds in wheat are as follow:

- In field studies, more than 90% control of diverse weed flora was observed with pre-emergence application of pyroxasulfone + pendimethalin 127.5 + 1500 g/ha, pyroxasulfone + flumioxazin 127.5 + 100 g/ha, pyroxasulfone + metribuzin 127.5 + 300 g/ha and oxyflourfen + metribuzin 300 + 300 g/ha. The wheat grain yields recorded in these treatments were statistically similar to weed free check treatment.

- Pyroxasulfone alone at 127.5 g/ha applied as pre-emergence effectively controlled the grass weeds namely, *Phalaris minor* and *Avena ludoviciana*, but was poor for control of broad-leaved weeds (*Rumex dentatus* and *Medicago denticulata*). However, combination of pyroxasulfone + metribuzin and pyroxasulfone + flumioxazin were very effective for control of diverse weed flora in wheat. As these combinations are having two mechanisms of action herbicides and will be helpful in managing the herbicide resistance problem in weeds.
- In rice-wheat system, double no-till system led to more problems of *Rumex dentatus* and *Medicago denticulata*. The infestation of *Cyperus rotundus* in maize was significantly reduced with adoption of no-till and application of pre-plant non-selective herbicide glyphosate in maize-wheat-greengram system. Wild oat infestation was observed higher in maize-wheat than in rice-wheat system. In a long-term maize-wheat system wild oat infestation was found more in conventional system compared to zero tillage system.
- Pot studies were conducted to identify and quantify the herbicide resistance in different weeds (*P. minor, Rumex dentatus, Avena ludoviciana, Chenopodium album and Polypogon monspeliensis*). For monitoring of herbicide resistance evolution in *P. minor,* 50 biotypes were collected across Haryana and evaluated in bioassay for resistance detection and found widespread multiple resistance (against clodinafop, pinoxaden and sulfosulfuron). Some of the biotypes also showed the additional resistance against metribuzin. For management of multiple herbicide resistant *P. minor, A. ludoviciana* and *Polypogon monspeliensis* (against clodinafop, pinoxaden, sulfosulfuron) pyroxasulfone, bixlozone + metribuzin and aclonifen + diflufenican were found effective. Pyroxasulfone, bixlozone + metribuzin and aclonifen + diflufenican were also effective against metribuzin resistant *P. minor.*
- For control of metsulfuron resistant *Rumex dentatus* and *Chenopodium album*, halauxifen + fluroxypyr, aclonifen + diflufenican, 2,4-D, carfentrazone, pendimethalin, and metribuzin were found effective.
- For control of broadleaved weeds in barley various herbicide and herbicide combinations were evaluated. Halauxifen + fluroxypyr at 200.6 (6.1+194.5) g/ha and carfentrazone 20 g/ha in combination with 2,4-D 400 g/ha or metsulfuron 4 g/ha effectively controlled the diverse broadleaved weed flora in barley.
- *Cynodon dactylon* is a problematic weed particularly under no till situations. In long term no till experiments, it has been observed that its infestation increases if not effectively controlled. For controlling *Cynodon dactylon* glyphosate, paraquat and glufosinate alone and in combinations were evaluated for two seasons (Fig. 4.11). Based on the pooled analysis, It was observed that paraquat 500 g/ha and glufosinate 400 g/ha were poor for control of *Cynodon dactylon.* The biomass reduction with paraquat and glufosinate was 59.7 and 59.1%, respectively. Spray of glyphosate at ≥1% spray solution (450 lit/ha) provided the effective control of *Cynodon dactylon*.

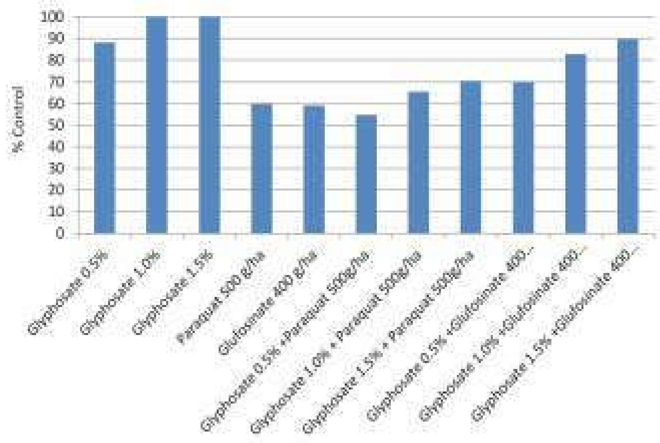


Fig. 4.11. Herbicide suitable against *Cynodon dactylon.*

Efficacy of pre-mix combination of bixlozone + metribuzin against weeds in wheat

Wheat is infested with diverse weed flora and for control of complex weed flora herbicide combinations are required. Therefore, keeping these in view, an experiment involving nine weed control treatments was conducted in 2024-25. Weed control treatments produced significant effect on weed dry weight and wheat grain yield. The highest yield was obtained under weed free situation (74.10 q/ha) (Table 4.1), whereas the minimum yield was recorded under weedy check (39.98 q/ha) due to strong weed competition. Among herbicides, ready mixture of bixlozone + metribuzin 900 (750+150) g/ha at 35 DAS showed the least weed dry weight of 1.6 g/ sq. m. at 120 DAS and whereas maximum was observed in weedy check with value of 408.2 g/m^2 at 120 DAS. All the herbicide treatments caused significant reduction in dry weight of weeds compared to untreated check and as a result of effective weed control there was significant improvement in yield over weedy check treatment. The pre-mix bixlozone + metribuzin applied at 35 DAS produced higher yield compared to its application at 25 DAS. This was due to better crop safety when applied at 35 DAS. The bixlozone + metribuzin at 750-900 g/ha applied at 35 DAS produced statistically similar yield as obtained under application of clodinafop + metribuzin at (60+210) 270 g/ha.

Table 4.1. Bixlozone + metribuzin for diverse weed flora control in wheat

Sr. No.	Herbicide treatments	Weed dry wt. 120 DAS	Yield, q/ha
1.	Bixlozone + metribuzin @ 600 (500+100) g/ha at 25 DAS	3.71(12.9)*	73.25
2.	Bixlozone + metribuzin @ 750 (625+125) g/ha at 25 DAS	3.27(9.7)	71.97
3.	Bixlozone+ metribuzin @ 900 (750+150) g/ha at 25 DAS	2.91(7.5)	70.98
4.	Bixlozone + metribuzin @ 600 (500+100) g/ha at 35 DAS	2.28(4.4)	74.07
5.	Bixlozone + metribuzin @ 750 (625+125) g/ha at 35 DAS	1.77(3.3)	75.00
6.	Bixlozone+ metribuzin @ 900 (750+150) g/ha at 35 DAS	1.47(1.6)	73.52
7.	Clodinafop+ metribuzin @ 270 (60+210) g /ha at 35 DAS	4.78(22.1)	74.55
8.	Weedy check	20.16(408.2)	39.98
9.	Weed free	1(0)	74.10
	CD (0.05)	1.34	7.83

* Original values are given in parenthesis and are √(x+1) transformed for statistical analysis

Improving resource use efficiency in wheat

Experiments were conducted to study water productivity (WP) of 12 wheat genotypes under different moisture levels (60, 80 & 100% of ETc). The findings of the study are mentioned below:

- The maximum mean yield of 6981kg/ha was recorded for LBP2023-8 followed by 6907 kg/ha for DBW466 and 6868 kg/ha for LBP2023-13.
- The mean water productivity (WP) increased from 2.59 kg/m^3 to 2.99 kg/m^3 with slight reduction in mean grain yield from 6850 kg/ha to 6686 kg/ha on changing the irrigation level from 100% ETc to 80% ETc.
- Among genotypes, the maximum mean WP was recorded to be 3.05 kg/m^3 for LBP2023-8 followed by 3.0 kg/m^3 for DBW466 and 2.98 kg/m^3 for LBP2023-21.

5 QUALITY AND BASIC SCIENCES

Maintenance and propagation of breeding material of biofortification traits

Various breeding materials propagated and maintained under institutional and CRP projects except NapHal carrying crosses at various stages of development are given in Table 5.1. The generation wise number of entries having ≥40 ppm Fe and Zn content and ≥13% protein content is given Table 5.2.

Table 5.1. Crosses for enhanced Fe, Zn, protein, and low phytate content along with high phytase levels using suitable donors with high yielding cultivars; selections made and advanced into higher generations during 2024-25 cropping season

High yielding cultivars	High Fe, Zn, and protein content	High phytase and low phytate levels	Three-way (High Fe, Zn, and phytase)	Double crosses (High Fe, Zn, and phytase)
HD2967	BC_2F_5, BC_1F_6	BC_1F_5, F_6, BC_1F_6, F_7	F_5	
HD3086	BC_1F_5, BC_2F_5, F_6, F_7,	BC_1F_5, BC_2F_5, F_6, F_7	F_5, F_7, BC_1F_8	BC_1F_4
HD 3059	F_6	F_6, BC_1F_7		
HD 3226		F_7		
WB 02	BC_2F_5, F_6	BC_2F_5, F_6, F_7, F_8		
DBW 88		F_6	F_7	
DBW 173		BC_1F_5, F_6, BC_1F_6, F_7		
DBW187		F_5, BC_2F_5, F_6	F_3, F_4	F_3
DBW 222		F_4	F_3, F_4	F_3
DBW 316	F_2			
DBW 303		F_4	F_3	F_3
DBW 327	F_2			
DBW 332	F_2			
PBW 502		BC_2F_3, BC_1F_4, F_5		
BNSR-6			F_3	
NABIMG09			F_4	
NABIMG10			F_4	
NABIMG11			F_4	
WH1105	F_6			
DPW 621-50	BC_4F_9			

Table 5.2. Biofortification components across generations for the cropping season 2024-25

Generation	Total entries	Fe ≥40 ppm	Zn ≥40 ppm	Protein (@12% moisture) ≥13%
F_4	277	114	4	26
F_5	70	59	3	18
F_6 and advanced	139	116	18	38

Maintenance and propagation of breeding material for soft wheat

During cropping season 2024-25, crosses were propagated using NapHal as one of the parents with high yielding background varieties. Various breeding materials propagated using NapHal under institutional project at various stages of development are given in Table 5.3. Number of entries having sedimentation volume ≤30 ml was 6, 7 and 13 respectively for F4, F5 and F6 and advanced, respectively. Based on sedimentation volume, GFeC and GZnC, more than 10 entries having NapHal background, have been selected for PYT breeding trials. Biscuit spread factor of more than 6 NapHal carrying genotypes (tested using standard methodology) was found to be more than 10. The breeding materials at various developmental stages were also screened for high grain iron content (GFeC), grain Zn content (GZnC), protein, high phytase and low phytic acid (Table 5.4). Based on yield, protein, GFeC and GZnC content, 16 entries have been advanced for PYT breeding trials while 5 entries have been selected and sent for multilocation testing.

Table 5.3. Crosses involving Nap Hal source of Glu-D1 double null trait

High yielding cultivars × NapHal	High Fe and Zn crosses	High phytase and low phytate levels	Three-way crosses (High Fe, Zn, and Phytase)	Multiple crosses (High Fe, Zn, and phytase)
HD 2967	BC_1F_{11}, BC_1F_{12}	F_5	F_9	F_4, F_8
HD 3086			BC_2F_5, F_8	F_4, BC_1F_6
DBW 187				F_5
DBW 173				F_4
HS 490	BC_2F_{10}			BC_1F_{10}
PBW 373	BC_3F_8			

Table 5.4. Mean and range of quality components across various generations during 2024-25

Gen.	Protein (%) (@12% moisture)		Fe (ppm)		Zn (ppm)		Phytase (FTU/kg)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
F_4	11.2	9.4-15.4	39.1	32.2-50.4	29.6	21.7-45.1	2463	599-6209
F_5	12.5	11.2-13.6	43.9	39.3-48.9	32.9	26.5-42.6	2678	1115-5563
F_6	12.5	11.0-14.3	41.4	34.4-46.8	34.0	29.5-41.7	2550	2324-3697

Anthocyanin content in RILs: RILs were developed by crossing between a colored genotype (NABI-MG11 (a black wheat genotype) with HD2967 in quality improvement program of the division. The fixed lines (n=270) grown in 2022-23 were quantified for their anthocyanin, Fe, Zn, and protein content. Total 20 lines had anthocyanin content higher than 30 ppm, the top 5 ranged from 46.1 to 61.2 ppm (Fig. 5.1). Parents of the RIL population, NABI-MG11 and HD2967 had anthocyanin content of 72.4 and 6.2 ppm, respectively.

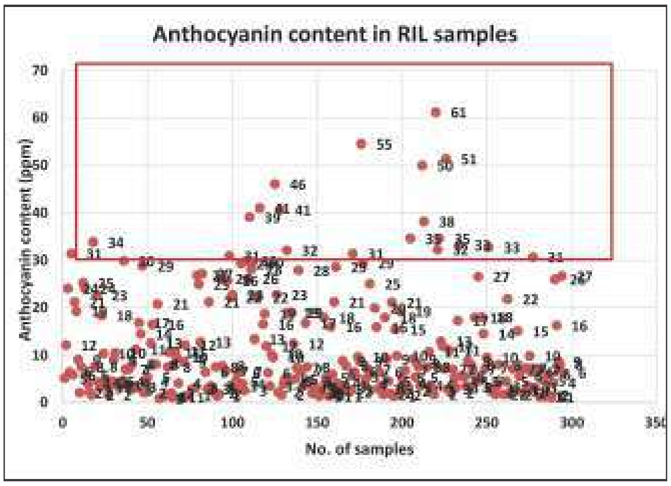


Fig. 5.1. Anthocyanin content in RIL samples. Anthocyanin content >30 ppm is shown in rectangular box

Validation of micro-test for sedimentation volume: In 82 varied samples (harvesting year 2023-24), sedimentation volume was calculated using standard 6 g method (AACC) and 1 g micro-test across a varied

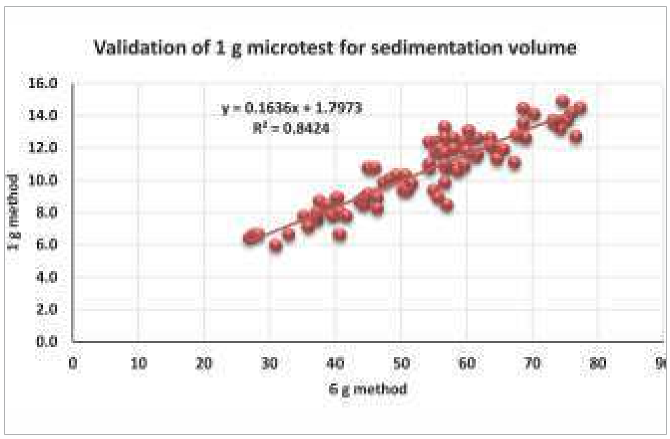


Fig. 5.2. Validation of 1g micro-test for sedimentation volume

range of 27-77 ml (with average sedimentation rate of 54 ml) employing SDS-lactic acid sedimentation method. The coefficient of determination (R^2) for the micro-test was found to be 0.84 while correlation coefficient (R) was 0.92, demonstrating that 1 g micro-test can effectively be harnessed for sedimentation volume calculation (Fig. 5.2).

Starch content variability across genotypes: The starch content in segregating lines, fixed lines, AVTs and released varieties (a set 62 varied genotypes), ranged from 46.0 to 70.3 g/100 g on dry weight basis with an average of 58.2%.

Pasta storage studies: Durum wheat is considered more suitable for pasta making; hence a study was carried out using 3 ICAR-IIWBR developed durum wheat varieties, *viz.* DBW47, 48 and 55 to extract semolina, make pasta and evaluate yellow pigment and β-carotene content at three months interval. Data for pigment retention in grain, semolina, and pasta has been given in Table 5.5. The data showed that the content of yellow pigment and β-carotene decreased on processing. The coefficient of determination (R^2) between yellow pigment and β-carotene was found to be 0.92.

Table 5.5. Pigment content of intact wheat, semolina, and extruded pasta during storage

Time scale (Texture)	Variety	β-Carotene (ppm)		Yellow pigment (ppm)		% share β-carotene of yellow pigment
		Avg	% retained	Content	% retained	
March (Grain)	DDW47	1.3		5.4		24.2
	DDW48	1.3		5.8		22.2
	DDW55	0.9		5.4		16.6
March (Semolina)	DDW47	1.1	85.0	5.0	93.4	22.0
	DDW48	0.8	60.1	5.2	90.7	14.7
	DDW55	0.8	90.3	5.1	96.1	15.7
March (Pasta)	DDW47	0.5	40.7	2.7	49.5	19.9
	DDW48	0.4	32.9	2.8	47.8	15.2
	DDW55	0.5	52.0	2.8	51.5	16.8
June (Pasta)	DDW47	0.4	33.0	2.7	51.3	15.6
	DDW48	0.4	34.3	2.3	40.7	18.7
	DDW55	0.5	60.1	2.7	50.8	19.7
September (Pasta)	DDW47	0.4	30.5	1.9	35.8	20.6
	DDW48	0.4	33.7	2.2	37.7	19.9
	DDW55	0.3	28.2	1.9	36.3	13.0

***In vitro* GI profiling of *Triticum dicoccum* grains:** *in vitro* Glycemic index profiling of 25 RIL lines of *T. dicoccum* populations developed by UAS, Dharwad was done using standardized protocol. The GI of these RIL lines ranged from 38.3 to 64.3 with average GI of 50.8, displaying a large range of variability in glycemic index (Fig. 5.3).

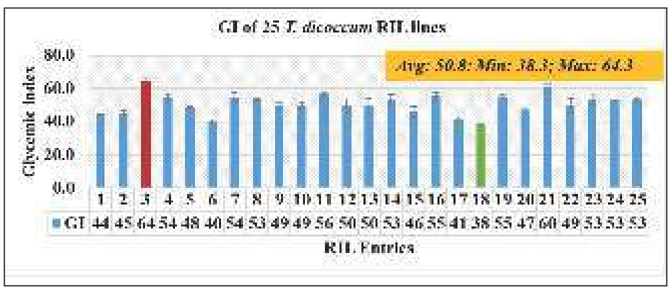


Fig. 5.3. In vitro Glycemic index profiling of 25 RIL lines of *T. dicoccum* lines

***In-silico* characterization and variability analysis of phytase gene in wheat**: Phytase is a key enzyme involved in the hydrolysis of phytic acid, thereby improving mineral bioavailability in cereals. The present work focused on the in-silico characterization and variability analysis of the phytase gene (*TaPAPhy_a2*) and its isozymes in wheat (*Triticum aestivum*), along with comparative analysis across other cereal crops. Approximately 35 phytase and isozyme sequences were retrieved from wheat and other cereals, with the wheat phytase sequence ACR23326.1 (purple acid phosphatase isoform A1) used as a reference. Sequence similarity searches, protein characterization, and conserved domain identification were performed using

BLASTP, ExPASy ProtParam, and the NCBI Batch Conserved Domain Search tool, respectively. Multiple sequence alignment and phylogenetic analysis were carried out using CLUSTAL Omega and MEGA 6.0 to elucidate evolutionary relationships and conserved functional regions. Analysis predicted the secondary structure of protein sequence constitutes dominant, long continuous strand of alpha helix constituting approx. 70-80% of total sequences followed by 15-20% of connecting loops and 5% of beta strand. A three-dimensional (3D) model for *TaPAPhy_a2* was developed by homology-based modelling using SWISS model to gain better insight into its molecular mechanism of enzyme action (Fig. 5.4).

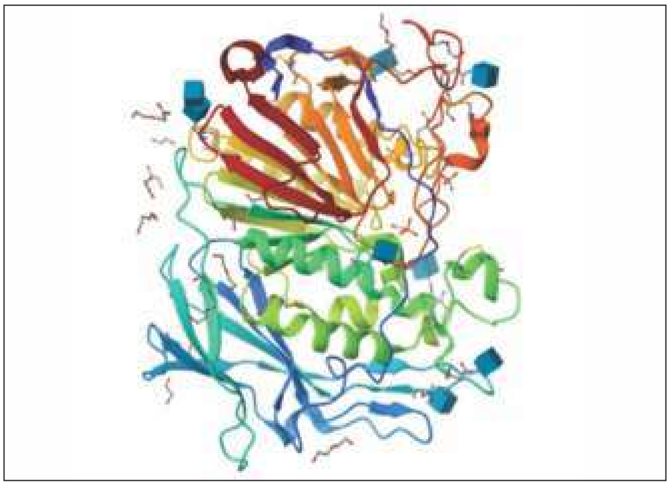


Fig 5.4. Homology modelling of TaPAPhy_a2 using Swiss model

Comparative analysis of wheat grass juices for health promoting phytochemicals: Wheat grass juice is being recognized as a rich source of nutraceutical compounds with significant health-promoting properties. The present study evaluated and compared the nutraceutical profile of wheat grass juice derived from diverse cereal genotypes, with emphasis on phytochemical composition and antioxidant potential. Wheat grass samples from colored wheat (RILs 110 and 116), *durum* wheat (DDW 48 and 55), bread wheat/*aestivum* (HI-1665 and DBW 327), and *dicoccum* wheat (MACS 2971 and HW 1098) were processed into fresh juice, lyophilized, and stored at −20 °C for biochemical analyses. Key parameters assessed included total chlorophyll, anthocyanins, phenolics, antioxidant potential, protein, and free amino acid content. Comparative analysis revealed significant genotypic variation, with dicoccum genotype HW 1098 exhibiting the highest antioxidant activity (90% DPPH reduction) and total chlorophyll content (9.93 mg g^{-1}). The study highlights promising cereal genotypes for superior wheat grass juice quality and potential functional food and nutraceutical applications.

Quality evaluation of chapati made with blended flour: A study was conducted to determine the effect of blending chick pea flour and finger millet flour ranging from 0-30% on wheat whole meal flour-based chapati (DBW187). The chapati score for the chick pea flour supplemented chapati was 6.6 while for finger millet supplemented chapati it was 6.1 as compared to pure wheat chapati 7.7 (control).

Wheat grit experiment: An experiment was conducted to utilise durum wheat varieties (DDW 47, DDW 48, and DDW 55) to produce wheat grits. In the present study, wheat grits obtained (using a stone mill) from three durum wheat varieties (DDW 47, DDW 48 and DDW 55), were evaluated for physicochemical and sensory attributes. The colour values in terms of Hunter colour attributes (L, a, b) for grits obtained varied from 59.7-62.8, 4.7-6.8, and 19.7-24.7, respectively. Further, the yellow pigment content of wheat grits varied from 5.53 to 6.65 ppm. Grits contained 9.12-10.4% protein and 1.33-1.43% mineral content. pH value of the grits varied from 6.35-6.39. Wheat grits manufacturing *via* milling also contributed towards the generation of by-product, containing about 10.98-11.01% protein, 2.13-2.42% ash content and 7.04-7.28 ppm yellow pigment, which has the potential to fulfil dietary needs *via* appropriate value addition. Further, the cooked sweetened milk-based *dalia* was liked by the sensory panellists, both as hot and cold desserts, with overall acceptability scores of 7.00-7.17 and 7.33-7.42, respectively. Durum-based wheat grits can be utilised as a mode to encourage value addition and product diversification.

Sensory acceptability of sugar snap cookies: An experiment was conducted to examine the storage-related changes in sugar snap cookies fortified with chickpea flour and finger millet flour. The cookies were prepared following the AACC 10.52 (2000) protocol, with chickpea flour and finger millet flour added at 40% levels on a flour basis. Changes during storage were monitored over a period of 90 days. The sensory acceptability scores of the control cookies, as well as those supplemented with chickpea and finger millet, were also assessed on a 9-point hedonic scale. The scores decreased from 8.00 to 6.50 for the control, 7.00 to 5.00 for the chickpea-supplemented, and 6.50 to 3.00 for the finger millet-supplemented cookies during the storage period of 90 days.

Generation of crosses for enhanced Fe, Zn, protein and low phytate content

Increasing essential micronutrient content in wheat genotypes and their bioavailability and bioaccessibility in terms of high phytase activity and their use as suitable donor parents in the background of high yielding cultivars is key to generate biofortified material. During 2024-25 cropping season, several crosses made into high yielding wheat cultivars' background (HD 2967, HD 3086, HD 3226, DBW 173, DBW 187, WB 02, DBW 316, DBW 327, DBW 332 etc.) using high phytase and low phytic acid mutants developed in the background of PBW 502 were advanced into higher generations based on phenotypic evaluations. The details of various lines and their generations, having higher beneficial components (Fe, Zn, protein, phytase) clubbed with lower antinutritional factors (phytic acid), raised during cropping season 2024-25 (Table 5.1).

Reflection of generation wise iron and zinc improvement

Generation wise Pearson's correlation between protein, iron and zinc and corresponding range of grain Fe and Zn has been given in Table 5.6. The data depicted positive correlation throughout generations between Fe and Zn inheritance, protein vs Fe, and protein vs Zn. The range of GFeC and GZnC across the generations has been found between 29.9-61.4 and 21.6-45.1 ppm, respectively. Further, more than 50 entries are being evaluated this year as PYT and more than 10 entries have been sent for multilocation testing.

Table 5.6. Generation wise Pearson’s correlation between biofortification components and range of quality components across various generations during 2024-25

Generation (No. of Entries)	Iron vs Zinc	Protein vs iron	Protein vs zinc	Protein (%)		Fe (ppm)		Zn (ppm)	
				Minima	Maxima	Minima	Maxima	Minima	Maxima
F_4 (110)	0.71	0.63	0.54	9.1	15.0	29.9	55.2	21.6	42.1
F_5 (44)	0.51	0.35	0.59	10.4	14.8	37.8	55.1	28.1	43.2
F_6 (57)	0.74	0.37	0.35	10.7	14.4	30.8	49.8	27.4	45.1
PYT (49)	0.46	0.41	0.35	9.8	15.0	34.0	61.4	26.6	43.4

Contribution to AICRP trials: Out of the various CRP PYT data (Karnal location) analysis, one entry has been contributed to QCWBN while another one to station trial on the basis of superior yield, high Fe, Zn, and protein for the cropping season 2025-26 (Table 5.7). Further, four high Fe and Zn containing genotypes acquired from Eternal University, Himachal Pradesh have been sown during the current cropping season to be used as potential high Fe and Zn parents.

Table 5.7. Comparative quality attributes of entries contributed wrt check varieties

Entry destination	Pedigree	PYT yield (q/ha)	Thousand kernel weight (g)	Protein (%) (@12% moisture)	Fe (ppm)	Zn (ppm)
QCWBN	HD3086*2/GLUPRO / 3*PBW568	67.5	53.3	13.1	50.7	41.1
Station trial	WB2/PBW502M474	74.8	44.7	11.2	44.4	32.9
DBW187	Check	66.7	48.7	12.6	47.2	26.6
DBW327	Check	72.8	55.2	10.1	45.1	32.5
WB2	Check	69.5	39.6	12.7	41.2	33.4
PBW502	Check	41.6	33.3	10.7	49.1	35.2

6 SOCIAL SCIENCES

India achieved an all-time record wheat production of 117.94 million tonnes during the *rabi* season 2024–25, overcoming major climatic adversities such as heavy rainfall, waterlogging in central India during grain filling and harvest, elevated early-season temperatures, low flowering temperatures, and a sharp February heatwave in northern regions. This outstanding achievement is primarily due to the widespread adoption of climate-resilient and bio-fortified wheat varieties developed by the ICAR–Indian Institute of Wheat and Barley Research (IIWBR), Karnal, and the All India Coordinated Wheat and Barley Improvement Program. These varieties, covering nearly 45% of India's wheat acreage and over 65% of wheat-growing zones, offer high protein content (>12%) and micronutrient enrichment (iron and zinc >40 ppm), supporting national goals of nutritional security.

Despite the tremendous progress, several challenges still persist in wheat and barley cultivation. These include large yield gaps, low awareness among farmers about improved varieties, limited access to quality seeds, and sub-optimal adoption of modern technologies. Barley, in particular, lags behind due to poor seed availability, especially of husk-less types, and low market support. Given the rising incidence of diabetes in India, barley holds significant dietary and health potential. However, its adoption as a staple food remains limited. To address this, ICAR-IIWBR is prioritizing the development of husk-less barley varieties and identifying suitable zones for its cultivation. Ensuring Minimum Support Price (MSP) and strengthening partnerships in seed production, processing, and value chains are essential for barley revival. Contract farming of malt barley has expanded, but similar support is required for food barley promotion.

During rabi 2024–25, wheat and barley technologies were disseminated through 24 Krishi Vigyan Kendras (KVKs), 15 AICRP centres, and other partner institutions. Demonstrations tailored to local constraints showcased improved practices, bridging yield gaps and promoting adoption. Under programs like SCSP, TSP, and Cluster Frontline Demonstrations and FLDs; farmers received inputs and seeds of recently released wheat and barley varieties. Field days, awareness programmes and interactive sessions engaged farmers, neighbouring stakeholders, and extension agents in learning about superior technologies. DA&FW and ICAR-IIWBR conducted regular consultations to issue timely advisories for managing climatic stressors like heat, waterlogging, and erratic rainfall. Farmers were encouraged to share seeds locally to facilitate varietal saturation. A multi-channel communication strategy ensured wide outreach and farmer engagement. The report highlights the success of barley FLDs, yield gains from field demonstrations, performance of bio-fortified wheat varieties, and an economic analysis of returns and constraints in barley production. These integrated efforts are driving resilient, sustainable, and nutrition-sensitive wheat and barley farming in India.

Barley Frontline Demonstrations (FLDs)

During the *rabi* crop season 2024-25, 140 hectares Barley Frontline Demonstrations (BFLDs) were allotted to 38 cooperating centers all over India in eight states/UT namely, Himachal Pradesh, Uttar Pradesh, Bihar, Jammu & Kashmir, Punjab, Haryana, Rajasthan and Madhya Pradesh. Out of these, 139.6 ha BFLDs were conducted by 38 centers, covering 146.2 hectares area of 403 farmers. Improved barley varieties with complete package of practices (irrigation management, nutrient management, weed control, seed treatment *etc.*) were demonstrated.

The highest gain in barley yield was recorded in Western UP (41.26%) followed by HP(40.11%), All UP (32.46%),Central UP (30.61%), Eastern UP (30.57%), MP (28.12%),UT of J&K (21.23%), Rajasthan-NWPZ (17.22%). The lowest gain in yield was reported in Haryana (6.05%) (Table 6.1). The overall yield gain over check across the country was 7.05 q/ha (20.16%). The yield

Table 6.1. State wise performance of improved varieties under Barley FLDs during rabi 2024-25

State	Mean Yield (q/ha)		Gain (%)
	Improved varieties	Check varieties	
HP	26.03	18.58	40.11***
Eastern UP	35.88	27.48	30.57***
Central UP	40.33	30.88	30.61***
Western UP	50.93	36.05	41.26***
All UP	39.08	29.50	32.46***
Bihar	37.25	31.33	18.91***
UT of J&K	25.55	21.08	21.23***
Punjab	48.28	44.85	7.64***
Haryana	47.35	44.65	6.05***
Rajasthan (NWPZ)	59.90	51.10	17.22***
Rajasthan (CZ)	42.33	36.60	15.64***
All Rajasthan	53.88	46.13	16.80***
MP	37.48	29.25	28.12***
All India	42.03	34.98	20.16***

**** Significant at 1 per cent level*

gain due to improved varieties over check was highest in NHZ (40.24%) followed by NEPZ (27.71%), CZ (25.58%) and NWPZ (14.07%) (Table 6.2). The overall yield gain across the country was 20.16%. Therefore, efforts should be made to increase barley yield in the NEPZ, CZ and NHZ by promoting recent barley production technologies in collaboration with the state department of agriculture.

Center wise data analysis revealed that the yield gain under barley FLDs was highest at center Basti (90.60%) followed by Lada Samastipur (40.83%) in NEPZ; Rewa (66.77%) followed by Lalitpur (37.23%) and Tikamgarh (29.16%) in CZ; Bajaura (45.63%) in NHZ; and Noida (47.40%) followed by Bijnor (32.54%) in NWPZ. The yield gain was lowest at Hisar (03.52%) in NWPZ.

Table 6.2. Zone wise barley productivity under FLDs over check during rabi 2024-25

Zone	Mean yield (q/ha)		Gain (%)
	FLDs	Check	
NHZ	26.03	18.56	40.24***
NEPZ	36.18	28.33	27.71***
NWPZ	48.56	42.57	14.07***
CZ	39.26	31.27	25.58***
All India	42.03	34.98	20.16***

**** Significant at 1 per cent level*

Major constraints impeding barley production in the country

Overall analysis of constraints in different zones clearly indicated that high cost of inputs, decline in water table, *Phalaris minor* (Mandusi) were the most serious constraints in the country. Non-availability of labour, small land holding, untimely rain, poor participation in exposure visits arranged by various departments, low price of grain, non-availability of seed of newly released variety and lack of facility of canal irrigation water were under serious category affecting barley production and productivity in the country (Table 6.3). Farmers need to be educated and up-skilled on recent barley production technologies, complete package of practices and soil health management. There is a need of government intervention to ensure supply of quality seed and inputs to the farmers. Farmers need to be updated on impact of climate change on barley

Table 6.3. Major constraints impeding barley production in the country (n=369)

Constraints	Score	Rank
High cost of inputs	444	I
Decline in water table	425	II
Phalaris minor (Mandusi)	409	III
Non availability of labour	360	IV
Small land holding	353	V
Untimely rain	284	VI
Poor participation in exposure visits arranged by various departments	282	VII
Low price of grain	279	VIII
Non availability of seed of newly released variety	276	IX
Lack of facility of canal irrigation water	271	X

cultivation and adaptation strategies for mitigation. To ensure better price, farmers have to go for quality barley production. There is a need to register barley growers on e-NAM platform for selling of barley.

The ICAR-IIWBR team accompanied by the experts from the Ministry of Agriculture & Farmers Welfare and the concerned centres monitored the Barley FLDs and SCSP Wheat Demonstrations during the *rabi* crop season 2024-25 at the following centres.

Team Leader	Centres Monitored	Dates of Monitoring
Dr. Anuj Kumar	Hisar	26 March, 2025
Dr. Satyavir Singh	Sangrur, Mansa, Bathinda	26-27 March, 2025
Dr. Anil Kumar Khippal	Kathua	16 April, 2025

Assessment of Farmers' perspective on crop residue management in Indo-Gangetic plains of India

A survey was conducted among 360 farmers from Punjab, Haryana and Western UP to assess awareness and adoption of crop residue management (CRM) practices. It was found that delayed harvesting of paddy/sugarcane, small time window for crop residue management, crop rotations (especially in case of vegetables clean fields are required), time taking job (20-30 Days required in stubble management), non-availability of CRM machines initially machines were not available), limited use of CRM machines (hardly one month), high cost of machines (especially for *ex-situ* management), unnecessary delay in harvesting of sugarcane due to sugar factory slip system, delayed payment for use of CRM technologies (1000/acre now 1200/acre), demand for baled paddy straw is limited and reduction in subsidies on CRM machines in recent years were the major reasons of stubble burning as perceived by the farmers. It was found that awareness programmes were organized by the State Department of Agriculture were the major source of information on CRM for most of the farmers. Programmes conducted by Krishi Vigyan Kendras (KVKs), along with information disseminated through radio and television, also played an important role in addressing this issue. Newspapers further contributed in mass awareness through regular publication of news and feature articles on CRM. In Punjab and Haryana both ex situ and in situ methods were adopted based on the requirement of the succeeding crop. But in Western UP, majority of the farmers opted ex situ management of crop residues. Majority of the farmers in all the three states adopted combine harvester with super SMS device, mulcher, cutter and spreader, hay rack and baler for ex situ management of crop residues. For in situ management zero tillage, happy seeder, super seeder, smart seeder and surface seeder technologies were used and farmers were satisfied with the adoption of all these technologies at their farm.

When it was investigated with agriculture officials it was found that they were having almost the same perspective. They reported period of stubble management is very less, crop diversification, in situ management of sugarcane trash is difficult, it is difficult to penalize farmers for stubble burning, un necessary delay in harvesting of sugarcane, non-receipt of funds for the adoption of CRM technologies, limited buyers of bales made of rice straw. Occasional burning of sugarcane stubbles was reported, with farmers indicating that the hard nature of the residues made their incorporation into the soil difficult and time-consuming. Retaining the residues on the soil surface was also considered impractical. Consequently, residue removal was viewed as the most feasible option, but its adoption was constrained by limited availability and high cost of CRM machinery, as well as a short operational window. Government agencies also observed that although the adoption of CRM technologies was initially slow, but with the concerted efforts of all the line departments it has been drastically reduced.

Promotion and impact evaluation of ICAR-IIWBR technologies at farmer's field

A comprehensive survey was undertaken, encompassing 560 wheat farmers in Punjab, Haryana, Rajasthan, Jammu & Kashmir, Himachal Pradesh, and Uttar Pradesh, along with 403 barley farmers in Himachal Pradesh, Uttar Pradesh, Bihar, Jammu & Kashmir (UT), Punjab, Haryana, Rajasthan, and Madhya Pradesh. The state-wise yield gain in wheat during 2024–25, indicates a positive and statistically significant improvement across all selected states. Uttar Pradesh recorded the highest yield gain (22.58%), followed by Jammu & Kashmir (16.52%), reflecting substantial enhancement in wheat productivity. Rajasthan (6.25%) and Haryana (5.12%) registered moderate yet meaningful gains, suggesting steady progress despite agro-climatic and resource constraints. Punjab, though exhibiting the lowest yield gain (4.52%), still showed a significant increase, likely due to its already high base yield and limited scope for further improvement. Similarly, the state-wise yield gain in barley during the 2024–25, revealing a substantial and statistically significant improvement in productivity across all the states considered. Himachal Pradesh recorded the highest yield gain (40.11%), indicating a remarkable enhancement in barley performance, possibly due to favourable climatic conditions and adoption of improved varieties. Uttar Pradesh (32.46%) and Madhya Pradesh (25.12%) also exhibited strong yield gains, reflecting effective crop management practices and technological interventions. Jammu & Kashmir (21.23%) and Bihar (18.91%) showed moderate yet significant improvements, suggesting steady progress in barley productivity. Rajasthan registered a yield gain of 16.80%, indicating positive growth despite agro-climatic constraints. Punjab (7.64%) and Haryana (6.05%) recorded relatively lower gains (Table 6.4).

The state-wise returns per rupee invested in wheat during the year 2024–25, reflecting the relative economic efficiency of wheat cultivation across selected states. Rajasthan recorded the highest return (₹5.13 per rupee invested), indicating superior profitability, possibly due to favourable cost–output relationships and efficient resource use. Haryana (₹4.71) and Punjab (₹4.42) also showed relatively high returns, suggesting economically viable wheat production systems supported by well-developed infrastructure and technology adoption. Jammu & Kashmir registered a return of ₹3.92, while Uttar Pradesh reported the lowest return (₹3.38), indicating comparatively lower economic gains per unit of investment. The state-wise returns per rupee invested in barley during 2024–25, indicating notable variation in economic returns across the selected states. Punjab recorded the highest return (₹3.67 per rupee invested), followed by Rajasthan (₹3.17) and Haryana (₹3.06). Uttar Pradesh (₹2.85) and Madhya Pradesh (₹2.78) showed moderate returns, suggesting reasonably balanced production economics. Jammu & Kashmir (₹2.33) and Himachal Pradesh (₹2.45) registered comparatively lower, influenced by higher production costs and agro-climatic constraints. Bihar recorded the lowest return (₹1.64), indicating limited profitability and highlighting the need for improved cost management, productivity enhancement, and market support. Overall, this indicates the significant inter-state differences in economic efficiency, emphasizing that profitability depends not only on yield performance but also on input costs, management practices, and market conditions.

Table 6.4. State wise yield gain in wheat demonstrations under SCSP programme during 2024-25

State and Zone	Mean yield (q/ha)		Gain (%)
	Improved varieties	Checks	
Punjab	55.45	53.05	4.52***
Haryana	56.95	54.18	5.12***
Rajasthan	58.25	54.83	6.25***
Jammu & Kashmir	32.63	28.00	16.52***
Overall (North Western Plains Zone)	34.38	30.13	14.11***
Uttar Pradesh (CZ)	53.48	50.73	5.42***

**** Significant at 1 per cent level*

Costs and returns for SCSP wheat demonstrations and barley FLDs *vis-à-vis* check plots

Profitability is one of the major factors influencing the adoption of any crop production technology. In this section, costs and returns analysis for wheat demonstrations under the SCSP programme and barley frontline demonstrations (FLDs) have been attempted across regions for the improved production technologies that were tested in the farmers' field during the 2024-25 *Rabi* season. Generally, in any economic study, total costs are discussed under two categories *viz.,* variable costs and fixed costs, the widely adopted norm. Nevertheless, variable costs alone are reckoned to be the cost incurred by the farmers ignoring the fixed costs. In any economic analysis of farm business, the fixed costs should also be taken into consideration to arrive at total costs for computing the net income. However, in the present analysis only operational or variable costs were considered to know the profitability of technology adoption with the assumption of fixed costs remain the same for the particular farm wherein the technology (or variety) has been demonstrated. Operational costs include expenditure incurred on labour, seeds, manure, fertilizers, plant protection chemicals, *etc*. The returns over variable costs give an idea of profitability accrued to the farmer after meeting all the day-to-day expenses. Cost of production was estimated to know the cost incurred in producing a unit quantity of crop output *i.e.,* ₹ per quintal. Returns per rupee of investment were also worked out to know the comparative profitability between wheat and barley.

For wheat demonstrations conducted under the SCSP programme, the data were collected by the KVKs of the respective states. The personal interview and discussion method were adopted with the aid of pre-tested schedules designed exclusively for the purpose of evaluating the technologies disseminated through wheat demonstrations and barley FLDs.

Costs and returns for wheat demonstrations *vis-à-vis* check plot

On an average, demonstration of improved wheat varieties at the farmers' field under the SCSP programme gave ₹4.44 per rupee of investment in comparison to the farmers' practice (₹4.16). A significant difference in returns per rupee of investment was noticed between the demonstrated and checks plots at the farmer's field. The profit per hectare in the demonstrated plot was the highest in Uttar Pradesh (₹124139), followed by Haryana (₹118593). The difference in profit levels between demonstration and check plots was the highest in the case of Uttar Pradesh. Operational costs were found to be lower in several wheat demonstrations in comparison to the check plots. Overall, by adopting a new wheat variety, a farmer earns a profit of ₹111468/ha comprising all regions. Further, ₹799 has to be spent to produce a quintal of wheat through a new variety against ₹619 (farmers' choice of variety in the check plots).

Costs and returns for barley FLDs *vis-à-vis* check plot

On an average, improved barley varieties demonstrated at the farmers' field under the FLD programme gave profit around ₹70741 per hectare. Punjab registered the highest returns per rupee of investment (₹3.67) through demonstrations, followed by Rajasthan (₹3.17) and Haryana (₹3.06). The difference in returns per rupee of investment between demonstration and check plots was the highest in Himachal Pradesh, followed by Uttar

Pradesh, Rajasthan and, Madhya Pradesh. The profit per hectare in FLDs was the highest in Rajasthan (₹93821), followed by Punjab (₹79270) and Haryana (₹76354). The difference in profit between FLD and check plots ranged from ₹23659 in Uttar Pradesh to ₹82668 in UT of J&K. The returns per rupee of investment across barley growing zones were the highest in the NWPZ (₹3.22), followed by CZ (₹2.81) and NHZ (₹2.45). Estimates of the cost of production indicated that the cost incurred in producing a unit quantity of barley output was the least (₹630 per quintal) in Punjab owing to relatively less operational costs coupled with relatively higher yield levels.

Overall, the profit analysis on wheat and barley indicated that the additional returns per hectare from the demonstrated varieties/technologies were more than the check varieties and/or technologies establishing the fact that demonstrations carry the technologies successfully from lab to land. However, the present estimates are only the indicators for comparison within the current year's *rabi* season (2024-2025) and may not have a complete inter-year relevance as the demonstrations (improved varieties were different across regions) were conducted at different sites as well as by different farm households. Further, the difference in profit earned from wheat/barley cultivation is subject to farm-farmer-region specific conditions as it varies from case to case.

Cluster demonstrations of climate resilient and bio-fortified wheat varieties

The reduction in yield due to climate change and also to overcome malnutrition, Ministry of Agriculture and Farmers Welfare allocated a project entitled- "Cluster Demonstration of Climate Resilient and Bio-fortified Wheat Varieties" under NFSM- National Food Security Mission dated October 13th, 2023. This project is approved for three years i.e. 2023-24 to 2025-26 by NFSM Cell - Crops and PHMF division of MOA&FW. In this project, 33 districts of 7 states are to be covered during 2023-26. These states and districts are selected on the basis of need-based interventions by identifying the location specific constraints to bridge yield gap and popularize the varieties. Out of these 33 districts, 11 districts were covered during 2024-25 crop season.

During the rabi crop season 2024-25, 440 hectares of wheat cluster demonstrations were allotted to 11 selected districts of 6 states, namely Punjab (100): Ferozepur, Uttarakhand (70): Udham Singh Nagar, Rajasthan (200): Baran & Karauli, UP (200): Chitrakoot & Fatehpur, MP (200): Guna & Rajgarh and Bihar (300): Araria, Purnea & Katihar. In these states, 1100 cluster demonstrations were conducted by 11 KVKs covering 440 hectares area benefitting 1053 farmers.

Among all the demonstrations, maximum yield gain (11.60%) was recorded in Purnea (Bihar) and minimum yield gain (0.74%) was recorded in Ferozepur (Punjab). It could be inferred from these findings that in state like Bihar, yield potential of climate resilient and bio-fortified wheat varieties could be realized by organizing cluster demonstrations with complete package of practices. The highest performing variety was DBW 222 with yield of 67.5 q/ha in Ferozepur, Punjab while at many centres it was noticed that performance of DBW 187 & DBW 359 was the highest against other demonstrated varieties.

Costs and Returns for Wheat (Cluster Demonstrations *vis-à-vis* Check Plot)

It is evident that on average, demonstration of improved wheat varieties at the farmers' field under the cluster demonstration programme gave more returns per rupee of investment in comparison to the farmers' practice. As observed, farmers of Moga, Punjab got the highest returns of ₹4.63 for per rupee invested while farmers of Chhattarpur, MP got the lowest of ₹1.08 for per rupee invested. A significant difference in returns per rupee of investment was observed between the demonstrated and check plots at the farmer's field. The profit per hectare in the demonstrated plots was highest in Moga, Punjab (₹48951), followed by Dholpur, Rajasthan (₹44935). The difference in profit levels between demonstration and check plots was the highest in the case of Balrampur, UP. The cost of cultivation was lowest in Moga, Punjab under demonstrated as well as check varieties whereas it was highest in Fatehpur UP for demonstrated variety.

7 BARLEY IMPROVEMENT

Barley is a climate-resilient rabi cereal grown across major agro-ecological zones of India, contributing to food, feed, forage, malting, and industrial uses, particularly in marginal areas. With rising demand from malting, nutrition, and climate-resilient farming systems, ICAR-IIWBR focuses on developing high-yielding, location-specific varieties with superior quality, nutritional traits, and resistance to major biotic and abiotic stresses. During the year, integrated phenotypic and molecular breeding, germplasm enhancement, and multi-location evaluations led to significant progress in varietal development, quality improvement, and disease resistance.

Barley germplasm rejuvenation and characterization

Rejuvenation

Five hundred seventy-one barley germplasm accessions were rejuvenated during the period. A wide range of variation was observed for metric traits such as days to heading (<80 days) 8-lines; days to maturity (<132 days), 11-lines; plant height (<90cm), 8-lines; and in addition, 56 barley wild species accessions and 67 genetic stocks were rejuvenated during the season.

Germplasm characterization

During the 2024-25 crop season a set of 142 promising barley germplasm accessions for high malting traits and AVT final year entries were also characterized as per DUS guidelines during the crop season.

Germplasm conservation

Fifty six barley accessions of *H. Spontaneum* were maintained in net house, besides 8553 barley accessions of barley germplasm are being maintained in Medium Term Storage (MTS) module at ICAR-IIWBR, Karnal at 4°C with 30% RH. A set of 49 barley reference varieties were maintained for validation of 32 DUS characters. Besides, maintenance of 108 of barley released varieties.

Germplasm exchange

A total of 214 barley accessions were supplied to various indenters from different organizations after completion of all requisite formalities under the MTA. In addition, 103 barley germplasm accessions were received for long-term storage in the MTS.

Database and inventories

Regularly updated database of barley notified varieties (109), barley genetic stocks (69) and barley germplasm inventory.

DUS project on barley

Seven candidate barley varieties-for the second year of testing, namely 2880-3840, 2883-2394, 23BARANA02, and 23BABC7301, and for the first year of testing, namely UB301, ABI07, and ABI14—were evaluated during 2024–25 against 19 reference varieties under DUS trials. In addition, a set of eight candidate varieties (Saras Jo, Prajo Koona, Yushjo Koona, Sahiya Jo, Deep Jo, Mohana Jo, Dasau Jo, and Kaknoi Jo) was sown at the lead centre for grow-out testing, DUS data recording, and seed multiplication. Morphological and metric data for both candidate and reference varieties were recorded in accordance with the DUS guidelines for barley. The data were subsequently compiled, analyzed, and submitted to the PPV&FR Authority.

Registration proposal submission to PPVFRA

Registration proposal of one barley variety, DWRB 223 (hulless) prepared and submitted to the authority.

International trials and nurseries

During rabi 2024–25, two international barley trials (IBYT-FFM and IBYT-ASA) comprising 21- genotypes and 3-check each, were received from ICARDA and evaluated across five locations each. Based on trial performance, a nursery EIBGN consisting of 24 promising lines and six national checks was constituted and supplied to 12 locations across NWPZ, NEPZ, and NHZ. Additionally, the NBGSN comprising 12 genetic stocks with key breeding traits was distributed to the same locations for utilization in breeding programmes.

Release of new barley varieties for different zones/states

During the year 2025, the Central Sub-Committee on Crops Standards, Notification and Release of Varieties for agricultural Crops released and notified three barley varieties for different growing conditions (Table 7.1).

New genetic stocks of barley registered

During the year 2025, two genetic stock were registered for their novel traits (Table 7.2).

Table 7.1. Barley variety released during 2025

S.N.	Variety	Parentage	Zone	Yield (q/ha)		Developed by	Production condition
				Average	Potential		
1.	DWRB223 (Hulless Barley)	PENCO/CHEV RON-BAR/3/LEGA CY// PENCO/ CHEVRON-BAR	NWPZ (Punjab, Haryana, Western UP & Rajasthan)	42.9	63.93	ICAR-IIWBR	Timely sown and Irrigated conditions., Resistant to rust and moderately Tolerance to lodging.
2.	KB 2031 (Azad Barley 34)	K 560/K 1149	NEPZ and NWPZ, including Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, and Jharkhand	37.07		CSAUA&T, Kanpur	Timely sown and irrigated conditions in salinity and alkanity
3.	UPB1106	UPB 1001/BH 965	NEPZ including eastern UP, Bihar, Jharkhand, Orrisa, West Bengal, Assam and plains of N.E states.	44.6	74.93	GBPUA&T, Pantnagar	Irrigated timely sown conditions

Table 7.2. Barley genetic stocks registered during 2025

S.N.	Name	Registration No	Year	Parentage	Trait	Institute
1.	BHS 490 (BBM 879)	INGR 25007	2025	HBL 704 / BHS369	Seedling resistance to all the pathotypes of leaf rust; adult plant resistance to yellow rust	ICAR-IARI RS, Shimla
2.	DWRBG28	INGR 25008	2025	DWRB123/EB921	Extra early maturity (112 days); higher protein content (14.2%).	ICAR-IIWBR, Karnal

Identification of new barley varieties

Three barley varieties – one food barley variety (DWRB244), and two malt-barley varieties (DWRB235 and DWRB238) were identified by the VIC in the 64th All India Wheat and Barley Research Workers Meet, held at RVSKVV, Gwalior during August 25-27, 2025.

Food barley variety DWRB 244

Food barley variety DWRB 244 is a six rowed hulless barley genotype (Fig. 7.1). This variety possesses promising traits viz; high grain yield (40.84 q/ha), yellow rust resistance, lodging tolerance and enriched with good quality traits like protein (12.7%), β-glucan (7.6%), zinc (38.1 ppm) and iron (41.1 ppm).

Fig. 7.1. Field view of DWRB244

Malt barley variety DWRB235

DWRB235 is a high yielding (56.22q/ha) two-row malt-barley variety identified for timely sown and irrigated conditions in the NWPZ (Fig. 7.2). This genotype has higher hectolitre weight (66.2) and bold grains (91.3%).

Malt barley variety DWRB238

DWRB238 is a high yielding (56.44q/ha) two-row malt barley variety identified for timely sown and irrigated conditions in the NWPZ (Fig. 7.3). This genotype has higher proportion of bold grains (96.4%) and diastatic power (105 ^{0}Linter).

Fig. 7.2. Field view of DWRB235

Fig. 7.3. Field view of DWRB238

Barley varieties under advance stage of testing

Two barley varieties one each in malt (DWRB2312) and dual-purpose (DWRB2318) barley have outperformed the best checks in their respective category and are in final stage of testing in NWPZ. DWRB2312 has recorded average grain yield as 56.69 q/ha, whereas DWRB2318 has recorded 179 q/ha as average green fodder when cut at 55th day after sowing, and additional 37.3 q of grains when harvested at maturity in NWPZ.

Feed, dual purpose and food barley improvement

Hybridization, selection in segregating generations and their advancement

Seventy-three fresh crosses in feed and dual purpose barley, and 45-crosses in food barley were attempted to superior varieties in these categories of barley. The selection were made in different segregating generations to identify the superior genotypes (Table 7.3).

Table 7.3. Selections made in different generations during 2024-25 crop seasons in feed and food barley

Generation	Rabi 2024-25 sown		Material Selected	
	Family	Cross	Family	Cross
Feed Barley				
F_1	96	96	31	31
F_2	84	67	83 single plants	26
F_3	28 (bulks)	6	52 single plants	5
F_4	53 (plant to row)	25	56 SPS	10
F_5	290	29	95 ABLs	10
F_6	76 ABLs	21	12 lines selected	10
Total		**244**		**108**
Food Barley				
F1	43	43	23	23
F2	62	62	50	50
F3	106	40	190	56
F4	108	32	86	25
F_5-F_8	86	12	3 advanced Bulks	03
Total	**405**	**189**	**352**	**157**

Station trials and entries contributed to AICRPW&B

Twenty-six lines from F6–F7 generations, PYT and EIBGN nurseries were evaluated with two checks (DWRB 137 and RD 2715) in two replications for feed and dual-purpose barley. Grain yield ranged from 14.57–51.02 q/ha in feed barley, with BST-FBDPB-2025-5, -4 and -6 outperforming the best check and showing strong yellow rust resistance. In dual-purpose barley, grain yield ranged from 19.5–52.83 q/ha and green fodder yield from 54.42–107.08 q/ha, with superior performance of BST-FBDPB-2025-24, -17, -16 and -4, all exhibiting high disease resistance. In IVT (2024–25), four entries (DWRB2411to 2414) were contributed to feed barley and six (DWRB2415 to 2420) to dual-purpose barley trials. Based on performance, DWRB2313 was promoted to AVT-I dual-purpose barley in NWPZ, while DWRB2314 and DWRB2316 advanced to AVT-I in CZ; in feed barley, DWRB2302 was promoted to AVT-I in NEPZ. Additionally, DWRB-2501 (BK2332) was entered in IVT-FB 2025–26, and three entries (DWRB-2502, DWRB-2503 and DWRB-2504) were entered in IVT-FB 2025–26 based on station performance and disease reaction.

Food Barley

Based on yield and disease resistance, two hulless barley genotypes (DWRB 2505 and DWRB 2506) were promoted in IVT under irrigated timely sown conditions. From IVT, DWRB 2408 and DWRB 2410 were promoted to AVT-I in NEPZ, while DWRB 2407, DWRB 2410 and DWRB 2425 advanced to AVT-I in the CZ.

Malt barley improvement

Hybridization, selection and genetic advancement of breeding materials

In order to develop superior varieties of malt barley a total of 663 lines of 503 crosses were raised during crop season of 2024-25. The breeding materials consisted of 139 fresh new crosses (F1), 105 progenies of F_2 generation, 122 progenies of F3 generation, 107 progenies of F4 generation, 89 progenies of F5 generation, 56 progenies of F6 and 45 progenies of F7 generation. Out of raised materials, a total of 772 progenies of 456 crosses were selected on the basis of phenotypic appearance for their further genetic advancement. The details of overall genetic material raised and field selection during the reported period have been given in Table 7.4.

Table 7.4. Details of breeding materials of malt barley (2024-25)

Generation	Materials grown		Field Selection	
	Progenies	Crosses	Progenies	Crosses
F1	139	139	139	139
F2	105	105	217	89
F3	122	76	143	72
F4	107	68	98	61
F5	89	59	86	46
F6	56	37	53	32
F7	45	19	36	17
Total	663	503	772	456

Evaluation of advanced bulks for yield and component traits

To identify suitable entries for inclusion in the IVT–malt barley, twenty-seven advanced bulks along with three checks (DWRUB52, DWRB219 and RD2849) were evaluated at Karnal during the 2024–25 crop season in a randomized block design with three replications. Data were recorded on key agronomic and quality traits including yield, phenology, yield components and protein content. Seven genotypes (MBST-1, MBST-3, MBST-5, MBST-11, MBST-17, MBST-21 and MBST-24) outperformed the best check (DWRB219) for grain yield, of which five were advanced to IVT–malt barley for NWPZ. Three entries (MBST-11, MBST-12 and MBST-21) exhibited immunity to yellow rust.

Contribution in coordinated trials

During the 2025–26 crop season, thirteen entries were contributed to various coordinated barley trials. Of these, five entries (DWRB2511 to DWRB2515) were included in IVT–malt barley, three (DWRB2546–DWRB2548) in IVT–feed barley, and five (DWRB2551–DWRB2555) in IVT–dual-purpose barley. Additionally, DWRB2312 (malt barley) and DWRB2318 (dual-purpose barley) were advanced to the final year of AVT in their respective trials.

Barley quality improvement

Phenol score evaluation of hulless barley

A total of 111 genotypes showed wide variation in phenol reaction (0–9). Most entries recorded low scores (0–3), desirable for reduced browning. A few genotypes, notably AM-17-(2018–19)-315 (HL), Norboo, Dolma, and Atahualpa, showed strong phenol response. The variation is useful for genotype identification and breeding selection.

Evaluation of malting quality of ICARDA and MBST materials

A total of 135 ICARDA barley genotypes evaluated during 2024–25 showed wide variability in malting traits, with several entries meeting industry benchmarks for diastatic power, hot water extract, filtration rate, and FAN. Although most genotypes showed partial conformity for friability and malt yield, eight genotypes satisfied all key malting quality criteria, identifying them as elite malt-grade candidates. MBST lines also exhibited substantial diversity in grain and malt quality traits, including friability, homogeneity, enzymatic strength, extract yield, and filtration rate. Only a small subset of lines met multiple industry standards, indicating strong potential for advancement in malting barley breeding and multi-location evaluation.

Development of genetic stocks for barley quality traits

Two novel barley genetic stocks were developed at ICAR-IIWBR. DWRBG34 (BK-312), a hulled two-row genotype, exhibited exceptionally high limit dextrinase activity (0.375 U/ml), showing a 34% improvement over the best check, and is a valuable donor for enhancing malting efficiency and extract yield. DWRBG31 (INBON-HI-(2017)-88), a hulless six-row genotype, recorded high resistant starch content (8.1%), representing a 12.5% gain over the best check, with strong potential for functional food applications. Both genetic stocks have been submitted to NBPGR for registration.

Marker assisted selection and breeding (MAS/MAB) program for quality traits in Barley

Diastatic power and free amino nitrogen are key malting quality traits for efficient fermentation. DWRBG30, a two-row hulled barley developed through marker-assisted backcrossing with introgression of malt quality QTLs on chromosome 4H, outperformed checks (DWRB182 and DWRB137) for DP, FAN, malt yield, homogeneity, and friability (Table 7.5). Its stable multi-location performance makes DWRBG30 a valuable genetic resource for malt barley improvement.

Two genotypes, RMB2401 and RMB2402, were identified for superior malting quality through multi-location testing at six centres in BQSN (Rabi 2024–25). RMB2401, a MAS-derived backcross line, showed improved malt friability and wort filtration, while RMB2402, developed using STS markers (HVM67 and EBMac471), and exhibited superior malt friability, homogeneity, and hot water extract. These genotypes demonstrated consistently high malting efficiency across locations. Marker-aided BC2F7 introgressed lines (two from DWRB101/EB921 and five from DWRB101/BCU390) showed moderate to high resistance to corn leaf aphid under epiphytotic and natural conditions at Karnal during Rabi 2024–25. Two multiparent populations and 104

Table 7.5. Characteristic malting traits of genotype DWRBG30 developed through MAS

Genotype	TGW (g)	Test Wt. (kg hl^{-1})	FAN (ppm)	Diastatic Power (°L)	Malt Yield (%)	Protein content (%)	Introgressed QTLs (Chr. 4H)
DWRBG30	59.0	66.1	174.6	113.4	89.9	12.7	Q.StMo-4HL-HVM67; Q.StMo-4HS-EBMac471

selected segregants for yield and malt/food quality were advanced and evaluated, and 445 new cross combinations were attempted for MAS/MAB targeting quality, yield, and leaf blight.

Use of physiological parameters to screen barley genotypes for abiotic stresses

Twenty-eight feed barley genotypes sown under station trial and thirty barley genotypes in the preliminary-yield trials were screened for some of the physiological traits related to abiotic stresses like heat and drought tolerance. Physiological parameters namely, chlorophyll content (SPAD), normalized difference vegetation index (NDVI), canopy temperature (CT), and chlorophyll fluorescence (CFL) were recorded. The maximum and minimum values recorded for these traits are given below in the table. Barley genotypes BST-2, BST-21, BST-22, and BST-23 were identified as the best genotypes based on the physiological data in barley station trial, whereas in case of PYT barley genotypes PYT-2, PYT-3, PYT-5, PYT-10 recorded with higher physiological values in more than one trait (Table 7.6).

Table 7.6. Physiological parameters studied in barley trials

Variable	Barley Station Trial			Preliminary Yield Trial		
	Minimum	Maximum	Average	Minimum	Maximum	Average
SPAD	41.1	57.4	50.44	39.1	57.6	50
CT	26.1	27.4	26.6	26.6	30.7	28.1
NDVI	0.49	0.79	0.59	0.45	0.73	0.64
CFL	0.758	0.819	0.792	0.702	0.818	0.786

Barley improvement for salinity stress conditions

Barley accessions validated for salinity tolerance

A total of five wild barley (*Hordeum spontaneum*) accessions (IC144117, IC144121, IC144123, IC144128 and IC145508) were validated for tolerance to salinity during 2024-25.

Diversity analysis in 104 released varieties under salinity conditions

A set of 104 released varieties was evaluated under field soil salinity conditions at Hisar Farm during 2024-25 in ABD. The data was recorded on 9 agro-morphological traits viz. plant height, days to heading, days to maturity, plant height, spike length, no. of grains/spike, no. of tillers/plant, 1000 grain weight and yield. Five varieties viz. K-508 (6R), Jyoti (6R), K-507 (6R), PL419 (6R) and RD2552 (6R) which were identified as promising under salinity conditions in the previous year were revalidated for salinity tolerance during 2024-25. The GxE plot and dendrogram analysis revealed a significant proportion of genetic diversity in the analysed panel. The varieties could be divided into 3 major clusters and 8 minor clusters.

Barley Plant Pathology

Evaluation of barley germplasm lines against stripe rust and spot blotch diseases

Total 109 barley genotypes were evaluated against stripe rust and spot blotch during second year (2024-25). Among these genotypes, total eight genotypes viz., IC138029, IC138033, IC138034, IC138066, IC138069, IC138072, IC138079, and IC445756 were found completely free from yellow rust whereas no entry was found resistant against spot blotch disease.

Effect of stripe rust disease severity on grain yield in barley stripe rust susceptible cv. Jyoti

In an experiment conducted during Rabi 2024-25, disease severity levels viz., 0, control (unprotected natural inoculation), 5S, 10S, 20S, 40S, 60S, 80S and 100S were achieved. The maximum yield loss (74.83%) was recorded in 100S severity level of stripe rust (Fig. 7.4).

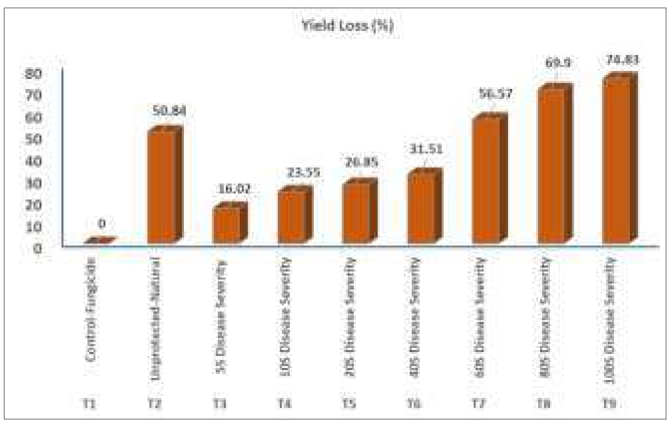


Fig. 7.4. Effect of stripe rust disease severity on grain yield in susceptible barley cv. Jyoti

Morpho-cultural and molecular variability in *Bipolaris sorokiniana* isolates

Morpho-cultural variability

Cultural characteristics of the isolates showed wide variation. Mycelial radial growth ranged from 19.0 to 83.70 mm, corresponding to growth rates of 1.90–8.37 mm day^{-1}, with Bs 1 being the fastest-growing isolate (83.70 mm; 8.37 mm day^{-1}) (Fig. 7.5a). Colony colour varied from creamy white to black, while texture differentiated isolates into smooth (14 isolates) and rough (13 isolates) types. Appressed colonies were observed in 12 isolates, whereas 15 isolates exhibited raised growth. Colony margins were predominantly irregular, zonation was observed in only two isolates, and exudation was recorded in the majority of isolates. Morphological traits also exhibited considerable variability. Conidial length and breadth ranged from 45.98–92.15 µm and 18.50–31.43 µm, respectively, with the largest conidium recorded in Bs 10 (92.15 × 29.29 µm). The average number of septa varied from 2.7 to 7.5 (Fig. 7.5b).

Molecular variability

Twenty-three B. sorokiniana isolates yielding high-quality genomic DNA were genotyped using 14 polymorphic SSR markers (19–25 bp; 59–60 °C) to assess molecular variability. A total of 45 alleles were detected, with 2–5 alleles per locus. Among the markers, three were biallelic, six showed three alleles, four had four alleles, and one marker exhibited five alleles, producing amplicons ranging from 100 to 310 bp. BS-30 was the least polymorphic marker (PIC = 0.087), whereas BS-2 showed the highest polymorphism (PIC = 0.694). Cluster analysis using the Unweighted Neighbor-Joining method in DARwin v6 grouped the isolates into three distinct clusters based on genetic dissimilarity (Fig. 7.5c). This grouping was further supported by Principal Coordinates Analysis (PCoA), which also resolved the isolates into three genetically distinct groups. The first three principal axes explained 40.60% of the total variation, with PCo1 (17.06%), PCo2 (12.72%), and PCo3 (10.81%) contributing sequentially (Fig. 7.5d).

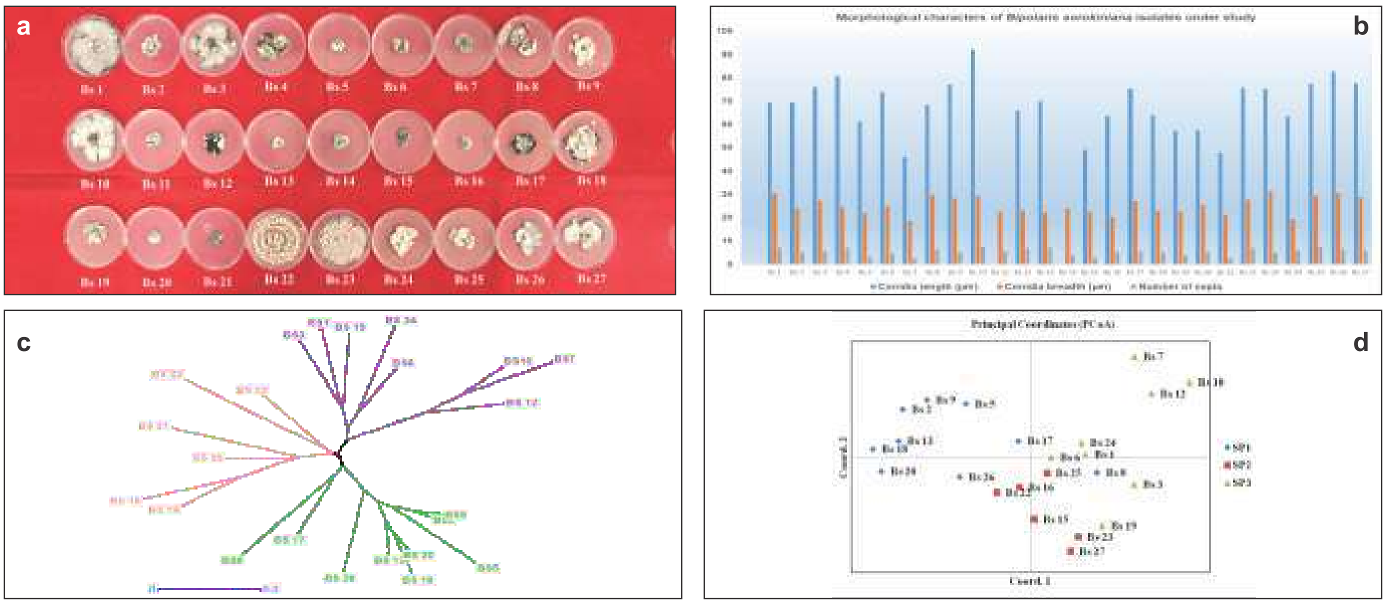


Fig 7.5. Cultural characters (a); Morphological characters (b); The Phylogenetic tree created using Unweighted Neighbors Joining method (c); Principal Coordinates Analysis of B. sorokiniana isolates with different population subgrouping from GenAlEx 6.5 software (d)

Virulence assessment of barley infecting *B. sorokiniana* isolates

The virulence analysis on susceptible barley cultivar RD 2508 revealed a broad spectrum of virulence. Among all B. sorokiniana isolates, Incubation period ranged from 3.5-9 days, lesion length ranged from 11.80-27.7 mm. lesion breadth was found to be varied from 2.70-5.00 mm, lesion size varied from 31.86-134.35 mm^2, lesion number varied from 30.8-80.3 lesions, disease severity (DS) varied from 9.26-77.78%, the values of AUDPC was ranged between 450-1577.5, NDVI ranged between from 0.22-0.47 and TGW values varied from 24.92-46.40 g. The strong negative correlations were found between TGW and both AUDPC (r = -0.98) and disease severity (r = -0.95).

8 REGIONAL STATION, FLOWERDALE, SHIMLA

Incidence of wheat and barley rusts in India and Nepal during 2024-25

The systematic surveillance of wheat and barley crops for rust diseases was carried out by multiple monitoring teams during the crop season 2024–25. During this season, wheat rusts were observed across multiple states in India. Disease intensity of leaf rust was more compared to stem and yellow rust. The first incidence of stripe rust (yellow rust) was detected late in January 2025 in a small patch of a farmer's field sown with wheat cultivar DBW303 at Nuhiyawali village, Sirsa district, Haryana. Likewise, leaf rust emerged with its first occurrence in the second week of January in a wheat field (cv. SW23) at Jandla village, Shri Anandpur Sahib block, Ropar district, Punjab. The stem rust was first observed during 1st week of February in Pune, Satara, and Sangli districts, with severity ranging from 20S to 60S. The wheat and barley rusts were kept under check with the help of cooperators, through exhaustive rust surveillance in different wheat growing areas of India and neighboring countries. No wheat blast or Ug99 type of virulences of *Puccinia graminis* f. sp. *tritici*, were reported from any of the wheat growing zones in India during 2024-25.

Pathotype distribution of *Puccinia* species on wheat and barley

All rust diseases of wheat appeared endemically in India. A total of 1293 samples of three rusts of wheat, stripe and stem rusts of barley collected from fourteen Indian states, and Nepal were analyzed during 2024-25.

Stripe rust of wheat and barley (*Puccinia striiformis*)

During current season, 155 stripe rust samples of wheat were analyzed from five states and two UTs (Himachal Pradesh, Punjab, Haryana, Uttarakhand, Rajasthan, Delhi and Ladakh) of India and Nepal. Eleven pathotypes of *Puccinia striiformis* f. sp. *trititci* (*Pst*, yellow rust of wheat) {238S119, 110S119, 46S119, T (47S103), P (46S103), 78S84, 6S0, 7S0, 14S64, 15S64 and 78S64} and one pathotype 0S0 (57) of *Puccinia striiformis* f. sp. *hordei* (*Psh*, yellow rust of barley) were identified. *Pst* populations were avirulent to *Yr5*, *Yr10*, *Yr15*, *Yr16*, *Yr32*, and *YrSP*.

Stem rust of wheat (*P. graminis* f. sp. *tritici*)

A total of two hundred sixty-one samples of wheat and barley stem (black) rust were received from five Indian states (Gujarat, Madhya Pradesh, Maharashtra, Karnataka and Tamil Nadu) during the crop season. Seven pathotypes of *P. graminis f. sp.tritici* were identified from the analysis of 261 samples. Population analyzed during the year had avirulence to *Sr24, Sr26, Sr27, Sr31, Sr32, Sr35, Sr39, Sr40, Sr43, SrTt3* and *SrTmp*. Diversity of black rust pathogen was maximum in Karnataka as maximum number of pathotypes were identified from this state.

Leaf rust of wheat (*P. triticina*)

A total of 877 samples of wheat leaf rust pathogen were analyzed from 14 states of India and neighboring country Nepal. Thirty-one pathotypes were identified in these samples. Pathotype 77-9 (121R60-1) was the most widely distributed and occurred in 42.30% of the samples followed by 52-4 (121R60-1,7) in 24.28% samples. The *P. triticina* population from Karnataka was highly diverse as highest number of pathotypes (23) was detected in the samples collected from Karnataka. From Nepal 13 pathotypes were detected in 98 samples. The detail of predominant pathotypes of *Puccinia* spp. observed on wheat in India during 2024-25 is listed in Table 8.1.

Table 8.1. Predominant pathotypes of *Puccinia spp.* on wheat in India

Wheat Rusts	Predominant pathotypes
Stem	79G31 (11), 62G29 (40A) and 127G29 (40-3)
Leaf	121R60-1 (77-9), 121R63-1,7 (52-4) and 121R63-1 (77-5)
Stripe	46S119, 47S103 and 110S119

Seedling resistance test (SRT) and characterization of *Lr*, *Sr* and *Yr* genes in AVT lines

Screening of wheat and barley lines for rusts resistance at seedling stage

To identify sources of rust resistance, over 2,400 wheat and barley lines were evaluated at the seedling stage during the 2024–25. The 204 advanced wheat lines were screened against 62 pathotypes belonging to three *Puccinia* species known to cause rust diseases in wheat. These included 15 pathotypes of *Puccinia striiformis* f. sp. *tritici* (stripe rust), 23 of *P. graminis* f. sp. *tritici* (stem rust), and 24 of *P. triticina* (leaf rust).

Rust resistant lines in AVT

MACS4147 was the only AVT entry exhibiting resistance to all pathotypes of the three rust pathogens. Other wheat lines showing resistance to individual rusts or in combinations are presented in Table 8.2. The wheat line DBW426 exhibited resistance to both black and brown rusts. Two entries (NIDW1542 and PBW938) conferred resistance to both brown and yellow rusts. Eleven entries (excluding those carrying the *Sr31* and *Sr24* genes) conferred resistance to black rust pathotypes (Table 8.2).

Table 8.2. Rust resistance in advanced wheat material (AVT: 2024-25)

Rusts	No. of lines	Variety/line
Brown, Black and Yellow	01	MACS4147(d)
Brown and Black	01	DBW426
Brown and Yellow	02	NIDW1542, PBW938
Black and Yellow	-	None
Brown only	42	BRW3959, CG1029, DDW65, GW554, GW555, GW556, GW561, GW563, GW1029, HD3090, HD3463, HD3515, HI1563, HI1633, HI1683, HI1687, HI1696, HI1697, HI1699, MACS4125, MACS4131, MACS4135, MACS4146, MACS6222, MACS6768, MACS6829, MACS6830, MACS6854, MACS6851, MPO1398, NIAW4267, NIAW4533, NIAW4581, NIDW1557, NIDW1561, NW8089, PBW833, RAJ4083*, UAS484, UBW22, WH1338, WSM138
Black only	11	DBW110, DBW303, DBW377, DBW462, HD3486, HP1983, K1317, MACS6837, MACS6844, MP4010, UP3145
Yellow only	08	DBW477M, HD3467, PBW915, PBW921, PBW942, PBW951, PBW953, SVPWL22-02

Characterization of rust resistance genes

Yr genes

Among the 204 lines of AVT, *Yr* genes were characterized in 114 lines. Three *Yr* genes viz. *Yr2*, *Yr9*, and *YrA* contributed to yellow rust resistance in Indian wheat material. Among the postulated *Yr* genes, the frequency of *Yr2* was maximum and it was characterized in 98 lines. *Yr9* was postulated in 08 entries.

Sr genes

Twelve stem rust resistance genes (*Sr2, Sr5, Sr7b, Sr8a, Sr9b, Sr9e, Sr11, Sr13, Sr24, Sr28, Sr30* and *Sr31*) were characterized in 165 AVT lines. The frequency of *Sr7b* and *Sr2* was maximum as they were postulated in 49 and 48 AVT entries, respectively, followed by *Sr11* and *Sr13*, which were characterized in 46 and 45 entries, respectively. *Sr31* linked with *Lr26* and *Yr9* and conferring resistance to all the known *Pgt* pathotypes in Indian subcontinent was postulated in eight AVT entries, while *Sr24* linked to *Lr24* was characterized in 24 entries.

Lr genes

Eight *Lr* genes *Lr1*, *Lr3*, *Lr10*, *Lr13*, *Lr23*, *Lr24*, *Lr26,* and *Lr28* were characterized in 148 entries. *Lr13* was the most commonly postulated leaf rust resistance gene that was characterized, alone or in combination, in maximum number of lines. The *Lr24* that is linked with *Sr24* was postulated in 24 entries. *Lr26,* tightly linked with *Yr9* and *Sr31*, was characterized in 8 lines. Other *Lr* genes i.e. *Lr3* and *Lr28* were postulated seven and two entries, respectively. Resistance to leaf rust in five entries was based on a combination of three different genes.

Race specific Adult Plant Resistance (APR) in AVT entries (2024-25)

Leaf rust

Seventy-five entries of AVT showed APR to one or the other pathotypes of *P. triticina.* APR to all the pathotypes (77-5, 77-9 and 104-2) of leaf rust pathogen was not observed in any of the entries. APR to individual pathotypes 77-5, 77-9 and 104-2 was observed in 13, 36 and 07 entries.

Stripe rust

Seventy-three lines showed APR to different tested pathotypes of stripe rust pathogen. Eleven lines had APR to 110S119 and 238S119. Five entries DBW296, DBW445, HI1612, HI8823 (D), UAS478 (D) possessed APR to both 110S119 and 46S119. Eighteen entries showed APR to 238S119.

Stem rust

Combined APR to *Pgt* pathotypes 11 & 40A was recorded in two AVT entries (MP3570 and PBW915). Likewise, HI8856 (d) exhibited APR to both 40A and 117-6. Seven entries (CG1052, DBW327, HD3293, KRL2203, MP3598, PBW942, and PBW943) had APR to pathotype 11.

Rust resistance in barley NBDSN and EBDSN lines during 2024-25

Two hundred forty-six NBDSN and eight EBDSN entries were screened against different pathotypes of three rusts of barley under precise conditions of temperature and light. None of the NBDSN or EBDSN entries conferred resistance to all the pathotypes of three rust pathogens *P. striiformis hordei* (stripe rust), *P. hordei* (leaf rust) and *P. graminis tritici* (stem rust). The detailed report is presented below.

NBDSN

None of the entries conferred resistance to all three rusts of barley. Eleven entries were resistant to both leaf and stripe rusts. Two entries (DWRB2422 and HUB290) were resistant to all the pathotypes of stripe and stem rust pathogens while DWRB2435 conferred resistance to leaf and stem rusts. (Table 8.3).

Table 8.3. Seedling rust resistance in NBDSN during 2024-25

Resistant to rusts	No. of lines	Lines
Leaf and Stripe	11	BHS498, BHS503, BHS504, HBL890, RD3137, RD3138, RD3139, RD3141, RD3142, RD3143, Rd3145
Leaf and stem	01	DWRB2435
Stripe and stem	02	DWRB2422, HUB290
Leaf	10	BHS505, DWRB2411, DWRB2429, HBL113, PL983, UPB1121, UPB1135, VLB118, VLB187, VLB191
Stripe	54	BH1058, BH1059, BH1063, BH1067, BH1071, BH1072, BH1073, DWRB137, DWRB182, DWRB238, DWRB2416, DWRB2418, DWRB2421, DWRB2430, DWRB2432, HBL891, HUB113, HUB303, JHSBB19, JHSBD11, JHSBD22, JHSBF21, JHSBF28, KB2301, NDB1841, PL890, PL955, PL982, RD2552, RD2715, RD2794, RD2899, RD2907, RD3088, RD3089, RD3090, RD3095, RD3102, RD3119, RD3120, RD3126, RD3128, RD3129, RD3130, RD3131, RD3133, RD3134, RD3140, RD3144, RD3146, RD3148, UPB1122, UPB1123, UPB1128

EBDSN

Resistance to all three rusts was not recorded in any EBDSN entry. Resistance to all the pathotypes of stripe rust pathogen was observed in three (DWRB238, DWRB2309, and DWRB137) entries of EBDSN. None of the entries conferred resistance to all the pathotypes of *P. hordei*.

Gene postulation (barley leaf rust) in NBDSN and EBDSN lines

Two genes (*Rph3* and *Rph19*) were postulated in 34 NBDSN lines. *Rph3* gene was postulated in 12 lines. Similarly, *Rph19* gene was postulated in 22 lines. Only two genes (*Rph3* and *Rph19*) were postulated in EBDSN entries. One entry (DWRB2312) carried *Rph3*, while two lines (DWRB238 and DWRB2304) had *Rph19*.

Molecular profiling of AVT lines

The *Yr9/Lr26/Sr31* gene was confirmed in eight AVT lines (GW563, HD3090, HI1633, HI1634, HI1699, HI1702, MACS6854, PBW771). The 500bp amplicon produced by dominant marker *Sr24#12* indicated the presence of *Lr24/Sr24* gene complex in twenty-four wheat lines (Fig. 8.1). Amplification of 150 bp band by molecular marker *csLV34* shows the presence of race nonspecific *Yr18/Lr34/Sr55* gene complex in nine AVT lines. Amplification of ~120 bp band by molecular marker *Sr2* specific marker (GWM533) showed the presence of *Sr2* gene in maximum of forty-eight AVT entries.

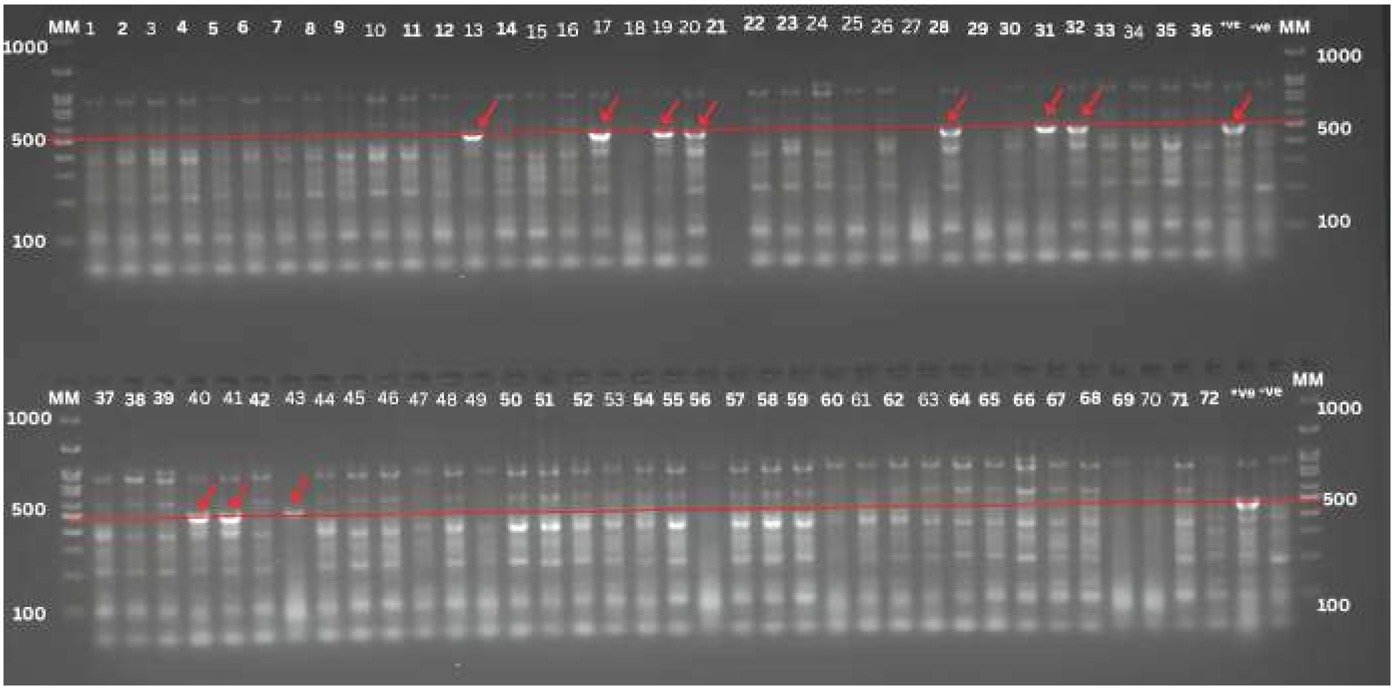


Fig. 8.1. Electrophoresis on 2.5 % agarose gel showing amplification profile of marker *SR24* #12 indicated the presence of *Sr24/Lr24* gene complex. Upper row, Lane 1(MM)- Gene Ruler 100 bp DNA ladder; Lane 38(+ve), lane 39 (-ve), lane 40 (MM) - Gene Ruler 100 bp DNA ladder

Genetics of rust resistance and developing rust resistant genetic stocks

Development of rust resistant genetic stocks

In barley, 14 crosses of Cebada Capa (*Rph7*), Trumph (*Rph12*) and Magnif104 (*Rph5*), made with RD3028, BH1035, VL173, KB1926, RD3089, RD3013, RD3016, and PL908, were advanced to F3 generations. In Wheat, for the development of genetic stocks for resistance to all three rusts (brown, black and yellow rust) one population was screened and advanced to F6 generation, population of six crosses was screened and advanced to F5 generations, and one population was advanced to F4 generation, one to F3 generations and four to F2 generations.

Pyramiding multiple rust resistance and generation advancement

Several germplasm lines and landraces harboring different leaf rust resistance genes such as *Lr10, Lr67, Lr23, Lr46, Lr13* and *Lr26* were crossed to develop F_1 lines with more than two leaf rust resistance genes. A total of 31 crosses from the previous season were sown in rows in 2024-25 cropping season. Among them 14 crosses were selected based on their resistance and other traits.

Development of durable rust resistance genotypes

The brown rust resistance line Hango-2 harboring *Lr80* gene was crossed with FLW lines that carry yellow rust resistance. A total of 8 direct and reciprocal crosses were made in 2023-24.

Introgression of yellow rust resistance to elite varieties of wheat

Three popular wheat varieties (HS562, HI1563 and DBW222) which are susceptible to yellow rust were selected to introgress multiple yellow and brown rust resistance genes from donors, which are resistance to yellow rust and bio-fortified with Fe and Zn.

Rust resistance studies in barley

Three different F2 families derived from crosses between resistant and susceptible parents were screened at seedling stage using most virulent pathotype of yellow rust and brown rust to deduce the number of genes governing the resistance and their inheritance pattern.

Wheat disease monitoring/ SAARC nursery

The 57th wheat disease monitoring nursery was planted at 40 strategic locations evenly distributed throughout India. Rust diseases were not recorded on any of the entries of WDMN planted at IIWBR, RS Shimla, Kalyani, Junagarh, Akola and Niphad. The yellow rust was noticed at all the locations of NHZ and NWPZ except at IIWBR, RS, Shimla and IARI, RS, Tutikandi, Shimla, where all the WDMN entries were yellow rust free. Brown rust appeared at all the locations of NEPZ except Kalyani. Of the 30 locations of WDMNs black rust was observed only at Powarkheda and Vijapur in CZ and Wellington in SHZ and all the entries were black rust free in all other zones. SAARC wheat disease monitoring nursery was planted at 33 locations in India, Bangladesh, Bhutan, Nepal and Pakistan.

National repository of pathotypes of *Puccinia* species on winter cereals

A collection of more than 150 pathotypes of different rust pathogens of wheat, barley, oat and linseed were maintained on host as well as cryo-preserved. For the smooth conduct of wheat and barley rust research, nucleus/bulk inocula of different pathotypes of wheat and barley rust pathogens was supplied to more than 50 scientists/research centers across India.

9 REGIONAL STATION, DALANG MAIDAN, LAHAUL & SPITI

The efficient utilization of Off-season summer nursery facility for development of varieties in shorter period of time; to improve the genetic gain and make the wheat breeding programme more efficient and effective. The ICAR-IIWBR Regional Station Dalang Maidan, Lahaul & Spiti, Himachal Pradesh is one of the strategic locations which helps in attaining this goal of many plant breeding programs. The natural environment of the valley provides excellent opportunity to the wheat and barley scientists of the country to use the facility for generation advancement and screening against yellow rust and powdery mildew diseases. The shuttle breeding approach helps in removing the photoperiodic alleles and providing better stability to the genotypes.

The ICAR-IIWBR, Regional Station located at Dalang Maidan, Lahaul & Spiti in Himanchal Pradesh act as a national service centre for providing various kind of support to wheat and barley researchers across the country. The progress made under different mandates during the year, 2025 is presented under following heads.

Generation advancement of wheat and barley crops during off season, 2025

During the period of May- October, 2025, more than 42,466 lines of wheat and barley breeding material from 45 Co-operators of different Institute across the country were advanced at ICAR-IIWBR Regional station, Dalang Maidan, by utilization summer nursery facility. The materials from all the major wheat zones were advanced at the station. The maximum materials were from NWPZ followed by NHZ, CZ, NEPZ and PZ. Apart from ICAR-IIWBR Karnal, ICAR-IARI New Delhi, CCS HAU Hisar, PAU RS Gurdaspur, NABI Mohali, VPKAS Almora, BISA Ludhiana and CSHPKV Palampur were major co-operators for utilizing the off-season facility. The sowing of all the materials was done during 16 - 21th May, 2025. All the research material was harvested at maturity in the month of Sep-Oct, 2025 and supplied to the respective researchers well in time. The disease pressure for both stripe rust and powdery mildew was adequate for screening of the lines and was properly utilized by wheat workers across the country. The station serves as a national Off-season nursery facility for wheat and barley researchers across the country.

Corrective hybridization

The summer nursery, 2025 was also utilized for corrective crossing and backcrossing for gene introgression, mapping of the traits for genetic study and various breeding programmes of wheat and barley. More than 1300 corrective crosses, back crosses/three-way crosses were attempted during the Off-season. Scientific, Technical/RA/SRF and staff members from different institutes such as ICAR-IIWBR, Karnal, ICAR-NBPGR, New Delhi, ICAR-IARI New Delhi, ICAR-IARI, RS, Shimla, ICAR-VPKAS Almora, SKUAST-J Jammu, CSKHPKVV, Palampur, NABI Mohali, PAU, Ludhiana, PAU, RS, Gurdaspur and many others visited the nursery during months of July and August, 2025 for attempting crosses.

Disease screening

The season was very favorable for the screening of yellow rust and powdery mildew. Around 14,000 lines were screened by various centers. The yellow rust incidence was first observed during end of July and disease pressure was highest during August, 2025. The leaf samples were collected for rust and sent to IIWBR, RS, Shimla for race identification. The Powdery mildew also appeared in patches during at the end of August 2025.

Natural repository of wheat and barley germplasm

The off-season facility also acts as a natural repository for wheat and barley germplasm and at present about 15000 wheat germplasm accessions and about 8000 barley accessions are being conserved and maintained under natural cool temperature conditions at the station.

Seed multiplication of important cultivars/ varieties

The seed multiplication of few barley genotypes from ICAR-IIWBR, Karnal was carried out at the station.

10 SEED AND RESEARCH FARM, HISAR

The ICAR-Indian Institute of Wheat and Barley Research, Seed and Research Unit, Hisar is located at the Southern bypass in the North-West of Hisar city. With an area of 200 acres, it is mandated with breeder seed production of popular/newly released wheat and barley varieties and evaluation of wheat and barley lines and trials under the All India Coordinated Wheat and Barley Improvement Programme. The main research focus is on evaluation of wheat and barley genotypes under natural soil salinity conditions.

Breeder seed production and revenue generation

Breeder seed production of popular/newly released wheat and barley varieties is an important activity of the Seed and Research Farm Hisar and during the season pertaining to 2024-25, 1099 quintals of the breeder seed of one wheat (DBW303) and seven barley varieties (DWRB137, DWRB223, DWRB101, DWRB182, DWRB123, DWRB219 and DWRB244) was produced. The variety wise seed produced is given in the Table 10.1.

Table 10.1. Breeder seed of different varieties produced during 2024-25

S. No.	Variety	Class of seed	Production(Q)
1	DWRB137	Breeder seed	164.60
2	DWRB223	Breeder seed	204.30
3	DWRB101	Breeder seed	28.80
4	DWRB182	Breeder seed	14.85
5	DWRB123	Breeder seed	11.70
6	DWRB219	Breeder seed	38.49
7	DWRB244	Breeder seed	34.20
8	DWRB303	Breeder seed	603.00
	Total		**1099**

Seed multiplication and revenue generation

During the crop season 2024-25, seed of 7 different popular varieties of barley was multiplied and supplied to ICAR-IIWBR, Karnal. Beside this, seed of four advance barley lines was also multiplied. The quantity of multiplied seed variety/advance line wise is presented in Table 10.2.

Table 10.2. Seed multiplication of different barley varieties produced during 2024-25

S. No.	Variety/Advance line	Quantity (Qtl's)
1	DWRB2316	4.05
2	DWRB2314	2.47
3	DWRB2313	4.05
4	DWRB2302	2.25
5	Karan 16	4.5
6	PL891	8.10
7	DWRB2304	3.15
8	Geetanjali	4.05
9	NDB943	3.60
10	BHS352	1.80
11	DWRB2304	3.15
	Total	**38.02**

Trials conducted/research achievements

Trials under multi-locational and multi-disciplinary research programme on wheat and barley improvement

Barley AVT/IVT-SST with 21 entries in 3 replications under two salinity environments was conducted during *rabi* 2024-25 and the data was submitted.

Station trials conducted

Wheat Station Trial (NWPZ/NEPZ/CZ/PZ-RI-TS) with 25 entries in 2 replications in simple lattice was conducted during *rabi* 2024-25.

Mutation breeding in barley

The M_2 generations of three popular and new barley varieties *viz.* DWRB137, DWRB219 which were given gamma dosage of 250 & 300 Gy were raised. Selection was exercised for dwarf plant type (lodging tolerant) and hull less mutant (*Nud1* mutant) from agronomically superior hulled varieties.

Barley accessions validated for salinity tolerance

A total of five wild barley (*Hordeum spontaneum*) accessions (IC144117, IC144121, IC144123, IC144128 and IC145508) were validated for tolerance to salinity during 2024-25.

Diversity analysis in 104 released varieties under salinity conditions:

A set of 104 released varieties was evaluated under field soil salinity conditions in augmented block design at Hisar Farm during 2024-25. The data was recorded on 9 agro-morphological traits viz. plant height, days to heading, days to maturity, plant height, spike length, no. of grains/spike, no. of tillers/plant, 1000 grain weight and yield. Five varieties *viz*. K-508 (6R), Jyoti (6R), K-507 (6R), PL419 (6R) and RD2552 (6R) which were identified as promising under salinity conditions in the previous year were revalidated for salinity tolerance during 2024-25 (Fig. 10.1).

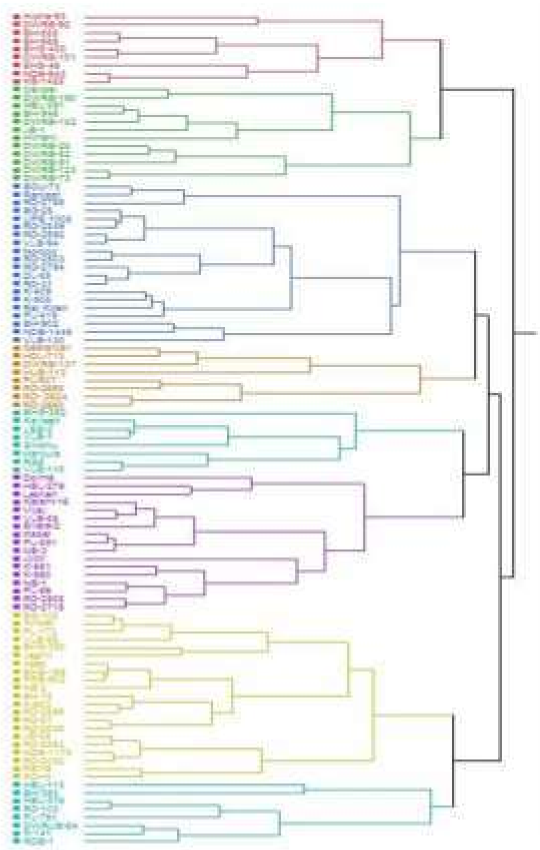


Fig. 10.1. Dendrogram based diversity analysis in 104 released barley varieties under salinity conditions

11 AICRP ON WHEAT & BARLEY

Crop Improvement

- The 2024-25 cropping season was a landmark year for Indian wheat production, reaching a record 117.94 million tonnes - an increase of 4.1% over the previous year-cultivated on 32.80 million hectares.
- During crop season 2024-25, a total of 39 genotypes were in the final year of yield evaluation in Advance Varietal Trials and SPL trial of different zones. Two genotypes MACS4135(d) (CZ & PZ) and HI8849(d) (CZ & PZ) were tested in two zones showing wider adaptability. Three genotypes namely DBW477, HD3495 and HD3471 were developed through marker assisted backcross breeding approach.
- 24 new genotypes were identified for release, during 64th All India Wheat and Barley Workers' Meet, held at RVSKVV, Gwalior. Three of these genotypes (DBW425, DBW426 & DBW445) were developed at ICAR-IIWBR, Karnal.
- A total of 28 trial series for five production conditions (ES-HF, IR-TS, IR-LS, RI-TS, RF-TS), including NIVTs, AVTs and Special trials were constituted for conduction during 2025-26 crop season.
- Nineteen trial series were conducted at 78 centers, involving 408 test genotypes and 69 checks. Of the 363 planned trials, 360 were conducted and 318 (88.33%) were reported.
- Monitoring teams rejected 15 trials and 8 test entries due to under-performance or genetic purity concerns.
- Molecular analysis of 77 AVT entries using 46 SSR and STS markers revealed strong genetic diversity, reinforcing potential for adaptation under stress and yield stability.
- Sixteen genotypes in AVTs and 90 in NIVTs were found promising across multiple agro-climatic regions.
- Breeder seed demand reached 17,401.84 quintals, while actual production hit 27,677.74 quintals-creating a surplus of 10,720.52 quintals. The most in-demand and productive varieties were DBW187, DBW303, and DBW222.
- Screening of 418 wheat lines at Bangladesh against wheat blast, identified 45 wheat blast resistant genotypes.
- INDB2417 and BWEM-8, genotypes showed better abiotic stress tolerance in DHTSN.
- Evaluation of both national and international nurseries added further strength to the breeding pipeline. Overall, the year highlighted substantial progress in wheat genetic advancement, seed distribution, and resilience against climate stress.

Crop Protection

Losses due to wheat and barley rusts have been minimized. There had been no wheat and barley rust epidemic during recent years. It was possible due to the strict vigilance, coordinated efforts of ICAR-IIWBR, SAUs, and State Dept. of Agriculture, monitoring pathotypes, evaluation of Advance Varietal Trial material and deployment of diverse rust resistant varieties. A total of 1224 varieties were evaluated in IPPSN, out of which 474 were identified as stem rust resistant, 929 as Leaf rust (S) resistant, 877 as Leaf rust (N) resistant, and 452 as stripe rust resistant. A total of 501 varieties were evaluated in PPSN. We identified 17 genotypes resistant to all three rusts, 49 as leaf and stripe rust resistant, 71 as leaf and stem rust resistant, and 18 resistant to both stem and stripe rust. Entries evaluated in various networks were: LBSN (204), KBSN (204), PMSN (204), LSSN (146), FSSN (204), HSSN (204), FRSN (204), and HBSN (204), with 1, 68, 2, 7, 55, 4, 13, and 24 entries found resistant, respectively. In EMDSN, 21 entries were reported resistant to all three rusts, KB, HB, and FS. Eleven entries were resistant to stem rust, leaf rust, KB, and FS. Seven entries were resistant to all three rusts, KB, FS, and PM. A total of 204 AVT entries were screened for resistance against shoot fly, brown wheat mite, foliar aphid and root aphid, resulting in 22, 8, 31 and 2 resistant genotypes respectively, while 581 NIVT entries were screened for resistance against foliar aphids, resulting in 2 resistant genotypes only. 1,293 rust samples from wheat and barley collected from 14 Indian states and Nepal were analyzed in 2024–25 for rust pathotypes. Stripe rust genes (*Yr2, Yr9, YrA*) identified in 148 lines, leaf rust genes (*Lr1, Lr3, Lr10* etc.) in 114 lines and stem rust genes (*Sr2, Sr5, Sr11*, etc.) were identified in 114 lines. 20 Disease-resistant lines were shared with 23 breeding centers; 18 used at 10–55% rate. New Disease Management strategies such as *Karnal bunt*: Azoxystrobin + Difenoconazole foliar spray@0.1%. *Loose smut*: Difenoconazole 3% WS@2.5g/kg seed; *Head scab*: KUSH-PlantEX@ 2ml/100 g seed; *Foliar blight*: KUSH-PhosphoBoost @ 2 ml/100 g seed were identified. For CCN *Trichoderma harzianum*@ 3.5kg/ha+50kg vermicompost found most effective. Wheat blast was tested on 418 genotypes at two different locations at Bangladesh.

Resource Management

The Resource Management group of the "All India Coordinated Wheat and Barley Improvement Project" (AICW&BIP) is not only evaluating the performance of newly developed genotypes but also actively working on developing and refining eco-friendly, location-specific, and cost-effective wheat and barley production technologies to increase the productivity and profitability of farmers. This work includes special trials on input-responsive technologies, tailored to the priorities of different wheat/barley growing zones. In five wheat/barley growing zones, fourteen varietal evaluation trial series were conducted at 92 locations under different growing conditions. The newly developed genotypes were evaluated against the existing varieties used as checks. In addition, eight special coordinated trials were also proposed to address the zone-wise problems and priorities. Zone-wise, 92 varietal evaluation trials were conducted. Out of the conducted trials, 10 trials were rejected either by monitoring team or due to low mean yield of the trial. The overall conduct of trial was 100 percent with a success and rejection rate of 89.1 percent and 10.9 percent, respectively. In NHZ, one coordinated trial of barley was proposed and conducted. In NWPZ, test entries PBW 921 and DBW 422 showed numerical superiorly over best check variety in late sown conditions while HD 3471^{M} showed numerical superiorly over best check variety under restricted irrigation conditions. In NEPZ, the test entry PBW 915 exhibited numerical superiorly (1.33%) over best check variety based on nine locations in timely sown conditions. In CZ, test entries GW 555 and GW 556 showed numerical superiority over their best check under timely and late sown condition, respectively. In HYPT of CZ, test entry HD 3463 showed significant superiority (5.15%) compared to the best check (DBW 377). In PZ, test entry CG 1045 demonstrated numerical superiority over the best check (MACS 6222) on the mean basis in timey sown conditions. In PZ, under IR-LS-DOS-TAS trial, based on four locations, test entry MACS 6829 showed significant superiority (8.99%) while three test entries namely HI 1687, DBW 426^{Q} and MACS 6830 exhibited numerical superiority (4.61-6.42%) over the best check (RAJ 4083). The test entry CG 1047 demonstrated significant superiority (4.89%) while NIAW 4267 was numerically superior (1.51%) over the best check NIAW 7130. The special trials conducted in different zones conducted are 71 with conduct percentage was 98.6. The maximum numbers of special trials were conducted in NWPZ (35) followed by NEPZ (16), CZ (10), NHZ (06) and PZ (04).

Quality & Basic Sciences

In 2024–25, All India Coordinated Research Project (AICRP) on wheat quality evaluated 227 Advance Varietal Trials (AVTs), 17 High Yield Potential Trials (HYPTs), 269 National Initial Varietal Trials (NIVTs), 36 Quality Component & Wheat Biofortification Nursery (QCWBN), 11 *dicoccum*, 4 Alkalinity Salinity Trial (AST), and 25 Initial Varietal Trials (IVTs) across India's wheat-growing zones to identify high-quality, nutrient-rich and product specific genotypes. Quality assessments included protein content, hectolitre weight sedimentation value, gluten, grain hardness, High Molecular Weight Glutenin Subunits (HMWGS), and micronutrient analysis (iron and zinc). Among *Triticum aestivum* genotypes, GW555, GW556 and CG1047 excelled in chapati while PBW915, MACS6844, CG1045 and DBW426Q in bread loaf volume. Several nutritionally superior lines were identified for high protein and micronutrient content in *T. aestivum* as well as *T. durum*. Zone-wise variability was significant: average protein content was 11.6% in *T. aestivum* while 11.5% in *T. durum*. Fe content reached 49.2 ppm in Northern Hills Zone (NHZ); Zn peaked at 49.4 ppm in Peninsular Zone (PZ). HMWGS analysis revealed 17.1% of entries with 10 Glu-1 score, associated with superior dough strength. Among NIVTs, maximum overall protein (12.8%), iron (45.3 ppm), and zinc (45.0 ppm) were recorded in NIVT 5B, NIVT 3B and NIVT 2, respectively. QCWBN screening identified 8 entries in the Central Zone (CZ) and 19 in the PZ meeting all three criteria (protein ≥13%, Fe ≥42 ppm, Zn ≥42 ppm). The results signify the progress in identifying wheat genotypes tailored to regional preferences, nutritional goals, and processing requirements. These findings contribute to India's ongoing efforts in wheat quality improvement and biofortification, addressing nutritional security alongside market competitiveness.

Barley Improvement

A total of 191 test entries, contributed by 14 centers, were evaluated against 25 check varieties in coordinated yield trials conducted across diverse agro-ecological conditions including rainfed (plains and hills), irrigated (plains), and saline soils. The entries represented various barley types, including malt, feed, dual-purpose, and hulless; however, the majority were hulled, with hulless types primarily tested in the northern hills and plains. The trials were executed at 10 main centers and 44 voluntary locations, encompassing ICAR institutes and SAUs, during the Rabi season of 2024–25.

All 186 proposed yield evaluation trials were conducted. However, 15 trials were rejected due to poor crop stand, improper layout, or other technical issues. Data were timely received for 171 trials, representing 91.94% of the proposed trials. Of these, 21 trials were excluded from pooled analysis owing to low site means or excessively high coefficients of variation (CV). Consequently, data from 150 trials-equating to 86.64% of the proposed trials and 87.71% of the received trials-were utilized in the final pooled analysis.

In 2024–25, three improved barley varieties were released, marking key progress in crop development. DWRB 223, a hulless, six-rowed variety, delivers an average yield of 42.9 q/ha with superior nutritional quality. KB 2031 (Azad Barley 34) is a high-yield, salt-tolerant variety suited for saline and alkaline soils, while UPB 1106 (Pant Jau 1106) is a high-yield feed type for the NEPZ, notable for its strong rust resistance. Additionally, five novel genetic stocks were registered with ICAR–NBPGR, showcasing traits such as high beta-glucan, elevated protein, salinity tolerance, rust resistance, and early maturity. Across 191 coordinated trials, 62 entries surpassed the best checks, including DWRB 238 (malt), RD 3109 (saline), DWRB 244 (hulless), RD 3126 (feed), and DWRB 2318 (dual-purpose). Molecular profiling of AVT-II entries using 43 SSR/STS markers identified 88 alleles, reflecting considerable genetic diversity. Breeder seed production totaled 1,213.35 q against an indent of 747.75 q, generating a surplus of 468.8 q, along with 52.92 q of nucleus seed. Collaboration with ICARDA facilitated IBYT-FFM and IBYT-ASA trials and the dissemination of an elite nursery to 12 locations. With 30–50% lower water requirements than wheat, tolerance to salinity up to 300 mM NaCl, and contributions to soil health and reduced greenhouse gas emissions, barley stands out as a sustainable, climate-resilient crop well-suited for organic farming and land reclamation.

In 2024–25, 468- entries in IBDSN; 246-entries in NBDSN, and 8-entries in EBDSN were screened for resistance to stripe rust and leaf blight at different hotspots. Of 468 IBDSN entries, 24 were rust-free (ACI = 0), and 263 were resistant (ACI <10). No entry met the criteria for moderate resistance to leaf blight. Among the 246-NBDSN entries, 17 were stripe rust-free (ACI = 0), and 151 showed resistance (ACI <10). No entry met the criteria for moderate resistance to leaf blight. Of the 8 EBDSN entries, 4 entries were completely free from yellow rust, while the remaining 4 showed resistant reactions. However, no entry in any of the nursery was found to possess resistance against leaf blight.

A total of four nurseries namely high limit dextrinase activity (BQSN 1), high resistant starch content (BQSN 2), malting quality traits (BQSN 3) and high thousand grain weight (BQSN 4) were constituted and evaluated at 6 locations. These nurseries were grown at Karnal, Hisar, Ludhiana, Pant Nagar, Durgapura and Kanpur and a total of 222 samples were analysed. Highest Limit Dextrinase activity was recorded in BK312; high resistant starch (%) in INBON-HI-(2017)-88; high starch (%) in 4th GSBSN (2017)-106; highest TGW in 4th GSBSN (2017)-106. For malt traits the promising genotypes were identified for Friability (%) (RMB2401, RMB2402, RMB2404), Wort Filtration rate (ml/hr) (RMB2401, RMB2402, RMB2404) and High TGW (MBST/2024-6, MBST/2024-10, MBST/2024-14, MBST/2024-15, MBST/2024-22, MBST/2024-23).

12 EXTENSION ACTIVITIES

Training programmes organized/conducted by ICAR–IIWBR, Karnal

S. No.	Date	Duration (Days)	No. of Trainees	Subject	Organized By
1	16-18 Feb., 2025	03	40 Farmers	उत्तराखंड में गेहूं एवं जौ की उन्नत खेती	ICAR-IIWBR, Karnal in collaboration with ATMA, Dehradun, Uttarakhand
2	24-26 Feb., 2025	03	45 Farmers	उत्तराखंड में गेहूं एवं जौ की आधुनिक खेती	ICAR-IIWBR, Karnal in collaboration with ATMA, Dehradun, Uttarakhand
3	15-19 Sep., 2025	05	25 Officers	Innovative Extension Methods for Upscaling Wheat and Barley Production Technology	ICAR-IIWBR, Karnal in collaboration with EEI Nilokheri, Haryana
4	16 Oct., 2025	01	40 Farmers	एक दिवसीय कृषक भ्रमण एवं प्रशिक्षण	ICAR-IIWBR, Karnal
5	19-20 Dec., 2025	02	22 Farmers	मध्य प्रदेश में गेहूं एवं जौ की उन्नत उत्पादन तकनीकें	ICAR-IIWBR, Karnal in collaboration with BAIF Bhopal, Madhya Pradesh
6	23 Dec., 2025	01	40 Farmers	उत्तराखंड में गेहूं एवं जौ की आधुनिक खेती	ICAR-IIWBR, Karnal in collaboration with ATMA, Dehradun, Uttarakhand

Coordination of visits at ICAR-IIWBR, Karnal

S. No.	Date	Institutes, State/Central Universities/ State/ Central School, NGOs, FPOs etc.	No. of visitors	Male	Female	Total
1	08.01.2025	Sitapur, Uttar Pradesh	50 Farmers	50	-	50
2	10.01.2025	Bijnor, Uttar Pradesh	55 Farmers	52	3	55
3	11.01.2025	Arpan Sewa Sansthan, Ganganagar, Rajasthan	52 Farmers	40	12	52
4	16.01.2025	Mandi, Himachal Pradesh	29 Officers	24	5	29
5	24.01.2025	Saharanpur, Uttar Pradesh	11 Farmers	9	2	11
6	30.01.2025	PM Shree Sr. Secondary School Sambhli, Karnal, Haryana	55 Students	26	29	55
7	30.01.2025	Motihari, Bihar	39 Farmers	39	-	39
8	30.01.2025	Raisen, Madhya Pradesh	40 Farmers	20	20	40
9	04.02.2025	Cooperative Dairy Training & Research Institute Meerut, Uttar Pradesh	60 Farmers	60	-	60
10	04.02.2025	Krishak ATMA Yojna Raisen, MP	60 Farmers	60	-	60
11	04.02.2025	Government Senior Secondary School, Kunjpura, Karnal, Haryana	9 Students	1	18	19
12	06.02.2025	United Way Mumbai NGO Phulera, Jaipur, Rajasthan	20 Farmers	20	-	20
13	08.02.2025	ICAR-CSWRI Avikanagar, Rajasthan	44 Students	17	27	44
14	09.02.2025	Dayal Singh Public School Karnal, Haryana	45 Students	16	29	45
15	10.02.2025	Chitkara University Rajpura, Punjab	49 Students	29	20	49
16	11.02.2025	Jhunjhunu, Rajasthan	15 Farmers	15	-	15
17	12.02.2025	Insaf Public School Taprana, Shamli, UP	103 Students	53	50	103
18	12.02.2025	Dhanlaxmi Srinivasan University Trichy, Tamil Nadu	112 Students	53	59	112
19	13.02.2025	ICAR-CSWRI Avikanagar, Rajasthan	59 Farmers	59	-	59
20	13.02.2025	Government Senior Secondary School, Rohtak, Haryana	55 Students	36	19	55
21	14.02.2025	Government Senior Secondary School Rohtak, Haryana	39 Students	24	15	39

S. No.	Date	Institutes, State/Central Universities/ State/ Central School, NGOs, FPOs etc.	No. of visitors	Male	Female	Total
22	17.02.2025	Don Bosco College of Agriculture Arakonam, Tamil Nadu	133 Students	57	76	133
23	18.02.2025	PM Shree Kendriya Vidyalay Ambala, Haryana	153 Students	77	76	153
24	18.02.2025	Kudumiyanmalai, Pudukkottai, Tamil Nadu	130 Students	57	73	130
25	19.02.2025	Agr. College & Res. Inst. Vazahavachanur, Thiruvannamalai, Tamil Nadu	105 Students	28	77	105
26	20.02.2025	Adhiparasakthi Agricultural College G.B. Nagar, Ranipet, Tamil Nadu	142 Students	56	86	142
27	20.02.2025	Adhiyamaan College of Agriculture & Research, Krishnagiri, Tamil Nadu	134 Students	60	74	134
28	24.02.2025	VOC Agricultural College & Research Institute, Vallanadu, Thoothukudi, Tamil Nadu	121 Students	45	76	121
29	24.02.2025	SRS Institute of Agriculture and Tech. Vedasandur, Tamil Nadu	99 Students	37	62	99
30	24.02.2025	Pushkaram College of Agriculture Science, Pudukottai, Tamil Nadu	132 Students	40	92	132
31	25.02.2025	College of Agriculture Technology, Kullapuram, Theni, Tamil Nadu	147 Students	54	93	147
32	25.02.2025	JSA College of Agriculture & Technology Tittagudi , Trichy, Tamil Nadu	130 Students	58	72	130
33	25.02.2025	College of Agriculture, Padannakkad, Kasargod, Kerala	106 Students	27	79	106
34	25.02.2025	Thanthai Roever Institute of Agriculture & Rural Development, Valikandapuram, Perambalur, Tamil Nadu	132 Students	62	70	132
35	25.02.2025	Dr. MS Swaminathan Agricultural College and Research Institute, Eachangkottai, Thanjavur , Tamil Nadu	151 Students	47	104	151
36	26.02.2025	SRM College of Agriculture Science, Tamil Nadu	118 Students	74	44	118
37	28.02.2025	MIT College of Agriculture & Technology, Tamil Nadu	132 Students	48	84	132
38	28.02.2025	Amar Singh College Lakhaoti, Uttar Pradesh	35 Students	25	10	35
39	01.03.2025	ICAR-NDRI, ERS, Kalyani, West Bengal	15 Officers	15	-	15
40	03.03.2025	Agriculture Department Jaisalmer, Rajasthan	60 Farmers	60	-	60
41	03.03.2025	S. Thangapazham Agricultural College Vasudevanallur, Tenkasi, Tamil Nadu	136 Students	52	84	136
42	04.03.2025	SRM College of Agricultural Sciences Baburayanpettai, Chengalpattu, Tamil Nadu	118 Students	-	118	118
43	05.03.2025	ATMA, Madhya Pradesh	7 Officers	7	-	7
44	09.03.2025	Jhunjhunu, Rajasthan	80 Farmers	80	-	80
45	10.03.2025	Palar Agricultural College, Vellore, Tamil Nadu	137 Students	65	72	137
46	12.03.2025	Bulandshar, Uttar Pradesh	28 Farmers	28	-	28
47	13.03.2025	Aravindhar Agricultural Institute of Technology Tiruvannamalai, Tamil Nadu	133 Students	61	72	133
48	15.03.2025	Bharath Institute of High Education and Research, Chennai	55 Students	32	23	55
49	17.03.2025	Hanumangarh, Rajasthan	40 Officers	40	-	40
50	17.03.2025	ATMA, Rajasthan	40 Officers	40	-	40
51	17.03.2025	Arunodaya Lok Kalyan Samiti Pratapgarh, Rajasthan	25 Farmers	25	-	25
52	18.03.2025	Sri Manakula Vinayagar College of Agricultural Sciences, Madagadipet, Puducherry, Tamil Nadu	146 Students	-	146	146
53	20.03.2025	Ganna Sansthan Muzffarnagar, UP	20 Farmers	20	-	20
54	21.03.2025	Sawai Madhopur, Rajasthan	40 Farmers	40	-	40
55	21.03.2025	Jasnagar, Nagaur, Rajasthan	40 Farmers	40	-	40
56	21.03.2025	Sawai Madhopur, Rajasthan	40 Farmers	40	-	40
57	22.03.2025	CSAUA & T, Kanpur, Uttar Pradesh	31 Students	29	2	31

S. No.	Date	Institutes, State/Central Universities/ State/ Central School, NGOs, FPOs etc.	No. of visitors	Male	Female	Total
58	25.03.2025	PGP College of Agricultural Sciences Namakkal, Tamil Nadu	135 Students	57	78	135
59	25.03.2025	Mother Teresa College of Agriculture Pudukottai, Tamil Nadu	128 Students	54	74	128
60	27.03.2025	Krishi Vigyan Kendra, Delhi	60 Farmers	60	-	60
61	27.03.2025	Agriculture Department, Panna, MP	8 Farmers	8	-	8
62	28.03.2025	GSSS, Uncha Samana, Karnal, Haryana	68 Students	32	36	68
63	02.04.2025	Chhatarpur, Madhya Pradesh	7 Farmers	7	-	7
64	02.04.2025	ATMA, Himachal Pradesh	9 Farmers	9	-	9
65	04.04.2025	CAFAD, Ghaziabad, Uttar Pradesh	48 Farmers	48	-	48
66	09.04.2025	KVK, Bajaura, Kullu, Himachal Pradesh	30 Students	13	17	30
67	20.04.2025	SVPUAVT, Meerut, Uttar Pradesh	26 Farmers	26	-	26
68	21.04.2025	Kanasangam University, Tamil Nadu	57 Students	23	34	57
69	23.04.2025	Nalanda College of Agriculture, Tamil Nadu	86 Students	34	52	86
70	25.04.2025	Delhi Public School, Karnal	70 Students	20	50	70
71	28.04.2025	TMU, Moradabad, Uttar Pradesh	21 Students	11	10	21
72	30.04.2025	PIET Sanskari School Ansals, Panipat, Haryana	46 Students	27	19	46
73	06.05.2025	SVPUA&T Modipuram, Meerut, UP	28 Students	28	-	28
74	30.05.2025	Hinoli, Bundikota, Rajasthan	55 Farmers	55	-	55
75	10.05.2025	IGKV, Raipur, Chhattishgarh	26 Students	13	13	26
76	20.05.2025	CARS, Chhuikhadan, Chhtishgarh	26 Students	14	12	26
77	14.07.2025	NABARD, Karnal, Haryana	36 Farmers	32	4	36
78	15.07.2025	SKRAU, Bikaner, Rajasthan	56 Students	56	-	56
79	26.08.2025	GBPUA&T, Pantnagar Uttarakhand	66 Farmers	-	66	66
80	12.09.2025	Galgotias University, Greater Noida, UP	24 Students	16	8	24
81	16.09.2025	SGRR, University, Dehradun, Uttarakhand	3 Students	1	2	3
82	18.09.2025	ATMA, Basti, Uttar Pradesh	45 Farmers	45	-	45
83	19.09.2025	Kailashlingam University, Tamil Nadu	25 Students	23	2	25
84	24.09.2025	Kailashlingam University, Tamil Nadu	30 Students	19	11	30
85	25.09.2025	Santkabirnagar, Uttar Pradesh	50 Farmers	50	-	50
86	25.09.2025	Katlehri, Karnal	39 Farmers	-	39	39
87	07.10.2025	Jaisalmer, Rajasthan	40 Farmers	40		40
88	08.10.2025	JNU, Jind Haryana	50 Students	22	28	50
89	09.10.2025	GSSS, Shekhpura, Karnal Haryana	54 Students	24	30	54
90	12.10.2025	Subrati, Alwar, Rajathan	45 Farmers	45	-	45
91	16.10.2025	Basti, Uttar Pradesh	40 Farmers	40	-	40
92	16.10.2025	NHRDF, Karnal, Hrayana	70 Farmers	70	-	70
93	25.10.2025	Ayodhya, Uttar Pradesh	27 Students	21	6	27
94	25.10.2025	Avadhpur, Devariya	45 Farmers	45		45
95	26.10.2025	Ayodhya, Uttar Pradesh	27 Students	21	6	27
96	26.10.2025	Avadhpur, Deoria, Uttar Pradesh	45 Farmers	45	-	45
97	31.10.2025	Mandi, Himachal Pradesh	24 Farmers	19	5	24
98	03.11.2025	GGSWU, Fatehgarh Sahib, Punjab	94 Students	34	60	94
99	04.11.2025	GMSSS, Biana, Karnal, Haryana	62 Students	34	28	62
100	17.11.2025	Baghpat, Uttar Pradesh	22 Farmers	22	-	22
101	21.11.2025	VELS University, Chennai	30 Students	18	12	30
102	24.11.2025	ATMA, Baran, Rajasthan	78 Farmers	78	-	78

S. No.	Date	Institutes, State/Central Universities/ State/ Central School, NGOs, FPOs etc.	No. of visitors	Male	Female	Total
103	24.11.2025	Bijnor, Uttar Pradesh	40 Farmers	40	-	40
104	28.11.2025	ATMA, Rohtash, Bihar	17 Farmers	17	-	17
105	29.11.2025	Firozabad, Uttar Pradesh	31 Farmers	31	-	31
106	03.12.2025	Delhi Public School, Karnal, Haryana	30 Students	30	-	30
107	03.12.2025	PIET Sanskari School Ansals, Panipat, Haryana	42 Students	42	-	42
108	03.12.2025	Sector 8, Karnal, Haryana	27 Students	7	20	27
109	04.12.2025	EEI, Nilokheri, Karnal, Haryana	24 Officers	12	12	24
110	08.12.2025	Ranchi, Jharkhand	23 Farmers	23	-	23
111	08.12.2025	Tawang, Arunachal Pradesh	18 Farmers	6	12	18
112	10.12.2025	AC&RI, Tamil Nadu	63 Students	11	52	63
113	15.12.2025	GSSS, Uncha Samana, Karnal, Haryana	83 Students	30	53	83
114	15.12.2025	SRS Institute of Agriculture and technology, Dingdigul, Tamil Nadu	65 Students	24	41	65
115	15.12.2025	Biher, Chennai, Tamil Nadu	46 Students	31	15	46
116	16.12.2025	PGPCAS, Namakkal, Tamil Nadu	101 Students	30	71	101
117	17.12.2025	ACRI, Madurai, Tamil Nadu	200 Students	70	130	200
118	17.12.2025	Pushkaram College of Agriculture Sciences, Pudukkottai, Tamil Nadu	81 Students	38	43	81
119	18.12.2025	Aravindhar Agricultural Institute of Technology, Tamil Nadu	66 Students	30	36	66
120	18.12.2025	Kumarguru Institute of Agriculture, Erode, Tamil Nadu	259 Students	133	126	259
121	19.12.2025	Kumarguru Institute of Agriculture, Erode, Tamil Nadu	174 Students	143	31	174
122	20.12.2025	RVS, Agri. College, Tamil Nadu	111 Students	54	57	111
123	20.12.2025	AC & RI, Tanjavur, Tamil Nadu	194 Students	100	94	194
124	22.12.2025	SBAC & RF, Karaikudi Tamil Nadu	62 Students	24	38	62
125	22.12.2025	TRIARD, Perambalur, Tamil Nadu	120 Students	72	48	120
126	26.12.2025	Bharsar, Pauri Garhwal, Uttarakhand	23 Students	9	14	23
127	31.12.2025	ICAR-CSWRI, NTRS, Kullu, HP	60 Farmers	34	26	60

Organization of Farmers Day/Field Day/Foundation Day *etc.*

S. No.	Date	Subject	Organized By
1	09 Feb, 2025	11th Foundation Day of ICAR-IIWBR, Karnal	ICAR-IIWBR, Karnal
2	26 March, 2025	A barley farmer field day was organized at village Bahabalpur, district Hisar	ICAR-IIWBR, RS, Hisar
3	29 March, 2025	Field Day and Technology Showcasing of Latest Wheat and Barley Varieties at Village Unn, Shamli, Uttar Pradesh	ICAR-IIWBR, Karnal
4	21 June, 2025	11th International Yoga Day	ICAR-IIWBR, Karnal
5	19 Aug, 2025	Farmer training programme at Shekhupuria, Sirsa	ICAR-IIWBR, RS, Hisar
6	20 Aug, 2025	Farmer training programme at Gorakhpur, Hisar	ICAR-IIWBR, RS, Hisar
7	03 Dec, 2025	Agricultural Education Day	ICAR-IIWBR, Karnal
8	05 Dec., 2025	World Soil Day at Brass Village, Karnal, Haryana	ICAR-IIWBR, Karnal
9	15 Dec 2025	Farmer training programme at Padampur, Sri Ganganagar	ICAR-IIWBR, Karnal
10	23 Dec., 2025	National Farmers Day	ICAR-IIWBR, Karnal

Participation in Exhibitions

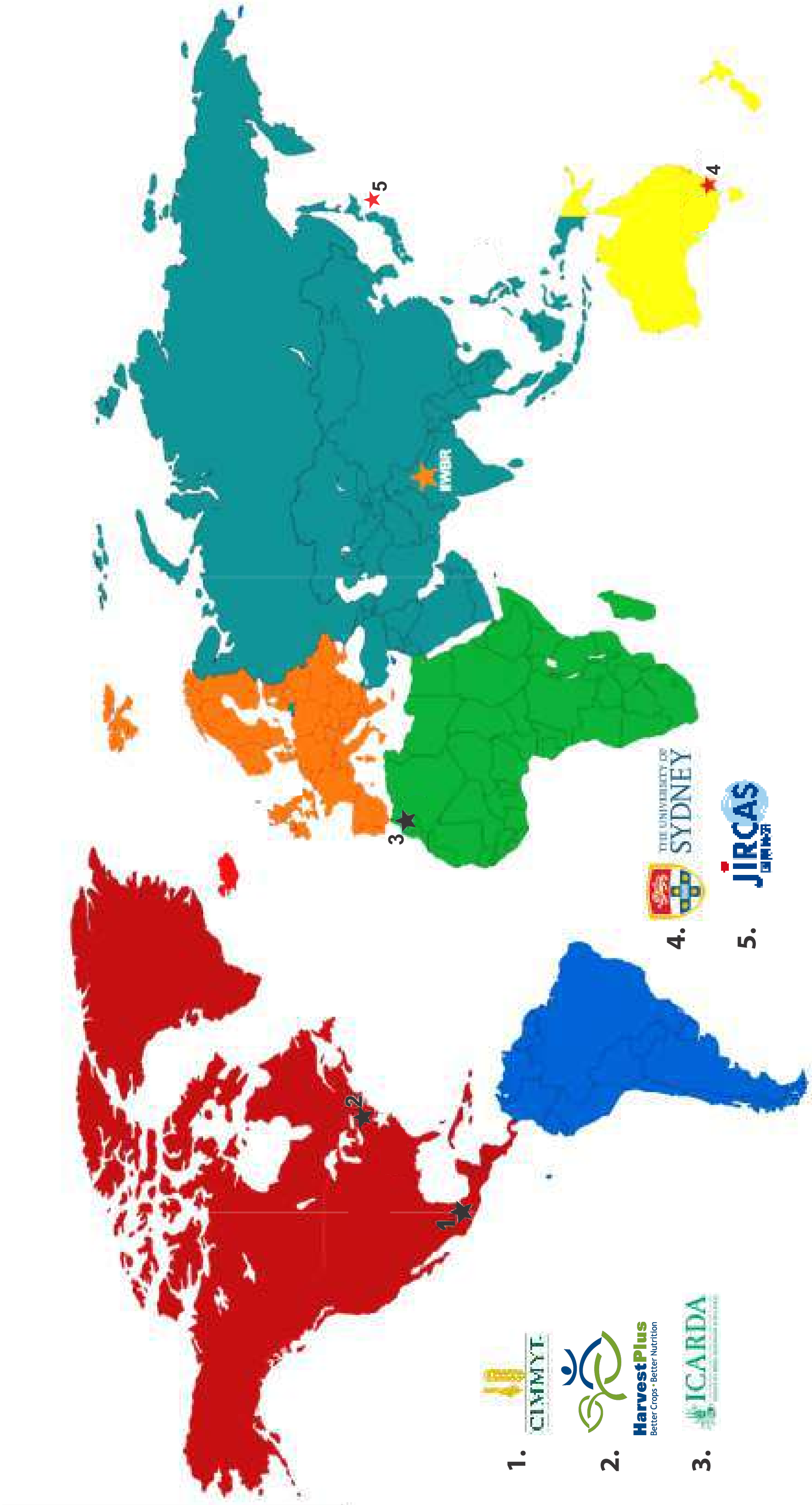
S. No.	Programme	Date	Organized By
1	Agriculture Science Congress (ASC) & Agri. Expo 2025	20-22 February, 2025	GBPUAT, Pantnagar, Uttarakhand
2	Dairy Mela evam Agri Expo	27 Feb. to 01 March 2025	ICAR-NDRI, Karnal
3	Sixth International Agronomy Congress	24-26 November 2025	Indian Society of Agronomy, National Physical Laboratory (NPL) in New Delhi

13 LINKAGES

ICAR - IIWBR has a strong and wide network of linkages and collaborations with research organizations both in India and abroad.

Funded coordinated centers and other institutes	29 funded Centers Departments of Agriculture of 17 states Around 52 voluntary Centers
Research Linkages	International institutes such as International Maize and Wheat Improvement Center (CIMMYT), Mexico; Australian Center for International Agricultural Research (ACIAR); Cornell University, USA; University of Sydney, Australia and International Crop Research Institute for Semi Arid Tropics (ICRISAT), Hyderabad; JIRCAS Japan; National institutes like IARI, NBPGR, New Delhi (ICAR); and PPV & FRA, New Delhi
Academic Linkages	CCSHAU, Hisar (Haryana), Kumaun University, Nainital (Uttarakhand), ICAR-Indian Agricultural Research Institute, New Delhi, Jaypee University of Information Technology, Waknaghai (Himachal Pradesh), Deenbandhu Chhoturam University of Science and Technology, Murthal (Haryana), Maharishi Markandeshwar University, Ambala (Haryana), Ch. Charan Singh University, Meerut (Uttar Pradesh), Indian Institute of Science Education and Research, Kolkata, Mohanpur (West Bengal), Banasthali University, Banasthali Vidyapith (Rajasthan), National Agri-food Biotechnology Institute (NABI), Mohali (Punjab), ICAR-CSSRI, Karnal (Haryana), Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (Puducherry), Lovely Professional University, Jalandhar (Punjab), DAV University, Jalandhar (Punjab), Indian institute of Food Processing Technology, Thanjavur (Tamilnadu), Maharishi Ma-kandeshwar University, Ambala (Haryana), Central University, Bhatinda,
IIWBR-SAUs Partnership	In order to promote ICAR-IIWBR wheat and barley varieties in different zones, 18 agreements were signed between ICAR-IIWBR and following SAU's and ICAR Institutes for large scale multiplication of breeder seed and further distribution in the respective zones; SKAUST, Jammu | GBPUA&T, Pantnagar | BHU, Varanasi | JNKVV, Jabalpur | RVSKVV, Gwalior | SKNAU, Jobner | SKRAU Bikaner | BAUT, Banda | RLBCAU, Jhansi | ICAR- IISS, Mau | RPCAU, Pusa, Bihar | BISA, Jabalpur, Ludhiana, Pusa, (Bihar) | UBKV, Coochbehar | CSAUT, Kanpur | SVPUAT, Meerut | ANDUAT, Ayodhya Agricultural University, Kota | UAS, Dharwad.
Linkages with industry	Barley network programme has strong linkages with malt industry.

INTERNATIONAL LINKAGE



14 INSTITUTE ACTIVITIES AND DISTINGUISHED VISITORS

Sri Deepak Shukla, DGM, Canara Bank visited ICAR-IIWBR on January 06, 2025. Dr Ratan Tiwari, Director ICAR-IIWBR heartily welcomed him and briefed about institution achievements.

The 33rd Institute Research Council (IRC) meeting was held on January, 9-10, 2025. All PIs of the Projects presented in brief about their achievements.

76th Republic Day was celebrated by ICAR-IIWBR, Karnal. Dr Ratan Tiwari, Director hoisted the national flag. He also apprised the staff about achievements of ICAR-IIWBR Karnal.

33rd IMC of ICAR-IIWBR was conducted under the chairmanship of Dr. Ratan Tiwari, Director on January 28, 2025. The IMC Members were apprised about all around development & research highlights by concerned PIs/In-charges of ICAR-IIWBR. Dr. S.K. Pradhan, ADG (FFC) and other IMC Members reviewed the research work of Institute and shared their valuable suggestions.

Dr. Jitendra Kumar Tomar, Director Agriculture, Govt. of Uttar Pradesh visited the institute on January 28, 2025 along with DDA, SDAO Ghaziabad and Former Director, IIWBR (Dr Gyanendra Singh). Dr. Tomar appreciated the efforts by the staff of this institute and praised Rotary Disk Drill's (Patented) role in conservation agriculture.

11th Foundation Day of ICAR-IIWBR was organized on February 09, 2025. On this occasion best worker awards and scientist team award were awarded to the staff. Dr. Himanshu Pathak, Former Secretary DARE and DG, ICAR was the chief guest on this occasion.

The Quinquennial Review Team (QRT) reviewed progress of ICAR-IIWBR on March 5-6, 2025 under the chairmanship of Dr NK Singh, National Professor and worthy QRT members. The team also reviewed the work done by institute's regional stations and AICRP on Wheat and Barley centres across all the five zones of Wheat and Barley cultivation in India. The team applauded the work of Wheat and Barley scientists and gave directions for future research.

A Brainstorming program entitled "Unlocking potential of wheat and barley crops for healthy and sustainable food system: A road map" was held during March 7-8, 2025. Dr. D.K. Yadava, DDG (Crop Sciences), Dr. Ch. Srinivasa Rao, Director, ICAR-IARI and Dr. GP Singh, Director, NBPGR graced the occasion. The prominent international scholar Dr. Ravi P. Singh and Dr. A.K. Joshi from CIMMYT, Dr. G.V. Subbarao from Japan and others delegates from ICARDA also shared their valuable suggestions.

Dr. Arun Kumar Joshi, MD BISA along with his team visited the field experiments conducted on March 17, 2025, at ICAR-IIWBR, Karnal.

Syngenta team visited ICAR-IIWBR, Karnal on March 17, 2025 to finalise Contract Research Projects with Agronomist and Extension expert of ICAR-IIWBR, Karnal.

An interaction meeting was held on April 8, 2025, at the ICAR-IIWBR, Karnal. The event brought together Dr. Ch. Srinivasa Rao, Director and Vice Chancellor of ICAR-IARI, New Delhi, who graced the occasion as the Chief Guest, along with students from the ICAR–IARI, MU, Karnal Hub. The programme was chaired by Dr. Ratan Tiwari, Director ICAR–IIWBR, Karnal.

Honourable Union Cabinet Minister of Agriculture and Farmers Welfare and Rural Development, Shri Shivraj Singh Chouhan Ji, visited on April 22, 2025 at ICAR-IIWBR, Karnal and interacted with the farmers.

भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल में "राजभाषा नीति एवं उसका कार्यान्वयन" विषय पर एक दिवसीय राजभाषा हिन्दी कार्यशाला का आयोजन दिनांक 23 मई, 2025 को किया गया। हिन्दी कार्यशाला में बतौर मुख्य अतिथि एवं वक्ता श्री कुमारपाल शर्मा, संयुक्त निदेशक (कार्यान्वयन), गृह मंत्रालय, भारत सरकार, नई दिल्ली ने राजभाषा नीति एवं उसका कार्यान्वयन पर अपने विचार व्यक्त किए।

The 34th Institute Research Council (IRC) meeting was held on May, 26, 2025 under the chairmanship of Director, Dr Ratan Tiwari. Progress of all institutional projects was presented by respective PIs.

International Yoga Day was organized on June 21, 2025 under the aegis of Director, ICAR-IIWBR. Ex Director Dr. Gyanender Singh, also participated in this programme.

34th IMC of the Institute was conducted under the chairmanship of Dr. Ratan Tiwari, Director, ICAR-IIWBR, Karnal on 8th July, 2025. The IMC Members were apprised about all around development & research highlights by concerned PIs/In-charges of ICAR-IIWBR. Dr. S.K. Pradhan, ADG (FFC), Dr. N. K. Singh, QRT Chairman and other IMC members interacted and shared their valuable suggestions for Institute's futuristic growth in wheat and barley.

79th Independence Day (August 15) was celebrated and Dr. Ratan Tiwari, Director, ICAR-IIWBR, hoisted the flag.

Hindi Pakhwara was organized during September 14-30, 2025 and various awreness programs were organized to boost the use of Hindi in official works and general conversation.

Swachchata Pakhwada 1.0 was–organized during September 16, 2025 to 30th September 30, 2025. All the staff participated in this Swachchata Abhiyan with great interest and enthusiasm. Dr BR Kamboj, Hon'ble VC, CCSHAU, Hisar graced the valedictory function.

Delegates from Uzbekistan, Dr. Muzaffar K. A. Ugli and Dr. Bakhtiyor I. Abdullaevich, visited ICAR-IIWBR, Karnal under the CIMMYT- BISA program during October, 21-22, 2025. The purpose of the visit was to share scientific experiences and strengthen collaborative research linkages with Central Asia.

Seed day was organized on October 30, 2025. More than 18000 farmers across the India got benefitted by receiving newly released wheat and barley varieties' seeds. Dr. Ratan Tiwari Director ICAR-IIBR, Karnal inaugurated the seed distribution programme on seed day.

35th Institute Research Council (IRC) meeting was held on October, 29-30, and November 7, 2025 under the chairmanship of Director, Dr Ratan Tiwari. Progress of all completed institutional projects was presented by respective PIs. Further, new proposals for the period 2025-30 were also presented during the meeting by Institute's scientists.

A way forward in the direction of Public-Private-Partnership mode was organized on November 06, 2025. Dr. Alok Mukherjee delivered the lead lecture in this meeting.

30th Research Advisory Committee Meeting was held on December 08, 2025 in the presence of Hon'ble Chairman Dr. P L Gautam and members, Dr. S K Pradhan, Dr. P S Birthal, Dr. A K Sharma, Dr. P C Sharma, Dr. Kuldeep Singh, Dr. Ratan Tiwari, Sh. Rajender Sandhu & Sh. Gurucharan Singh Sandhu. The committee approved and accepted the closure of ongoing projects and gave suggestions to rectify the new proposals for the tenure (2025-30).

Kisan Diwas program was celebrated on December 23, 2025. More than two hundred farmers from HP, Uttarakhand and Haryana participated in this programme.

Swachchata Pakhwada 2.0 was organized by ICAR-IIWBR from December 16-31, 2025 with full enthusiasm. Dr. NH Mohan, Director, NBAGR graced the valedictory program as chief guest.

15 AWARDS AND RECOGNITIONS

Awards

- Dr. Pramod Prasad was conferred with the best worker award-2024 of the ICAR-IIWBR under scientific category.
- Dr. Hanif Khan (Principal Scientist Plant Breeding) received Dr S. Nagarajan Memorial Award 2025 from Society for Advancement of Wheat and Barley Research (SAWBAR).
- Dr OP Gupta was conferred with the Prof. Mahtim Singh Memorial award 2025 of SAWBAR for outstanding contribution in wheat and barley quality science
- Dr Prem Lal Kashyap ranked in the Stanford/Elsevier top 2% scientists list for 2025.
- ICAR-IIWBR, Karnal received the recognition award from the PPV&FRA for filing number of registration applications of wheat and barley for registration under PPV&FRA, 2001.
- Dr. Mamrutha HM received best oral presentation award from Dept. of Agriculture Brainware University, Kolkata in the International Agriculture Conference on Future trends in agriculture (ICANFTA- 2025) AGRINEXT" held during 10th-12th February, 2025
- Article "Shri Anna fasalon ka mahatav evam unme lagane vale pramukh rog evam unaka prabandhan" written by Ravindra Kumar, Anuj Kumar, Amit Kumar Sharma, Vikas Gupta, Shubham Raj, Vaibhav Kumar Singh, Ishwar Singh, Santosh Kumar Bishnoi and Gyanendra Singh (2023) published in Gehun evam Jau Swarnima, received Best article award at foundation day of ICAR-IIWBR (on 09-02-2025).
- The article "Prakritik Kheti Khushhal Kisan Yojana (PK3Y): Safalata ki kahaniya" written by Akriti Thakur, Charu Lata, Ajit Singh, Rajneesh Sharma, Jayant Kalluguri, Subodh Kumar, Pramod Prasad, Om Prakash Gangwar published in Gehun evam Jau Swarnima Vol 15: 72-76, received second best article award at foundation day of ICAR-IIWBR (on 09-02-2025).
- Dr. Ravindra Singh Shekhawat awarded with best oral presentation award in the 33rd National Conference on "Land and Water Management for Ecological Restoration and Agricultural Sustainability" organized by Soil Conservation Society of India (Punjab State Chapter) and Punjab Agricultural University (PAU), Ludhiana held at PAU, Ludhiana during 08-10 December, 2025.

Fellow

- Dr. OP Gangwar honoured with SAWBAR Fellowship-2025 in Crop Protection.
- Dr Arun Gupta has been elected as fellow of SAWBAR for the year 2025 in Crop Improvement.

Recognitions

- Dr Sunil Kumar facilitated convening 30th RAC meeting of the institute on December 08, 2025 as member secretary RAC.
- Dr Sunil Kumar visited Shegaon (Buldhana) as member multi-ministerial committee from ICAR for assessing the situation of medical problems faced by some villagers (Apr 22-25, 2025). The final report was accepted by Ministry of Health, Govt. of India.
- Dr OP Gupta served as observer for ASRB combined NET 2025 and preliminary examination ARS, SMS (T-6)-2025 on 12th and 13th November 2025 at Mohali.

Technology certified by ICAR

Technologies certified by ICAR during 2025 are as given below:

Table 15.1. List of certified technologies by ICAR during 2025

Name of Technology	Developers	Registration Number	Year
Microsatellite technology for trapping genetic diversity in *Tileltia indica*	Lead: Dr Prem Lal Kashyap Associates: Drs Sudheer Kumar, Ravi Shekhar Kumar, Anju Sharma, Annie Khanna, Kajal, Shubham Raj, Poonam Jasrotia, Gyanendra Singh	ICAR-CS-IIWBR-technology -2025-041	2025
Adaptive Pest management technology for wheat crop under conservation agriculture system	Lead: Dr Poonam Jasrotia Associates: Drs Subhash Katare, Prem Lal Kashyap, Sudheer Kumar, Gyanendra Pratap Singh	ICAR-CS-IIWBR-technology -2025-032	2025
Diversification of rice-wheat with maize-based cropping system under conservation agriculture for higher system productivity and profitability	Lead: Dr. SC Tripathi Associates: Drs K Venkatesh, RP Meena, Nitesh Kumar	Accepted	2025
Pyroxasulfone for control of grassy weeds including multiple herbicide resistant Phalaris minor in wheat	Lead: Dr. RS Chhokar Associates: Drs Shiv Ram Samota, SC Gill, RK Sharma,Dharam Bir Yadav, Anil Kumar Khippal, HM Mamrutha, Nitesh Kumar, Ratan Tiwari	Accepted	2025

16 TRAINING AND CAPACITY BUILDING

As per the ICAR guidelines, annual training calendar was prepared for the scientists, technical, administrative, and supporting staff. The details of training attended by the staff under annual training programme are given below:

Table 16.1. National trainings attended

S. No.	Employee name	Category	Training	Place of training (ICAR)	Duration (Days)
1.	Dr. Usha Das	Scientific	114th FOCARS training	NAARM, Hyderabad	July 07- Oct16, 2025
2.	Dr Anil K Khipal	Scientific	Science Speaks: Communicate Your Research with Impact	NASC Complex, New Delhi	16–17 September, 2025

Table 16.2. Trainings organized

S. No.	Name	Co-ordinators	Period/Dates	Venue
1.	Uniform Data Recording and Reporting in AICRP on Wheat and Barley Crop Protection Trials	Drs. Pradeep Sharma, PL Kashyap, Ravindra Kumar	February 24-25, 2025	ICAR-IIWBR, Karnal
2.	Innovative extension methods for upscaling wheat and barley production technologies	Drs. Anuj Kumar & Ravindra Singh Shekhawat	September15-19, 2025	ICAR-IIWBR, Karnal in collaboration with EEI, Nilokheri, Haryana
3.	Madhya Pradesh mein Gehoon evam Jau ki Unnat Utpadan Taknikein	Drs. Anuj Kumar & Ravindra Singh Shekhawat	December 19-20, 2025	ICAR-IIWBR, Karnal in collaboration with BAIF, Bhopal, Madhya Pradesh

Table 16.3. Capacity building programmes organized under ICAR Seed Project during 2025

S. No.	Training	Title	Date	Kind of Stakeholders
1.	One day farmers scientist interaction at ICAR-IIWBR, Karnal	Promotion of wheat and barley technologies in NWPZ	February 9, 2025	Progressive farmers and private seed company representatives
2.	Field day at Village-Unn, Dist- Shamali, Uttar Pradesh	Technology showcasing of latest wheat and barley varieties	March 29, 2025	Progressive farmers and FPO's from Western Uttar Pradesh
3.	Seed Distribution Week for farmers at ICAR-IIWBR, Karnal	Seed distribution week	October13-18, 2025	Farmers from different wheat growing states (More than 18000 farmers)

Onboard of ICAR-IIWBR on iGOT Karmayogi

Karmayogi Bharat is a flagship national programme for capacity building of civil services, aimed at creating a robust digital learning ecosystem that enables continuous, anytime-anywhere learning and prepares officials to meet future governance challenges through the common platform, iGOT. In line with this vision, HRM Nodal Officers of ICAR institutes, functioning as Mission Directors (MDOs), have been instructed to onboard institute personnel onto the iGOT platform and assign courses as per cadre, in accordance with guidelines issued by ICAR-HRM-HQ.

The training interventions are designed on a cluster-wise basis to address the specific competency requirements of different categories of staff. At ICAR-IIWBR, a total of 96 staff members were successfully registered on the iGOT platform during January–December 2025 with the support of the Institute HRM Cell (Fig. 16.1). Courses were systematically assigned by the HRM Nodal Officer, and almost all registered personnel completed the prescribed courses during 2025, including modules on Yoga Break, Leave Rules, Critical Thinking, and related areas (Fig. 16.2). The cumulative learning engagement amounted to 665 learning hours.

This structured and cadre-specific approach has contributed to strengthening competencies across all levels of staff and has fostered a culture of continuous learning and professional development at ICAR-IIWBR.

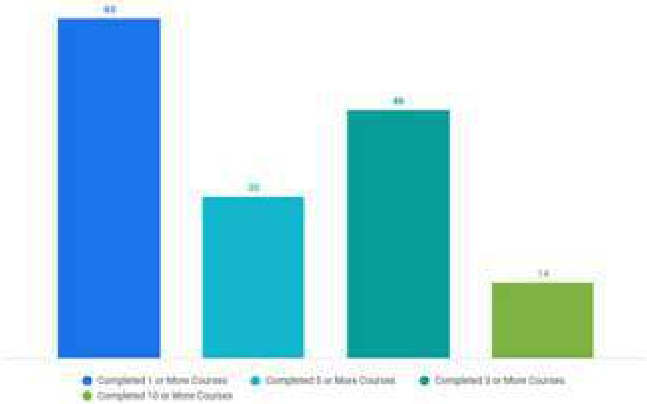


Fig. 16.1. Engagement Matrix of ICAR-IIWBR Staff during Jan-Dec 2025 on iGOT Platform

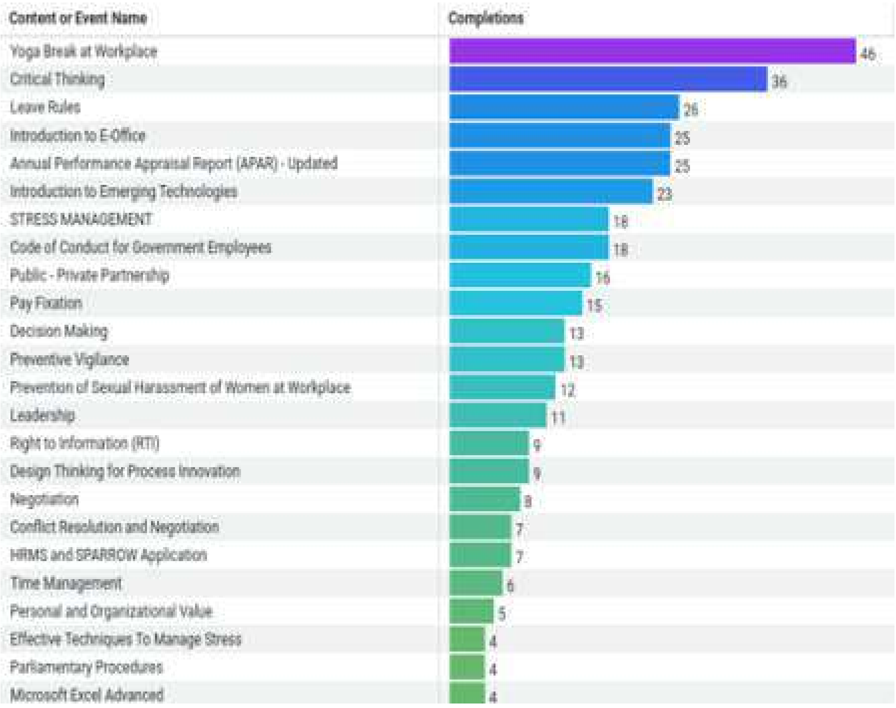


Fig. 16.2. List of courses attended by ICAR-IIWBR staff in 2025 on iGOT Platform

17 RESEARCH PROJECTS

A. Institute's funded projects:

Institute's funded projects completed in October, 2025 were being carried out under 7 programmes

RESEARCH PROGRAMS (2020-25)	
Program 1	Multilocational and Multidisciplinary Research Programme on Wheat and Barley Improvement
Program 2	Wheat improvement for enhancing genetic gain and productivity under changing climate
Program 3	Biotic stress management in wheat
Program 4	Enhancing the productivity, sustainability and resilience of wheat-based cropping systems
Program 5	Wheat Improvement for Industrial and Nutritional quality
Program 6	Barley for feed, food and Industrial purposes
Program 7	Technology outreach and Impact Evaluation

Program 1. Multilocational and Multidisciplinary Research Programme on Wheat and Barley Improvement (CRSCIIWBRCL20200010194)

Programme Leader:	Dr. Ratan Tiwari, Director, ICAR-IIWBR
Crop Improvement	PI: Dr. BS Tyagi (Till 30.04.2025); Dr OP Ahlawat w.e.f. 01.05.2025
Co-PIs	Drs. OP Ahlawat, Arun Gupta, Sindhu Sareen Hanif Khan, Sonia Sheoran, AK Sharma, Satish Kumar, Charan Singh, CN Mishra, Mamrutha HM, Vikas Gupta, UR Kamble, Rakesh Kumar Bairwa, Rinki, Ajay Verma
Crop Protection	PI: Dr. Pradeep Sharma
Co-PIs	Drs. Prem Lal Kashyap, Ravindra Kumar, OP Gangwar, P Prasad, Charu Lata Sharma, Jayanth Kallugudi
Resource Management	PI: Dr. SC Gill
Co-PIs	Drs. SC Tripathi , Rajender Chhokar, Anil Khippal, Neeraj Kumar, Ajay Verma
Quality & Basic Sciences	PI: Dr. Sunil Kumar
Co-PIs	Drs. Sunil Kumar, OP Gupta, Vanita Pandey, Anuj, Dinesh Kumar
Barley Improvement	PI: Dr. Om Vir Singh
Co-PIs	Drs. Chuni Lal, Jogendra Singh, Lokendra Kumar, Rekha Malik, OP Gupta, Santosh Kumar Bishnoi, Rinki, Ajay Verma
Social Sciences	PI: Dr. Satyavir Singh
Co-PIs	Drs. Anuj Kumar, Anil Khippal

Crop Improvement

Program 2. Wheat improvement for enhancing genetic gain and productivity under changing climate (CRSCIIWBRCL20200020195)
Programme Leader : Dr. BS Tyagi (Till 30.04.2025; Dr. OP Ahlawat w.e.f. 01.05.2025)
Project 1: Developing high yielding and climate resilient wheat varieties (PI: Dr. BS Tyagi; Till 30.04.2025; Dr. Sindhu Sareen w.e.f. 01.05.2025)

1.1:	Breeding wheat genotypes for high yield and wider adaptability in North Western Plains	PI: Dr. Hanif Khan
Co-PIs	Drs. CN Mishra, OP Gangwar, Raj Kumar, Mamrutha HM, Sunil Kumar, Rakesh Kumar Bairwa	
1.2:	Breeding wheat genotypes for high yield in North Eastern Plains	PI: Dr. Vikas Gupta
Co-PIs	Drs Charan Singh, AK Sharma, Sonia Sheoran, Ravindra Kumar	
1.3:	Breeding high yielding wheat genotypes for stress conditions of warmer regions of India	PI: Dr. Sindhu Sareen
Co-PIs	Drs. Amit Kumar Sharma, Pradeep Sharma, UR Kamble, Pramod Prasad	
1.4:	Improving wheat genotypes for grain quality and end products	PI: Dr. CN Mishra
Co-PIs	Drs. BS Tyagi, Vanita Pandey, Pramod Prasad, Satish Kumar	
1.5:	Breeding for early maturing and short duration wheat genotypes	PI: Dr. Charan Singh
Co-PI	Drs. Vikas Gupta, Sonia Sheoran, Rinki	

Project 2: Pre-breeding and germplasm enhancement (PI: Dr. BS Tyagi; Till 30.04.2025;Dr Arun Gupta w.e.f. 01.05.2025)		
2.1:	Wheat improvement utilizing novel germplasm resources through pre-breeding	PI: Drs. BS Tyagi (Till 30.04.2025); Charan Singh w.e.f. 01.05.2025
Co-PIs	Drs. Sindhu Sareen, Vikas Gupta, Arun Gupta, Hanif Khan, OP Gangwar, Rinki, Charan Singh, CN Mishra, Rakesh Kumar Bairwa	PI: Dr. Arun Gupta
2.2:	Strengthening of Wheat and Barley genetic resources for utilization in crop improvement	PI: Dr. Arun Gupta
Co-PIs	Drs. Charan Singh, Pradeep Sharma, Rakesh Kumar Bairwa, Rekha Malik	
2.3:	Strategic research for improving biotic stress	PI: Dr. Satish Kumar
Co-PIs	Drs. CN Mishra, AK Sharma, PL Kashyap, Jayanth Kallugudi	

Project 3: New insights & basic studies for integrating molecular, physiological and bioinformatic tools for augmenting wheat improvement (PI: Dr. OP Ahlawat)		
3.1:	Biotechnological, bioinformatics and microbiological interventions for wheat improvement	PI: Dr. OP Ahlawat
Co-PIs/CC-PIs	Co-PI: Drs. Ratan Tiwari, Rajender Singh, Pradeep Sharma, Sonia Sheoran, Suman Lata, Charu Lata	
CC-PIs:	Dr. Dinesh Kumar (IASRI-New Delhi), Dr. Harsh Vardhan Singh (NBAIM-Mau)	
3.2:	CRISPR/Cas9 genome editing and physiological interventions for wheat improvement	PI: Dr. Mamrutha HM (Till 12.06.2025); Dr Vanita Pandey (Since 13.06.2025)
Co-PIs	Drs. Rajender Singh, Rinki, Vanita Pandey, Charu Lata, Jayanth Kallugudi	

Crop Protection

Program 3. Biotic stress management in wheat (CRSCIIWBRCL20200030196) Programme Leader: Dr. Pradeep Sharma (PI-CP) Project 1: Management of biotic stresses of wheat by integrating innovative approaches (PI: Dr. Pradeep Sharma)		
1.1:	Management of wheat diseases by integrating molecular and agro-ecological approaches	PI: Dr. Ravindra Kumar
Co-PIs	Drs. Prem Lal Kashyap, Arun Gupta	
1.3:	Etiology and management of spike disease complex in wheat	PI: Dr. Prem Lal Kashyap
Co-PIs	Drs.Vikas Gupta, Rajender Singh, Pradeep Sharma	

Project 2: Physiologic specialization, resistance and molecular studies on wheat and barley rusts RS - Flowerdale, Shimla) (PI: Dr. OP Gangwar)		
2.1:	Mapping phenotypic diversity in wheat and barley rust pathogens, identifying resistance sources, and upkeep of culture collection	PI: Dr. OP Gangwar
Co-PIs	Drs. P Prasad, Charu Lata, Jayanth Kallugudi Associate: Dr. Subodh Kumar	
2.2:	Molecular studies on wheat and barley rust pathogens, gene pyramiding, and genetics of rust resistance	PI: Dr. P Prasad
Co-PIs	Drs. OP Gangwar, Charu Lata, Hanif Khan, Jayanth Kallugudi Associate: Dr. Subodh Kumar	

Resource Management

Program 4. Enhancing the productivity, sustainability and resilience of wheat-based cropping systems (CRSCIIWBRCL20200040197) Programme Leader: Dr. SC Gill (PI-RM)		
1.1:	Efficient nutrient management strategies for wheat-based cropping systems	PI: Dr. SC Gill
Co-PIs:	Drs. SC Tripathi, RS Chhokar, OP Ahlawat and Sunil Kumar	
1.2:	Conservation Agriculture for Sustainable Intensification of wheat-based systems	PI: Dr. Anil Khippal
Co-PIs:	Drs. SC Tripathi, RS Chhokar, SC Gill, Neeraj Kumar, OP Ahlawat, Mamrutha HM, and Charu Lata Sharma Raghuveer Singh (IIFSR, Modipuram), Santosh Bishnoi, Er. Swapnil Chaudhary (HAU) Associate: Ravindra Kumar	
1.3:	Improving resource use efficiency in wheat under conservation and conventional tillage practices	PI: Dr. Neeraj
Co-PIs:	Dr. SC Tripathi	

1.4:	Development of effective weed management practices for wheat-based cropping systems	PI: Dr. RS Chhokar
Co-PIs:	Drs. SC Tripathi, SC Gill, Anil Khippal, and VK Choudhary (DWR, Jabalpur)	

Quality & Basic Sciences

Program 5. Wheat Improvement for Industrial and Nutritional Quality (CRSCIIWBRSL20200050198)

Programme Leader: Dr. Sunil Kumar (PI-QBS)

Project1: Improvement of processing and nutritional quality of wheat using biochemical and molecular approachPI: Dr. Sunil Kumar

Co-PIs: OP Gupta, Vanita Pandey, Anuj Kumar, BS Tyagi, CN Mishra, *Dinesh Kumar

*Since 01/03/2025

Barley Improvement

Program 6. Barley for Feed, Food and Industrial Purposes (CRSCIIWBRCL20200060199)

Programme Leader: Dr. Om Vir Singh (PI-BI)

Project 1: Barley improvement and technological interventions for yield, quality, biotic and abiotic stress tolerance for better farmers livelihood (PI: Dr. Om Vir Singh)

1.1:	Pre-breeding for novel genetic variability in barley using innovative techniques	PI: Dr. SK Bishnoi
Co-PIs	Drs. Om Vir Singh, Chuni Lal, Rekha Malik, Jogendra Singh, Associate : OP Gupta	
1.2:	Genetic enhancement of malt barley with changing industrial requirements using conventional and molecular approaches	PI: Dr. Om Vir Singh
Co-PIs	Drs. Lokendra Kumar, Rekha Malik, SK Bishnoi, Ravindra Kumar, Rinki, OP Gupta, Ajay Verma	
1.3:	Genetic Amelioration of Grain Quality and Yield in Feed and Food Barley	PI: Dr. Chuni Lal
Co-PIs	Drs. Om Vir Singh, Jogendra Singh, Rekha Malik, Ravindra Kumar, Rinki, OP Gupta, Lokendra Kumar, Anuj Kumar (Jr)	

Social Sciences

Program 7. Technology Outreach and Impact Evaluation (CRSCIIWBRSL20200070200)

Programme Leader: Dr. Satyavir Singh

Project 1: Evaluation, Dissemination and Impact Assessment of Production Technologies (PI: Dr. Satyavir Singh)

1.1: Assessment of Farmers' Perspective on Crop Residue Management in Indo-Gangetic Plains of India	PI: Dr. Anuj Kumar
Co-PIs: Dr. Satyavir Singh	
1.2: Promotion and Impact Evaluation of ICAR-IIWBR Technologies at Farmers' Field	PI: Dr. Satyavir Singh
Co-PIs: Drs. Anuj Kumar, Anil Khippal, Raj Kumar, Ajay Verma, Dr. R Sendhil (Puducherry University, Puducherry)	

B. New Institute project themes: Institute's funded new projects will be carried out under 10 new programs (2025-30) starting from 01.11.2025

S. No.	Project Title	PI
1.	Multilocational and Multidisciplinary Research Programme on Wheat and Barley Improvement	Dr. Ratan Tiwari, Director, ICAR-IIWBR
2.	Maximization of wheat productivity by synchronizing genotype, environment and management (GxExM) interactions	Dr. Hanif Khan
3.	Pre-breeding in wheat and barley for untapped genomic resources	Dr. Arun Gupta
4.	Enhancing resource use efficiency in wheat for better and consistent/ sustainable remunerations	Dr. CN Mishra
5.	Mitigating climate-induced challenges in wheat and barley production	Dr. Sindhu Sareen
6.	Continued vibrancy in biotic stress management for sustaining production in wheat and barley	Dr. Pradeep Sharma
7.	Integrating Breeding Pipelines and Advanced Genomic Techniques	Dr. OP Ahlawat
8.	Wheat and barley technologies for better quality, health and industrial uses	Dr. Dinesh Kumar
9.	Climate-Smart Regenerative Agriculture and Resource efficient Agricultural Practices for Improving Productivity, Profitability and Soil Health in Wheat based Cropping Systems	Dr. SC Gill
10.	Impact assessment and research prioritization	Dr. Anuj Kumar

C. Externally Funded Project

Externally funded project (National Agencies)

S.N.	Name of the project	Funding Agency	PI/CC-PI	Co-PIs	Duration
1.	DUS testing in wheat	PPV&FRA, New Delhi	Nodal officer: Dr. Arun Gupta	Co-nodal Off.: Dr. Charan Singh	Since 2003
2.	DUS testing in barley	PPV&FRA, New Delhi	Nodal officer: Dr. Charan Singh	Co-nodal Off.: Dr. Arun Gupta	Since 2013
3.	ICAR-Network project on precision agriculture (NePPA 1013333)	ICAR	Dr. S C Tripathi	Drs. Anil Khippal, Neeraj Kumar, RP Meena, Mamrutha HM, Ravindra Kumar, SC Gill, RS Chhokar	2021-2026
4.	Characterisation of genetic resources: Germplasm characterization and trait discovery in wheat using genomics approaches and its integration for improving climate resilience, productivity and nutritional quality Sub-proeject-1 Biotic stress component	DBT	Dr. OP Gangwar	Drs. Hanif Khan, Pramod Prasad	March 2020 – Feb. 2027
5.	Development of herbicide tolerant wheat lines through physical mutagenesis	BRNS - DAE	Dr. Satish Kumar	Dr. Rajender Singh	2023-2026
6.	Genetic and genomic characterization of resistance to Karnal Bunt of wheat	SERB-DST (ANRF)	Dr. Satish Kumar	-	2024-2027
7.	Deciphering the genetic variability and factors responsible for rhizosheath formation in wheat for drought stress tolerance	DBT	Dr. Om Parkash Ahlawat	Dr. Pradeep Sharma	Sept.2023-Sept. 2026
8.	Artificial intelligence enabled biotic & abiotic stress detection and advisory mobile application for crops	NASF, ICAR, India	Dr. PL Kashyap	Dr. Anuj Kumar	2024-2027
9.	Development of synthetic microbiome for biotic stress and nutrient management in wheat	ICAR-NBAIM, Mau	Dr. Prem Lal Kashyap	-	2024-2027
10.	CRP on conservation agriculture (Enhancing the productivity and profitability of wheat-based conservation agriculture systems)	ICAR	Dr. RS Chhokar	Drs. SC Gill, Neeraj Kumar	Jul, 2015-2026 (ongoing)
11.	Enhancing climate resilience and ensuring food security with genome editing tools	ICAR-EFC project	Dr. Mamrutha HM	Drs. Rinki Rajender Singh Vanita Pandey Jayanth Kallugudi Charu Lata Sharma	2023-26

S.N.	Name of the project	Funding Agency	PI/CC-PI	Co-PIs	Duration
12.	Improvement of stress adaptive traits in crops using endophytes under different agroecology	ICAR-NICRA	Dr. Mamrutha HM	-	2022-Mar,2025
13.	CRP-Molecular Breeding to biotic and abiotic stresses, yield and quality traits in crop.	ICAR	Dr. CN Mishra	Dr. Satish Kumar	2020-25
14.	Incentivizing Research - Molecular genetic analysis of resistance/tolerance to different stresses in rice, wheat, chickpea and mustard including sheath blight complex genomics- Wheat Component.	ICAR	Dr. Sonia Sheoran	Drs. Rinki, Raj Kumar	2021-26
15.	Development and promotion of natural farming practices in wheat based cropping systems for sustainability and climate resilience in Haryana	RKVY, Haryana	Dr. Anil Kumar Khippal	Drs. OP Ahlawat, PL Kahsyap, SC Tripathi, Neeraj Kumar, Mamrutha HM, SC Gill, RS Chhokar, Charu Lata, Rinki	2023-2025
16.	CRP Biofortification in selected crops for nutritional security (ICAR) (Component: Wheat)	ICAR	Dr Sunil Kumar	Drs. OP Gupta, Anuj Kumar, Vanita Pandey, CN Mishra, BS Tyagi	2014-ongoing
17.	Cluster Demonstration of Climate Resilient and Biofortified Wheat Varieties	DA&FW (NFSM Cell)	Dr. Anuj Kumar	Drs. CN Mishra, RS Chhokar, Satyavir Singh, Umesh Kamble	2023- 2026
18.	CRP on Hybrid Technology – Wheat	ICAR	Dr. Sindhu Sareen	Drs. BS Tyagi, Satish Kumar, Pradeep Sharma	2017-ongoing
19.	Germplasm Characterization and Trait Discovery in Wheat using Genomics Approaches and its Integration for Improving Climate Resilience, Productivity and Nutritional quality" Sub Project-3: Evaluation of wheat germplasm for abiotic stresses	DBT	Dr. Sindhu Sareen	Drs. Vikas Gupta, Charan Singh, Arun Gupta & S. Sheoran	March 2020 – Feb. 2025
20.	Germplasm Characterization and Trait Discovery in Wheat using Genomics Approaches and its Integration for Improving Climate Resilience, Productivity and Nutritional quality" under mission programme of "Characterisation of Genetic Resources" Sub Project-3: Quality	DBT	Dr. OP Gupta	Dr. BS Tyagi	March 2020 – Feb. 2025

S.N.	Name of the project	Funding Agency	PI/CC-PI	Co-PIs	Duration
21.	CRP on Agrobiodiversity (Wheat)	ICAR (NBPGR)	Dr. Arun Gupta	Drs. Ravindra Kumar, Vanita Pandey, Rakesh Kumar Bairwa, OP Gangwar	Since 2021 (Ongoing)
22.	ICAR Seed Project- Seed Production in Agri. Crops	ICAR	Dr. Amit Sharma	Drs. Umesh Kamble, Rakesh K. Bairwa	Mar 2008 (ongoing)
23.	Tribal-Sub-Plan (TSP) project on Improving the Socio-economic condition and livelihood of tribes in India through extension education and development programmes	Ministry of Agriculture & Farmers' Welfare	Dr. Satyavir Singh	Drs. Anuj Kumar, AK Khippal, Raj Kumar	Since 2015
24.	Frontline Demonstrations on Barley	Ministry of Agriculture & Farmers' Welfare	Dr. Satyavir Singh	Drs. Anuj Kumar AK Khippal Raj Kumar	Ongoing
25.	Intellectual Property and Technology Ongoing Management (IP&TM) IPR (NAIF), Component-I	ICAR-NAIF	Dr. Vikas Gupta	Drs. Umesh Kamble, Anuj Kumar (FT)	Ongoing
26.	Creating state of the art diagnostic facility for Karnal bunt in wheat to facilitate wheat trade for disease free regions benefitting farmers of Haryana	RKVY, Haryana	Dr. Ravindra Kumar	Drs. Amit Sharma, BS Tyagi	2024-25
27.	Establishing of an agri-preneurship cum food processing centre for wheat-based products to enhance the income of small and marginal farmers of Haryana	RKVY, Haryana	Dr. Sunil Kumar	Drs. Vanita Pandey, Anuj Kumar, Vikas Gupta, Anuj Kumar (Sr.), OP Gupta	2024-25

Externally funded project (International Agencies)

S. No.	Name of the Project	Funding Agency	PI	CO-PIs	Duration	Budget (Rs Lakhs)
1.	Establishment of Nitrogen-efficient wheat production systems in Indo-Gangetic Plains by the deployment of BNI- technology.	JICA and JIRCAS Japan	Dr. CN Mishra	Drs. Ravindra Singh Shekhawat (from 17.07.2025), Rinki (from 17.07.2025), BS Tyagi (till 30.04.2025), HM Mamrutha (till 12.06.2025)	2022-27	400
2.	Accelerating the Mainstreaming of Elevated Zinc in Global Wheat Breeding: A "Fluoride in the Water" Approach to Nutrition	CIMMYT Mexico	Dr. CN Mishra	Drs. BS Tyagi (Till 30.04.2025), OP Gupta	2021-25	104
3.	Crop Sustain project to verify global potential of Biological Nitrification Inhibition (BNI)	CIMMYT, Mexico & NOVO Nordisk Foundation (Denmark)	Dr CN Mishra	-	2025-2028	359

D. Contract Research Projects

S. No.	Name of the project	Funding Agency	PI	Duration
1.	Mapping of major soil borne pathogens in wheat based cropping systems in India	Syngenta India Pvt Ltd.	Dr. Prem Lal Kashyap	2024-2026
2.	Evaluation of Pinoxaden 5% + Metribuzin 17.5% EC (225 g/L W/V) for weed control in wheat (Contract Research Project)	Syngenta India Ltd.	Dr. RS Chhokar	2022-2025
3.	Response of wheat to the application of bio-stimulants through foliar spray in terms of growth, yield, and quality of grains	Smartchem Technologies Ltd.	Dr. Mamrutha HM	2023-2025
4.	Bioefficacy of NU-1 and NU-2 for improving nitrogen use efficiency in wheat (Project No: IIWBR/CRP/RM-89)	M/s Ray Nano Science & Research Centre	Dr. SC Gill	2025-2027
5.	Efficacy of IIL 355 against weeds in wheat (Project No: IIWBR/CRP/RM-90)	Insecticides India Ltd.	Dr. RS Chhokar	2025-2027
6.	Efficacy of HIL25H-APM against weeds in wheat (Project No: IIWBR/CRP/RM-91)	Heranba Industries Ltd.,	Dr. RS Chhokar	2025-2027
7.	Efficacy of flufenacet 500 g/l SC and pyroxasulfone 63.75g/l + metamitron 350 g/l SC against weeds in wheat (Project No: IIWBR/CRP/RM-92)	Cropnosys India Pvt Ltd.	Dr. RS Chhokar	2025-2027
8.	Efficacy of IIH-224 against weeds in wheat (Project No: IIWBR/CRP/RM-93)	Indofil India Ltd	Dr. RS Chhokar	2025-2027

18 PUBLICATIONS

The ICAR-IIWBR staff is involved in publishing high impact research papers, books, book chapters, reports, bulletins, policy papers, and popular/technical articles impacting society in terms of knowledge and awareness. The numbers of these publications are given in table below followed by the list of research publications with their NAAS ratings:

S. no.	Type of publication	Number(s)
1.	Research publications with NAAS rating/impact factor	59
2.	Books/Edited books	07
3.	Book Chapters	16
4.	Technical Report/ Research Bulletins/ Technical Bulletins/ Extension Bulletins/ Folders/ Leaflets/ Training Manual	23
5.	Popular Article/Technical Article	21
6.	Souvenir articles	07
7.	Policy Paper	01
8.	e-Publications	03

Research publications with NAAS rating/impact factor:

Ahlawat, O. P., Walia, N., Sheoran, S., Venkatesh, K., Sharma, P., Mamrutha, H. M., Rinki, Tiwari, R., & Singh, G. (2025). Alleviating drought stress tolerance in a sensitive genotype of wheat (*Triticum aestivum* L.) through exogenous application of root exudates. *Communications in Soil Science and Plant Analysis*, 56(13), 2052–2065.https:/ /doi.org/ 10.1080/ 00103624.2025.2489117 **[NAAS Rating: 7.30]**

Bawari, M. R., Beniwal, R. S., Gangwar, O. P., Prasad, P., & Singh, A. (2025). Genetic and phenotypic evaluation of wheat genotypes for stripe rust resistance. *Journal of Plant Pathology*. https://doi.org/10.1007/s42161-025-02020-y **[NAAS Rating: 8.20]**

Brasier, C. M., Grünwald, N. J., Bourret, T. B., Govers, F., Scanu, B., Cooke, D. E. L., Bose, T., Prasad, P. (2025). Preserving the biologically coherent generic concept of Phytophthora, 'Plant Destroyer'. *Phytopathology*. https://doi.org/10.1094/PHYTO-11-24-0372-LE **[NAAS Rating: 8.60]**

Chakraborty, S., Mahapatra, S., Hooi, A. B., Tejabhushan, B., Alam, S. K. H., & Kashyap, P. L. (2025). Unveiling the role of phenol and defense-related enzymes in host resistance to spot blotch × wheat pathosystem. *Cereal Research Communications*, 53, 2401–2417. **[NAAS Rating: 7.60]**

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Das, U., Ansari, M. A., Ghosh, S., Patnaik, N. M., & Maji, S. (2025). Determinants of farm household resilience and its impact on climate-smart agriculture performance. *Agricultural Systems*, 227, 104370. **[NAAS Rating: 12.10]**

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Gangwar, O. P., Kumar, S., Bhardwaj, S. C., Prasad, P., Khan, H., Manjul, A. S., Lata, C., Kallugudi, J., Tiwari, R., & Adhikari, S. (2025). Pathotype characterization and geographical distribution of Puccinia striiformis f. sp. tritici in north India. *Plant Disease*. https://doi.org/ 10.1094/PDIS-07-25-1474-RE **[NAAS Rating: 10.40]**

Gupta, O. P., Singh, A., Malik, A., Pandey, V., Kumar, S., Ram, S., & Tiwari, R. (2025). A multifaceted analysis of wheat genotypes, fortification, and processing on iron and zinc bioavailability. *Food Chemistry*, 473, 142907. https://doi.org/10.1016/j.foodchem.2025.142907 **[NAAS Rating: 14.50]**

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Tripathi, S. C., Kumar, N., & Venkatesh, K. (2025). Nano urea's environmental edge and economic efficacy in boosting wheat grain yield across diverse Indian agro-climates. *Scientific Reports*, 15(1), 3598. **[NAAS Rating: 9.80]**

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19 राजभाषा कार्यान्वयन (प्रतिवेदन)

संस्थान में राजभाषा नीति के प्रभावी क्रियान्वयन के लिए समय–समय पर आवश्यक कदम उठाए गए हैं। इस संदर्भ में वर्ष 2025 के दौरान किए गए प्रमुख कार्यों का संक्षिप्त विवरण निम्नलिखित है:

- कार्यालयी पत्राचार, टिप्पणियों एवं प्रारूपण कार्यों में हिन्दी के प्रयोग को बढ़ावा दिया गया।
- राजभाषा हिन्दी के प्रचार–प्रसार एवं प्रगामी प्रयोग को बढ़ावा देने के लिए संस्थान राजभाषा कार्यान्वयन समिति की नियमित तिमाही बैठकों एवं कार्यशालाओं का आयोजन किया गया।
- समयबद्ध सूचना प्रणाली के अंतर्गत तिमाही प्रगति रिपोर्ट नियमानुसार प्रेषित की गई।
- कार्यालयी पत्राचार, प्रतिवेदन, सूचना–पट्ट, आदेश, टिप्पणियों एवं प्रारूपण कार्यों में हिन्दी के प्रयोग को बढ़ावा दिया गया।
- हिन्दी पखवाड़ा के अंतर्गत 14–30 सितम्बर, 2025 के दौरान अधिकारियों एवं कर्मचारियों द्वारा विभिन्न प्रतियोगिताओं में सक्रिय सहभागिता की गई।
- नगर राजभाषा कार्यान्वयन समिति, करनाल के स्तर पर कविता पाठ एवं निबन्ध लेखन जैसी दो प्रतियोगिताओं का सफलतापूर्वक आयोजन किया गया।
- सेवा पुस्तिकाओं में प्रविष्टियाँ हिन्दी में किए जाने की व्यवस्था सुनिश्चित की गई।
- संस्थान के सभी कम्प्यूटरों पर हिन्दी टाइपिंग (टंकण) सुविधा एवं यूनिकोड फॉन्ट का प्रयोग सुनिश्चित किया गया।
- राजभाषा से संबंधित सूचनाएँ एवं परिपत्र समय–समय पर सभी अनुभागों को प्रेषित किए गए।
- संस्थान राजभाषा कार्यान्वयन समिति की नियमित तिमाही बैठकों के उपरांत कार्यवृत्त जारी किया गया और उसे राजभाषा विभाग, गृह मंत्रालय, भारत सरकार की सूचना प्रबंधन प्रणाली पर समयानुसार प्रदर्शित किया गया।
- राजभाषा हिन्दी के प्रचार–प्रसार को सुदृढ़ करने के उद्देश्य से संस्थान द्वारा सोशल मीडिया जैसे फेसबुक, व्हाट्सएप एवं प्रिंट मीडिया के साथ–साथ विभिन्न समाचार पत्रों का प्रभावी रूप से उपयोग किया गया।
- राजभाषा अधिनियम 1963 की धारा 3(3) तथा राजभाषा नियम 1976 के नियम 5, 8 (4), 10 (4), 11 व 12 के प्रावधानों का पूर्ण रूप से अनुपालन सुनिश्चित किया गया।

हिन्दी साहित्य का प्रकाशन

संस्थान में राजभाषा हिन्दी के प्रोत्साहन और उसके व्यापक प्रयोग को सुनिश्चित करने हेतु विभिन्न प्रकार के साहित्य प्रकाशित किए गए।

पुस्तक प्रकाशन / वार्षिक प्रतिवेदन

अनुज कुमार, रविन्द्र कुमार, चन्द्र नाथ मिश्र, चरण सिंह, मंगल सिंह, रिंकी एवं वनिता पांडेय (2025)। गेहूँ एवं जौ स्वर्णिमा–2024 (अंक–16), भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, आईएसबीएनः 978–93–344–2262–7, पेज 1–130।

अनुज कुमार, रविन्द्र कुमार, चरण सिंह, रिंकी एवं मंगल सिंह (2025)। वार्षिक प्रतिवेदन 2024, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, पेज 1–165।

तकनीकी बुलेटिन / समाचार पत्र

ममृथा एचएम, रिंकी, अनुज कुमार, मंगल सिंह, अरूण गुप्ता, विकास गुप्ता, विनीत कुमार, प्रीती रानी, प्रदीप कुमार, वनिता पाण्डेय, बीएस त्यागी एवं रतन तिवारी (2025)। बदलती जलवायु परिस्थितियों में गेहूँ की खेती, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, तकनीकी बुलेटिन 36, आईएसबीएनः 978–93–342–7577 – 3, पेज 1–72।

अमित शर्मा, उमेश काम्बले, राकेश कुमार बैरवा, चरण सिंह, राजेन्द सिंह छोकर एवं रतन तिवारी (2025)। भारत में गेहूँ एवं जौ की उन्नत किस्में एवं उनकी बीज उपलब्धता, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, तकनीकी बुलेटिन 38, पेज 1–24।

रविन्द्र कुमार, विकास गुप्ता, चरण सिंह, प्रमोद कुमार, अरूण गुप्ता, ओम प्रकाश गंगवार, प्रदीप शर्मा, प्रेम लाल कश्यप, ईश्वर सिंह, अनुज कुमार एवं रतन तिवारी (2025)। गेहूँ के रतुआ रोगों के सफल प्रबंधन की गाथा : विगत एक दशक का अनुभव, भाकृअनुप –भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, तकनीकी बुलेटिन 39, पेज 1–34।

चन्द्र नाथ मिश्र, अनुज कुमार, मंगल सिंह, सतीश कुमार, विकास गुप्ता एवं रतन तिवारी (2025)। गेहूँ की जैव–संवर्धित किस्मों से पोषण सुरक्षा, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, तकनीकी बुलेटिन 44, आईएसबीएनः 978–93–344–1785–2, पेज 1–70।

सत्यवीर सिंह, अनुज कुमार, अनिल कुमार खिप्पल, मंगल सिंह, रमेश चन्द एवं रतन तिवारी (2025)। गेहूँ एवं जौ संदेश, जुलाई–दिसम्बर, 2024 (वर्ष 13, अंक 2), पेज 1–24।

विस्तार बुलेटिन

ओमवीर सिंह, जोगेन्द्र सिंह एवं लोकेन्द्र कुमार (2025)। छिलका रहित जौ : एक अद्भुत पोषक अनाज, बेजोड़ स्वास्थ्य लाभ और एक बेहतर अनाज विकल्प, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 102 / 2025, पेज 1–12।

जोगेन्द्र सिंह, ओमवीर सिंह, चुनी लाल, लोकेन्द्र कुमार, रेखा मलिक, अनिल कुमार खिप्पल, चरण सिंह, संतोष कुमार बिश्नोई, दिनेश कुमार, ओम प्रकाश गुप्ता, अजय वर्मा, मंगल सिंह एवं रतन तिवारी (2025)। डीडब्ल्यूआरबी 223, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 103 / 2025।

अनुज कुमार, मंगल सिंह, रमेश चन्द, सेठपाल, सत्यवीर सिंह एवं रतन तिवारी (2025)। जौ की उन्नतशील किस्में, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 105 / 2025।

अनुज कुमार, मंगल सिंह, रमेश चन्द, सेठपाल, सत्यवीर सिंह एवं रतन तिवारी (2025)। गेहूँ की उन्नतशील किस्में, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 106 / 2025।

अनुज कुमार, मंगल सिंह, रिंकी, चरण सिंह, वनिता पाण्डेय, राजेन्द्र सिंह छोकर, रविन्द्र सिंह शेखावत, सत्यवीर सिंह एवं रतन तिवारी (2025)। भारत में जलवायु अनुकूल गेहूँ की खेती, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 107 / 2025।

अरूण गुप्ता, भूदेव सिंह त्यागी, चरण सिंह, विकास गुप्ता, राकेश बैरवा, अमित कुमार शर्मा, उमेश काम्बले एवं रतन तिवारी (2025)। गेहूँ का उन्नत किस्म डीबीडब्ल्यू 386 (करण खुशबू) : उत्तर पूर्वी मैदानी क्षेत्र में सिंचित एवं समय से बीजाई के लिए, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल, विस्तार बुलेटिन 109 / 2025।

ऑनलाइन प्रकाशन

मंगल सिंह, अनुज कुमार, रविन्द्र सिंह शेखावत, विकास गुप्ता, राजेन्द्र सिंह छोकर, चन्द्र नाथ मिश्र, सेठपाल, सत्यवीर सिंह एवं रतन तिवारी (2025)। जैव–संवर्धित गेहूँ की खेती से पोषण सुरक्षा। ऑनलाइन हिन्दी कृषि पत्रिका कृषि सेवा, पेज 1–7।

ऑफलाइन प्रकाशन

अनुज कुमार, मंगल सिंह, मम्रुथा एचएम, रिंकी, वनिता पांडे, अश्वनी कुमार आर्य, हर्ष देव चौधरी एवं अरुण शर्मा (2025)। बदलता जलवयु एवं अजैविक तनावों के अनुकूल खेती, खेती, नवंबर, 2025, पृष्ठ 52–55।

पुरस्कार एवं सम्मान

संस्थान को नगर राजभाषा कार्यान्वयन समिति, भाकृअनुप– राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल में दिनांक 30 जून, 2025 को आयोजित 81वीं छमाही समीक्षा बैठक (जून, 2025) में वर्ष 2024–25 के दौरान सरकारी कामकाज (षोध संस्थान श्रेणी) में राजभाषा के उल्लेखनीय कार्य के लिए संस्थान को प्रथम पुरस्कार से सम्मानित किया गया।

इसी क्रम में वर्ष 2024–25 के दौरान हिन्दी साहित्य प्रकाशन के क्षेत्र में संस्थान की वार्षिक हिन्दी पत्रिका "गेहूँ एवं जौ स्वर्णिमा 2024" (अंक 16) के प्रकाशन के लिए नगर राजभाषा कार्यान्वयन समिति, भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल की दिनांक 30 जून, 2025 को आयोजित 81वीं छमाही समीक्षा बैठक (जून, 2025) में प्रथम पुरस्कार से सम्मानित किया गया।

राजभाषा विभाग, गृह मंत्रालय, भारत सरकार द्वारा क्षेत्रीय राजभाषा पुरस्कार

वर्ष 2024–25 के दौरान राजभाषा हिन्दी के प्रभावी क्रियान्वयन एवं उत्कृष्ट कार्यों करने के लिए राजभाषा हिन्दी विभाग, गृह मंत्रालय, भारत सरकार, नई दिल्ली द्वारा भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल को तृतीय पुरस्कार प्रदान किए जाने की घोषणा की गई है। यह पुरस्कार 'क' क्षेत्र के 50 से अधिक कार्मिकों वाले कार्यालयों वाली श्रेणी में दिया गया है। यह सम्मान संस्थान के लिए गौरव का विषय है और राजभाषा हिन्दी के सशक्त क्रियान्वयन की दिशा में एक महत्वपूर्ण उपलब्धि है।

गेहूँ एवं जौ स्वर्णिमा उत्कृष्ट लेख पुरस्कार

संस्थान की हिन्दी पत्रिका गेहूँ एवं जौ स्वर्णिमा के पंद्रहवें अंक 2023–24 में प्रकाशित लेख "श्री अन्न फसलों का महत्व एवं उनमें लगने वाले प्रमुख रोग व उनका एकीकृत रोग प्रबंधन" (रविन्द्र कुमार, व अन्य) को प्रथम उत्कृष्ट लेख पुरस्कार तथा लेख "प्राकृतिक खेती खुखहाल किसान योजना : सफलता की कहानियाँ" (आकृति ठाकुर, व अन्य) को द्वितीय उत्कृष्ट लेख पुरस्कार से संस्थान के 11वें स्थापना दिवस के अवसर पर सम्मानित किया गया।

राजभाषा कार्यान्वयन सम्बन्धी छःमाही एवं वार्षिक रिपोर्ट का संकलन

संस्थान द्वारा राजभाषा हिन्दी के कार्यान्वयन से सम्बंधित छःमाही एवं वार्षिक रिपोर्ट निर्धारित समय–सीमा में संकलित कर नगर राजभाषा कार्यान्वयन समिति, भाकृअनुप–राष्ट्रीय डेयरी अनुसंधान संस्थान (मानद विश्वविद्यालय), करनाल, हरियाणा को प्रेषित की गई।

तिमाही बैठकों का आयोजन

वर्ष 2025 के दौरान संस्थान की राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का नियमित रूप से आयोजन किया गया। इन बैठकों के दौरान राजभाषा हिन्दी के प्रयोग एवं उसके प्रचार–प्रसार से संबंधित विभिन्न विषयों पर गहन विचार–विमर्श किया गया। तदनुसार, संस्थान की राजभाषा कार्यान्वयन समिति द्वारा संस्तुत विकल्पों एवं लिए गए निर्णयों के प्रभावी, समयबद्ध एवं सुचारु क्रियान्वयन हेतु आवश्यक प्रशासनिक कार्रवाई की गई (तालिका 1)।

उपरोक्त बैठकों में संस्थान के सभी विभागों के प्रमुख अन्वेषकों, स्थापना एवं वित्त अनुभाग के मुख्य प्रशासनिक अधिकारी व मुख्य वित्त

तालिका 1. राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का विवरण

क्र.स.	तिमाही बैठक (वर्ष 2025)	आयोजन की तिथि	अध्यक्षता
1.	जनवरी–मार्च	19.03.2025	डॉ. रतन तिवारी, निदेशक
2.	अप्रैल–जून	26.06.2025	डॉ. रतन तिवारी, निदेशक
3.	जुलाई–सितम्बर	26.09.2025	डॉ. ओमवीर सिंह, कार्यकारी निदेशक
4.	अक्तूबर–दिसम्बर	18.12.2025	डॉ. रतन तिवारी, निदेशक

एवं लेखा अधिकारी तथा समिति के समस्त पदाधिकारियों ने भाग लिया। इन बैठकों में कार्यान्वयन से सम्बंधित सभी बिन्दुओं पर विचार विमर्श किया गया। संस्थान के राजभाषा हिन्दी अधिकारी द्वारा पिछली तिमाही बैठकों का विस्तृत ब्यौरा प्रस्तुत किया गया, जिसमें राजभाषा अधिनियम 1963 की धारा 3(3) के अनुपालन की स्थिति के संदर्भ में बताया गया। तद्उपरान्त पिछली तिमाहियों के अंतर्गत जारी पत्रिकाओं, फोल्डर्स, प्रतिवेदन, टिप्पणी मसौदा, द्विभाषीय फार्मों, आमंत्रण, कागजातों, निविदा प्रपत्र, निविदा सूचनाएँ, मांगपत्रों एवं जाँच बिन्दुओं इत्यादि से सम्बंधित चर्चाएँ की गईं, साथ ही माननीय संसदीय राजभाषा समिति को दिए गए आश्वासनों के सम्बन्ध में उचित कार्रवाई करने के लिए सभी विभाग प्रमुखों, अधिकारियों एवं कर्मचारियों को व्यक्तिशः आदेश जारी किए गए।

राजभाषा हिन्दी कार्यशालाओं का आयोजन

राजभाषा विभाग, गृह मंत्रालय, भारत सरकार तथा भारतीय कृषि अनुसंधान परिषद, नई दिल्ली से समय–समय पर प्राप्त दिशा–निर्देशों के अनुपालन में वर्ष 2025 के दौरान संस्थान में राजभाषा हिन्दी के प्रयोग को प्रोत्साहित करने तथा अधिकारियों/कर्मचारियों की कार्यकुशलता तथा भाषीय दक्षता में वृद्धि के उद्देश्य से विभिन्न राजभाषा हिन्दी कार्यशालाओं का आयोजन किया गया, जिनका विस्तृत विवरण निम्नलिखित है।

संस्थान की राजभाषा कार्यान्वयन समिति के तत्वाधान में दिनांक 16 जनवरी, 2025 को एक दिवसीय हिन्दी कार्यशाला का आयोजन संस्थान के निदेशक डॉ. रतन तिवारी की अध्यक्षता में किया गया। इस कार्यक्रम में बतौर मुख्य अतिथि एवं मुख्य वक्ता के रूप में श्री धीरज शर्मा, संयुक्त निदेशक, नगर राजभाषा कार्यान्वयन समिति, भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल ने **"राजभाषा हिन्दी के कार्यान्वयन के लिए संस्थान की पहल"** विषय पर अपने विचार व्यक्त किए। इस कार्यशाला में 50 से अधिक वैज्ञानिकों/अधिकारियों/कर्मचारियों ने भाग लिया।

डॉ. रतन तिवारी, निदेशक, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल की अध्यक्षता में दिनांक 15 सितम्बर, 2025 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला में बतौर मुख्य वक्ता डॉ. मंगल सिंह, राजभाषा प्रभारी ने "फोटो को टेक्स्ट में कैसे बदलें" विषय पर अपने विचार व्यक्त किए। इस कार्यशाला में 40 से अधिक वैज्ञानिकों/अधिकारियों/कर्मचारियों ने सक्रिय रूप से भाग लिया।

संस्थान में राजभाषा के प्रचार–प्रसार एवं शैक्षणिक जागरूकता के उद्देश्य से दिनांक 02 दिसम्बर, 2025 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। कार्यशाला की अध्यक्षता डॉ. रतन तिवारी, निदेशक, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल ने की। इस कार्यक्रम में बतौर मुख्य अतिथि एवं मुख्य वक्ता के रूप में श्रीमती टीना चौहान, प्रधानाचार्या, राधा कृष्ण, पब्लिक स्कूल, ठोल, कुरूक्षेत्र, हरियाणा ने "राष्ट्रीय शिक्षा नीति 2025" विषय पर अपने विचार व्यक्त किए। इस कार्यशाला में 40 से अधिक वैज्ञानिकों/अधिकारियों/कर्मचारियों ने सक्रिय रूप से भाग लिया तथा राष्ट्रीय शिक्षा नीति से सम्बंधित महत्वपूर्ण ज्ञान अर्जित किया।

राजभाषा उत्सव एवं हिन्दी पखवाड़ा (14–30 सितम्बर, 2025)

राजभाषा हिन्दी के प्रचार–प्रसार एवं कार्यालयीन कार्यों में इसके प्रभावी उपयोग को बढ़ावा देने के उद्देश्य से संस्थान में दिनांक 14 से 30 सितम्बर, 2025 तक राजभाषा उत्सव एवं हिन्दी पखवाड़ा का सफलतापूर्वक आयोजन किया गया। इस हिन्दी पखवाड़े का शुभारम्भ हिन्दी दिवस (14 सितम्बर) के अवसर पर किया गया। कार्यक्रम के उद्घाटन समारोह में संस्थान के निदेशक डॉ. रतन तिवारी ने राजभाषा हिन्दी के महत्व पर प्रकाश डाला और कर्मचारियों/अधिकारियों को अधिकाधिक हिन्दी में कार्य करने के लिए प्रेरित किया।

हिन्दी पखवाड़े के दौरान प्रमुख गतिविधियाँ

हिन्दी पखवाड़े के दौरान संस्थान में विभिन्न प्रतियोगिताओं का आयोजन किया गया, जिनका उद्देश्य राजभाषा हिन्दी के प्रभावी प्रचार–प्रसार के साथ–साथ वैज्ञानिकों, अधिकारियों एवं कर्मचारियों की हिन्दी में कार्यकुशलता को बढ़ाना तथा उनकी रचनात्मक अभिव्यक्ति को प्रोत्साहित करना था। हिन्दी पखवाड़े के दौरान सुलेख, भाषण, टिप्पणी मसौदा लेखन, आशु भाषण, कविता पाठ, अंताक्षरी, वाद–विवाद एवं निबन्ध लेखन जैसी आठ प्रतियोगिताएँ आयोजित की

गईं, जिनका विस्तृत विवरण निम्नलिखित है।

हिन्दी सुलेख प्रतियोगिता

संस्थान के समस्त वर्ग के अधिकारियों एवं कर्मचारियों की भागीदारी सुनिश्चित करते हुए दिनांक 15 सितम्बर, 2025 को वीएस माथुर हॉल में हिन्दी सुलेख प्रतियोगिता का सफल आयोजन किया गया। विजेता प्रतिभागियों का विवरण तालिका 2 में प्रस्तुत किया गया है।

तालिका 2. हिन्दी सुलेख प्रतियोगिता के विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्री रवि रंजन कुमार, तकनीकी सहायक	प्रथम
2.	श्री अम्बरीष कुमार पटेल, तकनीकी सहायक	
3.	कुमारी कोमल दहिया, सहायक	द्वितीय
4.	कुमारी अंजना सोलंकी, वाईपी–1	
5.	श्री लक्ष्य, सहायक	तृतीय
6.	डॉ. रविन्द्र कुमार, वरिष्ठ वैज्ञानिक	
7.	श्री सुरेन्द्र कुमार, मुख्य तकनीकी अधिकारी	प्रमाणपत्र
8.	श्री सुनील कुमार, सहायक प्रशासनिक अधिकारी	

भाषण प्रतियोगिता

संस्थान के सभी वर्ग के अधिकारियों एवं कर्मचारियों के लिए ''भारत में डिजिटल कृषि की उपयोगिता, समस्याएँ एवं समाधान'' विषय पर एक भाषण प्रतियोगिता दिनांक 16 सितम्बर, 2025 को वीएस माथुर हॉल में आयोजित की गई। विजेता प्रतिभागियों का विवरण तालिका 3 में प्रस्तुत किया गया है।

तालिका 3. भाषण प्रतियोगिता के विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्री ओम प्रकाश, तकनीकी अधिकारी	प्रथम
2.	श्री सुरेन्द्र सिंह, मुख्य तकनीकी अधिकारी	द्वितीय
3.	श्री अम्बरीष कुमार पटेल, तकनीकी सहायक	द्वितीय

टिप्पणी एवं मसौदा लेखन प्रतियोगिता

संस्थान के सभी वर्ग के अधिकारियों एवं कर्मचारियों के लिए टिप्पणी एवं मसौदा लेखन प्रतियोगिता दिनांक 17 सितम्बर, 2025 को वीएस माथुर हॉल में आयोजित की गई। विजेता प्रतिभागियों का विवरण तालिका 4 में प्रस्तुत किया गया है।

तालिका 4. टिप्पणी एवं मसौदा लेखन प्रतियोगिता के विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्री कृष्ण पाल, सहायक	प्रथम
2.	श्रीमती कोमल दहिया, सहायक	
3.	श्री सुनील कुमार, सहायक, प्रशासनिक अधिकारी	द्वितीय
4.	श्री लक्ष्य, सहायक	
5.	श्री नरेश कुमार, प्रवर श्रेणी लिपिक	तृतीय
6.	श्री सुनील कुमार, प्रवर श्रेणी लिपिक	
7.	श्री रमेश चन्द, सहायक	प्रमाणपत्र
8.	डॉ. अनुज कुमार, वैज्ञानिक, गुणवत्ता एवं मुलभूत विज्ञान	

वाद–विवाद प्रतियोगिता

संस्थान में कार्यरत आरए, एसआरएफ, वाईपी–I, वाईपी–II एवं परियोजनाओं से सम्बंधित अधिकारियों एवं कर्मचारियों के लिए ''क्या मानव को कृत्रिम बुद्धिमत्ता में प्रगति से डरना चाहिए?'' विषय पर वाद–विवाद प्रतियोगिता दिनांक 18 सितम्बर, 2025 को वीएस माथुर हॉल में आयोजित की गई। विजेता प्रतिभागियों का विवरण तालिका 5 में प्रस्तुत किया गया है।

तालिका 5. वाद–विवाद प्रतियोगिता के विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्री हर्ष देव चौधरी, वाईपी 1	प्रथम
2.	श्री अरुण शर्मा, वाईपी 1	द्वितीय
3.	श्री लव शर्मा, वाईपी 2	तृतीय
4.	श्री अनुज कुमार, वाईपी 1	

नराकास स्तर पर कविता पाठ प्रतियोगिता

भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल में नगर राजभाषा कार्यान्वयन समिति (नराकास) के स्तर पर कविता पाठ प्रतियोगिता दिनांक 19 सितम्बर, 2025 को डॉ. एस नागराजन हॉल में आयोजित की गई। इस प्रतियोगिता में अपने संस्थान सहित 10 से अधिक संस्थानों/बैंकों/ निगमों/भारतीय दूर संचार विभाग/जीवन बीमा निगम/केन्द्रीय विद्यालय के 28 से अधिक प्रतिभागियों ने अपनी प्रतिभा का प्रदर्शन किया। उत्कृष्ट प्रदर्शन करने वाले विजेता प्रतिभागियों का विवरण तालिका 6 में प्रस्तुत किया गया है।

तालिका 6. नराकास स्तर पर कविता पाठ प्रतियोगिता के विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्रीमती गार्गी श्री, केनरा बैंक, अंचल कार्यालय, करनाल	प्रथम
2.	कुमारी दिनिका, भारतीय संचार निगम लिमिटेड (बीएसएनएल), करनाल	
3.	कुमारी अंजना सोलंकी, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	द्वितीय
4.	कुमारी सरिता रानी, भारतीय संचार निगम लिमिटेड (बीएसएनएल), करनाल	
5.	श्री दीपक यादव, भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल	तृतीय
6.	श्री डिम्पल शर्मा, जवाहर नवोदय विद्यालय, सग्गा, करनाल	
7.	श्री सेठपाल, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	प्रोत्साहन

क्र. स.	विजेता प्रतिभागी	पुरस्कार
8.	श्रीमती चीन्मई पंडा, बैंक ऑफ बड़ौदा, क्षेत्रीय कार्यालय करनाल	
9.	श्री लक्ष्य, सहायक, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	
10.	श्री अनुज कुमार, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	प्रमाणप्रत्र
11.	श्री अमर सिंह, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	

अंताक्षरी प्रतियोगिता

संस्थान के सभी वर्गों की महिला अधिकारियों एवं कर्मचारियों के लिए अंताक्षरी प्रतियोगिता दिनांक 22 सितम्बर, 2025 को डॉ. एस नागराजन हॉल में आयोजित की गई। उत्कृष्ट प्रदर्शन करने वाली विजेता टीमों का विवरण तालिका 7 में प्रस्तुत किया गया है।

तालिका 7. अंताक्षरी प्रतियोगिता प्रतियोगिता में विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्रीमती शकुन्तला रानी, डॉ. प्रतिभा, कुमारी अंजली, कुमारी रवीना	प्रथम
2.	कुमारी अंजना सोलंकी, डॉ. जीनत वधवा, कुमारी प्रीती रानी, कुमारी प्रीति सिरसवाल	द्वितीय
3.	कुमारी ईशा, कुमारी शुभ वत्स, कुमारी मेघा, कुमारी श्रद्धा	तृतीय
4.	डॉ. सभ्यता, डॉ. स्वाति, श्रीमती रेणू शर्मा, डॉ. सुषमा मलिक	
5.	डॉ. चारुलता, डॉ. गरिमा सिगरोहा, डॉ शेफाली, डॉ. विजेता	प्रमाणपत्र
6.	श्रीमती बबली रानी, कुमारी जहावी, कुमारी शिवानी, कुमारी कोमल	प्रमाणपत्र

आशु भाषण प्रतियोगिता

संस्थान के सभी वर्गों के अधिकारियों एवं कर्मचारियों के लिए आशु भाषण प्रतियोगिता दिनांक 24 सितम्बर, 2025 को वीएस माथुर हॉल में आयोजित की गई। उत्कृष्ट प्रदर्शन करने वाले प्रतिभागियों का विवरण तालिका 8 में प्रस्तुत किया गया है।

तालिका 8. आशु भाषण प्रतियोगिता में विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1	डॉ. अनुज कुमार, प्रधान वैज्ञानिक	प्रथम
2.	श्री अम्बरीष कुमार पटेल, तकनीकी सहायक	
3.	श्री सेठपाल, वाईपी 1	द्वितीय
4.	श्री ओम प्रकाश तकनीकी अधिकारी	तृतीय
5.	श्री नरेश कुमार, प्रवर श्रेणी लिपिक	प्रमाणपत्र
6.	डॉ. उमेश काम्बले, वरिष्ठ वैज्ञानिक	

निबन्ध लेखन प्रतियोगिता

भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल में नगर राजभाषा कार्यान्वयन समिति (नराकास) के स्तर पर निबंध लेखन प्रतियोगिता दिनांक 26 सितम्बर, 2025 को वीएस माथुर हॉल में आयोजित की गई। इस प्रतियोगिता में भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल; भाकृअनुप–भारतीय कृषि अनुसंधान संस्थान, क्षेत्रीय केन्द्र, करनाल; केनरा बैंक, करनाल; बैंक ऑफ बड़ौदा अंचल कार्यालय, करनाल; भारत संचार निगम लिमिटेड, करनाल तथा अपने संस्थान सहित सात संस्थानों/निगमों/उपक्रमों/बैंकों के 23 से अधिक अधिकारियों/कर्मचारियों ने भाग लिया। उत्कृष्ट प्रदर्शन करने वाले विजेता प्रतिभागियों का विवरण तालिका 9 में दिया गया है।

राजभाषा उत्सव एवं हिन्दी पखवाड़े का समापन एवं पुरस्कार समारोह

राजभाषा उत्सव एवं हिन्दी पखवाड़े का समापन एवं पुरस्कार वितरण समारोह संस्थान के कार्यकारी निदेशक, डॉ. ओमवीर सिंह की अध्यक्षता में दिनांक 29 सितम्बर, 2025 को डॉ. एस नागराजन सभागार में आयोजित किया गया। निदेशक महोदय ने अपने संबोधन में राजभाषा हिन्दी को राष्ट्र की आत्मा बताते हुए दैनिक कार्यों में अधिकाधिक हिन्दी के प्रयोग पर बल दिया। उन्होंने कहा कि राजभाषा का प्रभावी प्रयोग प्रशासन को अधिक सरल, सुलभ एवं जनोन्मुखी बनाता है। इस अवसर पर संस्थान के राजभाषा प्रभारी डॉ. मंगल सिंह ने वर्ष 2025 के दौरान राजभाषा हिन्दी से सम्बंधित प्रमुख उपलब्धियों पर आधारित एक संक्षिप्त प्रतिवेदन प्रेषित किया तथा भविष्य में प्रस्तावित प्रमुख गतिविधियों की रूपरेखा को रेखांकित किया।

तालिका 9. निबंध लेखन प्रतियोगिता में विजेता प्रतिभागियों का विवरण

क्र. स.	विजेता प्रतिभागी	पुरस्कार
1.	श्री अम्बरीष कुमार पटेल, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	प्रथम
2.	श्रीमती सरिता रानी, भारतीय संचार निगम लिमिटेड (बीएसएनएल), करनाल	
3.	श्री सुनील कुमार, एएओ, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	द्वितीय
4.	श्री रवि रंजन कुमार, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	
5.	डॉ. उत्तम कुमार, भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल	तृतीय
6.	श्री अनुज कुमार, वाईपी 1, भाकृअनुप–राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल	
7.	श्री विकास सनवाल, भाकृअनुप–भारतीय कृषि अनुसंधान संस्थान, क्षेत्रीय केन्द्र, करनाल	प्रोत्साहन
8.	श्री नरेश कुमार, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	
9.	श्री लक्ष्य, भाकृअनुप–भारतीय गेहूँ एवं जौ अनुसंधान संस्थान, करनाल	प्रशंसा पत्र
10.	श्री प्रद्युमन मित्तल, बैंक ऑफ बड़ौदा, करनाल	
11.	श्रीमती चीन्मई पांडा, बैंक ऑफ बड़ौदा, करनाल	

निदेशक महोदय ने समारोह के दौरान विभिन्न प्रतियोगिताओं में उत्कृष्ट प्रदर्शन करने वाले प्रतिभागियों को पुरस्कार एवं प्रमाण पत्र प्रदान कर सम्मानित किया गया। डॉ. अनुज कुमार, सलाहकार, संस्थान राजभाषा कार्यान्वयन समिति ने कार्यक्रम का सफल संचालन किया।

प्रिंट मीडिया के माध्यम से राजभाषा हिन्दी का प्रचार–प्रसार

राजभाषा हिन्दी के व्यापक प्रचार–प्रसार में प्रिंट मीडिया की भूमिका अत्यंत महत्वपूर्ण रही है। इस दिशा में संस्थान द्वारा निरंतर सार्थक प्रयास किए जा रहे हैं। संस्थान की पत्र–पत्रिकाओं, समाचार पुस्तिकाओं, वार्षिक रिपोर्टों, ब्रोशर, पोस्टर तथा अन्य प्रकाशनों में हिन्दी के प्रभावी प्रयोग को प्राथमिकता दी गई। हिन्दी के प्रति जागरूकता एवं सम्मान की भावना विकसित के उद्देश्य से प्रिंट मीडिया के माध्यम से हिन्दी दिवस, हिन्दी पखवाड़ा तथा राजभाषा से संबंधित कार्यक्रमों की जानकारी व्यापक स्तर पर साझा की गई। वर्ष 2025 के दौरान प्रिंट मीडिया में प्रकाशित राजभाषा हिन्दी से संबंधित गतिविधियों की प्रमुख झलकियाँ निम्नवत हैं।


भाकृअनुप-भारतीय गेहूँ एवं जौ अनुसंधान संस्थान में हिन्दी दिवस का आयोजन


करनाल में हिन्दी दिवस एवं राजभाषा पखवाड़े का शुभारंभ


भारतीय गेहूँ एवं जौ अनुसंधान संस्थान में राष्ट्रीय शिक्षा नीति 2025 पर हिन्दी कार्यशाला आयोजित


भाकृअनुप-भारतीय गेहूँ एवं जौ अनुसंधान संस्थान को राजभाषा हिन्दी में तृतीय पुरस्कार


कलम से कम्प्यूटर तक का कार्य हिंदी में करने का संदेश


Krishisewa

जैव-संवर्धित गेहूँ की खेती से पोषण सुरक्षा

20 PERSONNEL

Headquarter, Karnal

Director

Dr. Ratan Tiwari

Director cell

Smt. Shakuntla, PS to Director
Sh. Sunder Lal, TO
Sh. Aman Kumar, SSS

Crop Improvement

Scientific staff

Dr. OP Ahlawat, Pr. Scientist & PI (Till 08/12/2025)
Dr. Arun Gupta, Pr. Scientist & PI (Since 09/12/2025)
Dr. Sindhu Sareen, Pr. Scientist
Dr. Raj Kumar, Pr. Scientist
Dr. Rajender Singh, Pr. Scientist
Dr. Binay Kumar Singh, Pr. Scientist
Dr. Amit Kumar Sharma, Pr. Scientist
Dr. Sonia Sheoran, Pr. Scientist
Dr. Hanif Khan, Pr. Scientist
Dr. Satish Kumar, Sr. Scientist
Dr. Charan Singh, Sr. Scientist
Dr. CN Mishra, Sr. Scientist
Dr. Vikas Gupta, Sr. Scientist
Dr. Umesh R Kamble, Sr. Scientist
Dr. Rinki, Sr. Scientist
Dr. Rakesh Bairwa, Scientist
Dr. Rajeswari V, Scientist

Technical & Supporting staff

Sh. Surendra Singh, CTO
Sh. Yogesh Kumar, CTO
Sh. Yogesh Sharma, CTO
Sh. P Chandrababu, ACTO
Dr. Rajendra Kumar, ACTO
Sh. Om Prakash, TO
Sh. Suresh Kumar, TO
Sh. Rajesh Kumar, TO
Sh. Rahul, Technician
Sh. Abhilash Kumar, Technician
Sh. Mohit Dhaka, Technician
Sh. Ravi Ranjan Kumar, Technician
Smt. Amresh, SSS

Crop Protection

Scientific staff

Dr. Pradeep Sharma, Pr. Scientist & PI
Dr. Pram Lal Kashyap, Sr. Scientist
Dr. Ravindra Kumar, Sr. Scientist
Dr. Charu Lata, Scientist
Dr. Karshanal J, Scientist

Technical & Supporting staff

Sh. Ishwar Singh, TO
Sh. Bhal Singh, TO

Resource Management

Scientific staff

Dr. SC Gill, Pr. Scientist & PI
Dr. RS Chhokar, Pr. Scientist
Dr. Anil Khippal, Pr. Scientist
Dr. Neeraj Kumar, Scientist

Technical & Supporting staff

Sh. Rajinder Pal Sharma, TO
Sh. Ambarish Kumar Patel, Technician
Sh. Lakhwinder Singh, SSS

Quality and Basic Sciences

Scientific staff

Dr. Sunil Kumar, Pr. Scientist & PI
Dr. Dinesh Kumar, Pr. Scientist
Dr. Om Prakash Gupta, Sr. Scientist
Dr. Anuj Kumar, Sr. Scientist
Dr. Vanita Pandey, Scientist (SS)

Technical & Supporting staff

Sh. Vijay Singh, TO

Social Sciences

Scientific staff

Dr. Satyavir Singh, Pr. Scientist & PI (Till 30/09/2025)
Dr. Anuj Kumar, Pr. Scientist & PI (Since 01/10/2025)
Dr. Ajay Verma, Pr. Scientist
Dr. Suman Lata, Pr. Scientist

Dr. Ravindra S. Shekhawat, Sr. Scientist

Dr. Usha Das, Scientist

Technical & Supporting staff

Dr. Mangal Singh, CTO

Dr. Ramesh Chand, CTO

Sh. Harinder Kumar, SSS

Barley Improvement

Scientific staff

Dr. Om Vir Singh, Pr. Scientist & PI (Till 05/11/2025)

Dr. Chuni Lal, Pr. Scientist & PI (Since 06/11/2025)

Dr. Jogendra Singh, Pr. Scientist

Dr. Lokendra Kumar, Pr. Scientist

Dr. Rekha Malik, Pr. Scientist

Technical & Supporting staff

Sh. Rampal Saini, Technician

Sh. Raguhraj Pratap, Technician

PME Cell

Dr. Hanif Khan, **Officer- In-charge**

Dr. Ramesh Chand, CTO

Administration

Sh. Ravi K Dobriyal, CAO

Sh. Sunil Kumar, AAO

Sh. Ramesh Kumar, AAO

Smt. Promila Verma, AAO

Sh. Ramesh Chand, Asstt.

Sh. Amar Singh, Asstt.

Sh. Sunil Kumar, UDC

Sh. Naresh Kumar, UDC

Smt. Hem Lata, Private Secretary

Smt. Komal, Asstt.

Sh. Lakshya Bhardwaj, Asstt.

Sh. Biru Ram, SSS

Sh. Desh Raj, SSS

Sh. Hawa Singh, SSS

Accounts and Audit

Smt. Neha, CFAO

Smt. Sushila, Asstt.

Sh. Krishan Pal, UDC

Sh. Sahil Kundu, Asstt.

Sh. Sonu Saini, Asstt.

Sh. Ramu Shah, SSS

Library

Dr. Ajay Verma, Officer-In-charge

Sh. Abhay Nagar, CTO

Farm Section

Dr. Vikas Gupta, Officer- In-charge

Dr. Rajendra Kumar, ACTO

Sh. Hawa Singh, SSS

Vehicle Section

Sh. Ramesh Chand, Asstt. & In-charge

Sh. Ram Jawari, TO

Sh. Kehar Singh, TO

Sh. Rajbir Singh, TO

Sh. Sunder Lal, TO

Sh. Vinod Kumar, STA

Regional Station, Flowerdale, Shimla

Scientific staff

Dr. OP Gangwar, Sr. Scientist & In-Charge (Till 12/06/2025)

Dr. Pramod Prasad, Sr. Scientist & In-Charge (Since 13/06/2025)

Dr. Jayant Kullugudi, Scientist

Technical & Supporting staff

Dr. Subhodh Kumar, ACTO

Sh. Swaroop Chand, Technician

Sh. Mukesh Kumar Mahato, Technician

Administrative staff

Sh. Anil Kumar, UDC

Regional Station, Dalang Maidan, Lahaul & Spiti

Scientific staff

Dr. Charan Singh, In-charge

Technical staff

Sh. Nand Lal, Sr. Tech.

Seed and Research Farm, Hisar

Scientific staff

Dr. S.K. Bishnoi, Scientist, In-charge

Dr S.C. Tripathi, Pr. Scientist

21 STAFF POSITION AND FINANCE

Staff position as on 31st December 2025

Scientific cadre strength

Designation	Sanctioned	Filled	Vacant
IIWBR, Karnal and Seed and Research Farm, Hisar			
Director	01	01	-
Principal Scientist	05	03	1+1*
Senior Scientist	12	08	3+1*
Scientist	42	30	12
IIWBR Regional Station, Shimla			
Principal Scientist	01	-	01
Scientist	05	04	01
IIWBR Regional Station, Dalang Maidan			
Scientist	01	-	01
Total	**67 (66+1)**	**46 (45+1)**	**21**

*Two positions on lien

Administrative cadre strength

Designation	Sanctioned	Filled	Vacant
IIWBR, Karnal			
CAO	01	01	-
AD(OL)	01	-	01
CF&AO	01	01	-
AO	01	-	01
AAO	03	03	-
FAO	01	-	01
PPS	01	01	-
Assistant	12	08	04
UDC	05	03	02
LDC	06	-	06
PS	01	01	-
PA	03	-	03
Steno Gr III	--	01*	-
Total	**36**	**18**	**18**

*As per the revised cadre strength this position has been abolished from the Institute cadre and the surplus personnel is being adjusted against other unfilled position.

Technical cadre strength

Designation	Sanctioned	Filled	Vacant
A. IIWBR, Karnal			
T-3 (Cat.II)	19	09	10
T-1 (Cat.I)	23	18	05
B. IIWBR Regional Station, Shimla			
T-3 (Cat.II)	02	01	01
T-1 (Cat.I)	03	02	01
C. IIWBR Regional Station, Dalang Maidan			
T-1 (Cat.I)	01	01	-
Total (A+B+C)	**48**	**31**	**17**

Skilled supporting staff cadre strength

Station	Sanctioned	Filled	Vacant
IIWBR, Karnal	18	08	10
Total	**18**	**08**	**10**

Summary

Cadre	Sanctioned	Filled	Vacant
Director	01	01	-
Scientific	66	45	21
Technical	48	31	17
Administrative	36	18*	18
Skilled supporting staff	18	08	10
Total staff	**169**	**103**	**66**

*one steno is surplus.

FINANCE

Resource Generation

Resource Generation Through Commercialization of Technologies

Commercialization of Wheat varieties was carried out through **granting of licenses** under MoA with differentprivate seed companies and registered seed growers. A total of **180 MoAs** were signed with different stakeholders for production and distribution of seeds of the following wheat varieties.

1.	DBW187	42 Agreements	8.	DBW371	03 Agreements
2.	DBW222	43 Agreements	9.	DBW372	14 Agreements
3.	DBW303	07 Agreement	10.	DBW377	06 Agreements
4.	DBW316	02 Agreements	11.	DBW386	06 Agreements
5.	DBW327	49 Agreements	12.	DBW443	01 Agreements
6.	DBW359	03Agreements	13.	JKW261	01 Agreements
7.	DBW370	01 Agreements	14.	DBWB223	02 Agreements

A total revenue of **Rs. 9080000-** (Ninety Lakhs Eighty Thousand rupees only) was generated through commercialization of wheat varieties.

Expenditure Statement upto 31-03-2025 (Rs. In Lakhs)
ICAR-IIWBR, KARNAL

Name of Scheme	HEAD	BE 2024-25	RE 2024-25	EXPENDITURE				Total Expenditure	% of EXP. Against RE
				Other than NEH, TSP & SCSP	NEH	TSP	SCSP		
1. IIWBR, KARNAL	Grants in Aid - Capital	266.00	226.00	210.00	0.00	0.0	16.00	226.00	100.00%
	Grants in Aid - Salaries	2850.00	2431.00	2431.00	0.0	0.0	0.0	2431.00	100.00%
	Grants in Aid - General :-								
	(1) Pension - 1270	400.00	383.17	383.17	0.0	0.0	0.0	383.17	100.00%
	(2) Others - 4234	947.30	930.54	755.54	125.00	9.89	40.00	930.43	99.99%
TOTAL-1		4463.30	3970.71	3779.71	125.00	9.89	56.00	3970.60	100.00%

Name of Scheme	HEAD	BE 2024-25	RE 2024-25	EXPENDITURE Other than NEH, TSP & SCSP	NEH	TSP	SCSP	Total Expenditure	% of EXP. Against RE
2. AICRP	Grants in Aid - Capital	14.00	14.00	14.00	0.00	0.0	0.0	14.00	100.00%
(Wheat &	Grants in Aid - Salaries	1950.00	1423.17	1423.17	0.00	0.0	0.0	1423.17	100.00%
Barley)	Grants in Aid - General :-								
	(1) Pension	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00%
	(2) Others	311.00	311.00	225.00	40.00	20.00	26.00	311.00	100.00%
TOTAL-2		2275.00	1748.17	1662.17	40.00	20.00	26.00	1748.17	100.00%
GRAND TOTAL (1+2)		6738.30	5718.88	5441.88	165.00	29.89	82.00	5718.77	100.00%

Expenditure Statement upto 31-12-2025 (Rs. In Lakhs)
ICAR-IIWBR, KARNAL

Name of Scheme	HEAD	BE 2025-26	Remittance upto 31.12.25	EXPENDITURE Other than NEH, TSP & SCSP	NEH	TSP	SCSP	Total Exp.	% of EXP. Against BE	% of EXP. Against RE
IIWBR, KARNAL	Grants in Aid - Capital	266.00	199.48	80.70	0.00	0.0	3.94	84.64	32%	42%
	Grants in Aid - Salaries	2510.00	1942.75	2079.11	0.0	0.0	0.0	2079.11	83%	107%
	Grants in Aid - General :-									
	(1) Pension - 1270	368.00	342.00	294.56	0.0	0.0	0.0	294.56	80%	86%
	(2) Others - 4234	936.50	702.34	566.28	82.02	2.79	24.55	675.64	72%	96%
TOTAL-1		**4080.50**	**3186.57**	**3020.65**	**82.02**	**2.79**	**28.49**	**3133.95**	**77%**	**98%**

Name of Scheme	HEAD	BE 2025-26	Remittance upto 31.12.25	EXPENDITURE Other than NEH, TSP & SCSP	NEH	TSP	SCSP	Total Exp.	% of EXP. Against BE	% of EXP. Against RE
AICRP	Grants in Aid - Capital	4.00	3.00	2.00	0.00	0.0	0.0	2.00	50%	67%
(Wheat &	Grants in Aid - Salaries	1440.00	1689.79	1689.79	0.00	0.0	0.0	1689.79	117%	100%
Barley)	Grants in Aid - General :-									
	(1) Pension	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0%	0%
	(2) Others	329.60	247.19	148.05	37.50	18.73	37.50	241.78	73%	98%
TOTAL-2		**1773.60**	**1939.98**	**1839.84**	**37.50**	**18.73**	**37.50**	**1933.57**	**109%**	**100%**
GRAND TOTAL (1+2)		**5854.10**	**5126.55**	**4860.49**	**119.52**	**21.52**	**65.99**	**5067.52**	**87%**	**99%**

22 JOINING, PROMOTIONS, TRANSFERS AND RETIREMENTS

Joining

Smt. Neha, CA&FO, joined ICAR-IIWBR, Karnal w.e.f. 28.01.2025

Dr. Dinesh Kumar, Principal Scientist, joined ICAR-IIWBR, Karnal w.e.f. 01.03.2025

Dr. Ravindra Singh Shekhawat, Senior Scientist, joined ICAR-IIWBR, Karnal w.e.f. 19.05.2025

Dr. Charu Lata, Scientist, joined ICAR-IIWBR, Karnal w.e.f. 16.06.2025

Dr. Karshanal J., Scientist, joined ICAR-IIWBR, Karnal w.e.f. 07-07-2025

Sh. Lakshay, Assistant, joined ICAR-IIWBR, Karnal w.e.f. 06.08.2025

Ms. Komal, Assistant, joined ICAR-IIWBR, Karnal w.e.f. 08.09.2025

Sh. Sonu Saini, Assistant, joined ICAR-IIWBR, Karnal w.e.f. 08.09.2025

Dr. Usha Das, Scientist, joined ICAR-IIWBR, Karnal w.e.f. 27.10.2025

Dr. Rajeswari V., Scientist, joined ICAR-IIWBR, Karnal w.e.f. 05.12.2025

Transfer/Outward movement

Dr. Mamrutha H.M, (Sr. Sci.), transferred to ICAR-NISST, R.S. Bengaluru on 12.06.2025

Ms. Nisha, Assistant, transferred to ICAR-IARI, New Delhi on 07.08.2025

Ms. Kirti Gupta, (T-1), selected as Technical Resignation Controller of Defence Accounts, Meerut on 28.08.25

Ms. Shruti, Assistant, transferred to ICAR-IARI, New Delhi on 04.09.2025

Superannuation

Sh. Khem Chand, SSS, ICAR-IIWBR, Karnal, superannuated on 28.02.2025

Dr. B.S Tyagi, Principal Scientist, ICAR-IIWBR, Karnal, superannuated on 30.04.2025

Smt. Shanti Devi, SSS, ICAR-IIWBR, Karnal superannuated on 30.04.2025

Sh. Rajinder Kumar Sharma, TO, ICAR-IIWBR, Karnal superannuated on 31.07.2025

Smt. Sunita Jaswal, CTO, ICAR-IIWBR, Karnal, superannuated on 11.08.2025

Dr. Satyavir Singh, Principal Scientist, ICAR-IIWBR, Karnal, superannuated on 30.09.2025

Sh. PHP Verma, CTO, ICAR-IIWBR, Karnal, superannuated on 31.10.2025

Sh. Subash Chand, (AO), ICAR-IIWBR, Karnal, superannuated on 31.10.2025

स्वच्छ भारत
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